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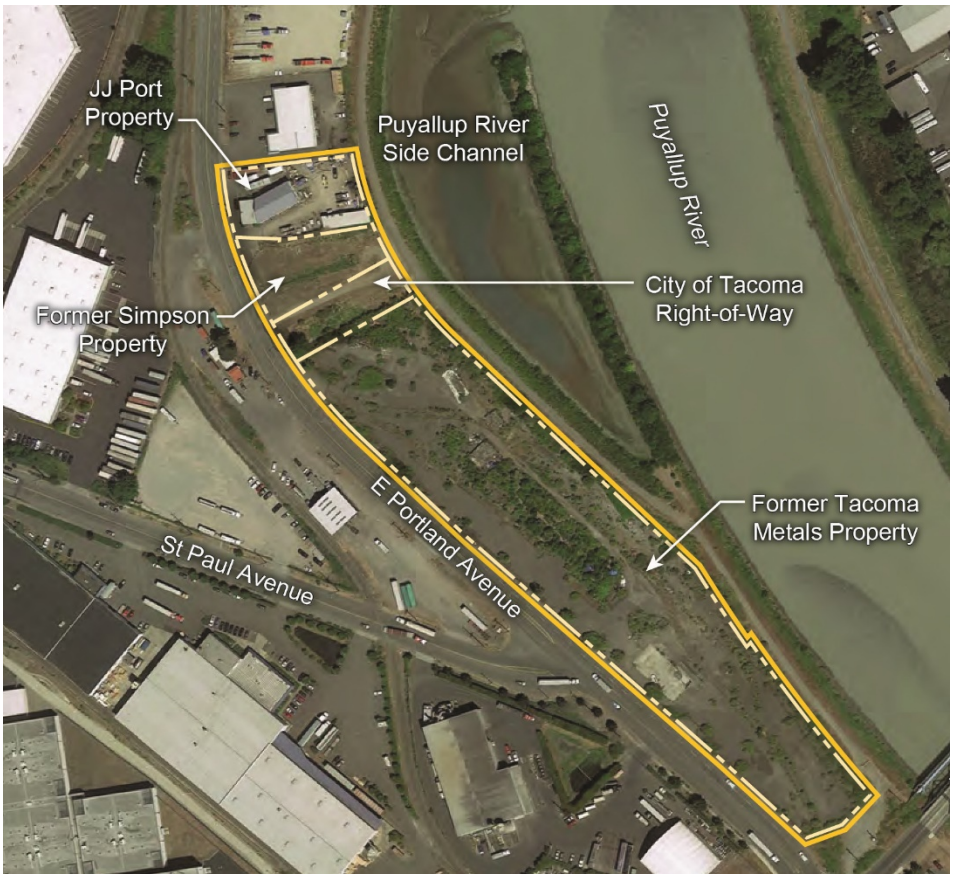
Final

Supplemental Remedial Investigation /Feasibility Study Work Plan

B36 Area, Area B, and Area D
Tacoma Metals Site
Tacoma, Washington



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List of Acronyms and Abbreviations

ALS	ALS Environmental
AO	Agreed Order
APN	Assessor Parcel Number
AST	above-ground storage tank
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
COCs	chemicals of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CPOC	conditional point of compliance
CUL	cleanup level
DRO	diesel-range organics
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FS	feasibility study
FSA	feasibility study addendum
GSAP	Groundwater Sampling and Analysis Plan
HASP	health and safety plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
International Paper	International Paper Company
MTCA	Model Toxics Control Act
MW	monitoring wells
ORO	oil-range organics
OSHA	Occupational Safety and Health Administration
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PRSC	Puyallup River Side Channel
QA	quality assurance
QC	quality control
QAPP	quality assurance project plan
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
SSAP	Soil Sampling and Analysis Plan
Site	Tacoma Metals Site
TP	test pit
TPH	total petroleum hydrocarbons
VOC	volatile organic compound
WAC	Washington Administrative Code
Work Plan	Supplemental Remedial Investigation/Feasibility Study Work Plan

Executive Summary

The Washington State Department of Ecology (Ecology) provided comments on the Revised Draft Remedial Investigation (RI) and Feasibility Study (FS) report prepared for the Estate of Sophie Sussman (Aspect 2018b) on December 3, 2018. In these comments (Ecology 2018), Ecology raised the following concerns with the RI/FS report:

- Soils impacted with total petroleum hydrocarbons (TPH) as diesel- and oil-range organics (DRO/ORO), total polycyclic aromatic hydrocarbons (cPAHs), and/or total naphthalenes above site soil cleanup levels (CULs) located at depths between 20 and 32 feet below ground surface (bgs) may be impacting the groundwater beneath the site, and have not been addressed in the FS
- Soil beneath the former 450,000-gallon above-ground storage tank (AST) and northeast of that area (towards the Puyallup River) has not been characterized
- Groundwater beneath the site in the area of City of Tacoma (18th Street) right-of-way is impacted by DRO/ORO, total cPAHs, and total naphthalenes and has not been addressed in the FS
- The wells along the northeastern boundary of the site proposed for the conditional point of compliance (CPOC) are impacted with contaminants above site groundwater CULs, and cannot be used to determine if impacted groundwater is migrating off site and impacting the Puyallup River

Based on these comments, International Paper Company is planning to perform a supplemental RI at the Tacoma Metals Site (Site) located in Tacoma, Washington (Figure 1-1). The activities to be performed include groundwater sampling of all existing wells and piezometers within the northwestern part of the Site, additional soil sampling in the vicinity of, and northeast of, the 450,000-gallon AST, and soil sampling on the JJ Port property. The data collected during this supplemental RI will be used to develop and evaluate alternatives in the updated FS to address a) TPH as DRO/ORO, cPAHs, and/or total naphthalenes at depths between 20 feet and 32 feet bgs that exceed respective cleanup levels within the on- and off-property area of the Site, b) DRO/ORO, cPAHs, and total naphthalenes in groundwater beneath the City of Tacoma right-of-way and former Simpson property; and c) proposed alternative CPOCs for the site; and determine if soils in the area of the former 450,000-gallon AST and northeast of that need to be addressed in the updated FS. Results of the supplemental RI, and any necessary revisions to the nature and extent of contamination and/or proposed remedy, will be incorporated into a supplemental RI report and updated FS report. The supplemental RI report and the updated FS report will also include conclusions and recommendations regarding RI results and an additional evaluation of FS remedial alternatives specifically regarding soil deeper than 15 feet bgs and site groundwater.

This Supplemental RI/FS Work Plan (Work Plan) summarizes the known nature and extent of contamination, identifies the objectives of the supplemental RI, and provides details related to the planning and implementation of the supplemental RI in accordance with Washington Administrative Code 173-340 and Washington State Model Toxics Control Act regulations. Section 1 provides the purpose and content of the Work Plan; a description and history of the Site (including both on-property and off-property parcels and their locations); and the project organization, including responsibilities of key team members. Section 2 provides the investigation results for the polycyclic aromatic hydrocarbon (PAH)-impacted portions of the Site (the B36 Area and Area B) and Area D and a description of the conceptual site model and exposure pathways. Section 3 presents the objectives of the supplemental RI. Section 4 provides a description of the planning and implementation of the supplemental RI. The appendices include site-specific plans including a site-specific health and safety plan, a groundwater sampling and analysis plan, a soil sampling and analysis plan, and a quality assurance project plan.

1 Introduction

The Washington State Department of Ecology (Ecology) provided comments on the Revised Draft Remedial Investigation (RI) and Feasibility Study (FS) prepared for the Estate of Sophie Sussman (Aspect 2018b) on December 3, 2018. In these comments (Ecology 2018), Ecology raised the following concerns with the RI/FS report:

- Soils impacted with total petroleum hydrocarbons (TPH) as diesel- and oil-range organics (DRO/ORO), total polycyclic aromatic hydrocarbons (cPAHs), and/or total naphthalenes above site soil cleanup levels (CULs) are located at depths between 20 and 32 feet below ground surface (bgs), may be impacting the groundwater beneath the site, and have not been addressed in the FS
- Soil beneath the former 450,000-gallon above-ground storage tank (AST) and northeast of that area (towards the Puyallup River) has not been characterized
- Groundwater beneath the site in the area of City of Tacoma (18th Street) right-of-way is impacted by DRO/ORO, total cPAHs, and total naphthalenes and has not been addressed in the FS
- The wells along the northeastern boundary of the site proposed for the conditional point of compliance (CPOC) are impacted with contaminants above site groundwater CULs, and cannot be used to determine if impacted groundwater is migrating off site and impacting the Puyallup River

Based on these comments, International Paper Company (International Paper) is planning to perform a supplemental RI at the Tacoma Metals Site (Site) located in Tacoma, Washington (Figure 1-1). The activities to be performed include groundwater sampling of all existing wells and piezometers within the northwestern part of the Site, additional soil sampling in the vicinity of, and northeast of, the 450,000-gallon AST, and soil sampling on the JJ Port property. The data collected during this supplemental RI will be used to develop and evaluate alternatives in the updated FS to address a) TPH as DRO/ORO, cPAHs, and/or total naphthalenes at depths between 20 feet and 32 feet bgs that exceed respective cleanup levels within the on- and off-property area of the Site, b) DRO/ORO, cPAHs, and total naphthalenes in groundwater beneath the City of Tacoma right-of-way and former Simpson property; and c) proposed alternative CPOCs for the site; and determine if soils in the area of the former 450,000-gallon AST and northeast of that need to be addressed in the updated FS. Results of the supplemental RI, and any necessary revisions to the nature and extent of contamination and/or proposed remedy, will be presented in a supplemental RI report and updated FS report. The supplemental RI report and updated FS will also include conclusions and recommendations regarding RI results and an additional evaluation of FS remedial alternatives specifically regarding soil deeper than 15 feet bgs and site groundwater.

This Supplemental RI/FS Work Plan (Work Plan) summarizes the known nature and extent of contamination, identifies the objectives of the supplemental RI, and provides details related to the planning and implementation of the supplemental RI in accordance with Washington Administrative Code (WAC) 173-340 and Washington State Model Toxics Control Act (MTCA) regulations (Ecology 2007). The purpose and content of the Work Plan is discussed further in Section 1.1. A site description, background, and history are provided in Section 1.2, and the supplemental RI project organization and responsibility are provided in Section 1.3.

1.1 Work Plan Purpose and Content

The purpose of this Work Plan is to:

- Describe the type of data to be collected and the use of those data; and
- Describe the procedures to be used in data collection, quality assurance, data analysis, and data interpretation;

To accomplish the above purpose, this Work Plan contains the following:

- The site description, background, and history, and the project organization and responsibility (Section 1.0)

- A description of the nature and extent of contamination in soil in the B36 Area, Area B, and Area D, and a discussion of the conceptual site model for the Site (Section 2.0)
- The objectives of the supplemental RI (Section 3.0)
- A description of planning and implementation of the supplemental RI (Section 4.0)
- References (Section 5.0)
- Boring logs (Appendix A)
- Analytical laboratory reports (Appendix B) and data validation reports produced by AECOM chemists (Appendix C)
- A health and safety plan (HASP), a groundwater sampling and analysis plan (GSAP), a soil sampling and analysis plan (SSAP), and quality assurance project plan (QAPP) (Appendices D, E, F, and G)

1.2 Site Description, Background, and History

The Site is generally located at 1919 Portland Avenue in Tacoma, Washington, in an industrial-zoned area (Figure 1-1). The Site is bounded to the northeast by the Puyallup River, to the southeast by the Lincoln Avenue Bridge (which crosses the Puyallup River), to the southwest by Portland Avenue, and to the northwest by industrial development. The property parcels within the site boundary include the Tacoma Metals on-property parcels (including Pierce County Assessor Parcel Numbers [APNs] 8950000390, 0320032043, and 8950000352) and the off-property parcels, including the former Simpson property (APN 8950000402), the JJ Port property (APN 0320032013), and the City of Tacoma (18th Street) right-of-way. The City of Tacoma right-of-way is located immediately northwest of the Tacoma Metals parcel APN 8950000390, the former Simpson property is located adjacent to and northwest of the City of Tacoma right-of-way, and the JJ Port property is located adjacent to and northwest of the former Simpson property. The Tacoma Metals on-property parcels measure a total of approximately 5.9 acres. The City of Tacoma right-of-way, the former Simpson property, and the JJ Port property measure approximately 0.4, 0.6, and 0.7 acre, respectively (Figure 1-2).

The Site is located in the Tacoma Tideflats physiographic area, which is part of the Puyallup River delta. Typical stratigraphy of the Tacoma Tideflats includes up to 10 feet of hydraulic fill (dredge) deposits of gravel, sand, silt, and organic debris underlain by silty and sandy deltaic sediments deposited by the Puyallup River. Glacial deposits typically underlie the Puyallup River sediments (Hart Crowser 1975). Soil materials encountered during the investigation activities at the Site have included sandy and gravelly fill materials (typically with varying quantities of wood, metal, or other debris), woody debris with and without matrix material (typically silt and sand), and native materials including sand, silt, and clay.

The Site has a relatively level topography with an average elevation of approximately 10 feet above mean sea level, except for the JJ Port property and portions of the City of Tacoma right-of-way. The elevation drops several feet immediately adjacent to the northwest property boundary of the former Simpson property. Therefore, the elevation of the JJ Port property is typically several feet lower than the elevation of the former Simpson property. In addition, a portion of the City of Tacoma right-of-way is also several feet lower than the adjacent land. No structures are currently located on the Tacoma Metals on-property parcels, the former Simpson property, or the City of Tacoma right-of-way. However, asphalt-paved areas and some concrete foundations from former buildings remain on the Tacoma Metals on-property parcels. Two buildings are located on the JJ Port property, and the area surrounding the buildings is used for parking vehicles and storing equipment.

The flow direction in shallow groundwater at the Site is influenced by tidal fluctuations in the Puyallup River and varies between high- and low-tide cycles. At low tide, the flow direction is generally toward the Puyallup River; at high tide, the flow direction is generally toward the Site, away from the Puyallup River. The magnitude of the shallow groundwater gradient is greater during low-tide conditions than during high-tide conditions, resulting in an overall net gradient towards the Puyallup River. A localized stagnation zone was observed in the central portions of the Site at high tide, primarily in the northwest portion of the Tacoma Metals on-property parcels. Depth to shallow groundwater varies with tidal levels; saturated conditions are generally encountered at approximately 10 feet bgs at the Site, with the exception of the JJ Port property and portions of the City of Tacoma right-of-way, where the depth to shallow groundwater is generally less because of topographic lows in these areas.

Historically, portions of the Site have been occupied by the following industrial facilities:

- St. Paul & Tacoma Lumber mill facilities including a creosoting plant (1900s to 1930s)

- A coke manufacturing plant (early 1940s)
- A metals recycling facility (1950s to 1990s)

In addition, several modifications have been made to the Puyallup River channel adjacent to the Site.

Portions of the Site were first developed by the St. Paul & Tacoma Lumber Company in the late 1900s to early 1910s, at which time the creosoting plant was constructed. The St. Paul & Tacoma Lumber mill facilities extended from the northwestern portion of the Tacoma Metals on-property parcels to the northwestern property boundary of the JJ Port property. The primary creosoting plant facilities included the main creosoting plant structure, which housed a 130-foot treatment retort and a 1,500-gallon AST, and two separate ASTs (102,000 gallon and 450,000 gallon) located northwest of the main structure. The main creosoting plant was located in the northwestern portion of the Tacoma Metals on-property parcels (referred to as the Creosoting Plant Area), and the two large ASTs were located on the former Simpson property. Other facilities included an overhead crane, rail spur, overhead tramways, a wharf, boardwalks, storage areas, and other structures of unknown purpose. The overhead crane, a rail spur, and elevated structures of unknown purpose that were identified in historical aerial photographs and site plans were located on the former Simpson property, and the remaining structures were located in the northwestern portion of the Tacoma Metals on-property parcels or the City of Tacoma right-of-way. The creosoting plant appears to have been operational until the late 1920s to early 1930s.

In the early 1940s, a coke manufacturing facility was constructed on portions of the Site. The coke plant appears to have been used to produce metallurgical coke and coal gas (as a byproduct of the coke production process) and appears to have been operational for only a short time beginning in 1943. The primary coke production structure was located in the central portion of the Tacoma Metals on-property parcels. Other structures associated with the coke plant were located in the northwestern portion of the Tacoma Metals on-property parcels, in the vicinity of the main creosoting plant structure. The creosoting plant was demolished prior to construction of the coke plant, and approximately 3 to 5 feet of fill material was placed over the Tacoma Metals on-property parcels, the City of Tacoma right-of-way, and the former Simpson property. The coke plant structures were constructed after placement of the fill layer. Most of the coke plant structures, except for part of the main building and several concrete foundation pads (three of which were located near former creosoting plant location), appear to have been demolished in the 1950s.

Beginning in the early 1950s, a metal recycling facility began operation on portions of the Site. Those portions of the Site were initially occupied by General Metals and subsequently by Tacoma Metals beginning in the early 1980s. Metals recycling does not appear to have been performed on the off-property parcels, although some debris and wastes may have accumulated northwest of the Tacoma Metals on-property parcels. The operational history of the metal recycling facility included the handling of scrap ferrous and non-ferrous metal and processing scrap metal materials. Processing included dismantling and draining transformers, dismantling lead-acid batteries and recovery and recycling lead from copper cables. Scrap materials containing copper, brass, lead, aluminum and stainless steel were processed, handled, and/or redistributed. Stockpiles of various materials and associated processing machinery were located throughout the Tacoma Metals on-property parcels, although most of the machinery appears to have been located in the central and northwestern portions of the Tacoma Metals on-property parcels. A part of the main coke plant structure, which was not demolished after coking operations ceased, appears to have been used as a processing and warehouse facility. However, most of the materials were stored outside, directly on the ground surface in piles or stacks. Most of the Tacoma Metals on-property parcels appear to have been paved with asphalt by the 1970s, but an area along the northwestern property boundary remained unpaved throughout the time when metal recycling was performed. Other structures associated with metals recycling included small structures associated with processing machinery and a warehouse building constructed to the east of the main building during the 1980s. Metals recycling operations ceased in 1999, and the property was vacated. The above-ground portions of former metal recycling structures have been demolished and removed from the Site, although most of the asphalt-paved areas and some concrete foundations remain.

Over the years, several modifications have been made to the Puyallup River channel. The Puyallup River channel was modified by construction of an earthen levee by the U.S. Army Corps of Engineers in the late 1940s and 1950s. Prior to construction of the levee, the southwestern bank of the river adjoined the northeastern boundary of the Site. During construction of the levee, the course of the river was shifted to the northeast, and a portion of the former Puyallup River channel located adjacent to the Site was isolated from the main channel. The former channel area, referred to as the Puyallup River side channel (PRSC), was gradually filled over time primarily with wood-waste material. The original levee remained intact until 2005, when the PRSC estuary habitat was constructed by the City of Tacoma. The wood-waste material that had accumulated in the former channel area was removed, and the original levee was breached to flood the former channel area. The course of the Puyallup River was not modified; portions of the original levee remained intact and were lowered to preserve

the main channel, but an estuary habitat was created within the former channel area. A new levee was constructed immediately northeast of the Site, between the Site and the PRSC.

On September 9, 1983, the U.S. Environmental Protection Agency (EPA) issued the owners of Tacoma Metals, Inc., a Notice of Non-Compliance for failure to comply with the Toxic Substance Control Act regulations. The violation concerned Tacoma Metals' transformer handling practices on portions of the Site. Ecology and EPA conducted a joint inspection during March 1988 and collected soil and sediment samples from a catch basin sump. Analytical results for these samples showed elevated concentrations of polychlorinated biphenyls (PCBs) and heavy metals (arsenic, cadmium, chromium, copper, lead, and mercury), which exceeded the MTCA Method A CULs. A partial cleanup of some PCB-contaminated areas was conducted in March 1989. Approximately 70 to 80 cubic yards of PCB-contaminated soils were excavated from two areas, treated on-site and disposed of off-site in a hazardous waste landfill.

Based on this investigation, Ecology placed the Site on the site information system list on February 14, 1992 and ranked the Site on August 17, 1992. The Site scored a ranking of 2 due to elevated levels of PCBs and metals detected in site soils. A rank of 1 indicates the highest level of concern and a rank of 5 indicates the lowest level of concern. Pursuant to Agreed Order (AO) DE 97-5435, an initial RI was performed at the Site between 2000 and 2001. The purpose of the 2000 RI was to characterize the nature and extent of impacts to environmental media, which included confirming the results of several limited investigations performed prior to the RI between 1988 and 1995, developing a conceptual site model, and evaluating remedial options based on findings of the investigation.

In June 2005, Ecology approved the construction of a temporary containment unit at the Site to store and treat the lead-contaminated soils that were discovered during the PRSC construction. Approximately 4,000 tons (3,100 cubic yards) of soil were stored and treated. The treatment consisted of the addition of a reagent to bond with the metals in the soil to immobilize them against leaching. By August 2007, soil treatment and transport of the soil to a landfill were completed.

A RI/FS report was previously produced, revised, and augmented by Kennedy/Jenks Consultants (KJC 2014) to address portions of the Site. In addition, International Paper prepared an FS Addendum (FSA) that identified a preferred cleanup action alternative for addressing PAH-impacted soil located in an off-property portion of the Site known as the B36 Area (AECOM 2015). Ecology sent comment letters on the September 2014 RI/FS report (KJC 2014) and June 2015 FSA (AECOM 2015) dated April 18, 2016 (Ecology 2016a), and April 21, 2016 (Ecology 2016b), respectively. Ecology agreed to proceed directly to the development of an Interim Action Work Plan without finalizing the FSA document. Therefore, International Paper prepared an Interim Action Work Plan for submittal to Ecology on May 19, 2017 (AECOM 2017a). Portions of the FSA document were incorporated into the Interim Action Work Plan to address Ecology comments on the FSA document. Ecology submitted comments to International Paper on September 19, 2017 (Ecology 2017). Based on these comments, the Interim Action Work Plan was revised and submitted to Ecology on November 17, 2017 (AECOM 2017b). In addition, the 2014 RI/FS report was revised and submitted to Ecology on February 28, 2018 by Aspect Consulting for the Estate of Sophie Sussman (Aspect 2018a). An additional version of the RI/FS report was prepared and submitted to Ecology on June 22, 2018 (Aspect 2018b) based on comments received from Ecology on April 25, 2018 (Ecology 2018). Additional comments were received from Ecology on both the Interim Action Work Plan (AECOM 2017b) and the Revised Draft RI/FS Report prepared for the Estate of Sophie Sussman (Aspect 2018b) on September 10, 2018 and December 3, 2018, respectively. This Work Plan addresses data gaps identified in Ecology comments on the Revised Draft RI/FS Report.

1.3 Project Organization and Responsibility

The project team will consist of personnel from AECOM and their subcontractors, as shown in Table 1-1. The following paragraphs describe the major positions and responsibilities of the investigation team, along with the approach to data quality assurance (QA) management. Key project personnel and regulatory personnel and their responsibilities for QA activities are also described below.

1.3.1 Project Coordinators

The AECOM Project Manager, Paul Kalina, will be International Paper's Project Coordinator and will be responsible for overseeing the implementation of the supplemental RI. Andrew Smith will be Ecology's Project Coordinator. To the maximum extent possible, all communications between Ecology and International Paper and all documents should be directed through the Project Coordinators. These documents include but are not limited to reports, approvals, and other correspondence concerning the activities performed pursuant to the AO. If Ecology or International Paper changes Project Coordinator, written notification will be provided to Ecology or International Paper in accordance with the AO.

1.3.2 Project Manager

The AECOM Project Manager, Paul Kalina, will be responsible for managing all aspects of implementation of the supplemental RI. Specific responsibilities include review and approval of work products, ensuring that appropriate field procedures are followed, reporting of deviations from the Ecology-approved Work Plan to the Ecology Project Coordinator, and ensuring that the data collected will satisfy the data quality objectives. International Paper will report substantive deviations from the Work Plan to the Ecology Project Coordinator within 24 hours of the occurrence of the deviation, by both telephone and email.

1.3.3 QA/QC Manager

The AECOM QA/quality control (QC) Manager, Lucy Panteleeff, is responsible for developing and managing procedures described in the QAPP, interfacing with the project laboratory and data quality assessment personnel, reviewing QA/QC audit reports, coordinating audit procedures, implementing necessary corrective action procedures, reviewing and evaluating analytical laboratory results, reviewing data quality assessment reports, and reporting to the AECOM Project Manager.

1.3.4 Field Sampling Personnel

The field sampling personnel are responsible for implementing the groundwater and soil sampling and handling procedures as specified in this work plan and referenced documents, ensuring field procedures follow the work plan, notifying the Project Manager and QA/QC Manager of difficulties encountered during the field program, and implementing corrective actions to the field procedures as approved by the Project Manager.

2 Nature and Extent of Contamination

The nature and extent of soil contamination in the northwestern portion of the Site has been evaluated based on data from investigations completed between 1988 and 2014. During the initial RI, impacts to environmental media related to former site use as a metals recycling facility were evaluated and characterized for the Tacoma Metals on-property parcels. However, additional historical Site uses including creosoting and coking operations were identified during the initial RI in the northwestern portion of the Site. Impacts to environmental media related to PAHs were identified during the initial RI but not characterized. Therefore, a supplemental RI was performed between 2002 and 2011 to evaluate and characterize potential impacts to environmental media related to PAHs. The supplemental RI was performed in phases, with each phase of work approved by Ecology prior to implementation. During the supplemental RI, PAH-impacted soil was identified in one boring (B36) located on the former Simpson property at depths less than 15 feet bgs, which is the depth interval identified in the MTCA as potentially associated with risks to excavation workers. Based on this, additional investigation work was performed in October 2014 in the vicinity of boring B36 to determine the extent of impacts. Historical sampling activities completed prior to October 2014 were previously reported in the Revised Draft RI/FS Report (Aspect 2018b) and are only summarized in this section. Additional investigation work performed in October 2014 was presented in the Interim Action Work Plan (AECOM 2017b) and is also presented in this Work Plan. Soil data are summarized on Tables 2-1 through 2-4 and on Plate 1.

Soil data are presented in this Work Plan by the geographic areas identified in the Interim Action Work Plan (AECOM 2017b). Data collected on the former Simpson and JJ Port properties, including the data collected in the B36 Area, are presented in Section 2.1. Data collected in the northwestern portion of the Tacoma Metals on-property parcels and the City of Tacoma right-of-way, including the data collected in Areas B and D, are presented in Section 2.2. The data discussed are representative of in-place soils present at the Site. In order to establish the nature and extent of contamination in soil, concentrations of chemicals were compared to the site soil CULs established in the Revised Draft RI/FS Report (Aspect 2018b). The conceptual site model presented in the Revised Draft RI/FS Report (Aspect 2018b) is summarized in Section 2.3.

2.1 B36 Area

This section summarizes the investigation results for the former Simpson and JJ Port properties, including the B36 Area. As previously discussed, the supplemental RI performed between 2002 and 2011 evaluated and characterized impacts from creosoting and coking operations on portions of the Site. Following the supplemental RI, an additional investigation was performed in October 2014 in the B36 Area. Soil analytical results for the former Simpson and JJ Port properties are included on Table 2-1 and Plate 1. The locations with exceedances of the site soil CULs for cPAHs, total naphthalenes, and DRO plus ORO are also shown on Plate 1.

The supplemental RI work area included the JJ Port and former Simpson properties and the bank area adjacent to the PRSC. A total of 14 borings were advanced during the supplemental RI, of which 3 borings were advanced in February 2006 (B34-B36) and 11 borings were advanced in October 2007 (B37-B47) (Plate 1). Boring logs for these locations are included in the Revised Draft RI/FS Report (Aspect 2018b). Between three and four soil samples were collected from each boring by Kennedy/Jenks Consultants (KJC), at depths ranging from 2 to 40 feet bgs, and were analyzed for DRO, ORO, and PAHs.

The October 2014 additional investigation work area was limited to the area around boring B36 on both the JJ Port and former Simpson properties. A total of 33 borings were advanced, of which 22 borings (B48 through B69) were advanced in early October 2014 (10/7/2014 and 10/8/2014) and 11 borings (B70 through B80) were advanced in late October 2014 (10/30/14) (Plate 1). Boring logs for these new boring locations are included in Appendix A. Between one and three soil samples were collected from each boring by KJC, at depths ranging from 3.5 to 18 feet, and were analyzed for DRO, ORO, and PAHs. In addition, samples from one boring (B69) were analyzed for volatile organic compounds (VOCs).

During the October 2014 investigation events, AECOM collected split samples from the same soil sampling locations and depth intervals as KJC. To confirm KJC's analytical results, AECOM had a small subset of those split samples analyzed by ALS Environmental (ALS), located in Kelso, Washington, in 2014. Dibenzofuran was included in ALS's reporting list, and dibenzofuran results are included in Table 2-1 for this subset of samples, in addition to results for the other analytes reported by KJC's laboratory. During the development of the FSA, locations that had been previously sampled but not analyzed were

identified for analysis to help further delineate treatment areas and volumes. In particular, PAH data were not available for some locations where TPH concentrations exceeded CULs and at shallow soil sampling locations where deeper soil sampling locations exceeded CULs. Therefore, AECOM performed additional analyses in 2015 on samples collected in October 2014 that had been stored frozen at ALS's laboratory. ALS laboratory reports are included as Appendix B. These analytical results are also provided in Table 2-1 and are flagged with "J" flags because they were analyzed outside of the recommended holding time. All ALS laboratory data were validated by AECOM chemists, and the data validation report is included as Appendix C.

2.2 Areas B and D

This section summarizes the investigation results for the northwestern portion of the Tacoma Metals on-property parcels and the City of Tacoma right-of-way, including Areas B and D. During the initial RI performed in 2000, impacts to environmental media related to former site use as a metals recycling facility were evaluated and characterized for the Tacoma Metals on-property parcels. During the initial RI and the supplemental RI, impacts to environmental media related to creosoting and coking operations were evaluated and characterized for the Tacoma Metals on-property parcels and the City of Tacoma right-of-way. Soil analytical results for the Tacoma Metals on-property parcels and the City of Tacoma right-of-way are included on Tables 2-2, 2-3, and 2-4 for PAHs and VOCs, TPH, and metals and PCBs, respectively. The soil analytical results for cPAHs, total naphthalenes, and DRO plus ORO and the locations with exceedances of the site soil CULs for these same chemicals are shown on Plate 1. As previously discussed, all sampling activities within this area of the Site were previously reported in the Revised Draft RI/FS Report (Aspect 2018b) and are only summarized in this section.

During the RI in the fall of 2000, sampling occurred in 19 test pits (test pit [TP]-1 through TP-9, TP-12, TP-48 through TP-54, TP-57, and TP-65) in the northwestern portion of the former Tacoma Metals on-property parcels (Plate 1). Between one and four soil samples were collected from each test pit at depths ranging from 0 to 10 feet bgs. Samples were collected and analyzed for the following:

- PAHs from selected depth intervals at TP-2, TP-5, TP-9, TP-49, and TP-57
- VOCs at all depth intervals at TP-2, TP-3, TP-4, TP-5, TP-9, TP-49, and TP-50
- TPH from selected depth intervals at TP-1 through TP-9, TP-12, TP-48 through TP-54, TP-57, and TP-65
- Metals at all depth intervals at TP-1 through TP-9, TP-12, TP-48 through TP-54, TP-57, and TP-65
- PCBs from selected depth intervals at TP-1, TP-3 through TP-7, TP-9, TP-12, TP-49, TP-50, TP-51, TP-53, TP-57, and TP-65

The supplemental RI work area included the northwestern portion of the Tacoma Metals on-property parcels and the City of Tacoma right-of-way. A total of 36 borings were advanced during the supplemental RI, of which 9 were completed as monitoring wells. Three borings were advanced in June 2002 (B1-B3), 11 borings were advanced in February 2003 (B6, B8, and monitoring well [MW]-13 through MW-21), 6 borings were advanced in November 2003 (B12-B17), 6 borings were advanced in March 2004 (B18-B23), and 10 borings were advanced in March 2005 (B24-B33) (Plate 1). Boring logs for these locations are included in the Revised Draft RI/FS Report (Aspect 2018b). Between one and four soil samples were collected from each boring, at depths ranging from 1 to 31.5 feet bgs, and were analyzed for PAHs. Samples from all borings not completed as monitoring wells (except two [B6 and B8]) and one boring completed as a monitoring well (MW-13) were analyzed for TPH. In addition, samples from three borings (B1-B3) were analyzed for VOCs.

Concentrations of PCBs exceed the site soil CULs at depths between 0 and 3 feet bgs at some locations in the northwestern portion of the Tacoma Metals on-property parcels (Table 2-4). Concentrations of arsenic, barium, cadmium, chromium, copper, lead, and selenium exceed the site soil CULs at depths between 0 and 6 feet bgs at some locations in the northwestern portion of the Tacoma Metals on-property parcels (Table 2-4).

2.3 Conceptual Site Model

The conceptual site model was originally presented in the RI/FS Report (KJC 2001), was updated in the Revised Augmented RI/FS Report (KJC 2014), and further updated in the Revised Draft RI/FS Report prepared for the Estate of Sophie Sussman (Aspect 2018b). Chemical migration pathways identified in the RI/FS Report included dissolution of contaminants from unsaturated soil by precipitation and downward migration to groundwater, dissolution of contaminants from unsaturated soil by precipitation with subsequent runoff to surface water, dissolution of contaminants from saturated soil into groundwater, and horizontal migration in the shallow groundwater zone both towards and away from the Puyallup River due to tidal fluctuation.

Additional chemical migration pathways include evaporation of VOCs into soil vapor and then transport to the atmosphere and transport of contaminated dust to the atmosphere. The Revised Augmented RI/FS Report (KJC 2014) concluded that a deeper fine-grained unit appears to have acted as a barrier to downward migration of chemicals of concern (COCs) in the Creosoting Plant Area, in the northwestern portion of the Tacoma Metals on-property parcels, and also appears to have influenced the lateral migration of COCs from the Creosoting Plant Area towards the northeast and north.

COCs do not appear to have migrated significantly beyond the northeastern site boundary and impacts to shallow groundwater were not identified along the southwestern margin of the PRSC in the 2010/2011 PRSC investigation (KJC 2012). These findings indicate that the potential groundwater to surface water and groundwater to sediment chemical migration pathways are currently incomplete for the Site.

The groundwater ingestion pathway is incomplete because shallow groundwater is not a potable water source. Complete exposure pathways identified in the Revised Draft RI/FS Report prepared for the Estate of Sophie Sussman (Aspect 2018b) include the following:

- Direct contact with on-site soil and surface water by industrial workers and trespassers
- Ingestion or dermal absorption of contaminants in on-site soil by industrial workers and trespassers
- Ingestion of contaminated on-site soil or surface water, direct contact, or indirect ingestion through the food chain by ecological receptors
- Ingestion or dermal absorption of off-site surface water by humans
- Ingestion or dermal absorption of off-site surface water by aquatic organisms
- Ingestion of impacted aquatic organisms by humans

3 Objectives of the Supplemental RI

This section presents the objectives of the supplemental RI. As previously discussed in the Introduction, Ecology identified concerns with the Revised Draft RI/FS Report prepared for the Estate of Sophie Sussman (Aspect 2018b). The objectives of the supplemental RI are to address Ecology's concerns regarding data gaps in the Revised Draft RI/FS Report as follows:

- Characterize soil beneath the former 450,000-gallon AST and northeast of that area (towards the Puyallup River) to a depth of at least 32 feet bgs
- Characterize current groundwater concentrations beneath the Site in the northwestern part of the on-property parcels, the City of Tacoma (18th Street) right-of-way, the former Simpson property, and the JJ Port property for all site COCs
- Evaluate tidal impacts on groundwater elevations and flow conditions in the northwestern part of the on-property parcels, the City of Tacoma (18th Street) right-of-way, the former Simpson property, and the JJ Port property
- Characterize the groundwater conditions along the northeastern boundary of the Site, and propose CPOC locations that are not impacted with contaminants above site groundwater CULs
- Obtain the information needed to evaluate alternatives for deep soil (depths greater than 15 feet bgs) and groundwater at the site in the updated FS report

4 Investigation Planning and Field Implementation

This section presents the order that work will be completed and describes the planning documents and field tasks involved to implement the supplemental RI. Section 4 is divided into the following subsections:

- Summary of work and work flow
- Investigation planning
- Field implementation

4.1 Summary of Work and Work Flow

A summary of work planned for this supplemental RI is included in this section. After planning tasks are complete, field activities will commence. Field activities generally include measurement of groundwater elevation relative to the tidal cycle, groundwater sampling, and soil boring and sampling. A more detailed list of all work elements that will be completed to implement this supplemental RI and their proposed sequence is shown below:

Planning

1. Finalize the HASP, GSAP, SSAP, and QAPP.
2. Procure drilling contractor.
3. Procure sample bottles from analytical laboratory.
4. Procure drums for investigation-derived waste.
5. Perform utility locate.

Field Implementation

1. Conduct a field kickoff meeting.
2. Mobilize personnel, equipment, materials, and supplies.
3. Locate groundwater sampling locations.
4. Measure groundwater elevations in all wells before and after groundwater sampling.
5. Collect groundwater samples from up to 28 sampling locations, including 25 monitoring wells and 3 piezometers, as identified in the GSAP (Appendix E) and submit to analytical laboratory.
6. Install submersible pressure transducers with data loggers to measure and record groundwater elevations as a function of time within tidal cycles in selected well(s).
7. Locate soil sampling locations via a handheld Global Positioning System device.
8. Collect soil samples at 7 initial locations, with potential additional “step out” locations, as identified in the SSAP (Appendix F) using a push probe drill rig and submit to analytical laboratory.
9. Store investigation-derived waste in drums on the Site.
10. Once analytical results are received for investigation-derived waste, ship offsite for disposal.
11. Demobilize personnel, equipment, and any extra materials and supplies.

4.2 Investigation Planning

Planning documents to complete the appendices are included as appendices to this Work Plan:

- HASP (Appendix D)

- GSAP (Appendix E)
- SSAP (Appendix F)
- QAPP (Appendix G)

A description of each planning document included with this Work Plan is provided in the subsections below.

4.2.1 Health and Safety Plan

All contractors and subcontractors are required to use workers trained for hazardous waste work in accordance with current Occupational Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Administration regulations. The OSHA standard for Hazardous Waste Operations and Emergency Response (HAZWOPER) (29 Code of Federal Regulations 1910.120) applies because of contaminant-related hazards, as well as traditional construction hazards on this project. Workers that do not perform intrusive work will not require HAZWOPER training. The drilling contractor will have a site health and safety officer who will ensure that all contractor personnel adhere to health and safety regulations. Prior to starting work, the drilling contractor will submit their corporate HASP to International Paper for review. The plan will include written documentation of employee training and medical certifications as required under WAC 296-62, Part P. Documentation of the following items is required for each site worker where work falls under the requirements of WAC 296-62, Part P:

- Initial 40-hour health and safety training and annual 8-hour refresher training
- Eight-hour supervisory training, required for the field supervisor
- Medical clearance from a licensed physician certifying that the worker is fit to participate in field activities and use personal protective equipment
- Current cardiopulmonary resuscitation and first aid certification for at least one member of each crew
- Provision of personal protective equipment for each worker at the highest level of protection planned for this Site (Level D)

The drilling contractor will be provided with a copy of the AECOM's HASP for reference.

AECOM employees performing field activities at the Site will work under the HASP included in Appendix D of this Work Plan. Health and safety for AECOM employees is also addressed by the AECOM corporate health and safety program.

The drilling contractor has responsibility for implementation, oversight, and enforcement of their HASP and has stop work authority for all elements completed at the Site. The HASP will address the following:

- Description of work and phases of work anticipated (with an activity hazard analysis)
- Contractor's safety and health policy
- Responsibility and lines of authority
- Subcontractors and suppliers
- Training requirements
- Safety and health inspections
- Accident reporting

In particular, activity hazard analyses must be prepared for each activity, in a level of detail that includes task sequence descriptions.

The following safety concerns require planning and will need to be addressed in the HASP:

- Extended work shifts, if planned
- Site access issues
- Potential contact with energized systems (electricity, pressurized slurry or water, etc.)

- Heavy equipment, including drilling equipment
- Use of power tools or powered equipment, crane, and rigging
- Manual lifting of heavy loads or repetitive motion
- Contact with hazardous animals, insects, plants, or other biohazards
- Heat or cold stress
- Exposure to high noise levels
- Hazardous waste work (contaminated sites)
- Use of hazardous materials/chemicals
- Dust control

4.2.2 Groundwater Sampling and Analysis Plan

The GSAP presented in Appendix E of this Work Plan includes requirements for the groundwater sampling to be performed at the Site. This groundwater sampling will be a one-time sampling event to obtain current groundwater conditions. The groundwater sampling will be performed at 25 existing wells and 3 existing piezometers (if present along the shoreline of the PRSC). If the piezometers cannot be located, then new wells will be installed close to the former locations of the piezometers. All groundwater samples will be analyzed for site COCs, including benzene, toluene, ethylbenzene, and xylenes (BTEX), naphthalenes (naphthalene, 1-methylnaphthalene, 2-methylnaphthalene), cPAHs, PCBs, Resource Conservation and Recovery Act (RCRA) metals plus copper (total and dissolved), and TPH (GRO and DRO/ORO). The QA elements are provided in the QAPP in Appendix G. The GSAP meets the requirements of WAC 173-340-820 and describes methods and procedures to be used in sampling the groundwater, including the following major elements:

- Background and site history
- Groundwater sampling and analysis
- Field documentation

Sample collection and chain-of-custody forms are included in the GSAP for the field team to use.

4.2.3 Soil Sampling and Analysis Plan

The SSAP presented in Appendix F of this Work Plan includes requirements for soil sampling at the JJ Port property and soil sampling beneath the former 450,000-gallon AST and northeast of that area (towards the Puyallup River). Additional soil data is needed to refine the extent of soil contamination on the JJ Port property to ensure the limits of solidification encompass soil that exceeds CULs and to characterize impacts in the vicinity of the former AST. The investigation will be completed with a push probe drill rig. Samples will be analyzed for site COCs, including BTEX, naphthalenes (naphthalene, 1-methylnaphthalene, 2-methylnaphthalene), cPAHs, PCBs, RCRA metals plus copper, and TPH (GRO and DRO/ORO). The QA elements are provided in the QAPP in Appendix G. The SSAP meets the requirements of WAC 173-340-820 and describes methods and procedures to be used in sampling the soil, including the following major elements:

- Soil sampling activities (at 7 initial locations, with potential additional “step out” locations, as described in the SSAP included in Appendix F)
- Sample analysis
- Decontamination and investigation-derived waste
- Field Documentation

Sample collection and chain-of-custody forms are included in the SSAP for the field team to use.

4.2.4 Quality Assurance Project Plan

QA/QC procedures developed to ensure that data quality objectives for the groundwater and soil sampling are met are described in the QAPP. The QAPP is provided in Appendix G of this Work Plan and will be reviewed by the sampling

personnel prior to sampling. If a QAPP revision occurs prior to implementation of supplemental RI work, the latest QAPP revision will apply. The QAPP includes the following major elements:

- Project organization and responsibility
- Data quality objectives
- Analytical procedures
- Data reduction, review, and reporting
- Quality control procedures
- Performance and system audits
- Preventative maintenance
- Data verification and validation procedures
- Corrective action
- Data quality assessment

4.3 Field Implementation

This section discusses the construction components of the interim action. It includes a description of the main construction elements and is presented in the order work will be completed. The contractor will be required to complete these tasks in accordance with the bid documents (plans and specifications) discussed in Section 6.3. The tasks presented below provide the general construction requirements, approach, and progression of work needed to complete *in situ* soil solidification at the Site.

4.3.1 Administration/Premobilization

No on-site work will be performed during this phase. The following work items will be performed:

- Procure drilling contractor.
- Procure sample bottles from analytical laboratory.
- Procure drums for investigation-derived waste

4.3.2 Utility Locates

Prior to conducting any intrusive work at the Site, private utility locates will be conducted to attempt to identify locations of underground utilities. Utility locates will be conducted in all work areas where drilling will occur. In addition, the contractor will also request a utility locate from the Washington Utility Notification center “call before you dig” program by dialing 811. If utilities are present in the work areas, their status will be determined, and a decision made as to whether they can be capped and demolished or if a reroute is needed.

4.3.3 Mobilization and Site Preparation

Mobilization will be performed following Ecology’s acceptance of the Work Plan. The drilling contractor and AECOM will mobilize all equipment and personnel required to complete the work described in this Work Plan.

4.3.4 Groundwater and Soil Sampling

Groundwater and soil sampling will be performed as described in the GSAP and the SSAP, included as Appendices E and F of this Work Plan.

4.3.5 Demobilization

Following drilling activities, AECOM and the drilling contractor will remove any equipment and unused materials from the Site. For drilling locations, the site surface will be returned to a condition equivalent to or better than current conditions.

4.3.6 Waste Management

Investigation-derived waste will be handled as discussed in the GSAP and the SSAP, included as Appendices E and F of this Work Plan.

4.3.7 Record Keeping and Reporting

AECOM will maintain records to document the work performed, as specified in the field documentation sections of the GSAP and SSAP. In addition, results of the supplemental RI will be reported in a supplemental RI report and updated FS report. At a minimum the supplemental RI report and updated FS report will include the following:

- A narrative summary of work completed as part of the supplemental RI
- Documentation of any deviations from this Work Plan
- Groundwater and soil sampling locations
- Groundwater and soil analytical results, and comparison to site CULs
- Groundwater elevations and maps of groundwater flow directions based on water level data, including data loggers
- Revisions to the nature and extent of contamination in the RI, as necessary, including updated maps with the extent of groundwater and soil exceeding site CULs
- Revisions to the evaluation of remedial alternatives in the FS, as necessary, to further address soil deeper than 15 feet bgs and site groundwater
- Boring logs for soil sampling locations and any new monitoring wells installed at the Site
- Photographs illustrating the supplemental RI work
- Documentation of waste disposition

The supplemental RI report and updated FS report will be provided to the Ecology Project Coordinator within 90 days of demobilization from the field.

5 References

AECOM. 2015. *Feasibility Study Addendum, B36 Area, Tacoma Metals Site, Tacoma, Washington.* Prepared for International Paper Company and Submitted to Ecology. June 30, 2015.

———. 2017a. *Draft Interim Action Work Plan, In Situ Soil Solidification, B36 Area, Area B, and Area D, Tacoma Metals Site, Tacoma, Washington.* Prepared for International Paper and Submitted to Ecology. May 19, 2017.

———. 2017b. *Final Interim Action Work Plan, In Situ Solidification, B36 Area, Area B, and Area D, Tacoma Metals Site, Tacoma, Washington.* Prepared for International Paper and Submitted to Ecology. November 17, 2017.

Aspect Consulting, LLC (Aspect). 2018a. *Revised Draft Remedial Investigation and Feasibility Study, Tacoma Metals, Inc. Site*. Prepared for Estate of Sophie Sussman. Project No. 160420. February 28, 2018.

———. 2018b. *Revised Draft Remedial Investigation and Feasibility Study, Tacoma Metals, Inc. Site.* Prepared for Estate of Sophie Sussman. Project No. 160420. June 22, 2018.

Hart Crowser. 1975. Geology of the Port of Tacoma. Seattle, Washington.

Kennedy/Jenks Consultants (KJC). 2001. Remedial Investigation/Feasibility Study Report, Former Tacoma Metals Facility. Prepared for Portland Avenue Associates, LLC. Tacoma, Washington. October 2001.

———. 2012. Revised Groundwater Investigation Summary, Puyallup River Side Channel Investigation. Prepared for Portland Avenue Associates, LLC. Tacoma, Washington. January 16, 2012.

———. 2014. Revised Augmented Remedial Investigation and Feasibility Study Report, Former Tacoma Metals Site, Tacoma, Washington. Prepared for Portland Avenue Associates, LLC. Tacoma, Washington. September 2014.

Washington State Department of Ecology (Ecology). 2007. Model Toxics Control Act Cleanup Regulation. Chapter 173-340 WAC. October 2007.

———. 2016a. Ecology Comments on the Revised Augmented Remedial Investigation and Feasibility Study Report, dated September 2014, prepared by Kennedy/Jenks, Former Tacoma Metals Site, Agreed Order DE 97-5435, Facility/Site No. 1257, Cleanup Site ID No. 3910. April 18.

———. 2016b. Ecology Comments on the Feasibility Study Addendum, B36 Area, Tacoma Metals Site, Tacoma, Washington, dated June 2015, prepared by AECOM, Former Tacoma Metals Site, Agreed Order DE 97-5435, Facility/Site No. 1257, Cleanup Site ID No. 3910. April 21.

———. 2018. Department of Ecology comments on Revised Draft Remedial Investigation and Feasibility Study, prepared for the Estate of Sophie Sussman by Aspect Consulting, dated June 22, 2018. December 3.

———. 2017. Ecology Comments on the Draft Interim Action Work Plan, In Situ Solidification, B36 Area, Area B, and Area D, Tacoma Metals Site, Draft Agreed Order DE 13740, Facility/Site No. 1257, Cleanup Site ID No. 3910. September 19.

Tables

Table 1-1. Project Contacts

Project Role	Name	Responsibility	Phone	E-Mail
AECOM				
Project Coordinator	Paul Kalina	Oversee the implementation of the AO and the supplemental RI and updated FS	206-438-2172	paul.kalina@aecom.com
Project Manager	Paul Kalina	Manage all aspects of the supplemental RI and updated FS project	206-438-2172	paul.kalina@aecom.com
QA/QC Manager	Lucy Panteleeff	Develop and manage QA/QC procedures described in the QAPP	206-438-2277	lucy.panteleeff@aecom.com
Field Lead	TBD	Manage the field activities	TBD	TBD
Ecology				
Project Coordinator	Andrew Smith	Oversee the implementation of the AO and the supplemental RI and updated FS	360-407-6316	andrew.smith@ecy.wa.gov
Subcontractors				
Driller	TBD	Manage subcontractor field crew	TBD	TBD
Laboratory	TBD	Sample analysis	TBD	TBD

Notes:
AO – agreed order
FS – feasibility study
QAPP – quality assurance project plan
QA/QC – quality assurance/quality control
RI – remedial investigation
TBD – to be determined

Table 2-1. Soil Analytical Results, B36 Area, Tacoma Metals Site

Sample ID:			MW-29 (B34)			MW-30 (B35)			MW-31 (B36)			B37			B38		
Depth (ft bgs):	Site Cleanup Levels[1]		7-8	18-19	30-31	6-7	32-33	39-40	8-10	23-24	31-32	5-6	14-15	21-22	5-6	14.5-15.5	22.5-23.5
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Feb-2006	Feb-2006	Feb-2006	Feb-2006	Feb-2006	Feb-2006	Feb-2006	Feb-2006	Feb-2006	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007
TPH (mg/kg)																	
Diesel	NE	NE	58.6 [7]	13.7 U	18.5 [8]	19.5 [7]	18.6 [8]	16.4 [8]	1,060 [8]	14,900 [8]	8,830 [8]	50 U	50 U	50 U	50 U	50 U	50 U
Oil	NE	NE	305	34.3 U	31.1 U	138	29.5 U	29.2 U	1,690	3,100 U	1,210 U	250 U	250 U	250 U	250 U	250 U	250 U
Diesel and Oil	2,000	NE	364	34.3 U	18.5	196.6	18.6	16.4	**2,750**	**14,900**	**8,830**	250 U	250 U	250 U	250 U	250 U	250 U
PAHs (mg/kg)																	
1-Methylnaphthalene	NE	NE	0.118 U	0.0140 U	0.282	0.148 U	1.02	0.363	7.59 U	819	501	NR	NR	NR	NR	NR	NR
2-Methylnaphthalene	NE	NE	0.118 U	0.0140 U	0.0127 U	0.148 U	0.890	0.170	7.59 U	25.1 U	88.2	NR	NR	NR	NR	NR	NR
Naphthalene	NE	NE	0.118 U	0.00992 J	0.0539	0.0504 J	1.93	0.658	1.62 J	204	296	0.020	0.01 U	0.01 U	0.015	0.01 U	0.01 U
Total Naphthalenes	4.5	0.24	0.118 U	0.00992 J	0.3359	0.0504 J	**3.84**	**1.19**	1.62 J	**1,023**	**885.2**	0.020	0.010 U	0.010 U	0.015 0	0.010 U	0.010 U
Acenaphthene	NE	NE	0.118 U	0.188	0.589	0.148 U	1.34	1.00	16.9	1,600	1,490	0.01 U	0.080	0.032	0.01 U	0.10	0.41
Acenaphthylene	NE	NE	0.118 U	0.0140 U	0.0127 U	0.0385 J	0.0588 U	0.0600 U	7.59 U	25.1 U	22.1 J	0.01 U	0.01 U	0.01 U	0.011	0.01 U	0.01 U
Anthracene	NE	NE	0.118 U	0.0140 U	0.354	0.860 J	0.163	0.132	20.0	417	2,540	0.01 U	0.01 U	0.01 U	0.040	0.033	0.015
Benzo[a]anthracene[2]	NE	NE	0.448	0.0217	0.0284	0.332	0.0588 U	0.0600 U	71.7	403	296	0.01 U	0.01 U	0.01 U	0.18	0.01 U	0.01 U
Benzo[a]pyrene[2]	NE	NE	0.491	0.0158	0.0102 J	0.755	0.0588 U	0.0600 U	88.8	271	151	0.01 U	0.01 U	0.01 U	0.24	0.01 U	0.01 U
Benzo[b]fluoranthene[2]	NE	NE	0.474	0.0217	0.00491 J	0.752	0.0588 U	0.0600 U	73.2	215	145	0.018	0.01 U	0.01 U	0.33	0.01 U	0.01 U
Benzo[g,h,i]perylene	NE	NE	0.244	0.00814 J	0.0127 U	0.513	0.0588 U	0.0600 U	26.0	60.3	50.4	0.013	0.01 U	0.01 U	0.095	0.01 U	0.01 U
Benzo[k]fluoranthene[2]	NE	NE	0.481	0.0225	0.00169 J	0.631	0.0588 U	0.0600 U	78.0	245	135	0.01 U	0.01 U	0.01 U	0.13	0.01 U	0.01 U
Chrysene[2]	NE	NE	0.519	0.0300	0.0154	0.993	0.0588 U	0.0600 U	114	281	507	0.016	0.01 U	0.01 U	0.27	0.01 U	0.01 U
Dibenzo[a,h]anthracene[2]	NE	NE	0.229	0.0154	0.0127 U	0.343	0.0588 U	0.0600 U	22.1	58.3	97.7	0.01 U	0.01 U	0.01 U	0.022	0.01 U	0.01 U
Dibenzofuran	NE	NE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	NE	NE	1.120	0.0369	0.534	0.247	0.241	0.291	103	1,690	1,560	0.016	0.01 U	0.01 U	0.21	0.049	0.017
Fluorene	NE	NE	0.118 U	0.0297	0.569	0.148 U	1.08	0.725	7.59 U	1,290	1,570	0.01 U	0.01 U	0.01 U	0.01 U	0.089	0.01 U
Indeno[1,2,3-cd]pyrene[2]	NE	NE	0.330	0.0215	0.0127 U	0.550	0.0588 U	0.0600 U	31.7	82.7	101	0.011	0.01 U	0.01 U	0.12	0.01 U	0.01 U
Phenanthrene	NE	NE	0.401	0.0221	1.020	0.122 J	1.47	1.08	19.1	3650	4050	0.011	0.01 U	0.01 U	0.034	0.13	0.060
Pyrene	NE	NE	0.671	0.0293	0.328	0.274	0.105	0.122	136	1,550	1,150	0.016	0.01 U	0.01 U	0.44	0.027	0.028
TTEC[2]	3.9	0.19	0.692	0.0264	0.0139	1.03	0.0588 U	0.0600 U	**118**	**374**	**234**	0.00306	0.01 U	0.01 U	0.321	0.01 U	0.01 U
VOCs (mg/kg)																	
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl tert-butyl ether	NE	NE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
[1] Site Cleanup Levels established in the Revised Draft RI/FS Report
[2] cPAH cleanup levels under MTCA are based on the calculated total toxicity of the mixture using the Toxicity Equivalency Methodology in WAC 173-340-708(8).
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[6] DUP-B100 is a field duplicate of sample B56.
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-- Not analyzed
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ft bgs - feet below ground surface
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J - estimated result
mg/kg - milligram per kilogram
MTCA - Model Toxics Control Act
NA - not applicable
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PAHs - polycyclic aromatic hydrocarbons
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U - Compound was analyzed for but not detected above the reporting limit shown.
VOC - volatile organic compound
WAC - Washington Administrative Code

Table 2-1. Soil Analytical Results, B36 Area, Tacoma Metals Site

Sample ID:	Site Cleanup Levels[1]		B39			B40			B41			B42		
Depth (ft bgs):			5.5-6.5	10-11	21-22	6.5-7.5	14-15	21.5-22.5	7-8	11-12	24.5-25.5	5-6	22-23	24.5-25.5
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007
TPH (mg/kg)														
Diesel	NE	NE	120	50 U	200	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Oil	NE	NE	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Diesel and Oil	2,000	NE	120	250 U	200	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
PAHs (mg/kg)														
1-Methylnaphthalene	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
2-Methylnaphthalene	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Naphthalene	NE	NE	1.8	0.24	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.028	0.01 U	0.01 U
Total Naphthalenes	4.5	0.24	1.8	**0.24**	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.028	0.01 U	0.01 U
Acenaphthene	NE	NE	0.51	1.1	0.41	0.01 U	0.011	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	1.3	0.01 U
Acenaphthylene	NE	NE	0.12	0.01 U	0.11	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.012	0.01 U	0.01 U
Anthracene	NE	NE	0.61	0.47	2.6	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.032	0.01 U	0.01 U
Benzo[a]anthracene[2]	NE	NE	0.99	0.019	6.7	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.11	0.01 U	0.01 U
Benzo[a]pyrene[2]	NE	NE	1.3	0.01 U	4.2	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.25	0.01 U	0.01 U
Benzo[b]fluoranthene[2]	NE	NE	2.0	0.01 U	5.0	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.36	0.01 U	0.01 U
Benzo[g,h,i]perylene	NE	NE	0.83	0.01 U	1.5	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.14	0.01 U	0.01 U
Benzo[k]fluoranthene[2]	NE	NE	0.62	0.01 U	1.9	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.12	0.01 U	0.01 U
Chrysene[2]	NE	NE	1.7	0.012	9.4	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.23	0.01 U	0.01 U
Dibenzo[a,h]anthracene[2]	NE	NE	0.24	0.01 U	0.58	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.040	0.01 U	0.01 U
Dibenzofuran	NE	NE	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	NE	NE	1.2	1.3	18	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.067	0.01 U	0.01 U
Fluorene	NE	NE	0.39	1.3	0.40	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Indeno[1,2,3-cd]pyrene[2]	NE	NE	1.0	0.01 U	1.9	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.17	0.01 U	0.01 U
Phenanthrene	NE	NE	1.3	1.90	2.1	0.019	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.052	0.015	0.01 U
Pyrene	NE	NE	1.1	0.770	15	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.089	0.01 U	0.01 U
TTEC[2]	3.9	0.19	1.8	0.0020	**5.9**	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.439	0.01 U	0.01 U
VOCs (mg/kg)														
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--	--	--	--
Methyl tert-butyl ether	NE	NE	--	--	--	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
[1] Site Cleanup Levels established in the Revised Draft RI/FS Report
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Table 2-1. Soil Analytical Results, B36 Area, Tacoma Metals Site

Sample ID:			B43				B44			B45			B46		
Depth (ft bgs):	Site Cleanup Levels[1]		6-7	14.5-15.5	28.5-29.5	34.5-35.5	2-3	14-15	31.5-32.5	6.5-7.5	11-12	21-22	6-7	13-14	21-22
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007	Oct-2007
TPH (mg/kg)															
Diesel	NE	NE	130	50 U	50 U	69	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Oil	NE	NE	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Diesel and Oil	2,000	NE	130	250 U	250 U	69	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
PAHs (mg/kg)															
1-Methylnaphthalene	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
2-Methylnaphthalene	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Naphthalene	NE	NE	0.028	0.26	0.91	0.43	0.045	0.01 U	0.052	0.01 U	0.01 U	0.01 U	0.01 U	0.022	0.01 U
Total Naphthalenes	4.5	0.24	0.028	**0.26**	**0.91**	**0.43**	0.045	0.01 U	0.052	0.01 U	0.01 U	0.01 U	0.01 U	0.022	0.01 U
Acenaphthene	NE	NE	0.015	0.033	1.4	1.0	0.01 U	0.01 U	0.55	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Acenaphthylene	NE	NE	0.01 U	0.01 U	0.01 U	0.01 U	0.076	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Anthracene	NE	NE	0.014	0.01 U	0.11	0.078	0.083	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Benzo[a]anthracene[2]	NE	NE	0.024	0.01 U	0.01 U	0.01 U	0.36	0.015	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.011
Benzo[a]pyrene[2]	NE	NE	0.010	0.01 U	0.01 U	0.01 U	0.73	0.014	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.014	0.01 U
Benzo[b]fluoranthene[2]	NE	NE	0.013	0.01 U	0.01 U	0.01 U	0.96	0.015	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.019	0.01 U
Benzo[g,h,i]perylene	NE	NE	0.01 U	0.01 U	0.01 U	0.01 U	0.43	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Benzo[k]fluoranthene[2]	NE	NE	0.01 U	0.01 U	0.01 U	0.01 U	0.25	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Chrysene[2]	NE	NE	0.036	0.01 U	0.01 U	0.01 U	0.67	0.013	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.024	0.01 U
Dibenzo[a,h]anthracene[2]	NE	NE	0.01 U	0.01 U	0.01 U	0.01 U	0.14	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Dibenzofuran	NE	NE	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	NE	NE	0.026	0.01 U	0.14	0.12	0.23	0.016	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.049	0.01 U
Fluorene	NE	NE	0.017	0.012	0.98	0.63	0.010	0.01 U	0.23	0.01 U	0.01 U	0.01 U	0.01 `	0.01 U	0.01 U
Indeno[1,2,3-cd]pyrene[2]	NE	NE	0.01 U	0.01 U	0.01 U	0.01 U	0.49	0.010	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Phenanthrene	NE	NE	0.11	0.012	1.5	0.33	0.077	0.010	0.081	0.01 U	0.01 U	0.01 U	0.015	0.085	0.01 U
Pyrene	NE	NE	0.027	0.01 U	0.062	0.053	0.40	0.023	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.045	0.01 U
TTEC[2]	3.9	0.19	0.018	0.01 U	0.01 U	0.01 U	1.19	0.019	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.020	0.01 U
VOCs (mg/kg)															
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl tert-butyl ether	NE	NE	--	--	--	--	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	--	--	--	--	--	--	--	--	--	--	--	--	--

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Table 2-1. Soil Analytical Results, B36 Area, Tacoma Metals Site

Sample ID:			B47			B48		B49		B50			B51		B52	B53	B54
Depth (ft bgs):	Site Cleanup Levels[1]		6-7	13-14	30.5-31.5	4.5-7	7-9	7	8-10	4-5	7-8	8-9	3.5-5	8.5-10	3.5-5	4-5	6-7
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Oct-2007	Oct-2007	Oct-2007	10/7/14	10/7/14	10/7/14	10/7/14	10/7/14	10/7/14	10/7/14	10/7/14	10/7/14	10/7/14	10/7/14	10/7/14
TPH (mg/kg)																	
Diesel	NE	NE	78	50 U	50 U	97.9 [3]	22.3 [4]	160 J[10]	31,800 [5]	10 U	1,150 [5]	104	182 [3]	58.9 [4]	10 U	497	33 [3]
Oil	NE	NE	250 U	250 U	250 U	164	166 [4]	2,000 J[10]	40,600 [5]	199	949 [5]	50 U	354	73.2 [4]	50 U	2,640	236
Diesel and Oil	2,000	NE	78	250 U	250 U	262	188	**2,160**	**72,400**	199	**2,099**	104	536	132	50 U	**3,137**	269
PAHs (mg/kg)																	
1-Methylnaphthalene	NE	NE	NR	NR	NR	0.109	0.139	0.096 J[10]	45.3	0.043 J[10]	20.1	0.408	0.077	0.147	0.033 U	0.540	0.033 U
2-Methylnaphthalene	NE	NE	NR	NR	NR	0.102	0.246	0.18 J[10]	62.2	0.069 J[10]	21.1	0.223	0.095	0.033 U	0.033 U	1.05	0.033 U
Naphthalene	NE	NE	0.038	0.01 U	0.01 U	0.262	0.719	0.33 J[10]	132	0.10 J[10]	28.3	0.624	0.213	0.151	0.033 U	1.56	0.101
Total Naphthalenes	4.5	0.24	0.038	0.01 U	0.01 U	0.473	**1.104**	0.606 J[10]	**239.5**	0.212 J[10]	**69.5**	**1.255**	0.385	**0.298**	0.033 U	3.15	0.101
Acenaphthene	NE	NE	0.01 U	0.01 U	0.01 U	0.086	0.237	0.074 J[10]	122	0.031 J[10]	51.9	1.55	0.165	0.401	0.033 U	0.851	0.059
Acenaphthylene	NE	NE	0.046	0.01 U	0.01 U	0.033 U	0.262	0.11 J[10]	2.58	0.026 J[10]	0.478	0.033 U	0.033 U	0.033 U	0.033 U	3.86	0.033 U
Anthracene	NE	NE	0.080	0.01 U	0.01 U	0.456	1.18	0.96 J[10]	256	0.082 J[10]	53.8	0.124	0.227	0.080	0.033 U	6.38	0.154
Benzo[a]anthracene[2]	NE	NE	0.37	0.011	0.01 U	0.123	3.98	1.1 J[10]	348	0.15 J[10]	43.8	0.121	0.348	0.129	0.033 U	15.4	0.181
Benzo[a]pyrene[2]	NE	NE	0.62	0.01 U	0.01 U	0.154	6.60	2.7 J[10]	284	0.30 J[10]	34.4	0.147	0.263	0.117	0.033 U	36.6	0.261
Benzo[b]fluoranthene[2]	NE	NE	0.81	0.011	0.01 U	0.258	6.82	3.7 J[10]	366	0.44 J[10]	36.6	0.187	0.409	0.137	0.033 U	40.5	0.389
Benzo[g,h,i]perylene	NE	NE	0.34	0.01 U	0.01 U	0.033 U	1.76	1.3 J[10]	66.4	0.23 J[10]	14.9	0.042	0.106	0.033 U	0.033 U	12.1	0.164
Benzo[k]fluoranthene[2]	NE	NE	0.22	0.01 U	0.01 U	0.081	2.60	0.78 J[10]	90.0	0.14 J[10]	14.0	0.072	0.158	0.058	0.033 U	10.5	0.119
Chrysene[2]	NE	NE	0.73	0.013	0.01 U	0.200	8.26	4.0 J[10]	770	0.48 J[10]	62.8	0.186	0.499	0.146	0.033 U	31.4	0.327
Dibenzo[a,h]anthracene[2]	NE	NE	0.095	0.01 U	0.01 U	0.108	0.714	0.43 J[10]	34.1	0.073 J[10]	6.29	0.033 U	0.033 U	0.033 U	0.033 U	4.57	0.053
Dibenzofuran	NE	NE	--	--	--	--	--	0.13 J[10]	13 [9]	0.033 J[10]	--	--	--	--	--	--	--
Fluoranthene	NE	NE	0.27	0.023	0.01 U	0.783	3.45	0.92 J[10]	755	0.29 J[10]	91.9	0.338	1.03	0.317	0.033 U	16.0	0.217
Fluorene	NE	NE	0.016	0.01 U	0.01 U	0.089	0.265	0.074 J[10]	83.9	0.025 J[10]	32.3	0.730	0.135	0.238	0.033 U	0.884	0.033 U
Indeno[1,2,3-cd]pyrene[2]	NE	NE	0.36	0.01 U	0.01 U	0.033 U	2.53	1.5 J[10]	95.4	0.22 J[10]	19.5	0.068	0.164	0.033 U	0.033 U	15.5	0.196
Phenanthrene	NE	NE	0.15	0.020	0.01 U	0.731	2.12	0.63 J[10]	359	0.14 J[10]	131	0.480	0.694	0.204	0.033 U	2.67	0.226
Pyrene	NE	NE	0.47	0.022	0.01 U	0.358	2.72	1.5 J[10]	648	0.44 J[10]	88.3	0.187	2.10	0.175	0.033 U	23.8	0.528
TTEC[2]	3.9	0.19	1.02	0.012	0.01 U	0.213	**8.35**	3.5 J[10]	**385**	0.41 J[10]	**47.0**	**0.194**	0.376	0.151	0.033 U	**45.6**	0.358
VOCs (mg/kg)																	
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl tert-butyl ether	NE	NE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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[6] DUP-B100 is a field duplicate of sample B56.
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-- Not analyzed
cPAH - carcinogenic polycyclic aromatic hydrocarbons
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ft bgs - feet below ground surface
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U - Compound was analyzed for but not detected above the reporting limit shown.
VOC - volatile organic compound
WAC - Washington Administrative Code

Table 2-1. Soil Analytical Results, B36 Area, Tacoma Metals Site

Sample ID:			B55			B56		DUP-B100[6]	B57		B58		B59	B60		B61	
Depth (ft bgs):	Site Cleanup Levels[1]		4-5	7.5-9	10-12	7-8.5	13-14	7-8.5	7.5-8.5	9-12	4-5	7.5-8.5	4.5-5.5	4.5-5	9-15	7-8	13-14
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	10/7/14	10/7/14	10/7/14	10/7/14	10/7/14	10/7/14	10/7/14	10/7/14	10/7/14	10/7/14	10/8/14	10/8/14	10/8/14	10/8/14	10/8/14
TPH (mg/kg)																	
Diesel	NE	NE	20 U	419 [4]	661 [4]	266 [4]	156 [4]	227 [4]	4,440 [4]	13,200 [5]	687 [4]	920 [4]	10 U	385	2,910 [4]	443 [4]	17.8 [4]
Oil	NE	NE	286	750 [4]	631 [4]	1,560 [4]	184 [4]	954 [4]	20,200 [4]	3,510 [5]	3,030 [4]	1,460 [4]	65.2	857	1,330 [4]	823 [4]	18.0 [4]
Diesel and Oil	2,000	NE	286	1,169	1,292	1,826	340	1,181	**24,640**	**16,710**	**3,717**	**2,380**	75	1,242	**4,240**	1,266	36
PAHs (mg/kg)																	
1-Methylnaphthalene	NE	NE	0.016 J[10]	1.04	3.94	2.14	0.663	4.46	9.60	866	3.1 J[10]	12.7	0.033 U	0.270	35.2	6.82	0.069
2-Methylnaphthalene	NE	NE	0.024 J[10]	0.821	2.87	1.93	0.410	3.64	13.5	1,320	3.4 J[10]	30.4	0.033 U	0.341	6.78	1.11	0.033 U
Naphthalene	NE	NE	0.039 J[10]	1.39	4.63	0.548	1.34	0.895	10.1	3,540	3.8 J[10]	1.49	0.033 U	0.611	23.8	2.72	0.033 U
Total Naphthalenes	4.5	0.24	0.079 J[10]	3.251	**8.57**	**4.618**	**2.413**	**8.995**	**33.2**	**5726**	**10.3** J[10]	**44.59**	0.033 U	1.222	**65.78**	**10.65**	0.069
Acenaphthene	NE	NE	0.010 J[10]	4.69	9.25	4.29	1.30	17.8	22.3	810	13 J[10]	36.1	0.033 U	0.597	109	8.76	0.380
Acenaphthylene	NE	NE	0.006 J[10]	1.72	0.587	0.497	0.087	0.476	10.3	7.07	3.9 J[10]	3.15	0.033 U	1.06	0.787	0.637	0.033 U
Anthracene	NE	NE	0.011 J[10]	9.89	31.2	20.3	1.33	30.6	1,230	1,270	51 J[10]	68.4	0.033 U	1.42	190	7.13	0.342
Benzo[a]anthracene[2]	NE	NE	0.033 J[10]	8.91	10.4	97.4	1.87	46.2	1,160	352	110 J[10]	84.2	0.058	3.28	40.2	11.0	0.288
Benzo[a]pyrene[2]	NE	NE	0.044 J[10]	19.4	10.8	18.8	2.22	46.0	1,550	209	130 J[10]	88.2	0.062	7.56	20.7	11.6	0.165
Benzo[b]fluoranthene[2]	NE	NE	0.067 J[10]	26.9	12.3	18.6	2.34	58.0	1,680	222	170 J[10]	112	0.084	8.72	26.2	12.4	0.165
Benzo[g,h,i]perylene	NE	NE	0.028 J[10]	6.78	2.84	2.14	0.472	12.8	418	20.6	59 J[10]	25.4	0.033 U	1.41	2.81	2.92	0.066
Benzo[k]fluoranthene[2]	NE	NE	0.021 J[10]	6.69	3.76	45.4	0.706	19.4	576	44.0	59 J[10]	37.2	0.033 U	4.39	10.6	5.60	0.064
Chrysene[2]	NE	NE	0.075 J[10]	13.9	22.8	55.7	2.63	116	5,650	857	210 J[10]	203	0.126	4.55	69.8	25.4	0.219
Dibenzo[a,h]anthracene[2]	NE	NE	0.0080 J[10]	0.433	1.07	13.0	0.201	6.84	255	11.0	17 J[10]	10.8	0.033 U	0.433	1.42	1.15	0.033 U
Dibenzofuran	NE	NE	0.015 J[10]	--	--	--	--	--	21 U[9]	280 [9]	7.7 J[10]	--	--	--	--	--	--
Fluoranthene	NE	NE	0.067 J[10]	24.9	26.1	28.6	4.77	46.9	418	894	150 J[10]	63.1	0.074	7.62	197	12.1	0.996
Fluorene	NE	NE	0.0089 J[10]	4.45	10.6	13.7	1.27	13.7	31.5	635	10 J[10]	40.6	0.033 U	0.508	105	7.53	0.326
Indeno[1,2,3-cd]pyrene[2]	NE	NE	0.028 J[10]	8.81	3.67	6.65	0.678	18.4	592	30.0	65 J[10]	34.8	0.033 U	1.92	4.08	4.06	0.077
Phenanthrene	NE	NE	0.063 J[10]	22.8	33.1	18.9	2.89	54.9	162	2,560	71 J[10]	114	0.095	1.96	420	20.5	2.03
Pyrene	NE	NE	0.083 J[10]	18.4	16.7	30.1	1.72	50.5	731	856	170 J[10]	61.1	0.07	5.39	135	13.7	0.750
TTEC[2]	3.9	0.19	0.060 J[10]	**24.7**	**14.1**	**37.5**	**2.83**	**62.0**	**2,033**	**283**	**170 J[10]**	**118**	0.087	**9.48**	**29.6**	**15.3**	**0.227**
VOCs (mg/kg)																	
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl tert-butyl ether	NE	NE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
[1] Site Cleanup Levels established in the Revised Draft RI/FS Report
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Table 2-1. Soil Analytical Results, B36 Area, Tacoma Metals Site

Sample ID:			B62		B63		B64		B65			B66	B67			B68	
Depth (ft bgs):	Site Cleanup Levels[1]		4-5	8-9	4-5	10.5-11.5	7.5-8.5	14-15	3.5-4.5	8-9	17-18	8-9	4-5	8-9	9-13	4-5	13.5-15
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	10/8/14	10/8/14	10/8/14	10/8/14	10/8/14	10/8/14	10/8/14	10/8/14	10/8/14	10/8/14	10/8/14	10/8/14	10/8/14	10/8/14	10/8/14
TPH (mg/kg)																	
Diesel	NE	NE	10 U	44.4	24.6	94.6 [4]	325 [4]	58.5 [4]	137	358 [4]	57.6 [5]	7,620 [4]	20 U	10 U	130 [4]	452	10 U
Oil	NE	NE	90	199	50 U	50.3 [4]	847 [4]	19.2 [4]	910	456 [4]	25.8 [5]	6,530 [4]	370	267	120 [4]	2,620	50 U
Diesel and Oil	2,000	NE	90	243	25	145	1,172	78	1,047	814	83	**14,150**	370	267	250	**3,072**	50 U
PAHs (mg/kg)																	
1-Methylnaphthalene	NE	NE	--	0.099	--	0.205	4.70	1.40	0.303	4.24	2.17	40.2	0.033 U	0.101	17.0	0.670	0.636
2-Methylnaphthalene	NE	NE	--	0.033 U	--	0.052	2.82	1.35	0.507	1.88	2.69	107	0.033 U	0.148	1.31	1.24	0.370
Naphthalene	NE	NE	--	0.159	--	0.165	5.47	2.79	1.19	4.62	3.02	82.3	0.033 U	0.307	8.21	2.58	1.28
Total Naphthalenes	4.5	0.24	--	**0.258**	--	**0.370**	**10.17**	**4.19**	1.493	**8.86**	**5.19**	**122.5**	0.033 U	**0.408**	**25.21**	3.250	**1.916**
Acenaphthene	NE	NE	--	0.376	--	1.97	4.46	2.22	0.469	5.59	2.89	272	0.033 U	0.206	19.9	1.26	0.389
Acenaphthylene	NE	NE	--	0.033 U	--	0.033 U	1.59	0.033 U	0.885	2.17	0.033 U	13.5	0.033 U	0.464	0.146	2.20	0.033 U
Anthracene	NE	NE	--	0.033 U	--	1.34	11.4	2.21	3.47	5.20	2.04	1,980	0.086	1.62	2.99	16.9	0.527
Benzo[a]anthracene[2]	NE	NE	--	0.033 U	--	1.13	14.8	0.454	9.23	4.70	0.463	407	0.095	4.88	2.01	32.6	0.033 U
Benzo[a]pyrene[2]	NE	NE	--	0.033 U	--	0.575	23.4	0.229	15.8	11.6	0.235	282	0.090	6.98	2.08	68.2	0.033 U
Benzo[b]fluoranthene[2]	NE	NE	--	0.033 U	--	0.601	27.0	0.238	20.2	12.0	0.256	345	0.110	11.0	2.15	81.2	0.033 U
Benzo[g,h,i]perylene	NE	NE	--	0.033 U	--	0.144	7.60	0.072	6.92	2.70	0.068	63.8	0.033 U	1.02	0.619	27.6	0.033 U
Benzo[k]fluoranthene[2]	NE	NE	--	0.033 U	--	0.216	10.3	0.103	5.90	4.03	0.097	113	0.040	5.43	0.666	23.1	0.033 U
Chrysene[2]	NE	NE	--	0.033 U	--	1.11	62.4	0.487	18.2	7.43	0.629	725	0.149	12.6	2.84	84.8	0.033 U
Dibenzo[a,h]anthracene[2]	NE	NE	--	0.033 U	--	0.033 U	2.86	0.033 U	1.97	0.831	0.033 U	25.8	0.033 U	0.367	0.199	8.64	0.033 U
Dibenzofuran	NE	NE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	NE	NE	--	0.108	--	6.90	13.7	1.87	15.9	8.38	2.68	1,450	0.137	10.3	6.00	44.1	0.483
Fluorene	NE	NE	--	0.169	--	1.95	3.08	1.66	0.419	5.39	2.58	315	0.033 U	0.274	14.7	1.36	0.805
Indeno[1,2,3-cd]pyrene[2]	NE	NE	--	0.033 U	--	0.214	10.3	0.097	9.17	3.90	0.091	99.2	0.033 U	1.47	0.809	39.2	0.033 U
Phenanthrene	NE	NE	--	0.132	--	4.17	14.3	5.15	4.85	13.7	9.79	1,160	0.116	2.20	21.6	10.3	1.87
Pyrene	NE	NE	--	0.033 U	--	3.35	11.5	1.25	12.1	4.70	1.62	1,000	0.131	5.36	3.46	37.8	0.366
TTEC[2]	3.9	0.19	--	0.033 U	--	**0.802**	**30.6**	**0.323**	**20.6**	**14.2**	**0.332**	**388**	0.116	**9.42**	**2.69**	**87.5**	0.033 U
VOCs (mg/kg)																	
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl tert-butyl ether	NE	NE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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Table 2-1. Soil Analytical Results, B36 Area, Tacoma Metals Site

Sample ID:			B69			B70	B71			B72			B73		B74	B75
Depth (ft bgs):	Site Cleanup Levels[1]		3.5-4.5	8.5-9.5	12.5-13.5	4-5	4-5	8-9	14-15	4-5	8-9	13-14	3.5-4.5	9-10	8-9	4-7
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	10/8/14	10/8/14	10/8/14	10/30/14	10/30/14	10/30/14	10/30/14	10/30/14	10/30/14	10/30/14	10/30/14	10/30/14	10/30/14	10/30/14
TPH (mg/kg)																
Diesel	NE	NE	1,560 [4]	18,300 [5]	6,970 [5]	20 U	100 U	51.9 [4]	10 U	93.2 [4]	10 U	10 U	14.3 [4]	10 U	12.8	16.8 [4]
Oil	NE	NE	3,570 [4]	3,830 [5]	2,160 [5]	50 U	205	35 [4]	50 U	484 [4]	50 U	50 U	74 [4]	50 U	50 U	46 [4]
Diesel and Oil	2,000	NE	**5,130**	**22,130**	**9,130**	50 U	50 U	87	50 U	577	50 U	50 U	88	50 U	13	63
PAHs (mg/kg)																
1-Methylnaphthalene	NE	NE	--	844	179	0.033 U	0.033 U	0.053	0.033 U	0.070	0.033 U	0.080	0.033 U	0.033 U	0.033 U	0.033 U
2-Methylnaphthalene	NE	NE	9.5 J[9]	1,420	292	0.033 U	0.033 U	0.033 U	0.033 U	0.113	0.033 U	0.084	0.033 U	0.033 U	0.033 U	0.033 U
Naphthalene	NE	NE	4.3 J[9]	392	654	0.033 U	0.061	0.075	0.033 U	0.242	0.033 U	0.033 U	0.053	0.033 U	0.033 U	0.055
Total Naphthalenes	4.5	0.24	**13.8** J[9]	**1236**	**833**	0.033 U	0.061	0.128	0.033 U	0.312	0.033 U	0.033 U	0.053	0.033 U	0.033 U	0.055
Acenaphthene	NE	NE	14 J[9]	1,070	269	0.122	0.033 U	0.502	0.033 U	0.441	0.033 U	0.152	0.033 U	0.033 U	0.074	0.164
Acenaphthylene	NE	NE	11 J[9]	22.5	2.13	0.033 U	0.054	0.033 U	0.033 U	0.325	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U
Anthracene	NE	NE	95 J[9]	889	158	0.033 U	0.065	1.92	0.033 U	2.16	0.033 U	0.065	0.094	0.033 U	0.033 U	0.112
Benzo[a]anthracene[2]	NE	NE	200 J[9]	326	90.5	0.138	0.310	1.19	0.033 U	1.50	0.033 U	0.033 U	0.397	0.033 U	0.064	0.332
Benzo[a]pyrene[2]	NE	NE	350 J[9]	192	52.2	0.212	0.618	0.594	0.033 U	11.1	0.033 U	0.033 U	0.741	0.033 U	0.073	0.749
Benzo[b]fluoranthene[2]	NE	NE	460 J[9]	210	66.5	0.301	0.878	0.744	0.033 U	16.2	0.033 U	0.033 U	1.04	0.033 U	0.081	1.05
Benzo[g,h,i]perylene	NE	NE	140 J[9]	36.9	9.69	0.089	0.312	0.162	0.033 U	3.16	0.033 U	0.033 U	0.159	0.033 U	0.033 U	0.199
Benzo[k]fluoranthene[2]	NE	NE	150 J[9]	81.0	23.0	0.086	0.243	0.231	0.033 U	5.20	0.033 U	0.033 U	0.282	0.033 U	0.033 U	0.270
Chrysene[2]	NE	NE	460 J[9]	437	73.1	0.308	0.686	1.42	0.033 U	14.6	0.033 U	0.033 U	0.896	0.033 U	0.080	0.789
Dibenzo[a,h]anthracene[2]	NE	NE	45 J[9]	16.2	3.87	0.033 U	0.127	0.051	0.033 U	0.887	0.033 U	0.033 U	0.074	0.033 U	0.033 U	0.090
Dibenzofuran	NE	NE	6.0 J[9]	570 [9]	180 [9]	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	NE	NE	160 J[9]	1,250	321	0.171	0.314	10.2	0.033 U	3.67	0.033 U	0.324	0.339	0.033 U	0.095	0.263
Fluorene	NE	NE	15 J[9]	758	222	0.033 U	0.033 U	0.897	0.033 U	0.323	0.033 U	0.164	0.033 U	0.033 U	0.033 U	0.099
Indeno[1,2,3-cd]pyrene[2]	NE	NE	170 J[9]	48.9	12.8	0.118	0.403	0.212	0.033 U	4.12	0.033 U	0.033 U	0.266	0.033 U	0.033 U	0.285
Phenanthrene	NE	NE	28 J[9]	3,120	870	0.123	0.139	1.74	0.053	1.40	0.033 U	0.285	0.185	0.033 U	0.088	0.199
Pyrene	NE	NE	270 J[9]	977	222	0.123	0.247	5.46	0.033 U	3.81	0.033 U	0.166	0.291	0.033 U	0.063	0.293
TTEC[2]	3.9	0.19	**460 J[9]**	**265**	**72.6**	0.279	0.821	**0.851**	0.033 U	**14.0**	0.033 U	0.033 U	0.956	0.033 U	0.088	0.960
VOCs (mg/kg)																
Benzene	0.03	0.0017	0.025 U	0.80 U	**0.035**	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	0.025 U	**13.1**	**0.852**	--	--	--	--	--	--	--	--	--	--	--
Methyl tert-butyl ether	NE	NE	0.025 U	0.80 U	0.025 U	--	--	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	0.025 U	**4.04**	0.064	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	0.050 U	**32.8**	1.19	--	--	--	--	--	--	--	--	--	--	--

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
[1] Site Cleanup Levels established in the Revised Draft RI/FS Report
[2] cPAH cleanup levels under MTCA are based on the calculated total toxicity of the mixture using the Toxicity Equivalency Methodology in WAC 173-340-708(8).
The mixture of cPAHs shall be considered a single hazardous substance and compared to the applicable MTCA Method B or C cleanup levels for benzo(a)pyrene.
TTEC was calculated using only results reported as detected.
[3] Sample contains diesel range organics that appear to be mineral spirits or kerosene.
[4] Sample appears to be weathered creosote.
[5] Sample appears to be creosote.
[6] DUP-B100 is a field duplicate of sample B56.
[7] Results in the diesel organics range are primarily due to overlap from heavy oil range.
[8] The sample chromatographic pattern does not resemble the fuel standard used for quantitation.
[9] Result reported from sample collected by AECOM and analyzed by ALS Environmental located in Kelso, Washington.
[10] Result reported from sample collected by AECOM and analyzed outside hold time by ALS Environmental located in Kelso, Washington.
[11] The soil recovery in this boring was between 2 to 3 ft per 5 ft of boring depth. Therefore, sample depth intervals are estimated. Although the sample collection interval was logged as 5 to 7 ft bgs, after further review of field logs and field notes, it is more likely that this sample was actually collected between 5 and 8 ft bgs.

-- Not analyzed
cPAH - carcinogenic polycyclic aromatic hydrocarbons
ft - feet
ft bgs - feet below ground surface
ID - identification
J - estimated result
mg/kg - milligram per kilogram
MTCA - Model Toxics Control Act
NA - not applicable
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NR - not reported
PAHs - polycyclic aromatic hydrocarbons
RI/FS - remedial investigation/feasibility study
TPH - total petroleum hydrocarbons
TTEC - Total Toxic Equivalent Concentration (sum of cPAH concentrations multiplied by their respective toxicity equivalency factors per WAC 173-340-708(8)(e))
U - Compound was analyzed for but not detected above the reporting limit shown.
VOC - volatile organic compound
WAC - Washington Administrative Code

Table 2-1. Soil Analytical Results, B36 Area, Tacoma Metals Site

Sample ID:			B76		B77		B78		B79		B80		
Depth (ft bgs):	Site Cleanup Levels[1]		8-9	12-14	5-7[11]	7.5-8.5	7.5-9	14-15	7.5-8.5	12-14	4-5	8-9	12-13
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	10/30/14	10/30/14	10/30/14	10/30/14	10/30/14	10/30/14	10/30/14	10/30/14	10/30/14	10/30/14	10/30/14
TPH (mg/kg)													
Diesel	NE	NE	1,480 [4]	300 [4]	140,000 J[10]	21,200 [5]	1,410 [4]	365 [5]	10 U	50.3 [4]	11.9 [4]	101 [4]	33.0 [4]
Oil	NE	NE	3,200 [4]	494 [4]	140,000 J[10]	13,600 [5]	3,310 [4]	233 [5]	57	61 [4]	106 [4]	522 [4]	210 [4]
Diesel and Oil	2,000	NE	**4,680**	794	**280,000**	**34,800**	**4,720**	598	57	111	118	623	243
PAHs (mg/kg)													
1-Methylnaphthalene	NE	NE	1.19	3.63	45 J[10]	127	0.667	2.06	0.033 U	0.474	0.033 U	0.177	0.100
2-Methylnaphthalene	NE	NE	2.49	1.60	16 J[10]	51.6	0.936	0.448	0.033 U	0.107	0.033 U	0.184	0.055
Naphthalene	NE	NE	6.64	4.12	21 J[10]	21.3	1.35	2.70	0.033 U	0.433	0.033 U	0.403	0.255
Total Naphthalenes	4.5	0.24	**10.32**	**9.35**	**82 J[10]**	**199.9**	2.953	**5.208**	0.033 U	**1.014**	0.033 U	**0.764**	**0.41**
Acenaphthene	NE	NE	4.94	7.42	540 J[10]	1210	1.03	21.2	0.033 U	3.88	0.033 U	0.196	0.153
Acenaphthylene	NE	NE	5.58	0.298	30 J[10]	23.6	2.78	0.120	0.033 U	0.033 U	0.033 U	0.694	0.138
Anthracene	NE	NE	18.6	8.71	380 J[10]	705	11.7	5.74	0.033 U	0.614	0.117	3.00	0.859
Benzo[a]anthracene[2]	NE	NE	66.3	7.99	320 J[10]	573	31.6	5.57	0.033 U	1.22	0.275	10.2	1.23
Benzo[a]pyrene[2]	NE	NE	79.0	7.92	240 J[10]	284	94.7	3.21	0.043	0.844	0.643	31.4	6.04
Benzo[b]fluoranthene[2]	NE	NE	86.8	7.78	300 J[10]	418	130	3.49	0.056	1.01	0.845	44.3	6.74
Benzo[g,h,i]perylene	NE	NE	22.4	1.83	110 J[10]	59.9	17.4	0.376	0.033 U	0.142	0.193	8.37	1.67
Benzo[k]fluoranthene[2]	NE	NE	32.6	2.90	110 J[10]	91.0	36.4	1.27	0.033 U	0.455	0.277	11.5	3.29
Chrysene[2]	NE	NE	78.6	11.9	420 J[10]	741	68.8	4.86	0.046	1.53	0.832	45.2	10.8
Dibenzo[a,h]anthracene[2]	NE	NE	2.91	0.57	31 J[10]	26.9	5.03	0.189	0.033 U	0.066	0.033 U	2.63	0.529
Dibenzofuran	NE	NE	--	--	330 J[10]	--	--	--	--	--	--	--	--
Fluoranthene	NE	NE	238	20.3	1,300 J[10]	2870	37.7	28.0	0.068	3.18	0.221	1.90	0.523
Fluorene	NE	NE	2.56	5.71	380 J[10]	910	1.26	12.7	0.033 U	1.09	0.033 U	0.242	0.123
Indeno[1,2,3-cd]pyrene[2]	NE	NE	28.8	2.43	120 J[10]	91	22.3	0.664	0.034	0.194	0.240	10.5	2.08
Phenanthrene	NE	NE	7.84	11.7	1,800 J[10]	5110	4.70	28.7	0.033 U	2.45	0.288	1.30	0.445
Pyrene	NE	NE	256	12.1	1,000 J[10]	1770	43.2	18.2	0.033 U	2.13	0.205	2.52	0.285
TTEC[2]	3.9	0.19	**102**	**10.2**	**330 J[10]**	**411**	**118**	**4.38**	0.052	**1.15**	0.815	**39.8**	**7.53**
VOCs (mg/kg)													
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--	--	--
Methyl tert-butyl ether	NE	NE	--	--	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	--	--	--	--	--	--	--	--	--	--	--

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
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[2] cPAH cleanup levels under MTCA are based on the calculated total toxicity of the mixture using the Toxicity Equivalency Methodology in WAC 173-340-708(8).
The mixture of cPAHs shall be considered a single hazardous substance and compared to the applicable MTCA Method B or C cleanup levels for benzo(a)pyrene.
TTEC was calculated using only results reported as detected.
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[6] DUP-B100 is a field duplicate of sample B56.
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[11] The soil recovery in this boring was between 2 to 3 ft per 5 ft of boring depth. Therefore, sample depth intervals are estimated. Although the sample collection interval was logged as 5 to 7 ft bgs, after further review of field logs and field notes, it is more likely that this sample was actually collected between 5 and 8 ft bgs.

-- Not analyzed
cPAH - carcinogenic polycyclic aromatic hydrocarbons
ft - feet
ft bgs - feet below ground surface
ID - identification
J - estimated result
mg/kg - milligram per kilogram
MTCA - Model Toxics Control Act
NA - not applicable
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U - Compound was analyzed for but not detected above the reporting limit shown.
VOC - volatile organic compound
WAC - Washington Administrative Code

Table 2-2. Soil Analytical Results for PAHs and VOCs, Areas B and D, Tacoma Metals Site

Sample ID:			TP-2			TP-3		TP-4	TP-5	TP-9	
Depth (ft bgs):	Site Cleanup Levels[1]		2-3	4-6	6-10	4-6	6-10	6-10	6-10	0-1	4-6
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000	10/4/2000	10/5/2000	10/5/2000
PAHs (mg/kg)											
1-Methylnaphthalene	NE	NE	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	NE	NE	--	--	--	--	--	--	--	--	--
Naphthalene	NE	NE	0.12	120	440	0.13	0.21	--	41	0.35	0.035 U
Total Naphthalenes	4.5	0.24	0.12	**120**	**440**	0.13	0.21	--	**41**	0.35	0.035 U
Acenaphthene	NE	NE	--	--	240	--	--	--	260	0.028	--
Acenaphthylene	NE	NE	--	--	7.1	--	--	--	19	0.014 J	--
Anthracene	NE	NE	--	--	380	--	--	--	750	0.067	--
Benzo[a]anthracene[2]	NE	NE	--	--	140	--	--	--	130	0.15	--
Benzo[a]pyrene[2]	NE	NE	--	--	110	--	--	--	95	0.14	--
Benzo[b]fluoranthene[2]	NE	NE	--	--	90	--	--	--	93	0.17	--
Benzo[g,h,i]perylene	NE	NE	--	--	34	--	--	--	39	0.17	--
Benzo[k]fluoranthene[2]	NE	NE	--	--	110	--	--	--	80	0.12	--
Chrysene[2]	NE	NE	--	--	230	--	--	--	190	0.28	--
Dibenzo[a,h]anthracene[2]	NE	NE	--	--	17	--	--	--	16	0.035	--
Fluoranthene	NE	NE	--	--	370	--	--	--	470	0.27	--
Fluorene	NE	NE	--	--	200	--	--	--	360	0.028	--
Indeno[1,2,3-cd]pyrene[2]	NE	NE	--	--	33	--	--	--	35	0.094	--
Phenanthrene	NE	NE	--	--	460	--	--	--	750	0.16	--
Pyrene	NE	NE	--	--	430	--	--	--	400	0.24	--
TTEC[2]	3.9	0.19	--	--	**151**	--	--	--	**132**	0.200	--
VOCs (mg/kg)											
Benzene	0.03	0.0017	**3.6**	**58**	**73**	1.8 U	3.3 U	1.7 U	230 U	140 U	7.0 U
Ethylbenzene	6	0.34	6	**140**	**870**	1.8 U	4.60	1.7 U	230 U	140 U	7.0 U
Toluene	4.5	0.27	**120**	**850**	**430**	**830**	**8**	**7.30**	**1,200**	**98 J**	**130**
Total Xylenes	14.6	0.83	14.4	**410**	**3,600**	38 U	**27**	3.4 U	230 U	140 U	7.0 U

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for PAHs and/or VOCs. Additional depth intervals at the locations shown may have been analyzed for other constituents.
[1] Site Cleanup Levels established in the Revised Draft RI/FS Report
[2] cPAH cleanup levels under MTCA are based on the calculated total toxicity of the mixture using the Toxicity Equivalency Methodology in WAC 173-340-708(8).
The mixture of cPAHs shall be considered a single hazardous substance and compared to the applicable MTCA Method B or C cleanup levels for benzo(a)pyrene.
TTEC was calculated using only results reported as detected.
[3] Method blank values for naphthalene and 2-methylnaphthalene are 34 and 13µg/l, respectively. All samples contained greater than 10 times the level found in the blank, thus not significantly affecting the data.
[4] Samples were analyzed for PAHs by EPA Method 8270C-SIM. Applicable results for analysis by EPA Method 8270C can be referenced in previous reports (KJC 2014).

-- Not analyzed
cPAH - carcinogenic polycyclic aromatic hydrocarbons
EPA - US Environmental Protection Agency
ft bgs - feet below ground surface
ID - identification
J - estimated result
M - estimated value of analyte found and confirmed by analyst, but with low spectral match
µg/l - microgram per liter
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MTCA - Model Toxics Control Act
NE - not established
PAHs - polycyclic aromatic hydrocarbons
RI/FS - remedial investigation/feasibility study
TTEC - Total Toxic Equivalent Concentration (sum of cPAH concentrations multiplied by their respective toxicity equivalency factors [TEFs] per WAC 173-340-708(8)(e))
U - Compound was analyzed for but not detected above the reporting limit shown
VOC - volatile organic compound
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Table 2-2. Soil Analytical Results for PAHs and VOCs, Areas B and D, Tacoma Metals Site

Sample ID:			TP-49			TP-50			TP-57	B1			B2
Depth (ft bgs):	Site Cleanup Levels[1]		2-3	4-6	6-10	0-1		2-3	0-1	10.5	20.5	26	21
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	10/17/2000	10/17/2000	10/17/2000	10/4/2000		10/4/2000	11/14/2000	Jun-02	Jun-02	Jun-02	Jun-02
PAHs (mg/kg)													
1-Methylnaphthalene	NE	NE	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	NE	NE	--	--	--	--	--	--	--	180 [3, 4]	41 [3, 4]	110 [3, 4]	20 [3, 4]
Naphthalene	NE	NE	0.0057 U	16	8.4	0.0054 U	--	0.0056 U	0.68	300 [3, 4]	110 [3, 4]	300 [3, 4]	58 [3, 4]
Total Naphthalenes	4.5	0.24	0.0057 U	**16**	**8.4**	0.0054 U	--	0.0056 U	0.68	**480** [3, 4]	**151** [3, 4]	**410** [3, 4]	**78** [3, 4]
Acenaphthene	NE	NE	--	--	440	--	--	--	0.081 U	200	49	130	33
Acenaphthylene	NE	NE	--	--	16	--	--	--	0.081 U	11	1.9	4.2	0.56
Anthracene	NE	NE	--	--	250	--	--	--	0.081 U	320 [4]	60 [4]	200 [4]	26 [4]
Benzo[a]anthracene[1]	NE	NE	--	--	150	--	--	--	0.22	79	18	43	9.7
Benzo[a]pyrene[1]	NE	NE	--	--	82	--	--	--	0.25	53	8.8	22	5.8
Benzo[b]fluoranthene[1]	NE	NE	--	--	73	--	--	--	0.31 M	34	7.5	17	4.7
Benzo[g,h,i]perylene	NE	NE	--	--	38	--	--	--	0.31 M	18 [4]	3.3 [4]	7.7 [4]	2 [4]
Benzo[k]fluoranthene[1]	NE	NE	--	--	54	--	--	--	0.22	52	8.9	20	5.1
Chrysene[1]	NE	NE	--	--	230	--	--	--	0.32 M	100	18	51	11
Dibenzo[a,h]anthracene[1]	NE	NE	--	--	14 M	--	--	--	0.081 U	8.1	1.3	4.2	1.1
Fluoranthene	NE	NE	--	--	810	--	--	--	0.53	290 [4]	86 [4]	170 [4]	35 [4]
Fluorene	NE	NE	--	--	390	--	--	--	0.08 U	180 [4]	54 [4]	140 [4]	28 [4]
Indeno[1,2,3-cd]pyrene[1]	NE	NE	--	--	31	--	--	--	0.19	17	3.4	7.9	2.2
Phenanthrene	NE	NE	--	--	1,300	--	--	--	0.26	520 [4]	140 [4]	390 [4]	84 [4]
Pyrene	NE	NE	--	--	620	--	--	--	0.63	290 [4]	74 [4]	160 [4]	35 [4]
TTEC[1]	3.9	0.19	--	--	**117**	--	--	--	0.355	**73**	**12.9**	**31.7**	**8.2**
VOCs (mg/kg)													
Benzene	0.03	0.0017	1.1 U	9 U	22 U	**1.2**	**1.3**	10 U	--	5,900 U	310 U	780 U	340 U
Ethylbenzene	6	0.34	1.1 U	**27**	**24**	1.1 U	1.1 U	1.1 U	--	5,900 U	310 U	780 U	340 U
Toluene	4.5	0.27	3.7	**1,600**	**270**	**430**	**610**	**270**	--	5,900 U	310 U	780 U	340 U
Total Xylenes	14.6	0.83	2.2 U	**78**	**142**	2.2 U	2.2 U	2.2 U	--	11,800 U	620 U	1,560 U	680 U

Notes:
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The mixture of cPAHs shall be considered a single hazardous substance and compared to the applicable MTCA Method B or C cleanup levels for benzo(a)pyrene.
TTEC was calculated using only results reported as detected.
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[4] Samples were analyzed for PAHs by EPA Method 8270C-SIM. Applicable results for analysis by EPA Method 8270C can be referenced in previous reports (KJC 2014).

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Table 2-2. Soil Analytical Results for PAHs and VOCs, Areas B and D, Tacoma Metals Site

Sample ID:			B3		B6	B8		MW-13	MW-14				MW-15	
Depth (ft bgs):	Site Cleanup Levels[1]		10	21.5	23-23.2	23.5-24	26.5-27	17.5	14-14.5	22-22.3	23.8-24	26-26.5	11-11.5	25-26
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Jun-02	Jun-02	Feb-03	Feb-03	Feb-03	Feb-03	Feb-03	Feb-03	Feb-03	Feb-03	Feb-03	Feb-03
PAHs (mg/kg)														
1-Methylnaphthalene	NE	NE	--	--	645	262	0.0786	--	2.10	36.3	14.5	5.06	0.357	0.0100 U
2-Methylnaphthalene	NE	NE	1.8 [3, 4]	11 [3, 4]	491	8.23	0.0761	3.9 [3, 4]	1.85	12.4	3.88	0.746	0.293	0.0100 U
Naphthalene	NE	NE	5.6 [3, 4]	26 [3, 4]	1,850	103	0.432	14 [3, 4]	0.980	54.1	25.8	1.03	0.695	0.0100 U
Total Naphthalenes	4.5	0.24	**7** [3, 4]	**37** [3, 4]	**2,986**	**373**	**0.587**	**17.9** [3, 4]	**4.930**	**102.8**	**44.2**	**6.836**	**1.345**	0.0100 U
Acenaphthene	NE	NE	0.7	8.3	596	281	0.581	7.7	0.224	60.5	18.4	1.31	0.403	0.0100 U
Acenaphthylene	NE	NE	0.054	0.075	5.64	3.13	0.0100 U	0.13	0.137	0.642	1.37	0.0100 U	0.0659	0.0100 U
Anthracene	NE	NE	120 [4]	2.5 [4]	229	49.6	0.222	0.17 [4]	0.102	20.0	11.3	0.0324	0.128	0.0100 U
Benzo[a]anthracene[1]	NE	NE	0.046	1.2	128	50.5	0.0165	0.022	0.444	9.43	3.92	0.0100 U	0.0799	0.0100 U
Benzo[a]pyrene[1]	NE	NE	0.032	0.25	65.8	21.1	0.0100 U	0.01	0.620	3.25	1.88	0.0100 U	0.0739	0.0100 U
Benzo[b]fluoranthene[1]	NE	NE	0.035	0.330	30.7	21.0	0.0100 U	0.0086 U	0.507	3.41	0.783	0.0100 U	0.0304 U	0.0100 U
Benzo[g,h,i]perylene	NE	NE	0.033 [4]	0.051 [4]	5.72	2.88	0.0100 U	0.0086 U[4]	0.433	0.936	1.17	0.0100 U	0.0304 U	0.0100 U
Benzo[k]fluoranthene[1]	NE	NE	0.037	0.260	65.8	24.8	0.0100 U	0.01	0.634	2.44	0.940	0.0100 U	0.0319	0.0100 U
Chrysene[1]	NE	NE	0.059	1.1	111	52.1	0.0107	0.029	0.578	8.62	3.41	0.0100 U	0.0719	0.0100 U
Dibenzo[a,h]anthracene[1]	NE	NE	0.017 U	0.028	8.28	3.86	0.0100 U	0.0086 U	0.0222 U	0.268	0.500 U	0.0100 U	0.0304 U	0.0100 U
Fluoranthene	NE	NE	0.15 [4]	7.4 [4]	570	277	0.386	0.078 [4]	0.622	61.5	25.1	0.0540	0.206	0.0100 U
Fluorene	NE	NE	0.39 [4]	9.2 [4]	455	239	0.617	4.1 [4]	0.380	64.4	31.6	0.676	0.258	0.0100 U
Indeno[1,2,3-cd]pyrene[1]	NE	NE	0.033	0.059	18.7	7.91	0.0100 U	0.0086 U	0.451	0.925	0.862	0.0100 U	0.0304 U	0.0100 U
Phenanthrene	NE	NE	0.39 [4]	23 [4]	1,590	822	1.98	4 [4]	0.612	179	72.4	0.322	0.585	0.0100 U
Pyrene	NE	NE	0.14 [4]	4.80 [4]	427	190	0.256	0.054 [4]	0.922	39.3	14.8	0.0332	0.268	0.0100 U
TTEC[1]	3.9	0.19	0.05	**0.45**	**92.1**	**32.4**	0.016	0.016	**0.832**	**4.98**	**2.56**	0.0100 U	0.09	0.0100 U
VOCs (mg/kg)														
Benzene	0.03	0.0017	11 U	760 U	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	**59**	760 U	--	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	11 U	760 U	--	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	**290**	1,520 U	--	--	--	--	--	--	--	--	--	--

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for PAHs and/or VOCs. Additional depth intervals at the locations shown may have been analyzed for other constituents.
[1] Site Cleanup Levels established in the Revised Draft RI/FS Report
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The mixture of cPAHs shall be considered a single hazardous substance and compared to the applicable MTCA Method B or C cleanup levels for benzo(a)pyrene.
TTEC was calculated using only results reported as detected.
[3] Method blank values for naphthalene and 2-methylnaphthalene are 34 and 13µg/l, respectively. All samples contained greater than 10 times the level found in the blank, thus not significantly affecting the data.
[4] Samples were analyzed for PAHs by EPA Method 8270C-SIM. Applicable results for analysis by EPA Method 8270C can be referenced in previous reports (KJC 2014).

-- Not analyzed
cPAH - carcinogenic polycyclic aromatic hydrocarbons
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ft bgs - feet below ground surface
ID - identification
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TTEC - Total Toxic Equivalent Concentration (sum of cPAH concentrations multiplied by their respective toxicity equivalency factors [TEFs] per WAC 173-340-708(8)(e))
U - Compound was analyzed for but not detected above the reporting limit shown
VOC - volatile organic compound
WAC - Washington Administrative Code

Table 2-2. Soil Analytical Results for PAHs and VOCs, Areas B and D, Tacoma Metals Site

Sample ID:			MW-16		MW-17		MW-18		MW-19		MW-20	MW-21	
Depth (ft bgs):	Site Cleanup Levels[1]		7.5-8	25-26	7.5-8	25-26	11.5-12	21.5-21.9	16-18	23.5-24	24-24.3	20.5-21.4	22.5-23.3
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Feb-03	Feb-03	Feb-03	Feb-03	Feb-03	Feb-03	Feb-03	Feb-03	Feb-03	Feb-03	Feb-03
PAHs (mg/kg)													
1-Methylnaphthalene	NE	NE	7.26	0.0100 U	0.156	0.0100 U	73.3	517	0.0819	0.184	0.694	106	1.23
2-Methylnaphthalene	NE	NE	9.95	0.0100 U	0.0790	0.0100 U	25.9	759	0.0787	0.0100 U	0.288	35.5	0.389
Naphthalene	NE	NE	40.1	0.0100 U	0.375	0.0100 U	326	1,750	0.0798	0.0100 U	0.631	100	0.664
Total Naphthalenes	4.5	0.24	**57.31**	0.0100 U	0.610	0.0100 U	**425.2**	**3,026**	0.240	0.1840	**1.613**	**241.5**	**2.283**
Acenaphthene	NE	NE	2.03	0.0100 U	0.371	0.0100 U	68.9	22.9	0.0539	0.462	0.433	456	0.788
Acenaphthylene	NE	NE	0.297	0.0100 U	0.0571	0.0100 U	0.0299 U	16.2	0.0100 U	0.0100 U	0.0186	1.41	0.0380
Anthracene	NE	NE	1.61	0.0100 U	0.254	0.0100 U	107	146	0.0342	0.0267	0.0468	283	1.05
Benzo[a]anthracene[1]	NE	NE	1.64	0.0100 U	0.146	0.0100 U	27.5	83.2	0.0100 U	0.0125	0.0323	170	0.312
Benzo[a]pyrene[1]	NE	NE	1.14	0.0100 U	0.0874	0.0100 U	17.9	42.8	0.0100 U	0.0100 U	0.0100 U	59.5	0.189
Benzo[b]fluoranthene[1]	NE	NE	0.864	0.0100 U	0.0185	0.0100 U	6.37	43.8	0.0100 U	0.0100 U	0.0100 U	59.0	0.129
Benzo[g,h,i]perylene	NE	NE	0.521	0.0100 U	0.0588	0.0100 U	1.95	5.50	0.0100 U	0.0100 U	0.0100 U	26.6	0.0777
Benzo[k]fluoranthene[1]	NE	NE	1.13	0.0100 U	0.0387	0.0100 U	7.96	42.3	0.0100 U	0.0100 U	0.0100 U	60.5	0.162
Chrysene[1]	NE	NE	1.56	0.0100 U	0.111	0.0100 U	27.9	75.4	0.0100 U	0.0100 U	0.0100 U	130	0.357
Dibenzo[a,h]anthracene[1]	NE	NE	0.0586 U	0.0100 U	0.0148 U	0.0100 U	1.39	3.54	0.0100 U	0.0100 U	0.0100 U	4.34	0.0100 U
Fluoranthene	NE	NE	3.66	0.0333	0.997	0.0359	110	371	0.0591	0.0117	0.0678	978	1.30
Fluorene	NE	NE	1.79	0.0100 U	0.306	0.0100 U	90.4	349	0.0725	0.232	0.238	639	0.876
Indeno[1,2,3-cd]pyrene[1]	NE	NE	0.513	0.0100 U	0.0454	0.0100 U	2.10	5.25	0.0100 U	0.0100 U	0.0100 U	24.4	0.0684
Phenanthrene	NE	NE	5.45	0.0100 U	0.222	0.0137	240	976	0.194	0.123	0.226	1,970	2.43
Pyrene	NE	NE	4.19	0.0100 U	0.995	0.0100 U	79.6	308	0.0100 U	0.0100 U	0.0380	884	1.08
TTEC[1]	3.9	0.19	1.57	0.0100 U	0.11	0.0100 U	**22.7**	**61.4**	0.0100 U	0.001	0.003	**92.6**	**0.260**
VOCs (mg/kg)													
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	--	--	--	--	--	--	--	--	--	--	--

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for PAHs and/or VOCs. Additional depth intervals at the locations shown may have been analyzed for other constituents.
[1] Site Cleanup Levels established in the Revised Draft RI/FS Report
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The mixture of cPAHs shall be considered a single hazardous substance and compared to the applicable MTCA Method B or C cleanup levels for benzo(a)pyrene.
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[4] Samples were analyzed for PAHs by EPA Method 8270C-SIM. Applicable results for analysis by EPA Method 8270C can be referenced in previous reports (KJC 2014).

-- Not analyzed
cPAH - carcinogenic polycyclic aromatic hydrocarbons
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ft bgs - feet below ground surface
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µg/l - microgram per liter
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Table 2-2. Soil Analytical Results for PAHs and VOCs, Areas B and D, Tacoma Metals Site

Sample ID:			B12			B13			B14		
Depth (ft bgs):	Site Cleanup Levels[1]		4-5	6.5-7.5	9-10	1-3	5-6	14-15	1-2	5-6	9-10
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03
PAHs (mg/kg)											
1-Methylnaphthalene	NE	NE	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	NE	NE	--	--	--	--	--	--	--	--	--
Naphthalene	NE	NE	3.48	0.191	3.28	1.44	0.218	826	0.713	1.63	4.52
Total Naphthalenes	4.5	0.24	3.48	0.191	**3.28**	1.44	0.218	**826**	0.713	1.63	**4.52**
Acenaphthene	NE	NE	0.953	0.0577	17.4	0.200 U	0.0565	140	0.200 U	3.84	3.78
Acenaphthylene	NE	NE	11.6	0.346	0.923	3.19	0.896	1.95	1.44	6.74	0.649
Anthracene	NE	NE	5.72	0.457	9.96	1.91	1.32	60.2	0.699	23.3	3.00
Benzo[a]anthracene[1]	NE	NE	15.9	0.0843	4.26	7.32	4.65	21.2	2.50	22.2	1.38
Benzo[a]pyrene[1]	NE	NE	19.5	0.271	2.13	6.64	5.90	6.95	2.78	22.7	1.75
Benzo[b]fluoranthene[1]	NE	NE	12.7	0.177	1.28	6.44	3.53	7.48	1.99	18.9	1.27
Benzo[g,h,i]perylene	NE	NE	12.6	0.271	0.982	4.77	4.33	2.30	2.24	14.5	1.16
Benzo[k]fluoranthene[1]	NE	NE	19.0	0.120	2.16	7.79	3.72	10.7	3.33	13.4	1.16
Chrysene[1]	NE	NE	17.7	0.115	3.32	7.21	4.70	1.98	3.11	29.6	2.25
Dibenzo[a,h]anthracene[1]	NE	NE	5.83	0.0799	0.382	2.17	1.09	1.18	0.966	5.18	0.403
Fluoranthene	NE	NE	35.3	0.129	22.3	12.5	10.4	106	4.61	54.7	4.42
Fluorene	NE	NE	2.42	0.0500 U	14.1	0.592	0.262	115	0.238	4.67	2.97
Indeno[1,2,3-cd]pyrene[1]	NE	NE	12.8	0.226	0.882	4.74	3.47	2.22	2.13	13.0	0.994
Phenanthrene	NE	NE	7.22	0.146	36.5	5.36	3.94	229	1.46	23.7	5.13
Pyrene	NE	NE	23.7	0.169	19.4	11.2	17.3	97.2	3.95	71.8	4.30
TTEC[1]	3.9	0.19	**26.3**	**0.341**	**3.06**	**9.56**	**7.59**	**11.2**	3.90	**30.3**	**2.29**
VOCs (mg/kg)											
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	--	--	--	--	--	--	--	--	--

Notes:
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Table 2-2. Soil Analytical Results for PAHs and VOCs, Areas B and D, Tacoma Metals Site

Sample ID:			B15			B16			B17		
Depth (ft bgs):	Site Cleanup Levels[1]		5-6	7-8	9-10	3-4	5-6	10-11	3-4	5-6	7-8
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03
PAHs (mg/kg)											
1-Methylnaphthalene	NE	NE	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	NE	NE	--	--	--	--	--	--	--	--	--
Naphthalene	NE	NE	0.421	0.0605	0.0167	0.0725	11.0	22.3	0.0258	0.353	0.535
Total Naphthalenes	4.5	0.24	0.421	0.0605	0.0167	0.0725	**11.0**	**22.3**	0.0258	0.353	0.535
Acenaphthene	NE	NE	0.115 U	0.0100 U	0.0676	0.0220	4.05	4.08	0.0179	0.110	0.205
Acenaphthylene	NE	NE	0.115 U	0.0100 U	0.0317	0.0178	0.208	0.217	0.0294	0.239	0.193
Anthracene	NE	NE	0.130	0.0100 U	0.0584	0.0185	0.806	1.15	0.0143	0.630	0.273
Benzo[a]anthracene[1]	NE	NE	0.474	0.0100 U	0.0376	0.0156	0.221	0.264	0.0301	1.65	0.171
Benzo[a]pyrene[1]	NE	NE	1.14	0.0100 U	0.104	0.0320	0.143	0.200 U	0.0494	1.66	0.250
Benzo[b]fluoranthene[1]	NE	NE	0.788	0.0100 U	0.0826	0.0320	0.130	0.200 U	0.0444	2.35	0.375
Benzo[g,h,i]perylene	NE	NE	1.06	0.0123	0.112	0.0171	0.117	0.200 U	0.0315	0.998	0.216
Benzo[k]fluoranthene[1]	NE	NE	0.941	0.0307	0.0868	0.0156	0.494	0.512	0.0279	1.36	0.444
Chrysene[1]	NE	NE	1.12	0.0526	0.0843	0.0206	0.911	1.10	0.0387	2.76	0.774
Dibenzo[a,h]anthracene[1]	NE	NE	0.329	0.0100 U	0.0384	0.010 U	0.100 U	0.200 U	0.150	0.406	0.168 U
Fluoranthene	NE	NE	0.352	0.0100 U	0.0776	0.0469	1.20	1.37	0.0437	2.86	0.501
Fluorene	NE	NE	0.115 U	0.0100 U	0.0626	0.0107	2.80	3.10	0.0129	0.105	0.193
Indeno[1,2,3-cd]pyrene[1]	NE	NE	0.711	0.0123	0.108	0.0327	0.104	0.200 U	0.0444	0.888	0.182
Phenanthrene	NE	NE	0.176	0.0100 U	0.0100 U	0.0554	3.15	4.73	0.0408	0.702	0.421
Pyrene	NE	NE	0.566	0.0149	0.0759	0.0391	1.26	1.41	0.0430	3.99	0.614
TTEC[1]	3.9	0.19	1.48	0.005	0.140	0.042	0.247	0.089	0.079	2.35	0.375
VOCs (mg/kg)											
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	--	--	--	--	--	--	--	--	--

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TTEC was calculated using only results reported as detected.
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Table 2-2. Soil Analytical Results for PAHs and VOCs, Areas B and D, Tacoma Metals Site

Sample ID:			B18			B19			B20		
Depth (ft bgs):	Site Cleanup Levels[1]		6-6.5	12-13	24-25	9-10	14-15	21-22	7-8	10-11	19-20
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04
PAHs (mg/kg)											
1-Methylnaphthalene	NE	NE	0.0521	0.262	2.84	3.66	0.411	360	0.204 U	6.01	1.39
2-Methylnaphthalene	NE	NE	0.0612	0.376	0.728	3.10	0.672	642	0.204 U	2.92	2.92
Naphthalene	NE	NE	0.0872	0.873	0.332	8.66	0.375	1,160	0.235	17.2	7.89
Total Naphthalenes	4.5	0.24	0.2005	**1.511**	**3.900**	**15.42**	**1.458**	**2162**	0.235	**26.13**	**12.2**
Acenaphthene	NE	NE	0.0100 U	0.841	1.92	2.37	0.348	384	0.204 U	3.32	1.22
Acenaphthylene	NE	NE	0.0100 U	0.221	0.0100 U	0.0809	0.0105	10.3 U	0.204 U	0.0734	0.0100 U
Anthracene	NE	NE	0.0100 U	1.25	0.0126	0.304	0.12	148	0.204 U	0.702	1.33
Benzo[a]anthracene[1]	NE	NE	0.0208	2.23	0.0100 U	0.189	0.0482	87.2	0.204 U	0.259	0.228
Benzo[a]pyrene[1]	NE	NE	0.0286	1.74	0.0100 U	0.186	0.043	48.3	0.204 U	0.166	0.075
Benzo[b]fluoranthene[1]	NE	NE	0.0521	2.10	0.0100 U	0.194	0.057	68.6	0.204 U	0.192	0.0967
Benzo[g,h,i]perylene	NE	NE	0.0130	0.812	0.0100	0.107	0.0158	16.1	0.204 U	0.0683	0.015
Benzo[k]fluoranthene[1]	NE	NE	0.0299	0.597	0.0100 U	0.0939	0.0245	25.4	0.204 U	0.0557	0.0533
Chrysene[1]	NE	NE	0.0325	2.02	0.0100 U	0.142	0.0412	76.2	0.204 U	0.206	0.144
Dibenzo[a,h]anthracene[1]	NE	NE	0.0456	0.319	0.0100 U	0.0678	0.0324	31.3	0.204 U	0.0544	0.0317
Fluoranthene	NE	NE	0.0182	4.75	0.0100	0.411	0.193	362	0.204 U	1.20	1.61
Fluorene	NE	NE	0.0143	0.817	0.702	1.13	0.600	341	0.204 U	1.71	3.89
Indeno[1,2,3-cd]pyrene[1]	NE	NE	0.0156	0.867	0.0100 U	0.115	0.0167	15.2	0.204 U	0.0633	0.0175
Phenanthrene	NE	NE	0.0482	6.41	0.264	1.18	0.784	920	0.204 U	2.40	5.23
Pyrene	NE	NE	0.0273	5.52	0.0100 U	0.377	0.131	301	0.204 U	0.958	1.22
TTEC[1]	3.9	0.19	0.045	**2.37**	0.0100 U	**0.253**	0.061	**71.8**	0.204 U	**0.231**	**0.119**
VOCs (mg/kg)											
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	--	--	--	--	--	--	--	--	--

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for PAHs and/or VOCs. Additional depth intervals at the locations shown may have been analyzed for other constituents.
[1] Site Cleanup Levels established in the Revised Draft RI/FS Report
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The mixture of cPAHs shall be considered a single hazardous substance and compared to the applicable MTCA Method B or C cleanup levels for benzo(a)pyrene.
TTEC was calculated using only results reported as detected.
[3] Method blank values for naphthalene and 2-methylnaphthalene are 34 and 13µg/l, respectively. All samples contained greater than 10 times the level found in the blank, thus not significantly affecting the data.
[4] Samples were analyzed for PAHs by EPA Method 8270C-SIM. Applicable results for analysis by EPA Method 8270C can be referenced in previous reports (KJC 2014).

-- Not analyzed
cPAH - carcinogenic polycyclic aromatic hydrocarbons
EPA - US Environmental Protection Agency
ft bgs - feet below ground surface
ID - identification
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µg/l - microgram per liter
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MTCA - Model Toxics Control Act
NE - not established
PAHs - polycyclic aromatic hydrocarbons

TTEC - Total Toxic Equivalent Concentration (sum of cPAH concentrations multiplied by their respective toxicity equivalency factors [TEFs] per WAC 173-340-708(8)(e))
U - Compound was analyzed for but not detected above the reporting limit shown
VOC - volatile organic compound
WAC - Washington Administrative Code

Table 2-2. Soil Analytical Results for PAHs and VOCs, Areas B and D, Tacoma Metals Site

Sample ID:			B21			B22			B23		
Depth (ft bgs):	Site Cleanup Levels[1]		8-9	13-15	18-19	6-7	11-12	19-20	6.5-7.5	9-10	18-20
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04
PAHs (mg/kg)											
1-Methylnaphthalene	NE	NE	0.389	0.598	22.0	0.373	0.828	0.637	0.100 U	0.801	<0.100
2-Methylnaphthalene	NE	NE	0.299	0.238	32.6	0.560	0.563	0.1 U	0.100 U	0.925	0.100 U
Naphthalene	NE	NE	0.402	0.234	45.2	0.731	0.918	0.1 U	0.100 U	1.78	0.100 U
Total Naphthalenes	4.5	0.24	**1.090**	1.070	**99.8**	1.664	**2.309**	0.637	0.100 U	**3.51**	0.100 U
Acenaphthene	NE	NE	0.284	0.550	29.5	0.326	1.26	8.62	0.100 U	1.73	0.174
Acenaphthylene	NE	NE	0.0267	0.0100 U	0.346	2.04	0.282	0.136	0.100 U	1.07	0.100 U
Anthracene	NE	NE	0.146	0.0361	11.3	2.77	2.33	4.61	0.100 U	5.82	0.100 U
Benzo[a]anthracene[1]	NE	NE	0.104	0.0100 U	6.93	3.40	1.99	2.06	0.100 U	12.8	0.100 U
Benzo[a]pyrene[1]	NE	NE	0.118	0.0100 U	3.51	8.26	1.34	0.679	0.100 U	15.8	0.122
Benzo[b]fluoranthene[1]	NE	NE	0.181	0.0100 U	5.00	9.09	1.55	0.959	0.100 U	16.2	0.226
Benzo[g,h,i]perylene	NE	NE	0.0701	0.0100 U	0.659	5.01	0.798	0.187	0.100 U	20.4	0.100 U
Benzo[k]fluoranthene[1]	NE	NE	0.0709	0.0100 U	2.72	3.64	0.319	0.340	0.100 U	7.69	0.100 U
Chrysene[1]	NE	NE	0.146	0.0100 U	4.10	4.68	1.77	1.71	0.100 U	23.0	0.100 U
Dibenzo[a,h]anthracene[1]	NE	NE	0.0488	0.0100 U	0.317	1.87	0.299	0.314	0.100 U	0.266 U	0.100 U
Fluoranthene	NE	NE	0.276	0.0205	29.5	2.92	5.87	14.3	0.100 U	27.0	0.105
Fluorene	NE	NE	0.222	0.507	28.9	0.575	1.87	11.6	0.100 U	1.25	0.100 U
Indeno[1,2,3-cd]pyrene[1]	NE	NE	0.0732	0.0100 U	0.711	5.05	0.961	0.195	0.100 U	17.6	0.100 U
Phenanthrene	NE	NE	0.407	0.554	73.7	1.24	5.15	33.6	0.100 U	3.58	0.131
Pyrene	NE	NE	0.240	0.0238	24.0	4.17	3.92	8.80	0.100 U	21.5	0.100 U
TTEC[1]	3.9	0.19	0.167	0.0100 U	**5.12**	**10.6**	**1.87**	**1.08**	0.100 U	**21.5**	0.145
VOCs (mg/kg)											
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	--	--	--	--	--	--	--	--	--

Notes:
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Results shown for locations and depth intervals analyzed for PAHs and/or VOCs. Additional depth intervals at the locations shown may have been analyzed for other constituents.
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U - Compound was analyzed for but not detected above the reporting limit shown
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Table 2-2. Soil Analytical Results for PAHs and VOCs, Areas B and D, Tacoma Metals Site

Sample ID:			B24			B25		B26			B27		
Depth (ft bgs):	Site Cleanup Levels[1]		9-10	15-16	30.5-31.5	14-15	30-31	6.5-7.5	18-19	25-26	7-8	22-23	24.5-25.5
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05
PAHs (mg/kg)													
1-Methylnaphthalene	NE	NE	0.0100 U	45.3	0.606	0.609	97.5	0.0366	5.57	3.07	0.123	0.541	437
2-Methylnaphthalene	NE	NE	0.01 U	62.6	0.380	0.0166	162	0.0616	1.40	5.79	0.181	0.700	872
Naphthalene	NE	NE	0.0100 U	50.9	0.239	0.344	25.7	0.181	7.63	13.7	0.0910	0.561	2,410
Total Naphthalenes	4.5	0.24	0.0100 U	**158.8**	**1.225**	**0.9696**	**285.2**	0.279	**14.60**	**22.56**	0.395	**1.802**	**3719**
Acenaphthene	NE	NE	0.01 U	23.3	1.86	0.498	126	0.0122	19.4	3.82	0.160	0.571	597
Acenaphthylene	NE	NE	0.01 U	0.363	0.0500 U	0.0100 U	1.65 U	0.0427	1.23	0.330 U	0.0692	0.0100 U	15.5
Anthracene	NE	NE	0.01 U	6.76	0.629	0.0145	58.2	0.0384	64.1	1.18	0.165	0.0771	163
Benzo[a]anthracene[1]	NE	NE	0.0100 U	1.41	0.264	0.0100 U	36.9	0.0595	34.6	0.539	0.300	0.0100 U	102
Benzo[a]pyrene[1]	NE	NE	0.0143	0.501	0.0951	0.0100 U	21.1	0.0668	20.3	0.330 U	0.409	0.0100 U	37.3
Benzo[b]fluoranthene[1]	NE	NE	0.0239	0.366	0.118	0.0100 U	15.6	0.116	15.9	0.330 U	0.447	0.0100 U	33.1
Benzo[g,h,i]perylene	NE	NE	0.0216	0.330 U	0.0500 U	0.0100 U	7.29	0.0397	7.75	0.330 U	0.272	0.0100 U	11.2
Benzo[k]fluoranthene[1]	NE	NE	0.0299	0.383	0.151	0.0203	17.9	0.0939	17.1	0.330 U	0.471	0.0100 U	34.0
Chrysene[1]	NE	NE	0.0280	1.27	0.262	0.0190	35.5	0.148	48.7	0.531	0.505	0.0100 U	92.8
Dibenzo[a,h]anthracene[1]	NE	NE	0.0100 U	0.330 U	0.0500 U	0.0100 U	3.11	0.0131	3.44	0.330 U	0.112	0.0100 U	4.86
Fluoranthene	NE	NE	0.0162	9.13	1.72	0.0186	148	0.250	137	2.69	0.513	0.0623	626
Fluorene	NE	NE	0.0100 U	16.8	2.08	0.170	108	0.0152	33.4	3.67	0.135	0.728	638
Indeno[1,2,3-cd]pyrene[1]	NE	NE	0.0174	0.330 U	0.0500 U	0.0100 U	6.64	0.0341	7.90	0.330 U	0.253	0.0100 U	10.8
Phenanthrene	NE	NE	0.0215	32.4	4.59	0.0388	361	0.217	178	9.60	0.493	1.65	1,790
Pyrene	NE	NE	0.0127	7.50	1.28	0.0209	134	0.228	101	2.18	0.587	0.0308	450
TTEC[1]	3.9	0.19	0.022	**0.730**	0.151	0.002	**29.5**	0.100	**28.7**	0.059	0.57	0.0100 U	**56.7**
VOCs (mg/kg)													
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	--	--	--	--	--	--	--	--	--	--	--

Notes:
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Results shown for locations and depth intervals analyzed for PAHs and/or VOCs. Additional depth intervals at the locations shown may have been analyzed for other constituents.
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TTEC was calculated using only results reported as detected.
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VOC - volatile organic compound
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Table 2-2. Soil Analytical Results for PAHs and VOCs, Areas B and D, Tacoma Metals Site

Sample ID:			B28			B29			B30		
Depth (ft bgs):	Site Cleanup Levels[1]		6-7	11-12	23.5-24.5	6.5-7.5	11-12	22.5-23.5	5.5-6.5	11-12	22.5-23.5
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05
PAHs (mg/kg)											
1-Methylnaphthalene	NE	NE	0.330 U	0.623	13.4	0.0706	1.15	114	0.0211 U	0.0468	5.97
2-Methylnaphthalene	NE	NE	0.330 U	0.229	20.1	0.330 U	0.711	168	0.0211 U	0.0572	5.25
Naphthalene	NE	NE	0.330 U	1.16	33.5	0.330 U	1.20	415	0.0297	0.188	0.643 U
Total Naphthalenes	4.5	0.24	0.330 U	**2.012**	**67.0**	0.071	**3.061**	**697**	0.0297	**0.292**	**11.22**
Acenaphthene	NE	NE	0.330 U	0.518	23.7	0.330 U	3.06	123	0.0211 U	0.0290	14.9
Acenaphthylene	NE	NE	0.330 U	0.0153	0.656 U	0.330 U	0.536	6.51 U	0.0211 U	0.0181	0.643 U
Anthracene	NE	NE	0.330 U	0.0784	7.00	0.330 U	12.9	45.7	0.0447	0.0285	13.7
Benzo[a]anthracene[1]	NE	NE	0.711	0.0182	3.91	0.723	4.33	25.1	0.0423	0.0154	4.47
Benzo[a]pyrene[1]	NE	NE	1.58	0.0153	0.824	0.832	4.79	8.18	0.0383	0.0119	2.20
Benzo[b]fluoranthene[1]	NE	NE	0.759	0.0134	0.915	0.896	3.57	7.83	0.0533	0.0125	1.72
Benzo[g,h,i]perylene	NE	NE	0.344	0.0100 U	0.656 U	0.576	2.57	6.51 U	0.0361	<0.0100	0.763
Benzo[k]fluoranthene[1]	NE	NE	0.883	0.0229	0.858	0.657	3.57	7.32	0.0652	0.0249	1.82
Chrysene[1]	NE	NE	1.05	0.0248	3.53	1.17	7.10	23.2	0.0689	0.0244	4.26
Dibenzo[a,h]anthracene[1]	NE	NE	0.33 U	0.0100 U	0.656 U	0.330 U	0.808	6.51 U	0.0211 U	0.0100 U	0.643 U
Fluoranthene	NE	NE	0.543	0.106	30.0	0.570	7.53	134	0.0914	0.0612	22.0
Fluorene	NE	NE	0.330 U	0.161	29.2	0.330 U	2.80	138	0.0211 U	0.0363	15.8
Indeno[1,2,3-cd]pyrene[1]	NE	NE	1.04	0.0100 U	0.656 U	0.520	2.11	6.51 U	0.0298	0.0100 U	0.698
Phenanthrene	NE	NE	0.330 U	0.180	85.7	0.330 U	5.20	376	0.0552	0.0869	47.5
Pyrene	NE	NE	0.952	0.0831	16.7	1.04	7.31	97.3	0.0972	0.0344	16.5
TTEC[1]	3.9	0.19	1.93	0.02	**1.43**	1.1	**6.3**	**13.7**	0.060	0.017	**3.11**
VOCs (mg/kg)											
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	--	--	--	--	--	--	--	--	--

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Table 2-2. Soil Analytical Results for PAHs and VOCs, Areas B and D, Tacoma Metals Site

Sample ID:			B31			B32			B33		
Depth (ft bgs):	Site Cleanup Levels[1]		6-7	19-20	24-25	6-7	11-12	19-20	6-7	18-19	20.5-21.5
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05
PAHs (mg/kg)											
1-Methylnaphthalene	NE	NE	0.330 U	22.9	4.91	0.0356	0.144	31.1	0.0683	0.0381	0.0593
2-Methylnaphthalene	NE	NE	0.330 U	2.10	7.77	0.0300	0.0947	25.3	0.0492	0.0151	0.0100 U
Naphthalene	NE	NE	0.330 U	9.29	17.7	0.0741	0.327	8.27	0.0454	0.0100 U	0.0100 U
Total Naphthalenes	4.5	0.24	0.330 U	**34.29**	**30.38**	0.1397	**0.566**	**64.67**	0.1629	0.0532	0.0593
Acenaphthene	NE	NE	0.330 U	50.6	8.30	0.0909	0.193	83.2	0.0100 U	0.0876	0.408
Acenaphthylene	NE	NE	0.351	1.27	0.360	0.0100 U	0.0521	6.56 U	0.0100 U	0.0100 U	0.0100 U
Anthracene	NE	NE	1.19	66.4	4.31	0.0262	0.157	255	0.0124	0.0244	0.0100 U
Benzo[a]anthracene[1]	NE	NE	3.69	19.2	2.72	0.0156	0.171	279	0.0211	0.0100 U	0.0100 U
Benzo[a]pyrene[1]	NE	NE	6.37	10.6	1.69	0.0184	0.241	202	0.0227	0.0100 U	0.0100 U
Benzo[b]fluoranthene[1]	NE	NE	5.85	8.02	1.30	0.0240	0.350	153	0.0243	0.0100 U	0.0100 U
Benzo[g,h,i]perylene	NE	NE	4.53	3.37	0.577	0.0222	0.934	82.3	0.0162	0.0100 U	0.0100 U
Benzo[k]fluoranthene[1]	NE	NE	4.65	8.36	1.35	0.0345	0.248	170	0.0340	0.0100 U	0.0100 U
Chrysene[1]	NE	NE	7.16	18.1	2.93	0.0273	0.369	318	0.0323	0.0100 U	0.0100 U
Dibenzo[a,h]anthracene[1]	NE	NE	1.53	1.70	0.330 U	0.0100 U	0.0990	32.2	0.0100 U	0.0100 U	0.0100 U
Fluoranthene	NE	NE	2.87	101	11.5	0.0653	0.362	1,000	0.0293	0.0269	0.0100 U
Fluorene	NE	NE	0.330 U	58.9	7.31	0.0542	0.102	43.7	0.0100 U	0.0986	0.0100 U
Indeno[1,2,3-cd]pyrene[1]	NE	NE	3.84	3.44	0.542	0.0166	0.371	76.2	0.0144	0.0100 U	0.0100 U
Phenanthrene	NE	NE	0.734	215	26.2	0.0634	0.463	755	0.0702	0.0547	0.0100 U
Pyrene	NE	NE	5.02	80.8	10.2	0.0366	0.411	813	0.0279	0.0164	0.0100 U
TTEC[1]	3.9	0.19	**8.40**	**14.9**	**2.31**	0.029	**0.369**	**276**	0.032	0.0100 U	0.0100 U
VOCs (mg/kg)											
Benzene	0.03	0.0017	--	--	--	--	--	--	--	--	--
Ethylbenzene	6	0.34	--	--	--	--	--	--	--	--	--
Toluene	4.5	0.27	--	--	--	--	--	--	--	--	--
Total Xylenes	14.6	0.83	--	--	--	--	--	--	--	--	--

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VOC - volatile organic compound
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Table 2-3. Soil Analytical Results for TPH, Areas B and D, Tacoma Metals Site

Sample ID:			TP-1	TP-2				TP-3			TP-4		
Depth (ft bgs):	Site Cleanup Levels[1]		0-1	0-1	2-3	4-6	6-10	0-1	4-6	6-10	0-1	2-3	6-10
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000
TPH (mg/kg)													
Diesel	NE	NE	560	130	1,700	2,900	10,000	14	1,300	280	270	--	67
Oil	NE	NE	1200	400	1,200	1,700	2,100	26	1,200	240	530	--	31
Diesel and Oil	2,000	NE	1760	530	**2,900**	**4,600**	**12,100**	40	**2,500**	520	800	--	98

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for TPH. Additional depth intervals at the locations shown may have been analyzed for other constituents.

[1] Site Cleanup Levels established in the Revised Draft RI/FS

[2] The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

[3] Laboratory control sample surrogate was outside designated control limits. Sample was re-extracted with acceptable surrogate recovieres; however, re-extracted data did not confirm original data, as the original data was significantly higher. Both data sets are reported.

[4] Results in the diesel organics range are primarily due to overlap from heavy oil range.

[5] Hydrocarbon concentration result in this sample is partially due to one or more individual peaks eluting in the diesel/heavy oil range.

[6] Hydrocarbon pattern most closely resembles a weathered heavy fuel oil product.

-- Not analyzed
"( )" - Samples were analyzed for diesel- and oil-range hydrocarbons by Ecology NWTPH-Dx (extended) with silica gel cleanup. Results not in paranthesis were analyzed by Ecology NWTPH-Dx (extended).
B - Indicates compound also detected in method blank
Ecology - Washington State Department of Ecology
ft bgs - feet below ground surface
ID - identification
mg/kg - milligram per kilogram
NE - not established
RI/FS - remedial investigation/feasibility study
TPH - total petroleum hydrocarbons
U - Compound was analyzed for but not detected above the reporting limit shown.
WAC - Washington Administrative Code

Table 2-3. Soil Analytical Results for TPH, Areas B and D, Tacoma Metals Site

Sample ID:			TP-5				TP-6			TP-7	
Depth (ft bgs):	Site Cleanup Levels[1]		0-1	2-3	4-6	6-10	0-1		2-3	0-1	2-3
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	10/4/2000	10/4/2000	10/4/2000	10/4/2000	10/4/2000		10/4/2000	10/4/2000	10/4/2000
TPH (mg/kg)											
Diesel	NE	NE	18	81	2,000	23,000	160	190	--	330	--
Oil	NE	NE	21	75	2,300	8,600	210	220	--	760	--
Diesel and Oil	2,000	NE	39	156	**4,300**	**31,600**	370	410	--	1,090	--

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for TPH. Additional depth intervals at the locations shown may have been analyzed for other constituents.

[1] Site Cleanup Levels established in the Revised Draft RI/FS

[2] The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

[3] Laboratory control sample surrogate was outside designated control limits. Sample was re-extracted with acceptable surrogate recovieres; however, re-extracted data did not confirm original data, as the original data was significantly higher. Both data sets are re

[4] Results in the diesel organics range are primarily due to overlap from heavy oil range.

[5] Hydrocarbon concentration result in this sample is partially due to one or more individual peaks eluting in the diesel/heavy oil range.

[6] Hydrocarbon pattern most closely resembles a weathered heavy fuel oil product.

-- Not analyzed
"( )" - Samples were analyzed for diesel- and oil-range hydrocarbons by Ecology NWTPH-Dx (extended) with silica gel cleanup. Results not in paranthesis were analyzed by Ecology NWTPH-Dx (extended).
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Table 2-3. Soil Analytical Results for TPH, Areas B and D, Tacoma Metals Site

Sample ID:			TP-8			TP-9			TP-12		TP-48	
Depth (ft bgs):	Site Cleanup Levels[1]		0-1	4-6		0-1	2-3	4-6	0-1	2-3	0-1	6-8.5
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	10/4/2000	10/4/2000		10/5/2000	10/5/2000	10/5/2000	10/5/2000	10/5/2000	10/17/2000	10/17/2000
TPH (mg/kg)												
Diesel	NE	NE	440	32	34	1,900	54	160	17	--	130	630
Oil	NE	NE	1200	49	70	3,000	72	250	17	--	290	870
Diesel and Oil	2,000	NE	1,640	81	104	**4,900**	126	410	34	--	420	1,500

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for TPH. Additional depth intervals at the locations shown may have been analyzed for other constituents.

[1] Site Cleanup Levels established in the Revised Draft RI/FS

[2] The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

[3] Laboratory control sample surrogate was outside designated control limits. Sample was re-extracted with acceptable surrogate recovieres; however, re-extracted data did not confirm original data, as the original data was significantly higher. Both data sets are reported.

[4] Results in the diesel organics range are primarily due to overlap from heavy oil range.

[5] Hydrocarbon concentration result in this sample is partially due to one or more individual peaks eluting in the diesel/heavy oil range.

[6] Hydrocarbon pattern most closely resembles a weathered heavy fuel oil product.

-- Not analyzed
"( )" - Samples were analyzed for diesel- and oil-range hydrocarbons by Ecology NWTPH-Dx (extended) with silica gel cleanup. Results not in paranthesis were analyzed by Ecology NWTPH-Dx (extended).
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ft bgs - feet below ground surface
ID - identification
mg/kg - milligram per kilogram
NE - not established
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TPH - total petroleum hydrocarbons
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Table 2-3. Soil Analytical Results for TPH, Areas B and D, Tacoma Metals Site

Sample ID:			TP-49				TP-50			TP-51	TP-52		
Depth (ft bgs):	Site Cleanup Levels[1]		0-1	2-3	4-6	6-10	0-1		2-3	0-1	0-1	4-6	6-10
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	10/17/2000	10/17/2000	10/17/2000	10/17/2000	10/4/2000		10/4/2000	11/14/2000	11/14/2000	11/14/2000	11/14/2000
TPH (mg/kg)													
Diesel	NE	NE	220	29	11,000	14,000	90	110	39	35 B	86 B	240	730
Oil	NE	NE	1,500	50	4,000	2,900	190	230	54	100	440	140	870
Diesel and Oil	2,000	NE	1,720	79	**15,000**	**16,900**	280	340	93	135	526	380	1,600

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for TPH. Additional depth intervals at the locations shown may have been analyzed for other constituents.

[1] Site Cleanup Levels established in the Revised Draft RI/FS

[2] The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

[3] Laboratory control sample surrogate was outside designated control limits. Sample was re-extracted with acceptable surrogate recovieres; however, re-extracted data did not confirm original data, as the original data was significantly higher. Both data sets are reported.

[4] Results in the diesel organics range are primarily due to overlap from heavy oil range.

[5] Hydrocarbon concentration result in this sample is partially due to one or more individual peaks eluting in the diesel/heavy oil range.

[6] Hydrocarbon pattern most closely resembles a weathered heavy fuel oil product.

-- Not analyzed
"( )" - Samples were analyzed for diesel- and oil-range hydrocarbons by Ecology NWTPH-Dx (extended) with silica gel cleanup. Results not in paranthesis were analyzed by Ecology NWTPH-Dx (extended).
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ft bgs - feet below ground surface
ID - identification
mg/kg - milligram per kilogram
NE - not established
RI/FS - remedial investigation/feasibility study
TPH - total petroleum hydrocarbons
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Table 2-3. Soil Analytical Results for TPH, Areas B and D, Tacoma Metals Site

Sample ID:			TP-53	TP-54	TP-57				TP-65	B1			B2
Depth (ft bgs):	Site Cleanup Levels[1]		0-1	0-1	0-1	2-3	4-6	6-10	0-1	10.5	20.5	26	21
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	11/14/2000	11/14/2000	11/14/2000	11/14/2000	11/14/2000	11/14/2000	11/14/2000	8/2002	8/2002	8/2002	8/2002
TPH (mg/kg)													
Diesel	NE	NE	690 B	160 B	2,200 B	66	170	88	5.3 U	5,500 [2]	2,700 [2]	7,300 [2]	1,600 [2]
Oil	NE	NE	700	310	4,700	98	200	350	11 U	2,200	640	1,600	420
Diesel and Oil	2,000	NE	1,390	470	**6,900**	164	370	438	16.3	**7,700**	**3,340**	**8,900**	**2,020**

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for TPH. Additional depth intervals at the locations shown may have been analyzed for other constituents.

[1] Site Cleanup Levels established in the Revised Draft RI/FS

[2] The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

[3] Laboratory control sample surrogate was outside designated control limits. Sample was re-extracted with acceptable surrogate recovieres; however, re-extracted data did not confirm original data, as the original data was significantly higher. Both data sets are reported.

[4] Results in the diesel organics range are primarily due to overlap from heavy oil range.

[5] Hydrocarbon concentration result in this sample is partially due to one or more individual peaks eluting in the diesel/heavy oil range.

[6] Hydrocarbon pattern most closely resembles a weathered heavy fuel oil product.

-- Not analyzed
"( )" - Samples were analyzed for diesel- and oil-range hydrocarbons by Ecology NWTPH-Dx (extended) with silica gel cleanup. Results not in paranthesis were analyzed by Ecology NWTPH-Dx (extended).
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mg/kg - milligram per kilogram
NE - not established
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TPH - total petroleum hydrocarbons
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Table 2-3. Soil Analytical Results for TPH, Areas B and D, Tacoma Metals Site

Sample ID:			B3			MW-13		B12			B13		
Depth (ft bgs):	Site Cleanup Levels[1]		10	21.5		17.5		4-5	6.5-7.5	9-10	1-3	5-6	14-15
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	8/2002	8/2002		Feb-03		Nov-03	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03
TPH (mg/kg)													
Diesel	NE	NE	20 [2]	180 [2]	250 [2]	130 [2,3]	70 [2,3]	1,910 (397)	43.0 (21.8)	1,310 (866)	734 (264)	114 (41.8)	1,680 (1,020) [4]
Oil	NE	NE	10 U	29 U	38	80 [3]	20 [3]	4,800 (1,250)	64.7 (25.0 U)	317 (125 U)	1,080 (551)	159 (47.1)	166 (98.0 U)
Diesel and Oil	2,000	NE	20	180	288	210 [3]	90 [3]	**6,710** (1,647)	107.7 (21.8)	1,627 (866)	1,814 (815)	273 (88.9)	1,846 (1,020)

Notes:
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[2] The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

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-- Not analyzed
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ft bgs - feet below ground surface
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mg/kg - milligram per kilogram
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TPH - total petroleum hydrocarbons
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Table 2-3. Soil Analytical Results for TPH, Areas B and D, Tacoma Metals Site

Sample ID:			B14			B15			B16		
Depth (ft bgs):	Site Cleanup Levels[1]		1-2	5-6	9-10	5-6	7-8	9-10	3-4	5-6	10-11
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03	Nov-03
TPH (mg/kg)											
Diesel	NE	NE	374 (178) [4]	927 (279)	436 (251)	266 (68.7)	12.8 (10.0 U)	19.5 (10.0 U)	10.0 U (10.0) U	457 (136)	139 (72.8)
Oil	NE	NE	1,410 (705)	1,590 (349)	298 (91.7)	666 (217)	25.0 (25.0) U	25.7 (25.0 U)	25.0 U (25.0) U	642 (59.6)	29.4 (25.0) U
Diesel and Oil	2,000	NE	1,784 (883)	**2,517** (628)	734 (343)	932 (286)	12.8 (25.0 U)	45.2 (25.0 U)	25.0 U (25.0) U	1,099 (196)	168 (72.8)

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
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[2] The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

[3] Laboratory control sample surrogate was outside designated control limits. Sample was re-extracted with acceptable surrogate recovieres; however, re-extracted data did not confirm original data, as the original data was significantly higher. Both

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[5] Hydrocarbon concentration result in this sample is partially due to one or more individual peaks eluting in the diesel/heavy oil range.

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Table 2-3. Soil Analytical Results for TPH, Areas B and D, Tacoma Metals Site

Sample ID:			B17			B18			B19		
Depth (ft bgs):	Site Cleanup Levels[1]		3-4	5-6	7-8	6-6.5	12-13	24-25	9-10	14-15	21-22
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Nov-03	Nov-03	Nov-03	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04
TPH (mg/kg)											
Diesel	NE	NE	10.0 U (10.0) U	138 (23.6)	361 (35.1)	19 [5]	18.3 [4]	10 U	180	15.1 [5]	5,990 [2]
Oil	NE	NE	25.0 U (25.0) U	768 (73.5)	1,200 (84.2 U)	25.0 U	32.6	25.0 U	28.0	25.0 U	680
Diesel and Oil	2,000	NE	25.0 U (25.0) U	906 (97.1)	1,561 (35.1)	19.0	50.9	25.0 U	208	15.1	**6,670**

Notes:
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[3] Laboratory control sample surrogate was outside designated control limits. Sample was re-extracted with acceptable surrogate recovieres; however, re-extracted data did not confirm original data, as the original data was significantly higher. Both data sets a

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Table 2-3. Soil Analytical Results for TPH, Areas B and D, Tacoma Metals Site

Sample ID:			B20			B21			B22		
Depth (ft bgs):	Site Cleanup Levels[1]		7-8	10-11	19-20	8-9	13-15	18-19	6-7	11-12	19-20
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04	Mar-04
TPH (mg/kg)											
Diesel	NE	NE	20.4 U	38.1	36.3	30.6	10.0 U	474	98.6	241	56.1 [2]
Oil	NE	NE	51.0 U	25.0 U	25.0 U	38.2	25.0 U	43.9	79.9	63.5	25.0 U
Diesel and Oil	2,000	NE	51.0 U	38.1	36.3	68.8	25.0 U	518	178.5	305	56.1

Notes:
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Results shown for locations and depth intervals analyzed for TPH. Additional depth intervals at the locations shown may have been analyzed for other constituents.

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[2] The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

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[5] Hydrocarbon concentration result in this sample is partially due to one or more individual peaks eluting in the diesel/heavy oil range.

[6] Hydrocarbon pattern most closely resembles a weathered heavy fuel oil product.

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Table 2-3. Soil Analytical Results for TPH, Areas B and D, Tacoma Metals Site

Sample ID:			B23			B24			B25		B26		
Depth (ft bgs):	Site Cleanup Levels[1]		6.5-7.5	9-10	18-20	9-10	15-16	30.5-31.5	14-15	30-31	6.5-7.5	18-19	25-26
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Mar-04	Mar-04	Mar-04	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05
TPH (mg/kg)													
Diesel	NE	NE	49.9	3,010	10.0 U	10.0 U	409	22.3	16.9	9,790	162 [6]	801	142
Oil	NE	NE	25.0 U	912	25.0 U	25.0 U	250 U	25.0 U	25.0 U	1,570	268	173	25.0 U
Diesel and Oil	2,000	NE	49.9	**3,922**	25.0 U	25.0 U	409	22.3	16.9	**11,360**	430	974	142

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for TPH. Additional depth intervals at the locations shown may have been analyzed for other constituents.

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[2] The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

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Table 2-3. Soil Analytical Results for TPH, Areas B and D, Tacoma Metals Site

Sample ID:			B27			B28			B29		
Depth (ft bgs):	Site Cleanup Levels[1]		7-8	22-23	24.5-25.5	6-7	11-12	23.5-24.5	6.5-7.5	11-12	22.5-23.5
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05
TPH (mg/kg)											
Diesel	NE	NE	92.3 [6]	68.7	8,750	686 [6]	24.7	238	61.5 [6]	291 [6]	3,920 [2]
Oil	NE	NE	258	25.0 U	1,940 U	1,620	25.0 U	49.3 U	116	217	1,000 U
Diesel and Oil	2,000	NE	350	68.7	**8,750**	**2,306**	24.7	238	178	508	**3,920**

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for TPH. Additional depth intervals at the locations shown may have been analyzed for other constituents.

[1] Site Cleanup Levels established in the Revised Draft RI/FS

[2] The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

[3] Laboratory control sample surrogate was outside designated control limits. Sample was re-extracted with acceptable surrogate recovieres; however, re-extracted data did not confirm original data, as the original data was significantly higher. Both data sets are reporte

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TPH - total petroleum hydrocarbons
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Table 2-3. Soil Analytical Results for TPH, Areas B and D, Tacoma Metals Site

Sample ID:			B30			B31			B32		
Depth (ft bgs):	Site Cleanup Levels[1]		5.5-6.5	11-12	22.5-23.5	6-7	19-20	24-25	6-7	11-12	19-20
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05	Mar-05
TPH (mg/kg)											
Diesel	NE	NE	21.1 U	25.2	159	163 [6]	1,140	213	14.2	112 [6]	3,650 [6]
Oil	NE	NE	52.9 U	25.0 U	49.0 U	229	162	30.5	25.0 U	119	1,310
Diesel and Oil	2,000	NE	52.9 U	25.2	159	392	1,302	244	14.2	231	**4,960**

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for TPH. Additional depth intervals at the locations shown may have been analyzed for other constituents.

[1] Site Cleanup Levels established in the Revised Draft RI/FS

[2] The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

[3] Laboratory control sample surrogate was outside designated control limits. Sample was re-extracted with acceptable surrogate recovieres; however, re-extracted data did not confirm original data, as the original data was significantly higher. Both data sets are r

[4] Results in the diesel organics range are primarily due to overlap from heavy oil range.

[5] Hydrocarbon concentration result in this sample is partially due to one or more individual peaks eluting in the diesel/heavy oil range.

[6] Hydrocarbon pattern most closely resembles a weathered heavy fuel oil product.

-- Not analyzed
"( )" - Samples were analyzed for diesel- and oil-range hydrocarbons by Ecology NWTPH-Dx (extended) with silica gel cleanup. Results not in paranthesis were analyzed by Ecology NWTPH-Dx (extended).
B - Indicates compound also detected in method blank
Ecology - Washington State Department of Ecology
ft bgs - feet below ground surface
ID - identification
mg/kg - milligram per kilogram
NE - not established
RI/FS - remedial investigation/feasibility study
TPH - total petroleum hydrocarbons
U - Compound was analyzed for but not detected above the reporting limit shown.
WAC - Washington Administrative Code

Table 2-3. Soil Analytical Results for TPH, Areas B and D, Tacoma Metals Site

Sample ID:			B33		
Depth (ft bgs):	Site Cleanup Levels[1]		6-7	18-19	20.5-21.5
Date Sampled:	Unpaved Shallow/Deep	Saturated Soils	Mar-05	Mar-05	Mar-05
TPH (mg/kg)					
Diesel	NE	NE	16.3	10 U	10 U
Oil	NE	NE	25.0 U	25.0 U	25.0 U
Diesel and Oil	2,000	NE	25.0 U	25.0 U	25.0 U

Notes:
Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for TPH. Additional depth intervals at the locations shown may have been analyzed for other constituents.

[1] Site Cleanup Levels established in the Revised Draft RI/FS

[2] The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

[3] Laboratory control sample surrogate was outside designated control limits. Sample was re-extracted with acceptable surrogate recovieres; however, re-extracted data did not confirm original data, as the original data was significantly higher. Both data sets are reported.

[4] Results in the diesel organics range are primarily due to overlap from heavy oil range.

[5] Hydrocarbon concentration result in this sample is partially due to one or more individual peaks eluting in the diesel/heavy oil range.

[6] Hydrocarbon pattern most closely resembles a weathered heavy fuel oil product.

-- Not analyzed
"( )" - Samples were analyzed for diesel- and oil-range hydrocarbons by Ecology NWTPH-Dx (extended) with silica gel cleanup. Results not in paranthesis were analyzed by Ecology NWTPH-Dx (extended).
B - Indicates compound also detected in method blank
Ecology - Washington State Department of Ecology
ft bgs - feet below ground surface
ID - identification
mg/kg - milligram per kilogram
NE - not established
RI/FS - remedial investigation/feasibility study
TPH - total petroleum hydrocarbons
U - Compound was analyzed for but not detected above the reporting limit shown.
WAC - Washington Administrative Code

Table 2-4. Soil Analytical Results for Metals and PCBs, Areas B and D, Tacoma Metals Site

Sample ID:	Site Cleanup Levels[1]				TP-1				TP-2				TP-3		
Depth (ft bgs):					0-1	2-3	4-6	6-10	0-1	2-3	4-6	6-10	0-1	4-6	6-10
Date Sampled:	Unpaved Shallow (to 6 ft bgs)	Unpaved Deep (6 to 15 ft bgs)	Paved Areas	Saturated Soils	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000	9/27/2000
Metals (mg/kg)															
Arsenic	10	10	13	0.15	**40**	--	--	--	10 U	5 U	6 U	6 U	5 U	7	10 U
Barium	102	1,650	1,867	83	**290**	--	--	--	**404**	47.2	58.1	53.8	63.5	63.8	110
Cadmium	14	726	773	NE	8.5	--	--	--	**18.2**	0.2 U	0.2 U	1.1	2.7	0.4	0.5 U
Chromium	67[2]	25,907[2]	1,000,000[2]	24,007[2]	**76**	--	--	--	67	18.6	15.4	18.6	26.9	15.4	18
Copper	217	53,333	53,333	14	**873**	--	--	--	**1,090**	20	35.2	79.6	44.1	33.2	42.4
Lead	118	1,601	1,601	150	**2,230**	**120**	90	30	**831**	10	85	72	46	106	93
Mercury	5.5	13	13	0.1	1.53	0.11	--	--	0.88	0.04	0.06 U	0.13	0.13	0.21	0.13
Selenium	0.3	233	5,333	0.26	10 U	--	--	--	10 U	5 U	6 U	6 U	5 U	7 U	10 U
Silver	1,133	1,133	1,133	0.69	1	--	--	--	0.9	0.3 U	0.4	0.4 U	0.3 U	0.4 U	0.7 U
PCBs (mg/kg)															
Total PCBs	0.65	1	5	NE	**1.25**	--	--	--	--	--	--	--	0.336	--	--

Notes:

Bold indicates the detected analyte exceeds the site cleanup level.

Results shown for locations and depth intervals analyzed for metals and/or PCBs. Additional depth intervals at the locations shown may have been analyzed for other constituents.

[1] Site Cleanup Levels established in the Revised Draft RI/FS

[2]Chromium cleanup levels are for chromium III.

-- Not analyzed

ft bgs - feet below ground surface

ID - identification

mg/kg - milligram per kilogram

NE - not established

PCB - polychlorinated biphenyl

RI/FS - remedial investigation/feasibility study

U - Compound was analyzed for but not detected above the reporting limit shown.

Table 2-4. Soil Analytical Results for Metals and PCBs, Areas B and D, Tacoma Metals Site

Sample ID:	Site Cleanup Levels[1]				TP-4				TP-5			TP-6			
Depth (ft bgs):					0-1	2-3	4-6	6-10	0-1	4-6	6-10	0-1	2-3	4-6	6-10
Date Sampled:	Shallow (to 6 ft bgs)	Deep (6 to 15 ft bgs)	Paved Areas	Saturated Soils	9/27/2000	9/27/2000	9/27/2000	9/27/2000	10/4/2000	10/4/2000	10/4/2000	10/4/2000	10/4/2000	10/4/2000	10/4/2000
Metals (mg/kg)															
Arsenic	10	10	13	0.15	**30**	--	--	7 U	5 U	6 U	10 U	**30**	**30**	--	--	--
Barium	102	1,650	1,867	83	**609**	--	--	60.1	59.4	67.7	52.3	**196**	**208**	--	--	--
Cadmium	14	726	773	NE	**21.6**	8	--	0.3 U	0.2 U	0.3 U	0.5 U	5.6	4.9	--	--	--
Chromium	67[2]	25,907[2]	1,000,000[2]	24,007[2]	**82**	--	--	16.9	59.9	38.2	24	**92**	59	--	--	--
Copper	217	53,333	53,333	14	**4,650**	--	--	24.6	28	37.3	56.1	**711**	**237**	--	--	--
Lead	118	1,601	1,601	150	**1,760**	**443**	**160**	9	8	56	248	**1,550**	**867**	54	40	60
Mercury	5.5	13	13	0.1	0.55	--	--	0.06 U	0.05 U	0.20	0.3	0.5	0.45	--	--	--
Selenium	0.3	233	5,333	0.26	10 U	--	--	7 U	**5**	6 U	10 U	**20**	**20**	--	--	--
Silver	1,133	1,133	1,133	0.69	1.2	--	--	0.4 U	0.4	0.4 U	0.8 U	1.9	2.1	--	--	--
PCBs (mg/kg)															
Total PCBs	0.65	1	5	NE	**8.3**	**2.85**	--	--	0.145	--	--	**0.86**	--	0.183	--	--

Notes:

Bold indicates the detected analyte exceeds the site cleanup level.

Results shown for locations and depth intervals analyzed for metals and/or PCBs. Additional depth intervals at the locations shown may have been analyzed for other constituents.

[1] Site Cleanup Levels established in the Revised Draft RI/FS

[2]Chromium cleanup levels are for chromium III.

-- Not analyzed

ft bgs - feet below ground surface

ID - identification

mg/kg - milligram per kilogram

NE - not established

PCB - polychlorinated biphenyl

RI/FS - remedial investigation/feasibility study

U - Compound was analyzed for but not detected above the reporting limit shown.

Table 2-4. Soil Analytical Results for Metals and PCBs, Areas B and D, Tacoma Metals Site

Sample ID:	Site Cleanup Levels[1]				TP-7		TP-8			TP-9			TP-12		TP-48	
Depth (ft bgs):					0-1	2-3	0-1	4-6		0-1	2-3	4-6	0-1	2-3	0-1	6-8.5
Date Sampled:	Shallow (to 6 ft bgs)	Deep (6 to 15 ft bgs)	Paved Areas	Saturated Soils	10/4/2000	10/4/2000	10/4/2000	10/4/2000		10/5/2000	10/5/2000	10/5/2000	10/5/2000	10/5/2000	10/17/2000	10/17/2000
Metals (mg/kg)																
Arsenic	10	10	13	0.15	10	--	5 U	6 U	5 U	**40**	--	6 U	5 U	--	**40**	70 U
Barium	102	1,650	1,867	83	**697**	--	**235**	38.4	42.1	**1,990**	--	**224**	37.5	--	**232**	67
Cadmium	14	726	773	NE	12.3	9	0.9	0.3	0.2 U	**59**	--	2.1	3.3	--	8	3 U
Chromium	67[2]	25,907[2]	1,000,000[2]	24,007[2]	**103**	--	33.9	17.5	15.7	**132**	--	24.2	19.4	--	52	18
Copper	217	53,333	53,333	14	**361**	--	41	29.6	47.8	**1,260**	--	59.9	21.3	--	**588**	45
Lead	118	1,601	1,601	150	**796**	--	31	25	26	**1,960**	20	93	17	--	**630**	40
Mercury	5.5	13	13	0.1	0.88	--	0.05 U	0.06 U	0.05 U	0.90	--	0.05 U	0.04 U	--	0.45	0.1 U
Selenium	0.3	233	5,333	0.26	**8**	--	5 U	6 U	5 U	30 U	--	6 U	5 U	--	30 U	70 U
Silver	1,133	1,133	1,133	0.69	1.5	--	0.3	0.4 U	0.7	2 U	--	0.4 U	0.3 U	--	2 U	4 U
PCBs (mg/kg)																
Total PCBs	0.65	1	5	NE	0.186	**9.28**	--	--	--	**2.6**	--	--	0.211	**0.835**	--	--

Notes:

Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for metals and/or PCBs. Additional depth intervals at the locations shown may have been analyzed for other constituents.

[1] Site Cleanup Levels established in the Revised Draft RI/FS

[2]Chromium cleanup levels are for chromium III.

-- Not analyzed
ft bgs - feet below ground surface
ID - identification
mg/kg - milligram per kilogram
NE - not established
PCB - polychlorinated biphenyl
RI/FS - remedial investigation/feasibility study
U - Compound was analyzed for but not detected above the reporting limit shown.

Table 2-4. Soil Analytical Results for Metals and PCBs, Areas B and D, Tacoma Metals Site

Sample ID:	Site Cleanup Levels[1]				TP-49				TP-50			TP-51	TP-52	TP-53	TP-54
Depth (ft bgs):					0-1	2-3	4-6	6-10	0-1	2-3		0-1	0-1	0-1	0-1
Date Sampled:	Shallow (to 6 ft bgs)	Deep (6 to 15 ft bgs)	Paved Areas	Saturated Soils	10/17/2000	10/17/2000	10/17/2000	10/17/2000	10/4/2000		10/4/2000	11/14/2000	11/14/2000	11/14/2000	11/14/2000
Metals (mg/kg)															
Arsenic	10	10	13	0.15	30 U	30 U	30 U	50 U	30 U	30 U	30 U	30 U	20 U	30 U	30 U
Barium	102	1,650	1,867	83	71	64	78	51	**208**	**293**	69	73	50	63	**242**
Cadmium	14	726	773	NE	1	1 U	1 U	2 U	8	**18**	1 U	1 U	1.0 U	1 U	8
Chromium	67[2]	25,907[2]	1,000,000[2]	24,007[2]	33	20	15	23	37	55	44	34	27	31	48
Copper	217	53,333	53,333	14	78	20	20	942	**1,100**	**530**	29	61	38.2	40	**273**
Lead	118	1,601	1,601	150	**150**	10	**150**	430	**380**	**570**	**150**	100	38	20	**410**
Mercury	5.5	13	13	0.1	0.13	0.05 U	0.44	0.12	0.49	0.61	0.05 U	0.05	0.06	0.05	0.98
Selenium	0.3	233	5,333	0.26	30 U	30 U	30 U	50 U	30 U	30 U	30 U	30 U	20 U	30 U	30 U
Silver	1,133	1,133	1,133	0.69	2 U	2 U	2 U	3 U	2 U	2 U	2 U	2 U	1 U	2 U	2 U
PCBs (mg/kg)															
Total PCBs	0.65	1	5	NE	0.425	--	--	--	**7.6**	--	0.165	0.413	--	0.205	--

Notes:

Bold indicates the detected analyte exceeds the site cleanup level.

Results shown for locations and depth intervals analyzed for metals and/or PCBs. Additional depth intervals at the locations shown may have been analyzed for other constituents.

[1] Site Cleanup Levels established in the Revised Draft RI/FS

[2]Chromium cleanup levels are for chromium III.

-- Not analyzed

ft bgs - feet below ground surface

ID - identification

mg/kg - milligram per kilogram

NE - not established

PCB - polychlorinated biphenyl

RI/FS - remedial investigation/feasibility study

U - Compound was analyzed for but not detected above the reporting limit shown.

Table 2-4. Soil Analytical Results for Metals and PCBs, Areas B and D, Tacoma Metals Site

Sample ID:	Site Cleanup Levels[1]				TP-57				TP-65
Depth (ft bgs):					0-1	2-3	4-6	6-10	0-1
Date Sampled:	Shallow (to 6 ft bgs)	Deep (6 to 15 ft bgs)	Paved Areas	Saturated Soils	11/14/2000	11/14/2000	11/14/2000	11/14/2000	11/14/2000
Metals (mg/kg)									
Arsenic	10	10	13	0.15	**60**	--	--	--	30 U
Barium	102	1,650	1,867	83	**2,740**	--	--	--	58
Cadmium	14	726	773	NE	**70**	1.7	--	--	1 U
Chromium	67[2]	25,907[2]	1,000,000[2]	24,007[2]	**145**	--	--	--	28
Copper	217	53,333	53,333	14	**7,410**	--	--	--	19
Lead	118	1,601	1,601	150	**2,710**	28	80	23	10 U
Mercury	5.5	13	13	0.1	0.6	--	--	--	0.05
Selenium	0.3	233	5,333	0.26	**40**	--	--	--	30 U
Silver	1,133	1,133	1,133	0.69	2 U	--	--	--	2 U
PCBs (mg/kg)									
Total PCBs	0.65	1	5	NE	**5.42**	--	--	--	0.146

Notes:

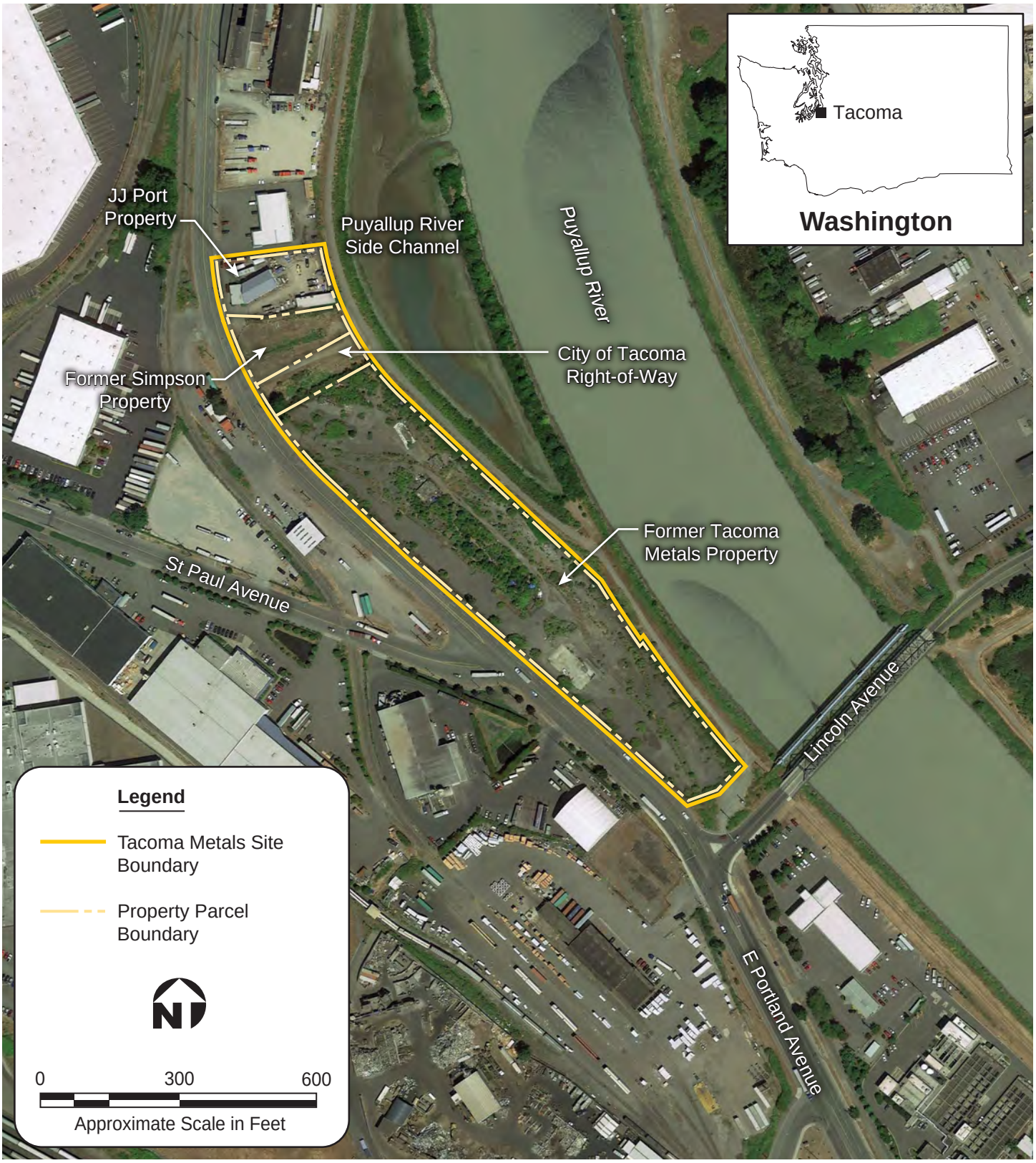
Bold indicates the detected analyte exceeds the site cleanup level.
Results shown for locations and depth intervals analyzed for metals and/or PCBs. Additional depth intervals at the locations shown may have been analyzed for other constituents.

[1] Site Cleanup Levels established in the Revised Draft RI/FS

[2]Chromium cleanup levels are for chromium III.

-- Not analyzed
ft bgs - feet below ground surface
ID - identification
mg/kg - milligram per kilogram
NE - not established
PCB - polychlorinated biphenyl
RI/FS - remedial investigation/feasibility study
U - Compound was analyzed for but not detected above the reporting limit shown.

Figures



Source: Google Earth Pro, imagery dated (7/10/2014)

Figure 1-1

Site Location Map

AECOM

Tacoma Metals Site
Tacoma, Washington

Legend

- Tacoma Metals Site Boundary
- Property Parcel Boundary
- Direct Push Soil Boring (2014)
- Previous Soil Boring
- Monitoring Well
- Test Pit
- Extent of Soil Exceeding Interim Action Cleanup Levels at Depths Less Than 15 ft bgs

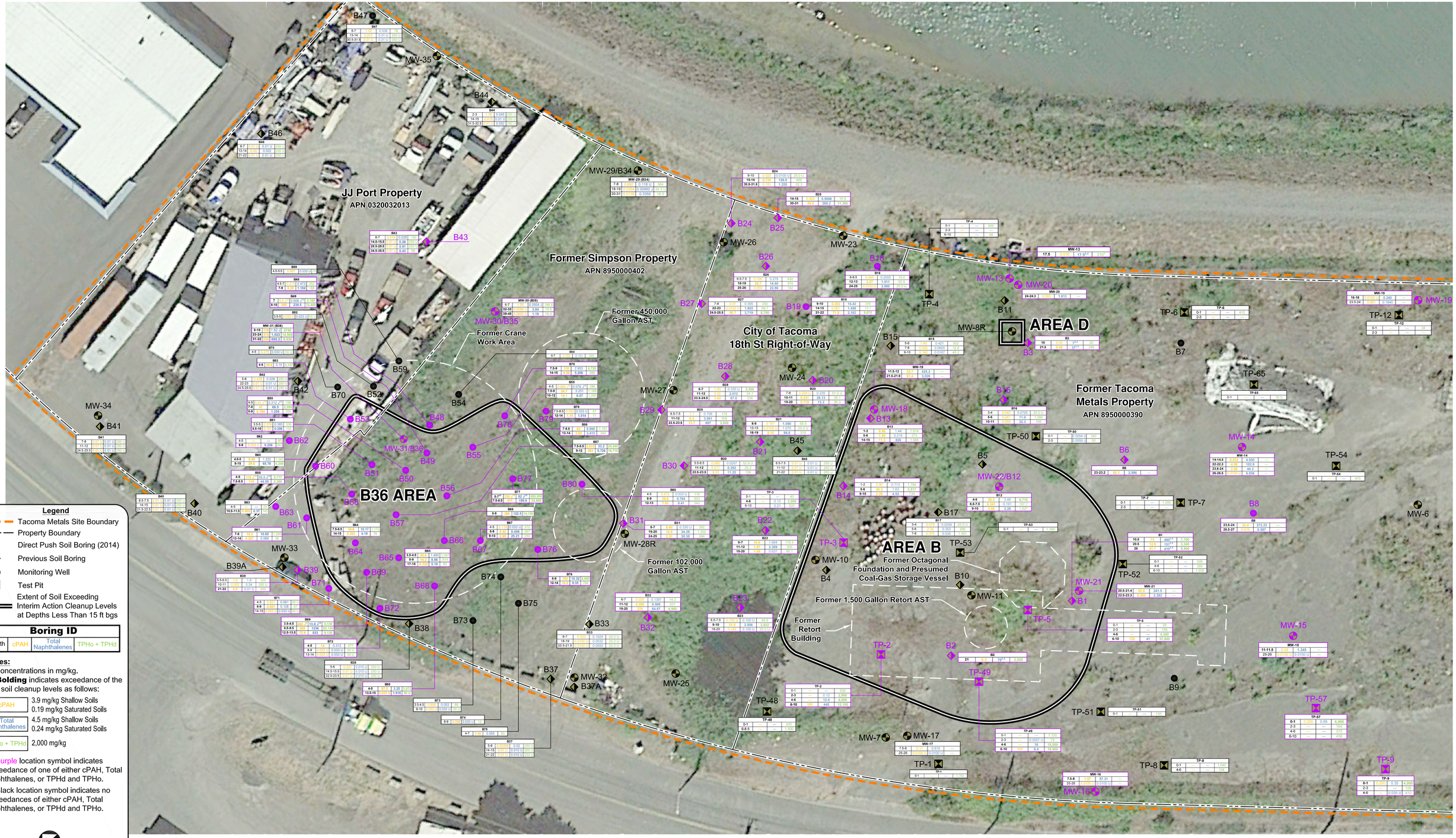
0 20 40
SCALE IN FEET

Figure 1-2
Site Plan
B36 Area, Area B, and Area D

Tacoma Metals Site
Tacoma, Washington

AECOM

J:\Seattle Support\Tacoma Metals\000_CAD\02-Sheets\C\Figure 1-2 (B36 Area_Area B_Area D_Site Plan).dwg
Mod: 05/02/2017, 06:58 | Plotted: 05/02/2017, 06:58 | jim.gibson



Legend

- Tacoma Metals Site Boundary
- Property Boundary
- Direct Push Soil Boring (2014)
- Previous Soil Boring
- Monitoring Well
- Test Pit
- Extent of Soil Exceeding Interim Action Cleanup Levels at Depths Less Than 15 ft bgs

Boring ID

Depth	cPAH	Total Naphthalenes	TPHo + TPHd

Notes:

1. Concentrations in mg/kg.
2. **Bolding** indicates exceedance of the site soil cleanup levels as follows:

cPAH	3.9 mg/kg Shallow Soils 0.19 mg/kg Saturated Soils
Total Naphthalenes	4.5 mg/kg Shallow Soils 0.24 mg/kg Saturated Soils
TPHo + TPHd	2,000 mg/kg

3. Purple location symbol indicates exceedance of one of either cPAH, Total Naphthalenes, or TPHd and TPHo.
4. Black location symbol indicates no exceedances of either cPAH, Total Naphthalenes, or TPHd and TPHo.

0 20 40
SCALE IN FEET

Plate 1

Soil Sampling Results
B36 Area, Area B, and Area D

Tacoma Metals Site
Tacoma, Washington

AECOM

\\seattle.na.aecomnet.com\seattle\DCS\Projects\Legacy_URS\IIP\Tacoma Metals\11 Reports and Deliverables\C - Interim Action Work PMS_Plate-1_cPAH Site Plan_REV-2.dwg
Mod: 01/10/2019, 09:20 | Plotted: 01/10/2019, 09:23 | mark.gagnon

Appendix A
Boring Logs

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: Northeast of B36 Simpson Property	**Boring Name:** B48
DRILLING COMPANY: ESN	DRILLER: Noel
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch
ISOLATION CASING: N/A	FROM N/A TO N/A FT.
BLANK CASING: N/A	FROM N/A TO N/A FT.
SLOTTED CASING: N/A	FROM N/A TO N/A FT.
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.
SEAL: Bentonite Granules	FROM 0 TO 15 FT.
GROUT: N/A	FROM N/A TO N/A FT.
Project Name: Former Tacoma Metals	
Project Number: 996098*00	
ELEVATION AND DATUM: bgs 10.20 ft.	TOTAL DEPTH: 15.0 ft. bgs
DATE STARTED: 10/7/14	DATE COMPLETED: 10/7/14
INITIAL WATER DEPTH (FT): 8.5	
LOGGED BY: DKM	
SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3		0			0.0		SW	**Well-graded SAND with gravel** Tan/light brown, sand with up to 50% gravel, <10% silt, moderately dense, slightly moist, no odor, no sheen.
								Wood	**WOOD DEBRIS (upper wood fill)** Brown/orange, wood fill (chips/sawdust/shavings), no soil matrix, moderately loose, slightly moist to moist, no odor, no sheen.
								GP	**Poorly graded GRAVEL** Light gray, angular rock or broken concrete, no odor, no sheen.
			5			25.9			
SS	2.5			B48-4.5-7		4.8		SP/ SM	**Poorly graded SAND with silt and gravel** Dark gray, medium to fine sand with ~10-20% silt and ~10-15% gravel, moderately dense, moist to wet, tideflat-like odor, possible light sheen.
				B48-7-9		0.6			
			10						
SS	3					0.0		Wood	**WOOD DEBRIS (lower wood fill)** Medium gray to tan, wood debris with 10-20% sandy silt matrix (varies locally), wet, no odor, no sheen.
			15						

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: East of B36 Simpson Property	**Boring Name:** B49
DRILLING COMPANY: ESN	DRILLER: Noel
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch
ISOLATION CASING: N/A	FROM N/A TO N/A FT.
BLANK CASING: N/A	FROM N/A TO N/A FT.
SLOTTED CASING: N/A	FROM N/A TO N/A FT.
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.
SEAL: Bentonite Granules	FROM 0 TO 15 FT.
GROUT: N/A	FROM N/A TO N/A FT.
Project Name: Former Tacoma Metals	
Project Number: 996098*00	
ELEVATION AND DATUM: bgs 10.00 ft.	TOTAL DEPTH: 15.0 ft. bgs
DATE STARTED: 10/7/14	DATE COMPLETED: 10/7/14
INITIAL WATER DEPTH (FT): 8.0	
LOGGED BY: DKM	
SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3.5		0			0.0		SW	**Well-graded SAND with gravel** Brown/tan, sand with up to 50% gravel, <10% silt, moderately dense, slightly moist, no odor, no sheen.
						0.1		Wood	**WOOD DEBRIS (upper wood fill)** Orange/brown, wood fill (chips/sawdust/shavings), no soil matrix, some gravel in bottom 6 inches, moderately loose, slightly moist, no odor, no sheen.
SS	2.5		5	B49-8-10		0.5		SM	**Silty SAND** Dark gray to dark brown, silty sand with 10-20% wood debris, some gravel, moderately loose, moist to wet, faint odor in lower 2 feet, no sheen.
SS	<1		10			2.6		Wood	**WOOD DEBRIS (lower food fill)** Brown, wood debris with 10-20% sitly matrix (varies locally), wet, slight to moderate odor, moderate to heavy sheen, no evident NAPL.
			15						

KJ PNW WK DRAFT B36 AREA BORING LOGS OCT 2014.GPJ KJ PNW.GDT 1/6/15

F-40.1
(6-87) (3-88) (8-90)

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: South of B36 Simpson Property		**Boring Name**	B50
DRILLING COMPANY: ESN	DRILLER: Noel	**Project Name**	Former Tacoma Metals
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number**	996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 9.80 ft.	TOTAL DEPTH: 11.0 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/7/14	DATE COMPLETED: 10/7/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 8.5	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 11 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3		0					SW/ SM	**Well-graded SAND with silt** Tan/brown, sand with gravel and 10-15% silt, moderately dense, slightly moist, no odor, no sheen.
								Wood	**WOOD DEBRIS (upper wood fill)** Orange/brown, wood fill (chips/sawdust/shavings), no soil matrix, moderately loose, moist, no odor, no sheen.
			5	B50-4-5		0.2		SM	**Silty SAND with gravel** Dark gray, silty sand with 10-15% wood debris and some gravel, moderately dense, moist to wet, moderate odor from ~4-5 feet bgs decreasing with depth, no sheen.
SS	4			B50-7-8		2.0			
				B50-8-9					
			10					Wood	**WOOD DEBRIS (lower wood fill)** Tan to gray, woody debris with 10-20% silty matrix material overall (varies locally), wet, no odor, no sheen.
SS	<1					0.2			

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: Southwest of B36 Simpson Property	**Boring Name:** B51
DRILLING COMPANY: ESN	DRILLER: Noel
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch
	Project Name: Former Tacoma Metals
	Project Number: 996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.
BLANK CASING: N/A	FROM N/A TO N/A FT.
SLOTTED CASING: N/A	FROM N/A TO N/A FT.
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.
SEAL: Bentonite Granules	FROM 0 TO 15 FT.
GROUT: N/A	FROM N/A TO N/A FT.
ELEVATION AND DATUM: bgs 9.40 ft.	TOTAL DEPTH: 15.0 ft. bgs
DATE STARTED: 10/7/14	DATE COMPLETED: 10/7/14
INITIAL WATER DEPTH (FT): 9.0	
LOGGED BY: DKM	
SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3		0					SW	**Well-graded SAND with gravel** Brown, mixed sand with gravel fill, some silt, moderately dense, slightly moist, no odor, no sheen.
						1.1		Wood GP	**WOOD DEBRIS (upper wood fill)** Orange/brown, wood fill (chips/sawdust/shavings), no soil matrix, no odor, no sheen.
				B51-3.5-5		5.3			**Poorly graded GRAVEL** Gray, crushed angular rock or concrete, no odor, no sheen.
			5					SM	**Silty SAND** Dark orange/brown to dark gray, silty sand, minor gravel, <10% wood debris including blocky wood with moderate odor between ~7-7.5 feet bgs, moderately dense, moist to wet, slight odor and sheen decreasing with depth.
SS	3.5					3.3			
						0.6			**WOOD DEBRIS (lower wood fill)** Gray to brown, blocky wood debris with 10-15% silty matrix overall (matrix % varies locally), wet, faint to moderate odor, medium sheen.
				B51-8.5-10		2.7			
			10						
SS	<1							Wood	
						2.4			
			15						

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: North of B36 JJ Port Property		**Boring Name**	B52
DRILLING COMPANY: ESN	DRILLER: Noel	**Project Name**	Former Tacoma Metals
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number**	996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 6.80 ft.	TOTAL DEPTH: 7.0 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/7/14	DATE COMPLETED: 10/7/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 6.8	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 7 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	2.5					0.0		SW	**Well-graded SAND with gravel** Tan/brown, sandy fill with up to 50% gravel, <10% silt, moderately dense, slightly moist, no odor, no sheen.
				B52-3.5-5		0.0		SP	**Poorly graded SAND with gravel** Brown, sand with 10-15% gravel and <10% silt, moderately dense, moist, no odor, no sheen.
			5						
SS	1.5					0.1		Wood	**WOOD DEBRIS (lower wood fill)** Gray/brown, blocky wood debris with 5-10% silty matrix, moist, no odor, no sheen.

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: West of B36 JJ Port Property	**Boring Name:** B53
DRILLING COMPANY: ESN	DRILLER: Noel
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch
ISOLATION CASING: N/A	FROM N/A TO N/A FT.
BLANK CASING: N/A	FROM N/A TO N/A FT.
SLOTTED CASING: N/A	FROM N/A TO N/A FT.
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.
SEAL: Bentonite Granules	FROM 0 TO 10 FT.
GROUT: N/A	FROM N/A TO N/A FT.
Project Name: Former Tacoma Metals	
Project Number: 996098*00	
ELEVATION AND DATUM: bgs 7.00 ft.	TOTAL DEPTH: 10.0 ft. bgs
DATE STARTED: 10/7/14	DATE COMPLETED: 10/7/14
INITIAL WATER DEPTH (FT): 6.5	
LOGGED BY: DKM	
SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3					0.0		SW	**Well-graded SAND with gravel** Medium brown, sandy fill with up to 40% gravel, <10% silt, moderately dense, slightly moist, no odor, no sheen.
								SP	**Poorly graded SAND with gravel** Orange/brown, medium to fine sand with 10-15% gravel, <10% silt, moderately dense, moist, no odor, no sheen.
				B53-4-5		0.0			**Silty SAND with gravel** Dark gray, silty sand with ~15-20% gravel, moderately dense, moist to wet, no odor, no sheen.
			5						
SS	2					0.0		SM	
								Wood	**WOOD DEBRIS (lower wood fill)** Gray to gray/brown, blocky wood debris with 5-15% silty matrix coating wood surfaces, wet, no odor, possible light sheen below ~9' bgs otherwise no sheen.
			10						

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: Northeast of B36 Simpson Property	**Boring Name:** B54
DRILLING COMPANY: ESN	DRILLER: Noel
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch
ISOLATION CASING: N/A	FROM N/A TO N/A FT.
BLANK CASING: N/A	FROM N/A TO N/A FT.
SLOTTED CASING: N/A	FROM N/A TO N/A FT.
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.
SEAL: Bentonite Granules	FROM 0 TO 10 FT.
GROUT: N/A	FROM N/A TO N/A FT.
Project Name: Former Tacoma Metals	
Project Number: 996098*00	
ELEVATION AND DATUM: bgs 10.30 ft.	TOTAL DEPTH: 10.0 ft. bgs
DATE STARTED: 10/7/14	DATE COMPLETED: 10/7/14
INITIAL WATER DEPTH (FT): 8.5	
LOGGED BY: DKM	
SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3		0			0.0		SW	**Well-graded SAND with gravel** Brown, sandy fill with up to 40% gravel, <10% silt, moderately dense, slightly moist, no odor, no sheen.
						0.0		Wood	**WOOD DEBRIS (upper wood fill)** Brown/orange, wood fill (chips/sawdust/shavings), no soil matrix, moderately loose, moist, no odor, no sheen.
			5						Angular crushed rock or concrete in sampler tip (below ~4.8' bgs)
SS	1.5			B54-6-7		0.2		SP/ SM	**Poorly graded SAND with silt and gravel** Dark gray to dark brown, sand with 10-20% silt and 10-15% gravel, some wood debris, moderately loose, moist to wet, slight odor, no sheen.
						0.0		Wood	**WOOD DEBRIS (lower wood fill)** Brown to gray, blocky wood debris with 5-15% silty matrix (varies locally), wet, no odor, no sheen.
			10						

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: East of B36 Simpson Property		**Boring Name**	B55
DRILLING COMPANY: ESN	DRILLER: Noel	**Project Name**	Former Tacoma Metals
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number**	996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 10.50 ft.	TOTAL DEPTH: 12.0 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/7/14	DATE COMPLETED: 10/7/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 10.0	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 12 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3.5					0.0		SW	**Well-graded SAND with gravel** Gray/brown to medium brown, sand with 40-45% gravel, minor silt, fill, moderately dense, slightly moist, no odor, no sheen.
						0.0		Wood	**WOOD DEBRIS (upper wood fill)** Orange/brown, wood fill (chips/sawdust/shavings), no soil matrix, moderately loose, moist, no odor, no sheen.
				B55-4-5		0.0			**Poorly graded SAND with silt and gravel** Dark brown (above ~7 feet bgs) to dark gray, sand with up to 20% silt, 5-10% gravel, >10% red/brown wood debris below ~7 feet bgs, moderately loose, moist to wet, slight odor and light sheen below ~7 feet bgs.
			5						
SS	2.5			B55-7.5-9		0.0		SP/ SM	
						0.0			
			10						
SS	1			B55-10-12		0.0		Wood	**WOOD DEBRIS (lower wood fill)** Brown, wood debris with 10-20% silty matrix overall (varies locally), wet, slight odor and light sheen.

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: Southeast of B36 Simpson Property		**Boring Name**	B56
DRILLING COMPANY: ESN	DRILLER: Noel	**Project Name**	Former Tacoma Metals
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number**	996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 10.10 ft.	TOTAL DEPTH: 15.0 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/7/14	DATE COMPLETED: 10/7/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 9.0	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 15 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3.5					0.1		SW	**Well-graded SAND with gravel** Brown/tan, sandy fill with >40% gravel, some silt, moderately dense, slightly moist, no odor, no sheen.
								Wood	**WOOD DEBRIS (upper wood fill)** Orange/brown, wood fill (chips/sawdust/shavings), no soil matrix, moderately loose, moist, no odor, no sheen.
						0.0		ML	**SILT with sand (with wood debris)** Dark brown, silt with >50% red/brown woody material, moderately soft, moist, no odor, no sheen.
			5						
SS	3			B56-7-8.5		0.8		SM	**Silty SAND** Dark gray, silty sand with some gravel, some wood debris, moderately loose, moist to wet, slight to moderate odor, light sheen.
						0.0			**WOOD DEBRIS (lower wood fill)** Gray, wood debris with 20-30% silty matrix overall (varies locally), wet, no odor, very light sheen.
			10						
SS	3			B56-13-14		0.0		Wood	
			15						

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: South of B36 Simpson Property	**Boring Name:** B57
DRILLING COMPANY: ESN	DRILLER: Noel
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch
ISOLATION CASING: N/A	FROM N/A TO N/A FT.
BLANK CASING: N/A	FROM N/A TO N/A FT.
SLOTTED CASING: N/A	FROM N/A TO N/A FT.
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.
SEAL: Bentonite Granules	FROM 0 TO 15 FT.
GROUT: N/A	FROM N/A TO N/A FT.
Project Name: Former Tacoma Metals	
Project Number: 996098*00	
ELEVATION AND DATUM: bgs 9.90 ft.	TOTAL DEPTH: 15.0 ft. bgs
DATE STARTED: 10/7/14	DATE COMPLETED: 10/7/14
INITIAL WATER DEPTH (FT): 8.5	
LOGGED BY: DKM	
SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	2.5					0.0		SW	**Well-graded SAND with gravel** Tan/brown, sandy fill with gravel, some silt, moderately dense, slightly moist, no odor, no sheen.
						0.3		Wood	**WOOD DEBRIS (upper wood fill)** Orange/brown, wood fill (chips/sawdust/shavings), up to 10% silty soil matrix, moderately loose, moist, faint odor, no sheen.
						1.0			
						84.6		Wood	**WOOD DEBRIS (blocky wood, no matrix)** Dark brown/gray, blocky wood with oily (stained) appearance, strong odor, heavy sheen.
			5			3.4		SM	**Silty SAND with gravel** Dark brown to dark gray, sand with >30% silt, some gravel, some wood debris, moist to wet, slight odor, light to medium sheen.
SS	3.5			B57-7.5-8.5		2.5			
			10	B57-9-12		24.7			**WOOD DEBRIS (lower wood fill)** Gray/silver, wood debris with 10-15% silty matrix (varies locally) between and coating wood material, soft matrix, wet, stong odor, heavy sheen, small NAPL blebs locally.
						73.3		Wood	
SS	4					15.6			
			15						

KJ PNW WK DRAFT B36 AREA BORING LOGS OCT 2014.GPJ KJ PNW.GDT 1/6/15

F-40.1
(6-87) (3-88) (8-90)

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: Southwest of B36 Simpson Property		**Boring Name**	B58
DRILLING COMPANY: ESN	DRILLER: Noel	**Project Name**	Former Tacoma Metals
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number**	996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 9.30 ft.	TOTAL DEPTH: 20.0 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/7/14	DATE COMPLETED: 10/7/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 8.0	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 20 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	2.5		0			0.1		SW	**Well-graded SAND with gravel** Brown, sandy fill with <30% gravel and some silt, moderately dense, slightly moist, no odor, no sheen.
								GP	**Poorly graded GRAVEL** Gray, crushed rock or concrete, no odor, no sheen.
								ML	**SILT with sand (with wood debris)** Orange/brown, sandy silt with >50% wood (chips/sawdust/shavings) debris, moderatley soft, moist, no odor, no sheen.
			5	B58-4-5		1.2			
SS	3.5			B58-7.5-8.5	▽	0.4		SP/ SM	**Poorly graded SAND with silt and gravel** Dark gray, sand with 10-15% silt and some gravel, moderately loose, moist to wet, faint odor, light sheen.
			10			4.0			**WOOD DEBRIS (lower wood fill)** Gray/silver to dark gray (varies locally), blocky wood debris with 5-10% silty matrix (varies locally) coating wood surfaces, wet, moderate to strong odor, medium to heavy sheen, NAPL blebs locally below ~16 feet bgs.
SS	3.5					34.7			
						39.0		Wood	
			15			5.6			
SS	3.5					31.8			
						52.1			
			20			74.3			

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: North of B36 JJ Port Property		**Boring Name**	B59
DRILLING COMPANY: ESN	DRILLER: Noel	**Project Name**	Former Tacoma Metals
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number**	996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 6.60 ft.	TOTAL DEPTH: 9.5 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/8/14	DATE COMPLETED: 10/8/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 7.0	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 9.5 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	2							SW	**Well-graded SAND with gravel** Brown, sandy fill with gravel and some silt, moderately dense, slightly moist, no odor, no sheen.
				B59-3.5-4.5		0.1		SP/ SM	**Poorly graded SAND with silt** Dark brown to dark gray, sand with >10% silt, some gravel, some brick fragments (orange/brown appearance) locally, moderately dense, moist, no odor, no sheen.
			5			0.0			
SS	2					0.2		Wood	**WOOD DEBRIS (lower wood fill)** Gray, blocky to fibrous wood debris with 10-15% silty matrix (varies locally) decreasing to <10% below ~7 feet bgs, wet, no odor, no sheen.
						0.0			

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: Southwest of B36 JJ Port Property		**Boring Name**	B60
DRILLING COMPANY: ESN	DRILLER: Noel	**Project Name**	Former Tacoma Metals
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number**	996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 7.30 ft.	TOTAL DEPTH: 16.0 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/8/14	DATE COMPLETED: 10/8/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 8.5	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 16 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	1					0.5		SW	**Well-graded SAND with gravel** Brown, sandy fill with gravel and some silt, moderately dense, slightly moist, no odor, no sheen.
			5	B60-4.5-5		0.2		SM	**Silty SAND with gravel** Dark brown to dark gray, silty sand with up to 20% gravel, moderately loose, moist, faint odor, very light sheen.
SS	2.5					0.1			**WOOD DEBRIS (lower wood fill)** Brown to gray-brown (below ~9 feet bgs, sharp color change), blocky to fibrous wood debris with 10-15% silty matrix (varies locally), moist to wet, no odor, no sheen above ~9 feet bgs, strong odor and heavy sheen below ~9 feet bgs, NAPL blebs on water surface in sampler 15-16 feet bgs.
			10			1.2		Wood	
SS	2			B60-9-15		1.9			
			15			3.7			
SS	<1					1.2			

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: Southwest of B36 JJ Port Property		**Boring Name**	B61
DRILLING COMPANY: ESN	DRILLER: Noel	**Project Name**	Former Tacoma Metals
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number**	996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 9.20 ft.	TOTAL DEPTH: 15.0 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/8/14	DATE COMPLETED: 10/8/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 9.5	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 15 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	1		0		Bentonite Granules	0.1		GW	**Well-graded GRAVEL with sand** Brown/tan to orange/brown, gravel fill with >40% sand, some silt, moderately dense, slightly moist to moist, no odor, no sheen.
SS	3		5	B61-7-8		0.0 0.1		ML	**SILT (with wood debris)** Dark brown to brown/orange, silt with up to 75% woody material, moderately soft, moist, faint odor, no sheen.
						0.2 0.5		Wood	**WOOD DEBRIS (lower wood fill)** Brown/gray, wood debris with 10-15% silty matrix (varies locally), moist to wet, faint odor, light sheen starting below ~9 feet bgs.
SS	3.5		10	B61-13-14		5.9 1.2		ML	In upper part of 10-15' sample (~11-13 feet bgs); loose, wet gravel and sand present in matrix with strong odor, heavy sheen, and small NAPL blebs locally. **Sandy SILT** Brown, sandy silt, moderately stiff, wet, slight odor, light sheen.
			15			0.9 0.2		SP	**Poorly graded SAND** Brown, medium to fine sand, moderately dense, wet, slight odor, light sheen.

KJ PNW WK DRAFT B36 AREA BORING LOGS OCT 2014.GPJ KJ PNW.GDT 1/6/15

F-40.1
(6-87) (3-88) (8-90)

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: West of B36 JJ Port Property		**Boring Name**	B62
DRILLING COMPANY: ESN	DRILLER: Noel	**Project Name**	Former Tacoma Metals
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number**	996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 7.50 ft.	TOTAL DEPTH: 15.0 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/8/14	DATE COMPLETED: 10/8/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 9.0	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 15 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3		0			0.0		SW	**Well-graded SAND with gravel** Brown, sandy fill with up to 40% gravel, some silt, minor brick debris, moderately dense, slightly moist, no odor, no sheen.
			5	B62-4-5		0.0			**Silty SAND with gravel** Dark brown, silty sand with 10-15% gravel, some wood debris, moderately loose, moist to wet, no odor, no sheen.
SS	2.5			B62-8-9		0.1		SM	
			10			0.0			**WOOD DEBRIS (lower wood fill)** Brown to gray/brown, blocky to fibrous wood debris, 10-15% silty matrix (varies locally), wet, no odor, no sheen.
SS	1							Wood	
			15			0.0			

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F-40.1
(6-87) (3-88) (8-90)

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: Southwest of B36 JJ Port Property	**Boring Name:** B63
DRILLING COMPANY: ESN	DRILLER: Noel
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch
	Project Name: Former Tacoma Metals
	Project Number: 996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.
BLANK CASING: N/A	FROM N/A TO N/A FT.
SLOTTED CASING: N/A	FROM N/A TO N/A FT.
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.
SEAL: Bentonite Granules	FROM 0 TO 15 FT.
GROUT: N/A	FROM N/A TO N/A FT.
ELEVATION AND DATUM: bgs 9.00 ft.	TOTAL DEPTH: 15.0 ft. bgs
DATE STARTED: 10/8/14	DATE COMPLETED: 10/8/14
INITIAL WATER DEPTH (FT): 9.5	
LOGGED BY: DKM	
SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	2		0–5	B63-4-5		0.0		SW	**Well-graded SAND with gravel** Brown to gray (below ~3 feet bgs), sandy fill with gravel and some silt, moderately dense, slightly moist, no odor, no sheen.
								SP	**Poorly graded SAND with gravel** Brownish gray, sand to fine gravel sized granular fill, some wood chips, moderately dense, slightly moist, no odor, no sheen.
SS	3		5–10			0.0		ML	**SILT (with wood debris)** Brown, silt with up to 80% soft woody debris, moderately soft, moist, no odor, no sheen.
						0.4		Wood	**WOOD DEBRIS (lower wood fill)** Brown to gray, blocky wood debris, <5% silty matrix, moist to wet, no odor, no sheen.
SS	4.5		10–15	B63-10.5-11.5		0.0		GP	**Poorly graded GRAVEL with sand** Brown, gravel (fine grains) with ~40% medium to coarse sand, some silt, loose, wet, faint odor, light sheen.
								ML	**Sandy SILT** Brown, sandy silt, soft at top grading downward to moderately stiff, wet, faint odor and light sheen in upper few inches, otherwise no odor and no sheen.
						0.0		SP	**Poorly graded SAND** Medium gray, poorly graded medium to coarse sand, some silt locally in small nodules, moderately dense, wet, no odor, no sheen.

KJ PNW WK DRAFT B36 AREA BORING LOGS OCT 2014.GPJ KJ PNW.GDT 1/6/15

F-40.1
(6-87) (3-88) (8-90)

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: South of B36 Simpson Property	**Boring Name:** B64
DRILLING COMPANY: ESN	DRILLER: Noel
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch
ISOLATION CASING: N/A	FROM N/A TO N/A FT.
BLANK CASING: N/A	FROM N/A TO N/A FT.
SLOTTED CASING: N/A	FROM N/A TO N/A FT.
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.
SEAL: Bentonite Granules	FROM 0 TO 15 FT.
GROUT: N/A	FROM N/A TO N/A FT.
Project Name: Former Tacoma Metals	
Project Number: 996098*00	
ELEVATION AND DATUM: bgs 9.60 ft.	TOTAL DEPTH: 15.0 ft. bgs
DATE STARTED: 10/8/14	DATE COMPLETED: 10/8/14
INITIAL WATER DEPTH (FT): 10.0	
LOGGED BY: DKM	
SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	2					0.0		SW	**Well-graded SAND with gravel** Brown, sandy fill with gravel and some silt, moderately dense, slightly moist, no odor, no sheen.
						0.0		SP	**Poorly graded SAND with gravel** Gray, medium to coarse sand, minor gravel, moderately dense, moist, faint odor, no sheen.
SS	3.5		5	B64-7.5-8.5		1.5		ML	**SILT (with wood debris)** Brown, silt with up to 70% soft woody debris, moderately soft, moist to wet, faint odor, light sheen.
						3.4			
			10			13.4		Wood	**WOOD DEBRIS (lower wood fill)** Greenish-brown to orange-brown, blocky wood debris, ~5% silty matrix, wet, moderate odor, medium sheen.
SS	3.5					10.9		GP	**Poorly graded GRAVEL with sand** Gray, angular gravel (small fragments) with ~30% sand, some silt, wet, strong odor, heavy sheen, small NAPL blebs locally.
						44		Wood	
				B64-14-15		7.6		ML	**WOOD DEBRIS (lower wood fill)** Brown to dark gray, wood debris with 10-15% silty matrix (varies locally), wet, moderate odor, heavy sheen.
			15			3.4		SP	**Sandy SILT** Brown, sandy silt, moderately stiff, wet, slight odor, light sheen. **Poorly graded SAND** Gray, poorly graded medium sand, moderately dense, wet, slight odor, light sheen.

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F-40.1
(6-87) (3-88) (8-90)

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: South of B36 Simpson Property	**Boring Name:** B65
DRILLING COMPANY: ESN	DRILLER: Noel
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch
	Project Name: Former Tacoma Metals
	Project Number: 996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.
BLANK CASING: N/A	FROM N/A TO N/A FT.
SLOTTED CASING: N/A	FROM N/A TO N/A FT.
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.
SEAL: Bentonite Granules	FROM 0 TO 20 FT.
GROUT: N/A	FROM N/A TO N/A FT.
ELEVATION AND DATUM: bgs 9.80 ft.	TOTAL DEPTH: 20.0 ft. bgs
DATE STARTED: 10/8/14	DATE COMPLETED: 10/8/14
INITIAL WATER DEPTH (FT): 9.0	
LOGGED BY: DKM	
SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	2.5					0.0		SW	**Well-graded SAND with gravel** Brown, sandy fill with gravel and some silt, moderately dense, slightly moist, no odor, no sheen.
						0.8		Wood	**WOOD DEBRIS (upper wood fill)** Orange/brown, wood fill (chips/sawdust/shavings), no soil matrix, moderately loose, moist, no odor, no sheen.
				B65-3.5-4.5		0.1		SM	
			5			0.0			**Silty SAND with gravel** Dark gray, silty sand with some gravel, moderately dense, moist, faint odor, no sheen.
								SP/ SM	**Poorly graded SAND with silt** Medium gray, medium sand with ~5-10% silt, moderately dense, moist, no odor, no sheen.
SS	3							SP	**Poorly graded SAND with gravel** Brown, medium to coarse sand with ~10-15% gravel, moist to wet, no odor, no sheen.
				B65-8-9		0.2			
						18.3			**WOOD DEBRIS (lower wood fill)** Dark brown (upper ~6 inches) to medium brown (above ~9.5 feet bgs) to medium gray (below ~9.5 feet bgs), wood debris with 10-15% silty matrix (varies locally), wet, moderate oder and medium to heavy sheen below ~9.5 feet bgs.
			10						
SS	2							Wood	
						3.3			
						10.9			
			15						
						5.2			
								GP	**Poorly graded GRAVEL with sand** Gray, gravel (fine grains) with >30% sand, wet, slight odor, light sheen.
SS	4			B65-17-18		3.5			
								SP	**Poorly graded SAND** Gray, poorly graded medium sand, moderately dense, wet, slight odor, light sheen.
						2.9			
			20						

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F-40.1
(6-87) (3-88) (8-90)

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: Southeast of B36 Simpson Property	**Boring Name:** B66
DRILLING COMPANY: ESN	DRILLER: Noel
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch
ISOLATION CASING: N/A	FROM N/A TO N/A FT.
BLANK CASING: N/A	FROM N/A TO N/A FT.
SLOTTED CASING: N/A	FROM N/A TO N/A FT.
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.
SEAL: Bentonite Granules	FROM 0 TO 15 FT.
GROUT: N/A	FROM N/A TO N/A FT.
Project Name: Former Tacoma Metals	
Project Number: 996098*00	
ELEVATION AND DATUM: bgs 10.10 ft.	TOTAL DEPTH: 15.0 ft. bgs
DATE STARTED: 10/8/14	DATE COMPLETED: 10/8/14
INITIAL WATER DEPTH (FT): 9.0	
LOGGED BY: DKM	
SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	2		0			1.3		SW	**Well-graded SAND with gravel** Brown, sandy fill with gravel and some silt, moderately dense, slightly moist, no odor, no sheen.
						2.8		Wood	**WOOD DEBRIS (blocky wood, no matrix)** Blocky wood with no matrix material, moist, slight odor, light sheen.
			5			14.0		SW	**Well-graded SAND with gravel** Brown, sandy fill with gravel and some silt, moderately dense, slightly moist, no odor, no sheen.
SS	2.5			B66-8-9		0.5		SM	**Silty SAND with gravel** Brown, sandy silt with some gravel, some wood debris, moderately loose, moist to wet, faint odor, no sheen.
						1.1			
			10			2.7			**WOOD DEBRIS (lower wood fill)** Brown to gray, wood debris with 5-15% silty matix (varies locally), wet, moderate to strong odor, medium to heavy sheen, NAPL blebs locally on water surface in 10-15 foot sampler but not observed on wood/silt surfaces.
SS	3					38.9		Wood	
						22.6			
			15			29.0			

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F-40.1
(6-87) (3-88) (8-90)

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: Southeast of B36 Simpson Property	**Boring Name:** B67
DRILLING COMPANY: ESN	DRILLER: Noel
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch
ISOLATION CASING: N/A	FROM N/A TO N/A FT.
BLANK CASING: N/A	FROM N/A TO N/A FT.
SLOTTED CASING: N/A	FROM N/A TO N/A FT.
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.
SEAL: Bentonite Granules	FROM 0 TO 15 FT.
GROUT: N/A	FROM N/A TO N/A FT.
Project Name: Former Tacoma Metals	
Project Number: 996098*00	
ELEVATION AND DATUM: bgs 10.10 ft.	TOTAL DEPTH: 15.0 ft. bgs
DATE STARTED: 10/8/14	DATE COMPLETED: 10/8/14
INITIAL WATER DEPTH (FT): 8.5	
LOGGED BY: DKM	
SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3		0			0.0		SW	**Well-graded SAND with gravel** Tan/brown, sandy fill with gravel, some silt, moderately dense, slightly moist, no odor, no sheen.
						0.0		Wood	**WOOD DEBRIS (upper wood fill)** Orange (above ~3.5 feet bgs) to brown (below ~3.5 feet bgs), wood fill (chips/shavings/sawdust), no soil matrix, modetetely loose, moist, faint odor and light sheen at ~4 to 4.5 feet bgs, otherwise no odor, no sheen.
			5	B67-4-5		0.0			
SS	3					2.2		SM	**Silty SAND** Dark gray, silty fine sand with up to 20% soft wood material, moderatly loose, moist to wet, faint odor, light sheen.
				B67-8-9		0.0			
			10			0.0		ML	**SILT (with wood debris)** Gray, silt with up to 40% wood debris, moderately soft, wet, faint odor and light sheen locally.
				B67-9-13					
SS	3							Wood	**WOOD DEBRIS (lower wood fill)** Gray/brown, blocky to fibrous wood debris with 5-15% silty matrix (varies locally), wet, faint odor, very light sheen.
			15						

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: Southeast of B36 Simpson Property		**Boring Name**	B68
DRILLING COMPANY: ESN	DRILLER: Noel	**Project Name**	Former Tacoma Metals
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number**	996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 10.40 ft.	TOTAL DEPTH: 15.0 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/8/14	DATE COMPLETED: 10/8/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 9.0	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 15 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3		0			0.0		SW	**Well-graded SAND with gravel** Tan/brown, sandy fill with gravel and some silt, moderately dense, slightly moist, no odor, no sheen.
						0.2		Wood	**WOOD DEBRIS (upper wood fill)** Orange to brown-orange, wood fill (chips/sawdust/shavings), no soil matrix, moderately loose, moist, faint odor in lower few inches, otherwise no odor, no sheen.
			5	B68-4-5		0.0		SM	**Silty SAND with gravel** Dark gray, silty sand with some gravel, moderately loose, moist, faint odor, no sheen.
SS	3					0.0		GW	**Well-graded GRAVEL with sand** Tan/brown, sandy gravel, moderately loose, moist, faint odor, no sheen.
						0.0		SM	**Silty SAND** Gray, silty fine to medium sand, some wood debris, moderately loose, moist to wet, no odor, no sheen.
			10			0.0		Wood	**WOOD DEBRIS (lower wood fill)** Brown (upper ~2 feet) to dark gray, blocky to fibrous wood debris with 10-15% silty matrix (varies locally), wet, no odor and no sheen above ~11 feet bgs, strong odor and medium sheen below ~11 feet bgs.
SS	3					50.3			
						37.2			
						2.2			
				B68-13.5-15		2.6		SP	**Poorly graded SAND** Gray, poorly graded medium sand, minor silt, moderately dense, wet, slight to moderate odor, light sheen.
			15			4.3			

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: South of B36 Simpson Property		**Boring Name**	B69
DRILLING COMPANY: ESN	DRILLER: Noel	**Project Name**	Former Tacoma Metals
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number**	996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 9.80 ft.	TOTAL DEPTH: 15.0 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/8/14	DATE COMPLETED: 10/8/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 8.5	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 15 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3		0			0.5		SW	**Well-graded SAND with gravel** Tan/brown, sandy fill with gravel and some silt, moderately dense, slightly moist, no odor, no sheen.
				B69-3.5-4.5		1.2		SM	**Silty SAND with gravel** Dark gray, silty sand with some gravel, moderately loose, moist, faint odor, no sheen.
			5			8.0			**WOOD DEBRIS (lower wood fill)** Dark gray, blocky wood debris with 10-15% silty matrix (varies locally), moist, moderate odor, medium sheen.
SS	3					23.7		Wood	
				B69-8.5-9.5		12.2			**Silty SAND (with wood debris)** Dark gray to dark brown/gray, silty sand with some gravel locally, up to 30% block to fibrous wood debris, moist to wet, moderate odor, medium to heavy sheen.
			10			8.5		SM	
SS	4.5			B65-12.5-13.5		8.8			
						23.5			
						3.5		ML	**SILT** Brown, silt, some fine root-like material, moderately stiff, wet, moderate odor, medium sheen.
						20.3		SP	**Poorly graded SAND** Dark gray, poorly graded medium sand, moderately dense, wet, strong odor, heavy sheen, NAPL blebs present.
			15			10.7			
						14.7			

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: North of B36 JJ Port Property	**Boring Name:** B70
DRILLING COMPANY: ESN	DRILLER:
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch
Project Name: Former Tacoma Metals	
Project Number: 996098*00	
ISOLATION CASING: N/A	FROM N/A TO N/A FT.
BLANK CASING: N/A	FROM N/A TO N/A FT.
SLOTTED CASING: N/A	FROM N/A TO N/A FT.
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.
SEAL: Bentonite Granules	FROM 0 TO 10 FT.
GROUT: N/A	FROM N/A TO N/A FT.
ELEVATION AND DATUM: bgs 7.20 ft.	TOTAL DEPTH: 10.0 ft. bgs
DATE STARTED: 10/30/14	DATE COMPLETED: 10/30/14
INITIAL WATER DEPTH (FT): 6.5	
LOGGED BY: DKM	
SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3					1.0		GW	**Well-graded GRAVEL with sand** Tan/brown, sandy gravel fill with some silt, moderately dense, slightly moist, no odor, no sheen.
						0		Wood	**WOOD DEBRIS (blocky wood, no matrix)** Brown, blocky wood debris, slight odor, no sheen.
			5	B70-4.5-5				ML	**Gravelly SILT with sand** Dark brown, sandy silt with ~10% woody debris, moderately soft, moist, no odor, no sheen.
SS	2					7.8		Wood	**WOOD DEBRIS (lower wood fill)** Brown, blocky wood fill with 10-15% silty matrix material, slight odor and sheen locally on wood surface above ~9 feet bgs; otherwise no odor, no sheen.
						1.8			
			10						

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: West of B36 Simpson Property	**Boring Name:** B71
DRILLING COMPANY: ESN	DRILLER:
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch
	Project Name: Former Tacoma Metals
	Project Number: 996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.
BLANK CASING: N/A	FROM N/A TO N/A FT.
SLOTTED CASING: N/A	FROM N/A TO N/A FT.
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.
SEAL: Bentonite Granules	FROM 0 TO 15 FT.
GROUT: N/A	FROM N/A TO N/A FT.
ELEVATION AND DATUM: bgs 10.00 ft.	TOTAL DEPTH: 15.0 ft. bgs
DATE STARTED: 10/30/14	DATE COMPLETED: 10/30/14
INITIAL WATER DEPTH (FT): 8.0	
LOGGED BY: DKM	
SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
								SW	**Well-graded SAND with gravel** Brown, sandy fill with gravel and some silt, moderately dense, slightly moist, no odor, no sheen.
SS	3.5					0		GP	**Poorly graded GRAVEL** Gray, angular crushed rock or concrete, no odor, no sheen.
						0		SP	
						0		SM	**Poorly graded SAND** Tan, poorly graded medium sand, minor silt and gravel, moderately loose, moist, no odor, no sheen.
				B71-4-5					
			5					SP/ SM	**Silty SAND with gravel** Dark gray, sand with ~30% silt and 10-15% gravel, moderately dense, moist, no odor, possible light sheen.
						0			**Poorly graded SAND with silt** Dark gray, medium to coarse sand with 10-15% silt, minor gravel, some wood debris locally (<10% overall), moderately loose, moist, no odor, possible light sheen.
SS	3					0		ML	
				B71-8.5-9.5				SM	**Sandy SILT** Tan/brown, sandy silt, moderately stiff, moist to wet, no odor, no sheen.
						0			
			10						**Silty SAND** Tan/brown, fine sand with ~30% silt, moderately dense, wet, no odor, no sheen at top of unit; slight odor and light sheen below ~8.5 feet bgs.
						0			
SS	4							SP	**Poorly graded SAND** Medium gray, poorly graded medium sand, minor silt and gravel, moderately dense, wet, faint odor, no sheen.
				B71-14-15		0			
			15						

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: Southwest of B36 Simpson Property		**Boring Name**	B72
DRILLING COMPANY: ESN	DRILLER:	**Project Name**	Former Tacoma Metals
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number**	996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 10.10 ft.	TOTAL DEPTH: 15.0 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/30/14	DATE COMPLETED: 10/30/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 8.0	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 15 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3		0			0		GW	**Well-graded GRAVEL with sand** Brown to tan, gravel fill with sand and some silt, minor brick-like fragments locally, moderately dense, slightly moist, no odor, no sheen.
			5	B72-4-5		0		SP/ SM	**Poorly graded SAND with silt and gravel** Dark gray, sand with 10-20% silt and up to 10% gravel, some wood debris locally, moderately loose, moist, no odor, no sheen.
SS	4			B72-8-9		0		ML	**Sandy SILT** Tan/brown, silt with 30% fine sand, layered texture, moderately stiff, moist to wet, no odor, no sheen.
			10			0		SP	**Poorly graded SAND** Medium gray, poorly graded medium sand, minor silt and fine gravel locally, moderately dense, wet, faint odor, no sheen.
SS	4.5			B72-13-14		0			
			15						

KJ PNW WK DRAFT B36 AREA BORING LOGS OCT 2014.GPJ KJ PNW.GDT 1/6/15

F-40.1
(6-87) (3-88) (8-90)

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: South of B36 Simpson Property	**Boring Name:** B73
DRILLING COMPANY: ESN / DRILLER:	**Project Name:** Former Tacoma Metals
DRILLING METHOD(S): Direct Push / DRILL BIT(S) SIZE: 2-inch	**Project Number:** 996098*00
ISOLATION CASING: N/A — FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 10.50 ft. / TOTAL DEPTH: 15.0 ft. bgs
BLANK CASING: N/A — FROM N/A TO N/A FT.	DATE STARTED: 10/30/14 / DATE COMPLETED: 10/30/14
SLOTTED CASING: N/A — FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 8.0
SIZE AND TYPE OF FILTER PACK: N/A — FROM N/A TO N/A FT.	LOGGED BY: DKM
SEAL: Bentonite Granules — FROM 0 TO 15 FT.	SAMPLING METHODS: Macrocore w/liner / WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A — FROM N/A TO N/A FT.	

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	2.5		5	B73-3.5-4.5		0		GW	**Well-graded GRAVEL with sand** Brown, gravel fill with sand and some silt, moderately dense, slightly moist, no odor, no sheen.
								Wood	**WOOD DEBRIS (upper wood fill)**
								SM	Red/brown, approximately 2-inch layer of fine wood debris (chips/sawdust/shavings), no matrix, moderately loose, no odor, no sheen.
								SW	**Silty SAND** Dark gray, silty sand with minor gravel, some wood debris locally, moderately loose, moist, no odor, no sheen.
SS	4		10	B73-9-10		0		SM	**Well-graded SAND with gravel** Brown changing to gray in lower 3 inches, medium to coarse sand with 10-20% gravel, moderately dense, moist, no odor, no sheen.
						0			**Silty SAND** Tan/brown, fine sand with ~30% silt, sand content increases with depth, moderately dense, moist to wet, no odor, no sheen.
SS	4		15			0		SP	**Poorly graded SAND** Gray, poorly graded medium sand with 5-10% silt, moderately dense, wet, faint odor below ~14 feet bgs; otherwise no odor, no sheen.

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: South of B36 Simpson Property		**Boring Name:** B74	
DRILLING COMPANY: ESN	DRILLER:	**Project Name:** Former Tacoma Metals	
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number:** 996098*00	
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 9.90 ft.	TOTAL DEPTH: 12.5 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/30/14	DATE COMPLETED: 10/30/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 8.5	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 12.5 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	SAMPLES RECOV. (FEET)	SAMPLES PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3		5					GW	**Well-graded GRAVEL with sand** Gravel fill material; depth uncertain (~3" gravel in sampler above wood fill material), no odor, no sheen.
								Wood	**WOOD DEBRIS (upper wood fill)** Orange/brown changing to medium brown below ~3.5 feet bgs, wood fill (chips/sawdust/shavings), no matrix, moderately loose, moist, no odor, no sheen. At ~4.5 feet bgs, angular rock fragments are mixed with wood material.
SS	2.5			B74-8-9		0		SM	**Silty SAND with gravel** Medium to dark gray, silty sand with some gravel, moderately dense, moist to wet, no odor, no sheen.
SS	1.5		10			6.3		Wood	**WOOD DEBRIS (lower wood fill)** Brown, blocky wood debris with 10-15% gray silty matrix, wet, moderate odor and medium sheen below ~11 feet bgs.

NOTES

1. Refusal at 12.5 feet bgs.

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: South of B36 Simpson Property	**Boring Name:** B75
DRILLING COMPANY: ESN / DRILLER:	**Project Name:** Former Tacoma Metals
DRILLING METHOD(S): Direct Push / DRILL BIT(S) SIZE: 2-inch	**Project Number:** 996098*00
ISOLATION CASING: N/A — FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 10.30 ft. / TOTAL DEPTH: 25.0 ft. bgs
BLANK CASING: N/A — FROM N/A TO N/A FT.	DATE STARTED: 10/30/14 / DATE COMPLETED: 10/30/14
SLOTTED CASING: N/A — FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 8.5
SIZE AND TYPE OF FILTER PACK: N/A — FROM N/A TO N/A FT.	LOGGED BY: DKM
SEAL: Bentonite Granules — FROM 0 TO 25 FT.	SAMPLING METHODS: Macrocore w/liner / WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A — FROM N/A TO N/A FT.	

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	1.5		0						**Fill - Gravel and Wood (sawdust/chips/shavings, without matrix)** Gravel, silty soil with grass and wood debris mixed in top part of sampler, actual depths uncertain (poor sample recovery).
			5	B75-4-7		0		SW	**Well-graded SAND with gravel** Medium gray, sand with ~30% gravel, some silt, moderately dense, moist, no odor, no sheen.
SS	3.5					0			
			10			0		Wood	**WOOD DEBRIS (lower wood fill)** Dark gray (upper ~6 inches) to reddish brown, blocky wood debis with 10-15% matrix (tan/brown to gray/brown silt), moist to wet, no odor, no sheen.
SS	3.5							ML	**Sandy SILT** Brown, sandy silt with 10-20% woody material, moderately soft, wet, no odor, no sheen.
			15			0		SP	**Poorly graded SAND** Gray, poorly graded medium sand, moderately dense, wet, no odor, no sheen.
SS	5					0			
			20						
SS	4							CL/ ML	**Silty CLAY** Tan, silty clay, interbedded with silty fine sand in upper 6 inches, moderately stiff to stiff, moderately high plasticity, wet, no odor, no sheen.
			25						

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: South of B36 Simpson Property	**Boring Name:** B76
DRILLING COMPANY: ESN / DRILLER:	**Project Name:** Former Tacoma Metals
DRILLING METHOD(S): Direct Push / DRILL BIT(S) SIZE: 2-inch	**Project Number:** 996098*00
ISOLATION CASING: N/A — FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 10.30 ft. / TOTAL DEPTH: 15.0 ft. bgs
BLANK CASING: N/A — FROM N/A TO N/A FT.	DATE STARTED: 10/30/14 / DATE COMPLETED: 10/30/14
SLOTTED CASING: N/A — FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 9.0
SIZE AND TYPE OF FILTER PACK: N/A — FROM N/A TO N/A FT.	LOGGED BY: DKM
SEAL: Bentonite Granules — FROM 0 TO 15 FT.	SAMPLING METHODS: Macrocore w/liner / WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A — FROM N/A TO N/A FT.	

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	3.5		0			0		SW	**Well-graded SAND with gravel** Tan/brown, gravel fill with sand, some silt, moderately dense, slightly moist, no odor, no sheen.
								Wood	**WOOD DEBRIS (upper wood fill)** Orange/brown (above ~3.8 feet) changing to to dark brown, wood fill (chips/sawdust/shavings) with no matrix, moderately loose, no odor, no sheen.
			5						
SS	4			B76-8-9		0		SW	**Well-graded SAND with gravel** Gray, gravelly sand, moderately dense, moist, no odor, no sheen.
						0		SP/SM	**Poorly graded SAND with silt and gravel** Dark gray, sand with 10-20% silt and some gravel, some wood material, moderately dense, moist to wet, no odor, no sheen.
			10						**WOOD DEBRIS (lower wood fill)** Brown, blocky wood debris with 10-15% silty matrix, wet, no odor, no sheen in upper portion; light sheen and odor below ~13.5 feet bgs.
SS	1.5			B76-12-14				Wood	Approximately 1 foot thickness of brown, soft, silt recovered in sampler, exact depth uncertain but estimated between 12-14 feet bgs.
			15			0.1			

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(6-87) (3-88) (8-90)

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: Southeast of B36 Simpson Property		**Boring Name**	B77
DRILLING COMPANY: ESN	DRILLER:	**Project Name**	Former Tacoma Metals
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number**	996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 10.20 ft.	TOTAL DEPTH: 11.0 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/30/14	DATE COMPLETED: 10/30/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 9.0	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 11 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	SAMPLES RECOV. (FEET)	SAMPLES PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	2							GW	**Well-graded GRAVEL with sand** Brown, gravel fill with sand and some silt, no odor, no sheen.
						0		Wood	**WOOD DEBRIS (upper wood fill)** Brown/orange (above ~3.5 feet bgs) to dark brown, wood debris (chips/sawdust/shavings) with no matrix, moderately loose, no odor, no sheen.
			5						
SS	3			B75-7.5-8.5		0.8		SM	**Silty SAND with gravel** Dark gray, silty sand with some gravel, minor wood debris locally, moderately soft to moderately dense (varies locally), moist to wet, slight to moderate odor, medium sheen.
						0.2		Wood	**WOOD DEBRIS (lower wood fill)** Brown, blocky wood debris with 10-20% sitly matrix, wet, no odor, no sheen.
			10						
SS	1								

NOTES

1. Refusal at 11 feet bgs.

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: East of B36 Simpson Property	**Boring Name:** B78
DRILLING COMPANY: ESN	DRILLER:
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch
Project Name: Former Tacoma Metals	
Project Number: 996098*00	
ISOLATION CASING: N/A	FROM N/A TO N/A FT.
BLANK CASING: N/A	FROM N/A TO N/A FT.
SLOTTED CASING: N/A	FROM N/A TO N/A FT.
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.
SEAL: Bentonite Granules	FROM 0 TO 15 FT.
GROUT: N/A	FROM N/A TO N/A FT.
ELEVATION AND DATUM: bgs 10.60 ft.	TOTAL DEPTH: 15.0 ft. bgs
DATE STARTED: 10/30/14	DATE COMPLETED: 10/30/14
INITIAL WATER DEPTH (FT): 9.5	
LOGGED BY: DKM	
SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	2.5		0			0		GW	**Well-graded GRAVEL with sand** Gravel fill with sand and some silt (suspected based on ground surface, but not recovered in sampler).
			5					Wood	**WOOD DEBRIS (upper wood fill)** Brown/orange (above ~4.5 feet bgs) changing to dark brown, wood debris (chips/sawdust/shavings) with no matrix, moderately loose, no odor, no sheen.
SS	3			B78-7.5-9		0		SM	**Silty SAND** Dark brown to dark gray, silty sand with 10-15% wood debris, moderately loose, moist to wet, no odor, no sheen.
			10					Wood	**WOOD DEBRIS (lower wood fill)** Brown, wood debris with 20-30% silty matrix (varies locally), wet, medium to heavy sheen and medium odor below ~9.5 feet bgs.
SS	2.5			B78-14-15		0		ML	**SILT (with wood debris)** Brown with silvery appearance locally, silt with up to 30% wood debris, soft, wet, medium to heavy sheen, medium odor.
			15						

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(6-87) (3-88) (8-90)

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: East of B36 Simpson Property		**Boring Name**	B79
DRILLING COMPANY: ESN	DRILLER	**Project Name**	Former Tacoma Metals
DRILLING METHOD(S): Direct Push	DRILL BIT(S) SIZE: 2-inch	**Project Number**	996098*00
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 10.80 ft.	TOTAL DEPTH: 15.0 ft. bgs
BLANK CASING: N/A	FROM N/A TO N/A FT.	DATE STARTED: 10/30/14	DATE COMPLETED: 10/30/14
SLOTTED CASING: N/A	FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 9.3	
SIZE AND TYPE OF FILTER PACK: N/A	FROM N/A TO N/A FT.	LOGGED BY: DKM	
SEAL: Bentonite Granules	FROM 0 TO 15 FT.	SAMPLING METHODS: Macrocore w/liner	WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A	FROM N/A TO N/A FT.		

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	5					0.3		SW	**Well-graded SAND with gravel** Brown, fill gravel with sand, <10% silt, moderately dense, slightly moist, no odor, no sheen.
								Wood	**WOOD DEBRIS (upper wood fill)** Orange/brown, wood debris (chips/sawdust/shavings) with no matrix, moderately loose, no odor, no sheen.
			5			0			
						0		SM	**Silty SAND with gravel** Brown, sitly sand with some gravel and wood debris, moderately loose, moist, no odor, no sheen.
SS	5			B79-7.5-8.5		0		SP/ SM	**Poorly graded SAND with silt** Dark gray, sand with 10-15% silt, some wood debris, minor gravel, moderately loose, moist to wet, no odor, no sheen.
			10			0			**Sandy SILT (with wood debris)** Brown, sandy silt with 20-30% wood debris overall (varies locally), soft, wet, slight to moderate odor locally, light sheen.
SS	5			B79-12-14		0		ML	
						0			
			15			0.4		SP	**Poorly graded SAND** Medium gray, poorly graded medium sand, moderately dense, wet, heavy sheen and medium odor.

Boring Log

Kennedy/Jenks Consultants

BORING LOCATION: Southeast of B36 Simpson Property	**Boring Name** B80
DRILLING COMPANY: ESN / DRILLER:	**Project Name** Former Tacoma Metals
DRILLING METHOD(S): Direct Push / DRILL BIT(S) SIZE: 2-inch	**Project Number** 996098*00
ISOLATION CASING: N/A — FROM N/A TO N/A FT.	ELEVATION AND DATUM: bgs 10.10 ft. / TOTAL DEPTH: 15.0 ft. bgs
BLANK CASING: N/A — FROM N/A TO N/A FT.	DATE STARTED: 10/30/14 / DATE COMPLETED: 10/30/14
SLOTTED CASING: N/A — FROM N/A TO N/A FT.	INITIAL WATER DEPTH (FT): 8.0
SIZE AND TYPE OF FILTER PACK: N/A — FROM N/A TO N/A FT.	LOGGED BY: DKM
SEAL: Bentonite Granules — FROM 0 TO 15 FT.	SAMPLING METHODS: Macrocore w/liner / WELL COMPLETION: ☐ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: N/A — FROM N/A TO N/A FT.	

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	BACKFILL DETAILS	PID	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SS	2.5		5	B80-4-5		0		SP	**Poorly graded SAND** Dark gray, medium to coarse sand, minor gravel, ~10% wood chips, moderately loose, moist, no odor, no sheen. 1.5 inch angular rock fragment with orange wood fill (no matrix).
SS	2.5		10	B80-8-9		0		SP/ SM	**Poorly graded SAND with silt** Medium brown to gray/brown, medium sand with 10-20% silt, some wood debris locally, moderately dense, moist to wet, no odor, no sheen.
						0		Wood	**WOOD DEBRIS (lower wood fill)** Brown, blocky wood debris with 10-15% soft brown silt matrix, wet, no odor, no sheen.
SS	4		15	B80-12-13		0		SP/ SM	**Poorly graded SAND with silt** Brown, medium to coarse sand with 15-20% silt, minor gravel, moderately dense, wet, light sheen locally, no odor.
						0		ML	**SILT (with wood debris)** Brown, silt with 50-70% wood debris, soft, wet, faint odor and light sheen locally.

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F-40.1
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Appendix B
Analytical Laboratory Reports

ALS Environmental
ALS Group USA, Corp
1317 South 13th Avenue
Kelso, WA 98626
T: 1-360-577-7222
F: 1-360-636-1068
www.alsglobal.com

November 10, 2014

Analytical Report for Service Request No: K1411111

Paul Kalina
URS Corporation
1501 4th Ave.,Suite 1400
Seattle, WA 98101

RE: IP Tacoma Metals/33764085

Dear Paul:

Enclosed are the results of the sample(s) submitted to our laboratory on October 9, 2014. For your reference, these analyses have been assigned our service request number **K1411111**.

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Environmental is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3375. You may also contact me via email at Janet.Malloch@alsglobal.com.

Respectfully submitted,

ALS Group USA Corp. dba ALS Environmental

Janet Malloch
Project Manager

ALS ENVIRONMENTAL

Client:	URS Corporation	**Service Request No.:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Received:**	10/09/14
Sample Matrix:	Soil		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier IV validation deliverables including summary forms and all of the associated raw data for each of the analyses. When appropriate to the method, method blank results have been reported with each analytical test.

Sample Receipt

Five soil samples were received for analysis at ALS Environmental on 10/09/14. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

General Chemistry Parameters

No anomalies associated with the analysis of these samples were observed.

Diesel and Residual Range Organics by NWTPH-Dx

Elevated Detection Limits:
Several samples required dilution due to the presence of elevated levels of non-target analyte. The reporting limits were adjusted to reflect the dilution.

Surrogate Exceptions:
The control criteria for o-Terphenyl or n-Triacontane in several samples were not applicable. The analysis of the samples required a dilution, which resulted in a surrogate concentration below the reporting limit. No further corrective action was appropriate.

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) criterion for the replicate analysis of Residual Range Organics (RRO) in sample was not applicable because the analyte concentration was not significantly greater than the Method Reporting Limit (MRL). Analytical values derived from measurements close to the detection limit are not subject to the same accuracy and precision criteria as results derived from measurements higher on the calibration range for the method.

Sample Notes and Discussion:
The samples did not resemble Stoddard solvent or a petroleum product.

No other anomalies associated with the analysis of these samples were observed.

Gasoline Range Organics by NWTPH-Gx

No anomalies associated with the analysis of these samples were observed.

Approved by: Janet Mallock

Volatile Organic Compounds by EPA Method 8260

Calibration Verification Exceptions:
The following analyte was flagged as outside the control criterion for Continuing Calibration Verification (CCV) MS13\1021F003.D: Chloromethane. In accordance with the EPA Method, 80% or more of the CCV analytes must have passed within 20% of the true value. The remaining analytes are allowed a 40% difference as per the ALS SOP. The CCV met these criteria. No further corrective action was required.

The ALS control criterion for the following analyte was not met in Continuing Calibration Verification (CCV) MS13\1021F003.D: Dichlorodifluoromethane. In accordance with ALS standard operating procedures, an MRL check standard containing the analyte of concern was analyzed each day of analysis. The MRL check standard verifies instrument sensitivity was adequate to detect the analyte at the MRL on the day of analysis. Because the sensitivity was shown to be adequate to detect the compound in question, and the field samples analyzed in this sequence did not contain the analyte in question, the data quality has not been significantly affected. No further corrective action was taken.

No other anomalies associated with the analysis of these samples were observed.

Polynuclear Aromatic Hydrocarbons by EPA Method 8270

Calibration Verification Exceptions:
The following analyte was flagged as outside the control criterion for Continuing Calibration Verification (CCV) MS07\1028F002.D: Fluoranthene. In accordance with the EPA Method, 80% or more of the CCV analytes must have passed within 20% of the true value. The remaining analytes are allowed a 40% difference as per the ALS SOP. The CCV met these criteria. No further corrective action was required.

No other anomalies associated with the analysis of these samples were observed.

Approved by Janet L Mallorh_____

CHAIN OF CUSTODY

ALS Environmental

1317 South 13th Ave., Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

SR# 1411111

PAGE 5 OF 5 COC#

PROJECT NAME: IP-Tacoma Metals
PROJECT NUMBER: 33764085
PROJECT MANAGER: Paul Kalina
COMPANY NAME: URS
ADDRESS: 1501 4th Ave, Ste 1400
CITY/STATE/ZIP: Seattle/WA/98101-3225
E-MAIL ADDRESS: Paul.Kalina@urs.com
PHONE #: 206-438-2172 FAX #: 866-495-5282
SAMPLER'S SIGNATURE: Bret Waldren

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625 ☐ 8270 ☐ SIM PAH ☒	Volatile Organics 624 ☐ 8260 ☐ 8270LL ☐	Hydrocarbons (*see below) Gas ☐ Diesel ☒ Oil ☒	Oil & Grease/TRPH 1664 HEM ☐ 1664 SGT ☐	PCBs Aroclors ☐ Congeners ☐	Pesticides/Herbicides 608 ☐ 8081 ☐ 8141 ☐ 8151 ☐	Chlorophenolics Tri ☐ Tetra ☐ PCP ☐	Metals, Total or Dissolved (See List below)	Cyanide ☐ Hex-Chrom ☐	(circle) pH, Cond., Cl, SO4, PO4, F, NO2, NO3, BOD, TSS, TDS, Turb.	(circle) NH3-N, COD, TKN, TOC, DOC, NO2+NO3, T-Phos	TOX 9020 ☐ AOX 1650 ☐ 506 ☐	Alkalinity ☐ CO3 ☐ HCO3 ☐	Dioxins/Furans 1613 ☐ 8290 ☐	Dissolved Gases RSK 175 ☐ CO2 ☐ Methane ☐ Ethane ☐ Ethene ☐	REMARKS
B-68-S-4-100814	10/8/14	1425		S		X		X													
B-68-S-13.5-100814	↓	1430		↓		X		X													
B-69-S-4.5-100814		1455				X		X													
B-69-S-8.5-100814		1500				X		X													
B-69-S-12.5-100814		1505				X		X													

REPORT REQUIREMENTS

- X I. Routine Report: Method Blank, Surrogate, as required
- ___ II. Report Dup., MS, MSD as required
- ___ III. CLP Like Summary (no raw data)
- ___ IV. Data Validation Report
- ___ V. EDD

INVOICE INFORMATION

P.O. # 33764085
Bill To: Paul Kalina

TURNAROUND REQUIREMENTS

___ 24 hr. ___ 48 hr.
___ 5 day
___ Standard (15 working days)
___ Provide FAX Results
Hold
Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI (NORTHWEST) OTHER: _____ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

Hold upon reciept

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:		RECEIVED BY:		RELINQUISHED BY:		RECEIVED BY:	
Signature:	Date/Time: 10/8/14 1825	Signature: Janet Mallock	Date/Time: 10/8 1830	Signature:	Date/Time:	Signature:	Date/Time:
Printed Name: Bret Waldren	Firm: URS	Printed Name: Janet Mallock	Firm: ALS	Printed Name:	Firm:	Printed Name:	Firm:

PC JM

Cooler Receipt and Preservation Form

Client / Project: URS Service Request *K14* 11111

Received: 10/8/14 Opened: 10/8/14 By: UR Unloaded: 10/9/14 By: AR

1. Samples were received via? *Mail* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other* _____ *NA*
3. Were custody seals on coolers? NA Y N If yes, how many and where? _____
   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected. Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
4.5	4.4	8.8	8.7	-0.1	345			
2.8	2.7	5.5	5.4	-0.1	325			

4. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* _____
5. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
6. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA Y N
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
12. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions: _____

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/8/14
Sample Matrix:	Soil	**Date Received:**	10/9/14
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Solids, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
B-69-S-4.5-100814	K1411111-003	**74.3**	-	1	10/22/14 11:41	
B-69-S-8.5-100814	K1411111-004	**50.6**	-	1	10/22/14 11:41	
B-69-S-12.5-100814	K1411111-005	**79.9**	-	1	10/22/14 11:41	

ALS Group USA, Corp.

dba ALS Environmental

QA/QC Report

Client:	URS Corporation	**Service Request:**	K1411111
Project	IP Tacoma Metals/33764085	**Date Collected:**	10/08/14
Sample Matrix:	Soil	**Date Received:**	10/09/14
		Date Analyzed:	10/22/14

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	B-69-S-12.5-100814	**Units:**	Percent
Lab Code:	K1411111-005	**Basis:**	As Received

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1411111-005DUP Result	Average	RPD	RPD Limit
Solids, Total	160.3 Modified	-	79.9	78.0	79.0	2	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client: URS Corporation **Service Request:** K1411111
Project: IP Tacoma Metals/33764085
Sample Matrix: Soil

Surrogate Recovery Summary
Diesel and Residual Range Organics

Extraction Method: EPA 3550B **Units:** Percent
Analysis Method: NWTPH-Dx **Level:** Low

Sample Name	Lab Code	Sur1	Sur2
B-69-S-4.5-100814	K1411111-003	106 D #	285 D #
B-69-S-8.5-100814	K1411111-004	191 D *	103 D
B-69-S-12.5-100814	K1411111-005	134 D	117 D
Batch QC	K1411494-003	87 D	100 D
Batch QCDUP	KWG1414518-1	37 D *	40 D *
Method Blank	KWG1414518-5	82	87
Lab Control Sample	KWG1414518-4	84	86

Surrogate Recovery Control Limits (%)

Sur1	o-Terphenyl	50-150
Sur2	n-Triacontane	50-150

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	NA
Sample Matrix:	Solid	**Date Received:**	NA

Diesel and Residual Range Organics

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1414518-5	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	NWTPH-Dx		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	ND	U	25	1	10/21/14	10/31/14	KWG1414518	
Residual Range Organics (RRO)	ND	U	99	1	10/21/14	10/31/14	KWG1414518	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	82	50-150	10/31/14	Acceptable
n-Triacontane	87	50-150	10/31/14	Acceptable

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/08/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Diesel and Residual Range Organics

Sample Name:	B-69-S-4.5-100814	**Units:**	mg/Kg
Lab Code:	K1411111-003	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	NWTPH-Dx		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	**6500**	DZ	1400	20	10/21/14	11/01/14	KWG1414518	
Residual Range Organics (RRO)	**27000**	DZ	5400	20	10/21/14	11/01/14	KWG1414518	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	106	50-150	11/01/14	Acceptable
n-Triacontane	285	50-150	11/01/14	Outside Control Limits

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/08/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Diesel and Residual Range Organics

Sample Name:	B-69-S-8.5-100814	**Units:**	mg/Kg
Lab Code:	K1411111-004	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	NWTPH-Dx		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	**49000**	DZ	740	5	10/21/14	10/31/14	KWG1414518	
Residual Range Organics (RRO)	**22000**	DZ	3000	5	10/21/14	10/31/14	KWG1414518	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	191	50-150	10/31/14	Outside Control Limits
n-Triacontane	103	50-150	10/31/14	Acceptable

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/08/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Diesel and Residual Range Organics

Sample Name:	B-69-S-12.5-100814	**Units:**	mg/Kg
Lab Code:	K1411111-005	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	NWTPH-Dx		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	**9600**	DZ	240	5	10/21/14	10/31/14	KWG1414518	
Residual Range Organics (RRO)	**4400**	DZ	940	5	10/21/14	10/31/14	KWG1414518	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	134	50-150	10/31/14	Acceptable
n-Triacontane	117	50-150	10/31/14	Acceptable

Comments:

QA/QC Report

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Extracted:**	10/21/2014
Sample Matrix:	Solid	**Date Analyzed:**	11/01/2014

Duplicate Sample Summary
Diesel and Residual Range Organics

Sample Name:	Batch QC	**Units:**	mg/Kg
Lab Code:	K1411494-003	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	NWTPH-Dx	**Extraction Lot:**	KWG1414518

Analyte Name	MRL	Sample Result	Batch QCDUP KWG1414518-1 Duplicate Sample Result	Duplicate Sample Average	Relative Percent Difference	RPD Limit
Diesel Range Organics (DRO)	640	ND	ND	ND	-	40
Residual Range Organics (RRO)	640	2100	1000	1600	69 #	40

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Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Extracted:**	10/21/2014
Sample Matrix:	Solid	**Date Analyzed:**	10/31/2014

Lab Control Spike Summary
Diesel and Residual Range Organics

Extraction Method:	EPA 3550B	**Units:**	mg/Kg
Analysis Method:	NWTPH-Dx	**Basis:**	Dry
		Level:	Low
		Extraction Lot:	KWG1414518

	Lab Control Sample KWG1414518-4 Lab Control Spike			
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**
Diesel Range Organics (DRO)	233	267	87	42-134
Residual Range Organics (RRO)	151	133	113	48-141

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Client: URS Corporation **Service Request:** K1411111
Project: IP Tacoma Metals/33764085

Cover Page - Organic Analysis Data Package
Gasoline Range Organics

Sample Name	Lab Code	Date Collected	Date Received
B-69-S-8.5-100814	K1411111-004	10/08/2014	10/09/2014
B-69-S-12.5-100814	K1411111-005	10/08/2014	10/09/2014
B-69-S-8.5-100814	KWG1414551-1	10/08/2014	10/09/2014

Client: URS Corporation **Service Request:** K1411111
Project: IP Tacoma Metals/33764085
Sample Matrix: Soil

Surrogate Recovery Summary
Gasoline Range Organics

Extraction Method: EPA 5030A/5030B **Units:** Percent
Analysis Method: NWTPH-Gx **Level:** Med

Sample Name	Lab Code	Sur1
B-69-S-8.5-100814	K1411111-004	85
B-69-S-12.5-100814	K1411111-005	86
B-69-S-8.5-100814DUP	KWG1414551-1	89
Method Blank	KWG1414551-3	81
Lab Control Sample	KWG1414551-2	83

Surrogate Recovery Control Limits (%)

Sur1 = 4-Bromofluorobenzene 50-150

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Gasoline Range Organics

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1414551-3	**Basis:**	Dry
Extraction Method:	EPA 5030A/5030B	**Level:**	Med
Analysis Method:	NWTPH-Gx		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Gasoline Range Organics-NWTPH	ND	U	5.0	1	10/22/14	10/22/14	KWG1414551	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
4-Bromofluorobenzene	81	50-150	10/22/14	Acceptable

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/08/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Gasoline Range Organics

Sample Name:	B-69-S-8.5-100814	**Units:**	mg/Kg
Lab Code:	K1411111-004	**Basis:**	Dry
Extraction Method:	EPA 5030A/5030B	**Level:**	Med
Analysis Method:	NWTPH-Gx		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Gasoline Range Organics-NWTPH	**2900**	Y	590	1	10/22/14	10/22/14	KWG1414551	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
4-Bromofluorobenzene	85	50-150	10/22/14	Acceptable

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/08/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Gasoline Range Organics

Sample Name:	B-69-S-12.5-100814	**Units:**	mg/Kg
Lab Code:	K1411111-005	**Basis:**	Dry
Extraction Method:	EPA 5030A/5030B	**Level:**	Med
Analysis Method:	NWTPH-Gx		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Gasoline Range Organics-NWTPH	**490**	Y	74	1	10/22/14	10/22/14	KWG1414551	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
4-Bromofluorobenzene	86	50-150	10/22/14	Acceptable

Comments:

QA/QC Report

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Extracted:**	10/22/2014
Sample Matrix:	Soil	**Date Analyzed:**	10/22/2014

Duplicate Sample Summary
Gasoline Range Organics

Sample Name:	B-69-S-8.5-100814	**Units:**	mg/Kg
Lab Code:	K1411111-004	**Basis:**	Dry
Extraction Method:	EPA 5030A/5030B	**Level:**	Med
Analysis Method:	NWTPH-Gx	**Extraction Lot:**	KWG1414551

			B-69-S-8.5-100814DUP KWG1414551-1			
			Duplicate Sample			
Analyte Name	**MRL**	**Sample Result**	**Result**	**Average**	**Relative Percent Difference**	**RPD Limit**
Gasoline Range Organics-NWTPH	590	2900	3000	2900	3	40

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QA/QC Report

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Extracted:**	10/22/2014
Sample Matrix:	Soil	**Date Analyzed:**	10/22/2014

Lab Control Spike Summary
Gasoline Range Organics

Extraction Method:	EPA 5030A/5030B	**Units:**	mg/Kg
Analysis Method:	NWTPH-Gx	**Basis:**	Dry
		Level:	Med
		Extraction Lot:	KWG1414551

Lab Control Sample
KWG1414551-2
Lab Control Spike

Analyte Name	Result	Spike Amount	%Rec	%Rec Limits
Gasoline Range Organics-NWTPH	27.0	25.0	108	77-122

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Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client: URS Corporation **Service Request:** K1411111
Project: IP Tacoma Metals/33764085

Cover Page - Organic Analysis Data Package
Volatile Organic Compounds

Sample Name	Lab Code	Date Collected	Date Received
B-69-S-8.5-100814	K1411111-004	10/08/2014	10/09/2014
B-69-S-12.5-100814	K1411111-005	10/08/2014	10/09/2014

Client: URS Corporation **Service Request:** K1411111
Project: IP Tacoma Metals/33764085
Sample Matrix: Soil

Surrogate Recovery Summary
Volatile Organic Compounds

Extraction Method: EPA 5035A/5030B **Units:** Percent
Analysis Method: 8260C **Level:** Med

Sample Name	Lab Code	Sur1	Sur2	Sur3
B-69-S-8.5-100814	K1411111-004	104	100	100
B-69-S-12.5-100814	K1411111-005	100	99	101
Batch QC	K1411237-001	99	98	100
Method Blank	KWG1414207-4	103	98	98
Method Blank	KWG1414698-3	101	99	97
Batch QCMS	KWG1414207-1	102	102	106
Batch QCDMS	KWG1414207-2	101	100	105
Lab Control Sample	KWG1414207-3	101	101	102
Lab Control Sample	KWG1414698-1	100	101	100
Duplicate Lab Control Sample	KWG1414698-2	100	101	102

Surrogate Recovery Control Limits (%)

Sur1	=	Dibromofluoromethane	55-132
Sur2	=	Toluene-d8	81-124
Sur3	=	4-Bromofluorobenzene	64-132

Results flagged with an asterisk (*) indicate values outside control criteria.

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Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Volatile Organic Compounds

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1414207-4	**Basis:**	Dry
Extraction Method:	EPA 5035A/5030B	**Level:**	Med
Analysis Method:	8260C		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Dichlorodifluoromethane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	*
Chloromethane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	*
Vinyl Chloride	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Bromomethane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Chloroethane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Trichlorofluoromethane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
1,1-Dichloroethene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Acetone	ND	U	2.0	1	10/21/14	10/21/14	KWG1414207	
Carbon Disulfide	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Methylene Chloride	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
Methyl tert-Butyl Ether	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
trans-1,2-Dichloroethene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
1,1-Dichloroethane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
2,2-Dichloropropane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
cis-1,2-Dichloroethene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
2-Butanone (MEK)	ND	U	2.0	1	10/21/14	10/21/14	KWG1414207	
Bromochloromethane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Chloroform	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
1,1,1-Trichloroethane (TCA)	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Carbon Tetrachloride	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
1,1-Dichloropropene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Benzene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
1,2-Dichloroethane (EDC)	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Trichloroethene (TCE)	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
1,2-Dichloropropane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Dibromomethane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Bromodichloromethane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
cis-1,3-Dichloropropene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
4-Methyl-2-pentanone (MIBK)	ND	U	2.0	1	10/21/14	10/21/14	KWG1414207	
Toluene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
trans-1,3-Dichloropropene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
1,1,2-Trichloroethane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Tetrachloroethene (PCE)	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Volatile Organic Compounds

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1414207-4	**Basis:**	Dry
Extraction Method:	EPA 5035A/5030B	**Level:**	Med
Analysis Method:	8260C		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
2-Hexanone	ND	U	2.0	1	10/21/14	10/21/14	KWG1414207	
1,3-Dichloropropane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Dibromochloromethane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
1,2-Dibromoethane (EDB)	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
Chlorobenzene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Ethylbenzene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
1,1,1,2-Tetrachloroethane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
m,p-Xylenes	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
o-Xylene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Styrene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Bromoform	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Isopropylbenzene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
1,1,2,2-Tetrachloroethane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
Bromobenzene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
n-Propylbenzene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
1,2,3-Trichloropropane	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
2-Chlorotoluene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
1,3,5-Trimethylbenzene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
4-Chlorotoluene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
tert-Butylbenzene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
1,2,4-Trimethylbenzene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
sec-Butylbenzene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
4-Isopropyltoluene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
1,3-Dichlorobenzene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
1,4-Dichlorobenzene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
n-Butylbenzene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
1,2-Dichlorobenzene	ND	U	0.050	1	10/21/14	10/21/14	KWG1414207	
1,2-Dibromo-3-chloropropane	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
1,2,4-Trichlorobenzene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
Hexachlorobutadiene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
Naphthalene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	
1,2,3-Trichlorobenzene	ND	U	0.20	1	10/21/14	10/21/14	KWG1414207	

* See Case Narrative

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Volatile Organic Compounds

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1414207-4	**Basis:**	Dry

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Dibromofluoromethane	103	55-132	10/21/14	Acceptable
Toluene-d8	98	81-124	10/21/14	Acceptable
4-Bromofluorobenzene	98	64-132	10/21/14	Acceptable

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Volatile Organic Compounds

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1414698-3	**Basis:**	Dry
Extraction Method:	EPA 5030A/5030B	**Level:**	Med
Analysis Method:	8260C		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Dichlorodifluoromethane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Chloromethane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Vinyl Chloride	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Bromomethane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Chloroethane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Trichlorofluoromethane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
1,1-Dichloroethene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Acetone	ND	U	2.0	1	10/21/14	10/22/14	KWG1414698	
Carbon Disulfide	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Methylene Chloride	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
Methyl tert-Butyl Ether	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
trans-1,2-Dichloroethene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
1,1-Dichloroethane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
2,2-Dichloropropane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
cis-1,2-Dichloroethene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
2-Butanone (MEK)	ND	U	2.0	1	10/21/14	10/22/14	KWG1414698	
Bromochloromethane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Chloroform	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
1,1,1-Trichloroethane (TCA)	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Carbon Tetrachloride	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
1,1-Dichloropropene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Benzene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
1,2-Dichloroethane (EDC)	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Trichloroethene (TCE)	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
1,2-Dichloropropane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Dibromomethane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Bromodichloromethane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
cis-1,3-Dichloropropene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
4-Methyl-2-pentanone (MIBK)	ND	U	2.0	1	10/21/14	10/22/14	KWG1414698	
Toluene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
trans-1,3-Dichloropropene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
1,1,2-Trichloroethane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Tetrachloroethene (PCE)	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Volatile Organic Compounds

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1414698-3	**Basis:**	Dry
Extraction Method:	EPA 5030A/5030B	**Level:**	Med
Analysis Method:	8260C		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
2-Hexanone	ND	U	2.0	1	10/21/14	10/22/14	KWG1414698	
1,3-Dichloropropane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Dibromochloromethane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
1,2-Dibromoethane (EDB)	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
Chlorobenzene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Ethylbenzene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
1,1,1,2-Tetrachloroethane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
m,p-Xylenes	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
o-Xylene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Styrene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Bromoform	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Isopropylbenzene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
1,1,2,2-Tetrachloroethane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
Bromobenzene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
n-Propylbenzene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
1,2,3-Trichloropropane	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
2-Chlorotoluene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
1,3,5-Trimethylbenzene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
4-Chlorotoluene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
tert-Butylbenzene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
1,2,4-Trimethylbenzene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
sec-Butylbenzene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
4-Isopropyltoluene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
1,3-Dichlorobenzene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
1,4-Dichlorobenzene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
n-Butylbenzene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
1,2-Dichlorobenzene	ND	U	0.050	1	10/21/14	10/22/14	KWG1414698	
1,2-Dibromo-3-chloropropane	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
1,2,4-Trichlorobenzene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
Hexachlorobutadiene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
Naphthalene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	
1,2,3-Trichlorobenzene	ND	U	0.20	1	10/21/14	10/22/14	KWG1414698	

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Volatile Organic Compounds

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1414698-3	**Basis:**	Dry

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Dibromofluoromethane	101	55-132	10/22/14	Acceptable
Toluene-d8	99	81-124	10/22/14	Acceptable
4-Bromofluorobenzene	97	64-132	10/22/14	Acceptable

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/08/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Volatile Organic Compounds

Sample Name:	B-69-S-8.5-100814	**Units:**	mg/Kg
Lab Code:	K1411111-004	**Basis:**	Dry
Extraction Method:	EPA 5035A/5030B	**Level:**	Med
Analysis Method:	8260C		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Dichlorodifluoromethane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	*
Chloromethane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	*
Vinyl Chloride	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Bromomethane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Chloroethane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Trichlorofluoromethane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
1,1-Dichloroethene	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Acetone	ND	U	300	1	10/21/14	10/21/14	KWG1414207	
Carbon Disulfide	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Methylene Chloride	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
Methyl tert-Butyl Ether	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
trans-1,2-Dichloroethene	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
1,1-Dichloroethane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
2,2-Dichloropropane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
cis-1,2-Dichloroethene	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
2-Butanone (MEK)	ND	U	300	1	10/21/14	10/21/14	KWG1414207	
Bromochloromethane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Chloroform	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
1,1,1-Trichloroethane (TCA)	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Carbon Tetrachloride	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
1,1-Dichloropropene	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Benzene	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
1,2-Dichloroethane (EDC)	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Trichloroethene (TCE)	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
1,2-Dichloropropane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Dibromomethane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Bromodichloromethane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
cis-1,3-Dichloropropene	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
4-Methyl-2-pentanone (MIBK)	ND	U	300	1	10/21/14	10/21/14	KWG1414207	
Toluene	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
trans-1,3-Dichloropropene	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
1,1,2-Trichloroethane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Tetrachloroethene (PCE)	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/08/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Volatile Organic Compounds

Sample Name:	B-69-S-8.5-100814	**Units:**	mg/Kg
Lab Code:	K1411111-004	**Basis:**	Dry
Extraction Method:	EPA 5035A/5030B	**Level:**	Med
Analysis Method:	8260C		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
2-Hexanone	ND	U	300	1	10/21/14	10/21/14	KWG1414207	
1,3-Dichloropropane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Dibromochloromethane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
1,2-Dibromoethane (EDB)	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
Chlorobenzene	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Ethylbenzene	**11**		7.3	1	10/21/14	10/21/14	KWG1414207	
1,1,1,2-Tetrachloroethane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
m,p-Xylenes	**18**		7.3	1	10/21/14	10/21/14	KWG1414207	
o-Xylene	**10**		7.3	1	10/21/14	10/21/14	KWG1414207	
Styrene	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Bromoform	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Isopropylbenzene	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
1,1,2,2-Tetrachloroethane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
Bromobenzene	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
n-Propylbenzene	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
1,2,3-Trichloropropane	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
2-Chlorotoluene	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
1,3,5-Trimethylbenzene	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
4-Chlorotoluene	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
tert-Butylbenzene	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
1,2,4-Trimethylbenzene	**33**		30	1	10/21/14	10/21/14	KWG1414207	
sec-Butylbenzene	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
4-Isopropyltoluene	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
1,3-Dichlorobenzene	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
1,4-Dichlorobenzene	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
n-Butylbenzene	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
1,2-Dichlorobenzene	ND	U	7.3	1	10/21/14	10/21/14	KWG1414207	
1,2-Dibromo-3-chloropropane	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
1,2,4-Trichlorobenzene	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
Hexachlorobutadiene	ND	U	30	1	10/21/14	10/21/14	KWG1414207	
Naphthalene	**4500**	D	590	20	10/21/14	10/22/14	KWG1414698	
1,2,3-Trichlorobenzene	ND	U	30	1	10/21/14	10/21/14	KWG1414207	

* See Case Narrative

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/08/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Volatile Organic Compounds

Sample Name:	B-69-S-8.5-100814	**Units:**	mg/Kg
Lab Code:	K1411111-004	**Basis:**	Dry

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Dibromofluoromethane	104	55-132	10/21/14	Acceptable
Toluene-d8	100	81-124	10/21/14	Acceptable
4-Bromofluorobenzene	100	64-132	10/21/14	Acceptable

Comments:

Analytical Results

Client: URS Corporation
Project: IP Tacoma Metals/33764085
Sample Matrix: Soil

Service Request: K1411111
Date Collected: 10/08/2014
Date Received: 10/09/2014

Volatile Organic Compounds

Sample Name: B-69-S-12.5-100814
Lab Code: K1411111-005

Units: mg/Kg
Basis: Dry

Extraction Method: EPA 5035A/5030B
Analysis Method: 8260C

Level: Med

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Dichlorodifluoromethane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	*
Chloromethane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	*
Vinyl Chloride	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Bromomethane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Chloroethane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Trichlorofluoromethane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
1,1-Dichloroethene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Acetone	ND	U	74	1	10/21/14	10/21/14	KWG1414207	
Carbon Disulfide	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Methylene Chloride	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
Methyl tert-Butyl Ether	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
trans-1,2-Dichloroethene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
1,1-Dichloroethane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
2,2-Dichloropropane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
cis-1,2-Dichloroethene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
2-Butanone (MEK)	ND	U	74	1	10/21/14	10/21/14	KWG1414207	
Bromochloromethane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Chloroform	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
1,1,1-Trichloroethane (TCA)	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Carbon Tetrachloride	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
1,1-Dichloropropene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Benzene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
1,2-Dichloroethane (EDC)	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Trichloroethene (TCE)	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
1,2-Dichloropropane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Dibromomethane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Bromodichloromethane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
cis-1,3-Dichloropropene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
4-Methyl-2-pentanone (MIBK)	ND	U	74	1	10/21/14	10/21/14	KWG1414207	
Toluene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
trans-1,3-Dichloropropene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
1,1,2-Trichloroethane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Tetrachloroethene (PCE)	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/08/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Volatile Organic Compounds

Sample Name:	B-69-S-12.5-100814	**Units:**	mg/Kg
Lab Code:	K1411111-005	**Basis:**	Dry
Extraction Method:	EPA 5035A/5030B	**Level:**	Med
Analysis Method:	8260C		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
2-Hexanone	ND	U	74	1	10/21/14	10/21/14	KWG1414207	
1,3-Dichloropropane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Dibromochloromethane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
1,2-Dibromoethane (EDB)	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
Chlorobenzene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Ethylbenzene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
1,1,1,2-Tetrachloroethane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
m,p-Xylenes	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
o-Xylene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Styrene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Bromoform	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Isopropylbenzene	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
1,1,2,2-Tetrachloroethane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
Bromobenzene	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
n-Propylbenzene	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
1,2,3-Trichloropropane	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
2-Chlorotoluene	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
1,3,5-Trimethylbenzene	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
4-Chlorotoluene	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
tert-Butylbenzene	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
1,2,4-Trimethylbenzene	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
sec-Butylbenzene	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
4-Isopropyltoluene	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
1,3-Dichlorobenzene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
1,4-Dichlorobenzene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
n-Butylbenzene	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
1,2-Dichlorobenzene	ND	U	1.9	1	10/21/14	10/21/14	KWG1414207	
1,2-Dibromo-3-chloropropane	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
1,2,4-Trichlorobenzene	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
Hexachlorobutadiene	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	
Naphthalene	**1600**	D	300	20	10/21/14	10/21/14	KWG1414207	
1,2,3-Trichlorobenzene	ND	U	7.4	1	10/21/14	10/21/14	KWG1414207	

* See Case Narrative

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/08/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Volatile Organic Compounds

Sample Name:	B-69-S-12.5-100814	**Units:**	mg/Kg
Lab Code:	K1411111-005	**Basis:**	Dry

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Dibromofluoromethane	100	55-132	10/21/14	Acceptable
Toluene-d8	99	81-124	10/21/14	Acceptable
4-Bromofluorobenzene	101	64-132	10/21/14	Acceptable

Comments:

QA/QC Report

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Extracted:**	10/21/2014
Sample Matrix:	Soil	**Date Analyzed:**	10/21/2014

Lab Control Spike Summary
Volatile Organic Compounds

Extraction Method:	EPA 5035A/5030B	**Units:**	mg/Kg
Analysis Method:	8260C	**Basis:**	Dry
		Level:	Med
		Extraction Lot:	KWG1414207

Lab Control Sample
KWG1414207-3
Lab Control Spike

Analyte Name	Result	Spike Amount	%Rec	%Rec Limits
Dichlorodifluoromethane	0.705	1.00	71	21-143
Chloromethane	0.704	1.00	70	50-121
Vinyl Chloride	0.835	1.00	84	53-125
Bromomethane	0.916	1.00	92	29-171
Chloroethane	1.01	1.00	101	53-134
Trichlorofluoromethane	0.764	1.00	76	42-119
1,1-Dichloroethene	0.989	1.00	99	67-141
Acetone	5.56	5.00	111	47-142
Carbon Disulfide	1.90	2.00	95	48-140
Methylene Chloride	0.850	1.00	85	69-121
Methyl tert-Butyl Ether	0.979	1.00	98	64-126
trans-1,2-Dichloroethene	0.963	1.00	96	76-128
1,1-Dichloroethane	1.01	1.00	101	70-124
2,2-Dichloropropane	0.955	1.00	96	49-136
cis-1,2-Dichloroethene	0.941	1.00	94	77-124
2-Butanone (MEK)	5.25	5.00	105	65-139
Bromochloromethane	0.978	1.00	98	73-117
Chloroform	0.952	1.00	95	73-125
1,1,1-Trichloroethane (TCA)	0.936	1.00	94	61-136
Carbon Tetrachloride	0.941	1.00	94	72-140
1,1-Dichloropropene	0.963	1.00	96	65-130
Benzene	0.956	1.00	96	70-134
1,2-Dichloroethane (EDC)	0.976	1.00	98	70-126
Trichloroethene (TCE)	0.911	1.00	91	69-126
1,2-Dichloropropane	0.936	1.00	94	73-121
Dibromomethane	0.975	1.00	98	75-124
Bromodichloromethane	0.960	1.00	96	76-128
cis-1,3-Dichloropropene	0.968	1.00	97	57-132
4-Methyl-2-pentanone (MIBK)	5.05	5.00	101	73-126
Toluene	0.930	1.00	93	74-118
trans-1,3-Dichloropropene	0.853	1.00	85	55-129
1,1,2-Trichloroethane	0.949	1.00	95	73-118
Tetrachloroethene (PCE)	0.930	1.00	93	65-126
2-Hexanone	4.67	5.00	93	54-123
1,3-Dichloropropane	0.919	1.00	92	70-121

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

QA/QC Report

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Extracted:**	10/21/2014
Sample Matrix:	Soil	**Date Analyzed:**	10/21/2014

Lab Control Spike Summary
Volatile Organic Compounds

Extraction Method:	EPA 5035A/5030B	**Units:**	mg/Kg
Analysis Method:	8260C	**Basis:**	Dry
		Level:	Med
		Extraction Lot:	KWG1414207

Lab Control Sample
KWG1414207-3
Lab Control Spike

Analyte Name	Result	Spike Amount	%Rec	%Rec Limits
Dibromochloromethane	0.951	1.00	95	64-126
1,2-Dibromoethane (EDB)	0.973	1.00	97	70-122
Chlorobenzene	0.951	1.00	95	72-115
Ethylbenzene	0.943	1.00	94	72-121
1,1,1,2-Tetrachloroethane	0.952	1.00	95	71-120
m,p-Xylenes	1.98	2.00	99	74-124
o-Xylene	0.992	1.00	99	73-123
Styrene	1.02	1.00	102	77-122
Bromoform	0.987	1.00	99	54-141
Isopropylbenzene	0.977	1.00	98	68-121
1,1,2,2-Tetrachloroethane	0.918	1.00	92	63-127
Bromobenzene	0.937	1.00	94	66-118
n-Propylbenzene	0.919	1.00	92	61-134
1,2,3-Trichloropropane	0.957	1.00	96	76-128
2-Chlorotoluene	0.960	1.00	96	68-127
1,3,5-Trimethylbenzene	0.976	1.00	98	68-129
4-Chlorotoluene	0.903	1.00	90	66-121
tert-Butylbenzene	0.947	1.00	95	65-131
1,2,4-Trimethylbenzene	0.975	1.00	98	69-123
sec-Butylbenzene	0.917	1.00	92	57-132
4-Isopropyltoluene	0.980	1.00	98	68-127
1,3-Dichlorobenzene	0.922	1.00	92	69-117
1,4-Dichlorobenzene	0.918	1.00	92	69-114
n-Butylbenzene	0.926	1.00	93	52-142
1,2-Dichlorobenzene	0.923	1.00	92	75-114
1,2-Dibromo-3-chloropropane	0.842	1.00	84	46-132
1,2,4-Trichlorobenzene	0.916	1.00	92	55-134
Hexachlorobutadiene	0.917	1.00	92	52-136
Naphthalene	0.814	1.00	81	48-144
1,2,3-Trichlorobenzene	0.975	1.00	98	49-149

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Extracted:**	10/21/2014
Sample Matrix:	Soil	**Date Analyzed:**	10/22/2014

Lab Control Spike/Duplicate Lab Control Spike Summary
Volatile Organic Compounds

Extraction Method:	EPA 5030A/5030B	**Units:**	mg/Kg
Analysis Method:	8260C	**Basis:**	Dry
		Level:	Med
		Extraction Lot:	KWG1414698

	Lab Control Sample KWG1414698-1 Lab Control Spike			Duplicate Lab Control Sample KWG1414698-2 Duplicate Lab Control Spike					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Dichlorodifluoromethane	0.688	1.00	69	0.625	1.00	63	21-143	10	40
Chloromethane	0.719	1.00	72	0.676	1.00	68	50-121	6	40
Vinyl Chloride	0.863	1.00	86	0.801	1.00	80	53-125	7	40
Bromomethane	0.847	1.00	85	0.850	1.00	85	29-171	0	40
Chloroethane	1.03	1.00	103	0.991	1.00	99	53-134	3	40
Trichlorofluoromethane	0.814	1.00	81	0.746	1.00	75	42-119	9	40
1,1-Dichloroethene	1.05	1.00	105	0.982	1.00	98	67-141	7	40
Acetone	5.50	5.00	110	5.58	5.00	112	47-142	1	40
Carbon Disulfide	1.98	2.00	99	1.87	2.00	93	48-140	6	40
Methylene Chloride	0.891	1.00	89	0.849	1.00	85	69-121	5	40
Methyl tert-Butyl Ether	1.06	1.00	106	1.07	1.00	107	64-126	1	40
trans-1,2-Dichloroethene	1.02	1.00	102	0.969	1.00	97	76-128	5	40
1,1-Dichloroethane	1.04	1.00	104	1.02	1.00	102	70-124	2	40
2,2-Dichloropropane	1.02	1.00	102	0.976	1.00	98	49-136	4	40
cis-1,2-Dichloroethene	0.972	1.00	97	0.940	1.00	94	77-124	3	40
2-Butanone (MEK)	5.59	5.00	112	5.72	5.00	114	65-139	2	40
Bromochloromethane	1.03	1.00	103	1.02	1.00	102	73-117	1	40
Chloroform	0.973	1.00	97	0.953	1.00	95	73-125	2	40
1,1,1-Trichloroethane (TCA)	1.02	1.00	102	0.980	1.00	98	61-136	4	40
Carbon Tetrachloride	1.00	1.00	100	0.939	1.00	94	72-140	6	40
1,1-Dichloropropene	1.01	1.00	101	0.960	1.00	96	65-130	5	40
Benzene	0.999	1.00	100	0.960	1.00	96	70-134	4	40
1,2-Dichloroethane (EDC)	0.973	1.00	97	0.952	1.00	95	70-126	2	40
Trichloroethene (TCE)	0.965	1.00	97	0.937	1.00	94	69-126	3	40
1,2-Dichloropropane	0.955	1.00	96	0.933	1.00	93	73-121	2	40
Dibromomethane	0.979	1.00	98	0.990	1.00	99	75-124	1	40
Bromodichloromethane	0.978	1.00	98	0.963	1.00	96	76-128	2	40
cis-1,3-Dichloropropene	0.990	1.00	99	0.981	1.00	98	57-132	1	40
4-Methyl-2-pentanone (MIBK)	5.53	5.00	111	5.66	5.00	113	73-126	2	40
Toluene	0.963	1.00	96	0.934	1.00	93	74-118	3	40
trans-1,3-Dichloropropene	0.877	1.00	88	0.875	1.00	88	55-129	0	40
1,1,2-Trichloroethane	0.963	1.00	96	0.981	1.00	98	73-118	2	40
Tetrachloroethene (PCE)	0.979	1.00	98	0.933	1.00	93	65-126	5	40
2-Hexanone	5.13	5.00	103	5.42	5.00	108	54-123	6	40
1,3-Dichloropropane	0.924	1.00	92	0.928	1.00	93	70-121	0	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client: URS Corporation
Project: IP Tacoma Metals/33764085
Sample Matrix: Soil

Service Request: K1411111
Date Extracted: 10/21/2014
Date Analyzed: 10/22/2014

Lab Control Spike/Duplicate Lab Control Spike Summary
Volatile Organic Compounds

Extraction Method: EPA 5030A/5030B
Analysis Method: 8260C

Units: mg/Kg
Basis: Dry
Level: Med
Extraction Lot: KWG1414698

	Lab Control Sample KWG1414698-1 Lab Control Spike			Duplicate Lab Control Sample KWG1414698-2 Duplicate Lab Control Spike					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Dibromochloromethane	0.966	1.00	97	0.968	1.00	97	64-126	0	40
1,2-Dibromoethane (EDB)	0.968	1.00	97	0.984	1.00	98	70-122	2	40
Chlorobenzene	0.961	1.00	96	0.956	1.00	96	72-115	1	40
Ethylbenzene	0.973	1.00	97	0.944	1.00	94	72-121	3	40
1,1,1,2-Tetrachloroethane	0.972	1.00	97	0.976	1.00	98	71-120	0	40
m,p-Xylenes	2.04	2.00	102	2.00	2.00	100	74-124	2	40
o-Xylene	1.02	1.00	102	1.00	1.00	100	73-123	1	40
Styrene	1.07	1.00	107	1.05	1.00	105	77-122	2	40
Bromoform	0.990	1.00	99	1.04	1.00	104	54-141	5	40
Isopropylbenzene	1.00	1.00	100	0.982	1.00	98	68-121	2	40
1,1,2,2-Tetrachloroethane	0.926	1.00	93	0.920	1.00	92	63-127	1	40
Bromobenzene	0.942	1.00	94	0.927	1.00	93	66-118	2	40
n-Propylbenzene	0.962	1.00	96	0.917	1.00	92	61-134	5	40
1,2,3-Trichloropropane	0.948	1.00	95	0.955	1.00	96	76-128	1	40
2-Chlorotoluene	0.985	1.00	99	0.954	1.00	95	68-127	3	40
1,3,5-Trimethylbenzene	1.02	1.00	102	0.984	1.00	98	68-129	4	40
4-Chlorotoluene	0.936	1.00	94	0.908	1.00	91	66-121	3	40
tert-Butylbenzene	0.996	1.00	100	0.947	1.00	95	65-131	5	40
1,2,4-Trimethylbenzene	1.06	1.00	106	1.02	1.00	102	69-123	4	40
sec-Butylbenzene	0.960	1.00	96	0.904	1.00	90	57-132	6	40
4-Isopropyltoluene	1.05	1.00	105	1.01	1.00	101	68-127	4	40
1,3-Dichlorobenzene	0.936	1.00	94	0.917	1.00	92	69-117	2	40
1,4-Dichlorobenzene	0.934	1.00	93	0.906	1.00	91	69-114	3	40
n-Butylbenzene	1.05	1.00	105	0.990	1.00	99	52-142	5	40
1,2-Dichlorobenzene	0.950	1.00	95	0.919	1.00	92	75-114	3	40
1,2-Dibromo-3-chloropropane	0.971	1.00	97	0.972	1.00	97	46-132	0	40
1,2,4-Trichlorobenzene	1.02	1.00	102	1.01	1.00	101	55-134	0	40
Hexachlorobutadiene	0.982	1.00	98	0.923	1.00	92	52-136	6	40
Naphthalene	1.06	1.00	106	1.05	1.00	105	48-144	0	40
1,2,3-Trichlorobenzene	1.07	1.00	107	1.03	1.00	103	49-149	4	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client: URS Corporation **Service Request:** K1411111
Project: IP Tacoma Metals/33764085

Cover Page - Organic Analysis Data Package
Semi-Volatile Organic Compounds by GC/MS

Sample Name	Lab Code	Date Collected	Date Received
B-69-S-4.5-100814	K1411111-003	10/08/2014	10/09/2014
B-69-S-8.5-100814	K1411111-004	10/08/2014	10/09/2014
B-69-S-12.5-100814	K1411111-005	10/08/2014	10/09/2014

Client: URS Corporation **Service Request:** K1411111
Project: IP Tacoma Metals/33764085
Sample Matrix: Soil

Surrogate Recovery Summary
Semi-Volatile Organic Compounds by GC/MS

Extraction Method: EPA 3541 **Units:** Percent
Analysis Method: 8270D **Level:** Low

Sample Name	Lab Code	Sur1	Sur2	Sur3
B-69-S-4.5-100814	K1411111-003	70	70	99
B-69-S-8.5-100814	K1411111-004	80 D	67 D	85 D
B-69-S-12.5-100814	K1411111-005	63	67	85
Method Blank	KWG1414210-3	53	53	66
Lab Control Sample	KWG1414210-1	60	65	74
Duplicate Lab Control Sample	KWG1414210-2	66	61	71

Surrogate Recovery Control Limits (%)

Sur1	=	Nitrobenzene-d5	29-116
Sur2	=	2-Fluorobiphenyl	32-104
Sur3	=	Terphenyl-d14	37-133

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1414210-3	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
2-Methylnaphthalene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Acenaphthylene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Acenaphthene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Dibenzofuran	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Fluorene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Phenanthrene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Anthracene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Fluoranthene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Pyrene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Benz(a)anthracene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Chrysene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Benzo(b)fluoranthene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Benzo(k)fluoranthene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Benzo(a)pyrene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Indeno(1,2,3-cd)pyrene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Dibenz(a,h)anthracene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Benzo(g,h,i)perylene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Nitrobenzene-d5	53	29-116	10/27/14	Acceptable
2-Fluorobiphenyl	53	32-104	10/27/14	Acceptable
Terphenyl-d14	66	37-133	10/27/14	Acceptable

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/08/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	B-69-S-4.5-100814	**Units:**	mg/Kg
Lab Code:	K1411111-003	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**4.3**		2.6	1	10/21/14	10/27/14	KWG1414210	
2-Methylnaphthalene	**9.5**		2.6	1	10/21/14	10/27/14	KWG1414210	
Acenaphthylene	**11**		2.6	1	10/21/14	10/27/14	KWG1414210	
Acenaphthene	**14**		2.6	1	10/21/14	10/27/14	KWG1414210	
Dibenzofuran	**6.0**		2.6	1	10/21/14	10/27/14	KWG1414210	
Fluorene	**15**		2.6	1	10/21/14	10/27/14	KWG1414210	
Phenanthrene	**28**		2.6	1	10/21/14	10/27/14	KWG1414210	
Anthracene	**95**	D	13	5	10/21/14	10/29/14	KWG1414210	
Fluoranthene	**160**	D	13	5	10/21/14	10/29/14	KWG1414210	*
Pyrene	**270**	D	51	20	10/21/14	10/29/14	KWG1414210	
Benz(a)anthracene	**200**	D	13	5	10/21/14	10/29/14	KWG1414210	
Chrysene	**460**	D	51	20	10/21/14	10/29/14	KWG1414210	
Benzo(b)fluoranthene	**460**	D	51	20	10/21/14	10/29/14	KWG1414210	
Benzo(k)fluoranthene	**150**	D	51	20	10/21/14	10/29/14	KWG1414210	
Benzo(a)pyrene	**350**	D	51	20	10/21/14	10/29/14	KWG1414210	
Indeno(1,2,3-cd)pyrene	**170**	D	13	5	10/21/14	10/29/14	KWG1414210	
Dibenz(a,h)anthracene	**45**		2.6	1	10/21/14	10/27/14	KWG1414210	
Benzo(g,h,i)perylene	**140**	D	13	5	10/21/14	10/29/14	KWG1414210	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Nitrobenzene-d5	70	29-116	10/27/14	Acceptable
2-Fluorobiphenyl	70	32-104	10/27/14	Acceptable
Terphenyl-d14	99	37-133	10/27/14	Acceptable

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/08/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	B-69-S-8.5-100814	**Units:**	mg/Kg
Lab Code:	K1411111-004	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**3400**	D	200	50	10/21/14	10/29/14	KWG1414210	
2-Methylnaphthalene	**1700**	D	200	50	10/21/14	10/29/14	KWG1414210	
Acenaphthylene	**29**	D	20	5	10/21/14	10/27/14	KWG1414210	
Acenaphthene	**1200**	D	200	50	10/21/14	10/29/14	KWG1414210	
Dibenzofuran	**570**	D	39	10	10/21/14	10/29/14	KWG1414210	
Fluorene	**1000**	D	200	50	10/21/14	10/29/14	KWG1414210	
Phenanthrene	**3000**	D	200	50	10/21/14	10/29/14	KWG1414210	
Anthracene	**780**	D	39	10	10/21/14	10/29/14	KWG1414210	
Fluoranthene	**1400**	D	200	50	10/21/14	10/29/14	KWG1414210	*
Pyrene	**1300**	D	200	50	10/21/14	10/29/14	KWG1414210	
Benz(a)anthracene	**320**	D	20	5	10/21/14	10/27/14	KWG1414210	
Chrysene	**290**	D	20	5	10/21/14	10/27/14	KWG1414210	
Benzo(b)fluoranthene	**240**	D	20	5	10/21/14	10/27/14	KWG1414210	
Benzo(k)fluoranthene	**81**	D	20	5	10/21/14	10/27/14	KWG1414210	
Benzo(a)pyrene	**190**	D	20	5	10/21/14	10/27/14	KWG1414210	
Indeno(1,2,3-cd)pyrene	**75**	D	20	5	10/21/14	10/27/14	KWG1414210	
Dibenz(a,h)anthracene	**24**	D	20	5	10/21/14	10/27/14	KWG1414210	
Benzo(g,h,i)perylene	**68**	D	20	5	10/21/14	10/27/14	KWG1414210	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Nitrobenzene-d5	80	29-116	10/27/14	Acceptable
2-Fluorobiphenyl	67	32-104	10/27/14	Acceptable
Terphenyl-d14	85	37-133	10/27/14	Acceptable

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/08/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	B-69-S-12.5-100814	**Units:**	mg/Kg
Lab Code:	K1411111-005	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**370**	D	120	50	10/21/14	10/29/14	KWG1414210	
2-Methylnaphthalene	**260**	D	120	50	10/21/14	10/29/14	KWG1414210	
Acenaphthylene	**4.7**		2.4	1	10/21/14	10/27/14	KWG1414210	
Acenaphthene	**340**	D	120	50	10/21/14	10/29/14	KWG1414210	
Dibenzofuran	**180**	D	12	5	10/21/14	10/28/14	KWG1414210	
Fluorene	**320**	D	120	50	10/21/14	10/29/14	KWG1414210	
Phenanthrene	**1000**	D	120	50	10/21/14	10/29/14	KWG1414210	
Anthracene	**150**	D	12	5	10/21/14	10/28/14	KWG1414210	
Fluoranthene	**440**	D	120	50	10/21/14	10/29/14	KWG1414210	*
Pyrene	**370**	D	120	50	10/21/14	10/29/14	KWG1414210	
Benz(a)anthracene	**110**	D	12	5	10/21/14	10/28/14	KWG1414210	
Chrysene	**86**	D	12	5	10/21/14	10/28/14	KWG1414210	
Benzo(b)fluoranthene	**81**	D	12	5	10/21/14	10/28/14	KWG1414210	
Benzo(k)fluoranthene	**28**	D	12	5	10/21/14	10/28/14	KWG1414210	
Benzo(a)pyrene	**67**	D	12	5	10/21/14	10/28/14	KWG1414210	
Indeno(1,2,3-cd)pyrene	**24**		2.4	1	10/21/14	10/27/14	KWG1414210	
Dibenz(a,h)anthracene	**7.4**		2.4	1	10/21/14	10/27/14	KWG1414210	
Benzo(g,h,i)perylene	**22**		2.4	1	10/21/14	10/27/14	KWG1414210	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Nitrobenzene-d5	63	29-116	10/27/14	Acceptable
2-Fluorobiphenyl	67	32-104	10/27/14	Acceptable
Terphenyl-d14	85	37-133	10/27/14	Acceptable

Comments:

Client:	URS Corporation	**Service Request:**	K1411111
Project:	IP Tacoma Metals/33764085	**Date Extracted:**	10/21/2014
Sample Matrix:	Soil	**Date Analyzed:**	10/27/2014

Lab Control Spike/Duplicate Lab Control Spike Summary
Semi-Volatile Organic Compounds by GC/MS

Extraction Method:	EPA 3541	**Units:**	mg/Kg
Analysis Method:	8270D	**Basis:**	Dry
		Level:	Low
		Extraction Lot:	KWG1414210

	Lab Control Sample KWG1414210-1 Lab Control Spike			Duplicate Lab Control Sample KWG1414210-2 Duplicate Lab Control Spike					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	2.19	3.33	66	2.13	3.33	64	44-92	3	40
2-Methylnaphthalene	2.23	3.33	67	2.12	3.33	64	44-95	5	40
Acenaphthylene	2.54	3.33	76	2.23	3.33	67	48-105	13	40
Acenaphthene	2.53	3.33	76	2.14	3.33	64	49-97	17	40
Dibenzofuran	2.62	3.33	78	2.24	3.33	67	47-101	15	40
Fluorene	2.63	3.33	79	2.23	3.33	67	46-103	17	40
Phenanthrene	2.82	3.33	84	2.67	3.33	80	52-108	5	40
Anthracene	2.98	3.33	89	2.73	3.33	82	53-106	9	40
Fluoranthene	3.01	3.33	90	2.86	3.33	86	47-117	5	40
Pyrene	2.79	3.33	84	2.53	3.33	76	53-124	10	40
Benz(a)anthracene	2.73	3.33	82	2.61	3.33	78	54-109	4	40
Chrysene	2.72	3.33	82	2.51	3.33	75	53-109	8	40
Benzo(b)fluoranthene	2.82	3.33	85	2.61	3.33	78	53-110	8	40
Benzo(k)fluoranthene	2.52	3.33	75	2.53	3.33	76	52-112	0	40
Benzo(a)pyrene	2.66	3.33	80	2.69	3.33	81	51-114	1	40
Indeno(1,2,3-cd)pyrene	2.91	3.33	87	2.71	3.33	81	53-112	7	40
Dibenz(a,h)anthracene	2.69	3.33	81	2.69	3.33	81	53-114	0	40
Benzo(g,h,i)perylene	2.80	3.33	84	2.70	3.33	81	50-110	4	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Environmental
ALS Group USA, Corp
1317 South 13th Avenue
Kelso, WA 98626
T: 1-360-577-7222
F: 1-360-636-1068
www.alsglobal.com

November 10, 2014

Analytical Report for Service Request No: K1411112

Paul Kalina
URS Corporation
1501 4th Ave.,Suite 1400
Seattle, WA 98101

RE: IP Tacoma Metals/33764085

Dear Paul:

Enclosed are the results of the sample(s) submitted to our laboratory on October 9, 2014. For your reference, these analyses have been assigned our service request number **K1411112**.

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Environmental is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3375. You may also contact me via email at Janet.Malloch@alsglobal.com.

Respectfully submitted,

ALS Group USA Corp. dba ALS Environmental

Janet Malloch
Project Manager

ALS ENVIRONMENTAL

Client:	URS Corporation	**Service Request No.:**	K1411112
Project:	IP Tacoma Metals/33764085	**Date Received:**	10/09/14
Sample Matrix:	Soil		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier IV validation deliverables including summary forms and all of the associated raw data for each of the analyses. When appropriate to the method, method blank results have been reported with each analytical test.

Sample Receipt

Twenty soil samples were received for analysis at ALS Environmental on 10/09/14. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

General Chemistry Parameters

No anomalies associated with the analysis of these samples were observed.

Diesel and Residual Range Organics by NWTPH-Dx

Elevated Detection Limits:
Several samples required dilution due to the presence of elevated levels of non-target analytes. The reporting limits were adjusted to reflect the dilution.

Surrogate Exceptions:
The control criteria for n-Triacontane in several samples were not applicable. The analysis of the samples required a dilution, which resulted in a surrogate concentration below the reporting limit. No further corrective action was appropriate.

Sample Notes and Discussion:
The samples did not resemble a Stoddard solvent fingerprint nor a petroleum product.

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) criterion for the replicate analysis of Residual Range Organics (RRO) in sample Batch QC was not applicable because the analyte concentration was not significantly greater than the Method Reporting Limit (MRL). Analytical values derived from measurements close to the detection limit are not subject to the same accuracy and precision criteria as results derived from measurements higher on the calibration range for the method.

No other anomalies associated with the analysis of these samples were observed.

Approved by Janet Mallock

Polynuclear Aromatic Hydrocarbons by EPA Method 8270

Calibration Verification Exceptions:
The following analyte was flagged as outside the control criterion for Continuing Calibration Verification (CCV) MS07\1028F002.D: Fluoranthene. In accordance with the EPA Method, 80% or more of the CCV analytes must have passed within 20% of the true value. The remaining analytes are allowed a 40% difference as per the ALS SOP. The CCV met these criteria. No further corrective action was required.

Elevated Detection Limits:
Sample B-57-S-9-100714 required dilution due to the presence of elevated levels of target analyte. The reporting limits were adjusted to reflect the dilution.

No other anomalies associated with the analysis of these samples were observed.

Approved by Janet Mallock

ALS Environmental

~~APEX LABS~~

CHAIN OF CUSTODY

Lab # K1411112 COC 1 of 5

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

Company: URS	Project Mgr: Paul Kalina	Project Name: IP-Tacoma Metals	Project # 33764085
Address: 1501 4th Ave. Ste 1400, Seattle, WA 98101-3225	Phone: 206-438-2172	Fax: 866-495-5282	Email: paul.kalina@urs.com
Sampled by: Bret Waldron			

Site Location: OR (WA)

Other: _____

ANALYSIS REQUEST

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200- COLS	1200-Z
1	B-48-S-3-100714		10/7	~~1005~~ 0925	S	2		X						X							
2	B-48-S-4-100714			0920		1		X						X							
3	B-48-S-7-100714			0935		2		X						X							
4	B-49-S-7-100714			0900		2		X						X							
5	B-49-S-8-100714			0855		2		X						X							
6	B-50-S-4-100714			1005		1		X						X							
7	B-50-S-7-100714			1010		1		X						X							
8	B-50-S-8-100714			1015		1		X						X							
9	B-51-S-3.5-100714			1035		2		X						X							
10	B-51-S-8-100714		↓	1040	↓	2		X						X							

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

TAT Requested (circle)

1 Day 2 Day 3 Day

4 DAY 5 DAY Other: Hold

SPECIAL INSTRUCTIONS:

Hold Samples upon reciept

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [signature]	Signature: Janet Mallory	Signature:	Signature:
Date: 10/8/14	Date: 10/8	Date:	Date:
Printed Name: Bret Waldron	Printed Name: Janet Mallory	Printed Name:	Printed Name:
Time: 1825	Time: 1830	Time:	Time:
Company: URS	Company:	Company:	Company:

ALS Environmental

~~APEX LABS~~

CHAIN OF CUSTODY

Lab # K1411112 COC 2 of 5

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

Company: URS	Project Mgr: Paul Kalina	Project Name: IP-Tacoma Metals	Project # 33764085
Address: 1501 4th Ave, Ste 1400, Seattle, WA 98101-3225	Phone: 206-438-2172	Fax: 866-495-5282	Email: paul.kalina@urs.com
Sampled by: Bret Waldron			

Site Location: OR (WA)

Other: _____

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200-COLS	1200-Z
							ANALYSIS REQUEST														
1	B-52-S-3.5-100714		10/7/14	1115	S	2		X						X							
2	B-53-S-4-100714			1140		2		X						X							
3	B-54-S-6-100714			1235		1		X						X							
4	B-55-S-4-100714			1315		1		X						X							
5	B-55-S-7.5-100714			1305		1		X						X							
6	B-55-S-10-100714			1310		2		X						X							
7	B-56-S-7-100714			1355		2		X						X							
8	B-56-S-13-100714			1357		1		X						X							
9	B-57-S-7.5-100714			1425		2		X						X							
10	B-57-S-9-100714		↓	1435	↓	1		X						X							

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

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

SAMPLES ARE HELD FOR 30 DAYS

SPECIAL INSTRUCTIONS: Hold Samples upon reciept

RELINQUISHED BY:		RECEIVED BY:	
Signature:	Date: 10/8/14	Signature: Janet Mallorca	Date: 10/8
Printed Name: Bret Waldron	Time: 1825	Printed Name: Janet Mallorca	Time: 1850
Company: URS		Company:	

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

PC JM

Cooler Receipt and Preservation Form

Client / Project: URS Service Request *K14* 11112

Received: 10/8/14 Opened: 10/8/14 By: UA Unloaded: 10/9/14 By: AR

1. Samples were received via? *Mail* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *(Hand Delivered)*
2. Samples were received in: (circle) *(Cooler)* *Box* *Envelope* *Other* _____ *NA*
3. Were custody seals on coolers? NA Y (N) If yes, how many and where? _____
   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
4.5	4.4	8.8	8.7	-0.1	345			
2.8	2.7	5.5	5.4	-0.1	325			

4. Packing material: *Inserts* *(Baggies)* *(Bubble Wrap)* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* _____
5. Were custody papers properly filled out (ink, signed, etc.)? NA (Y) N
6. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA (Y) N
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA (Y) N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA (Y) N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA (Y) N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* (NA) Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* (NA) Y N
12. Was C12/Res negative? (NA) Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions: _____

Page ____ *of* ____

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	URS Corporation	**Service Request:**	K1411112
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/7/14
Sample Matrix:	Soil	**Date Received:**	10/9/14
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Solids, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
B-49-S-8-100714	K1411112-005	**45.7**	-	1	10/22/14 11:41	
B-57-S-7.5-100714	K1411112-019	**37.9**	-	1	10/22/14 11:41	
B-57-S-9-100714	K1411112-020	**41.7**	-	1	10/22/14 11:41	

ALS Group USA, Corp.

dba ALS Environmental

QA/QC Report

Client:	URS Corporation	**Service Request:**	K1411112
Project	IP Tacoma Metals/33764085	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Replicate Sample Summary

Solids, Total

Sample Name:	Lab Code:	MRL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
Batch QC	K1411111-005DUP	-	79.9	78.0	79.0	2	20	10/22/14
Batch QC	K1411224-012DUP	-	22.5	22.4	22.5	<1	20	10/22/14

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client: URS Corporation **Service Request:** K1411112
Project: IP Tacoma Metals/33764085

Cover Page - Organic Analysis Data Package
Diesel and Residual Range Organics

Sample Name	Lab Code	Date Collected	Date Received
B-49-S-8-100714	K1411112-005	10/07/2014	10/09/2014
B-57-S-7.5-100714	K1411112-019	10/07/2014	10/09/2014
B-57-S-9-100714	K1411112-020	10/07/2014	10/09/2014

Client: URS Corporation **Service Request:** K1411112
Project: IP Tacoma Metals/33764085
Sample Matrix: Soil

Surrogate Recovery Summary
Diesel and Residual Range Organics

Extraction Method: EPA 3550B **Units:** Percent
Analysis Method: NWTPH-Dx **Level:** Low

Sample Name	Lab Code	Sur1	Sur2
B-49-S-8-100714	K1411112-005	91 D #	141 D #
B-57-S-7.5-100714	K1411112-019	98 D #	245 D #
B-57-S-9-100714	K1411112-020	129 D	168 D *
Batch QC	K1411494-003	87 D	100 D
Batch QCDUP	KWG1414518-1	37 D *	40 D *
Method Blank	KWG1414518-5	82	87
Lab Control Sample	KWG1414518-4	84	86

Surrogate Recovery Control Limits (%)

Sur1	o-Terphenyl	50-150
Sur2	n-Triacontane	50-150

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411112
Project:	IP Tacoma Metals/33764085	**Date Collected:**	NA
Sample Matrix:	Solid	**Date Received:**	NA

Diesel and Residual Range Organics

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1414518-5	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	NWTPH-Dx		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	ND	U	25	1	10/21/14	10/31/14	KWG1414518	
Residual Range Organics (RRO)	ND	U	99	1	10/21/14	10/31/14	KWG1414518	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	82	50-150	10/31/14	Acceptable
n-Triacontane	87	50-150	10/31/14	Acceptable

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411112
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/07/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Diesel and Residual Range Organics

Sample Name:	B-49-S-8-100714	**Units:**	mg/Kg
Lab Code:	K1411112-005	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	NWTPH-Dx		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	**20000**	DZ	2200	20	10/21/14	11/01/14	KWG1414518	
Residual Range Organics (RRO)	**32000**	DZ	8800	20	10/21/14	11/01/14	KWG1414518	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	91	50-150	11/01/14	Acceptable
n-Triacontane	141	50-150	11/01/14	Acceptable

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411112
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/07/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Diesel and Residual Range Organics

Sample Name:	B-57-S-7.5-100714	**Units:**	mg/Kg
Lab Code:	K1411112-019	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	NWTPH-Dx		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	**11000**	DZ	2700	20	10/21/14	11/01/14	KWG1414518	
Residual Range Organics (RRO)	**60000**	DZ	11000	20	10/21/14	11/01/14	KWG1414518	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	98	50-150	11/01/14	Acceptable
n-Triacontane	245	50-150	11/01/14	Outside Control Limits

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411112
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/07/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Diesel and Residual Range Organics

Sample Name:	B-57-S-9-100714	**Units:**	mg/Kg
Lab Code:	K1411112-020	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	NWTPH-Dx		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	**34000**	DZ	1200	5	10/21/14	10/31/14	KWG1414518	
Residual Range Organics (RRO)	**22000**	DZ	4800	5	10/21/14	10/31/14	KWG1414518	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	129	50-150	10/31/14	Acceptable
n-Triacontane	168	50-150	10/31/14	Outside Control Limits

Comments:

QA/QC Report

Client:	URS Corporation	**Service Request:**	K1411112
Project:	IP Tacoma Metals/33764085	**Date Extracted:**	10/21/2014
Sample Matrix:	Solid	**Date Analyzed:**	11/01/2014

Duplicate Sample Summary
Diesel and Residual Range Organics

Sample Name:	Batch QC	**Units:**	mg/Kg
Lab Code:	K1411494-003	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	NWTPH-Dx	**Extraction Lot:**	KWG1414518

			Batch QCDUP KWG1414518-1			
			Duplicate Sample		**Relative**	
Analyte Name	**MRL**	**Sample Result**	**Result**	**Average**	**Percent Difference**	**RPD Limit**
Diesel Range Organics (DRO)	640	ND	ND	ND	-	40
Residual Range Organics (RRO)	640	2100	1000	1600	69 #	40

Results flagged with an asterisk (*) indicate values outside control criteria.

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Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	URS Corporation	**Service Request:**	K1411112
Project:	IP Tacoma Metals/33764085	**Date Extracted:**	10/21/2014
Sample Matrix:	Solid	**Date Analyzed:**	10/31/2014

Lab Control Spike Summary
Diesel and Residual Range Organics

Extraction Method:	EPA 3550B	**Units:**	mg/Kg
Analysis Method:	NWTPH-Dx	**Basis:**	Dry
		Level:	Low
		Extraction Lot:	KWG1414518

	Lab Control Sample KWG1414518-4 Lab Control Spike			
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**
Diesel Range Organics (DRO)	233	267	87	42-134
Residual Range Organics (RRO)	151	133	113	48-141

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client: URS Corporation **Service Request:** K1411112
Project: IP Tacoma Metals/33764085

Cover Page - Organic Analysis Data Package
Semi-Volatile Organic Compounds by GC/MS

Sample Name	Lab Code	Date Collected	Date Received
B-49-S-8-100714	K1411112-005	10/07/2014	10/09/2014
B-57-S-7.5-100714	K1411112-019	10/07/2014	10/09/2014
B-57-S-9-100714	K1411112-020	10/07/2014	10/09/2014

Client: URS Corporation **Service Request:** K1411112
Project: IP Tacoma Metals/33764085
Sample Matrix: Soil

Surrogate Recovery Summary
Semi-Volatile Organic Compounds by GC/MS

Extraction Method: EPA 3541 **Units:** Percent
Analysis Method: 8270D **Level:** Low

Sample Name	Lab Code	Sur1	Sur2	Sur3
B-49-S-8-100714	K1411112-005	64	73	88
B-57-S-7.5-100714	K1411112-019	71	74	93
B-57-S-9-100714	K1411112-020	61 D	61 D	77 D
Method Blank	KWG1414210-3	53	53	66
Lab Control Sample	KWG1414210-1	60	65	74
Duplicate Lab Control Sample	KWG1414210-2	66	61	71

Surrogate Recovery Control Limits (%)

Sur1	= Nitrobenzene-d5	29-116
Sur2	= 2-Fluorobiphenyl	32-104
Sur3	= Terphenyl-d14	37-133

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411112
Project:	IP Tacoma Metals/33764085	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1414210-3	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
2-Methylnaphthalene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Acenaphthylene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Acenaphthene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Dibenzofuran	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Fluorene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Phenanthrene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Anthracene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Fluoranthene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Pyrene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Benz(a)anthracene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Chrysene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Benzo(b)fluoranthene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Benzo(k)fluoranthene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Benzo(a)pyrene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Indeno(1,2,3-cd)pyrene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Dibenz(a,h)anthracene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	
Benzo(g,h,i)perylene	ND	U	0.33	1	10/21/14	10/27/14	KWG1414210	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Nitrobenzene-d5	53	29-116	10/27/14	Acceptable
2-Fluorobiphenyl	53	32-104	10/27/14	Acceptable
Terphenyl-d14	66	37-133	10/27/14	Acceptable

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411112
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/07/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	B-49-S-8-100714	**Units:**	mg/Kg
Lab Code:	K1411112-005	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**46**		4.4	1	10/21/14	10/27/14	KWG1414210	
2-Methylnaphthalene	**21**		4.4	1	10/21/14	10/27/14	KWG1414210	
Acenaphthylene	ND	U	4.4	1	10/21/14	10/27/14	KWG1414210	
Acenaphthene	**31**		4.4	1	10/21/14	10/27/14	KWG1414210	
Dibenzofuran	**13**		4.4	1	10/21/14	10/27/14	KWG1414210	
Fluorene	**22**		4.4	1	10/21/14	10/27/14	KWG1414210	
Phenanthrene	**57**		4.4	1	10/21/14	10/27/14	KWG1414210	
Anthracene	**320**	D	22	5	10/21/14	10/28/14	KWG1414210	
Fluoranthene	**250**	D	22	5	10/21/14	10/28/14	KWG1414210	*
Pyrene	**330**	D	22	5	10/21/14	10/28/14	KWG1414210	
Benz(a)anthracene	**170**	D	22	5	10/21/14	10/28/14	KWG1414210	
Chrysene	**550**	D	87	20	10/21/14	10/28/14	KWG1414210	
Benzo(b)fluoranthene	**210**	D	22	5	10/21/14	10/28/14	KWG1414210	
Benzo(k)fluoranthene	**72**	D	22	5	10/21/14	10/28/14	KWG1414210	
Benzo(a)pyrene	**150**	D	22	5	10/21/14	10/28/14	KWG1414210	
Indeno(1,2,3-cd)pyrene	**64**		4.4	1	10/21/14	10/27/14	KWG1414210	
Dibenz(a,h)anthracene	**22**		4.4	1	10/21/14	10/27/14	KWG1414210	
Benzo(g,h,i)perylene	**56**		4.4	1	10/21/14	10/27/14	KWG1414210	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Nitrobenzene-d5	64	29-116	10/27/14	Acceptable
2-Fluorobiphenyl	73	32-104	10/27/14	Acceptable
Terphenyl-d14	88	37-133	10/27/14	Acceptable

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411112
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/07/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	B-57-S-7.5-100714	**Units:**	mg/Kg
Lab Code:	K1411112-019	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	21	1	10/21/14	10/27/14	KWG1414210	
2-Methylnaphthalene	**21**		21	1	10/21/14	10/27/14	KWG1414210	
Acenaphthylene	**28**		21	1	10/21/14	10/27/14	KWG1414210	
Acenaphthene	**31**		21	1	10/21/14	10/27/14	KWG1414210	
Dibenzofuran	ND	U	21	1	10/21/14	10/27/14	KWG1414210	
Fluorene	**45**		21	1	10/21/14	10/27/14	KWG1414210	
Phenanthrene	**120**		21	1	10/21/14	10/27/14	KWG1414210	
Anthracene	**1000**	D	110	5	10/21/14	10/28/14	KWG1414210	
Fluoranthene	**260**		21	1	10/21/14	10/27/14	KWG1414210	
Pyrene	**710**	D	110	5	10/21/14	10/28/14	KWG1414210	
Benz(a)anthracene	**910**	D	110	5	10/21/14	10/28/14	KWG1414210	
Chrysene	**3400**	D	1100	50	10/21/14	10/28/14	KWG1414210	
Benzo(b)fluoranthene	**1500**	D	110	5	10/21/14	10/28/14	KWG1414210	
Benzo(k)fluoranthene	**510**	D	110	5	10/21/14	10/28/14	KWG1414210	
Benzo(a)pyrene	**1200**	D	110	5	10/21/14	10/28/14	KWG1414210	
Indeno(1,2,3-cd)pyrene	**630**	D	110	5	10/21/14	10/28/14	KWG1414210	
Dibenz(a,h)anthracene	**290**		21	1	10/21/14	10/27/14	KWG1414210	
Benzo(g,h,i)perylene	**540**	D	110	5	10/21/14	10/28/14	KWG1414210	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Nitrobenzene-d5	71	29-116	10/27/14	Acceptable
2-Fluorobiphenyl	74	32-104	10/27/14	Acceptable
Terphenyl-d14	93	37-133	10/27/14	Acceptable

Comments:

Analytical Results

Client:	URS Corporation	**Service Request:**	K1411112
Project:	IP Tacoma Metals/33764085	**Date Collected:**	10/07/2014
Sample Matrix:	Soil	**Date Received:**	10/09/2014

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	B-57-S-9-100714	**Units:**	mg/Kg
Lab Code:	K1411112-020	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**1400**	D	240	50	10/21/14	10/28/14	KWG1414210	
2-Methylnaphthalene	**810**	D	48	10	10/21/14	10/28/14	KWG1414210	
Acenaphthylene	ND	U	24	5	10/21/14	10/27/14	KWG1414210	
Acenaphthene	**720**	D	48	10	10/21/14	10/28/14	KWG1414210	
Dibenzofuran	**280**	D	24	5	10/21/14	10/27/14	KWG1414210	
Fluorene	**460**	D	24	5	10/21/14	10/27/14	KWG1414210	
Phenanthrene	**1700**	D	240	50	10/21/14	10/28/14	KWG1414210	
Anthracene	**990**	D	240	50	10/21/14	10/28/14	KWG1414210	
Fluoranthene	**900**	D	48	10	10/21/14	10/28/14	KWG1414210	*
Pyrene	**760**	D	48	10	10/21/14	10/28/14	KWG1414210	
Benz(a)anthracene	**220**	D	24	5	10/21/14	10/27/14	KWG1414210	
Chrysene	**440**	D	24	5	10/21/14	10/27/14	KWG1414210	
Benzo(b)fluoranthene	**180**	D	24	5	10/21/14	10/27/14	KWG1414210	
Benzo(k)fluoranthene	**55**	D	24	5	10/21/14	10/27/14	KWG1414210	
Benzo(a)pyrene	**140**	D	24	5	10/21/14	10/27/14	KWG1414210	
Indeno(1,2,3-cd)pyrene	**60**	D	24	5	10/21/14	10/27/14	KWG1414210	
Dibenz(a,h)anthracene	ND	U	24	5	10/21/14	10/27/14	KWG1414210	
Benzo(g,h,i)perylene	**56**	D	24	5	10/21/14	10/27/14	KWG1414210	

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Nitrobenzene-d5	61	29-116	10/27/14	Acceptable
2-Fluorobiphenyl	61	32-104	10/27/14	Acceptable
Terphenyl-d14	77	37-133	10/27/14	Acceptable

Comments:

ALS Environmental
ALS Group USA, Corp
1317 South 13th Avenue
Kelso, WA 98626
T +1 360 577 7222
+1 360 636 1068
.alsglobal.com

June 08, 2015 **Analytical Report for Service Re uest No** K1505210

Paul Kalina
AECOM
1501 4th Ave.,Suite 1400
Seattle, WA 98101

RE IP Tacoma Metals 33 640 5.

Dear Paul,

Enclosed are the results of the sample(s) submitted to our laboratory October 08, 2014
For your reference, these analyses have been assigned our service request number **1505210.**

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3375. You may also contact me via email at Janet.Malloch@alsglobal.com.

Respectfully submitted,

ALS Group USA Corp. dba ALS Environmental

For JM

Janet Malloch
Project Manager

ALS ENVIRONMENTAL

Client:	AECOM	**Service Request No.:**	K1505210
Project:	IP Tacoma Metals/ 33764085.	**Date Received:**	10/08/14-10/31/14
Sample Matrix:	Soil		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier IV validation deliverables including summary forms and all of the associated raw data for each of the analyses. When appropriate to the method, method blank results have been reported with each analytical test.

Sample Receipt

Six soil samples were received for analysis at ALS Environmental between 10/08/14 and 10/31/14. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory. These samples were originally logged under Service Requests K1411110, K1411111, K1411112, and K14123304.

Diesel Range Organics by Method NWTPH-Dx

Holding Time Exceptions:
The samples were received past holding time. The analysis was performed as soon as possible after receipt by the laboratory. The data was flagged to indicate the holding time violation.

Surrogate Exceptions:
The control criteria for o-Terphenyl and n-Triacontane in sample B-77-S-5-103014 were not applicable. The analysis of the sample required a dilution, which resulted in a surrogate concentration below the reporting limit. No further corrective action was appropriate.

Elevated Detection Limits:
The detection limit was elevated for Diesel Range Organics (DRO) and Residual Range Organics (RRO) in all field samples. The sample extracts were diluted prior to instrumental analysis to protect the instrument injection port from unnecessary fouling. The extracts were highly colored, which suggested the presence of elevated levels of higher-boiling components and indicated the need to perform a dilution prior to injection into the instrument.

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) criterion for the replicate analysis of Residual Range Organics (RRO) in sample Batch QC was not applicable because the analyte concentration was not significantly greater than the Method Reporting Limit (MRL). Analytical values derived from measurements close to the detection limit are not subject to the same accuracy and precision criteria as results derived from measurements higher on the calibration range for the method.

No other anomalies associated with the analysis of these samples were observed.

Approved by: _____

Polynuclear Aromatic Hydrocarbons by EPA Method 8270

Holding Time Exceptions:
The analysis of all samples was initially performed past the recommended holding time. The extraction was not requested within the holding time of the samples. Efforts were made to analyze the samples as soon as possible once the extraction was requested. The data was flagged to indicate the holding time violation.

Calibration Verification Exceptions:
The following analytes were flagged as outside the control criterion for Continuing Calibration Verification (CCV) MS14\0601F002.D: Pyrene and Terphenyl-d14. In accordance with the EPA Method, 80% or more of the CCV analytes must have passed within 20% of the true value. The remaining analytes are allowed a 40% difference as per the ALS SOP. The CCV met these criteria. No further corrective action was required.

The following analytes were flagged as outside the control criterion for Continuing Calibration Verification (CCV) MS14\0603F003.D: Benzo(g,h,i)perylene. In accordance with the EPA Method, 80% or more of the CCV analytes must have passed within 20% of the true value. The remaining analytes are allowed a 40% difference as per the ALS SOP. The CCV met these criteria. No further corrective action was required.

The following analytes were flagged as outside the control criterion for Continuing Calibration Verification (CCV) MS14\0604F002.D: Dibenz(a,h)anthracene and Benzo(g,h,i)perylene. In accordance with the EPA Method, 80% or more of the CCV analytes must have passed within 20% of the true value. The remaining analytes are allowed a 40% difference as per the ALS SOP. The CCV met these criteria. No further corrective action was required.

Surrogate Exceptions:
The control criteria for Fluorene-d10, Fluoranthene-d10, and Terphenyl-d14 in samples B-58-S-4-100714, B-58-S-4-100714MS, B-58-S-4-100714DMS, B-69-S-4.5-100814 and B-77-S-5-103014 were not applicable. The analysis of the sample required a dilution, which resulted in a surrogate concentration below the reporting limit. No further corrective action was appropriate.

Matrix Spike Recovery Exceptions:
The control criteria for matrix spike recovery of all analytes for sample B-58-S-4-100714 were not applicable. The analyte concentration in the sample was significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery.

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) for Naphthalene, 2-Methylnaphthalene, 1-Methylnaphthalene, Acenaphthene, and Dibenzofuran in the replicate matrix spike analyses of sample B-58-S-4-100714 was outside control criteria. All spike recoveries and the RPD for the analytes in question were within acceptance limits in the LCS/DLCS, indicating the analytical batch was in control. No further corrective action was taken.

Elevated Detection Limits:
The detection limit was elevated for all analytes in samples B-58-S-4-100714, B-58-S-4-100714MS, B-58-S-4-100714DMS, B-69-S-4.5-100814, and B-77-S-5-103014. The sample extract was diluted prior to instrumental analysis due to relatively high levels of non-target background components. The extract was highly colored and viscous, which indicated the need to perform a dilution prior to injection into the instrument. Clean-up of the extract was performed within the scope of the method, but did not eliminate enough of the background components to prevent dilution. The results were flagged to indicate the matrix interference.

Sample B-58-S-4-100714 required dilution due to the presence of elevated levels of Chrysene. The reporting limits were adjusted to reflect the dilution.

Approved by_____

Sample B-49-S-7-100714 required dilution due to the presence of elevated levels of Chrysene, Benzo(b)fluoranthene, and Benzo(a)pyrene. The reporting limits were adjusted to reflect the dilution.

Sample B-77-S-5-103014 required dilution due to the presence of elevated levels of Acenaphthene, Phenanthrene, Fluoranthene, and Pyrene. The reporting limits were adjusted to reflect the dilution.

The detection limit for all analytes for samples B-58-S-4-100714 and B-55-S-4-100714 was elevated due to less than optimal sample mass extracted for analysis. The sample contained low percent solids which prevented extraction of the sample mass necessary to achieve target detection limits.

No other anomalies associated with the analysis of these samples were observed.

Approved by 

ALS Environmental

~~APEX LABS~~

CHAIN OF CUSTODY

Lab # K1411110 COC 3 of 5

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

Company: URS | Project Mgr: Paul Kalina | Project Name: IP-Tacoma Metals | Project # 33764085

Address: 1501 4th Ave, Ste 1400, Seattle, WA 98101-3225 | Phone: 206-438-2172 | Fax: 866-495-5282 | Email: paul.kalina@urs.com

Sampled by: Bret Waldron

Site Location: OR (WA) Other: _____

ANALYSIS REQUEST

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200-COLS	1200-Z
1	B-58-S-4-100714		10/7/14	1515	S	1		X						X							
2	B-58-S-7.5-100714		10/7/14	1510		1		X						X							
3	B-59-S-3.5-100814		10/8/14	0835		1		X						X							
4	B-60-S-4.5-100814		10/8/14	0900		1		X						X							
5	B-60-S-9-100814		10/8/14	0905		1		X						X							
6	B-61-S-7-100814		10/8/14	0945		1		X						X							
7	B-61-S-13-100814		10/8/14	0955		2		X						X							
8	B-62-S-4-100814		10/8/14	1025		1		X						X							
9	B-62-S-8-100814		10/8/14	1030		1		X						X							
10	B-63-S-4-100814		10/8/14	1050		1		X						X							

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

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

SPECIAL INSTRUCTIONS: Hold samples upon reciept

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY:		RECEIVED BY:	
Signature:	Date: 10/8/14	Signature: Janet Mallorh	Date: 10/8
Printed Name: Bret Waldron	Time: 1825	Printed Name: Janet Mallorh	Time: 1830
Company: URS		Company:	

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

ALS Environmental

~~APEX LABS~~

CHAIN OF CUSTODY

Lab # K1411110 COC 4 of 5

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

Company: URS | Project Mgr: Paul Kalina | Project Name: IP-Tacoma Metals | Project # 33764085

Address: 1501 4th Ave, Ste 1400, Seattle, WA 98101-3225 | Phone: 206-438-2172 | Fax: 866-495-5282 | Email: paul.kalina@urs.com

Sampled by: Bret Waldron

Site Location: OR (WA)

Other: _____

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200-COLS	1200-Z
1	B-63-S-10.5-100814		10/8/14	1055	S	1		X						X							
2	B-64-S-7.5-100814			1130																	
3	B-64-S-14-100814			1135																	
4	B-65-S-3.5-100814			1215		1															
5	B-65-S-8-100814			1220		2															
6	B-65-S-17-100814			1225		1															
7	B-66-S-8-100814			1255		1															
8	B-67-S-4-100814			1345		1															
9	B-67-S-8-100814			1350		1															
10	B-67-S-9-100814		↓	1355		1		↓						↓							

ANALYSIS REQUEST

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

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

SPECIAL INSTRUCTIONS: Hold Samples upon reciept.

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [signature]	Signature: Janet Mallorh	Signature:	Signature:
Date: 10/8/14	Date: 10/8	Date:	Date:
Printed Name: Bret Waldron	Printed Name: Janet Mallorh	Printed Name:	Printed Name:
Time: 1825	Time: 1830	Time:	Time:
Company: URS	Company:	Company:	Company:

PC JM

Cooler Receipt and Preservation Form

Client / Project: URS Service Request K14 11110

Received: 10/8/14 Opened: 10/8/14 By: MI Unloaded: 10/9/14 By: MI

1. Samples were received via? *Mail* *Fed Ex* *UPS* *DHL* *PDX* *Courier* (*Hand Delivered*)
2. Samples were received in: (circle) (*Cooler*) *Box* *Envelope* *Other*_____ *NA*
3. Were custody seals on coolers? NA Y (N) If yes, how many and where?_____
   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
4.5	4.4	8.8	8.7	-0.1	345			
2.8	2.7	5.5	5.4	-0.1	325			

4. Packing material: *Inserts* (*Baggies*) (*Bubble Wrap*) *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* _____
5. Were custody papers properly filled out (ink, signed, etc.)? NA (Y) N
6. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA (Y) N
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA (Y) N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA (Y) N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA (Y) N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* (NA) Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* (NA) Y N
12. Was C12/Res negative? (NA) Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

*Notes, Discrepancies, & Resolutions:*_____

Page ____ *of* ____

CHAIN OF CUSTODY

ALS Environmental

1317 South 13th Ave., Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

SR# K1411111

PAGE 5 OF 5 COC#

PROJECT NAME: IP-Tacoma Metals
PROJECT NUMBER: 33764085
PROJECT MANAGER: Paul Kalina
COMPANY NAME: URS
ADDRESS: 1501 4th Ave, Ste 1400
CITY/STATE/ZIP: Seattle/WA/98101-3225
E-MAIL ADDRESS: Paul.Kalina@urs.com
PHONE #: 206-438-2172 FAX #: 866-495-5282
SAMPLER'S SIGNATURE: Bret Waldron

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☐ 8270LL☐ SIM PAH☒	Volatile Organics 624☐ 8260☒	Hydrocarbons (*see below) Gas☐ Diesel☒ Oil☒ 8021☐ BTEX☐	Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐	PCBs Aroclors☐ Congeners☐	Pesticides/Herbicides 608☐ 8081☐ 8141☐ 8151☐	Chlorophenolics - 8151M Tri☐ Tetra☐ PCP☐	Metals, Total or Dissolved (See List below)	Cyanide☐ Hex-Chrom☐	(circle) pH, Cond., Cl, SO4, PO4, F, NO2, NO3, BOD, TSS, TDS, Turb.	(circle) NH3-N, COD, TKN, TOC, DOC, NO2+NO3, T-Phos	TOX 9020☐ AOX 1650☐ 506☐	Alkalinity ☐ CO3☐ HCO3☐	Dioxins/Furans 1613☐ 8290☐	Dissolved Gases RSK 175☐ CO2☐ Methane☐ Ethane☐ Ethene☐	REMARKS
B-68-S-4-100814	10/8/14	1425		S		X		X													
B-68-S-13.5-100814		1430				X		X													
B-69-S-4.5-100814		1455				X		X													
B-69-S-8.5-100814		1500				X		X													
B-69-S-12.5-100814		1505				X		X													

REPORT REQUIREMENTS

- X I. Routine Report: Method Blank, Surrogate, as required
- ___ II. Report Dup., MS, MSD as required
- ___ III. CLP Like Summary (no raw data)
- ___ IV. Data Validation Report
- ___ V. EDD

INVOICE INFORMATION

P.O. # 33764085
Bill To: Paul Kalina

TURNAROUND REQUIREMENTS

___ 24 hr. ___ 48 hr.
___ 5 day
___ Standard (15 working days)
___ Provide FAX Results
Hold
Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: ___ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

Hold upon reciept

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: Bret Waldron	Signature: Janet Mallock	Signature	Signature
Date/Time: 10/8/14 1825	Date/Time: 10/8 1830	Date/Time	Date/Time
Printed Name: Bret Waldron	Printed Name: Janet Mallock	Printed Name	Printed Name
Firm: URS	Firm: ALS	Firm	Firm

PC JM

Cooler Receipt and Preservation Form

Client / Project: URS Service Request K14 11111

Received: 10/8/14 Opened: 10/8/14 By: UA Unloaded: 10/9/14 By: AR

1. Samples were received via? *Mail* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other* _____ *NA*
3. Were custody seals on coolers? NA Y N If yes, how many and where? _____
   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
4.5	4.4	8.8	8.7	-0.1	345			
2.8	2.7	5.5	5.4	-0.1	325			

4. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* _____
5. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
6. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA Y N
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
12. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions: _____

Page ____ *of* ____

ALS Environmental

~~APEX LABS~~

CHAIN OF CUSTODY

Lab # K1411112 COC 1 of 5

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

Company: URS	Project Mgr: Paul Kalina	Project Name: IP-Tacoma Metals	Project # 33764085
Address: 1501 4th Ave. Ste 1400, Seattle, WA 98101-3225	Phone: 206-438-2172	Fax: 866-495-5282	Email: paul.kalina@urs.com
Sampled by: Bret Waldron			

Site Location: OR (WA)

Other: _____

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200-COLS	1200-Z
							ANALYSIS REQUEST														
1	B-48-S-3-100714		10/7	~~1005~~ 0925	S	2		X						X							
2	B-48-S-4-100714			0920		1		X						X							
3	B-48-S-7-100714			0935		2		X						X							
4	B-49-S-7-100714			0900		2		X						X							
5	B-49-S-8-100714			0855		2		X						X							
6	B-50-S-4-100714			1005		1		X						X							
7	B-50-S-7-100714			1010		1		X						X							
8	B-50-S-8-100714			1015		1		X						X							
9	B-51-S-3.5-100714			1035		2		X						X							
10	B-51-S-8-100714		↓	1040	↓	2		X						X							

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

TAT Requested (circle)

1 Day 2 Day 3 Day

4 DAY 5 DAY Other: Hold

SPECIAL INSTRUCTIONS:

Hold Samples upon reciept

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY:		RECEIVED BY:	
Signature:	Date: 10/8/14	Signature: Janet Mallory	Date: 10/8
Printed Name: Bret Waldron	Time: 1825	Printed Name: Janet Mallory	Time: 1830
Company: URS		Company:	

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

ALS Environmental

~~APEX LABS~~

CHAIN OF CUSTODY

Lab # K1411112 COC 2 of 5

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

Company: URS	Project Mgr: Paul Kalina	Project Name: IP-Tacoma Metals	Project # 33764085
Address: 1501 4th Ave, Ste 1400, Seattle, WA 98101-3225	Phone: 206-438-2172	Fax: 866-495-5282	Email: paul.kalina@urs.com
Sampled by: Bret Waldron			

Site Location: OR (WA)

Other: _____

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200- COLS	1200-Z
							ANALYSIS REQUEST														
1	B-52-S-3.5-100714		10/7/14	1115	S	2		X						X							
2	B-53-S-4-100714			1140		2		X						X							
3	B-54-S-6-100714			1235		1		X						X							
4	B-55-S-4-100714			1315		1		X						X							
5	B-55-S-7.5-100714			1305		1		X						X							
6	B-55-S-10-100714			1310		2		X						X							
7	B-56-S-7-100714			1355		2		X						X							
8	B-56-S-13-100714			1357		1		X						X							
9	B-57-S-7.5-100714			1425		2		X						X							
10	B-57-S-9-100714		↓	1435	↓	1		X						X							

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

TAT Requested (circle)

1 Day 2 Day 3 Day

4 DAY 5 DAY Other: Hold

SPECIAL INSTRUCTIONS:

Hold Samples upon reciept

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY:		RECEIVED BY:	
Signature: Bret	Date: 10/8/14	Signature: Janet Mallory	Date: 10/8
Printed Name: Bret Waldron	Time: 1825	Printed Name: Janet Mallory	Time: 1850
Company: URS		Company:	

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

PC JM

Cooler Receipt and Preservation Form

Client / Project: URS Service Request K14 11112

Received: 10/8/14 Opened: 10/8/14 By: UL Unloaded: 10/9/14 By: AR

1. Samples were received via? *Mail* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *(Hand Delivered)*
2. Samples were received in: (circle) *(Cooler)* *Box* *Envelope* *Other*_____ *NA*
3. Were custody seals on coolers? NA Y (N) If yes, how many and where?_____
   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
4.5	4.4	8.8	8.7	-0.1	345			
2.8	2.7	5.5	5.4	-0.1	325			

4. Packing material: *Inserts* *(Baggies)* *(Bubble Wrap)* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* _____
5. Were custody papers properly filled out (ink, signed, etc.)? NA (Y) N
6. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA (Y) N
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA (Y) N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA (Y) N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA (Y) N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* (NA) Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* (NA) Y N
12. Was C12/Res negative? (NA) Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

*Notes, Discrepancies, & Resolutions:*_____

Page____ of____

CHAIN OF CUSTODY

ALS Environmental

1317 South 13th Ave., Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

SR# K1412309

PAGE 1 OF 3 COC#

PROJECT NAME	IP - Tacoma Metals
PROJECT NUMBER	33764085
PROJECT MANAGER	Paul Kalina
COMPANY NAME	URS
ADDRESS	1501 4th Ave, Suite 1400
CITY/STATE/ZIP	Seattle, WA 98101-3225
E-MAIL ADDRESS	Paul.Kalina@URS.com
PHONE #	206-438-2172 FAX # 866-495-5282
SAMPLER'S SIGNATURE	Eric Storkelson

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625 ☐ 8270 ☐ 8270LL ☐ SIM PAH ☐	Volatile Organics 624 ☐ 8260 ☐ 8021 ☐ BTEX ☐	Hydrocarbons Gas ☐ Oil & Grease/TRPH 1664 HEM ☐ (see below) Diesel ☐ Oil ☐ 1664 SGT ☐	PCBs Aroclors ☐ Congeners ☐	Pesticides/Herbicides 608 ☐ 8081 ☐ 8141 ☐ 8151 ☐	Chlorophenolics - 8151M Tri ☐ Tetra ☐ PCP ☐	Metals, Total or Dissolved (See List below)	Cyanide ☐ Hex-Chrom ☐	(circle) pH, Cond., Cl, SO4, PO4, F, NO2, NO3, BOD, TSS, TDS, Turb.	(circle) NH3-N, COD, TKN, TOC, DOC, NO2+NO3, T-Phos	TOX 9020 ☐ AOX 1650 ☐ 506 ☐	Alkalinity ☐ CO_3 ☐ HCO_3 ☐	Dioxins/Furans 1613 ☐ 8290 ☐	Dissolved Gases CO_2 ☐ RSK 175 ☐ Methane ☐ Ethane ☐ Ethene ☐	REMARKS
B-70-S-4.5-103014	10/30/14	845		S	1	X		X												
B-71-S-4.5-103014		910				X		X												
B-71-S-8.5-103014		915				X		X												
B-71-S-14-103014		920				X		X												
B-72-S-4-103014		945				X		X												
B-72-S-8-103014		940				X		X												
B-72-S-13-103014		935				X		X												
B-73-S-3.5-103014		1005				X		X												
B-73-S-9-103014		1007				X		X												
B-74-S-8-103014		1020				X		X												

REPORT REQUIREMENTS

- X I. Routine Report: Method Blank, Surrogate, as required
- ___ II. Report Dup., MS, MSD as required
- ___ III. CLP Like Summary (no raw data)
- ___ IV. Data Validation Report
- ___ V. EDD

INVOICE INFORMATION

P.O. # 33764085

Bill To: Paul Kalina

TURNAROUND REQUIREMENTS

___ 24 hr. ___ 48 hr.

___ 5 day

___ Standard (15 working days)

___ Provide FAX Results

HOLD

Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: ___ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

Hold upon receipt

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:		RECEIVED BY:		RELINQUISHED BY:		RECEIVED BY:	
Signature	Date/Time 10/30/14 1500	Signature	Date/Time 10/31/14 0830	Signature	Date/Time	Signature	Date/Time
Printed Name Eric Storkelson	Firm AECOM	Printed Name Bill Kell	Firm ALS	Printed Name	Firm	Printed Name	Firm

ALS Environmental

CHAIN OF CUSTODY

SR# 4176907

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PAGE 2 OF 3 COC#

PROJECT NAME	IP - Tacoma Metals
PROJECT NUMBER	33764085
PROJECT MANAGER	Paul Kalina
COMPANY NAME	URS
ADDRESS	1501 4th Ave, Suite 1400
CITY/STATE/ZIP	Seattle, WA 98101-3225
E-MAIL ADDRESS	Paul.Kalina@URS.com
PHONE #	206-438-2172 FAX # 866-495-5282
SAMPLER'S SIGNATURE	Eric Starkerson

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625 ☐ 8270 ☐ 8270LL ☐ SIM PAH ☐	Volatile Organics 624 ☐ 8260 ☐ 8021 ☐ BTEX ☐	Hydrocarbons (*see below) Gas ☐ Diesel ☐ Oil ☐ 1664 SGT ☐	Oil & Grease/TRPH 1664 HEM ☐	PCBs Aroclors ☐ Congeners ☐	Pesticides/Herbicides 608 ☐ 8081 ☐ 8141 ☐ 8151 ☐	Chlorophenolics - 8151M Tri ☐ Tetra ☐ PCP ☐	Metals, Total or Dissolved (See List below)	Cyanide ☐ Hex-Chrom ☐	(circle) pH, Cond., Cl, SO4, PO4, F, NO2, NO3, BOD, TSS, TDS, Turb.	(circle) NH3-N, COD, TKN, TOC, DOC, NO2+NO3, T-Phos	TOX 9020 ☐ AOX 1650 ☐ 506 ☐	Alkalinity ☐ CO3 ☐ HCO3 ☐	Dioxins/Furans 1613 ☐ 8290 ☐	Dissolved Gases RSK 175 ☐ Methane ☐ Ethane ☐ Ethene ☐ CO2 ☐	REMARKS
B-75-S-3-103014	10/30/14	1040		S	1	X		X														
B-76-S-8-103014		1115				X		X														
B-76-S-13-103014		1105				X		X														
B-77-S-5-103014		1140				X		X														
B-78-S-7.5-103014		1155				X		X														
B-78-S-14-103014		1200				X		X														
B-79-S-7.5-103014		1220				X		X														
B-79-S-12-103014		1225				X		X														
B-80-S-4-103014		1255				X		X														
B-80-S-8-103014	↓	1300		↓	↓	X		X														

REPORT REQUIREMENTS

- [X] I. Routine Report: Method Blank, Surrogate, as required
- [ ] II. Report Dup., MS, MSD as required
- [ ] III. CLP Like Summary (no raw data)
- [ ] IV. Data Validation Report
- [ ] V. EDD

INVOICE INFORMATION

P.O. # 33764085

Bill To: Paul Kalina

TURNAROUND REQUIREMENTS

- [ ] 24 hr. [ ] 48 hr.
- [ ] 5 day
- [ ] Standard (15 working days)
- [ ] Provide FAX Results

HOLD

Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

Hold upon receipt

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [signature]	Signature: Bibi Kell	Signature:	Signature:
Date/Time: 10/30/14 1500	Date/Time: 10/31/14 0830	Date/Time:	Date/Time:
Printed Name: Eric Starkerson	Printed Name: Bibi Kell	Printed Name:	Printed Name:
Firm: AECOM	Firm: ALS	Firm:	Firm:

CHAIN OF CUSTODY

ALS Environmental

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SR# K1412304

PAGE 3 OF 3 COC#

PROJECT NAME	IP - Tacoma Metals
PROJECT NUMBER	33764085
PROJECT MANAGER	Paul Kalina
COMPANY NAME	URS
ADDRESS	1501 4th Ave, Suite 1400
CITY/STATE/ZIP	Seattle, WA 98101-3225
E-MAIL ADDRESS	Paul.Kalina@URS.Com
PHONE #	206-438-2172 FAX # 866-495-5282
SAMPLER'S SIGNATURE	Eric Starkerson

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☒ 8270LL☐ SIM PAH☒	Volatile Organics 624☐ 8260☐	Hydrocarbons (*see below) Gas☐ Diesel☒ Oil☒	Oil & Grease/TPPH 1664 HEM☐ 1664 SGT☐	PCBs Aroclors☐ Congeners☐	Pesticides/Herbicides 608☐ 8081☐ 8141☐ 8151☐	Chlorophenolics - 8151M Tri☐ Tetra☐ PCP☐	Metals, Total or Dissolved (See List Below)	Cyanide☐ Hex-Chrom☐	(circle) pH, Cond., Cl, SO4, PO4, F, NO2, NO3, BOD, TSS, TDS, Turb.	(circle) NH3-N, COD, TKN, TOC, DOC, NO2+NO3, T-Phos	TOX 9020☐ AOX 1650☐ 506☐	Alkalinity☐ CO3☐ HCO3☐	Dioxins/Furans 1613☐ 8290☐	Dissolved Gases CO2☐ RSK 175☐ Methane☐ Ethane☐ Ethene☐	REMARKS
B-80-S-12-103014	10/30/14	1305		S	1	X	X														

REPORT REQUIREMENTS

- ☒ I. Routine Report: Method Blank, Surrogate, as required
- ☐ II. Report Dup., MS, MSD as required
- ☐ III. CLP Like Summary (no raw data)
- ☐ IV. Data Validation Report
- ☐ V. EDD

INVOICE INFORMATION

P.O. # 33764085

Bill To: Paul Kalina

TURNAROUND REQUIREMENTS

☐ 24 hr. ☐ 48 hr.

☐ 5 day

☐ Standard (15 working days)

☐ Provide FAX Results

HOLD

Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

HOLD upon receipt

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [signature]	Signature: [signature]	Signature	Signature
Date/Time: 10/30/14 1500	Date/Time: 10/31/14 0930	Date/Time	Date/Time
Printed Name: Eric Starkerson	Printed Name: Bibi Kell	Printed Name	Printed Name
Firm: AECOM	Firm: ALS	Firm	Firm

PC Joint

Cooler Receipt and Preservation Form

Client / Project: UPS / IP-Tacoma Metals Service Request *K14* 12304

Received: 10/31/14 Opened: 10/31/14 By: BK Unloaded: 10/31/14 By: BK

1. Samples were received via? *Mail* (*Fed Ex*) *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) (*Cooler*) *Box* *Envelope* *Other*_____ *NA*
3. Were custody seals on coolers? NA (Y) N If yes, how many and where? 1 front
   If present, were custody seals intact? (Y) N If present, were they signed and dated? (Y) N

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
-0.5	-0.6	1.0	0.9	-.1	339		8416 3777 0630	

4. Packing material: *Inserts* *Baggies* (*Bubble Wrap*) *Gel Packs* (*Wet Ice*) *Dry Ice* *Sleeves* _____
5. Were custody papers properly filled out (ink, signed, etc.)? NA (Y) N
6. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA (Y) N
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA (Y) N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA (Y) N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA (Y) N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* (NA) Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* (NA) Y N
12. Was C12/Res negative? (NA) Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions: _____

Page ____ *of* ____

Analytical Report

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Collected:**	10/07/14 - 10/30/14
Sample Matrix:	Soil	**Date Received:**	10/08/14 - 10/31/14
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Solids, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
B-58-S-4-100714	K1505210-001	**49.9**	-	1	05/27/15 11:44	
B-69-S-4.5-100814	K1505210-002	**79.7**	-	1	05/27/15 11:44	
B-49-S-7-100714	K1505210-003	**66.9**	-	1	05/27/15 11:44	
B-50-S-4-100714	K1505210-004	**69.1**	-	1	05/27/15 11:44	
B-55-S-4-100714	K1505210-005	**49.2**	-	1	05/27/15 11:44	
B-77-S-5-103014	K1505210-006	**53.1**	-	1	05/27/15 11:44	

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project	IP Tacoma Metals/33764085.	**Date Collected:**	10/07/14
Sample Matrix:	Soil	**Date Received:**	10/08/14
		Date Analyzed:	05/27/15

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	B-58-S-4-100714	**Units:**	Percent
Lab Code:	K1505210-001	**Basis:**	As Received

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1505210-001DUP Result	Average	RPD	RPD Limit
Solids, Total	160.3 Modified	-	49.9	51.8	50.9	4	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client: AECOM/URS Corporation **Service Request:** K1505210
Project: IP Tacoma Metals/33764085.

Cover Page - Organic Analysis Data Package
Diesel and Residual Range Organics

Sample Name	Lab Code	Date Collected	Date Received
B-49-S-7-100714	K1505210-003	10/07/2014	10/08/2014
B-77-S-5-103014	K1505210-006	10/30/2014	10/31/2014

Client: AECOM/URS Corporation **Service Request:** K1505210
Project: IP Tacoma Metals/33764085.
Sample Matrix: Soil

Surrogate Recovery Summary
Diesel and Residual Range Organics

Extraction Method: EPA 3550B **Units:** Percent
Analysis Method: NWTPH-Dx **Level:** Low

Sample Name	Lab Code	Sur1	Sur2
B-49-S-7-100714	K1505210-003	100 D	103 D
B-77-S-5-103014	K1505210-006	711 D #	0 D #
Batch QC	K1505236-002	114	118
Batch QCDUP	KWG1504510-1	114	122
Method Blank	KWG1504510-3	106	108
Lab Control Sample	KWG1504510-2	115	106

Surrogate Recovery Control Limits (%)

Sur1	= o-Terphenyl	50-150
Sur2	= n-Triacontane	50-150

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Analytical Results

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA

Diesel and Residual Range Organics

Sample Name:	Method Blank	**Units:**	mg/Kg
Lab Code:	KWG1504510-3	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	NWTPH-Dx		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	ND	U	25	1	05/22/15	06/01/15	KWG1504510	
Residual Range Organics (RRO)	ND	U	100	1	05/22/15	06/01/15	KWG1504510	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	106	50-150	06/01/15	Acceptable
n-Triacontane	108	50-150	06/01/15	Acceptable

Comments:

Analytical Results

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Collected:**	10/07/2014
Sample Matrix:	Soil	**Date Received:**	10/08/2014

Diesel and Residual Range Organics

Sample Name:	B-49-S-7-100714	**Units:**	mg/Kg
Lab Code:	K1505210-003	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	NWTPH-Dx		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	**160**	DZ	76	2	05/22/15	06/02/15	KWG1504510	*
Residual Range Organics (RRO)	**2000**	DZ	310	2	05/22/15	06/02/15	KWG1504510	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	100	50-150	06/02/15	Acceptable
n-Triacontane	103	50-150	06/02/15	Acceptable

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Collected:**	10/30/2014
Sample Matrix:	Soil	**Date Received:**	10/31/2014

Diesel and Residual Range Organics

Sample Name:	B-77-S-5-103014	**Units:**	mg/Kg
Lab Code:	K1505210-006	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	NWTPH-Dx		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Diesel Range Organics (DRO)	**140000**	DZ	5200	20	05/22/15	06/01/15	KWG1504510	*
Residual Range Organics (RRO)	**140000**	DZ	21000	20	05/22/15	06/01/15	KWG1504510	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
o-Terphenyl	711	50-150	06/01/15	Outside Control Limits
n-Triacontane	0	50-150	06/01/15	Outside Control Limits

Comments:

QA/QC Report

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Extracted:**	05/22/2015
Sample Matrix:	Sediment	**Date Analyzed:**	06/01/2015

Duplicate Sample Summary
Diesel and Residual Range Organics

Sample Name:	Batch QC	**Units:**	mg/Kg
Lab Code:	K1505236-002	**Basis:**	Dry
Extraction Method:	EPA 3550B	**Level:**	Low
Analysis Method:	NWTPH-Dx	**Extraction Lot:**	KWG1504510

			Batch QCDUP KWG1504510-1			
		Sample	**Duplicate Sample**		**Relative Percent**	
Analyte Name	**MRL**	**Result**	**Result**	**Average**	**Difference**	**RPD Limit**
Diesel Range Organics (DRO)	33	67	68	67	2	40
Residual Range Organics (RRO)	130	250	260	260	2 #	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

QA/QC Report

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Extracted:**	05/22/2015
Sample Matrix:	Sediment	**Date Analyzed:**	06/01/2015

Lab Control Spike Summary
Diesel and Residual Range Organics

Extraction Method:	EPA 3550B	**Units:**	mg/Kg
Analysis Method:	NWTPH-Dx	**Basis:**	Dry
		Level:	Low
		Extraction Lot:	KWG1504510

Lab Control Sample
KWG1504510-2
Lab Control Spike

Analyte Name	Result	Spike Amount	%Rec	%Rec Limits
Diesel Range Organics (DRO)	290	267	109	42-134
Residual Range Organics (RRO)	140	133	105	48-141

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client: AECOM/URS Corporation **Service Request:** K1505210
Project: IP Tacoma Metals/33764085.

Cover Page - Organic Analysis Data Package
Polynuclear Aromatic Hydrocarbons

Sample Name	Lab Code	Date Collected	Date Received
B-58-S-4-100714	K1505210-001	10/07/2014	10/08/2014
B-69-S-4.5-100814	K1505210-002	10/08/2014	10/08/2014
B-49-S-7-100714	K1505210-003	10/07/2014	10/08/2014
B-50-S-4-100714	K1505210-004	10/07/2014	10/08/2014
B-55-S-4-100714	K1505210-005	10/07/2014	10/08/2014
B-77-S-5-103014	K1505210-006	10/30/2014	10/31/2014
B-58-S-4-100714MS	KWG1504770-1	10/07/2014	10/08/2014
B-58-S-4-100714DMS	KWG1504770-2	10/07/2014	10/08/2014

QA/QC Report

Client: AECOM/URS Corporation **Service Request:** K1505210
Project: IP Tacoma Metals/33764085.
Sample Matrix: Soil

Surrogate Recovery Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method: EPA 3541 **Units:** Percent
Analysis Method: 8270D SIM **Level:** Low

Sample Name	Lab Code	Sur1	Sur2	Sur3
B-58-S-4-100714	K1505210-001	141 D #	110 D #	360 D #
B-69-S-4.5-100814	K1505210-002	215 D #	79 D #	693 D #
B-49-S-7-100714	K1505210-003	62	57	63
B-50-S-4-100714	K1505210-004	72	65	67
B-55-S-4-100714	K1505210-005	58	57	60
B-77-S-5-103014	K1505210-006	581 D #	338 D #	890 D #
Method Blank	KWG1504770-5	63	73	59
B-58-S-4-100714MS	KWG1504770-1	176 D #	118 D #	334 D #
B-58-S-4-100714DMS	KWG1504770-2	159 D #	90 D #	275 D #
Lab Control Sample	KWG1504770-3	69	73	68
Duplicate Lab Control Sample	KWG1504770-4	68	73	69

Surrogate Recovery Control Limits (%)

Sur1	=	Fluorene-d10	17-104
Sur2	=	Fluoranthene-d10	27-106
Sur3	=	Terphenyl-d14	35-109

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Polynuclear Aromatic Hydrocarbons

Sample Name:	Method Blank	**Units:**	ug/Kg
Lab Code:	KWG1504770-5	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
2-Methylnaphthalene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
1-Methylnaphthalene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Acenaphthylene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Acenaphthene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Dibenzofuran	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Fluorene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Phenanthrene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Anthracene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Fluoranthene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Pyrene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Benz(a)anthracene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Chrysene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Benzo(b)fluoranthene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Benzo(k)fluoranthene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Benzo(a)pyrene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Indeno(1,2,3-cd)pyrene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Dibenz(a,h)anthracene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	
Benzo(g,h,i)perylene	ND	U	2.5	1	05/28/15	06/03/15	KWG1504770	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	63	17-104	06/03/15	Acceptable
Fluoranthene-d10	73	27-106	06/03/15	Acceptable
Terphenyl-d14	59	35-109	06/03/15	Acceptable

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Collected:**	10/07/2014
Sample Matrix:	Soil	**Date Received:**	10/08/2014

Polynuclear Aromatic Hydrocarbons

Sample Name:	B-58-S-4-100714	**Units:**	ug/Kg
Lab Code:	K1505210-001	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**3800**	D	510	100	05/28/15	06/01/15	KWG1504770	*
2-Methylnaphthalene	**3400**	D	510	100	05/28/15	06/01/15	KWG1504770	*
1-Methylnaphthalene	**3100**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Acenaphthylene	**3900**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Acenaphthene	**13000**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Dibenzofuran	**7700**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Fluorene	**10000**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Phenanthrene	**71000**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Anthracene	**51000**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Fluoranthene	**150000**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Pyrene	**170000**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Benz(a)anthracene	**110000**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Chrysene	**210000**	D	2600	500	05/28/15	06/01/15	KWG1504770	*
Benzo(b)fluoranthene	**170000**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Benzo(k)fluoranthene	**59000**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Benzo(a)pyrene	**130000**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Indeno(1,2,3-cd)pyrene	**65000**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Dibenz(a,h)anthracene	**17000**	D	510	100	05/28/15	06/01/15	KWG1504770	*
Benzo(g,h,i)perylene	**59000**	D	510	100	05/28/15	06/01/15	KWG1504770	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	141	17-104	06/01/15	Outside Control Limits
Fluoranthene-d10	110	27-106	06/01/15	Outside Control Limits
Terphenyl-d14	360	35-109	06/01/15	Outside Control Limits

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Collected:**	10/08/2014
Sample Matrix:	Soil	**Date Received:**	10/08/2014

Polynuclear Aromatic Hydrocarbons

Sample Name:	B-69-S-4.5-100814	**Units:**	ug/Kg
Lab Code:	K1505210-002	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**2200**	D	780	250	05/28/15	06/01/15	KWG1504770	*
2-Methylnaphthalene	**3100**	D	780	250	05/28/15	06/01/15	KWG1504770	*
1-Methylnaphthalene	**2200**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Acenaphthylene	**3400**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Acenaphthene	**6500**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Dibenzofuran	**2200**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Fluorene	**6000**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Phenanthrene	**20000**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Anthracene	**64000**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Fluoranthene	**150000**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Pyrene	**180000**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Benz(a)anthracene	**140000**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Chrysene	**290000**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Benzo(b)fluoranthene	**270000**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Benzo(k)fluoranthene	**91000**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Benzo(a)pyrene	**220000**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Indeno(1,2,3-cd)pyrene	**100000**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Dibenz(a,h)anthracene	**27000**	D	780	250	05/28/15	06/01/15	KWG1504770	*
Benzo(g,h,i)perylene	**94000**	D	780	250	05/28/15	06/01/15	KWG1504770	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	215	17-104	06/01/15	Outside Control Limits
Fluoranthene-d10	79	27-106	06/01/15	Acceptable
Terphenyl-d14	693	35-109	06/01/15	Outside Control Limits

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Collected:**	10/07/2014
Sample Matrix:	Soil	**Date Received:**	10/08/2014

Polynuclear Aromatic Hydrocarbons

Sample Name:	B-49-S-7-100714	**Units:**	ug/Kg
Lab Code:	K1505210-003	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**330**		3.7	1	05/28/15	06/03/15	KWG1504770	*
2-Methylnaphthalene	**180**		3.7	1	05/28/15	06/03/15	KWG1504770	*
1-Methylnaphthalene	**96**		3.7	1	05/28/15	06/03/15	KWG1504770	*
Acenaphthylene	**110**		3.7	1	05/28/15	06/03/15	KWG1504770	*
Acenaphthene	**74**		3.7	1	05/28/15	06/03/15	KWG1504770	*
Dibenzofuran	**130**		3.7	1	05/28/15	06/03/15	KWG1504770	*
Fluorene	**74**		3.7	1	05/28/15	06/03/15	KWG1504770	*
Phenanthrene	**630**		3.7	1	05/28/15	06/03/15	KWG1504770	*
Anthracene	**960**		3.7	1	05/28/15	06/03/15	KWG1504770	*
Fluoranthene	**920**		3.7	1	05/28/15	06/03/15	KWG1504770	*
Pyrene	**1500**		3.7	1	05/28/15	06/03/15	KWG1504770	*
Benz(a)anthracene	**1100**		3.7	1	05/28/15	06/03/15	KWG1504770	*
Chrysene	**4000**	D	37	10	05/28/15	06/04/15	KWG1504770	*
Benzo(b)fluoranthene	**3700**	D	37	10	05/28/15	06/04/15	KWG1504770	*
Benzo(k)fluoranthene	**780**		3.7	1	05/28/15	06/03/15	KWG1504770	*
Benzo(a)pyrene	**2700**	D	37	10	05/28/15	06/04/15	KWG1504770	*
Indeno(1,2,3-cd)pyrene	**1500**		3.7	1	05/28/15	06/03/15	KWG1504770	*
Dibenz(a,h)anthracene	**430**		3.7	1	05/28/15	06/03/15	KWG1504770	*
Benzo(g,h,i)perylene	**1300**		3.7	1	05/28/15	06/03/15	KWG1504770	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	62	17-104	06/03/15	Acceptable
Fluoranthene-d10	57	27-106	06/03/15	Acceptable
Terphenyl-d14	63	35-109	06/03/15	Acceptable

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Collected:**	10/07/2014
Sample Matrix:	Soil	**Date Received:**	10/08/2014

Polynuclear Aromatic Hydrocarbons

Sample Name:	B-50-S-4-100714	**Units:**	ug/Kg
Lab Code:	K1505210-004	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**100**		3.6	1	05/28/15	06/03/15	KWG1504770	*
2-Methylnaphthalene	**69**		3.6	1	05/28/15	06/03/15	KWG1504770	*
1-Methylnaphthalene	**43**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Acenaphthylene	**26**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Acenaphthene	**31**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Dibenzofuran	**33**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Fluorene	**25**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Phenanthrene	**140**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Anthracene	**82**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Fluoranthene	**290**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Pyrene	**440**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Benz(a)anthracene	**150**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Chrysene	**480**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Benzo(b)fluoranthene	**440**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Benzo(k)fluoranthene	**140**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Benzo(a)pyrene	**300**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Indeno(1,2,3-cd)pyrene	**220**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Dibenz(a,h)anthracene	**73**		3.6	1	05/28/15	06/03/15	KWG1504770	*
Benzo(g,h,i)perylene	**230**		3.6	1	05/28/15	06/03/15	KWG1504770	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	72	17-104	06/03/15	Acceptable
Fluoranthene-d10	65	27-106	06/03/15	Acceptable
Terphenyl-d14	67	35-109	06/03/15	Acceptable

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Collected:**	10/07/2014
Sample Matrix:	Soil	**Date Received:**	10/08/2014

Polynuclear Aromatic Hydrocarbons

Sample Name:	B-55-S-4-100714	**Units:**	ug/Kg
Lab Code:	K1505210-005	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**39**		5.1	1	05/28/15	06/03/15	KWG1504770	*
2-Methylnaphthalene	**24**		5.1	1	05/28/15	06/03/15	KWG1504770	*
1-Methylnaphthalene	**16**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Acenaphthylene	**6.0**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Acenaphthene	**10**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Dibenzofuran	**15**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Fluorene	**8.9**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Phenanthrene	**63**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Anthracene	**11**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Fluoranthene	**67**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Pyrene	**83**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Benz(a)anthracene	**33**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Chrysene	**75**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Benzo(b)fluoranthene	**67**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Benzo(k)fluoranthene	**21**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Benzo(a)pyrene	**44**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Indeno(1,2,3-cd)pyrene	**28**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Dibenz(a,h)anthracene	**8.0**		5.1	1	05/28/15	06/03/15	KWG1504770	*
Benzo(g,h,i)perylene	**28**		5.1	1	05/28/15	06/03/15	KWG1504770	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	58	17-104	06/03/15	Acceptable
Fluoranthene-d10	57	27-106	06/03/15	Acceptable
Terphenyl-d14	60	35-109	06/03/15	Acceptable

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Collected:**	10/30/2014
Sample Matrix:	Soil	**Date Received:**	10/31/2014

Polynuclear Aromatic Hydrocarbons

Sample Name:	B-77-S-5-103014	**Units:**	ug/Kg
Lab Code:	K1505210-006	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM		

Analyte Name	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Naphthalene	**21000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*
2-Methylnaphthalene	**16000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*
1-Methylnaphthalene	**45000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*
Acenaphthylene	**30000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*
Acenaphthene	**540000**	D	12000	2500	05/28/15	06/01/15	KWG1504770	*
Dibenzofuran	**330000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*
Fluorene	**380000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*
Phenanthrene	**1800000**	D	12000	2500	05/28/15	06/01/15	KWG1504770	*
Anthracene	**380000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*
Fluoranthene	**1300000**	D	12000	2500	05/28/15	06/01/15	KWG1504770	*
Pyrene	**1000000**	D	12000	2500	05/28/15	06/01/15	KWG1504770	*
Benz(a)anthracene	**320000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*
Chrysene	**420000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*
Benzo(b)fluoranthene	**300000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*
Benzo(k)fluoranthene	**110000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*
Benzo(a)pyrene	**240000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*
Indeno(1,2,3-cd)pyrene	**120000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*
Dibenz(a,h)anthracene	**31000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*
Benzo(g,h,i)perylene	**110000**	D	1200	250	05/28/15	06/01/15	KWG1504770	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Fluorene-d10	581	17-104	06/01/15	Outside Control Limits
Fluoranthene-d10	338	27-106	06/01/15	Outside Control Limits
Terphenyl-d14	890	35-109	06/01/15	Outside Control Limits

Comments:

ALS Group USA, Corp. dba ALS Environmental

QA/QC Report

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Extracted:**	05/28/2015
Sample Matrix:	Soil	**Date Analyzed:**	06/01/2015

Matrix Spike/Duplicate Matrix Spike Summary
Polynuclear Aromatic Hydrocarbons

Sample Name:	B-58-S-4-100714	**Units:**	ug/Kg
Lab Code:	K1505210-001	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270D SIM	**Extraction Lot:**	KWG1504770

		B-58-S-4-100714MS KWG1504770-1 Matrix Spike			B-58-S-4-100714DMS KWG1504770-2 Duplicate Matrix Spike					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	3800	7880	498	818 #	4640	498	168 #	23-114	52 *	40
2-Methylnaphthalene	3400	4600	498	232 #	2610	498	-168 #	24-115	55 *	40
1-Methylnaphthalene	3100	3220	498	33 #	1810	498	-250 #	26-133	56 *	40
Acenaphthylene	3900	8430	498	901 #	6230	498	460 #	32-117	30	40
Acenaphthene	13000	5790	498	-1403 #	3780	498	-1806 #	33-118	42 *	40
Dibenzofuran	7700	4450	498	-649 #	2900	498	-961 #	34-131	42 *	40
Fluorene	10000	4940	498	-1058 #	4240	498	-1200 #	33-125	15	40
Phenanthrene	71000	24200	498	-9328 #	17600	498	-10652#	29-125	31	40
Anthracene	51000	31100	498	-4091 #	30300	498	-4253 #	30-127	3	40
Fluoranthene	150000	76300	498	-15015#	74100	498	-15458#	35-139	3	40
Pyrene	170000	111000	498	-12593#	110000	498	-12796#	27-134	1	40
Benz(a)anthracene	110000	94800	498	-2558 #	87300	498	-4057 #	35-122	8	40
Chrysene	210000	214000	498	1223 #	187000	498	-4098 #	36-126	13	40
Benzo(b)fluoranthene	170000	215000	498	8060 #	184000	498	1944 #	35-124	15	40
Benzo(k)fluoranthene	59000	69600	498	2048 #	63300	498	796 #	38-124	9	40
Benzo(a)pyrene	130000	172000	498	8208 #	147000	498	3262 #	37-123	15	40
Indeno(1,2,3-cd)pyrene	65000	97400	498	6562 #	78200	498	2715 #	28-133	22	40
Dibenz(a,h)anthracene	17000	23500	498	1324 #	20100	498	639 #	32-125	16	40
Benzo(g,h,i)perylene	59000	94300	498	6997 #	74700	498	3064 #	33-128	23	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

QA/QC Report

Client:	AECOM/URS Corporation	**Service Request:**	K1505210
Project:	IP Tacoma Metals/33764085.	**Date Extracted:**	05/28/2015
Sample Matrix:	Soil	**Date Analyzed:**	06/01/2015

Lab Control Spike/Duplicate Lab Control Spike Summary
Polynuclear Aromatic Hydrocarbons

Extraction Method:	EPA 3541	**Units:**	ug/Kg
Analysis Method:	8270D SIM	**Basis:**	Dry
		Level:	Low
		Extraction Lot:	KWG1504770

	Lab Control Sample KWG1504770-3 Lab Control Spike			Duplicate Lab Control Sample KWG1504770-4 Duplicate Lab Control Spike					
Analyte Name	**Result**	**Spike Amount**	**%Rec**	**Result**	**Spike Amount**	**%Rec**	**%Rec Limits**	**RPD**	**RPD Limit**
Naphthalene	347	500	69	330	500	66	32-124	5	40
2-Methylnaphthalene	341	500	68	321	500	64	27-126	6	40
1-Methylnaphthalene	334	500	67	316	500	63	37-129	5	40
Acenaphthylene	371	500	74	348	500	70	38-126	6	40
Acenaphthene	371	500	74	350	500	70	39-124	6	40
Dibenzofuran	366	500	73	346	500	69	41-130	6	40
Fluorene	382	500	76	366	500	73	39-129	4	40
Phenanthrene	370	500	74	352	500	70	39-123	5	40
Anthracene	387	500	77	369	500	74	38-130	5	40
Fluoranthene	394	500	79	376	500	75	39-135	5	40
Pyrene	436	500	87	423	500	85	39-134	3	40
Benz(a)anthracene	423	500	85	401	500	80	46-120	5	40
Chrysene	407	500	81	391	500	78	49-120	4	40
Benzo(b)fluoranthene	443	500	89	425	500	85	51-121	4	40
Benzo(k)fluoranthene	401	500	80	375	500	75	55-120	7	40
Benzo(a)pyrene	396	500	79	371	500	74	49-122	6	40
Indeno(1,2,3-cd)pyrene	372	500	74	333	500	67	40-128	11	40
Dibenz(a,h)anthracene	390	500	78	363	500	73	43-125	7	40
Benzo(g,h,i)perylene	404	500	81	379	500	76	49-122	6	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Appendix C
Data Validation Report

AECOM

AECOM
1501 4th Ave
Suite 1400
Seattle, WA 98101
www.aecom.com

206 438 2700 tel
866 495 5288 fax

Memorandum

To	Paul Kalina, Project Manager	Info	FINAL
Subject	Summary Data Quality Review IP – Tacoma Metals Soil Sampling – October 2014 ALS Laboratory Groups K1505210		
From	Lucy A. Panteleeff, Chemist Amy L. Dahl, Chemist		
Date	June 24, 2015		

The summary data quality review of 6 soil samples collected October 7 through October 30, 2014 has been completed. The samples were submitted to the ALS Environmental (ALS) laboratory located in Kelso, Washington. Samples were analyzed for ultra low-level polycyclic aromatic hydrocarbons (PAHs) by Environmental Protection Agency (EPA) Method 8270D modified by selected ion monitoring (SIM) and total solids (TS) by EPA Method 160.3. Select samples were analyzed for total petroleum hydrocarbons (TPH, diesel and residual range) by Washington State Department of Ecology (Ecology) Method NWTPH-Dx. The analyses were performed in general accordance with methods specified in EPA's *Test Methods for Evaluating Solid Waste (SW-846)*, Ecology's *Analytical Methods for Petroleum Hydrocarbons*, June 1997, and Standard Methods for the Examination of Water and Wastewater. For this report, the sample identifications do not include the sampling date suffix. The following samples are associated with ALS laboratory group K1505210:

Sample ID	ALS ID	Parameters
B-58-S-4-100714	K1505210-001	PAHs, TS
B-69-5-4.5-100814	K1505210-002	PAHs, TS
B-49-S-7-100714	K1505210-003	PAHs, TPH, TS
B-50-S-4-100714	K1505210-004	PAHs, TS
B-55-S-4-100714	K1505210-005	PAHs, TS
B-77-S-5-103014	K1505210-006	PAHs, TPH, TS

Upon receipt by ALS, the sample jar information was compared to the associated chain-of-custody (COC). The cooler and cooler blank temperatures were recorded as part of the check-in procedure. One cooler temperature (-0.6°C) was outside the EPA-recommended limits of greater than 0°C and less than or equal to 6ºC. Data were not qualified based on the cooler temperature.

Data validation is based on method performance criteria and quality control (QC) criteria as documented in the *Sampling and Analysis Plan (SAP), Area E Additional Investigation, Near Tacoma Metals Property, Tacoma, Washington, October 2014* and current ALS control limits. The laboratory provided EPA Contract Laboratory Program-equivalent validatable data packages. For the summary quality assurance (QA) review, holding times, instrument performance, initial and continuing calibrations, method blanks, surrogate recoveries, laboratory control sample (LCS) results, matrix duplicate results, matrix spike/matrix spike duplicate (MS/MSD) results, and reporting limits were reviewed to assess compliance with applicable methods. Calculation checks and review of the raw data were not included in the data review. If data qualification was required, data were qualified in accordance with *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, June 2008 and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, January 2010.

Summary Data Quality Review
IP – Tacoma Metals
Soil Sampling – October 2014
ALS Laboratory Group K1505210

The data reported for laboratory group K1505210 applies to a subset of samples collected in October 2014 by AECOM that were splits of samples collected by Kennedy Jenks and fills a gap in the data (refer to the main text of the Feasibility Study Addendum for additional information). Additional data for a subset of these sample splits was reported by ALS in November 2014 as part of laboratory groups K1411111 and K1411112. As the analytical results of the split samples reported in November 2014 confirmed the Kennedy Jenks data, no data from K1411111 or K1411112 were reported except for dibenzofuran, which was not analyzed for the samples collected by Kennedy Jenks. A streamlined data review was performed for the dibenzofuran data associated with laboratory groups K1411111 and K1411112 covering the QA elements identified above but will not be discussed further in this report. No validation qualifiers for dibenzofuran results were warranted based on this review.

A summary of qualifiers assigned to results in these laboratory groups are included in Table 1. Qualifiers that may be assigned to results include:

- U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
- J - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
- UJ - The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
- R - The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
- DNR - Do Not Report. Another result is available that is more reliable or appropriate.

Organic Analyses

Samples were analyzed for TPH and PAHs by the methods identified in the introduction to this report.

1. Holding Times – Acceptable except as noted below:

   General – At the request of AECOM, samples were analyzed several months outside of holding time. All data were qualified as estimated and flagged 'J' based on holding time exceedances.

   PAHs by Method 8270D-SIM – B-69-S-4.5 was originally analyzed on October 27, 2014 and reported with laboratory group K1411111. The percent differences between the results for B-69-S-4.5 reported with laboratory group K1505210 and the original analysis varied from 6% to 69%. Therefore, the PAH results reported out of holding time for laboratory group K1505210 should be considered qualitative and should not be used to assess compliance with action levels.

2. Instrument Performance (Tunes – applicable to PAHs only) – Acceptable

3. Initial Calibrations – Acceptable

4. Continuing Calibrations – Acceptable except as noted below:

   PAHs by Method 8270D-SIM – The percent differences for the following PAHs were outside the control limits of +/- 20% in several continuing calibration verifications.

Analysis Date:	Analyte	% Difference
June 1, 2015	Pyrene	26%
	Terphenyl-d14	24%
June 3, 2015	Benzo(g,h,i)perylene	-23%
June 4, 2015	Dibenz(a,h)anthracene	-24%
	Benzo(g,h,i)perylene	-24%

   The data were not qualified based on the surrogate (terphenyl-d14) outlier. As dibenz(a,h)anthracene and benzo(g,h,i)perylene were not reported from the analysis on June 4, 2015, no data were qualified based on these continuing calibration verification results. The results for pyrene in samples B-58-S-4, B-69-4.5, and B-77-S-5 and benzo(g,h,i)perylene in samples B-49-S-7, B-50-S-4, and B-55-S-4 were qualified based on holding time exceedances; therefore, no further qualification was necessary.

5. Blanks – Acceptable

6. Surrogates – Acceptable except as noted below:

   NWTPH-Dx – The percent recoveries of o-terphenyl (771%) and n-triacontane (0%) in B-77-S-5 were outside the control limits of 50-150%. As the diesel-range and residual-range TPH results for B-77-S-5 were qualified based on holding time exceedances, no further qualification was necessary.

   PAHs by Method 8270D-SIM – The percent recoveries for several surrogates were outside the control limits in the following samples due to high PAH concentrations:

Sample ID Control Limits:	Fluorene-d10 17-104%	Fluoranthene-d10 27-106%	Terphenyl-d14 35-109%
B-58-S-4	141%	110%	360%
B-69-S-4.5	215%	ok	693%
B-77-S-5	581%	338%	890%
B-58-S-4 (MS)	176%	118%	334%
B-58-S-4 (MSD)	159%	ok	275%

ok –recovery was within control limits

As the PAH results for these samples were qualified based on holding time exceedances, no further qualification was necessary.

7. Internal Standards (applicable to PAHs only) – Acceptable

8. Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) – Acceptable

9. Matrix Spike/Matrix Spike Duplicate (MS/MSD) – Acceptable except as noted below:

   NWTPH-Dx – An MS/MSD was not performed in association with this analysis. Precision was assessed using the duplicate results. Accuracy was assessed using the LCS results.

   PAHs by Method 8270D-SIM – An MS/MSD was performed using B-58-S-4. The percent recoveries for all the PAHs and several relative percent differences were outside control limits.
   As the concentrations for all PAHs in B-58-S-4 were more than four times the spike concentration and the PAH results were qualified based on holding time exceedances, data were not qualified for PAHs based on these MS/MSD results.

10. Laboratory Duplicate – Acceptable where applicable

    NWTPH-Dx – A laboratory duplicate was performed using a sample from an unrelated project. Results were comparable.

11. Reporting Limits – Acceptable

    General – The results for one or more organic analytes were flagged ‘D’ by the laboratory to indicate that the result was reported from a dilution of the sample. No additional qualifiers are necessary based on the ‘D’ qualifier assigned by the laboratory.

    NWTPH-Dx – The results for diesel-range and/or residual-range TPH in all samples were flagged ‘Z’, ‘to indicate that the chromatographic fingerprint did not resemble a petroleum product. No additional qualifiers are necessary based on the ‘Z’ qualifiers assigned by the laboratory.

Conventional Parameter

The samples were analyzed for total solids by EPA Method 160.3.

1. Holding Times – Acceptable

2. Laboratory Duplicate – Acceptable

   A laboratory duplicate was performed using B-58-S-4-100714. Results were comparable.

3. Reporting Limits – Acceptable

Summary Data Quality Review
IP – Tacoma Metals
Soil Sampling – October 2014
ALS Laboratory Group K1505210

Overall Assessment

The data reported in this laboratory group, as qualified, are considered to be usable for meeting project objectives. The completeness for laboratory group K1505210 is 100%.

Table 1. Summary of Qualified Data

Sample ID	Laboratory ID	Analyte	Laboratory Result	Units	Final Result
B-58-S-4	K1505210-001	1-Methylnaphthalene	3,100	ug/Kg	3,100 J
		2-Methylnaphthalene	3,400	ug/Kg	3,400 J
		Acenaphthene	13,000	ug/Kg	13,000 J
		Acenaphthylene	3,900	ug/Kg	3,900 J
		Anthracene	51,000	ug/Kg	51,000 J
		Benz(a)anthracene	110,000	ug/Kg	110,000 J
		Benzo(a)pyrene	130,000	ug/Kg	130,000 J
		Benzo(b)fluoranthene	170,000	ug/Kg	170,000 J
		Benzo(g,h,i)perylene	59,000	ug/Kg	59,000 J
		Benzo(k)fluoranthene	59,000	ug/Kg	59,000 J
		Chrysene	210,000	ug/Kg	210,000 J
		Dibenz(a,h)anthracene	17,000	ug/Kg	17,000 J
		Dibenzofuran	7,700	ug/Kg	7,700 J
		Fluoranthene	150,000	ug/Kg	150,000 J
		Fluorene	10,000	ug/Kg	10,000 J
		Indeno(1,2,3-cd)pyrene	65,000	ug/Kg	65,000 J
		Naphthalene	3,800	ug/Kg	3,800 J
		Phenanthrene	71,000	ug/Kg	71,000 J
		Pyrene	170,000	ug/Kg	170,000 J
B-69-S-4.5	K1505210-002	1-Methylnaphthalene	2,200	ug/Kg	2,200 J
		2-Methylnaphthalene	3,100	ug/Kg	3,100 J
		Acenaphthene	6,500	ug/Kg	6,500 J
		Acenaphthylene	3,400	ug/Kg	3,400 J
		Anthracene	64,000	ug/Kg	6,4000 J
		Benz(a)anthracene	140,000	ug/Kg	140,000 J
		Benzo(a)pyrene	220,000	ug/Kg	220,000 J
		Benzo(b)fluoranthene	270,000	ug/Kg	270,000 J
		Benzo(g,h,i)perylene	94,000	ug/Kg	94,000 J
		Benzo(k)fluoranthene	91,000	ug/Kg	91,000 J
		Chrysene	290,000	ug/Kg	290,000 J
		Dibenz(a,h)anthracene	27,000	ug/Kg	27,000 J
		Dibenzofuran	2,200	ug/Kg	2,200 J
		Fluoranthene	150,000	ug/Kg	150,000 J
		Fluorene	6,000	ug/Kg	6,000 J
		Indeno(1,2,3-cd)pyrene	100,000	ug/Kg	100,000 J
		Naphthalene	2,200	ug/Kg	2,200 J
		Phenanthrene	20,000	ug/Kg	20,000 J
		Pyrene	180,000	ug/Kg	180,000 J

Sample ID	Laboratory ID	Analyte	Laboratory Result	Units	Final Result
B-49-S-7	K1505210-003	1-Methylnaphthalene	96	ug/Kg	96 J
		2-Methylnaphthalene	180	ug/Kg	180 J
		Acenaphthene	74	ug/Kg	74 J
		Acenaphthylene	110	ug/Kg	110 J
		Anthracene	960	ug/Kg	960 J
		Benz(a)anthracene	1,100	ug/Kg	1,100 J
		Benzo(a)pyrene	2,700	ug/Kg	2,700 J
		Benzo(b)fluoranthene	3,700	ug/Kg	3,700 J
		Benzo(g,h,i)perylene	1,300	ug/Kg	1,300 J
		Benzo(k)fluoranthene	780	ug/Kg	780 J
		Chrysene	4,000	ug/Kg	4,000 J
		Dibenz(a,h)anthracene	430	ug/Kg	430 J
		Dibenzofuran	130	ug/Kg	130 J
		Fluoranthene	920	ug/Kg	920 J
		Fluorene	74	ug/Kg	74 J
		Indeno(1,2,3-cd)pyrene	1,500	ug/Kg	1,500 J
		Naphthalene	330	ug/Kg	330 J
		Phenanthrene	630	ug/Kg	630 J
		Pyrene	1,500	ug/Kg	1,500 J
		Diesel-range TPH	160	mg/Kg	160 J
		Residual-range TPH	2,000	mg/Kg	2,000 J
B-50-S-4	K1505210-004	1-Methylnaphthalene	43	ug/Kg	43 J
		2-Methylnaphthalene	69	ug/Kg	69 J
		Acenaphthene	31	ug/Kg	31 J
		Acenaphthylene	26	ug/Kg	26 J
		Anthracene	82	ug/Kg	82 J
		Benz(a)anthracene	150	ug/Kg	150 J
		Benzo(a)pyrene	300	ug/Kg	300 J
		Benzo(b)fluoranthene	440	ug/Kg	440 J
		Benzo(g,h,i)perylene	230	ug/Kg	230 J
		Benzo(k)fluoranthene	140	ug/Kg	140 J
		Chrysene	480	ug/Kg	480 J
		Dibenz(a,h)anthracene	73	ug/Kg	73 J
		Dibenzofuran	33	ug/Kg	33 J
		Fluoranthene	290	ug/Kg	290 J
		Fluorene	25	ug/Kg	25 J
		Indeno(1,2,3-cd)pyrene	220	ug/Kg	220 J
		Naphthalene	100	ug/Kg	100 J
		Phenanthrene	140	ug/Kg	140 J
		Pyrene	440	ug/Kg	440 J
B-55-S-4	K1505210-005	1-Methylnaphthalene	16	ug/Kg	16 J

Sample ID	Laboratory ID	Analyte	Laboratory Result	Units	Final Result
		2-Methylnaphthalene	24	ug/Kg	24 J
		Acenaphthene	10	ug/Kg	10 J
		Acenaphthylene	6	ug/Kg	6 J
		Anthracene	11	ug/Kg	11 J
		Benz(a)anthracene	33	ug/Kg	33 J
		Benzo(a)pyrene	44	ug/Kg	44 J
		Benzo(b)fluoranthene	67	ug/Kg	67 J
		Benzo(g,h,i)perylene	28	ug/Kg	28 J
		Benzo(k)fluoranthene	21	ug/Kg	21 J
		Chrysene	75	ug/Kg	75 J
		Dibenz(a,h)anthracene	8	ug/Kg	8 J
		Dibenzofuran	15	ug/Kg	15 J
		Fluoranthene	67	ug/Kg	67 J
		Fluorene	8.9	ug/Kg	8.9 J
		Indeno(1,2,3-cd)pyrene	28	ug/Kg	28 J
		Naphthalene	39	ug/Kg	39 J
		Phenanthrene	63	ug/Kg	63 J
		Pyrene	83	ug/Kg	83 J
B-77-S-5-103014	K1505210-006	1-Methylnaphthalene	45,000	ug/Kg	45,000 J
		2-Methylnaphthalene	16,000	ug/Kg	16,000 J
		Acenaphthene	540,000	ug/Kg	540,000 J
		Acenaphthylene	30,000	ug/Kg	30,000 J
		Anthracene	380,000	ug/Kg	380,000 J
		Benz(a)anthracene	320,000	ug/Kg	320,000 J
		Benzo(a)pyrene	240,000	ug/Kg	240,000 J
		Benzo(b)fluoranthene	300,000	ug/Kg	300,000 J
		Benzo(g,h,i)perylene	110,000	ug/Kg	110,000 J
		Benzo(k)fluoranthene	110,000	ug/Kg	110,000 J
		Chrysene	420,000	ug/Kg	420,000 J
		Dibenz(a,h)anthracene	31,000	ug/Kg	31,000 J
		Dibenzofuran	330,000	ug/Kg	330,000 J
		Fluoranthene	1,300,000	ug/Kg	1,300,000 J
		Fluorene	380,000	ug/Kg	380,000 J
		Indeno(1,2,3-cd)pyrene	120,000	ug/Kg	120,000 J
		Naphthalene	21,000	ug/Kg	21,000 J
		Phenanthrene	1,800,000	ug/Kg	1,800,000 J
		Pyrene	1,000,000	ug/Kg	1,000,000 J
		Diesel-range TPH	140,000	mg/Kg	140,000 J
		Residual-range TPH	140,000	mg/Kg	140,000 J

Appendix D
Health and Safety Plan

AECOM

Submitted to
Washington State
Department of Ecology
300 Desmond Drive
Lacey, WA 98503

Submitted by
AECOM
1111 Third Avenue
Suite 1600
Seattle, WA 98101
March 2020

Appendix D
Health and Safety Plan

Supplemental Remedial Investigation/Feasibility Study Work Plan

B36 Area, Area B, and Area D
Tacoma Metals Site
Tacoma, Washington

Prepared for
International Paper Company
6400 Poplar Avenue
Memphis, TN

Prepared by
AECOM
1111 Third Avenue, Suite 1600
Seattle, WA

Expiration Date (Max 1-Year from signature date)

Preparer
Anders Utter _____ Date:_____

Area/Regional SHEM
Fred Merrill
Manager, Safety, Health, and Environment _____ Date:_____

Project Manager
Paul Kalina
Senior Project Manager _____ Date :_____

HASP Summary

Project Name:	*Supplemental Remedial Investigation/Feasibility Study Work Plan* Tacoma Metals Site, Tacoma, Washington	Project Number:	60557045
Summary Revision Date:		Client Name:	International Paper Company

Report ALL SH&E Incidents, no matter how minor, to the Incident Hotline: 800-348-5046

Injury, Property Damage, Vehicle, Security, Regulatory Inspection, Environmental Impact, and any potentially work related injury, discomfort/ pain, or damage.

Identify the nearest Occupational Clinic and Hospital to the site that accepts AECOM Workers Compensation Insurance (see **Attachment A** for instructions). If the nearest such clinic or hospital is an unreasonable distance from the site, identify nearer hospitals or clinics. Attach maps and directions to the clinics and hospitals in **Attachment A**.

Occupational Clinic:	US Healthworks Medical Group of Washington	Nearest Hospital:	Tacoma General Hospital
Address:	2624 S 38th St Tacoma, WA 98409	Address:	315 Martin Luther King Jr Way Tacoma, WA 98405
Phone Number:	(253) 475-5908	Phone Number:	(253) 403-1000

Key Personnel

Project Manager (PM):	Paul Kalina	Cell Phone:	(206) 310-5097
Site Supervisor (SS)	TBD	Cell Phone	TBD
Safety Officer (SSO):	TBD	Cell Phone	TBD
AECOM SH&E Mgr.	Fred Merrill	Cell Phone:	(206) 719-1105
Client PM:	Philip J Slowiak	Cell Phone:	(901) 604-1952

List ALL Short-Service Employees, including subcontractors (<6 Months with Company in Current Area/Job Description): N/A

List ALL Subcontractors and their Site Safety Officers: TBH prior to field work.

PM must positively verify subcontractors are approved in Subport for the work described. If there were any limitations/ conditions of approval, describe them and how they are being met.

☐ I have verified that all subcontractors are approved in Subport, and that all conditions of approval are met.
PM Name_____ PM Signature_____ Date _____

Note: This Summary is intended to provide key information only and cannot be substituted for reading, understanding, and complying with the full HASP. This summary may be continually updated as tasks and personnel change. Use Continuation Sheets if necessary.

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Attachment A Hospital/Clinic Directions/Maps, Incident Reporting, and Response Flow Chart

Attachment B AECOM SH&E Field Applicable Procedures

Attachment C Safety Data Sheets (SDSs)

Attachment D Site Orientation

Attachment E Project/Task-Specific Pre-Job Hazard Assessments or Job Safety Analysis

Attachment F Operational Security Plan

List of Acronyms and Abbreviations

CFR	code of federal regulations
DCS	design and consulting services
EZ	exclusion zone
FS	feasibility study
HASP	health and safety plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HR	Human Resources
ISS	*insitu* soil solidification
JSA	job safety analysis
OSP	operational security plan
PM	Project Manager
PPE	personal protection equipment
PRSC	Puyallup River side channel
RI	remedial investigation
SDS	safety data sheet
SH&E	safety health and environment
Site	Tacoma Metals Site
THA	task hazard assessment
US	United States

1 Introduction

This health and safety plan (HASP) is designed to identify, evaluate, and control safety and health hazards and to outline emergency response actions for AECOM-managed activities. This HASP must be kept on-site during work activities and made available to all workers, including subcontractors and other site occupants for informational purposes. AECOM subcontractors are expected to independently characterize, assess, and control site hazards created by their specific scope of work.

This section of the HASP summarizes important AECOM safety health and environment (SH&E) procedures that apply to all Design and Consulting Services (DCS) Americas jobs. See **Attachment B** for complete copies of applicable field SH&E Procedures.

Project Assumptions

This site is an AECOM-controlled site.

- Site management will assist in locating subsurface utilities, vessels, and structures located on the property and outside the scope of the utility locator service.
- No confined spaces will be entered on this project.
- No un-shored excavations will be entered.
- Work will be performed during daylight hours.

1.1 Applicable References

This HASP conforms to the regulatory requirements and guidelines established in the following documents:

- Title 29, Part 1910 of the Code of Federal Regulations (29 CFR 1910), Occupational Safety and Health Standards (with special attention to Section 120, Hazardous Waste Operations and Emergency Response).
- 29 CFR 1926, Safety and Health Regulations for Construction.
- National Institute for Occupational Safety and Health (NIOSH)/Occupational Safety and Hazards Administration (OSHA)/U.S. Coast Guard/U.S. Environmental Protection Agency, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Publication No. 85-115, 1985.
- The requirements in this HASP also conform to AECOM's Safety for Life Program requirements as specified in the AECOM SH&E Manual.
- Agreed Order No. DE 13740.
- Supplemental Remedial Investigation/Feasibility Study (RI/FS) Work Plan, B36 Area, Area B, and Area D, Tacoma Metals Site, Tacoma, Washington.

2 Site Information and Scope of Work

2.1 Site Description

The Tacoma Metals Site (Site) is generally located at 1919 Portland Avenue in Tacoma, Washington, in an industrially zoned area within the Tacoma Tideflats. The Site is bounded to the northeast by the Puyallup River, to the southeast by the Lincoln Avenue Bridge, which crosses the Puyallup River, to the southwest by Portland Avenue, and to the northwest by the off-property parcels. The off-property parcels include the City of Tacoma right-of-way and two private (former Simpson and JJ Port) properties. The City of Tacoma right-of-way is located immediately northwest of the on-property parcels, the former Simpson property is located adjacent to and northwest of the City of Tacoma right-of-way, and the JJ Port property is located adjacent to and northwest of the former Simpson property. The Tacoma Metals property measures approximately 5.9 acres. The City of Tacoma right-of-way, the former Simpson property, and the JJ Port property measure approximately 0.4, 0.6, and 0.7 acre, respectively.

The former Simpson property has relatively flat topography with an average elevation of approximately 10 feet above mean sea level. The elevation drops several feet immediately adjacent to the northwest property boundary. Therefore, the elevation of the JJ Port property is typically several feet lower than the elevation of the former Simpson property. Soil materials encountered in the vicinity of the B36 Area have included sandy- and gravelly-fill materials (typically with varying quantities of wood, metal, or other debris), woody debris with and without matrix material (typically silt and sand), and native materials including sand, silt, and clay.

The flow direction in shallow groundwater at the Site is influenced by tidal fluctuations in the Puyallup River and varies between high- and low-tide cycles. At low tide, the flow direction is generally toward the Puyallup River; at high tide, the flow direction is generally toward the Site, away from the Puyallup River. The magnitude of the shallow groundwater gradient is greater during low-tide conditions than during high-tide conditions, resulting in an overall net gradient towards the Puyallup River. Depth to shallow groundwater varies with tidal levels. Saturated conditions are generally encountered at approximately 8 to10 feet below ground surface.

A former homeless encampment was moved from the former Simpson and City of Tacoma right-of-way property in 2017 by the City of Tacoma.

2.2 Site Background/History

Historically, the Site has been occupied by the following industrial facilities: St. Paul & Tacoma Lumber Company mill facilities, a coke manufacturing plant, and a metals recycling facility. The St. Paul & Tacoma Lumber Company mill facilities extended from the northwestern portion of the on-property parcels to the northwestern property boundary of the JJ Port property including the former Simpson property. Two above-ground storage tanks with capacities of 102,000 and 450,000 gallons were located on the former Simpson property. Other facilities that were located on the former Simpson property include an overhead crane, a rail spur, and elevated structures of unknown purpose that were identified in historical aerial photographs and site plans. A creosoting plant located in the northwest portion of the Tacoma Metals property (referred to as the Creosoting Plant Area) appears to have been constructed in the late 1900s to the early 1910s and appears to have been operational until the late 1920s to early 1930s. Coking operations occurred in the 1940s on the Tacoma Metals Property, including the Creosoting Plant Area. No structures are currently present on the former Simpson property. Two buildings are located on the JJ Port property, and the area surrounding the buildings is used for parking vehicles and storing equipment.

Over the years, several modifications have been made to the Puyallup River channel. The Puyallup River channel was modified by construction of an earthen levee by the U.S. Army Corps of Engineers in the late 1940s and 1950s. Prior to construction of the levee, the southwestern bank of the river adjoined the northeastern boundary of the Site. During construction of the levee, the course of the river was shifted to the northeast, and a portion of the former Puyallup River channel located adjacent to the Tacoma Metals property and the off-property parcels was isolated from the main channel. The

former channel area, referred to as the Puyallup River side channel (PRSC), was gradually filled over time primarily with wood-waste material.

The original levee remained intact until 2005, when the PRSC estuary habitat was constructed by the City of Tacoma. The wood-waste material that had accumulated in the former channel area was removed, and the original levee was breached to flood the former channel area. The course of the Puyallup River was not modified; portions of the original levee remained intact and were lowered to preserve the main channel, but an estuary habitat was created within the former channel area. A new levee was constructed immediately northeast of the Tacoma Metals Property and off-property parcels, between the Site and the PRSC.

2.3 Client or Third-Party Operations at Site

International Paper Company is currently the site owner of the former Simpson property. The Washington State Department of Natural Resources is currently the site owner of the Tacoma Metals on property parcels. No structures are currently located on the Tacoma Metals on-property parcels, the former Simpson property, and the City of Tacoma right-of-way. However, asphalt-paved areas and some concrete foundations from former buildings remain on the Tacoma Metals on-property parcels. Two buildings are located on the JJ Port property, and the area surrounding the buildings is used for parking vehicles and storing equipment.

2.4 Scope of Work

This HASP covers the following field work to be performed in accordance with the scope identified in the Supplemental RI/FS Work Plan: Additional groundwater sampling of all existing wells and piezometers within the northwestern part of the site. Groundwater sampling activities are covered in detail in the sampling and analysis plan (Appendix E). Additional soil sampling will occur in the vicinity of and northeast of the 450,000-gallon above-ground storage tank, and on the JJ Port property. Soil sampling activities are covered in detail in the soil sampling and analysis plan (Appendix F). Supplemental RI field work activities are summarized here:

- Groundwater sampling of all existing wells and piezometers within the northwestern part of the site.
- Collection of soil samples for analysis of chemicals of concern from three soil borings advanced by a direct push (Geoprobe®) rig on the JJ Port property and former Simpson property.

2.5 Scope of Work Risk Assessment

☐ Low Risk (examples: non-intrusive work, occasional exposure and/or low risk hazards)

☒ Medium Risk (examples: intrusive work coupled with potential security issues, heavy equipment use, frequent exposure and/or moderate hazards)

☐ High Risk (examples: complicated scope, large/ multiple work crews, and/or constant exposure to hazards).

3 AECOM Safety Health and Environment Program

3.1 AECOM Policy

Safety, Health and Environment Policy Statement

AECOM

Purpose

This policy establishes the framework to attain best-in-class Safety, Health and Environmental (SH&E) performance for AECOM's employees in the global marketplace.

Commitment

AECOM is committed to exceptional levels of performance in protecting its people and the environment. As stated in our Core Values, keeping our people safe is our most important measure of success. We strive to be the beacon of safety excellence in the industries and global communities in which we work.

To advance our SH&E program, we are committed to:

- Zero work-related injuries to AECOM employees and protection of the environment as a result of our activities.
- Providing a highly effective SH&E management system that drives continual review and improvement.
- Meeting client requirements and properly incorporating all safety, health and environmental rules and regulations at the local, state, provincial and national levels.
- Developing an exceptional safety culture where our people embrace ownership for the safety of themselves and others.
- Substantial improvements toward our goals of pollution prevention, resource conservation and environmental sustainability.
- Setting and meeting aggressive SH&E performance goals and Core Value Metrics to promote continuous improvement.
- Working with employees and business partners in order to continuously improve SH&E performance.
- Recognizing and celebrating those who contribute to excellent SH&E performance.
- Striving to make AECOM the provider of choice for the safe execution of design, build, finance, operate and maintenance work globally.

The commitment to this policy by the leadership, management and employees of AECOM provides the foundation for a safe workplace, operational excellence and long-term business success.

Expectations

Safety is a core value and a key to our success. We demand continuous improvement in our journey toward a zero incident culture, where everyone is committed to safety, health and environmental excellence.

To that end, we demand:

- Our leaders, managers, supervisors and employees demonstrate their commitment in their actions and decisions to assure that every person goes home safe every day.
- Our employees embrace safety as a core value both on and off the job.
- Each employee is committed to his/her own safety and that of his/her fellow employees.
- We will incorporate Life-Preserving Principles into our work planning and execution.
- We proactively and aggressively identify, manage and eliminate hazards in the workplace.
- We train and prepare our people to have the knowledge, skills, competency and equipment required to work safely.
- We stop our employees from working if the work cannot be executed safely or if conditions or behaviors on the work activity are unsafe.
- All employees immediately report safety, health and/or environmental incidents, near-misses, unsafe conditions, and at-risk behaviors to their supervisor; and that we diligently work to correct the problem.

Our SH&E expectations will be accomplished by the demonstrated leadership of management, compliance with regulatory requirements and participation of AECOM personnel.

Communication

This Policy will be reviewed annually to ensure it meets the needs of the company, and will be made available to all persons under the control of the company.

Sincerely:

M. Burke

Michael S. Burke
Chairman and Chief Executive Officer

04 March 2016
Date

3.2 Safety for Life

"Safety for Life" is a comprehensive integrated AECOM Safety Management System that drives our nearly 100,000 employees toward AECOM's commitment to achieving zero work-related injuries and/or illnesses; preventing damage to property and the environment; and maintaining an environmentally friendly and sustainable workplace. Our Safety for Life program is supported by nine Life Preserving Principles that apply to all AECOM activities.

3.3 Life Preserving Principles

Demonstrated Management Commitment
Our Executive, senior and project managers will lead the SH&E improvement process and continuously demonstrate support and commitment.

Employee Participation
Our employees will be encouraged and empowered to become actively engaged in our safety processes through their active participation in safety committees, training, audits, observations and inspections. Employees will be encouraged to participate in health initiatives and adopt a healthy lifestyle.

Budgeting and Staffing for Safety
Our safety staff will be competent, fully trained and qualified to provide technical resources to our internal and external clients. A budget to support safety activities will be included in project proposals.

Pre-Planning
Our design, engineering, project and construction management staff will deploy effective risk mitigation efforts to design, plan and build safety into every project. Pre-Project and Pre-Task planning will be an effective tool in protecting our employees and the environment.

Contractor Management
Our project staff will work closely with our sub-consultants, subcontractors, contractors and Joint Venture Partners to provide a safe work environment for employees and members of the public. Our goal of SH&E performance excellence will be equally shared by all project participants.

Recognition and Rewards
Our employees will be recognized for their efforts in working safely and their support of our safety efforts.

Safety Orientation and Training
Our employees will be provided with effective safety training in order to identify and mitigate hazards in the workplace to prevent injuries to themselves and others who may be affected by their actions.

Incident Investigation
Our managers and safety professionals will investigate all recordable incidents and serious near misses to identify contributing factors and root causes in order to prevent a reoccurrence. Lessons learned shall be identified, communicated and implemented.

Fit for Duty
Our employees are responsible to report to work each day fit for duty and not to pose a health and safety hazard to themselves or others.

3.4 Driving and Vehicle Safety

The proper operation of vehicles is critical to protecting the safety of AECOM employees and subcontractors. Drivers face numerous hazards while operating vehicles. Some of the hazards include collision with another vehicle, collision with a fixed object, vehicle break down or failure, or falling asleep or becoming otherwise incapacitated while driving. All employees will adhere to Driving procedure S3NA-005-PR1, which includes the following key practices:

- Authorized Drivers - Managers must authorize drivers following evaluation of driver criteria to drive and maintain an AECOM-owned, leased, or rented vehicle, a client or customer-owned vehicle, or a personal vehicle operated in the course of conducting AECOM business.
- Electronic Devices Prohibited - AECOM prohibits use of all portable electronic devices while operating a motor vehicle/ equipment, which includes being stopped at a traffic light or stop sign. This includes cell phones, two-way radios, and other items whether hand-held or hands-free. Electronic devices include, but are not limited to, all mobile phones, pagers, iPods, MP3s, GPS, DVD players, tablets, laptops and other portable electronic devices that can cause driver distraction. Hands-free device use is not allowed.
    - GPS units and devices used for navigation may only be used if factory installed or secured to the vehicle with a bracket that allows drivers to view the image without having to take their eyes off the road. Electronic devices shall be setup for operation prior to commencing driving activities and shall not be changed by the driver while driving.
- Vehicle Inspections - The driver shall conduct pre-trip vehicle inspections prior to each trip. A vehicle inspection checklist, S3NA-005_FM2, can be used to guide and document the inspection process. Vehicle inspection is to include a 360-degree walk-around and visual inspection under the vehicle for leaks and obstructions prior to moving the vehicle.
- Training - All drivers shall complete defensive driver training. Additional training (i.e., hands-on defensive driver training) may apply for medium and high-risk drivers; see Driving procedure S3NA-005-PR1 and SH&E Training procedure S3NA-003-PR1 for more details.
- Journey Management Plan - Drivers who undertake trips in excess of 250 miles (400 kilometers) one way, drive in remote or hazardous areas, or when otherwise deemed necessary, shall develop and document a Journey Management Plan using S3NA-005-FM1 or equivalent.
- Secure Loads - Cargo is only to be carried within the passenger compartment of a vehicle when segregated and restrained to prevent objects from becoming distractions, obstructions or projectiles to occupants should emergency vehicle maneuvers be required (e.g., harsh braking or crash). All goods transported on flatbed trucks or in pickup beds must be securely fastened to prevent them from becoming hazards. All applicable laws and regulations regarding securing of loads must be met. It is prudent to check the load after a few miles to ensure that load has not shifted or loosened prior to completing the remainder of the trip.
- Backing Up - Reversing the vehicle is to be avoided if at all possible. If backing up is necessary, use the following guidelines:
    - Pre-plan all vehicle movements.
    - If the pull-through method of parking is not possible, drivers will scan parking spot/area for hazards and back in, thereby facilitating departure where the first move is forward.
    - A light tap of the horn should be used to alert others of your intention to back up.
    - Avoid tight spaces.
    - Vehicles over 10,000 pounds gross vehicular weight are required to have a competent spotter in place when backing. A competent spotter is one that has received spotter training.
    - All vehicles shall have a competent spotter in place when backing in an active work zone. Parking and public access areas are recommended but not required to have a spotter.

3.5 Fitness for Duty

One of AECOM's nine Life-Preserving Principles is Fitness for Duty (see Fitness for Duty procedure S3NA-008-PR1). Fitness for Duty means that individuals are in a state (physical, mental, and emotional) that enables them to perform assignments competently and in a manner that does not threaten the health and safety of themselves or others. On certain projects or for specific tasks, fit for duty certifications may be requested of medical providers by SH&E Managers or Human Resources (HR). Employees should report to work fit for duty and unimpaired by substances or fatigue. Supervisors must observe their employees and work with the employee, SH&E staff, and HR to address deficiencies. AECOM will not tolerate retaliation against any employee for filing a complaint or concern regarding their fitness for duty or participating in any way in an investigation.

3.5.1 Medical Surveillance

AECOM's S3NA-128-PR1, Medical Screening and Surveillance, details the requirements to participate in a medical monitoring program. Medical Surveillance provides a streamlined process to determine if employees meet the physical requirements to perform assigned duties as defined by applicable regulations. It is also designed to provide a means to collect data relevant to exposure to chemical and physical agents for the protection of the workers and to confirm the effectiveness of health and safety programs.

3.5.2 Fatigue

One aspect of fit for duty is fatigue management. AECOM has developed procedures that limit work periods or require additional rest under certain circumstances, including during long-distance travel or when working at high altitudes. These procedures also set limits on extended work periods of 14 hours per day or 60 hours per week. A fatigue management plan is required if longer working hours are necessary (see Fatigue Management Procedure S3NA-009-PR1).

3.5.3 Substance Abuse

Drug and alcohol abuse pose a serious threat to the health and safety of employees, clients, and the general public as well as the security of our job sites, equipment, and facilities. AECOM is committed to the elimination of illegal drug use and alcohol abuse in its workplace and regards any misuse of drugs or alcohol by employees to be unacceptable. AECOM Substance Abuse Prevention Procedure (S3NA-019-PR1) prohibits the use, possession, presence in the body, manufacture, concealment, transportation, promotion, or sale of the following items or substances on company premises. Company premises refer to all property, offices, facilities, land, buildings, structures, fixtures, installations, aircraft, automobiles, vessels, trucks and all other vehicles and equipment—whether owned, leased, or used.

- Illegal drugs (or their metabolites), designer and synthetic drugs, mood or mind-altering substances, and drug use related paraphernalia unless authorized for administering currently prescribed medication
- Controlled substances that are not used in accordance with physician instructions or non-prescribed controlled substances
- Alcoholic beverages while at work or while on any customer- or AECOM-controlled property

This policy does not prohibit lawful use and possession of current medication prescribed in the employees name or over-the-counter medications. Employees must consult with their health care provider about any prescribed medication's effect on their ability to perform work safely and disclose any restrictions to their supervisor.

Although some states may pass laws legalizing medical or recreational marijuana use, the use, sale, distribution, and possession of marijuana are violations of federal law and AECOM policy and will subject an employee to disciplinary action up to and including termination in accordance with controlling law.

3.6 Hand Safety

The hands are exposed to hazards more than any body part. SH&E Hand Safety Procedure S3NA-317-PR1 describes requirements and best practices, including these notable practices:

- **All personnel shall have gloves in their immediate possession 100 percent** of the time when in a shop or on a work site. Gloves that address the hazard shall be worn when employees work with or near any materials or equipment that present the potential for hand injury due to sharp edges, corrosives, flammable and irritating materials, extreme temperatures, splinters, etc. Use the Gloves Needs Assessment (S3NA-317-FM1) to help determine the appropriate glove for the hazard(s).

- **Fixed open-blade knives are prohibited** from use during the course of AECOM work. Examples of fixed open-blade knives include pocket knives, multi-tools, hunting knives, and standard utility knives. For more information about cutting tools, see S3NA-317-ATT1 Safe Alternative Tools.

3.7 Hazard Communication

Hazardous materials that may be encountered on-site as existing environmental or physical/health contaminants are addressed in this HASP. Their properties, hazards, and associated required controls will be communicated to all affected staff and subcontractors in accordance with the requirements of AECOM Procedure S3NA-115-PR1 Hazardous Materials Communication, including these key elements:

- All personnel shall be briefed on the hazards of any chemical product they use and shall be aware of and have access to the Safety Data Sheets (SDS).
- All containers on-site shall be properly labeled to indicate their contents. Labeling on any containers not intended for single-day, individual use shall contain additional information indicating potential health and safety hazards (flammability, reactivity, etc.).

In addition, any employee or organization (contractor or subcontractor) intending to bring any hazardous material onto this AECOM-controlled work site must first provide a copy of the item's SDS to the Site Supervisor or Site Safety Officer for review and filing. The Site Supervisor or Site Safety Officer will maintain copies of all SDS on-site and in **Attachment C**. SDS may not be available for locally obtained products, in which case an alternate form of product hazard documentation will be acceptable.

3.8 Hazardous Material handling and Waste Management

If hazardous, solid, and/or municipal wastes are generated during any phase of the project, the waste shall be accumulated, labeled, and disposed of in accordance with applicable federal, state, provincial, territorial, and/or local regulations and SH&E Procedure S3NA-116-PR1 Hazardous Materials Shipping. A site-specific Entity Letter may be required for the Site/client; if so, only persons named on the entity letter are allowed to sign waste shipping papers "***on behalf of International Paper Company***." Any individual signing shipping papers must have valid Department of Transportation and Resource Conservation and Recovery Act training for waste shipment. Consult the HZM/HZW & TDG page on Ecosystem or the SH&E Manager for further guidance on AECOM and regulatory procedures and training requirements.

3.9 Housekeeping and Personal Hygiene

Basic housekeeping requirements for offices and work sites, as well as personal hygiene and sanitation standards, can be found in S3NA-013-PR1 Housekeeping. Inspections should be performed at the regular interval specified below. The housekeeping inspection form S3NA-013-FM1 is available for use.

Complete the table below regarding site-specific Housekeeping and Personal Hygiene requirements:

Handwashing: Water, soap, and paper towels or equivalent supplies will be located in the field vehicle. Site staff will wash hands and face after completing work activities and prior to breaks or meals.

Toilets: Portable toilets will be located on-site during long-term field activities.

NOTE: A minimum of one toilet must be provided for every 20 personnel on-site. For mobile crews where work activities and locations permit transportation to nearby toilet facilities, on-site facilities are not required.

Water will be located inside field vehicles.

A water supply meeting the following requirements will be utilized:

***Potable Water* - An adequate supply of potable water will be available for field personnel consumption. Potable water can be provided in the form of water bottles, canteens, water coolers, or drinking fountains. Disposable drinking cups for single use and a waste receptacle will be provided as needed. Water containers will be refilled daily and disinfected regularly. Potable water containers will be properly identified in order to distinguish them from non-potable water sources.**

***Non-Potable Water* - Non-potable water may be used for hand washing and cleaning activities. Non-potable water will not be used for drinking purposes. All containers of non-potable water will be marked with a label stating "Non-Potable Water, Not Intended for Drinking Water Consumption."**

3.10 Lone Worker

AECOM discourages employees from working alone (i.e., where AECOM personnel are out of visual and audio range of others) when performing field tasks (see SH&E Procedure S3AM-314-PR, Working Alone). Lone work activities will not be permitted at the Site.

3.11 Safety Observations

Safety observations are observations made by employees or subcontractors of a condition or behavior that could contribute to an incident, prior to the incident occurring. Observations can also identify positive behaviors or interventions which contribute to the prevention of incidents. Large, long-term projects may benefit from the use of LifeGuard to track and trend observations on a site level. For all other projects, observations should be logged using IndustrySafe. Both reporting systems can be accessed on any safety page of Ecosystem. The QR codes below can also be used from a smartphone/device while off the AECOM network.

LifeGuard

IndustrySafe
Safety Management Software

3.12 Short Service Employee

A Short Service Employee is an employee with fewer than 6 months experience working on field projects or an employee who has not completed the required training or received required certifications (see the Short Service Employee Procedure, S3NA-002-PR1). The Project Manager (PM) will identify all Short Service Employees working on the project, and each Short Service Employee will be assigned to an experienced team member so all activities may be monitored. Short Service Employees shall be easily identified in the field environment, such as with a specific colored hardhat or a manufacturer-approved orange stripe applied to a standard-issue hardhat, or must be clearly identified by some other system. Any new employee shall wear the designated Short Service Employee identifier until the PM determines the employee has the knowledge, skills, and ability related to the specific hazard on the project.

3.13 Stop Work Authority

AECOM empowers and expects all employees to exercise their Stop Work Authority (see Stop Work Authority Procedure S3NA-002-PR1) if an incident appears imminent or when hazardous behaviors or conditions are observed. A stop-work request can be informal if the situation can be easily corrected or may require shutting down operations if revised procedures are necessary to mitigate the hazard. If an AECOM employee observes an imminently hazardous situation on a site controlled by others (i.e., a client-managed contractor), the employee can always stop work for themselves by removing themselves from the situation. Employees also may attempt to stop work to avoid allowing the contractor to come to harm by immediately notifying the contractor foreman or site engineer, or if necessary, the client or party managing the contractor.

No employee should object to the issuance of a stop-work request, nor can any disciplinary action be levied against the employee. All employees must agree that the situation has been mitigated before resuming work. No employee will be disciplined for refusing to work if they feel it is unsafe.

4 Roles and Responsibilities

Roles and responsibilities for the project team are defined in SH&E Procedure S3NA-209-PR1, Safe Work Standards and Rules. The PM is ultimately responsible for the development of this HASP and establishing a budget to implement the controls and training required. The PM is also responsible for ensuring that the plan is implemented, that appropriate documentation is generated, and that records are maintained. The SH&E Manager is responsible for reviewing and approving this HASP and assisting with other SH&E matters upon request. A Site Safety Officer may be appointed to oversee implementation of the HASP in the field. All project team members are responsible for reviewing and abiding by this HASP, performing daily (or more frequent) task hazard assessments, stopping work when necessary to correct unsafe behaviors or conditions, and reporting incidents promptly to the PM and AECOM Incident Reporting Hotline (Incident Hotline 800-348-5046).

4.1 Project Manager

The PM has overall management authority and responsibility for all site operations, including safety. The PM will provide the Site Supervisor with work plans, staff, and budgetary resources that are appropriate to meet the safety needs of the project operations. Some of the PM's specific responsibilities include the following:

- Verifying that personnel to whom this HASP applies, including AECOM subcontractors, have received a copy of it, with ample opportunity to review the document and to ask questions.
- Providing the concurring SH&E Manager with updated information regarding conditions at the Site and the scope of site work if changes occur that will affect the accuracy of this HASP.
- Providing adequate authority and resources to the Site Supervisor or Site Safety Officer to allow for the successful implementation of all necessary SH&E Procedures.
- Maintaining regular communications with the Site Supervisor or Site Safety Officer and, when necessary, the AECOM Client SH&E PM.
- Coordinating the activities of AECOM subcontractors and ensuring that they are aware of the pertinent health and safety requirements for these projects, when applicable.
- Conducting Safety System Auditing by way of Management Site Visits and/or PM Self Assessments on a regular basis.
- Approving amendments to the HASP (in conjunction with the Site Supervisor or Site Safety Officer).
- Coordinating activities with the client as needed to ensure the safe implementation of this HASP.

4.2 Site Supervisor

The Site Supervisor has the overall responsibility and authority to direct work operations at the job site according to the provided work plans and HASP. The PM may act as the Site Supervisor while on-site. The Site Supervisor’s responsibilities include the following:

- Discussing deviations or drift from the work plan with the Site Safety Officer and PM.
- Discussing safety issues with the PM, Site Safety Officer, and field personnel.
- Assisting the Site Safety Officer with the development and implementation of corrective actions for site safety deficiencies.
- Assisting the Site Safety Officer with the implementation of this HASP and ensuring compliance.
- Assisting the Site Safety Officer with inspections of the Site for compliance with this HASP and applicable SH&E Procedures.

- Reviewing Job Safety Analyses (JSAs) and Task Hazard Assessments (THAs) with the work crew.
- Reporting incidents and ensuring incidents and observations are logged into Lifeguard or IndustrySafe.
- Verifying that all operations are in compliance with the requirements of this HASP and halting any activity that poses a potential hazard to personnel, property, or the environment.
- Temporarily suspending individuals from field activities for infractions against the HASP, pending consideration by the Site Safety Officer, the SH&E Manager, and the PM.

4.3 Site Safety Officer

The Site Safety Officer supports the Site Supervisor in providing a safe work environment. The Site Supervisor may act as the Site Safety Officer on sites without one. The Site Safety Officer's responsibilities include the following:

- Updating the site-specific HASP to reflect changes in site conditions or the scope of work. HASP updates must be reviewed and approved by the SH&E Manager.
- Inspecting the Site for compliance with this HASP and the SH&E Procedures using the appropriate field audit inspection checklist found in IndustrySafe.
- Coordinating with Site Supervisor to review JSAs and THAs with the work crew.
- Assisting as needed to report incidents and verify that incidents and observations are logged into Lifeguard or IndustrySafe.
- Working with the Site Supervisor and PM to develop and implement corrective action plans to correct deficiencies discovered during site inspections. Deficiencies will be discussed with project management to determine appropriate corrective action(s).
- Contacting the SH&E Manager for technical advice regarding safety issues.
- Determining emergency evacuation routes, establishing and posting local emergency telephone numbers, and arranging emergency transportation.
- Checking that all site personnel and visitors have received the proper training, orientation, and medical clearance prior to entering the Site.
- Establishing controlled work areas (as designated in this HASP or other safety documentation).
- Facilitating or co-leading daily tailgate meetings and maintaining attendance logs and records.
- Discussing potential SH&E hazards with the Site Supervisor, the SH&E Manager, and the PM.
- Selecting an alternate Site Safety Officer by name and informing him/her of their duties, in the event that the Site Safety Officer must leave or is absent from the Site.
- Verifying that all operations are in compliance with the requirements of this HASP.
- Issuing a "Stop Work Order" under the conditions set forth in this HASP.
- Temporarily suspending individuals from field activities for infractions against the HASP, pending consideration by the SH&E Manager and the PM.

4.4 Employees

Responsibilities of employees associated with this project include, but are not limited to, the following:

- Understanding and abiding by the SH&E Procedures specified in the HASP and other applicable safety policies, and clarifying those areas where understanding is incomplete
- Providing feedback to SH&E management for continuous improvement relating to omissions and modifications in the HASP or other safety policies and procedures
- Notifying the Site Supervisor or Site Safety Officer of unsafe conditions and acts
- Stopping work if there is doubt about how to safely perform a task or if unsafe acts or conditions are observed (including subcontractors or team contractors)
- Speaking up and refusing to work on any site or operation where the SH&E Procedures specified in this HASP or other safety policies are not being followed
- Contacting the Site Supervisor or Site Safety Officer or the SH&E Manager at any time to discuss potential concerns

4.5 Subcontractors

The requirements for subcontractor selection and subcontractor safety responsibilities are outlined in AECOM Procedure S3NA-213-PR1, Subcontractor Management. Each AECOM subcontractor is responsible for assigning specific work tasks to its employees. Each subcontractor's management will provide qualified employees and allocate sufficient time, materials, and equipment to safely complete assigned tasks. In particular, each subcontractor is responsible for equipping its personnel with any required personnel protective equipment (PPE) and all required training.

AECOM considers each subcontractor to be an expert in all aspects of the work operations for which it is tasked to provide, and each subcontractor is responsible for compliance with the regulatory requirements that pertain to those services, as well as all other requirements applicable to its work. Each subcontractor is expected to perform its operations in accordance with its own unique safety policies and procedures, in order to ensure that hazards associated with the performance of the work activities are properly controlled. Copies of any required safety documentation for a subcontractor's work activities will be provided to AECOM for review prior to the start of on-site activities.

Hazards not listed in this HASP but known to any subcontractor, or known to be associated with a subcontractor's services, must be identified and addressed to the AECOM PM or the Site Supervisor prior to beginning work operations. The Site Supervisor or authorized representative has the authority to halt any subcontractor operations, and to remove any subcontractor or subcontractor employee from the Site for failure to comply with established health and safety procedures or for operating in an unsafe manner.

4.6 Visitors

Authorized visitors (e.g., client representatives, regulators, AECOM management staff, etc.) requiring entry to any work location on the Site will be briefed by the PM, Site Supervisor, or Site Safety Officer on the hazards present at that location. Visitors will be escorted at all times at the work location and will be responsible for compliance with their employer's health and safety policies. In addition, this HASP specifies the minimum acceptable qualifications, training, and PPE that are required for entry to any controlled work area; visitors must comply with these requirements at all times.
If the site visitor requires entry to any exclusion zone (EZ), but does not comply with the above requirements, all work activities within the EZ must be suspended.

Unauthorized visitors, and visitors not meeting the specified qualifications, will not be permitted within established controlled work areas.

5 Training and Documentation

The following sections describe the standard practices or programs that AECOM will establish to prepare employees to perform work safely and consistent with AECOM policy and procedures.

5.1 HASP and Site Orientation

The PM shall conduct a project/site-specific HASP orientation prior to the start of field operations, with support as needed by the SH&E Manager, Site Safety Officer, or Site Supervisor. This meeting will involve representatives from all organizations with a direct contractual relationship with AECOM on the job site. Minimum items to be covered are listed in **Attachment D**. Participants will then sign the HASP Personnel Acknowledgement register at the end of the HASP.

5.2 Daily Tailgate Meetings and THA review

The Site Supervisor, Site Safety Officer, or designee shall facilitate a tailgate meeting to discuss the specific requirements of this HASP, review the applicable JSAs, and/or complete THAs prior to the commencement of daily project activities. Attendance at the daily tailgate meeting is mandatory for all employees and subcontractors at the Site contracted to AECOM. Simultaneous operations are encouraged to attend each other's tailgate meetings or, at the very least, the supervisors shall discuss the coordination of activities and associated hazards of each other's tasks. The supervisor will then convey the information to the work crew. The Tailgate Meeting must be documented by the Site Supervisor or Site Safety Officer on a Daily Tailgate Meeting form, a blank copy of which is included in **Attachment E**.

5.3 Worker Training and Qualifications

All personnel at the Site must be qualified and experienced in the tasks they are assigned. SH&E Training Procedure S3NA-003-PR1 establishes the general training requirements for AECOM employees. In addition, S3NA-117-PR1, Hazardous Waste Operations, explains the Hazardous Waste Operations and Emergency Response (HAZWOPER) training, and S3NA-128-PR1, Medical Screening and Surveillance details the medical surveillance requirements.

Check all required training on the table below. Verify training records of employees and subcontractors.

Site Specific Training Requirements	
Training	Applies to
☒ HASP Orientation	All Employees and Subcontractors
☒ HAZWOPER 40-hour	On HAZWOPER sites, in EZ, exposed to hazardous contamination
☒ HAZWOPER Supervisor	Employees managing others in HAZWOPER activities
☒ Fit Test/Respiratory Protection	Employees needing to wear respirators
☒ Hazardous Materials Shipping	Employee responsible for shipping HZM/HZW/DG and/or signing manifests
☒ Annual Medical Surveillance/ Clearance	Employees working in an exclusion zone and the regulatory required exposure limit **is** exceeded for 30 or more days a year
☒ Biennial Medical Surveillance/ Clearance	Working in an exclusion zone more than 30 days a year and the regulatory required exposure limit is **not** exceeded
☒ OSHA 10-hour Construction	Employees working near heavy equipment

Site Specific Training Requirements	
☒ OSHA 30-hour Construction	Supervisor/Site Safety Officer overseeing work with heavy equipment
☒ Defensive Driving; Field Safety	All Employees or Subcontractors
☐ Client requirements:	

Notes:
DG – dangerous goods
EZ – exclusion zone
HASP – Health and Safety Plan
HAZWOPER – Hazardous Waste Operations and Emergency Response
HZM – hazardous materials
HZW – hazardous waste
OSHA – Occupational Safety and Health Administration

5.3.1 Competent Person

A competent person is an employee who, through education, training, and experience, has knowledge of applicable regulatory requirements; is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees; and who has authorization to take prompt corrective measures to eliminate them.

AECOM's Competent Person Designation Procedure, S3NA-202-PR1, explains the roles, responsibilities, and procedures of naming a competent person. Complete the table below and include a S3NA-202-FM1 Competent Person Designation Form for each AECOM competent person (subcontractors to use an equivalent process).

The following site activities require a competent person:

	Activity	Name of Person
☒	Hearing Protection	TBD prior to start of project
☒	Heavy Equipment	TBD prior to start of project
☒	Trench & Excavations	TBD prior to start of project
☒	Respiratory Protection	TBD prior to start of project

Note:
TBD – To be determined.

6 Hazard Assessment and Control

AECOM has adopted an approach to hazard assessment and control that incorporates both qualitative and quantitative methods to identify hazards and the degree to which they may impact employees and AECOM operations. See S3NA-209-PR1, Risk Assessment and Management, for details regarding AECOM's process. The following sections define AECOM's hazard assessment approach.

6.1 SH&E Procedures

All AECOM SH&E Procedures, in their controlled copy version, are available on the internal SH&E Policy and Procedures Ecosystem page. The applicable field procedures checklist is in the Physical Hazards section below and procedures are included in **Attachment B**.

6.2 Pre-Job Hazard Assessment/Job Safety analysis

A pre-job hazard assessment or JSA is to be developed for each discrete task planned as part of the project. This assessment lays out the steps of the job, potential hazards, and mitigation measures. Form S3NA-209-FM4 or a client required equivalent may be used. A blank copy is included in **Attachment E**.

6.3 Task Hazard Assessment

The THA is a handwritten field form that is based on "Stop and Think" as the first thing you do before starting work activities. It is often paired with the daily tailgate meeting or work permit issuance. Not all risks can be anticipated in this HASP or the pre-job hazard assessment process; therefore, the THA is used to assess, mitigate, and document the site-specific conditions and changes to the hazard profile prior to and throughout the work task. Proper implementation of the THA program protects worker health and safety. A blank THA form is included in **Attachment E**. The THA must be signed by all employees each day and initialed whenever a changed condition provokes a change in hazard controls.

6.3.1 Hazard Categories

JSAs and THAs should include consideration of the following hazard categories when identifying hazards and task specific controls:

- Energy Sources (line of fire, electricity, pressure, compression/tension)
- Fall (slip/trip, fall to same level, fall from height)
- Contact with (struck against, struck by, contact with sharp/abrasives)
- Caught (in, under, between, by)
- Strain/Overexertion (lifting, repetition, push/pull, bending, twisting)
- Exposure (temperature, radiation, noise, chemicals, radiation, hazardous atmosphere)

6.4 4-Sight

When preparing hazard assessments and throughout the day workers should use "4-Sight." This is a mental process through which workers ask themselves (and each other) four questions designed to effectively assess hazards. Using these questions during each task, especially those without formal JSA or THA, will help workers identify hazards and condition changes so that they can control them or stop work to seek assistance.

1. What am I about to do?
2. What could go wrong?
3. What could be done to make it safer?
4. What have I done to communicate the hazards?

7 Physical Hazard Assessment

7.1 Physical Hazards

A physical hazard is a hazard that threatens the physical safety of an individual; contact with the hazard typically results in an injury. The following table summarizes the physical hazards or activities containing physical hazards present at the Site and the associated procedures that address protection and prevention of harm.

All checked procedures are included in **Attachment B** for implementation and reference.

The following are all applicable hazards/activities for this project:

	Hazard/Activity	Site Specific Description	Applicable Procedure
☒	Bloodborne Pathogens	Biohazards from refuse of former homeless encampment	S3AM-111-PR1
☒	Cold Stress	Wintertime field work	S3NA-112-PR1
☒	Compressed Gases	Calibration gases for PID	S3NA -114-PR1
☒	Corrosive Reactive Materials	Sample bottle handling during sampling and packaging (occasional)	S3NA -125-PR1
☒	Drilling, Boring & Direct Push Probing	Borehole advancement (frequent)	S3NA -321-PR1
☒	Excavation	Activities associated with ISS	S3NA -303-PR1
☒	Hazardous Waste Operations	Soil remediation and groundwater monitoring	S3NA -117-PR1
☒	Heat Stress	Summertime field work	S3NA -113-PR1
☒	Heavy Equipment	Excavators and drill rigs associated with ISS activities.	S3NA -309-PR1
☒	Material Storage	On-site equipment storage and possible soil drum storage	S3NA -316-PR1
☒	Respiratory Protection	Potential chemical vapor exposure; dusts generated during ISS (bentonite and cement)	S3NA -123-PR1
☒	Underground Utilities	Utility locating	S3NA -331-PR1
☒	Wildlife, Plants and Insects	Potential biological hazards	S3NA -313-PR1

Notes:
Text in Hazard/Activity column links to procedure.
ISS – *in situ* soil solidification
PID – photoionization detector

8 Chemical Hazard Assessment

AECOM will perform tasks that can expose personnel to a variety of hazards due to the operational activities, physical conditions of the work locations, and potential presence of environmental contaminants. This section presents a variety of potential chemical hazards, exposure pathways, and related mitigation actions. See S3NA-110-PR1, Toxic and Hazardous Substances, for information on planning, training, monitoring, and details on several specific chemicals (benzene, cadmium, chromium, hydrogen sulfide, lead, and silica).

8.1 Potential Chemical Hazards

The following table summarizes the hazardous properties of potential chemical hazards for this project:

	Chemical Name	Maximum Concentration Found On-site	Media	Primary Routes of Exposure	PEL	TLV
☒	PAHs	110 mg/kg	Soil and water	Inhalation	0.2 mg/m^3	0.2 mg/m^3
☒	TPH-diesel	14,000 mg/kg	Soil and water	Inhalation	n/a	15 ppm
☒	TPH-oil	8,600 mg/kg	Soil and water	Inhalation	5 mg/m^3 [b]	5 mg/m^3 [b]
☒	Arsenic	60 mg/kg	Soil and water	Dermal	0.5 mg/m^3	0.2 mg/m^3
☒	Barium	2,740 mg/kg	Soil and water	Dermal	0.5 mg/m^3	0.5 mg/m^3
☒	Cadmium	70 mg/kg	Soil and water	Dermal	0.005 mg/m^3	0.01 mg/m^3
☒	Chromium	145 mg/kg	Soil and water	Dermal	0.5 mg/m^3	0.5 mg/m^3
☒	Copper	7,410 mg/kg	Soil and water	Dermal	1.0 mg/m^3	1.0 mg/m^3
☒	Lead	2,710 mg/kg	Soil and water	Dermal	0.05 mg/m^3	0.05 mg/m^3
☒	Mercury	1.53 mg/kg	Soil and water	Dermal	0.1 mg/m^3	0.025 mg/m^3
☒	Selenium	40 mg/kg	Soil and water	Dermal	0.2 mg/m^3	0.2 mg/m^3
☒	Silver	2.1 mg/kg	Soil and water	Dermal	0.01 mg/m^3	0.01 mg/m^3
☒	PCBs	9.28 mg/kg	Soil and water	Absorption, Ingestion	1 mg/m^3 (42% chlorine); 0.5 mg/m^3 (54% chlorine)	1 mg/m^3 (42% chlorine); 0.5 mg/m^3 (54% chlorine)

Notes:
mg/kg – milligrams per kilogram
mg/m^3 – milligrams per cubic meter
n/a – not applicable
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
PEL – permissible exposure limits
PPM – parts per million
TLV – threshold limit values
TPH – total petroleum hydrocarbons

8.2 Potential Exposure Pathways

Occupational exposure to chemical hazards associated with the work activities could potentially occur by two primary routes (inhalation and skin contact) and one indirect route (incidental ingestion).

8.2.1 Inhalation

The primary risks associated with AECOM's scope of work pertain to potential exposure to airborne contaminants and explosion hazards. Constituents that potentially pose an occupational concern to employees by the inhalation route are carbon monoxide, hydrogen sulfide, methane, and volatile organic compounds. Air monitoring will be performed within the employee breathing zone to assess the need to implement appropriate control measures or stop work. In addition, air monitoring will be performed at the source to assess potential explosion hazards.

8.2.2 Skin Contact

Personnel handling residual product or waste and associated equipment may be exposed to chemical hazards by skin contact or adsorption. However, exposure is expected to be limited since workers will be required to wear appropriate PPE (i.e., appropriate work gloves, body clothing, and/or face shield).

Although the homeless encampment adjacent to the site has been removed, sharps (hypodermic needles) and other biohazards may be observed at the site. Personnel will be instructed to avoid contact with sharps or any other refuse that present a biohazard and to contact the project manager for proper disposal.

8.2.3 Ingestion

Personnel handling residual product or waste and associated equipment, including project hazardous materials, may be exposed by incidental ingestion. Typically, this exposure occurs if proper PPE was not used or personal hygiene was not practiced. Personal protection against exposure via ingestion can be accomplished by performance of proper decontamination procedures when exiting contaminated work areas, as well as using the correct PPE.

8.3 Decontamination

All possible and necessary steps shall be taken to reduce or minimize contact with chemicals and contaminated/impacted materials while performing field activities. Decontamination steps are outlined in Hazardous Waste Operations procedure S3NA-117-PR1. Some key elements are as follows:

- All persons and equipment entering the EZ shall be considered contaminated, and thus must be properly decontaminated prior to exiting to clean areas of the Site.
- Avoid reactions between the solutions and contaminated materials. Review the applicable SDS.
- All contaminated PPE and decontamination materials shall be contained, stored, and disposed of in accordance with site-specific requirements determined by site management.
- Use caution while working around decontamination stations, including the decontamination pad, which may be a slip or trip hazard.
- Use disposable equipment when possible and practical.
- All employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. The level of PPE may be equivalent to the level of PPE required in the EZ. Other PPE may include splash protection, such as face-shields and splash suits, and knee protectors.
- All decontaminated equipment shall be visually inspected for contamination prior to leaving the Contaminant Reduction Zone.

Decontamination Procedures & Equipment		
Procedure		**Equipment Needed**
Personnel should wash hands and face after leaving the work zone and before eating. Formal decontamination procedures are required.		Soap, water, wash buckets and brushes
Equipment Decontamination Procedures		
Type Equipment	**Decontamination Solution**	**Procedure**
Groundwater and Soil Sampling Equipment	Alconox	Wash equipment with a long-handed brush in a wash tub containing Alconox detergent water. Equipment will be inspected for further decontamination, as needed.
Boots	Alconox	Wash boots with a long-handled brush in a wash tub containing Alconox detergent water. Boots will be inspected for further decontamination, as needed.
Waste Handling for Decontamination		
Waste Streams/Products		**Disposal Procedures**
Disposal sampling equipment		Collect in trash bags and disposed of in the appropriate drums.
Nitrile gloves		Collect in trash bags and disposed of in the appropriate drums.
Tyvek and boot covers (if needed)		Collect in trash bags and disposed of in the appropriate drums.
Sharps (hypodermic needles, refuse with biohazards, etc.)		Do not touch or otherwise handle materials. Contact project manager for coordination of proper disposal.

8.4 Air Monitoring

Monitoring shall be performed within the work area on-site in order to detect the presence and relative levels of toxic substances. The data collected throughout monitoring shall be used to determine the appropriate levels of PPE. Monitoring shall be in accordance with Exposure Monitoring Procedure S3NA-127-PR1 and specified in the work permit and/or JSAs for the tasks. Key elements of the procedure include the following:

- Calibration of monitoring equipment and/or daily bump tests shall be conducted to verify calibrations and confirm alarm function.
- Personal monitoring and result evaluation must be directed by a Certified Industrial Hygienist or Certified Safety Professional.

8.4.1 Real-Time Exposure Measurement/ Equipment

Monitoring shall be performed within the work area on-site in order to detect the presence and relative levels of toxic substances. The data collected throughout monitoring shall be used to determine the appropriate levels of PPE. Monitoring shall be conducted as specified in the work permit and JSAs as work is performed. All instrumentation needs to be rated intrinsically safe to prevent fire or explosion.

The following real-time monitoring equipment will be used at the Site. If additional equipment is needed, the HASP will be updated accordingly:

	Instrument	Manufacturer/Model	Substances Detected
☒	PID/FID	RAE Systems mini-RAE Photovac Microtip HNu Model Hnu (min. 10.6 eV bulb)	• Petroleum hydrocarbons • Organic Solvents
☒	Multi- or 4-Gas Detectors	RAE Systems Multi-RAE	• Lower Explosive Limit • Oxygen • Carbon Monoxide • Hydrogen Sulfide

Notes:
FID – flame ionization detector
PID – photoionization detector
eV – electron volt

8.4.2 Health and Safety Action Levels

An action level is a point at which increased protection is required due to the concentration of contaminants in the work area or other environmental conditions. The concentration level (above background level) and the ability of the PPE to protect against that specific contaminant determine each action level. The action levels are based on concentrations in the breathing zone. If ambient levels are measured that exceed the action levels in areas accessible to unprotected personnel, necessary control measures (barricades, warning signs, and mitigation actions to limit, etc.) must be implemented prior to commencing activities at the specific work area.

Personnel should also be able to upgrade or downgrade their level of protection with the concurrence of the Site Supervisor, Site Safety Officer, or the Safety Manager.

Reasons to upgrade include:

- Known or suspected presence of dermal hazards;
- Occurrence or likely occurrence of gas, vapor, or dust emission; or
- Change in work task that will increase the exposure or potential exposure to hazardous materials.

Reasons to downgrade include:

- New information indicating that the situation is less hazardous than was originally suspected;
- Change in site conditions that decrease the potential hazard; or
- Change in work task that will reduce exposure to hazardous materials.

8.4.3 Monitoring Procedures

The monitoring procedures shown below are general guidelines for sampling activities. The reviewing SH&E Manager may modify any or all of these for site-specific application. A reading in excess of the action level outlined below will require additional ventilation for 30 minutes, followed by re-monitoring.

Parameter	Zone Location and Monitoring Interval	Response Level	Response Activity
VOCs and volatile hydrocarbons (total by PID)	Breathing zone, continuously during tasks where exposure to VOCs and volatile hydrocarbons is possible	< 5 ppm	Continue monitoring; may continue work in required PPE.
		5- 25 ppm (sustained for 5 minutes)	STOP WORK and notify PM. Investigate the cause of elevated VOC measurements and identify measures to reduce concentrations (cover impacted soils, ventilation, etc.). Work activities shall only continue once levels have decreased to or below 5 units above background. If levels continue above 5 units, only individuals who are medically qualified to wear respiratory protection are permitted to continue work activities with PM approval. Don Level C PPE (organic vapor respirator cartridges), continue monitoring, and initiate continuous air monitoring for benzene.
		> 25 ppm (sustained for 5 minutes)	Cease work, exit, and contact the Site Safety Officer, Site Supervisor, and PM.

Notes:

PID – photoionization detector

PM – Project Manager

PPE – personal protective equipment

ppm – parts per million

VOC – volatile organic compound

9 Environmental Impact Prevention

AECOM strives to avoid or control environmental impacts from our operations through planning and implementation of best practices as well as preparing responses to react to environmental incidents. Environmental Compliance procedure S3NA-204-PR1 provides details on permitting and planning requirements.

	Potential Environmental Impact	Description of Hazard and Permit or Control Being Implemented
☐	Air Emissions	Any operations where air emissions may negatively impact the surrounding environment, air emission permits, etc. and discuss associated control
☒	Hazardous Waste Management	Storage, treatment, or disposal of hazardous waste at the project site, RCRA Part B permits or equivalent, 90-day storage procedures, etc.
☐	Storm Water Pollution	Operations that may generate/discharge storm water from the project site, NPDES/general construction storm water discharge permits, etc.
☐	Wetlands	Use the FWS online wetlands mapper (http://www.fws.gov/wetlands/Data/mapper.html) to determine if any wetlands exists on your project site, are adjacent to your project, or may be negatively impacted by your project, any regulatory permits and control measures
☐	Critical Habitat	Use the FWS online critical habitat mapper tool (http://criticalhabitat.fws.gov/) to determine if any plant or animal critical habitats exists on, adjacent to, or may be otherwise impacted by your project, any regulatory permits and control measures
☐	Other:	

Notes:
FWS – U.S. Fish and Wildlife Service
NPDES – National Pollutant Discharge Elimination System
RCRA – Resource Conservation and Recovery Act

9.1 Incidental Spill Prevention and Containment

Spill prevention and containment planning must be conducted and appropriate control measures established, consistent with regulatory requirements. Personnel are not expected to perform a response action related to an uncontrolled release of a hazardous substance. However, in the event of an incidental release of a hazardous material, a response will be performed to absorb, neutralize, or otherwise control the release within the immediate work area. Procedures contained in the SDS of the hazardous material will be implemented to perform the response. The Emergency Response section of this HASP contains information on spill reporting, pre- and post- spill evaluation, and response.

9.1.1 Spill Prevention and Containment Practices

Work activities may involve the use of hazardous materials (e.g., fuels, solvents) or work involving drums or other containers. When these activities exist, the procedures outlined below will be used to prevent or contain spills:

- All hazardous material will be stored in appropriate containers and labelled.
- Tops/lids will be placed back on containers after use.

- Containers of hazardous materials will be stored appropriately away from moving equipment.
- Containers shall only be lifted using equipment specifically manufactured for that purpose.
- Drums/containers will be secured and handled in a manner which minimizes spillage and reduces the risk of musculoskeletal injuries.
- Equipment will be inspected daily for signs of leaks, wear, or strain on parts that, if ruptured or broken, would result in a spill.
- Refueling should occur in designated areas where incidental spills can be prevented from reaching permeable ground surfaces.
- Whenever possible, position parked or stationary equipment over secondary containment and/ or absorbent materials to prevent spills from reaching permeable ground surfaces.
- A spill response kit, to include an appropriate empty container, materials to allow for booming or diking the area to minimize the size of the spill, and appropriate clean-up material (e.g., speedy dri, absorbent pads, etc.) will be available on the Site and positioned for quick and easy access.

10 Personal Protective Equipment

PPE is considered the last line of defense in hazard control. PPE is meant to protect workers when all other methods (elimination, engineering, and administrative) have been exhausted. All employees must be trained in the proper use and maintenance of PPE. See Procedure S3NA-208-PR1, Personal Protective Equipment.

A PPE assessment (see S3NA-208-FM1) can be performed to help determine PPE requirements. PPE upgrades for individual tasks or steps of a task are to be identified in JSAs or THAs.

Minimum Required PPE (per AECOM PPE and HAZWOPER Procedures) includes the following:

- Hard hat
- Safety glasses w/ side shields (may be clear or shaded)
- Safety toe work boots
- Long pants and shirts with sleeves (short or long; cover shoulders–no tank or muscle shirt styles)

The table below summarizes site-specific PPE required for this project.

Face/ Eyes	Head/ Ears
☒ Spoggles (Safety Glasses with foam liner for dust protection) ☐ Welding mask/goggles ☐ Chemical goggles ☐ Face shield (splash) ☐ Face shield (impact)	☐ Helmet with chin strap ☐ Wide brimmed hat ☒ Earplugs ☐ Over-ear hearing protection
Hands	**Legs/ Feet**
☒ Nitrile ☐ Leather ☐ Cut, abrasion and puncture resistant ☐ Impact-resistant ☐ Other Chemical Resistant: _____	☐ High ankle boots ☐ Snake guards ☐ Rubber boots/waders ☐ Metatarsal Guards ☐ Electrically-resistant boots
Body	**Equipment**
☒ Sunscreen ☒ Insect repellent (DEET) ☐ Permethrin applied to clothing ☐ Long-sleeved shirt ☒ High-visibility vest ☐ High-visibility pants ☐ Disposable coveralls ☐ Flame retardant clothing ☐ Fall protection ☐ Personal floatation device ☐ Other:_____	☐ Air/noise monitoring equipment (specify): ☐ Traffic/Work zone control equipment (specify): ☐ Communication beyond cell phones (specify): ☐ Fire controls (specify):

11 Site Control

The purpose of site control is to protect the public from inadvertently coming into contact with site hazards and to protect AECOM employees being impacted by hazards. This section details the equipment and actions needed to promote optimal site control.

11.1 Site Work Zones

Site layout and site control need to be coordinated achieve a productive work environment and efficient work process while minimizing exposure of employees and the public to hazards associated with the work. Consider the following items when planning the site layout and controls:

- "Line of Fire" hazards—overhead utilities, falling/ tipping equipment, release of energy/ pressure, flying debris
- Noise, dust, odor suppression
- Contamination containment and decontamination area layout
- Traffic control for site vehicles/equipment (public traffic control requires Traffic Control Plan)
- Restricted access for areas requiring special training, skills, or certifications
- Restriction of work near railroads
- Presence or creation of excavations
- Loading/unloading areas
- Portable restrooms
- Dumpsters and bins
- Equipment laydown
- Heavy equipment parking
- Overnight safety and security needs

The boxes marked below are site controls **already** in place:

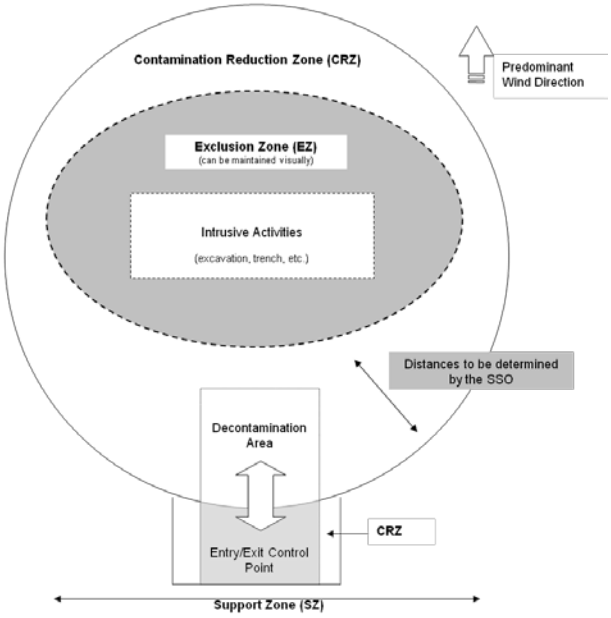
☐	Work area is within a facility/ property with secure and restricted access provided by client or third party
☐	Work area is enclosed within facility/ property but access is not restricted via locks, guards, or gates
☒	Work area is on a property that is open and access by the public is likely
☐	Work area is on a property that is open but access by the public is unlikely
☐	Work area is in a roadway or right of way of a roadway (Traffic Control Plan required S3NA-306-PR1)
☐	Work area is on or near railroad (including right of way, active lines, and crossings)
☐	Other (describe):

The boxes marked below are site controls that need to be added to protect the public and the AECOM work team.

	Control Item	Description of type and application
☒	Fence	Security fence with three strand barb wire was installed at the Site.
☐	Locks	
☒	Barricades	See fence.
☒	Cones	Cones to delineate work areas may be used.
☒	Tape	Danger and Caution tape may be used around open excavations.
☐	Hole Covers	
☐	Other:	

11.2 Site Control Map/Diagram

Insert diagrams and/or maps to document the site layout and controls (barricades, fences, cones, caution tape, etc.) that will be used. Identify exclusion zone, contamination reduction zone, and support zone as applicable.



11.3 Simultaneous and Neighboring Operations

Simultaneous and neighboring operations present a need for added coordination and communication to address hazards that are presented by multiple operations.

Activity/Company	Hazard	Controls/Mitigations & Communication Methods
Simultaneous Operation (within the Site)		
Not applicable		
Neighboring Operation (outside/ bordering the Site)		
Not applicable		

11.4 Site Security

All projects should be reviewed for the potential for personal security issues (e.g., assault, robbery, threat, etc.). Check all of the following that apply:

☐ Project site located in a higher crime area or has a history of security incidents

☐ Working outside of regular cellular telephone service

☒ Idle property with potential for trespasser(s) to shelter in buildings/structures and assault personnel

☐ Working at night

Site security is necessary to:

- Prevent the exposure of unauthorized. Unprotected people to site hazards;
- Avoid the increased hazards from vandals or persons seeking to abandon other wastes on the Site;
- Prevent theft; and
- Avoid interference with safe working procedures.

11.4.1 To Maintain Security during Working Hours

- Establish an identification system to identify authorized persons and limitations to their approved activities.
  - CONTACT: 911 if unauthorized personnel are present.
- Maintain chain linked fencing (with three strand barbed wire) around the Site. Ensure that fence gates are secured closed and locked when not in use.
- Lock gates while working inside secure fencing.
- Have PM approve all visitors to the Site. Ensure they are approved and have a valid work purpose for entering the Site.
- Have trained site personnel accompany visitors at all times and provide them with the appropriate protective equipment.
- Maintain vehicle ready to evacuate, pointed toward gate entrance.

11.4.1.1 If Gate Is Approached by Unauthorized Persons

1. Notify the AECOM Team (including subcontractors) of the situation and inform them to monitor the situation from a distance.
2. With two AECOM Employees standing near the AECOM or Subcontractor vehicle, not closer than 20 feet from the fence, the AECOM employee, in a calm voice, shall inform the unauthorized person that this is an authorized area and they are not allowed onto the premises.
   a. *The gate shall remain locked at all times the conversation is occurring, and the AECOM employee or subcontractor shall not approach closer than 20 feet.*
   b. *The vehicle can be used as cover or for quick evacuation if needed; remain within 6 feet of vehicle.*

3. If the person(s) does not listen, becomes agitated, or is threatening, keep a calm voice and allow the unauthorized person to speak. Signal to the AECOM Team (or subcontractor) to contact 911. This can be done by removing the hard hat and holding it under the arm. This signal shall be discussed during the SH&E Kickoff Meeting and Tailgate SH&E Meeting prior to commencing work for the day.
4. The AECOM person who is monitoring the situation (not actively engaged in speaking with the person) shall call 911 and inform them that there is a person attempting to trespass onto the secured Site.

11.4.2 To Maintain Security during Non-Working Hours

- Ensure that fence gates are securely closed and are properly locked prior to leaving the Site.
- Do not leave equipment or supplies outside, even if they are within the fencing.
- Enlist public enforcement agencies, such as the local police department, if the Site presents a significant risk to local health and safety.

11.4.3 Operational Security Plans

All facilities maintained by AECOM must maintain an Operational Security Plan (OSP) describing the conditions of the site or facility, and identifying basic emergency response procedures. This requirement applies to field trailers maintained by AECOM for use on project sites. A blank OSP template is available in Global Resilience Group Standard GRG-001-RP4. The OSP must be maintained by the PM at the field trailer and a copy provided to the Global Resilience Group, which can be found on Ecosystem. The OSP plans as well as active shooter guidelines are provided in **Attachment F**.

12 Emergency Response

AECOM requires that all projects plan for reasonably foreseeable emergencies (see Emergency Response Planning Procedure S3NA-010-PR1). Prior to the start of site operations, all personnel shall review the table below for site-specific information regarding evacuations, muster points, communication, and other site-specific emergency procedures. An Incident Response Flow Chart is included in **Attachment A**.

12.1 Incident/Emergency Contact Information

AECOM Contacts			
Name	**Title**	**Telephone Number**	**Mobile Phone**
Paul Kalina	Project Manager	(206) 438-2172	(206) 310-5097
TBD	Site Supervisor	TBD	TBD
TBD	Site Safety Officer	TBD	TBD
Shelley Brown	Region SH&E Manager	(562) 544-3506	
Fred Merrill	Area SH&E Manager	(206) 719-1105	(206) 719-1105
Incident Reporting	DCS Incident Reporting & Help Line	(800) 348-5046	
AECOM Nurse direct	Use only after incident reporting line	(877) 878-9525	
Client Contacts			
Philip Slowiak	Client Project Manager	(901) 419-3845	(901) 604-1952
	Other Client Stakeholder		
Organization/Agency			
Police Department			911
Fire Department			911
Ambulance Service (EMT will determine appropriate hospital for treatment)			(253) 460-1239
Hospital: (Site personnel to use for emergency care) Tacoma General Hospital, 315 Martin Luther King Jr. Way, Tacoma, WA 98405			(253) 403-1000
Occupational Clinic: (Site personnel to use for non-emergency care) US Healthworks Medical Group of Washington, 2624 S 38th St, Tacoma, WA 98409			(253) 475-5908
Poison Control Center			(800) 222-1222
Pollution Emergency			(800) 424-8802
INFOTRAC (AECOM's account number 74984)			(800) 535-5053
AECOM Hazardous Material Shipping Help Line			(800) 381-0664
Public Utilities			
Tacoma Power Click! Cable TV Tacoma Water			(253) 502-8600 (253) 502-8900 (253) 502-8600
Call Before You Dig			811

Notes:

DCS - design and consulting services

EMT – emergency medical technician

SH&E – safety health and environment

TBD – to be determined

US - United States

12.2 Muster Location

Muster location will be determined during the daily safety meetings conducted at the Site and recorded in the field logbook.

12.3 Communication Procedures

Project field personnel will generally be located within line-of-sight, and routine communications will be conducted using cell phone. Emergency communications will also employ equipment horns and/or air horns.

12.4 CPR/ First Aid Trained Personnel

Project field lead personnel will be trained and certified in CPR and First Aid.

12.5 Incident Reporting

Incidents involving or affecting an AECOM employee or subcontractor will be reported in a prompt manner verbally to the site supervisor and PM, and the following steps will be taken:

1. If the incident is a significant or life-threatening emergency, the employee or supervisor shall immediately dial 911 or the appropriate emergency contact phone number for the Site.
2. The employee or supervisor shall contact the Incident Hotline (800-348-5046).
3. The employee or supervisor must notify his/her operational leaders and the Area SH&E Mananger.
4. The supervisor, or delegate, must make initial notification in IndustrySafe within 4 hours for significant incidents, or 24 hours for less significant events.
5. Client and account management notifications may also apply. The PM will make any necessary notifications.

Any injury, even if no treatment is required, and any incident for which assistance by SH&E Management is needed must be immediately communicated to the Incident Hotline at (800-348-5046).

All incidents are also to be reported to IndustrySafe within the timeframes listed below:

Incident Type	IndustrySafe Reporting Time Frame
Significant Incident, including any injury	➔ 4 Hours
All Other Incidents	➔ 24 Hours

Significant Incident:

- Fatality
- Amputation
- Hospitalization for treatment for more than 24 hours (admission)
- Any single event resulting in more than one employee requiring medical treatment or more than one employee being away from work more than 3 days
- Any SH&E-related Consent Agreement/Order/Lawsuit or enforcement action seeking more than $10,000 or alleging criminal activity

- Any spill or release of a hazardous material that is reportable to a regulatory agency
- Any Notices of Violation resulting from not operating within a regulatory agency permit/license or consent
- Any incident resulting in property damage expected to exceed $10,000 United States (US) dollars
- Any security-related incident that could have caused significant harm to an AECOM employee
- Any Near Miss event that may have resulted in any of the above consequences but because of "luck" did not result in harm to persons, property or the environment

All Other Incidents:

- Any injury or illness to an AECOM employee or subcontractor, even if it does not require medical attention, including work-related injuries/illnesses that have become significantly aggravated by the work environment
- An injury to a member of the public, or clients, occurring on an AECOM-controlled work site
- Re-occurring conditions such as back pain or cumulative trauma disorders (e.g., carpal tunnel syndrome)
- Fire, explosion, or flash that is not an intended result of a planned event (e.g., remediation process, laboratory Procedure)
- Any incident involving company-owned, rented, or leased vehicles (including personal vehicles used for company business)
- Any failure to comply with the requirements of a regulatory permit issued to AECOM

In the event of an incident involving or affecting an AECOM employee or subcontractor, scan the QR code below to access the IndustrySafe reporting system from your smartphone/device.

12.6 Medical Emergencies

In the event of a life-threatening or critical emergency, AECOM employees should dial 911 and follow the recommended instructions. However, in less serious situations, an injured employee or a co-worker should contact the Incident Hotline at 800-348-5046 to ensure that the employee receives the best care at the best time (i.e., within the first hour following an injury or potential injury). By contacting the Incident Hotline, the worker can be connected with AECOM's nurses for first aid advice. If recommended by the nurse, the supervisor or a co-worker should drive the injured employee to the project-designated clinic or hospital. A map to the designated hospital and clinic is attached as **Attachment A,** and the locations and addresses are included in the table above as well as in the HASP Summary on Page i.

12.7 Vehicle Incidents

All vehicles should be rented through Carson Wagonlit Travel (accessible via Ecosystem) to ensure that AECOM insurance is included in the rental rate. All other insurances should be declined. AECOM's rental vehicle insurance policy for National/Enterprise or Avis can be found on the DCS Americas United States or Canada travel pages. **Drivers MUST print and carry the applicable insurance policy for the rental**.

In the event of a vehicle incident (including collisions as well as mechanical difficulties such as breakdowns and flat tires), the following responses are recommended:

- For breakdowns and flat tires, contact an emergency provider.
- For rental vehicles, contact the rental company.
- To the extent possible, AECOM personnel should not change flat tires or perform similar repairs.
- If a collision has occurred, assess the situation and move all occupants (except the injured) out of further harm's way. If safe to do so, remove the car from the traveled way. Call 911 if necessary, and report the incident to the Incident Hotline at 800-348-5046 as soon as practical. If appropriate, wait for police to arrive before moving vehicles. Provide insurance information to other drivers if necessary or requested and collect the same. If possible, obtain names and phone numbers of witnesses. Take photographs of the scene if possible. DO NOT ADMIT LIABILITY, AGREE TO PAY FOR DAMAGE, OR SIGN A DOCUMENT RELATED TO AN INCIDENT EXCEPT AS REQUIRED BY LAW.

12.8 Spill or Release

AECOM employees are not expected to take action or to participate in rescues or responses to chemical releases (including of petroleum products) beyond the initial discovery of the release and immediate mitigation actions such as closing a valve, placing absorbents, and notifying the client and or public emergency response system (911), unless there is a contractual provision for this response and specially trained employees.

12.8.1 Environmental Spill/Release Reporting

All environmental spills or releases of hazardous materials (e.g., fuels, solvents, etc.), whether in excess of the Reportable Quantity or not, will be reported according to the incident reporting procedure. In determining whether a spill or release must be reported to a regulatory agency, the Site Supervisor or qualified worker will assess the quantity of the spill or release and evaluate the reporting criteria against the state-specific reporting requirements, applicable regulatory permit, and/or client-specific reporting procedures. **If reporting to a US state or federal regulatory agency is required, AECOM has 15 minutes from the time of the spill/release to officially report it.**

The spill containment program addresses the following site-specific information:

- Potential hazardous substance spills and available controls
- Initial notification and response
- Spill evaluation and response
- Post-spill evaluation

12.8.2 Spill Evaluation and Response

The Site Safety Officer is responsible for evaluating spills and determining the appropriate response. When this evaluation is being made, the spill area is isolated and demarcated to the extent possible. When an incidental release occurs, clean-up personnel receive instructions in a pre-clean-up meeting as to spill conditions, PPE, response activities, decontamination, and waste handling.

The procedures of the Emergency Response section of this HASP are immediately implemented when the spill is determined to require emergency precautions and action. If necessary to protect those outside the clean-up area, notification of the appropriate authorities is made.

The following are general measures that response/clean-up personnel take when responding to a spill:

- To minimize the potential for a hazardous spill, hazardous substances, control/absorbent media, drums and containers, and other contaminated materials are properly stored and labeled.

- When a spill occurs, only those persons involved in overseeing or performing spill containment operations will be allowed within the designated hazard areas. If necessary, the area will be roped or otherwise blocked off. Unauthorized personnel are kept clear of the spill area.
- Appropriate PPE is donned before entering the spill area.
- Appropriate spill control measures are applied during spill response.
- Whenever possible without endangerment of personnel, the spill is stopped at the source or as close to the source as possible.
- Ignition points are removed if fire or explosion hazards exist.
- Surrounding reactive materials are removed.
- Drains or drainage in the spill area are blocked or surrounded by berms to exclude the spilled waste and any materials applied to it.
- Provisions are made to contain and recover a neutralizing solution, if used.
- Small spills or leaks from a drum, tank, or pipe will require evacuation of at least 10 feet in all directions to allow clean-up and to prevent employee exposure. For small spills, sorbent materials such as sand, sawdust, or commercial sorbents are placed directly on the spill to prevent further spreading and aid in recovery.
- Spill area is sprayed with appropriate foam where the possibility of volatile emissions exists.
- If the spill results in the formation of a toxic vapor cloud from vaporization, reaction with surrounding materials, or the outbreak of fire, further evacuation may be required.
- To dispose of spill waste, all contaminated sorbents, liquid waste, or other spill clean-up will be placed in small quantities in approved drums for proper storage or disposal as hazardous waste.

12.8.3 Post Spill Evaluation

As part of the incident investigation and reporting documentation, a written spill response report shall be prepared at the conclusion of clean-up operations. The report will include, at a minimum, the following information:

- Date of spill incident
- Cause of incident
- Spill response actions
- Any outside agencies involved, including their incident reports
- Lessons learned or suggested improvements

The spill area is inspected to ensure the area has been satisfactorily cleaned. The use of surface and air sampling is utilized in this determination as necessary. The root cause of the spill is examined and corrective steps taken to ensure the engineering and control measures in place have performed as required. If alternative precautions or measures are needed, they are made available and implemented.

All durable equipment placed into use during clean-up activities is decontaminated for future utilization. All spill response equipment and supplies are re-stocked as required.

12.9 Fire

AECOM employees are not expected to attempt to put out fires. Stop work; notify all AECOM personnel, move upwind, and contact 911 and/or emergency response at the Site. If employees have been properly trained in the operation of a fire extinguisher, they may attempt to put out a small fire, provided that the following conditions are met:

- The fire must be small (i.e., smaller than a trash can) and in its early stages.
- The employee must have an escape route.
- The employee must be trained and know they have the right type of extinguisher.
- The employee must be safe from toxic gases.
- There must be no hazardous conditions that could quickly accelerate the fire (i.e., presence of chemicals, especially dry grass, etc.).
- Above all, if in doubt, the employee must not attempt to fight the fire.

13 Personnel Acknowledgement

By signing below, the undersigned acknowledges that he/she has reviewed the AECOM Health and Safety Plan for the Tacoma Metals Site. The undersigned also acknowledges that he/she has been instructed in the contents of this document and understands the information pertaining to the specified work and will comply with the provisions contained therein. The employee understands that they are NOT to perform any work that they have not been adequately trained for and that they are to stop work if it is unsafe to proceed. Finally, the employee understands to notify the Site Supervisor and the Incident Hotline at 800-348-5046 for any incident, ***including ANY injury even if no first aid or medical treatment is required.***

PRINT NAME	SIGNATURE	ORGANIZATION	DATE

Attachment A
Hospital and Clinic Directions/ Maps, Incident Reporting, and Response Flow Chart

Hospital- Address, written directions, and mapped route from Site

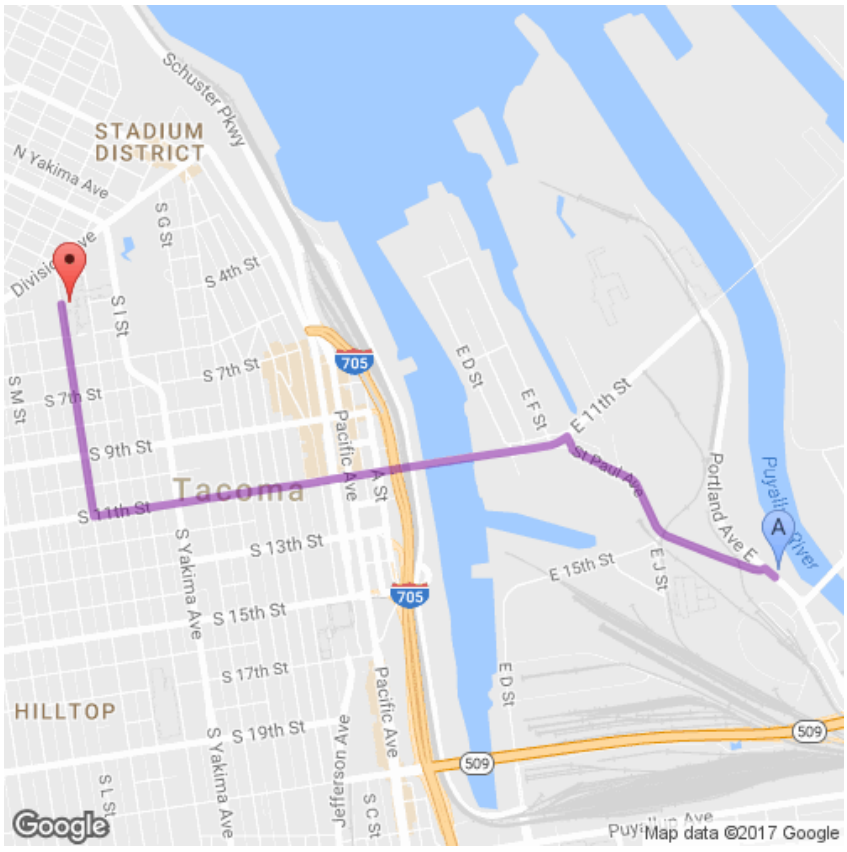
Tacoma General Hospital
315 Martin Luther King Jr Way
Tacoma, WA 98405

DRIVING DIRECTIONS

From: 1919 Portland Avenue
Tacoma, WA 98421
New Start Address

To: 315 Martin Luther King Jr Way
Tacoma, WA 98405

1. Head **northwest** on **Portland Ave E** toward **St Paul Ave**	174 ft
2. Turn **left** onto **St Paul Ave**	0.6 mi
3. Turn **right** to stay on **St Paul Ave**	184 ft
4. Turn **left** onto **E 11th St**	1.2 mi
5. Turn **right** onto **M.L.K. Jr Way**	0.5 mi
Destination will be on the right	
Estimated driving time: 9 minutes	2.3 mi



Occupational Clinic- Address, written directions, and mapped route from Site

US Healthworks Medical Group of Washington
2624 S 38th St
Tacoma, WA 98409

DRIVING DIRECTIONS

From: 1919 Portland Avenue
Tacoma, WA 98421
New Start Address

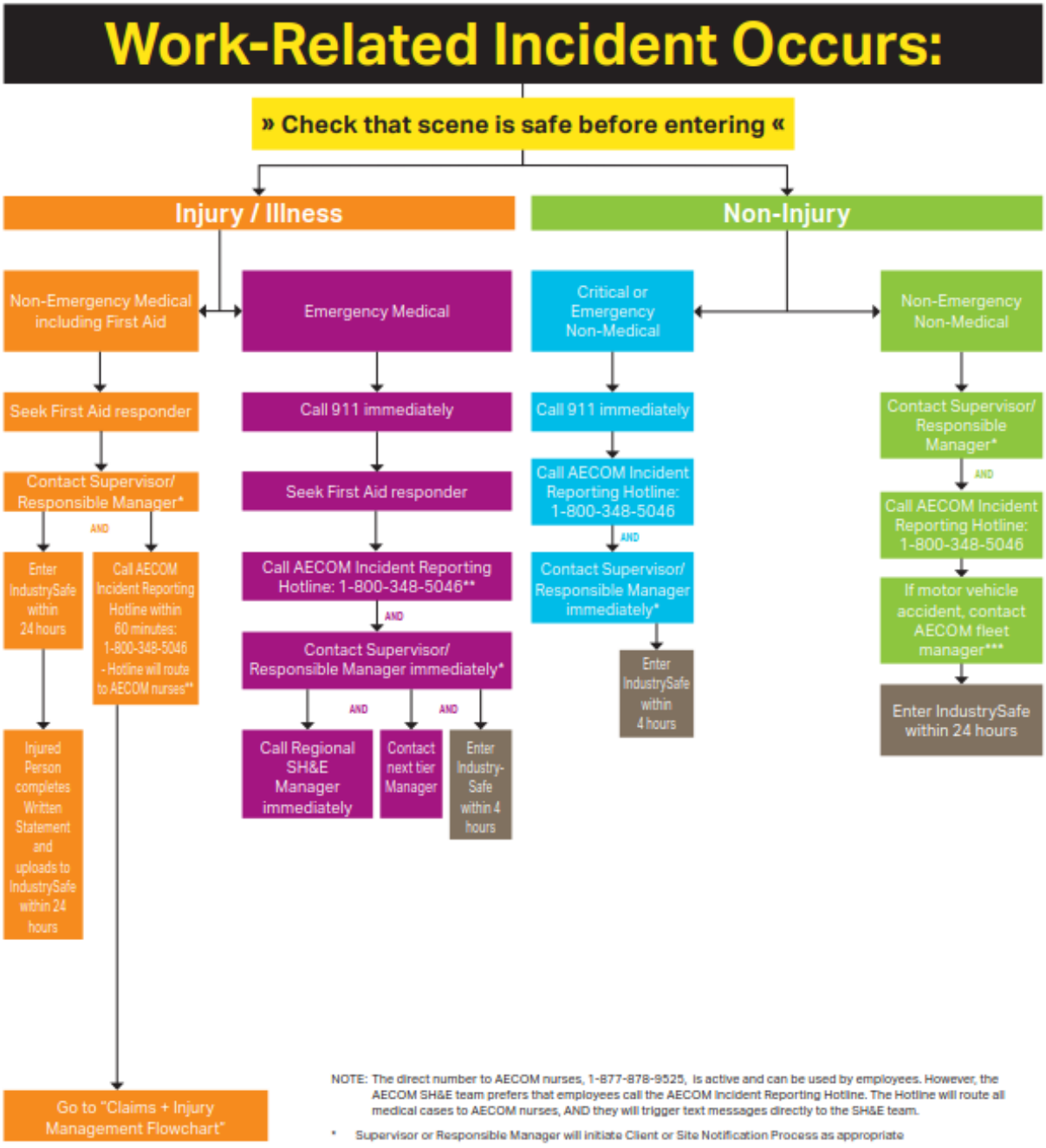
To: 2624 S 38th St
Tacoma, WA 98409

1. Head **southeast** on **Portland Ave E** toward **Lincoln Ave**	0.8 mi
2. Turn **right** onto **E 27th St**	226 ft
3. Merge onto **I-5 S** via the ramp on the **left** to **Portland**	2.0 mi
4. Take exit **132A** toward **S 38th St**	1.1 mi
5. Merge onto **S 38th St**	0.3 mi
Destination will be on the left	
Estimated driving time: 8 minutes	4.3 mi

AECOM

Work-Related Incident Flowchart for Employees

DCS - Americas



NOTE: The direct number to AECOM nurses, 1-877-878-9525, is active and can be used by employees. However, the AECOM SH&E team prefers that employees call the AECOM Incident Reporting Hotline. The Hotline will route all medical cases to AECOM nurses, AND they will trigger text messages directly to the SH&E team.

* Supervisor or Responsible Manager will initiate Client or Site Notification Process as appropriate

** If injured person is an AECOM subcontractor, call AECOM's nurses at 877-878-9525, or direct sub to their own provider.

*** For all AECOM vehicles, call Element at 1-800-446-7052.

Updated October 2016

Attachment B
AECOM SH&E Field Applicable Procedures

AECOM SH&E Field Applicable Procedures

All AECOM SH&E Procedures, in their controlled copy version, are available on the internal SH&E Policy and Procedures Ecosystem page.

Programmatic procedures referenced in this document (for example SH&E Training) **DO NOT** need to be printed for inclusion in this HASP. Only procedures that are needed for field activity reference and application **MUST** be printed in full and included in this section.

Copy the Field Procedure Checklist from the Physical Hazards Section 7.1 to become your table of contents for these attachments. Include only those procedures checked as applicable to this project.

	Hazard/Activity	Site Specific Description	Applicable Procedure
☒	Bloodborne Pathogens	Biohazards from refuse of former homeless encampment	S3AM-111-PR1
☒	Cold Stress	Wintertime field work	S3NA-112-PR1
☒	Compressed Gases	Calibration gases for PID	S3NA-114-PR1
☒	Corrosive Reactive Materials	Sample bottle handling during sampling and packaging (occasional)	S3NA-125-PR1
☒	Drilling, Boring & Direct Push Probing	Borehole advancement (frequent)	S3NA-321-PR1
☒	Excavation	Activities associated with ISS	S3NA-303-PR1
☒	Hazardous Waste Operations	Soil remediation and groundwater monitoring	S3NA-117-PR1
☒	Heat Stress	Summertime field work	S3NA-113-PR1
☒	Heavy Equipment	Excavators and drill rigs associated with ISS activities.	S3NA-309-PR1
☒	Material Storage	On-site equipment storage and possible soil drum storage	S3NA-316-PR1
☒	Respiratory Protection	Potential chemical vapor exposure; dusts generated during ISS (bentonite and cement)	S3NA-123-PR1
☒	Underground Utilities	Utility locating	S3NA-331-PR1
☒	Wildlife, Plants and Insects	Potential biological hazards	S3NA-313-PR1

Notes:
Text in Hazard/Activity column links to procedure.
ISS – *in situ* soil solidification
PID – photoionization detector

AECOM SH&E Field Applicable Procedures

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☒	Excavation	Activities associated with ISS	S3NA-303-PR1
☒	Hazardous Waste Operations	Soil remediation and groundwater monitoring	S3NA-117-PR1
☒	Heat Stress	Summertime field work	S3NA-113-PR1
☒	Heavy Equipment	Excavators and drill rigs associated with ISS activities.	S3NA-309-PR1
☒	Material Storage	On-site equipment storage and possible soil drum storage	S3NA-316-PR1
☒	Respiratory Protection	Potential chemical vapor exposure; dusts generated during ISS (bentonite and cement)	S3NA-123-PR1
☒	Underground Utilities	Utility locating	S3NA-331-PR1
☒	Wildlife, Plants and Insects	Potential biological hazards	S3NA-313-PR1

Notes:
Text in Hazard/Activity column links to procedure.
ISS – *in situ* soil solidification
PID – photoionization detector

Americas

Bloodborne Pathogens

S3AM-111-PR1

1.0 Purpose and Scope

1.1 Define the AECOM procedures for eliminating and/or controlling occupational exposure to Bloodborne Pathogens on AECOM projects and activities.

1.2 A written Exposure Control Plan shall be developed and implemented during all AECOM operations where there is a reasonable potential for occupational exposure of AECOM employees and/or subcontractors to bloodborne pathogens as a regulated waste.

1.3 This procedures requirements apply to all AECOM Americas employees and operations. Any jurisdictional requirements exceeding those identified in this procedure shall be met when conduction work in the given jurisdiction.

2.0 Terms and Definitions

2.1 **Blood** – Human whole blood; human blood components such as plasma or platelets; and human blood products such as clotting factors.

2.2 **Bloodborne Pathogens (BBP)** – Pathogenic microorganisms that are present in human blood and that can infect and cause disease in persons who are exposed to blood containing these pathogens including but not limited to hepatitis B virus (HBV), human immunodeficiency virus (HIV), hepatitis C, malaria, syphilis, babesiosis, brucellosis, leptospirosis, arboviral infections, relapsing fever, human T-lymphotrophic virus Type I, and viral hemorrhagic fever (Ebola).

2.3 **Exposure Control Plan** *(S3AM-111-ATT1)* – A plan that addresses the requirements applicable to specific AECOM projects and activities designed to eliminate or minimize employee exposure. The Exposure Control Plan shall be incorporated into the location specific SH&E Plan and shall be accessible to all employees. The Exposure Control Plan shall include:

- Exposure determination.
- The schedule and method of implementation for:
  - Methods of compliance;
  - Hepatitis B Vaccination;
  - Post exposure Evaluation;
  - Communications of Hazards to employees; and
  - Record Keeping.
- Documentation methods for exposure incidents, to include:
  - Routes of exposure; and
  - The circumstances for which and exposure incident occurred.

Note: In the State of California this plan shall also address exposures to airborne pathogens.

2.4 **SH&E Plan** – A document prepared for a specific project or program that details the hazards, precautions, emergency planning, medical, and training requirements for that project or program.

2.5 **Occupational Exposure (Exposed) –** Reasonably anticipated skin, eye mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of an employee's duties. Employees will be considered to be potentially exposed, even though they are using the universal precautions specified for the project or program.

2.6 **Other Potentially Infectious Materials (OPIM)** – Body fluids and tissues including: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, saliva, and any other body fluid that is visibly contaminated with blood. When it is difficult or impossible to differentiate between body fluids, all body fluids should be treated as if they are potentially infectious.

Note: In the State of California airborne pathogens are also considered infectious materials.

2.7 **Regulated Waste** – (1) liquid or semi-liquid blood or other potentially infectious materials; (2) contaminated items that would release blood or other potentially infectious materials in a liquid or semi-liquid state if compressed; (3) items that are caked with dried blood or other potentially infectious materials and are capable of being released during handling; (4) objects contaminated with blood that can pierce the skin; and (5) pathological and microbiological wastes containing blood or other potentially infectious materials.

2.8 **Source Individual** – An individual, typically one who has been injured, whose blood or saliva has come in contact with another individual, typically one who has rendered first aid or Cardio Pulmonary Resuscitation (CPR) to the injured party.

2.9 **Universal Precautions** – All body fluids and materials potentially contaminated by body fluids will be considered to be infectious unless the fluids were from the person performing the clean up or decontamination activities. All employees coming in contact with another person's body fluids shall assume that the fluids are infectious and shall wear prescribed Personal Protective Equipment.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.3 S3AM-017-PR1 Injury & Illness Recordkeeping

3.4 S3AM-128-PR1 Medical Screening & Surveillance

3.5 S3AM-208-PR1 Personal Protective Equipment

3.6 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Occupational Health Manager**

- Will review and maintain all medical records generated as a result of post-exposure follow-up and maintain all medical records related to the follow-up.
- Will, where appropriate, consult with AECOM's local medical providers about follow-up recommendations.

4.1.2 **SH&E Manager**

- Will review project / program-specific Exposure Control Plans (normally part of the SH&E Plan) prior to the initial mobilization, at least annually for continuing projects or programs, and whenever necessary to reflect modified tasks or procedures that affect occupational exposure to bloodborne pathogens.
- Will consult with the Occupational Health Manager regarding all bloodborne pathogens exposure incidents.
- Will maintain training records and post-exposure follow-up information.
- Will confirm that site-specific training is conducted for all employees working at sites where regulated wastes were disposed or for employees who may be occupationally exposed while working at a facility that handles regulated wastes.

- Will confirm the Hepatitis B vaccine is made available to all employees with a potential occupational exposure (e.g. paramedic, medical laboratory employee, etc.).
- Will review all incident reports and arrange for post-exposure follow-up with AECOM's local medical provider.
- Will offer recommendations on how to prevent an incident from recurring.

4.1.3 **Manager**

- See that all recommendations made by the SH&E Manager are implemented.
- Support the SH&E Manager in their efforts to prevent occupational and non-occupational exposures to bloodborne pathogens.

4.1.4 **Employee**

- Use all PPE and universal precautions required to prevent exposure to infectious materials.
- Follow the exposure control methods outlined in their Exposure Control Plan.
- Report potential exposure incidents to their Supervisor or Manager immediately.

4.2 Potential Exposure Situations

4.2.1 There are a few activities within AECOM where potential occupational exposures to blood or other potentially infectious materials are of concern. These activities may include:

- Investigations of properties that received regulated wastes.
- Site visits or audits at Treatment Storage and Disposal facilities where medical waste is handled.
- Site visits or audits at medical or health care facilities.
- The provision of first-aid or cardiopulmonary resuscitation (CPR) to AECOM, subcontractor, or client personnel (if the action is part of the employee's occupations duties [e.g. paramedic] and not provided as a voluntary action).

4.2.2 Although AECOM does offer first-aid and CPR training to its employees on a regular basis, providing such aid is often on a voluntary basis and not directed by AECOM. As such, potential exposures may not be considered occupational exposures within the context of the OSHA Bloodborne Pathogens Standard. Site-specific Exposure Control Plans shall differentiate voluntary first-aid duties from occupational exposures as a component of the exposure determination. Refer to *S3AM-209-PR1 Risk Assessment & Management.*

4.3 Unforeseen Exposure Situations

4.3.1 Occasionally, potentially infectious material is encountered during a activity where none was expected; when this happens, the work shall be stopped, employee training conducted, and an exposure control plan prepared prior to resuming activities with potential exposures.

4.4 Employee Training

4.4.1 All personnel who will work on projects or programs which involve potential contact with regulated wastes will be required to attend a training class prior to the start of the project or program and annually for continuing projects or programs. Refer to *S3AM-003-PR1 SH&E Training.* The specific requirements and provisions of the written Exposure Control Plan shall be provided to each AECOM Employee and subcontractor assigned to work at the program / project.

4.4.2 Either of the following two sources of employee training will be used by AECOM to educate Employees on the hazards of exposure to bloodborne pathogens:

- The local chapter of the American Red Cross or other recognized training provider.
- AECOM's in-house training program.

4.4.3 Training sessions will review the following:

- Requirements of OSHA's Bloodborne Pathogens Standard or equivalent, applicable jurisdictional requirements.
- Review of AECOM's Bloodborne Pathogen Procedure (this document).
- Situations within AECOM that may involve exposure to bloodborne pathogens.
- Bloodborne diseases and symptoms of disease.
- Means of transmission.
- Work practice controls to reduce risk.
- Use of personal protective equipment to reduce risk.
- Incident reporting.
- AECOM's Post-Exposure Medical Follow-Up Procedures:

4.4.4 When contracting for CPR and first-aid training sessions, AECOM will request that each session include a section on the hazards associated with exposure to bloodborne pathogens and protective measures that shall be followed when administering first aid, CPR, or other emergency medical care. At the end of the session, Employees will be provided with a copy of this procedure. This procedure will be reviewed and a question-and-answer session will be conducted at the end of the presentation.

4.4.5 If the training provider cannot provide such training, AECOM will conduct a Blood Borne Pathogen training session prior to the start of the first aid or CPR class.

4.4.6 AECOM has and will have little control over employees who have not received AECOM provided first aid or CPR training, but who choose to perform Good Samaritan acts. Any Employee who does perform a Good Samaritan act that results in exposure to blood or other potentially infectious materials will, however, be provided with post-exposure medical follow-up as described in this procedure.

4.5 Personal Protective Equipment

4.5.1 All body fluids and materials potentially contaminated by body fluids will be considered to be infectious. All Employees coming in contact with another person’s body fluids shall assume that the fluids are infectious and shall wear prescribed personal protective equipment (PPE), refer to *S3AM-208-PR1 Personal Protective Equipment*.

4.5.2 The use of PPE to prevent exposure is more appropriate for the types of occupational and non-occupational exposures Employees might encounter than is the use of engineering or work practice controls that are more effectively instituted in medical care or laboratory facilities where employees are actually handling blood and other potentially infectious materials.

4.5.3 PPE such as Tyvek coveralls, shoe covers, and gloves will be provided to all field team members involved in site activities where regulated wastes may be present. Site-specific PPE requirements will be identified in the written Exposure Control Plan. The same type of PPE will also be available, if it is deemed necessary, for Employees involved with activities at TSD facilities that handle regulated wastes.

4.5.4 PPE will be provided to affected Employees at no cost.

4.6 Universal Precautions Kits

4.6.1 In those work areas where there is the potential for exposure to infectious materials, a universal precaution kit shall be readily available. The kit shall permit the clean-up, neutralization, transportation, and disposal of up to 1 litre of blood or body fluids. The kit shall contain the following items at a minimum:

- Safety shield/mask combination
- Liquid proof apron
- Medical-grade vinyl/nitrile gloves
- Liquid solidifier/deodorizer
- Pickup scoop with scraper
- Red biohazard waste bag with tie
- Germicidal solution with dry wipe
- Antimicrobial hand wipe
- ID tag
- Instructions for use

4.7 Personal Hygiene

4.7.1 Special provisions will be made so that hand washing facilities are available on-site for sites that are known to be contaminated with regulated wastes. Alcohol wipes will be available in the event that hand washing facilities are not immediately available.

4.7.2 To reduce the potential for infection, if skin contact with blood or other potentially infectious materials occurs, the exposed area should be washed with non-abrasive soap and water as soon as possible. Hand washing will also help to prevent the transfer of contamination from the hands to other areas of the body or other surfaces that may be contacted later. Even when protective gloves are worn, hands should be washed with non-abrasive soap and running water as soon as possible after the gloves are removed.

4.7.3 The use of an alcohol wipes should not be relied upon as the primary means of personal hygiene. Hands should be thoroughly washed with soap and running water as soon as possible.

4.7.4 If mucous membranes, such as the eyes, come in direct contact with blood or other potentially infectious materials, the area should be washed or flushed with water as soon as possible and reported immediately.

4.8 Reporting Exposure Incidents

4.8.1 All incidents in which an employee has been exposed to blood or other potentially infectious materials shall be reported to the employee's Supervisor and to the SH&E Manager immediately. An IndustrySafe on-line report shall be completed in accordance with *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*. After reviewing the report, the SH&E Manager will provide recommendations, when appropriate, for preventing recurrence of the incident.

4.9 Medical Follow-Up to Exposure Incidents

4.9.1 Once notified, the SH&E Manager will in turn discuss the incident with AECOM's Occupational Health Manager and/or medical provider and make arrangements for an evaluation, refer to *S3AM-128-PR1 Medical Screening & Surveillance*. Prompt medical attention is important in the event of an exposure incident. If the incident occurs in the field, the Employee will either be asked to visit the local hospital or, if he/she chooses, return immediately to the office to visit AECOM's local medical provider.

4.9.2 An attempt will be made to test the affected employee, and if applicable, the source individual's blood, for bloodborne pathogens. No testing will be performed without the written consent of the exposed Employee or the source individual. If initially, the exposed Employee or the source individual does not consent to HIV serological testing, but does consent to HBV serological testing, AECOM will make provisions with the local medical provider to preserve the blood sample for at least 90 days in the event that after counselling efforts, the Employee voluntarily consents to HIV testing.

4.9.3 AECOM will rely on the professional judgment of its Occupational Health Manager and/or local medical providers in the event of an exposure incident. Evaluations and follow-up procedures will be provided according to the recommendations of the United States Public Health Service (USPHS), World Health Organization, or other Public Health organization in Canada and other countries in the Americas current at the time these evaluations and procedures take place. Minimally, a post-exposure evaluation and follow-up will include the following elements:

- Documentation of the route(s) of exposure
- Circumstances under which the exposure incident occurred
- Identification and documentation of the source individual in the case of first aid or emergency medical treatments
- Collection and testing of source individuals and exposed employee's blood for HBV and HIV serological status as soon as feasible and upon consent
- Post-exposure vaccination when medically indicated, as recommended by the USPHS
- Counselling, if necessary
- Evaluation of reported illnesses

4.9.4 Any and all follow-up recommendations offered by the physician will be immediately instituted by the SH&E Manager with the guidance of the Occupational Health Manager and/or the local medical provider and at no cost to the affected Employee. Repeat testing, counselling, and follow-up, if recommended, will also be provided at no cost to the Employee. AECOM will rely on the Occupational Health Manager and/or the local medical provider to provide counselling to Employees concerning infection status, including results of and interpretation of medical tests and advising the Employee about the protection of personal contacts.

4.9.5 All medical providers shall submit to AECOM's Occupational Health Manager and the affected Employee a written opinion of the post-exposure evaluation within 15 days of the completion of the evaluation.

4.9.6 All medical records generated as a result of the post-exposure evaluation will be retained in the office of the Occupational Health Manager, and as applicable AECOM's medical services provider, under lock and key and will be maintained with the strictest confidentiality. Refer to *S3AM-017-PR1 Injury & Illness Recordkeeping.*

4.10 Hepatitis Vaccination

4.10.1 Prior to performing site visits or field investigations where regulated wastes are stored, processed, or known to have been disposed of, AECOM will consult with the Occupational Health Manager and/or the local medical providers to determine if a hepatitis A or B vaccination is appropriate given the site conditions and the proposed scope of work. Where possible the first Hepatitis B vaccinations will be given prior to working at sites with known, potential occupational exposures.

4.10.2 Although AECOM does offer first-aid and CPR training to its Employees on a regular basis, providing such aid is often voluntary and not as a specified job duty of an Employee. As such, potential exposures may not be considered occupational within the context of the government Bloodborne Pathogens Standard. Pre-exposure hepatitis vaccinations will not typically be offered for voluntary roles.

4.10.3 Post-exposure hepatitis vaccination will be offered to Employees involved in an exposure incident within 24 hours of possible exposure.

4.10.4 The vaccinations discussed above shall be provided to Employees at no cost if required by the exposure determination.

4.11 Housekeeping

4.11.1 Other than through the provision of first aid or CPR, there is no potential for occupational exposure to blood or other potentially infectious materials within any of the AECOM offices. Therefore, the housekeeping requirements and requirements for warning signs and labels contained in the OSHA Bloodborne Pathogens standard are not applicable to our office operations.

4.11.2 When working at a site where regulated wastes have been disposed of, the specific housekeeping and warning sign requirements will be prescribed by the client and/or in the site-specific HASP.

4.11.3 When working at a client's facility, AECOM will review the facilities plan for compliance with all the requirements of the Bloodborne Pathogens Standard and will observe all housekeeping requirements, wear required PPE, and acknowledge all warning signs and labels as specified in the client's plan. If the client does not have an effective plan, AECOM will prepare a plan as part of the written Exposure Control Plan.

4.12 Regulated Waste Generated by AECOM

4.12.1 Any regulated waste generated by AECOM as a result of first aid activities or clean-up of potentially infectious material will be collected in sealed, watertight containers and disposed of according to the Host Employer's BBP program or disposed of through a permitted regulated waste facility.

4.12.2 Disposal manifests shall be maintained in accordance with local or governmental regulations.

4.13 Material Decontamination

4.13.1 Any areas or equipment that are contaminated by potentially infectious material will be decontaminated using a 10% solution of household bleach. Utilize appropriate personal protective equipment to control exposure to the bleach (e.g. safety goggles, gloves, etc.). Refer to *S3AM-208-PR1 Personal Protective Equipment*.

4.14 Procedure and Plan Review

4.14.1 All Exposure Control Plans for projects or programs extending over one year shall be reviewed annually by the SH&E Manager and affected Employees.

5.0 Records

5.1 Each SH&E Manager will maintain records and provide copies of the records to the Occupational Health Manager, related to bloodborne pathogens in accordance with the provisions of the standard and *S3AM-017-PR1 Injury & Illness Recordkeeping.*

5.2 Records maintained in accordance will include bloodborne pathogens exposure incidents, post-exposure follow-up, vaccination status, and training for all Employees with potential occupational exposure.

5.3 Employee medical and training records required by this procedure shall be provided upon request for examination and copying to the Employee, to anyone having written consent of the subject employee, or to State, Province, or Federal Occupational Safety and Health regulatory agencies.

6.0 Attachments

6.1 S3AM-111-ATT1 Bloodborne Pathogens Exposure Control Plan

6.2 S3AM-111-FM1 Hepatitis B Vaccination Declination

Americas

Cold Stress

S3AM-112-PR1

1.0 Purpose and Scope

1.1 To protect employees from the severest effects of cold stress (hypothermia) and cold injury and to identify exposures to cold working conditions under which it is believed nearly all employees can be repeatedly exposed without adverse health effects.

1.2 This procedure applies to all AECOM Americas based employees and operations working outdoors in damp and cool (below 50 degrees Fahrenheit [°F] or 10 degrees Celsius [°C]) conditions or anytime temperatures are below 32°F or 0°C.

2.0 Terms and Definitions

2.1 **Cold Stress** – The production of physiological effects due to cold temperatures and\or wind chill.

2.2 **Equivalent Chill Temperature (ECT)** – Also known as Wind Chill (see below).

2.3 **Frostnip** – Superficial cooling of tissues without cellular destruction.

2.4 **Frostbite –** Freezing of tissue, resulting in tissue destruction.

2.5 **Hypothermia –** Condition of reduced core body temperature to 95^{o}F (35^{o}C) resulting in loss of dexterity, loss of mental alertness, collapse, and possible death.

2.6 **Wind Chill –** The combined effect of air temperature and wind. Also expressed as "equivalent chill temperature" (ECT), wind chill is defined as heat loss resulting from the effects of air temperature and wind velocity upon exposed skin.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-128-PR1 Medical Screening & Surveillance Program

3.3 S3AM-208-PR1 Personal Protective Equipment

3.4 S3AM-314-PR1 Working Alone

3.5 S3AM-315-PR1 Working On or Near Water

3.6 S3AM-333-PR1 Marine Safety & Vessel Operations

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Ensuring the safety of employees on their project sites, consistent with regulatory standards.
- Implement cold stress prevention measures as applicable at each work site.
- Develop/coordinate a work-warning regimen, as applicable.
- Confirm cold stress hazard assessments/evaluations were completed for the planned activities.
- Assign employees physically capable of performing the assigned tasks. Consider acclimation to cold weather when evaluating employee capability.
- Confirm employees are properly trained to recognize the symptoms of cold stress.

4.1.2 **Safety, Health and Environment (SH&E) Manager**

- Conduct/support cold stress assessments/evaluations.
- Conduct/support incident investigations related to potential cold stress-related illnesses.
- Assist project teams develop appropriate work-warming regimens.
- Provide cold stress awareness training.

4.1.3 **Supervisor**

- Identify the tasks that may be most impacted by cold stress and communicate the hazard to the assigned employees.
- Confirm that employees have been trained on the recognition of cold stress-related illnesses.
- Confirm that adequate supplies of warm fluids/drinks are readily available to employees.
- Confirm that a warm/sheltered rest area is available, as applicable.
- Conduct cold stress monitoring, as applicable.
- Implement the work-warming regimen.
- Confirm that first aid measures are implemented once cold stress symptoms are identified.
- Confirm that employees are physically capable of performing the assigned tasks and are not in a physically compromised condition.

4.1.4 **Employee**

- Observe each other for the early symptoms of cold stress-related illnesses.
- Maintain an adequate intake of available fluids.
- Report to work in a properly rested condition.
- Report all suspected cold stress-related illnesses.

4.2 Requirements

4.2.1 Carefully plan work anticipated to be performed in cool or cold conditions. If possible, heavy work should be scheduled during the warmer parts of the day or when the wind is most calm. Include costs in project budgets for specialized equipment and supplies needed to complete the field activities.

4.2.2 Staff working in extreme cold (wind chill or ECT below 10^{o}F or -12^{o}C) shall not work alone. The Buddy System shall be utilized to keep an eye on each other and to watch for signs of cold stress. Refer to *S3AM-314-PR1 Working Alone*. Watch for symptoms and signs of hypothermia

4.2.3 Monitor weather forecasts and weather conditions such as ambient temperature, wind speed, and precipitation. Use observations prior to entering and while in the field to ensure appropriate protections are in place:

- If possible, move the work to a warm location.
- If possible and as applicable, erect shelters or screens around the work area.
- If possible, heat the work area.
- If possible, adjust schedule according to the cold conditions, work level and worker acclimatization.
- Implement a work-warming regimen by taking breaks out of the cold. As applicable, consult *S3AM-112 ATT1 Temperature Thresholds* to determine wind chill and work-warming schedule.
- Take frequent short breaks in warm dry shelters to allow your body to warm up. Limit time of exposure to the cold. If shelter is not readily available, consider supplying temporary shelters.

- Provide assistance to prevent body heat loss, such as:
  - Providing appropriate sources of heat (e.g. warm packs, portable heaters, etc.).
  - Use of insulating materials on equipment handles when temperatures drop below 30°F (-1°C).

4.2.4 All staff working in extreme cold or snow conditions should understand the following guidelines for preventing and detecting hypothermia and frostbite; refer to *S3AM-112-ATT2 Symptoms & Treatment*:

- Ensure appropriate PPE requirements are established and adhered to.
- Avoid exhaustion or fatigue because energy is needed to keep muscles warm.
- Because prolonged exposure to cold air or to immersion in cold water at temperatures even well above freezing can lead to dangerous hypothermia, whole-body protection shall be used.
- Eat high calorie snacks to help maintain body metabolism.
- Confirm extra blankets or sleeping bags are on-site.
- Drink plenty of warm liquids. It is easy to become dehydrated in cold weather.
- Avoid caffeine and alcohol, which can act as diuretics. Alcohol consumption, depending upon quantity, can dilate blood vessels enhancing body heat loss or constrict blood vessels decreasing heat delivery to extremities.
- NEVER IGNORE SHIVERING. Persistent or violent shivering is a clear warning that you are on the verge of hypothermia.
- If you experience frost bite or hypothermia, find shelter and warmth and contact a medical practitioner if symptoms persist, refer to *S3AM-128-PR1 Medical Screening & Surveillance*.

4.3 Training

Before they begin work in a cold environment, employees that might be exposed to cold stress will be informed of the potential for cold stress and how to prevent cold stress. Employees that have not had the training within the twelve prior months shall repeat the training before exposure to cold stress, refer to *S3AM-003-PR1 SH&E Training*. Employees potentially exposed to cold stress will receive training including, but not limited to:

4.3.1 Sources of cold stress, the influence of protective clothing, and the importance of acclimatization.

4.3.2 How the body loses heat.

4.3.3 Recognition of cold-related illness symptoms.

4.3.4 Cold stress preventative/corrective measures including, but not limited to:

- Weather monitoring.
- Proper eating and drinking practices.
- Work-warming schedules and proper re-warming techniques.
- Buddy system.
- Safe cold work practices appropriate to the work that is to be performed.
- Proper use of cold environment personal protective clothing.

4.3.5 The harmful effects of excessive alcohol consumption in a cold stress environment.

4.3.6 The hazards associated with unstable snow or ice build ups.

4.3.7 First aid procedures for symptoms related to cold stress.

4.4 Personal Protective Equipment (PPE)

Wearing the right clothing is crucial to avoiding cold stress. The type of fabric also makes a difference. Cotton loses its insulation value when it becomes wet. Wool, on the other hand, retains its insulation even when wet. Adequate insulating dry clothing will be required in air or wind chill temperatures below 40 °F (4.4°C)

All PPE will comply with the requirements of *S3AM-208-PR1 Personal Protective Equipment* and consider the following requirements:

4.4.1 Wear at least 3 layers of clothing to help prevent cold stress. It is important to preserve the air space between the body and the outer layer of clothing to retain body heat.

- Wear a middle layer of down, wool, or similar materials to provide insulation.
- Avoid cotton, especially blue jeans.
- Wear an outer layer to break the wind and allow some ventilation (e.g., Gortex® or nylon)
- Do not wear tight clothing. Loose clothing allows better ventilation.

4.4.2 Wear proper clothing, including head coverings and gloves or mittens for cold, wet, and windy conditions.

4.4.3 Wear a hat or hardhat liner. Up to 40 percent of body heat can be lost when the head is left exposed.

4.4.4 Use insulated footwear with adequate traction to prevent slips and falls.

4.4.5 Wear insulated boots or other insulated footwear, and insulated gloves to help reduce the chance of frostbite.

4.4.6 Keep a change of dry clothing available in case work clothes become wet.

4.4.7 Eye and face protection for employees employed outdoors in a snow and/or ice-covered terrain should be supplied.

- Sunglasses (with UVA and UVB protection) and sunscreen should be used when there is a persistent combination of snow and direct sun.
- Special safety goggles to protect against blowing ice crystals and ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) should be required when there is an expanse of snow coverage causing a potential eye exposure hazard.
- Ensure face guards are used to protect skin in cold, windy conditions, including riding on an unshielded vehicle.

4.5 General Cold Stress Prevention Measures

4.5.1 In order to prevent hypothermia:

- Wear appropriate clothing and PPE as determined by the weather conditions.
- When active, ventilate excess heat by opening or removing outer layers of clothing to avoid sweating.
    - Start with the mitten or gloves, unless protection from ice, snow, or cold metal surfaces is needed.
    - Next remove head gear and neck wrappings.
    - Then coats/parkas should be opened at the waist and sleeves.
    - Finally, layers of clothing should be taken off.
    - When resting or tired, or colder conditions are encountered, add additional layers of clothing/ close outer layers in the reverse of the above order, or get out of the cold. Have a sweet drink but do not indulge in heavy eating.

- Garments worn to keep out rain and spray should also allow water vapor to escape.
- Take advantage of heat from the sun and stay out of the wind as much as possible.
- Have available emergency shelter providing protection from wind and rain and insulation from the ground.
- Replace wet clothing. If wet clothing cannot be replaced, then cover it with a layer of non-breathing material to prevent evaporation. Place an insulation layer over this non-breathing material.
- Get adequate rest; conserve energy.
- Get adequate nutrition to replenish energy stores; rest after meals.
- Drink adequate fluids to avoid dehydration.
- If any project / location staff member shows signs of hypothermia, stop and treat him/her.

4.5.2 In order to prevent frost bite:

- Dress to prevent hypothermia and protect the feet and hands.
- Avoid obstruction of circulation by, for example, tight boots or tightly fitting clothing.
- Avoid nicotine (particularly cigarettes) and do not consume alcohol.
- Keep ears and nose covered and out of the wind.
- Frostbite of the corneas of the eyes can be prevented by protective goggles.
- Adopt a “buddy system” of constantly watching the faces of others in the party for white skin tissue, which is evidence of frostbite (frostnip).
- Practice constant personal vigilance for signs of trouble in one’s own fingers and toes; when in doubt, investigate thoroughly before it is too late.

4.5.3 Adequate, insulating dry clothing that will help maintain core temperatures above 96.8°F (37°C) shall be provided to employees if work is performed in air temperatures below 40°F (4.4°C). Wind chill cooling rate and the cooling power of air are critical factors. The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required.

4.5.4 An Equivalent Chill Temperature (ECT) chart relating the actual dry bulb air temperature and the wind velocity is presented in *S3AM-112-ATT1 Temperature Thresholds*. Unless unusual or extenuating circumstances exist, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Superficial or deep local tissue freezing will occur only at temperatures below 32°F (0°C) regardless of wind speed. However, older employees, those with circulatory problems and those with previous cold injuries require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions that should be considered.

4.5.5 Continuous exposure of skin should not be permitted when the air speed and temperature results in an ECT of –25°F (-32°C) or below.

4.5.6 At air temperatures of 40°F (4.4°C) or less, it is imperative that employees who become immersed in water or whose clothing becomes wet be immediately removed from the cold environment, provided a change of clothing, and be treated for hypothermia.

4.5.7 If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment.

4.5.8 Adequate protection, such as general ventilation, shall be incorporated into any warming shelter design to prevent carbon monoxide poisoning.

4.5.9 Operation of internal combustion or similar devices within warming shelters is prohibited.

4.5.10 If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.

4.5.11 Walking and working surfaces shall be cleared of ice and snow to prevent slips and falls.

4.5.12 Confirm that employees carry fire starter materials if working in remote areas.

4.5.13 Supplies such as PPE, fuels, enclosures, de-icing, traction aids, warm drinks, and batteries will be specified by the SH&E Manager and/or the Manager and made available. These supplies will be inspected at least weekly during cold weather projects and replaced when necessary.

4.6 Cold Stress Prevention Measures for the Hands

4.6.1 Special protection of the hands is required to maintain manual dexterity for the prevention of accidents including, but not limited to the following:

- If fine work is to be performed with bare hands for more than 10 to 20 minutes in an environment below 60^{o}F (15^{o}C), special provisions should be established for keeping the employees' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars should be covered by thermal insulating material at temperatures below 30^{o}F (-1^{o} C).
- If the air temperature falls below 60^{o}F (15^{o}C) for sedentary work, 40^{o}F (4.4^{o} C) for light work, or 20^{o}F (-6^{o}C) for moderate work, and fine manual dexterity is not required, employees should use gloves.

4.6.2 To prevent contact frostbite, employees should wear anti-contact gloves:

- When cold surfaces below 20°F (-6°C) are within reach, each employee should be warned to prevent inadvertent contact by bare skin.
- If the air temperature is 0°F (-18°C) or less, employees should protect their hands with mittens or appropriate gloves. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens or gloves.
- Ensure an adequate supply of dry gloves is available to replace wet gloves.

4.6.3 Provisions for additional total body protection are required if work is performed in an environment at or below 40^{o}F (4.4^{o}C). The employees should wear cold protective clothing appropriate for the level of cold and physical activity.

4.6.4 Additional Cold Stress Prevention Measures:

For work practices at or below 10^{o}F (-12^{o}C) ECT, the following will apply:

- The employee should be under constant protective observation (buddy system or supervision).
- The work rate should not be so high as to cause heavy sweating that will result in wet clothing. If heavy work is being performed, rest periods should be taken in heated shelters and opportunities to change into dry clothing should be provided.
- New employees should not be required to work full time in the cold during the first days of employment until they become acclimated to the working conditions and required protective clothing. Refer to *S3AM-112-ATT1 Temperature Thresholds* for guidance.
- The weight and bulkiness of clothing should be included in estimating the required work performance and weights to be lifted by the employee.
- The work should be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats should not be used. The employee should be protected from drafts to the greatest extent possible.

4.6.5 Employees handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperatures below 40°F should take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of "cryogenic fluids" or those liquids with a boiling point that is just above ambient temperature.

4.6.6 Trauma sustained in freezing or subzero conditions requires special attention, because an injured employee is predisposed to cold injury. Special provisions should be made to prevent hypothermia and freezing of damaged tissue in addition to providing for first aid treatment.

4.7 Hypothermia in Water

4.7.1 Loss of body heat heat to the water is a major cause of deaths in boating and working near water incidents. Often the cause of death is listed as drowning; however, the primary cause is often hypothermia. It should also be noted that alcohol lowers the body temperature around 2 to 3 degrees by dilating the blood vessels. Do not drink alcohol around cold water. The following table shows the effects of hypothermia in water:

WATER TEMPERATURE		EXHAUSTION	SURVIVAL TIME
32.5°F	(0°C)	Under 15 minutes	Under 15 to 45 minutes
32.5 to 40°F	(0 to 4°C)	15 to 30 minutes	30 to 90 minutes
40 to 50°F	(4 to 10°C)	30 to 60 minutes	1 to 3 hours
50 to 60°F	(10 to 16°C)	1 to 2 hours	1 to 6 hours
60 to 70°F	(16 to 21°C)	2 to 7 hours	2 to 40 hours
70 to 80°F	(21 to 27°C)	3 to 12 hours	3 hours to indefinite
Over 80°F	(27°C)	Indefinite	Indefinite

4.7.2 Some points to remember when water is a potential hazard:

- Wear a personal flotation device when drowning is a potential hazard. Refer to *S3AM-315-PR1 Working On or Near Water*, and *S3AM-333-PR1 Marine Safety & Vessel Operations*.
- If the water is less than 50°F (10°C), wear a wet suit or dry suit for work in water (e.g., wading, or if a significant potential to fall in water exists).
- While in the water, do not attempt to swim unless to reach nearby safety. Unnecessary swimming increases the rate of body heat loss. Keep the head out of the water. This will increase survival time.
- Keep a positive attitude about rescue. This will increase chances of survival.
- If there is more than one person in the water, huddling is recommended to conserve body heat.

4.7.3 If an employee or equipment is to work on ice and the water beneath the ice is or may be more than 3¼ feet (1m) deep at any point:

- Test the ice prior to commencing to ensure it will support the load to be placed on it. Ongoing testing may be necessary.
- If there is any risk of falling through the ice employees must wear personal protective equipment that will ensure buoyancy and protect against hypothermia at all times while on the ice.

4.8 Work-Warming Regimen

4.8.1 If work is performed continuously in the cold at an equivalent chill temperature (ECT) at or below 19°F (–7°C), heated warming shelters (tents, cabins, rest rooms, etc.) should be made available nearby. The employees should be encouraged to use these shelters at regular intervals; the frequency will depend on the severity of the environmental exposure. Refer to *S3AM-112-ATT1 Temperature Thresholds* for guidance.

4.8.2 The onset of heavy shivering, minor frostbite (frostnip), the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the shelter.

4.8.3 When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing should be loosened to permit sweat evaporation or a change of dry work clothing provided.

4.8.4 A change of dry work clothing should be provided as necessary to prevent employees from returning to the cold environment with wet clothing.

5.0 Records

5.1 Exposure assessments will be documented in the location's files.

6.0 Attachments

6.1 S3AM-112-ATT1 Temperature Thresholds

6.2 S3AM-112-ATT2 Symptoms & Treatment

Americas

Heat Stress

S3AM-113-PR1

1.0 Purpose and Scope

1.1 Establishes a Heat Illness Prevention Program to guide employees in preventing heat illness, recognition of the symptoms of heat stress-related illnesses and in taking the appropriate corrective action.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

2.0 Terms and Definitions

2.1 **Acclimated –** Employees who have developed physiological adaptation to hot environments characterized by increased sweating efficiency, circulation stability, and tolerance of high temperatures without stress. Acclimatization occurs after 7 to 10 consecutive days of exposure to heat and much of its benefit may be lost if exposure to hot environments is discontinued for a week.

2.2 **Chemical Protective Clothing (CPC)** – Apparel that is constructed of relatively impermeable materials intended to act as a barrier to physical contact of the Employee with potentially hazardous materials in the workplace. Such materials include Tyvek® coveralls (all types) and polyvinyl chloride coveralls and rain suits.

2.3 **Heat Cramps** – A form of heat stress brought on by profuse sweating and the resultant loss of salt from the body.

2.4 **Heat Exhaustion** – A form of heat stress brought about by the pooling of blood in the vessels of the skin and in the extremities.

2.5 **Heat Rash** – A heat-induced condition characterized by a red, bumpy rash with severe itching.

2.6 **Heat Stress** – The combination of environmental and physical work factors that constitute the total heat load imposed on the body.

2.7 **Heat Stroke** – The most serious form of heat stress, which involves a profound disturbance of the body's heat-regulating mechanism.

2.8 **Sunburn** – Caused by unprotected exposure to ultraviolet radiation present in sunlight that is damaging to the skin (Refer to *S3AM-121-PR1 Non-Ionizing Radiation*). The injury is characterized by red painful skin, blisters, and/or peeling.

2.9 **Unacclimated** – Employees who have not been exposed to hot work conditions for one week or more or who have become heat-intolerant due to illness or other reasons.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.3 S3AM-010-PR1 Emergency Response Planning

3.4 S3AM-121-PR1 Non-Ionizing Radiation

3.5 S3AM-208-PR1 Personal Protective Equipment

3.6 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedures

4.1 Roles and Responsibilities

4.1.1 Managers

- Evaluate the need for heat illness prevention measures and incorporate as appropriate into the Safe Work Plan or Task Hazard Analysis.
- Allocate sufficient resources for the management of heat illness in the field including the provision of water, a shaded break area, and sufficient schedule to allow for breaks.

4.1.2 Safety, Health and Environment (SH&E) Manager

- Provide heat illness awareness training.
- Assist in developing appropriate work-rest schedules.
- Conduct/support incident investigations related to potential heat stress-related illnesses.

4.1.3 Supervisor

- Identify those tasks that may be most impacted by heat stress and communicate the hazard to the assigned Employees.
- Confirm that Employees have been trained on the recognition of heat illness.
- Confirm that this procedure, along with any applicable Safe Work Plan and/or Task Hazard Analysis (and heat exposure control plan that may be contained therein) are made available to affected Employees.
- Confirm that adequate supplies of appropriate fluids are readily available to Employees.
- Confirm that a proper rest area is available.
- Conduct heat illness monitoring, as applicable.
- Implement the work-rest schedule.
- Confirm that first aid measures are implemented once heat stress symptoms are identified.
- Confirm personnel are physically capable of performing the assigned tasks and are not in a physically compromised condition.
- Report all suspected heat illnesses.

4.1.4 Employee

- Observe each other for the early symptoms of heat illnesses.
- Maintain an adequate intake of available fluids.
- Be familiar with heat stress hazards, predisposing factors, and preventative measures.
- Report to work in a properly vested and hydrated condition.
- Report all suspected heat stress-related illnesses.

4.2 Restrictions

4.2.1 The Buddy System is required when working in high heat conditions; Employees shall not work alone.

4.2.2 Employees shall not be exposed to levels exceeding those specified for the given work level and work-rest regimen as listed in *S3AM-113-ATT1 Temperature Thresholds*.

4.2.3 Clothing corrections shall be applied in accordance with the tables provided in *S3AM-113-ATT1 Temperature Thresholds*.

4.3 Exposure Controls

4.3.1 It shall be determined whether Employees are or may be exposed to hazardous heat levels. The Supervisor shall:

- Conduct a heat stress assessment to determine the potential for hazardous exposure of Employees. Assessment shall include, but not limited to:
  - Ambient temperature.
  - Amount of sunshine (cloudy, clear). Refer to *S3AM-121-PR1 Non-Ionizing Radiation* additional direction concerning ultraviolet radiation exposures.
  - Other radiant heat sources (e.g. motor, fire, etc.).
  - Humidity.
  - Air flow.
  - Amount or type of physical labor being performed,
  - Physical condition of the Employees (e.g., acclimated/not)
  - Protective clothing in use.
  - Referral to *S3AM-113-ATT1 Temperature Thresholds* to assist in determining whether hazardous heat exposures may exist.
- If potential for hazardous exposure is identified, the Supervisor shall develop and implement a heat stress exposure control plan within the Safe Work Plan and/or Task Hazard Analysis. Refer to *S3AM-209-PR1 Risk Assessment & Management.*

4.3.2 If Employees are or may be exposed, the Supervisor shall implement engineering controls (e.g., shelters, cooling devises, etc.) to reduce the exposure of Employees to levels below those specified for the given work level and work-rest regimen as listed in *S3AM-113-ATT1 Temperature Thresholds*.

4.3.3 If engineering controls are not practicable, the Supervisor shall reduce the exposure of Employees to levels below those listed in *S3AM-113-ATT1 Temperature Thresholds* by providing administrative controls, including a work-rest cycle or personal protective equipment, if the equipment provides protection equally effective as administrative controls.

4.3.4 If Employees are or may be exposed, the Supervisor shall provide and maintain an adequate supply of cool, fresh, potable water close to the work area for the use of a heat exposed Employee. Water shall be provided (paid) by the project or program; if Employees purchase their own drinking water because water is not otherwise available on site, they shall be reimbursed.

4.3.5 If an Employee shows signs or reports symptoms of heat stress or strain, they shall be removed from the hot environment and treated by an appropriate first aid attendant on site, if available, or by a physician, refer to *S3AM-113-ATT2 Symptoms & Treatment* for more specifics.

4.4 Heat Stress Planning

4.4.1 Heat stress can be a significant site hazard, especially for Employees wearing CPC. To prepare for emergency response planning, refer to *S3AM-010-PR1 Emergency Response Planning* procedure.

4.4.2 The project and site specific risks need to be planned using the SH&E Plan and the Task Hazard Assessments (THA). Refer to the *S3AM-209-PR1 Risk Assessment & Management* procedure.

4.4.3 The heat a worker is exposed to may be a combination of air temperature, radiant heat, and humidity. The WBGT (wet-bulb globe thermometer) is a useful index of the environmental contribution to heat stress. Because WBGT is only an index of the environment, the contributions of

work demands, clothing, and state of acclimatization shall also be accounted for, as described in the following steps.

- Monitor ambient temperatures and conduct heat stress monitoring in accordance with the location specific SH&E Plan. Revise the heat stress monitoring and controls if there are any reports of discomfort due to heat stress.
- Monitor temperatures in each unique environment in which workers perform work (e.g., take WBGT measurements inside truck cabs for truck drivers, and take separate WBGT measurements in the outdoor area where field employees work, etc.). Follow manufacturer's instructions on proper use of the WBGT.
- Determine if individual workers are acclimatized or un-acclimatized. Full heat acclimatization requires up to 3 weeks of continued physical activity under heat-stress conditions similar to those anticipated for the work. Its loss begins when the activity under those heat-stress conditions is discontinued, or when there is a sustained increase in temperatures of 10 °F (5.6 °C) or more, and a noticeable loss occurs after 4 days. A worker can be considered acclimatized for the purpose of this procedure when they have been exposed to the site conditions (including level of activity) for 5 of the last 7 days.
- Determine the approximate workload of each worker or group of workers. The following examples (Table 1) can be used for comparison:

Table 1
Examples of Activities within Workload Categories

Categories	Example Activities
Resting	Sitting quietly
	Sitting with moderate arm movements
Light	Sitting with moderate arm and leg movements
	Standing with light work at machine or bench while using mostly arms
	Using a table saw
	Standing with light or moderate work at machine or bench and some walking about
Moderate	Scrubbing in a standing position
	Walking about with moderate lifting or pushing
	Walking on level at 3.5 miles/hr (6 km/hr) while carrying 6.6 lbs (3kg) weight load
Heavy	Carpenter sawing by hand
	Shoveling dry sand
	Heavy assembly work on a non-continuous basis
	Intermittent heavy lifting with pushing or pulling (e.g., pick-and-shovel work)
Very Heavy	Shoveling wet sand

- Determine the approximate proportion of work within an hour during a typical shift. Typically, the initial work schedule will be 60 minutes of work per hour (100 percent work) with a small break in the morning and afternoon, as appropriate, and a 30-minute lunch break mid-day.
- For workers wearing cloth coveralls (e.g., Nomex fire resistant clothing), add 3 to the measured WBGT. For impermeable clothing, such as Tyvek or Saranex, the WBGT procedures cannot be used. For these situations, workers should begin physiological monitoring as soon as the temperature in the work area exceeds 70ºF (21°C).
- Use the collected information to develop appropriate work to rest schedules as detailed in *S3AM-113-ATT1 Temperature Threshold*.

4.4.4 Given the work demands (light, moderate, heavy or very heavy), heat of the work environment, and such aspects as PPE in use, workload will be adjusted appropriately to allow for proper acclimation.

- This is the process by which the body "gets used to" hot work environments. This is achieved by slowly increasing workloads.
- New and returning Employees (absent one week or more) who have not had time to acclimatize may be more susceptible to heat related illnesses, even in seemingly low risk heat exposures.
- All Employees shall be allowed time to acclimatize in the event of a heat wave. All Employees assigned to a new process with additional heat exposures shall be allowed to acclimatize.
- Minimize workload and gradually increase as tolerance is built up. Allow for more frequent breaks.
- While acclimatization normally takes approximately 5 to 7 days, heightened monitoring of these Employees will be maintained for the first 14 days.

4.4.5 Employees shall be instructed in the recognition of heat stress symptoms, the first aid treatment procedures for severe heat stress, and the prevention of heat stress injuries. Employees shall be encouraged to immediately report any heat stress that they may experience or observe in fellow Employees. Supervisors shall use such information to adjust the work-rest schedule to accommodate such problems.

4.4.6 Wherever possible, a designated break area should be established in an air conditioned space, or in shaded areas where air conditioning is impractical. The break area should be equipped to allow Employees to loosen or remove protective clothing, and sufficient seating should be available for all Employees. During breaks, Employees shall be encouraged to drink plenty of water or other liquids, even if not thirsty, to replace lost fluids and to help cool off. Cool water should be available at all times in the break area, and in the work area itself unless hygiene/chemical exposure issues prevent it.

4.5 Symptoms and Treatment

4.5.1 Refer to *S3AM-113-ATT2 Symptoms & Treatment*.

4.5.2 Employees who exhibit ANY signs of significant heat stress (e.g., profuse sweating, confusion and irritability, pale, clammy skin) shall be relieved of all duties at once, made to rest in a cool location, and provided with large amounts of cool water.

4.5.3 Anyone exhibiting symptoms of heat stroke (red dry skin, or unconsciousness) shall be taken immediately to the nearest medical facility. Steps shall be taken to cool the person during transportation (clothing removal, wet the skin, air conditioning, etc.).

4.5.4 Severe heat stress (heat stroke) is a life-threatening condition that shall be treated by a competent medical authority.

4.6 Prevention

4.6.1 Requirements for working in extreme heat may be triggered by a regulatory established criteria (e.g. CAL/OSHA requires high heat procedures when temperature equals or exceeds 95°F) or as a result of a hazard analysis assessing various contributory factors (refer to *S3AM-113-ATT1 Temperature Thresholds*). Employees working in extreme heat or sun should understand and apply the following guidelines for preventing and detecting heat exhaustion and heat stroke.

- When possible, begin hydrating at least three days prior to working in high heat conditions.
- Review the heat stress exposure control plan within the Safe Work Plan and/or Task Hazard Analysis.
- If the supervisor is not immediately available confirm a reliable method of communication is in place to allow for contact with supervision. In the absence of cellular reception a satellite phone or similar device may be required.

- Take frequent short breaks in areas sheltered from direct sunlight; eat and drink small amounts frequently.
- Try to schedule work for the coolest part of the day, early morning and evening.
- Avoid strenuous physical activity outdoors during the hottest part of the day.
- Avoid sudden changes of temperature. Refer *to S3AM-113-ATT1 Temperature Thresholds*.
- Air out a hot vehicle before getting into it.
- Obtain medical direction if taking diuretics during hot weather (a lower dose may be necessary).
- When working in heat, drink 1 quart of water per hour of work.
- Avoid caffeine and alcohol as they increase dehydration.
- Monitor urine frequency and color to detect dehydration. Refer to the *S3AM-113-ATT3 Dehydration Chart.*
- The Buddy System is required when working in high heat conditions to enable effective communication and cross-observation for indications of heat stress.
- Initiate emergency response procedures when necessary, including contacting emergency medical services as appropriate and in accordance with the Emergency Response Plan.

4.6.2 Personal Protective Equipment

- Review the *S3AM-208-PR1 Personal Protective Equipment* procedure.
- Wear a hat and light-colored, loose-fitting clothing to reflect the sun.
- Apply sunscreen to exposed skin (SPF 30 or greater, follow directions on label).
- Wear sunglasses with UV protection.
- Pack extra water to avoid dehydration (try freezing water in bottles overnight to help keep the water cooler for longer during the day).

4.7 Work-Rest Schedule Practices

4.7.1 Intake of fluid will be increased beyond that which satisfies thirst, and it is important to avoid "fluid debt," which will not be made up as long as the individual is sweating.

- Two 8-ounce glasses of water should be taken prior to beginning work, then up to 32 ounces (1 quart) per hour during the work shift; fluid replacement at frequent intervals is most effective.
- The best fluid to drink is water; liquids like coffee or soda do not provide efficient hydration and may increase loss of water.
- If commercial electrolyte drinks (e.g., Gatorade) are used, the drink should be diluted with water, or 8 ounces of water should be taken with each 8 ounces of electrolyte beverage.

4.7.2 Additional salt is usually not needed and salt tablets should not be taken.

4.7.3 Replacement fluids should be cool and fresh, but not cold.

4.7.4 Breaks will be taken in a cool, shaded location, and any impermeable clothing should be opened or removed.

- A relatively cool, shaded area shall be provided for breaks when working in hot environments. For hazardous waste sites, the rest area should be located in the support zone adjacent to the contamination reduction zone, situated so that part of it is in the decontamination area so workers can take breaks without going through full decontamination.

- If shade is not available, shaded areas shall be constructed. This same type of canopy can be set up to shade personnel performing various types of work in hot weather.
- Cooling measures other than shade (e.g., misting, air conditioned break areas, air conditioned vehicles, etc.) can be used in lieu of shade provided it can be demonstrated that they are at least as effective in cooling employees.
- Employees should have access to these rest areas at break times and at any other time when suffering from heat illness or believing a preventive recovery period is needed.

4.7.5 Dry clothing or towels will be available to minimize chills when taking breaks.

4.7.6 Manual labor will not be performed during breaks, other than paperwork or similar light tasks.

4.7.7 Other controls that may be used include:

- Scheduling work at night or during the cooler parts of the day (6 am–10 am, 3 pm–7 pm).
- Erecting a cover or partition to shade the work area.
- Auxiliary cooling - wearing cooling devices beneath protective garments, but over any underclothing.
  - If cooling devices are worn, only physiological monitoring will be used to determine work activity.
  - These vests typically provide cooling via one of two methods: the use of ice or other frozen media, or the use of a vortex cooler. Each method has its advantages and disadvantages.
  - The frozen media vest requires a means for freezing the media, and the media (usually water or "blue ice") will melt, requiring replacement.
  - The vortex cooler tends to cool more uniformly. Instead of frozen media, this vest uses the expansion of compressed air to cool the wearer. The drawback is the compressed air requirement, but this is negated when the wearer is already using an airline respirator supplied by a compressor. A vortex cooler should not be supplied from air cylinders, as this will draw down the cylinders rapidly.
- Auxiliary cooling should be considered when the following conditions exist:
  - Ambient temperature over 80°F (26°C).
  - Workers are wearing impermeable garments (i.e., Tyvek, Saranex, Chemrel, etc.).
  - It is desirable to have long work shifts with minimum interruption.

4.8 Evaluating the Work-Rest Schedule's Effectiveness

4.8.1 Once a work-rest schedule is established, the Supervisor shall continually evaluate its effectiveness through observation of Employees for signs/symptoms of heat stress. Have workers assess themselves and their body's reaction to the heat and work conditions (self-assessment), and report any signs or symptoms of heat illness. These can include nausea or dizziness, heat cramps, extreme thirst, or very dark urine.

4.8.2 Measurement or physiological monitoring of each Employee's vitals (e.g., pulse, blood pressure, and temperature) can provide additional information in determining if the schedule is adequate. Refer to *S3AM-113-ATT1 Temperature Thresholds* for additional guidance on when physiological monitoring should be conducted.

4.8.3 Frequency of physiological monitoring is increased or decreased depending upon such factors as worker fitness, acclimatization, temperature of the work environment, type of PPE, etc.

Based on the results of the physiological monitoring and on the workers' self-assessments, the work period may be adjusted as follows:

- The work period may be increased (generally, by 5- to 10-minutes intervals, up to a maximum of 4 hours) if the results of the first 2 hours of the physiological monitoring and the workers' self-assessments indicate that workers are recovering adequately (see below), and on the judgment of the SH&E Manager.
- The work period shall be decreased if the results of the physiological monitoring and the workers' self-assessment indicate that workers are NOT recovering adequately (see below).

4.8.4 If physiological monitoring is conducted, the Employee and/or the SH&E Manager (or appropriate designate) shall measure and record body temperature and pulse rate as described below.

4.8.5 Monitor body temperature to determine if Employees are adequately dissipating heat build-up. Ear probe thermometers which are adjusted to oral temperature (aural temperature) are convenient and the preferred method of measurement. Determine work/rest regimen as follows:

- Measure oral body temperature at the end of the work period. Oral body temperatures are to be obtained prior to the employee drinking water or other fluids.
- If temperature exceeds 99.6°F (37.5°C), shorten the following work period by 1/3 without changing the rest period.
- If, at the next rest period, temperature still exceeds 99.6°F (37.5°C), the worker should not be allowed to continue work until repeated temperature measurements are in the acceptable range (i.e., less than 99.6°F). Do not leave the worker alone during the recovery time. Watch for signs of heat illness and be prepared to implement emergency response as necessary.
- Do not allow a worker to wear impermeable PPE when his/her oral temperature exceeds 100.6°F (38.1°C).

4.8.6 At the start of the workday each Employee's baseline pulse rate (in beats per minute [bpm]) is determined by taking a pulse count for 15 seconds and multiplying the result by four or by using an automated pulse count device. Pulse rates can then be measured at the beginning of each break period and two minutes thereafter to determine if the rest period allows for adequate recovery.

- Take the radial (wrist) pulse as early as possible in the rest period and determine the worker's heart rate in beats per minute. The heart rate is determined by counting the pulse for ten seconds and multiplying the number by 6 to get the beats per minute. Record this as P1.
- Wait 2 minutes and repeat the pulse measurement. Record this as P2.
- If P1 is greater than or equal to 110 beats per minute (bpm) and if (P1 – P2) is less than or equal to 10 bpm (indicating that workers are not recovering adequately), shorten the next work cycle by 1/3 without changing the rest period.
- At the next rest period, if P1 is still equal to or greater than 110 bpm, and if (P1 – P2) is still less than or equal to 10 bpm, shorten the following work cycle by 1/3 without changing the rest period.
- At the third rest period, if P1 is still equal to or greater than 110 bpm and (P1 – P2) is still less than or equal to 10 bpm, the worker should not be allowed to continue work until repeated pulse measurements are in the acceptable range (i.e., P1 is less than 110 bpm and (P1 – P2) is greater than 10 bpm). Do not leave the worker alone during the recovery time. Watch for signs of heat illness and be prepared to implement emergency response as necessary.

4.8.7 Use of an automated or similar blood pressure device will be used to assess each Employee's blood pressure at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:

- If the blood pressure of an Employee is outside of 90/60 to 150/90, then the Employee will not be allowed to begin or resume work; extend the break period by at least five minutes, at the end of which blood pressure rates will be re-measured and the end-of-break criteria again applied.

4.8.8 All physiological monitoring of heat stress will be documented using *S3AM-113-FM1 Heat Stress Monitoring Log.*

4.9 Training

4.9.1 Employees and their Supervisors that may be exposed to the hazard will be trained and oriented to the hazard and the controls prior to work commencing.

4.9.2 Those Employees, including Supervisors, potentially exposed to heat stress will receive training, refer to the *S3AM-003-PR1 SH&E Training* procedure. Training will include, but is not limited to:

- Sources of heat stress (environmental and personal), influence of protective clothing, and importance of acclimatization;
- How the body handles heat and acclimatization;
- Recognition of heat-related illness symptoms;
- Preventative/corrective measures including, but not limited to;
  - Employees will be informed of the harmful effects of excessive alcohol consumption in the prevention of heat stress.
  - All Employees will be informed of the importance of adequate rest and proper diet in the prevention of heat stress.
- First aid procedures for heat stress-related illnesses; and
- Immediate reporting of any heat-related incident (injury, illness, near-miss), refer to the *S3AM-004-PR1 Incident Reporting, Notifications & Investigation* procedure.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-113-ATT1 Temperature Thresholds

6.2 S3AM-113-ATT2 Symptoms & Treatment

6.3 S3AM-113-ATT3 Dehydration Chart

6.4 S3AM-113-FM1 Heat Stress Monitoring Log

Americas

Compressed Gases

S3AM-114-PR1

1.0 Purpose and Scope

1.1 This procedure provides the requirements for using, handling, storing, transporting, disposition and/or decommissioning compressed gas cylinders.

1.2 This procedure applies to all AECOM Americas based employees and operations.

2.0 Terms and Definitions

2.1 **Compressed Air (Non-Breathable)** – Air that is at a pressure greater than that of the atmosphere. Compressed air shall not be used for cleaning purposes except where reduced to less than 30 psi and then only with effective chip guarding and personal protective equipment. Utilized for tools, equipment, and mechanical machinery and cleaning purposes as described in this procedure.

2.2 **Compressed Gas** – Any material or mixture in a pressure vessel having:

- An absolute pressure exceeding 40 pounds per square inch (PSI) at 70°F (25 pounds per square inch gauge); or
- An absolute pressure exceeding 104 Psia at 130°F, regardless of the pressure at 70°F.

2.3 **Cylinder –** Pressure vessel designed for pressures higher than 40 Psia and having a circular cross section.

2.4 **Decommission** – The removal of a compressed gas cylinder from service by rendering it permanently unusable.

2.5 **Disposition** – Recycling, treatment, or disposal of a compressed gas cylinder and/or its contents.

2.6 **Pneumatics –** The use of pressurized air to affect mechanical motion for machinery, equipment and tools.

2.7 **Psi** – Pounds per square inch.

2.8 **Psia –** Pounds per square inch absolute (i.e., pressure in a container that would appear on an ordinary gauge plus the local atmospheric pressure [14.696 psi at sea level]), psig- pounds per square inch gauge.

2.9 **Psig** – Pounds per square inch gauge. The pressure in a vessel or container as registered on a gauge attached to the container. This reading does not include the pressure of the atmosphere outside the container.

2.10 **Pressure Relief Valve** – A device installed on most cylinders to prevent the rupture of a normally pressurized cylinder when it is inadvertently exposed to fire or high temperatures.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-116-PR1 Hazardous Materials Shipping

3.3 S3AM-127-PR1 Exposure Monitoring

3.4 S3AM-208-PR1 Personal Protective Equipment

3.5 S3AM-209-PR1 Risk Assessment & Management

3.6 S3AM-332-PR1 Hot Work

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Ensuring the safety of employees on their project sites.
- Implement these procedures during all activities involving compressed gases.
- Seek consultation with the SH&E Manager when unknown compressed gas cylinders are encountered.
- Confirm employees have received the appropriate training as it relates to compressed gases/compressed gas cylinders.
- Confirm a hazard assessment/evaluation of the activities involving compressed gases has been completed.
- Contact the SH&E Manager prior to any compressed gas cylinder operation.
- Immediately report any leaking/suspected leaking compressed gas cylinder(s) to the SH&E Manager and implement the appropriate emergency action(s).
- Immediately report the discovery of any unknown compressed gas cylinder(s) to the SH&E Manager and cordon off the area in all directions a minimum of 50 feet (15.24 meters).
- Confirm that all compressed gas cylinders are properly inspected, stored, and, secured.
- Confirm that all compressed gas cylinders are handled in a safe manner, protecting both the person and cylinder.
- Confirm that all compressed gas cylinder manifolds and connections are properly made and inspected.
- Confirm an appropriate emergency response plan is established prior to the start of any compressed gas cylinder operation.

4.1.2 **SH&E Manager**

- Review and authorize all compressed gas cylinder operations.
- Conduct/support compressed gas hazard assessments/evaluations.
- Provide awareness training to project teams regarding hazards of encountered compressed gases.
- Support the identification/disposition of unknown compressed gas cylinders.
- Support the development of a site-specific cylinder plan.

4.1.3 **Employee**

- Immediately report any leaking/suspected leaking compressed gas cylinder(s) to a Manager.
- Immediately report the discovery of any unknown compressed gas cylinders to Project Manager.
- Properly handle all compressed gas cylinders.
- Shall be supervised by employees experienced in the operation of compressed gas tools and equipment.

4.2 Training

4.2.1 On-site orientation to the hazards of the equipment and the proper use, handling, and storage shall be completed for all employees handling or coming into contact with compressed air tools and equipment or compressed gas cylinders. Refer to *S3AM-003-PR1 SH&E Training* and *S3AM-114-ATT1 Compressor Safety*.

4.2.2 Employees shall be instructed on the PPE requirements for the applicable tasks. Refer to *S3AM-208-PR1 Personal Protective Equipment*.

4.3 General Use of Compressed Air or Gas

4.3.1 Compressed air or other compressed gases are not to be used to blow dirt, chips, or dust from clothing while it is being worn. Compressed air used for other types of cleaning (other than clothing/persons) is to be limited to 30 psig.

4.3.2 The use of blown compressed air is to be controlled, and proper personal protective equipment or safeguards utilized, to protect against the possibility of eye injury to the operator or other persons.

4.3.3 Compressed air or gases are not to be used to empty containers of liquids.

4.3.4 Compressed gases are not to be used to elevate or otherwise transfer any hazardous substance from one container to another unless the containers are designed to withstand the operating gas pressure with a safety factor of at least four.

4.3.5 Compressed cylinders of unknown content will not be opened, but will be returned to the supplier, manufacturer or equivalent.

4.4 Air Compressor Operations

4.4.1 Air compressor equipment should be operated only by authorized and trained employees.

4.4.2 The air intake should be from a clean, outside, fresh air source. Screens or filters can be used to clean the air.

4.4.3 Air compressors should never be operated at speeds faster than the manufacturer's recommendation.

4.4.4 Equipment should not become overheated.

4.4.5 Moving parts, such as compressor flywheels, pulleys, and belts that could be hazardous should be effectively guarded.

4.4.6 Keep the air supplied tools clean and dry. Dust, moisture, and corrosive fumes can damage tools.

4.4.7 eep tools clean, lubricated, and maintained according to manufacturer's instructions.

4.4.8 Only use attachments and accessories recommended by the manufacturer.

4.4.9 Review the manufacturer's instruction before using a tool.

4.4.10 Post warning signs where pneumatic tools are used.

4.4.11 Set up screens or shields in areas where nearby workers may be exposed to flying fragments, chips, dust, and excessive noise.

4.4.12 Be aware of proper handling and ergonomics while using the tool.

4.4.13 Reduce physical fatigue by supporting heavy tools with a counter-balance wherever possible

4.4.14 Refer to *S3AM-114-ATT1 Compressor Safety* for additional information.

4.5 Air Hoses

4.5.1 Use the proper hose and fittings of the correct diameter.

4.5.2 Use hoses specifically designed to resist abrasion, cutting, crushing and failure from continuous flexing.

4.5.3 Choose air-supply hoses that have a minimum working pressure rating of 1035 kPa (150 psig) or 150% of the maximum pressure produced in the system, whichever is higher.

4.5.4 Check hoses regularly for cuts, bulges and abrasions. Tag and replace, if defective.

4.5.5 Blow out the air line before connecting a tool. Hold hose firmly and blow away from yourself and others.

4.5.6 Make sure that hose connections fit properly and are equipped with a mechanical means of securing the connection (e.g., chain, wire, or positive locking device).

4.5.7 Install quick disconnects of a pressure-release type rather than a disengagement type. Attach the male end of the connector to the tool, NOT the hose.

4.5.8 Do not operate the tool at a pressure above the manufacturer's rating.

4.5.9 Turn off the air pressure to hose when not in use or when changing power tools.

4.5.10 Do not carry a pneumatic tool by its hose.

4.5.11 Do not use compressed air to blow debris or to clean dirt from clothes.

4.5.12 All pipes, hoses, and fittings shall have a rating of the maximum pressure of the compressor. Compressed air pipelines should be identified (psi) as to maximum working pressure.

4.5.13 Air supply shutoff valves should be located (as near as possible) at the point-of-operation.

4.5.14 Air hoses should be kept free of grease and oil to reduce the possibility of deterioration.

4.5.15 Avoid trip hazards. Hoses should not be strung across floors or aisles where they are liable to cause employees to trip and fall. When possible, air supply hoses should be suspended overhead, or otherwise located to afford efficient access and protection against damage.

4.5.16 Hose ends shall be secured to prevent whipping if an accidental cut or break occurs.

4.5.17 Pneumatic impact tools, such as riveting guns, should never be pointed at a person.

4.5.18 Before a pneumatic tool is disconnected (unless it has quick disconnect plugs), the air supply shall be turned off at the control valve and the tool bled.

4.5.19 Shop air used for cleaning should be regulated to15 psi unless equipped with diffuser nozzles to provide lesser pressure.

4.5.20 Goggles, face shields or other eye protection shall be worn by employees using compressed air for cleaning equipment.

4.5.21 Static electricity can be generated through the use of pneumatic tools. This type of equipment shall be grounded or bonded if it is used where fuel, flammable vapors or explosive atmospheres are present.

4.5.22 The following are hazards associated with the use of compressed air tools and equipment:

- Poorly designed tool (wrist strain);
- Vibration (vibration-induced white finger);
- Noise (hearing loss); and
- Dust (respiratory problems).

4.5.23 The following hazards have the potential to cause serious bodily injury when working with compressed air:

- Incorrect tool selection;
- Use of damaged tool;
- Improper, inadequate, or no guards;
- Rotating shaft (entanglement);
- Wheel breakage (grinder);
- Flying chips;
- Whipping of the hose;
- Accidental start up;

- Air embolism (compressed air injected into the body);
- Dropped tool; and
- Tripping over hose.

4.6 Compressed Air Equipment Maintenance

4.6.1 Only authorized and trained employees should service and maintain air compressor equipment.

4.6.2 Exposed, non-current-carrying, metal parts of compressor should be effectively grounded.

4.6.3 Low Flash Point lubricants should not be used on compressors because of its high operating temperatures that could cause a fire or explosion.

4.6.4 Equipment should not be over lubricated.

4.6.5 Gasoline or diesel fuel powered compressors shall not be used indoors.

4.6.6 Equipment placed outside but near buildings should have the exhausts directed away from doors, windows and fresh air intakes.

4.6.7 Soapy water of lye solutions can be used to clean compressor parts of carbon deposits, but kerosene or other flammable substances should not be used. Frequent cleaning is necessary to keep compressors in good working condition.

4.6.8 The air systems should be completely purged after each cleaning.

4.6.9 During maintenance work, the switches of electrically operated compressors should be locked open and tagged to prevent accidental starting.

4.6.10 Portable electric compressors should be disconnected from the power supply before performing maintenance.

4.7 Compressed Gas Cylinder Requirements

4.7.1 Cylinders are not to be used unless they bear Department of Transportation (DOT) or Transportation of Dangerous Goods (TDG) markings showing that they have been tested as required by DOT or TDG regulations.

4.7.2 Cylinders shall never be dropped, struck, or permitted to strike each other violently. Cylinders may be moved by tilting and rolling them on their bottom edges.

4.7.3 Valve protection caps shall always be kept on cylinders when they are being moved or stored, and until ready for use. Caution should be exercised as insects such as spiders, wasps, and bees may be encountered in cylinder caps.

4.7.4 Do not lift cylinders by the valve protection cap.

4.7.5 Cylinder valves are to be kept closed except when gas is being used or when connected to a permanent manifold. Valves of empty cylinders shall be closed.

4.7.6 Cylinders shall never be used as rollers or supports, or for any purpose other than carrying gas.

4.7.7 Valves and regulators shall be inspected for foreign materials such as oil or dirt and deficiencies such as damaged threads or broken gauges. Deficient valves or regulators shall be removed from service and replaced.

4.7.8 Threads on regulator connections or other auxiliary equipment shall be the same as those on the cylinder valve outlet.

4.7.9 Regulators shall be specific to the gas being used and no adapters may be used to connect regulators to cylinders.

4.7.10 When withdrawing cylinder content, open the cylinder valve slowly using the appropriate tool (e.g., manufacturer supplied, non-sparking, etc.). Point the valve opening away from yourself and other persons.

4.7.11 Before a regulator is removed from a cylinder, close the cylinder valve and release all pressure from the regulator. This procedure also serves as a check to confirm that the main cylinder valve is completely closed.

4.7.12 Never hammer the valve wheel in attempting to open or close the valve.

4.7.13 No person, except the owner of the cylinder or person authorized by the owner, shall refill a cylinder (Exceptions to this includes the filling of self-contained breathing apparatus cylinders with Grade D breathing air, or the filling of the [Foxboro] Organic Vapor Analyzer (OVA) hydrogen cylinders). Disposable cylinders shall not be refilled with any material after use of the original contents.

4.7.14 Cylinders of compressed gas shall be stored in areas where they are protected from external heat sources such as flame impingement, intense radiant heat, electric arc, or high-temperature steam lines.

4.7.15 Cylinders are to be stored in an assigned, well-ventilated area, with full and empty cylinders stored separately. Empty cylinders shall be marked empty'.

4.7.16 Stored fuel gases and oxygen cylinders are to be separated by at least 20 feet, or by a fire wall at least 5 feet high that has a fire-resistance rating of at least ½ hour.

4.7.17 Oxygen, nitrogen, helium, or freon cylinders shall only be stored or transported in an upright or horizontal position. Acetylene cylinders shall always be kept in an upright position. All horizontally-placed cylinders are to be secured by chocks or ties to prevent rolling.

4.7.18 Cylinders are to be secured to a fixed object by chain or equivalent fastening device whenever they are placed in an upright position. The protective cap is not to be removed or the cylinder valve opened until the cylinder is secured.

4.7.19 Repair of leaks shall never be attempted on a pressurized system. System pressure should be reduced to atmospheric pressure as rapidly as possible, and the Manager notified immediately.

4.7.20 Compressed gas cylinders shall be legibly marked for the purpose of identifying the gas content with either the chemical or the trade name of the gas. Such marking is to be done by means of stenciling, stamping or labelling, and shall not be readily removable. Whenever practical, the marking is to be located on the shoulder of the cylinder. Positive identification of the gas in any cylinder is required before connecting cylinders for use.

4.7.21 Gas cylinders moved by hoist shall be handled in suitable cradles or job-made s ip materials boxes. Any slings used for this purpose shall be specifically designed for that cylinder handling.

4.7.22 Cylinders shall not be placed where they might form part of an electrical circuit.

4.7.23 Transfer of compressed gases (including acetylene) from one cylinder to another, or mixing of gases in a cylinder, is prohibited.

4.7.24 Oxygen cylinders are never to be stored near:

- Highly combustible materials, especially oil and grease;
- Reserve stocks of acetylene or other fuel gas cylinders; and
- Any other substance likely to cause or accelerate fire.

4.7.25 Compressed oxygen is never to be used:

- As breathing air;
- To purge pipelines, tanks, or any confined area;
- To supply a head-pressure tank;
- In pneumatic tools;
- In oil preheating burners;

- To start internal combustion engines;
- For ventilation;
- For cleaning clothing; and
- In any other way as a substitute for compressed air.

4.7.26 Use of a cylinder's contents for purposes other than those intended by the supplier is prohibited.

4.7.27 Cylinders of compressed natural gas or propane equipped with a pressure relief device shall always be positioned in a manner that this device remains above the liquid level (e.g., if stored or installed horizontally on a forklift, relief device is positioned at the top).

4.7.28 Storage of liquefied petroleum gas (LPG) within buildings is prohibited, and outdoor storage or LPG shall meet applicable building and fire codes.

4.8 Special Precautions for Compressed Gas Cylinders Containing Hydrogen

4.8.1 Inside buildings, cylinders of hydrogen should be separated from oxygen cylinders by a minimum distance of 20 feet (6.1 meters) or by a barrier of non-combustible material at least 5 feet (1.5 meters) high having a fire resistance rating of at least one half hour.

4.8.2 Conspicuous signs should be posted in hydrogen storage areas forbidding smoking, open flames or the use of lights or lighting not approved for use in flammable areas.

4.8.3 Hydrogen storage areas shall be labeled, "Hydrogen-Flammable Gas-No Smoking-No Open Flame" or equivalent.

4.9 Inspection of Compressed Gas Cylinders

4.9.1 Prior to formally accepting any delivered compressed gas cylinders, a visual inspection of each cylinder will be documented as specified below. In addition, all compressed gas cylinders stored at an AECOM facility will be inspected monthly.

- Visually inspect cylinders, refer to *S3AM-114-FM1 Compressed Gas Cylinder Inspection.*
- Verify that all the required markings are on the cylinders.
- If required, determine when the cylinder was last hydrostatically-tested.
- Inspect the safety relief devices, if required.
- If any defects are noted during the inspection, the cylinder should be refused on delivery and a new delivery requested (notify the Manager).

4.9.2 Where compressed gas cylinders are stored at an AECOM facility, a qualified person will be designated to confirm cylinder activities comply with the requirements in this procedure. Inspection entails the evaluation of the integrity of the cylinder as well as the serviceability of any attached manifold and valve fittings. Inspection activities of cylinders beyond visual inspection are recommended to be conducted in isolation or a remote location for worker and public safety. The inspection of any cylinder will be conducted by a qualified person, refer to *S3AM-114-FM1 Compressed Gas Cylinder Inspection*.

4.10 Cylinder Inspection Procedures

4.10.1 All cylinder inspection procedures will adhere to the applicable regulatory requirement. At a minimum, the inspection process will include the following procedures:

- Observe the cylinder from a safe distance to identify any visual markings or other information.
- Inspect the cylinder size, shape, and general condition (if visible, include the valve system/stem in the inspection process).
- If the cylinder or valve system appears to be in poor condition or has lost structural integrity, do not approach the cylinder. Observations indicating a cylinder is in poor condition may include:

- Leaking,
- Hissing sound,
- Odor in vicinity of the cylinder,
- Rusty components,
- Bulging side wall or end, and/or
- Corroded valve system.

4.10.2 If the cylinder is determined to be in poor condition, cordon the area off and limit access to necessary employees only.

4.10.3 Wear applicable PPE and approach the cylinder with the appropriate direct reading air monitoring instrument (do not approach from the ends of the cylinder), then determine the airborne contaminant concentrations in the immediate area.

4.10.4 Document cylinder information (e.g., visible markings, labels, placards, etc.).

4.10.5 Cylinders presenting potential deficiencies (e.g., dent, missing labels, valve protection cap cannot be removed by hand, corrosion, etc. shall be tagged o ot se', remo ed from use, and returned to the supplier.

4.11 Ground Transport of Compressed Gas Cylinders

4.11.1 AECOM will transport (drive/haul) quantities of compressed gases which do not exceed Materials of Trade (MOT) quantities, whereas the transport of placardable quantities is prohibited without the proper DOT / TDG licenses/credentials and consultation with the SH&E Manager.

4.11.2 Compressed gas cylinders in portable service are to be conveyed by suitable trucks, to which they are securely fastened. All gas cylinders in service shall be securely held in substantial racks or secured to other rigid structures so that they will not fall or be knocked over.

4.12 Air/Common Carrier Transport

4.12.1 All shipping of compressed gases via air/common carrier including instrument gases, regardless of quantity, shall be conducted by a qualified and trained HazMat Shipper (Level 1-2 Shipper) or jurisdictional equivalent, and shall conducted under the oversight of a designated DOT/International Air Transport Association (IATA) shipping specialist, or jurisdictional equivalent. Refer to *S3AM-116-PR1 Hazardous Materials Shipping.*

4.12.2 No compressed gas cylinder, regardless of contents or quantity, will be shipped via an external carrier vendor (i.e., UPS, FedEx, etc.) without the authorization of:

- SH&E Manager, and
- DOT/IATA shipping specialist.

4.12.3

4.13 Cylinder Color Coding Determination

4.13.1 The color coding of compressed gas cylinders is established by the Compressed Gas Association, which has assigned specific colors to categories or classes of chemicals/substances. It is important to note there is currently not requirement to adhere to this color coding scheme.

4.13.2 While recently manufactured cylinders reflect the color coding guidance established by the CGA, older cylinders may not reflect this nomenclature. It is also possible for cylinders to have been repainted a different color from their original.

4.13.3 Cylinder contents should never be determined by the color of the cylinder alone. Colors are not uniform throughout the compressed gas industry.

4.13.4 Cylinder contents shall be identified by a decal, label, tag, or stenciling. If an identifying label is lacking or not legible, return the container to the supplier, unused.

4.14 Air Monitoring Requirements

4.14.1 Air monitoring requirements are dependent upon the specific substances contained within the cylinders and will be specified within the site-specific safety plan prepared prior to commencement of field activities. Air monitoring parameters, refer to *S3AM-127-PR1 Exposure Monitoring*, may include, but are not limited to:

- Explosivity (i.e., lower explosive limit [LEL]), and
- Chemical-specific substance (e.g., chlorine, ammonia, arsine, etc.).

4.14.2 Action levels will be identified in the site-specific safety plan.

4.15 Cylinder Staging

4.15.1 Staging involves the organization, and sometimes consolidation, of cylinders that have similar contents or characteristics.

4.15.2 The staging of cylinders will occur in a remote location at the site in order to minimize the potential injury or property damage from an accidental release or emergency decompression (if the integrity of the cylinder is in question, it should not be moved).

4.15.3 Safe distances will be based on the e acuation distances pro ided in 's mergency esponse Guidebook (most current edition).

4.15.4 When multiple cylinders containing different substances are present, the distance should be based on the greatest evacuation distance required by the substances present.

4.16 Cylinder Disposition & Decommissioning Activities

4.16.1 Disposition refers to the recycling, treatment, or disposal of a compressed gas cylinder and/or its contents.

4.16.2 Recovery and recycling of materials are preferred over any other method of disposition. Cylinder disposition activities shall be approved by the SH&E Manager.

4.16.3 An effort should be made to recover and recycle the contents of a cylinder; however, if recovering or recycling the contents is not possible, then other options include:

- Venting to the Atmosphere,
- Flaring,
- Neutralization, and
- Detonation.

4.16.4 Under no circumstances will poisonous, toxic, or ozone-depleting substances be vented to the atmosphere. Only cylinders containing flammable gases should be detonated, as the flammable contents will be consumed in the subsequent explosion.

4.16.5 If the cylinder valve has been determined to be inoperable, then the available options for disposition are limited to having an outside vendor perform the remote opening and sampling of the cylinder, or detonation of the cylinder where the cylinder contents are consumed in the subsequent explosion (flammable gases only).

4.16.6 All cylinders shall be inventoried, staged, and inspected.

4.16.7 Prior to the commencement of cylinder disposition and decommissioning activities, local emergency response agencies (i.e., Fire Department, Medical, and Emergency Response, if separate) shall be confirmed and, as applicable, activities coordinated with the local agencies.

4.16.8 Air monitoring is mandatory during cylinder disposition and decommissioning operations.

4.16.9 A SH&E Manager shall be contacted during the planning stages of a cylinder disposition and decommissioning effort in order to determine whether a site-specific cylinder plan is required.

4.17 Venting to the Atmosphere

4.17.1 Cylinders that contain non-flammable, non-toxic materials can be vented to the atmosphere. All venting activities will be performed in accordance with the following procedures:

- Atmospheric venting will be accomplished at a remote location and in compliance with all applicable environmental air regulatory requirements.
- Atmospheric venting activities will be completed in a Level B Ensemble (unless otherwise specified in the site-specific safety plan and cylinder plan).
- Venting activities will be dependent upon a wind direction that does not carry the outgas plume in the direction of an adjacent public structure.
- The cylinder will be properly grounded to confirm a static charge is not generated, potentially resulting in ignition of a flammable gas.
- All tools used on the cylinder will be non-sparking.
- Low-pressure discharging will not exceed 15 pounds per square inch gauge (psig).
- Once discharging has started, all workers will retreat to the exclusion zone (minimum 100 feet) around the remote location until the discharging process is complete.

4.18 Flaring

4.18.1 Flaring activities involve the combustion of the cylinder contents through the discharge of a low-intensity flame. Flaring activities will be performed in accordance with the following procedures:

- Flaring will be accomplished at a remote location and in compliance with all applicable environmental air regulatory requirements.
- All personnel involved with flaring activities shall be appropriately trained and wear PPE appropriate to the hazards (e.g. Nomex fire-retardant forearm-length gloves, other fire-retardant clothing, self-contained breathing apparatus, etc.).
- Flaring activities will be dependent upon a wind direction that does not carry the combustion plume in the direction of any offsite structure or activity, or into uncontrolled (public access) areas.
- The cylinder will be properly grounded to confirm a static charge is not generated, potentially resulting in ignition of a flammable gas.
- All tools used on the cylinder will be non-sparking.
- Low-pressure discharging will not exceed 15 pounds per square inch gauge (psig).
- A hot work permit shall be completed prior to the start of flaring activities, refer to *S3AM-332-PR1 Hot Work*.
- No other cylinders will be within 50 feet (15.24 meters) of the cylinder being flared.
- Flaring activities will use a low-pressure discharge and maintain a small, low-intensity flame.
- A firewatch will be established, with a worker stationed outside the exclusion zone with a fire extinguisher (20A:100B:C) during flaring activities (i.e., fire watch). During the work the worker assigned to the firewatch will have no other duties.
- The flare will be positioned so that it is not pointing toward any flammable materials, persons, or equipment in the immediate area.

4.19 Neutralization

4.19.1 Neutralization refers to the on-site neutralization of the cylinder contents through a controlled chemical reaction process. Specialized equipment may be necessary based on the chemical involved, as well as reaction by-products, catalysts, or physical conditions (i.e., temperature, acidic, basic, etc.). Neutralization activities will be performed in accordance with the following procedures:

- Neutralization is the required disposition method for cylinders containing acid gases, as well as many alkaline gases.
- The neutralization process shall be approved by a professional engineer (e.g., chemical) or based on a published chemical-specific neutralization methodology.
- Liquid levels in the reaction vessels will be maintained at least 12 inches (30.5 centimeters) below the top of the vessel.
- Based on the specific chemical reaction, the temperature of the reaction vessel and its contents will be monitored continuously and controlled accordingly.
- Pressure levels will be maintained within acceptable limits to prevent the reaction from accelerating, unwanted by-product formation, or the break-through of the chemical intended to be neutralized.
- Employees involved in neutralization activities shall be appropriately trained and wear the PPE identified within the site-specific safety plan and cylinder plan.

4.20 Detonation

4.20.1 Detonation refers to the use of explosives to open and subsequently consume the contents of the cylinder by the heat generated during the explosion. Detonation activities will be performed in accordance with the following procedures:

- All personnel involved with detonation activities shall be appropriately trained and wear PPE appropriate to the hazards (e.g. Nomex fire-retardant forearm-length gloves, other fire-retardant clothing, self-contained breathing apparatus, etc.).
- A detonation plan shall be submitted to and approved by the SH&E Manager prior to the commencement of cylinder detonation activities.
- The detonation of compressed gas cylinders will be completed under the guidance of experienced ordnance and explosives (OE) professional who is licensed in the use of explosives.
- A sufficient amount of explosives will be used to consume the entire contents of the cylinder (flammable gases only).
- A blast pit will be excavated where all detonations will take place.
- The OE professional will determine the blast hazard zone/potential debris impact zone, and this area will be evacuated prior to the detonation.
- The OE professional will sound a warning signal (e.g., horn or equivalent) three times to indicate that a detonation is imminent and confirm all persons have evacuated the blast hazard zone prior to detonation.
- Employees will be on standby outside the blast hazard zone with fire extinguishers (minimum rating of 20A:100B:C).

4.21 Cylinder Decommissioning Operations

4.21.1 Decommissioning refers to the removal of a compressed gas cylinder from service by rendering it permanently unusable.

4.21.2 Prior to decommissioning, cylinder contents will be verified, removed from the cylinder, and the cylinder purged with an inert gas (e.g., nitrogen, carbon dioxide, etc.).

4.21.3 All identifying marks or decals will be removed from the cylinder.

4.21.4 The SH&E Manager shall be contacted prior to the decommissioning of compressed gas cylinders that contain or previously contained:

- Ethylene oxide,

- Arsine,
- Diborane,
- Hydrogen selenide,
- Cyanogen chloride,
- Amines,
- Hydrogen sulfide,
- Acetylene, or
- Methyl mercaptan.

4.21.5 Additional safety precautions may be necessary due to highly reactive residues left behind by these substances.

4.21.6 The recommended methods of decommissioning include:

- Burning/torch-cutting an elongated hole into the side of the cylinder, refer to *S3AM-332-PR1 Hot Work;*
- Torch-cutting the cylinder in half; and
- Crushing the cylinder.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-114-ATT1 Compressor Safety

6.2 S3AM-114-FM1 Compressed Gas Cylinder Inspection

Americas

Hazardous Waste Operations

S3AM-117-PR1

1.0 Purpose and Scope

1.1 Provides requirements for AECOM operations pertaining to hazardous waste and emergency response (HAZWOPER) services. In Canada and South America, there is no direct counterpart to HAZWOPER; however, as due diligence and in compliance with applicable duty of care/general duty clauses, staff working in Canada and South America will comply with this procedure as far as it aligns with the location's respective legislation.

1.2 Provides a procedure intended to address small incidental spills from work related equipment and supplies. For operations with bulk quantities of fuels, chemicals, oils, and for operations where AECOM is providing emergency response services for spills, the SH&E Manager or designee shall specify spill prevention and preparedness criteria including training, equipment, and proficiency.

1.3 To define appropriate procedures to decontaminate both equipment and personnel when exposure to hazardous chemicals or physical agents has occurred.

1.4 This procedure applies to all AECOM Americas-based employees and operations.

2.0 Terms and Definitions

2.1 **Contamination Reduction Zone (CRZ)** – The transition area between the contaminated area and the clean area where decontamination activities occur.

2.2 **Decontamination** – The process of removing or neutralizing contaminants that have accumulated on personnel or equipment.

2.3 **Emergency Response** – A response effort by employees from outside the immediate release area or by other designated responders (e.g.., mutual-aid groups, local fire departments, etc.) to an occurrence that results, or is likely to result, in an uncontrollable release of a hazardous substance or whenever a release requires that a federal, state, territorial or provincial agency be notified, such as:

- A release at or above a reportable quantity (RQ) of a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substance (40 CFR 302.8) is required to be reported to the National Response Center (NRC).
- A release at or above provincial reporting thresholds, if any, or alternatively those specified under the Canadian Transportation of Dangerous Goods Act are reportable under the Canadian Environmental Protection to the respective provincial or territorial Environmental Regulatory Agency .
- A hazardous chemical release at or above an RQ under the Emergency Planning and Community Right-to-Know Act (EPCRA) (Title III under the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 350-372) is required to be reported to state and local officials.
- A release in violation of a facilities Spill Prevention, Control, and Countermeasure (SPCC) Plan (40 CFR 112).

Responses to incidental release of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area or by maintenance personnel are not considered to be emergency responses within the scope of the HAZWOPER standard. Responses to releases of hazardous substances where there is no potential safety or health hazard are not considered to be emergency responses.

2.4 **Exclusion Zone (EZ)** – The area where contamination does or could occur.

2.5 **First Responder** – First responders are individuals who are likely to witness or discover a hazardous substance release, injury, fire, or other incident and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond first aid, initial control of the incident, and notifying the authorities and others of the incident.

2.6 **Hazardous Materials** – A hazardous material is any item or agent (biological, chemical, physical) that has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors. Additionally a hazardous material may be defined as any substance or chemical which is a "health hazard" or "physical hazard," including chemicals that are carcinogens, toxic agents, irritants, corrosives, sensitizers; agents that act on the hematopoietic system; agents that damage the lungs, skin, eyes, or mucous membranes; chemicals that are combustible, explosive, flammable, oxidizers, pyrophoric, unstable-reactive, or water-reactive; and chemicals that in the course of normal handling, use, or storage may produce or release dusts, gases, fumes, vapor, mists, or smoke that may have any of the previously mentioned characteristics. This may be caused when released by spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, disposing into the environment, by being transported or moved, and items or chemicals that are "special nuclear source" or by-product materials or radioactive substances.

2.7 **Hazardous Materials Specialist** – Hazardous materials specialists are individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician; however, those duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with federal, state, local, and other government authorities in regards to site activities.

2.8 **Hazardous Materials Technician** – Hazardous materials technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder in that they will approach the point of release in order to plug, patch, or otherwise stop the release of a hazardous substance.

2.9 **Hazardous Waste** – Hazardous waste is waste that is dangerous or potentially harmful to our health or the environment. Hazardous wastes can be liquids, solids, gases, or sludge. They can be discarded commercial products, like cleaning fluids or pesticides, or the by-products of manufacturing processes. Hazardous waste are divided into:

- Listed wastes (http://www.epa.gov/osw/hazard/wastetypes/listed.htm);
- Characteristic wastes (http://www.epa.gov/osw/hazard/wastetypes/characteristic.htm);
- Universal wastes (http://www.epa.gov/osw/hazard/wastetypes/universal/index.htmwastes); and
- Mixed wastes;
- Specific procedures determine how waste is identified (http://www.epa.gov/osw/hazard/wastetypes/wasteid/index.htm), classified, listed, and delisted.

2.10 **Health and Safety Plan (SH&E PLAN)** – A document prepared for each project that contains site-specific information including the Emergency Response Plan for the project.

2.11 **Incidental Releases** - A response to a spill or release of a hazardous substance (in quantities below its RQ) where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area using equipment and materials available to them at the time or the spill or release. Any spill or release that cannot be managed with the personnel, materials, and equipment at the site shall be considered an Emergency Response.

- Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses. Handling of incidental releases shall be in accordance with applicable standard operating procedures.

2.12 **Incident Command System (ICS)** – ICS is a standardized on-scene incident management concept designed specifically to allow responders to adopt an integrated organizational structure equal to the complexity and demands of any single incident or multiple incidents without being hindered by jurisdictional boundaries. In the ICS the first person responding to an incident becomes the Incident Commander and turns that title and duties over to more qualified responders as they arrive on scene.

2.13 **Incident Commander** – The Incident Commander (IC) is responsible for all aspects of the response, including developing incident objectives and managing all incident operations. The title and responsibilities are typically assumed by a qualified IC from the client or public sector.

2.14 **Support Zone (SZ)** – An uncontaminated zone where administrative and other support functions (e.g. first aid, equipment supply, emergency information, etc.) are located.

3.0 References

3.1 RS2-003-PR1 Disruptive Event Response Standard

3.2 S3AM-003-PR1 SH&E Training

3.3 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.4 S3AM-010-PR1 Emergency Response Planning

3.5 S3AM-012-PR1 First Aid

3.6 S3AM-017-PR1 Injury & Illness Recordkeeping

3.7 S3AM-127-PR1 Exposure Monitoring

3.8 S3AM-128-PR1 Medical Screening & Surveillance

3.9 S3AM-208-PR1 Personal Protective Equipment

3.10 S3AM-209-PR1 Risk Assessment & Management

3.11 S3AM-213-PR1 Subcontractor Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Enforces and supports the implementation of SH&E Plans, Location Specific Emergency Response Plans, and Spill Response Plans;
- Prepare or request a SH&E Plan for every AECOM project with Hazardous Waste Operations and Emergency Response Activities, refer to *S3AM-209-PR1 Risk Assessment & Management*;
- Verify that all personnel working on the project are qualified to perform the activities they are assigned (see HAZWOPER and Emergency Spill Response Training requirements below);
- Request client's emergency response procedures;
- Appoint a Site Safety Officer (SSO) with appropriate qualifications for the specific hazardous waste project;
- Confirm that the SSO for complex projects, such as those with complicated remediation activities, has no duties other than site safety and health of the field team;
- Confirm the communication of the location-specific emergency response plan details to all employees assigned to a field project;
- Authorize the procurement of the necessary decontamination supplies;

- Verify that the applicable decontamination steps are clearly defined in the approved SH&E Plan;
- Verify staff are appropriately trained to execute the defined decontamination procedures;
- Verify that adequate staffing is available to safely conduct the applicable decontamination steps;
- Confirm that the necessary communications equipment for the project is available;
- Confirm that incident investigations are performed as required and a report is filed. Refer to *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*;
- During spill response, all AECOM emergency responders and their communications shall be coordinated and controlled through the Manager. The individual in charge shall implement the and shall be responsible for the following tasks:
    - Become the individual in charge at the incident until relieved by more qualified personnel;
    - Notify the appropriate agency, the AECOM incident Reporting line, and operations. Refer to *S3AM-117-ATT1 Spill Notification Numbers North America* for US and Canadian required notifications;
    - Designate a safety supervisor who is knowledgeable about the operations being implemented at the emergency response site and who will have specific responsibility to identify and evaluate hazards and to provide direction on the safety of operations for the emergency at hand. If the safety supervisor judges activities to be an Immediately Dangerous to Life or Health (IDLH) and/or to involve an imminent danger condition, the safety supervisor shall have the authority to alter, suspend, or terminate those activities. The safety official shall immediately inform the individual in charge of the ICS of any actions needed to be taken to correct these hazards at the emergency scene;
    - Identify all hazardous substances or conditions present and address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance, and handling procedures;
    - Implement appropriate emergency operations. Refer to *S3AM-010-Emergency Response Planning*;
    - Limit the number of emergency response personnel at the emergency site;
    - Implement the buddy system in groups of two or more;
    - Confirm that the PPE worn is appropriate for the hazards to be encountered;
    - Implement appropriate decontamination procedures after emergency operations have terminated.
- Responsibility for the emergency response shall be transferred upon arrival of a more qualified AECOM Incident Commander or a Public Service Incident Commander.
- Confirm appropriate communications concerning an emergency event are initiated as per *S3AM-010-PR1 Emergency Response Planning* and *RS2-003-PR1 Disruptive Event Standard*.

4.1.2 **SH&E Manager or designee**

- Provide technical guidance for:
    - The development and implementation of SH&E Plans and Emergency Response Plans;
    - The Incident Commander regarding the correct way to respond to the spill;
    - Project-specific Spill Response Plans when required;
- Prepare emergency action plans as part of project SH&E Plans and emergency reference sheets;

- Interface with the local emergency responders when necessary;
- Interface with clients regarding facility emergency response procedures;
- Decide whether AECOM or an outside emergency response company will clean up the spill;
- Report spills, as necessary, to state/provincial environmental agencies;
- Review the incident report and facilitate the post-response discussion;
- Review and revise this procedure as necessary based on recommendations from post-response discussions;
- Advise Managers and Supervisors on the necessary decontamination procedures for the known or reasonably anticipated chemical hazards and physical agents associated with the planned scope of work;
- Support the project team to verify that adequate protective measures are in-place (e.g. Engineering Controls, Administrative Controls, Personal Protective Equipment, etc.).

4.1.3 **Site Safety Officer (SSO)**

- Verify that a SH&E PLAN is available for the project and is reviewed prior to the commencement of site activities;
- Conduct pre-entry briefing and daily tailgate meetings and review facility, site-specific emergency procedures, and site specific decontamination procedures;
- Communicate the site-specific emergency response details to all employees assigned to a field project;
- Establish the designated site work zones (e.g., EZ, CRZ, SZ, etc.);
- Enforce the applicable decontamination steps as defined in the approved SH&E Plan;
- Initiate Stop Work and emergency response procedures as required;
- Account for all AECOM and subcontractor employees after site evacuation;
- Brief on-site and off-site responders in the event of an emergency;
- Conduct site-specific training on the applicable decontamination steps/procedures;
- Procure the necessary decontamination supplies and establishing the decontamination line;

4.1.4 **Employees**

- Maintain HAZWOPER training, or equivalent training as it relates to the given jurisdiction;
- Follow the SH&E Plan and emergency procedures prepared for the project;
- Initiate Stop Work if necessary;
- Initiate emergency response via verbal communications or the alarm system if first to encounter an emergency;
- Follow the defined decontamination steps as stated in the approved SH&E Plan;
- Follow precautions and safe handling practices to avoid spills;
- Alert Manager to any deteriorating hazardous materials containers within the office or project area;
- Report all spills and leaks to the Manager immediately;
- Secure the spill area as quickly as possible and prevent the migration of exterior spilled materials or substances to drains or other openings; and

4.1.5 **All personnel** (e.g., AECOM employees, general laborers, equipment operators, chemists, supervisors, etc.) performing activities at hazardous waste sites that expose or potentially expose them to hazardous wastes and health hazards are considered HAZWOPER site workers and shall meet the training and medical surveillance requirements specified in 29 CFR 1910.120(e) and (f), respectively. Additional training may be required based on site activities including related exposures and risks (e.g., confined space entry, excavations, fall protection, other materials [lead], etc.). These additional training requirements are to be outlined in the project- or site-specific SH&E Plan.

4.2 Project SH&E Documentation—SH&E Plan

4.2.1 The project SH&E documentation prepared for HAZWOPER activities is referred to as a site-specific SH&E Plan, and shall meet the requirements presented in 29 CFR 1910.120(b)(4).

4.2.2 A safety and health risk or hazard analysis for each on-site task that will be performed.

4.2.3 The required SH&E Plan elements include:

- A description of the work location, the site history, and a summary of any information available concerning site hazards (including both physical hazards and contamination conditions);
- A summary of the work activities to be performed under AECOM's scope of activities;
- Identified risks shall include both chemical and physical hazards to which personnel may be exposed during the conduct of the work task;
- Protective measures for each work task to prevent or mitigate the potential hazards identified in the hazard analyses;
- Personal protective equipment (PPE) requirements for each work task**.** Refer to *S3AM-208-PR1 Personal Protective Equipment*;
- Frequency and types of air monitoring, personal monitoring, and environmental sampling techniques and instrumentation to be used;
- Site control measures;
- Decontamination procedures;
- An emergency response plan, *S3AM-010-PR1 Emergency Response Planning*, addressing actions to be taken in the event of each type of credible incident that might result during the performance of planned work activities, including minor and major injuries, and chemical release and fire. Response plans shall address the means for coordinating the evacuation of all on-site personnel in the event of a catastrophic incident.

4.2.4 Responsibility for development of each AECOM SH&E Plan will be coordinated between the Manager and the SH&E Manager or SH&E Department designee as part of project initiation. Regardless of where the SH&E Plan is developed, it will be reviewed and approved by the SH&E Manager prior to submission to any agency outside of AECOM.

4.2.5 Contractors and Subcontractors

- The health and safety of the employees of any contractor or subcontractor who does not have a contract directly with AECOM, and for whom AECOM does not have contractual safety oversight, is the responsibility of that contractor or subcontractor. The contractor or subcontractor shall evaluate the hazards and potential hazards to their own employees and shall adhere to their own Health and Safety Plan;
- Subcontractors who maintain a contract directly with AECOM shall comply with AECOM SH&E program requirements. Refer to *S3AM-213-PR1 Subcontractor Management*;
- In addition, all AECOM subcontractors' Health and Safety Plans shall, at a minimum conform to the requirements of the AECOM SH&E Plan. The AECOM SH&E Plan does not, nor is it intended to, address procedures of contractors or subcontractors during their site activities.

4.3 Personnel Qualifications— Training and Medical Surveillance

4.3.1 HAZWOPER-qualified employees shall participate in the following medical surveillance and training requirements. Medical surveillance and SH&E training requirements are further described in *S3AM-128-PR1 Medical Screening & Surveillance* and *S3AM-003-PR1 SH&E Training* respectively.

4.3.2 Employees receiving initial and refresher responder training shall be issued a certificate indicating training competency. Copies of all training records shall be maintained in accordance with the *S3AM-003-PR1 SH&E Training*.

4.3.3 Medical Surveillance

- Specific HAZWOPER medical examination protocols have been developed by AECOM's Corporate Medical Provider (CMP) to meet the requirements of 29 CFR 1910.120(f). To be medically qualified to perform HAZWOPER work, employees receive the following medical examinations:
    - Initial (Baseline) Examination — The initial examination is part of pre-employment requirements and shall be completed (with results received) prior to the employee's start of work date;
    - Annual Examination — HAZWOPER-qualified employees will complete a medical examination once each year. Medical qualification expires on the anniversary date of the last examination completed. There will be no "grace period" exemptions beyond this date without the express approval of the Region SH&E Manager. At the recommendation of the SH&E Department, the CMP may approve an alternate examination frequency at periods of up to two years (biennial) in cases in which the worker's exposures to environmental contaminants are infrequent and typically well below any occupational exposure limits (e.g., senior management personnel);
    - Termination Examination — When reassigned to non-HAZWOPER duties or at the conclusion of employment at AECOM, HAZWOPER-qualified personnel will be provided with the opportunity to receive a termination medical examination;
    - Special Examinations — The SH&E Department and the CMP will jointly determine the need for special examinations because of:
        - Unusual exposure conditions; and
        - In response to possible overexposures.
- The CMP will determine the medical protocol elements for each of these examinations based on exposure information provided by the SH&E Department. The CMP will evaluate the results of each Employee's examination and will provide a written statement of medical clearance clearly stating medical compliance with the HAZWOPER regulatory standard (29 CFR 1910.120(f)) and approval of the Employee to perform unrestricted HAZWOPER activities. For initial and annual examinations, the CMP will also evaluate the Employee for the use of air purifying and supplied air respiratory protection. The written evaluation from these examinations will indicate the CMP's approval/limitations on the Employee's use of respiratory protection;
- If an Employee does not wish to participate in part or in the complete medical surveillance program, and is permitted by the given jurisdiction, the employee shall provide a written statement of refusal. Refer to *S3AM-128-PR1 Medical Screening & Surveillance*;

4.3.4 Training - HAZWOPER

All personnel assigned to work at a hazardous waste site, sampling at Treatment, Storage and/or Disposal Facilities (TSDFs), or are performing Remediation and Investigation Activities, shall participate in training meeting the requirements of 29 CFR 1910.120(e), or equivalent training as it relates to the given jurisdiction. All personnel shall have the following training:

- 40-hour initial Training — Before being assigned to a HAZWOPER site, AECOM Employees shall complete 40 hours of off-site training meeting the requirements of 29 CFR 1910.120(e)(3)(i). At the conclusion of training, personnel will receive a written certification of course completion, signed by the instructor, that indicates the course of instruction (40-hour HAZWOPER) and training dates. A copy of this certification shall be provided to the employee's SH&E Manager. Employees are responsible for maintaining their own copy of this certificate and for presenting it to the SSO when working on any HAZWOPER site;
- 3 days of on-the-job training — The Employee shall receive 3 days of actual supervision by a trained experienced supervisor;
- Refresher 8-Hour Training — To remain qualified to perform on-site HAZWOPER work activities, each AECOM Employee will complete 8 hours of HAZWOPER refresher training meeting the requirements of 29 CFR 1910.120(e)(8) at yearly intervals following completion of Initial 40-hour training. At the conclusion of training, personnel will receive a written certification of course completion, signed by the instructor, that indicates the course of instruction (8-hour HAZWOPER Refresher) and the training date. A copy of this certification shall be provided to the employee's SH&E Manager. Employees are responsible for maintaining their own copy of this certificate and for presenting it to the SSO when working on any HAZWOPER site;
- 8-hour Supervisor 8-Hour Training - any AECOM Employee acting in a management capacity for HAZWOPER activities (e.g., project manager, site safety officers, etc.) shall complete an additional 8 hours of HAZWOPER Supervisor training meeting the requirements of 29 CFR 1910.120(e)(4). Although this training is required only once, supervisors shall maintain their overall HAZWOPER qualification through annual completion of refresher training. At the conclusion of Supervisor 8-Hour Training personnel will receive a written certification of course completion, signed by the instructor that indicates the course of instruction and the training date. A copy of this certification shall be provided to the SH&E Manager. Employees are responsible for maintaining their own copy of this certificate and for presenting it to the SSO when working on any HAZWOPER site;
- 24-Hour HAZWOPER Training — Site support contractors and site visitors may qualify to substitute 24-hour HAZWOPER training in place of 40-hour training, as specified in 29 CFR 1910.120(e)(3)(ii). Personnel potentially qualifying for this alternative training include:
    - Site support personnel who will not work in any Exclusion Zone areas;
    - Subcontractors and site visitors whose duties will not entail significant exposure to site contaminants defined as not working in any areas where airborne contaminant concentrations exceed one-half of any applicable occupational exposure limit, and no contact or exposure to materials with site contaminant concentrations exceeding natural background levels. The SH&E Manager shall approve the substitution of 24-hour training for initial 40-hour training. Persons qualifying for 24-hour training shall provide written certification of course completion prior to beginning work on site. Persons completing 24-hour training shall complete 8 hours of annual refresher training at the required interval to maintain eligibility for on-site work and shall provide proof of this training (as necessary to demonstrate retraining) prior to beginning work on site.

Available Training Sources:

- On-site training provided by the SH&E Department;
- Outsourced training providers approved by the SH&E Department;

4.3.5 Training – Emergency Response

On an as-needed basis, if a project requires AECOM to provide a HAZMAT emergency response team, the following training requirements shall be met:

- Operations Level – a minimum of 8 hours of initial and refresher training for those responsible for acting defensively in the case of a release, attempting to contain the release from a safe distance;
- HAZMAT Technician – at least 24 hours of initial training and 8 hours of refresher training. They will participate in operations-level training and know how to implement the emergency response plan for the facility/site/project location;
- HAZMAT Specialist – at least 24 hours of initial training and 8 hours of refresher training. They will be trained in the same content as the HAZMAT Technician, as well as in how to develop a site safety and control plan;
- Incident Commander – will have at least 40 hours of training covering the Operations Level training and techniques for implementing the emergency response plan and directing the incident. They will be knowledgeable in relevant regulations. The Incident Commander will become the individual in charge of a site-specific incident command system and will coordinate and control communications with external agencies;

4.3.6 Subcontractor Personnel Training Records

Any subcontractor organization whose employees will support AECOM operations at a HAZWOPER site will:

- Provide the Manager with a copy of their written HAZWOPER medical surveillance and training program requirements. The elements of the program(s) shall be similar to those for AECOM's own program, as detailed above. Refer to *S3AM-213-PR1 Subcontractor Management*;
- Provide the Manager with written certification of a physician's approved medical clearance for each employee who will work on the site. Certification can be demonstrated by:
  - A copy of the physician's signed medical clearance for each employee (preferred); or
  - A letter identifying the medical status and clearance expiration date of every employee, signed by the company's safety director or an officer of the company.
  - A copy of the each employee's training certifications, which will include:
    - The initial 40-hour training certificate (24-hour training may be substituted with SH&E Manager approval);
    - The most current Refresher training certificate (shall be current within the previous one-year period);
    - A copy of the Supervisor training certificate for each person serving in a site supervisory capacity (e.g., project manager, site safety officers, etc.).

4.4 HAZWOPER and Spill Response Equipment

4.4.1 Specific HAZWOPER activity and spill response equipment shall be identified in the site specific SH&E PLAN. All AECOM offices and project sites that store chemicals at their location shall have the appropriate spill response equipment. Such equipment may include the following:

- Over-pack containers of varying capacities;
- Absorbent material such as vermiculite or commercially prepared, absorbent containing pillows, rolls, sheets, or booms;
- Acid and base neutralizing agents;
- Chemically resistant gloves for solvents, alcohols, and acids;
- Poly-coated Tyvek coveralls;
- Safety goggles;
- Respiratory protection;

4.4.2 Spill response equipment shall be placed adjacent to areas where chemicals are routinely handled, stored, and/or where shipments are received. Similar types of spill response equipment shall also be available in any AECOM vehicle or rented vehicle in which chemicals are being transported. Location of spill response equipment shall be selected to permit access outside of likely spill locations.

4.4.3 Spill Response Equipment for Field Programs

- The amount of chemicals being used during a field program will dictate the types and quantity of spill response equipment that is brought to the site;
- If several squirt bottles of decontamination solution are all that is being brought to a site, a few spill pillows and a one-gallon bucket (3.8 liters) may be sufficient to respond to a spill of these materials;
- If gallons of chemicals are being delivered to the site in drums or bulk tanks, a greater variety of spill response equipment will be needed. As indicated previously, during these types of field programs, a separate spill plan will be incorporated into the project or site specific SH&E Plan, and will provide a greater level of detail regarding the specific spill response effort for that field program. Refer to *S3AM-209-PR1 Risk Assessment & Management*;

4.5 Personal Protective Equipment (PPE) Ensembles

4.5.1 Defined HAZWOPER PPE ensembles are specified for general use on all AECOM HAZWOPER operations. The project SH&E Plan may specify modifications to these requirements to meet site-specific conditions. Refer also to *S3AM-208-PR1 Personal Protective Equipment* for additional information concerning PPE requirements.

4.5.2 Level D Ensemble

The Level D ensemble provides a minimal level of skin protection (primarily against physical rather than chemical hazards) and no respiratory protection. Level D PPE is the minimum work uniform to be used on HAZWOPER sites. Its use is appropriate when there is no significant potential for encountering hazardous substances or health hazards while working in controlled work areas.

Level D Equipment List:

- Hard hat;
- Eye protection;
- Safety-toe work boots;
- Shirts with sleeves and long pants (shorts are unacceptable for use); and
- Hearing protection (as required).

4.5.3 Modified Level D Ensemble

The Modified Level D ensemble provides moderate skin protection against contact with hazardous substances, but no respiratory protection. Its use is appropriate where there is a moderate-to-low potential for skin contact with known hazardous substances and health hazards, but no significant inhalation hazard is anticipated. The Modified Level D ensemble will consist of the Level D ensemble, supplemented by the addition of one or more of the following items:

Modified Level D Equipment List:

- Full faceshield;
- Plain (uncoated) disposable coveralls;
- Chemical-resistant disposable outer coveralls;

- Chemical-resistant outer gloves taped to outer coveralls;[1]
- Chemical-resistant inner gloves; and[1]
- Chemical-resistant safety-toe boots (taped to outer coveralls).

4.5.4 Level C Ensemble

The Level C ensemble provides moderate skin protection against contact with hazardous substances and moderate respiratory protection. Its use is appropriate where there is the potential for skin contact with known hazardous substances and health hazards, together with a limited and well-defined potential for exposure via inhalation.

Level C Equipment List:

- Full-face air-purifying respirator (APR) equipped with cartridge types as designated in the project SH&E PLAN;[2]
- Plaind (uncoated) disposable coveralls;
- Chemical-resistant disposable outer coveralls;
- Chemical-resistant outer gloves taped to outer coveralls;[3]
- Chemical-resistant inner gloves;
- Hard hat;
- Safety-toe boots taped to coveralls; the use of boot covers (e.g., booties) or chemical-resistant boots may be specified; and
- Hearing protection (as required).

4.5.5 Level B Ensemble

The Level B ensemble provides both the highest level of inhalation exposure protection and considerable skin contact protection. Its use is appropriate where there are significant known or suspected hazardous substances and health hazards, involving both skin and inhalation exposure (up to and including Immediately Dangerous to Life or Health [IDLH] conditions) or where adverse atmospheric conditions cannot be mitigated by use of air purifying respirators (e.g. oxygen deficient atmospheres or chemicals with poor warning properties). The use of Level B PPE requires prior approval by the SH&E Manager.

Level B Equipment List:

- Supplied air respirator (SCBA or airline system with Grade D or better breathing air);
- Chemical-resistant disposable outer coveralls;
- Chemical-resistant outer glove taped to outer coveralls;[3]
- Chemical-resistant inner gloves;[3]
- Hard hat;
- Chemical resistant safety-toe boots taped to coveralls; and
- Hearing protection (as required).

1 Selection of specific glove types/materials will be provided in the project SH&E Plan based on consideration of the contaminants and the physical conditions of the work.

2 Selection of specific cartridges will be made by the SH&E Department (or Competent Person – Respiratory Protection as designated by the SH&E manager) based on contaminants present. A cartridge change-out frequency will also be specified in the SH&E based on the manufacturer's cartridge performance data.

3 Selection of specific glove types/materials will be provided in the project SH&E based on consideration of the contaminants and the physical conditions of the work.

4.5.6 Level A Ensemble

The Level A ensemble provides the highest level of both respiratory and skin protection, up to and including protection against skin contact with vapor-phase contaminants. The use of Level A PPE requires prior approval by the Americas SH&E Director.

Specific Level A ensemble components will be determined on a case-by-case basis by the SH&E Department.

4.6 Emergency Response Plans

4.6.1 A Location Specific Emergency Response Plan shall be developed and implemented to handle anticipated emergencies prior to performing emergency response operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, and OSHA personnel. The plan shall be reviewed and approved by the SH&E Manager prior to issue.

4.6.2 AECOM'S *S3AM-010-PR1 Emergency Response Planning* shall apply and employees shall evacuate from the danger area whenever an emergency occurs, provided the associated contract does not require AECOM to provide emergency response services

4.6.3 AECOM Employees are not expected to take action or to participate in rescues or responses to chemical releases beyond the initial discovery of the release and immediate mitigation actions such as closing a valve, placing absorbents, and notifying the client and or public emergency response system (911).

- If AECOM Employees are to participate in the response to a chemical release beyond the initial reaction, there shall be a contractual provision for this response and the Employees shall be specifically trained for this response;
- This document is designed to provide guidelines on how to prepare a written plan that will confirm prompt and proper response to an emergency situation that arises during field investigations and to outline the duties of AECOM Employees during a field emergency and the associated training requirements.

4.6.4 Site specific SH&E plans that are prepared to comply with the HAZWOPER standard (29 CFR 1910.120) shall address emergency response. This standard specifically outlines the elements that shall be contained in an emergency response plan. However, the definition of emergency response, as written in 29 CFR 1910.120, focuses on emergencies involving the uncontrolled release of hazardous substances. Under 29 CFR 1910.120, an employer can opt to evacuate employees from the danger area when such an emergency occurs. AECOM does not expect its Employees to actively assist in the handling of uncontrollable chemical releases that may occur during the implementation of field programs. As such, and as provided by the HAZWOPER standard, AECOM is exempt from the emergency response plan requirements of the standard as long as it provides an emergency action plan within the SH&E PLAN that complies with 29 CFR 1910.38 (a). Therefore, all emergency response plans required under 29 CFR 1910.120 will be written to comply with 29 CFR 1910.38 (a).

- There are two types of emergency situations that AECOM personnel shall be prepared for and that shall be addressed in the emergency response plan. These include:
  - Emergencies related to the operations of our clients at the facility where AECOM is working;
  - Emergencies related to our own on-site activities/investigations.
- Employees are not to accept the role of Incident Commander without specific authority from the SH&E Manager and the Manager responsible for the project. Assuming the role of the Incident Commander requires training beyond the scope of this Procedure.

4.6.5 The HAZWOPER standard does not prohibit AECOM Employees from performing limited response activities.

- Appropriately trained AECOM Employees can provide voluntary First Aid services;
- AECOM Employees can provide response assistance by placing absorbent pillows or vermiculite around a small, contained spill that occurs during sampling efforts;
- Refer to Spill Response, Incidental procedures contained herein which describes the specific procedures that AECOM will follow when responding to an incidental chemical spill.

4.6.6 Field Project Preparation

- Every SH&E Plan that is prepared by AECOM will contain a Location Specific Emergency Response Plan in which the required elements of an emergency action plan will be addressed. Refer to *S3AM-010-PR1 Emergency Response Planning*;
- When AECOM is working at an operating facility, the emergency response procedures of the facility will be appended to the SH&E Plan or the Location Specific Emergency Response Plan;
- As a minimum, each emergency response plan shall contain the following topics as required by 29 CFR 1910.38 (a):
    - Procedures and contact information for reporting emergencies to public service responders and on-site (client or host employer) emergency control centers;
    - Pre-emergency planning and coordination with outside parties;
    - Emergency escape procedures and emergency escape route assignments;
    - Procedures to be followed by employees who remain to operate critical site operations before they evacuate;
    - Procedures to account for all employees after emergency evacuation is complete;
    - Rescue and medical duties for those employees who are trained to perform them;
    - Preferred means of reporting fires and other emergencies;
    - PPE to protect employees from expected exposures and potential exposures during an emergency;
    - Names of persons or departments who can be contacted for further information (i.e. emergency reference sheet);
    - Site security and control;
    - Availability of medical surveillance for workers who might have been exposed to chemicals, bloodborne pathogens, or other biological agents as a result of project work or emergency response;
    - Emergency medical treatment and first aid;
    - Emergency alerting and response procedures;
    - Critique of response and follow-up.
- In addition, each plan shall establish the specific alarm system that will be used on site to warn employees of an AECOM emergency. The chosen alarm signals should not conflict with alarm signals already in place at the facility.

4.6.7 Client Facility Emergency Response Procedures

- AECOM implements field programs on active properties, including manufacturing facilities. These facilities have typically developed an emergency response plan that is specific to facility-related emergencies. If AECOM is working at an operating facility, emergency procedures established by the facility shall be followed in the event of a facility catastrophe.

AECOM personnel shall be aware of and familiar with the alarm signals used at the facility to alert personnel to an emergency. AECOM personnel shall also know where to assemble in the event of a facility evacuation as the facility shall be able to account for all personnel, including subcontractors such as AECOM in the event of an evacuation.

- The first priority in AECOM's preparation of a project emergency action plan is to confirm that the responsibilities under the client's emergency response plan are fully understood. Because of the nature of their business, many of our clients have in-house fire brigades, medical staff, and hazardous materials teams that can assist AECOM in the event of an emergency related to our field activities. In many instances, our clients prefer or require that subcontractors seek emergency assistance through their facility first before calling outside responders to the site.
- A copy of the facility's procedures shall be made available to AECOM so that the information can be incorporated into the SH&E Plan or attached to the Location Specific Emergency Response Plan. If this information is not available to AECOM prior to arriving on site, the SSO shall meet with client representatives upon arrival to the facility to review procedures in the event of an emergency related to plant operations.

4.6.8 Escape Routes and Procedures

Although emergency evacuation procedures are included in AECOM's initial 40-hour HAZWOPER training, emergency procedures at each site will be different. Employees shall be instructed about the location specific emergency response plan. Updating training is required anytime escape routes or procedures change. An evacuation drill will be conducted for projects that are scheduled for one month or longer. Visitors and untrained employees shall not be allowed into the project area until they receive a safety briefing including evacuation alarms and procedures.

Prior to the commencement of on-site activities, the SSO shall determine how AECOM employees will evacuate each AECOM work area of the site:

- Two or more routes that are separate or remote from each other for each work area shall be identified. Multiple routes are necessary in case one is blocked by fire or chemical spill. These routes shall not overlap because, if a common point were obstructed, all intersecting routes would be blocked;
- Prominent wind direction should also be considered when designating escape routes and assembly areas. Escape routes and assembly areas should be upwind of the site whenever possible;
- Upon arrival to the site, the SSO shall verify that the selected routes are appropriate for evacuation. During an emergency, the quickest and most direct route should be selected. However, when working at an operating facility, the established escape routes of the facility should be used whenever possible;
- In the event of a facility-related emergency, all AECOM employees shall meet at the facility's assembly area so that the client can verify that AECOM has evacuated the property.

4.6.9 Alarm Signals

An emergency communication system shall be in effect at all sites.

- The most simple and effective emergency communication system in many situations will be direct verbal communications. However, verbal communications shall be supplemented any time voices cannot be clearly perceived above ambient noise levels and any time a clear line of sight cannot be easily maintained among all AECOM personnel because of distance, terrain, or other obstructions;
- Portable two-way radio communications may be used when employees shall work out of the line of sight of other workers;
- When it is necessary to supplement verbal communications, Employees shall be informed of the established emergency signals. The following emergency signals, or other appropriate signals, shall be implemented using handheld portable air horns, whistles, or similar devices.

Signals shall be capable of being perceived above ambient noise by all employees in the affected portions of the workplace:

- o One Blast: General Warning—A relatively minor and localized, yet important, on-site event. An example of this type of an event would be a minor chemical spill where there is no immediate danger to life or health yet personnel working on the site should be aware of the situation so that unnecessary problems can be avoided. If one horn blast is sounded, personnel shall stop all activity and equipment on-site and await further instructions from the SSO;
- o Three Blasts: Medical Emergency—A medical emergency for which immediate first aid or emergency medical care is required. If three horn blasts are sounded, all First Aid Providers should respond as appropriate. All other activity and equipment should stop and personnel should await further instructions from the SSO;
- o Three Blasts Followed by One Continuous Blast: Immediate Threat to Life and Health — A situation that could present an immediate danger to life and health of personnel onsite. Examples include fires, explosions, large hazardous chemical release, severe weather-related emergencies, or security threats. If three horn blasts followed by a continuous blast are sounded, all activity and equipment shall stop. All personnel shall evacuate the site and meet in the designated assembly area where the SSO will account for all employees. The SSO will arrange for other emergency response actions if necessary. Information concerning the need to follow decontamination procedures during an emergency evacuation will be addressed in the Location Specific Emergency Response Plan;

- The SSO or his designate will acknowledge the distress signal with two short blasts on the air-horn or whistle;
- One Continuous Blast Following Any of the Above: All Clear/Return to Work — Personnel who sound the initial alarm are required to send an all clear signal when the emergency is over.

4.6.10 Accounting Method for All Employees after Evacuation

The SSO is responsible for determining that all AECOM employees have been successfully evacuated from the work area(s):

- It is the responsibility of each AECOM subcontractor to verify that all of its employees evacuated the site and to report this information to the SSO. All employees shall meet at the designated assembly area;
- A headcount is an acceptable way to determine complete evacuation when the field team is of a small size. The site log-in book or equivalent should be referenced when attempting to account for more than 10 people. In the event of a facility-related emergency, the SSO shall notify facility representatives that all AECOM employees and AECOM subcontract employees have successfully evacuated the work area(s);
- The SSO shall notify emergency responders if any employee is unaccounted for and where on the site they were last seen;
- In the event of a project-related emergency, the SSO will provide off-site emergency responders or on-site HAZMAT teams or fire brigades (Incident Commander) with all available knowledge about the emergency situation upon their arrival to the scene.

4.6.11 Employees Who Remain to Operate Critical Site Operations Before They Evacuate

All equipment and operations are required to cease in accordance with the established alarm signal procedures. The only exception will be related to health and safety:

- The SSO shall determine at the time of the emergency if health and safety will be jeopardized by immediate stoppage of any particular piece of equipment;

- If such a determination is made, personnel involved in critical operations shall be minimized. Once it is determined that the operation is no longer needed or the threat to the operators is imminent, operations will cease and the operators will immediately evacuate.

4.6.12 Rescue and Medical Response

- Only currently trained individuals will administer first aid, CPR or an AED. Refer to *S3AM-012-PR1 First Aid*.
- In the event of an incident, refer to material's SDS labels to confirm proper first aid is administered for the hazardous material and call the nearest Poison Centre or 911. Refer to *S3AM-012-PR1 First Aid*.
    - The American National Standards Institute (ANSI) Standard for Emergency Eyewash and Shower Equipment (ANSI Z358.1-1998) recommends that the affected body part shall be flushed immediately and thoroughly for at least 15 minutes using a large supply of clean fluid under low pressure. However, other references recommend a minimum 20-minute flushing period if the nature of the contaminant is not known. The flushing or rinsing time can be modified if the identity and properties of the chemical are known. For example, at least:
        - 5 minutes flushing time for mild irritants;
        - 20 minutes for moderate to severe irritants;
        - 20 minutes for non-penetrating corrosives;
        - 60 minutes for penetrating corrosives;
        - If irritation persists, repeat the flushing procedure.
- It is important to note that ingestion of any chemical is not likely to occur in the workplace. If ingestion does occur, evidence indicates that inducing vomiting is not necessary in most situations where there has been an occupational chemical ingestion.
    - Induction of vomiting should only be recommended if the chemical has very high, short-term (acute) toxicity, and medical follow-up is not readily available;
    - In these cases, first aiders should receive special training on how to safely and effectively induce vomiting in the appropriate circumstances.
- If the injury is life threatening, the Emergency Medical System (EMS) should be called (911). Depending on the procedures established for the project, the SSO would contact an emergency responder directly or notify the facility representatives for medical assistance;
- If the employee needs medical attention that cannot be provided on-site, the SSO shall escort the individual to the local hospital identified on the emergency reference sheet and shall remain with the person until release or admittance is determined. The escort will relay all appropriate medical information to the Manager and SH&E Manager.

4.6.13 On-site and Off-site Communications

Regardless of the size or location of AECOM's field projects, it is extremely important that both on-site and off-site communications be maintained so that in the event of an emergency employees can contact each other or place a phone call immediately with the appropriate responder(s).

A reliable and approved form of communication (e.g. two way radio, cell phone, etc.) is required when members of the field team are working in separate areas of the site and verbal communications are no longer effective because of distance. A communication device shall be available for each team that is working in a separate area of the site.

When AECOM is working at an occupied facility, a telephone may be accessible. When AECOM is working on abandoned properties or when there is no access to a phone, as appropriate, a cellular telephone, two-way radio, or satellite telephone shall be brought to the work location.

4.6.14 Preferred Means of Reporting

Employees shall immediately notify the Supervisor of incidents and emergencies, and report in accordance with *S3AM-004-PR1 Incident Reporting, Notification & Investigation*:

- Unless facility representatives specifically indicate that they prefer AECOM personnel to notify them first of an emergency, the SSO will directly contact the appropriate emergency responders listed on the Location Specific Emergency Response Plan;
- Additional communications within AECOM concerning an emergency event may be required as per *S3AM-010-PR1 Emergency Response Planning* and *RS2-003-PR1 Disruptive Event Standard*;
- "Dangerous occurrences" shall be reported immediately to the police, employer, vehicle owner/leaser and the dangerous goods owner. Such events would include spills, bulk container damage, fire, explosion, and transportation accidents involving dangerous goods;
- Confirm and seek direction on external reporting requirements. Each jurisdiction has regulations governing the minimum quantities for reporting based on the type of product spilled or release refer to *S3AM-117-ATT1 Spill Notification Numbers for North America*;

Individuals who have knowledge of a spill, release, or unlawful discharge, shall notify authorities immediately. Reporting does not imply guilt or assign blame. The following details are to be reported:

- Location and time of spill;
- Description of circumstances leading to spill;
- Type and quantity of material or substance spilled;
- Details of any action taken at the site of the spill;
- Description of location of spill and immediately surrounding the area;
- Any additional information in respect of the spill that the Minister, Environmental Protection Officer or person designated by regulations requires.

4.6.15 First Responder

First responders shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the following areas:

- An understanding of what hazardous substances are, and the risks associated with them in an incident;
- An understanding of the potential outcomes associated with an emergency;
- The ability to recognize the presence of hazardous substances and physical hazards in an emergency;
- An understanding of the role of the first responder;
- The ability to realize the need for additional resources and to make appropriate notifications to the communication center.

4.6.16 First Responder HAZWOPER Operations Level

First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release:

- They are trained to respond in a defensive fashion without actually trying to stop the release; Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures;

- First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:
    - Knowledge of the basic hazard and risk assessment techniques;
    - Know how to select and use proper personal protective equipment provided to the first responder operational level;
    - An understanding of basic hazardous materials terms;
    - Know how to perform basic control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with their unit;
    - Know how to implement basic decontamination procedures;
    - An understanding of the relevant standard operating procedures and termination procedures;

4.6.17 Hazardous Materials Technician

Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

- Know how to implement the employer's emergency response plan;
- Know the classification, identification, and verification of known and unknown materials by using field survey instruments and equipment;
- Be able to function within an assigned role in the Incident Command System, refer to *Federal Emergency Management Agency—FEMA: Incident Command System*;
- Know how to select and use proper specialized chemical PPE provided to the hazardous materials technician;
- Understand hazard and risk assessment techniques;
- Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with the unit;
- Understand and implement decontamination procedures;
- Understand termination procedures;
- Understand basic chemical and toxicological terminology and behavior.

4.6.18 Hazardous Materials Specialist

Hazardous materials specialists shall have received at least 24 hours of training equal to the technician level and in addition have competency in the following areas and the employer shall so certify:

- Know how to implement the local emergency response plan;
- Understand classification, identification, and verification of known and unknown materials by using advanced survey instruments and equipment;
- Know the state or applicable jurisdictional emergency response plan;
- Be able to select and use proper specialized chemical PPE provided to the hazardous materials specialist;
- Understand in-depth hazard and risk techniques;
- Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available;

- Be able to determine and implement decontamination procedures;
- Have the ability to develop a site safety and control plan;
- Understand chemical, radiological, and toxicological terminology and behavior.

4.7 Decontamination Procedures

4.7.1 When possible, all necessary steps shall be taken to reduce or minimize contact with chemicals and impacted materials while performing field activities (e.g., avoid sitting or leaning on, walking through, dragging equipment over, tracking, or splashing potential or known impacted materials).

4.7.2 All personal decontamination activities shall be performed with an attendant (buddy) to provide assistance to personnel that are performing decontamination activities. An attendant may not be required for Level D equipment removal and decontamination. Depending on specific site hazards, attendants may be required to wear a level of protection that is equal to the required level in the exclusion zone.

4.7.3 All persons and equipment entering the EZ shall be considered contaminated, and thus, shall be properly decontaminated prior to entering the SZ. No equipment, including personal protective equipment or contaminated clothing shall be taken or worn into the SZ.

4.7.4 Decontamination procedures may vary based on site conditions and nature of the contaminant. If chemicals or decontamination solutions are used, care should be taken to minimize reactions between the solutions and contaminated materials. In addition, personnel shall assess the potential exposures created by the decontamination chemical(s) or solutions. The safety data sheets shall be reviewed, implemented, and filed by personnel contacting the chemicals/solutions.

4.7.5 All contaminated personal protective equipment (PPE) and decontamination materials shall be stored and disposed of in accordance with site-specific requirements identified in the approved work plan.

4.7.6 For all Level A and B ensembles, adequate supplied air shall be available to allow the employee to safely complete all necessary decontamination steps.

4.7.7 Where decontamination procedures involving radioactive materials are required, the removable limits for both personnel and equipment will be specified by a Certified Health Physicist or Certified Industrial Hygienist in the project's approved Radiation Protection Plan or approved safety planning document.

4.7.8 Materials Needed to Decontaminate Personnel and/or Equipment

- The equipment required to perform decontamination may vary based on site-specific conditions and nature of the contaminant(s). The following equipment is commonly used for decontamination purposes:
  - Soft-bristle scrub brushes or long-handled brushes to remove contaminants;
  - Hoses, buckets of water or garden sprayers for rinsing;
  - Large plastic/galvanized wash tubs or children's wading pools for washing and rinsing solutions;
  - Large plastic garbage cans or similar containers lined with plastic bags for the storage of contaminated clothing and equipment;
  - Metal or plastic cans or drums for the temporary storage of contaminated liquids;
  - Paper or cloth towels for drying protective clothing and equipment; and
  - Poly or plastic sheeting to lay down and form the base for the CRZ, as well as to contain contaminants and decontamination fluids.

4.7.9 Personal Decontamination Steps

- The decontamination plan shall be in writing and shall specify the exact steps in either wet or dry decontamination or personnel exiting the EZ to the SZ. The decontamination plan shall also address respirator cartridge change out, SCBA bottle changes and equipment decontamination.

4.7.10 Decontamination Steps during a Medical Emergency

- If decontamination can be done:
  - Wash, rinse and/or cut off protective clothing and equipment.
- If decontamination cannot be done:
  - Wrap the victim in blankets, plastic sheeting, or rubber to reduce contamination of other personnel;
  - Alert emergency and offsite medical personnel to potential contamination;
  - Instruct them about specific decontamination procedures if necessary;

4.7.11 Equipment Decontamination Steps

- All equipment leaving the EZ shall be considered contaminated and shall be properly decontaminated to minimize the potential for exposure and off-site migration of impacted materials. Such equipment may include, but is not limited to: sampling tools, heavy equipment, vehicles, PPE (hoses, cylinders, etc.), and various handheld tools;
- All Employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. The level of PPE may be equivalent to the level of protection required in the EZ. Other PPE may include splash protection, such as face-shields and splash suits, and knee protectors. Following equipment decontamination, Employees may be required to follow the proper personal decontamination procedures above;
- For larger equipment, a high-pressure washer may need to be used. Some contaminants require the use of a detergent or chemical solution and scrub brushes to confirm proper decontamination. Personnel operating a high pressure washer will be trained in the operation of the equipment and follow the manufacturer's operational instructions;
- For smaller equipment, use the following steps for decontamination:
  - Remove majority of visible gross contamination in EZ;
  - Wash equipment in decontamination solution with a scrub brush and/or power wash heavy equipment;
  - Rinse equipment;
  - Visually inspect for remaining contamination;
  - Follow appropriate personal decontamination steps outlined above.
- All decontaminated equipment shall be visually inspected for contamination prior to leaving the CRZ. Signs of visible contamination may include an oily sheen, residue or contaminated soils left on the equipment. All equipment with visible signs of contamination shall be discarded or re-decontaminated until clean. Depending on the nature of the contaminant, equipment may have to be analyzed using a wipe method or other means.

4.8 Employee Exposure Monitoring

4.8.1 Explosive levels, oxygen levels, and airborne contaminants may present potential hazards to HAZWOPER personnel working within controlled work areas and to non-HAZWOPER workers and the general public present outside the controlled work areas.

4.8.2 As appropriate, exposure monitoring at HAZWOPER sites will be conducted to determine explosive and oxygen levels, monitor and control employee exposures to airborne contaminants, and to determine and regulate controlled work area boundaries (e.g., support zone, contamination reduction zone, and exclusion zone) for the protection of non-HAZWOPER workers and the general public.

4.8.3 Specific exposure monitoring requirements will be established in individual SH&E Plans. Refer to *S3AM-127-PR1 Exposure Monitoring*. All monitoring efforts using direct reading instruments and will remain part of the project file.

4.8.4 Work Area Exposure Monitoring

- Work area exposure monitoring will include breathing zone readings for the maximum exposed worker(s);
- Results will be used to determine adequacy of PPE (especially respiratory protection). Specific criteria for upgrade/downgrade will be established in the SH&E Plan.

4.8.5 Perimeter Exposure Monitoring

- Perimeter air samples will be collected when the potential exists for airborne contaminants to migrate off-site and will be collected near the work zones when performing work at an active client facility. Refer to *S3AM-127-PR1 Exposure Monitoring*;
- Perimeter exposure monitoring will be conducted at locations downwind from the project activities at a minimum (also upwind if the potential exists for offsite contamination to migrate onto the site).

4.8.6 Exposure results will be posted on site and explained in a safety briefing.

4.8.7 Employees will receive a written statement of results within 15 days of receipt from the laboratory.

4.8.8 Results of all personal exposure monitoring will be provided to the SH&E department for inclusion in the employee medical records, refer to *S3AM-017-PR1 Injury & Illness Recordkeeping***.**

5.0 Records

5.1 All forms and documents generated during a HAZWOPER project will be maintained in the project file.

5.2 All medical screening and surveillance documentation shall be retained for 30 years.

6.0 Attachments

6.1 S3AM-117-ATT1 Spill Notification Number for North America

Americas

Respiratory Protection

S3AM-123-PR1

1.0 Purpose and Scope

1.1 This procedure establishes a written respiratory protection program with the required elements and work site-specific procedures for respirator selection, use, and maintenance for any workplace where respirators are necessary to protect the health of an Employee.

1.2 The primary objective shall be to prevent exposure to atmospheric contaminants as far as feasible by accepted engineering control measures (e.g. enclosure or confinement of the operation, general and local exhaust ventilation [LEV], and substitution of less toxic materials). If respiratory hazards remain, suitable administrative controls and respiratory protective equipment requirements shall be established.

1.3 This procedure applies to all AECOM Americas-based employees and operations, except where local or governmental regulations are more stringent**.**

2.0 Terms and Definitions

2.1 **Action Level (AL)** – An airborne concentration of a potentially toxic or hazardous substance, measured in parts per million by volume (ppm), microgram per cubic meter (µg/m3) milligram per cubic meter (mg/m3) or fibres per cubic centimetre (f/cc), that triggers certain provisions as required by the applicable jurisdictional legislation. In many cases the action level is 50% of the established exposure limit.

2.2 **Air-purifying respirator** – A respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

2.3 **Approved** – Equipment tested and listed by the Bureau of Mines, jointly by the Mining Enforcement and Safety Administration (MESA), and the National Institute for Occupational Safety and Health (NIOSH), or jointly by the Mine Safety and Health Administration (MSHA) and NIOSH. Please note Canadian Standards Association (CSA) bases respirator selection on NIOSH criteria for the testing and certification of respirators.

2.4 **Assigned protection factor (APF)** – The ratio of the ambient concentration of an airborne substance (outside the respirator) to the concentration of the substance inside the respirator.

2.5 **Atmosphere-supplying respirator** – A respirator that supplies the user with breathing air from a source independent of the ambient atmosphere, including supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

2.6 **Breakthrough** – The first perception of an odor, taste or irritation experienced while wearing an air-purifying respirator. Breakthrough is generally an indication that the cartridges are saturated and are no longer filtering out the contaminant. Breakthrough can also be an indication of an improperly functioning respirator.

2.7 **Established Exposure Limit** – The maximum regulatory exposure concentration to which an individual may be exposed to for an 8- hour time weighted average (TWA).

- This limit is referred to by different terminology depending upon the given jurisdiction (e.g. Permissible Exposure Limit (PEL), Contamination Limit, Occupational Exposure Limit (OEL), Threshold Limit Value (TLV), etc.).
- Acceptable methods of adjusting this limit to correspond to a different exposure period (e.g. 10 hours) vary by jurisdiction and substance.

2.8 **Filtering facepiece (dust mask)** – A negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

2.9 **Fit factor** – A quantitative estimate of the fit of a particular respirator to a specific individual, typically estimating the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

2.10 **Fit test** – The use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test [QLFT] and Quantitative fit test [QNFT].)

2.11 **Hazardous atmosphere** – Any atmosphere, either immediately or not immediately dangerous to life or health, that is oxygen-deficient or that contains a toxic or disease-producing contaminant exceeding the legally established permissible exposure limit or, where applicable, the Threshold Limit Value established by the American Conference of Governmental Industrial Hygienists.

2.12 **Immediately dangerous to life or health (IDLH)** – An atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

2.13 **Maximum use concentration (MUC)** – The maximum concentration of an airborne contaminant from which an employee is expected to be protected when wearing a respirator, determined by the assigned protection factor of the respirator or class of respirators and the occupational exposure limit for that contaminant. The MUC is usually determined mathematically by multiplying the assigned protection factor (APF) specified for a respirator by the established exposure limit, which can include a short-term exposure limit and a ceiling limit or any other exposure limit used for that chemical agent, as defined by the authority having jurisdiction.

MUC = APF x established exposure limit

2.14 **Negative pressure respirator (tight fitting)** – A respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

2.15 **Oxygen-deficient atmosphere –** An atmosphere with oxygen content below 19.5 percent by volume.

2.16 **Physician or other licensed health care professional (PLHCP)** – An individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the health care services required by local or governmental respiratory protection standards.

2.17 **Positive pressure respirator** – A respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

2.18 **Powered air-purifying respirator (PAPR)** – An air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

2.19 **Pressure demand respirator** – A positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

2.20 **Qualitative fit test (QLFT)** – A pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

2.21 **Quantitative fit test (QNFT)** – An assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

2.22 **Self-contained breathing apparatus (SCBA)** – An atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

2.23 **Supplied-air respirator (SAR) or airline respirator** – An atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

2.24 **Tight-fitting facepiece** – A respiratory inlet covering that forms a complete seal with the face.

2.25 **User seal check** – An action conducted by the respirator user to determine if the respirator is properly sealed to the face.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-114-PR1 Compressed Gases

3.3 S3AM-128-PR1 Medical Screening & Surveillance

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Respiratory Protection Program Administrator**

The Respiratory Protection Program Administrator will be established at each project/location where employees are required to wear respirators. The Respiratory Protection Program Administrator will:

- Verify full compliance with this procedure.
- Assist with the arranging of any required medical evaluations or any other additional medical attention related to the use of a respirator.
- Perform or arrange suitable providers to perform the program evaluations described in this procedure.
- Maintain required inspections and testing/certifications of SCBA units

4.1.2 **Manager /Supervisor**

- Verify compliance with the respiratory protection program set forth in this procedure.
- Verify that only those employees who are medically qualified, properly trained, and fit tested are assigned to respirator work.
- Verify that respirators are provided, repaired, or replaced as may be required due to wear and deterioration.
- Confirm that the emergency rescue service is available to respond prior to any employees entering the IDLH area.

4.1.3 **SH&E Manager (or designee)**

- Monitor compliance with the various aspects of this program.
- Provide technical assistance regarding respirator selection and use, evaluate the effectiveness of this program, and support respirator training and fit testing (e.g. determine cartridge change out schedule for negative air respirators).
- Audit company compliance with this procedure.

4.1.4 **Employee**

- Use respiratory protection in accordance with instructions and training received.
- Maintain the respirator in accordance with this procedure and the manufacturer's instructions.
- Immediately report any malfunction of the respirator to the Supervisor or Manager or other responsible person.
- For employees who wish to wear respirators on a voluntary basis when not required to by AECOM or a regulatory agency, the employee shall complete *S3AM-123-FM2 – Voluntary Use of Respirators* or an equivalent form.

4.2 Training

4.2.1 Employees who wear respiratory protection shall receive training before they are assigned to a task that requires the use of respiratory protection.

4.2.2 Employees that may be exposed to a respiratory hazard will be instructed on the hazard and the controls prior to beginning work.

4.2.3 Atmospheric testing will be carried out by qualified personnel trained in the use, calibration, and interpretation of the test equipment.

4.2.4 Retraining shall be administered annually, and when the following situations occur:

- Changes in the workplace or the type of respirator render previous training obsolete;
- Inadequacies in the Employee's knowledge or use of the respirator indicate that the Employee has not retained the requisite understanding or skill; or
- Any other situation arises in which retraining appears necessary to verify safe respirator use.

4.2.5 Basic Respirator Training Program

Respirator training classes will include, at a minimum, the following**:**

- Instruction in the nature of the respiratory hazards, whether acute, chronic, or both, and a description of potential health effects if the respirators are not used;
- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;
- The limitations and capabilities of the respirator;
- Proper fitting, including demonstrations and practice in wearing, adjusting, determining the fit of, and performing a user seal check each time respirator is donned. Refer to *S3AM-123-ATT1 Fit Testing Protocol*, *S3AM-123-FM1 Respiratory Equipment Fit Test* and *S3AM-123-ATT2 User Seal Check*;
- How to inspect, put on, use and remove the respirator;
- How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;
- The procedures for maintenance and storage of the respirator;
- How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and
- The general requirements of local or governmental Respiratory Protection Standards.

4.3 Medical Surveillance

4.3.1 No Employee shall be assigned to a task that requires the use of a respirator unless it has been determined that he/she is physically able to perform the work while using the required respirator.

4.3.2 Prior to wearing a respirator and in accordance with the applicable jurisdictional requirements, Employees shall complete medical screening to identify any relevant psychological or physiological impediments to respiratory protection use. Screening may require an initial baseline medical surveillance examination, based on jurisdictional requirements or screening results, performed by a PLHCP in accordance with the requirements of *S3AM-128-PR1 Medical Screening & Surveillance Program.*

4.3.3 Additional medical examinations will be provided to employees who wear respirators when:

- An Employee reports medical signs or symptoms that are related to ability to use a respirator;
- A PLHCP, Supervisor, or the Respiratory Protection Program Administrator determines that an Employee needs to be reevaluated;
- Information from the Respiratory Protection Program, including observations made during fit testing and program evaluation, indicates a need for Employee reevaluation; or
- A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature, etc.) that may result in a substantial increase in the physiological burden placed on an Employee.

4.3.4 All medical surveillance examinations shall be at no cost to the employee and occur during normal working hours; shall be convenient, understandable, and confidential; and the Employee will be given the chance to discuss results with examining physician.

4.4 Respirator Selection

4.4.1 The location or project specific SH&E Plan shall identify applicable respiratory hazards and develop appropriate controls, which may include respiratory protection. If respiratory protection is necessary the SH&E Plan shall detail the requirements.

4.4.2 SH&E Managers or his/her designated representative shall select and provide an appropriate respirator based on:

- The respiratory hazard(s) to which the employee may be exposed, including oxygen deficiency. Identify potential contaminants, concentrations, and the physical state of airborne contaminants:
    - Particulates (dust, fibers, micro-organisms, smoke, fumes).
        - Indicate the presence of any oil in particulate hazards. (may be produced by motor vehicles, air compressor systems using oil lubricators) If unknown, oil shall be assumed to be present.
    - Vapor and gases
        - Gases which may produce an oxygen deficiency (i.e. helium, argon, carbon monoxide and nitrogen).
        - Gases which are acids or produce acids when in contact with moisture (i.e. sulphur oxides, carbon dioxide, hydrogen chloride).
        - Gases which are alkaline or produce alkalis in reaction with moisture (i.e. ammonia, amines, phosphine).
        - True gases or vapors from evaporation of organic liquids (i.e. acetone, toluene, benzene).
        - Metal reacted with an organic compound (i.e. tetra-ethyl lead: was used in leaded fuel and still in aviation fuel, organic phosphates).
        - Mercury vapor.
        - Radon.
- The eye and face hazards to which the employee may be exposed (absorption, irritant, impact).
- Workplace or user factors that may affect respirator performance and reliability.

4.4.3 SH&E Managers or his/her designated representative shall identify and evaluate the respiratory hazard(s) in the workplace. Evaluations shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form.

4.4.4 Respiratory protection is required for those operations in which engineering controls or work practice controls are not feasible to reduce toxic or hazardous substance exposure at or below the AL (or if applicable, established exposure limit).

4.4.5 Where the employee exposure cannot be identified or reasonably estimated, the atmosphere shall be considered IDLH.

4.4.6 Only approved respirators shall be selected and they shall be used in compliance with the conditions of their certification.

4.4.7 Respirators shall be selected from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

4.5 Fit Testing Procedures

4.5.1 After the medical assessment is complete, employees using a tight-fitting respirator shall pass an appropriate QLFT or QNFT prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually (or as required by the applicable jurisdiction) thereafter. Refer to *S3AM-123-ATT1 Fit Testing Protocol*.

4.5.2 Fit testing shall be performed using the same make, model, style and size of respirator the user would be expected to use.

4.5.3 Should the fit test fail, alternative makes, models, styles and sizes shall be tested to find a correct fit for the user.

4.5.4 Respiratory protective equipment shall not be used unless a satisfactory fit test has been achieved for that particular equipment.

4.5.5 Fit testing shall also verify user competency in donning, doffing, inspecting and performing of seal checks.

4.5.6 Additional fit tests will be performed:

- Whenever there is an indication that changes in the Employee's physical condition might have an effect on respirator fit (such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight);
- If the Employee notifies his/her Supervisor or SH&E Manager that the fit of his/her respirator is unacceptable.

4.6 Interference with Facepiece Seal

4.6.1 AECOM shall not permit respirators with tight-fitting facepieces to be worn by Employees who have:

- Facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or
- Any condition that interferes with the face-to-facepiece seal or valve function.

4.6.2 If an employee wears corrective glasses or goggles or other personal protective equipment, the Supervisor or Manager shall confirm that such equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user.

4.6.3 Employees shall perform a user seal check each time they don the respirator. Refer to *S3AM-123-ATT2 User Seal Check Procedures*.

4.7 Specification of Proper Level of Respiratory Protection

4.7.1 The SH&E Manager or his/her designated and qualified representative shall provide guidance on the proper selection and use of all respiratory protective devices, including half-face and full-face air purifying respirators, airline respirators, and self-contained breathing apparatus. This information is generally specified as part of the written site-specific SH&E plan and Task Hazard Assessment (THA).

4.7.2 Employees engaged in activities not covered by a THA or SH&E plan shall stop work and consult with the SH&E Manager or his/her designated representative to determine the proper equipment to use prior to resuming activities. Whenever appropriate, exposure levels will be measured to verify that the actual use conditions are within the limitations of the approvals specified by NIOSH/MSHA for the selected respirator.

4.8 Cartridges

4.8.1 NIOSH certifies three classes of filters*:

Three categories of resistance to filter efficiency degradation:	Three levels of filter efficiency:
N (**N**ot resistant to oil)	95% (called “95”)
R (**R**esistant to oil)	99% (called “99”)
P (oil **P**roof)	99.97% (called “100”)

*Filters are available in any combination of the above.

4.8.2 Generally cartridge color denotes the type of contaminant the cartridge was designed to filter:

Olive:	Multi-contaminant
White:	Acid gas
Black:	Organic vapors
Green:	Ammonia gas
Yellow:	Acid gas and organic vapors
Blue:	Carbon Monoxide
Purple (Magenta):	Radioactive material, except tritium & noble gases
Purple:	Any particulates - P100
Orange:	Any particulates - P95, P99, R95, R99, R100
Teal:	Any particulates free of oil - N95, N99, or N100

Please note; this is only a basic listing and should only be used as a reference. Combinations, deviations or additional types may be encountered. To ensure proper cartridge selection consult the cartridge supplier to ensure applicability to the contaminant(s) anticipated

4.8.3 Filter cartridges shall be changed out whenever an increase in breathing resistance is detected by the user.

4.8.4 When available, chemical cartridges that are equipped with end-of-service life indicators (ESLI) shall be utilized. In those cases, cartridges should be changed when indicated by the ESLI. A buddy system should be used so coworkers can monitor each other’s cartridge color condition.

4.8.5 In the absence of cartridges equipped with an ESLI, employees shall change chemical cartridges on the following schedule:

- Immediately if breakthrough is perceived or if resistance to breathing is detected by the user; and
- In accordance with the change out schedule based upon the anticipated contaminant concentration, environmental conditions, employee work rate, and the specific data provided by manufacturer.

4.8.6 When PAPRs are worn, the same rules apply with the exception that filter cartridges should be changed when airflow through the filter elements decreases to an unacceptable level, as indicated by the manufacturer’s test device.

4.9 Air-Supplying Respirator Use

4.9.1 Air-supplying respirators will be specified for use when it has been determined that any of the following conditions exist:

- The oxygen concentration is less than 19.5 percent;
- The contaminant is unknown or its concentration cannot be quantified;
- The airborne contaminant concentration is above its IDLH;
- An air-purifying respirator canister or cartridge that removes the contaminant is not available;
- The contaminant concentration is above the concentration for which an air-purifying canister or cartridge is approved; or
- The contaminant concentration is above the MUC of a full-face air-purifying respirator.

4.9.2 No Employee may engage in an operation requiring the use of an air-supplied respirator unless the SH&E Manager or his/her designated representative has reviewed the operation and approved its use.

4.9.3 The determination of the type of air-supplying respirator (i.e., SCBA, airline, demand, pressure demand, etc.) appropriate for the job, outside standby persons, communication, proper training and equipment, notification procedures, and necessary action should be part of the THA or SH&E Plan. Mandatory equipment including SCBA or SAR with auxiliary air supply and emergency appropriate retrieval equipment or equivalent rescue means shall be made by the SH&E Manager or his/her designated representative at the time of the THA or SH&E Plan review. The need for any additional precautions (i.e., equipment specific training, on-site health and safety support, etc.) shall also be determined by the SH&E Manager or his/her designated representative.

4.10 Minimum Procedures for IDLH Atmospheres

4.10.1 One Employee or, when needed, more than one Employee shall be located outside the IDLH atmosphere. This employee shall be responsible for communicating with the Employees in the IDLH atmosphere, alerting rescue services if needed, and restricting entrance to the IDLH area by untrained and unapproved persons.

4.10.2 Visual, voice, or signal line communication shall be maintained between the Employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere.

4.10.3 The Employee(s) located outside the IDLH atmosphere shall be trained and equipped to provide effective emergency rescue or to initiate on-site rescue services.

4.10.4 If on-site rescue services are to be used, the Manager or Supervisor shall confirm that the service is available to respond prior to any employees entering the IDLH area.

4.10.5 Employee(s) located outside the IDLH area and/or on-site rescue services shall be equipped with:

- Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either
- Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or
- Equivalent means for rescue where retrieval equipment would create a hazard to the Employees in the IDLH area.

4.11 Breathing Air

4.11.1 Compressed air used for respiration shall be of high purity and shall meet, as a minimum, the requirements of the specification for Grade D breathing air as described in Compressed Gas Association Specification G-7.1 (ANSI Z86.1).

4.11.2 Oxygen shall NOT be used as a source of breathing air at any time in open-circuit SCBAs or airline respirators.

4.11.3 Compressor Supplied Breathing Air

- All compressors used for filling SCBA air cylinders or for supplying airline respirators shall be equipped with the following safety and standby devices:
    - The compressor intake shall be located to verify that only respirable (uncontaminated) air is admitted. This requires attention to the location of the compressor intake with respect to compressor engine exhaust, chemical storage or use areas, and suitable intake screening or filtration.
    - Alarms to indicate compressor failure (such as low-pressure air horns, etc.) shall be installed in the system.
    - A receiver of sufficient capacity to enable the respirator wearer to exit from a contaminated atmosphere shall be provided.
- If an oil-lubricated compressor is used to supply breathing air, it shall be equipped with both of the following devices:
    - A continuous reading carbon monoxide monitoring system set to alarm should the carbon monoxide concentration exceed 10 parts per million; and,
    - A high temperature alarm which will activate when the discharge air exceeds 110 percent of the normal operating temperature in degrees Fahrenheit.
- An in-line purifying filter assembly to remove oil, condensed water, particulates, odors, and organic vapors shall be used in conjunction with the air compressor.

4.11.4 Compressed Air Cylinder Systems for Airline Respirators

- Compressed air cylinders shall meet the requirements of *S3AM-114-PR1 Compressed Gases*.
- Compressed air cylinder systems used to supply airline respirators shall be equipped with low pressure warning bells (e.g., Scott Pak-Alarm) or similar warning devices to indicate air pressure in the manifold below 500 pounds per square inch (psi). When such systems are used, one employee shall be assigned as safety standby within audible range of the low pressure alarm.
- Airline hose couplings shall be incompatible with outlets for other gas systems to prevent inadvertently supplying airline respirators with non-respirable gases or oxygen.
- The air pressure at the hose connection to airline respiratory equipment shall be within the range specified in the approval of the equipment by the manufacturer.
- Routine inspection and maintenance of the air compressor shall be performed.

4.11.5 Compressed Air Cylinder Systems for Recharging SCBAs

- When a cascade system is used to recharge SCBA air cylinders, it shall be equipped with a high-pressure supply hose and coupling rated at a capacity of at least 3,000 psi.

4.11.6 Escape/Egress Units

- Escape/egress unit respirators are intended for use in areas where escape with a short-term (minimum 5 minutes) air supply is necessary. It is important that escape bottle size be provided that will allow the employee to get to a safe location considering breathing rate and distance.
- Escape bottles are required on air-line respirators used in IDLH and high hazard work conditions.
- They may be used as adjuncts to airline pressure demand respirators as a backup air supply or as independent emergency devices in areas where respiratory protection is not normally required.

- Appropriate training shall be conducted and documented prior to assigning Employees to tasks or locations subject to the use of these respirators.
- Escape/egress units (minimum 5 minutes) shall never be used to enter a hazardous atmosphere or as primary standby respirators for confined space entry.

4.12 Respirator Inspection, Cleaning, Maintenance, and Storage

When respirator use is required, only properly cleaned and maintained NIOSH/MSHA approved respirators shall be used.

4.12.1 Inspection

- Respirators should be inspected before and after use using *S3AM-123-FM3 Respiratory Equipment Inspection*, or equivalent. The respirator should not be used and removed and marked out of service if any item on the checklist fails inspection.
- Respirators for emergency use should be inspected once per month.
- Defects shall be reported to their Supervisor or Manager. No defective respirator shall be issued or worn.

4.12.2 Cleaning and Maintenance

- Respirator facepiece assemblies shall be cleaned and sanitized minimally after each day of use in accordance with the requirements specified in *S3AM-123-ATT3 Respirator Cleaning*.
- The respirator should also be inspected for any damaged parts (repair should only be done by trained personnel with the proper tools).
- Respiratory equipment shall not be passed from one person to another until it has been cleaned and sanitized.
- Respiratory equipment shall be maintained according to manufacturer's instructions.
- In field situations, a pre-moistened towelette (e.g., baby wipes) can be used. The mask should then be rinsed with clean warm water and dried. Towelettes or wipes shall be compatible with the respirator materials.
- Alcohol should never be used to clean masks as it can damage the facepieces and rubber parts.
- Where respirators are assigned to individual employees, management shall verify compliance with cleaning and maintenance requirements by periodic inspection and field audits of respiratory equipment.

4.12.3 Storage

- Store clean respirators so that they are protected from dust, excessive moisture, damaging chemicals, temperature extremes and direct sunlight or UV light. They should be placed in a sealed plastic bag and stored in the original box or similar container which blocks light.

4.13 Hygiene

4.13.1 Employees shall leave the work area to wash, change cartridges, or if they detect breakthrough or resistance.

4.14 Costs

4.14.1 The costs for training, medical examinations, fit testing, respirators, spectacle kits, and cleaning materials should be considered as operational costs.

4.15 Program Evaluation

4.15.1 The SH&E Manager or his/her designated representative shall conduct evaluations of the workplace as necessary to verify that the provisions of the current written program are being effectively implemented and that it continues to be effective.

4.15.2 The SH&E Manager shall regularly (i.e., during annual training) consult Employees required to use respirators to assess their views on program effectiveness and to identify any problems. Any problems that are identified during this assessment shall be corrected. Factors to be assessed include but are not limited to:

- Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);
- Appropriate respirator selection for the hazards to which the Employee is exposed;
- Proper respirator use under the workplace conditions the Employee encounters; and
- Proper respirator maintenance.

5.0 Records

5.1 Medical records under this section shall be maintained at a minimum in accordance with *S3AM-128-PR1 Medical Screening & Surveillance.*

5.2 Fit Test Records shall be maintained in the Employee's health and safety records. *S3AM-123-FM1 Respiratory Equipment Fit Test*, or equivalent, will be used to document each fit test.

5.3 Training Records shall be maintained in accordance with *S3AM-003-PR1 SH&E Training***.**

6.0 Attachments

6.1 S3AM-123-ATT1 Fit Testing Protocol

6.2 S3AM-123-ATT2 User Seal Check

6.3 S3AM-123-ATT3 Respirator Cleaning

6.4 S3AM-123-FM1 Respiratory Equipment Fit Test

6.5 S3AM-123-FM2 Voluntary Use of Respirators

6.6 S3AM-123-FM3 Respiratory Equipment Inspection

6.7

Americas

Corrosive & Reactive Materials

S3AM-125-PR1

1.0 Purpose and Scope

1.1 This procedure applies to all AECOM Americas-based employees and operations where corrosive and/or reactive materials are used or stored.

1.2 The purpose of this procedure is to protect employees from the hazards of corrosive and reactive materials. This procedure considers a corrosive material as one that has a pH less than 2.0 (acid), or greater than 12.5 (base). A reactive material is a chemical that may be sensitive to shock, or may react with air or water depending upon its makeup.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 S3AM-115-PR1 Hazardous Materials Communication

3.2 S3AM-116-PR1 Hazardous Materials Shipping

3.3 S3AM-123-PR1 Respiratory Protection

3.4 S3AM-208-PR1 Personal Protective Equipment

4.0 Procedure

4.1 Implementation of this procedure is the responsibility of the Manager directing activities of the facility, site, or project location.

4.2 Appoint a responsible person who will:

4.2.1 Inspect storage areas periodically.

4.2.2 Monitor the quantity of corrosive and reactive materials on site, as well as that of incoming materials.

4.2.3 Review work practices that involve corrosive and reactive materials.

4.3 Require that all employees working with corrosive or reactive materials, or who may be exposed to such materials, are trained in accordance with *S3AM-115-PR1 – Hazardous Materials Communication*.

4.4 Control the use of corrosive and reactive materials by AECOM personnel.

4.4.1 Order only those materials and quantities that are needed to complete a job.

4.4.2 Check incoming corrosive and reactive materials for proper labeling in accordance with *S3AM-115-PR1 Hazardous Materials Communication*.

- Label materials, if needed, as they arrive on site.
- Mark reactive materials containers with the date of receipt of the chemical.

4.4.3 Check incoming corrosive and reactive materials for safety data sheets (SDS). If SDSs are not provided or are already on file, order them from the manufacturer, distributor, or vendor.

4.4.4 Add incoming corrosive and reactive chemicals to the hazardous materials inventory, if not already present, following procedures set forth in *S3AM-115-PR1 Hazardous Materials Communication.*

4.4.5 Do not store any quantity of corrosive or reactive materials in an office (with the exception of limited quantities of consumer products). These materials are to be stored off site, or at an on-site laboratory or storage area.

4.5 Store corrosive and reactive materials as indicted in the MSDS:

4.5.1 In a cool, dry environment, free from extremes of temperature and humidity.

4.5.2 In a manner that separates them from other materials (including flammables and oxidizers) and from each other.

- Separate acids and bases.
- Separate reactive materials from acids and bases, and protect from contact with water.

4.5.3 On materials that are acid-resistant (Teflon-coated, plastic, etc.) for small containers.

4.5.4 Covered, not stacked on one another, on acid-resistant material for carboys (approximately 5 gallons/22 liters).

4.5.5 On individual racks or securely blocked on skids, with closure (plug) facing upward to prevent leakage from drums.

4.6 Require that labeling and signage are in place.

4.6.1 Label containers with the appropriate warning word to indicate the hazard, such as: DANGER; WARNING; CAUTION; CORROSIVE; OXIDIZER.

4.7 Use corrosive and reactive materials appropriately.

4.7.1 Prior to use and in accordance with MSDS, safe-handling procedures shall be developed for each operation, and type and concentration of the chemical. In all cases, review the MSDS and product information before use.

4.7.2 Follow *S3AM-208-PR1 Personal Protective Equipment* when working with or around corrosive and reactive materials. Review the MSDS for the chemical used to determine the specific type of PPE needed, to include at a minimum:

- Chemical-splash goggles
- Chemical-resistant gloves
- Chemical-resistant apron

4.7.3 Obtain medical care immediately in the event of:

- Skin or eye exposure (e.g., splash) to corrosive liquids
- Inhalation of vapors of corrosive liquids that cause respiratory discomfort.

4.7.4 Require an eyewash station to be located in all areas where acids or bases are used. Safety showers shall be nearby if significant acid or base quantities are involved.

- Place emergency eyewashes and showers in accessible locations that require no more than 10 seconds to reach, and are in a travel distance no greater than 25 feet (7.5 meters) from the hazard.
- Keep the areas surrounding eyewashes and safety showers free of stored materials or debris at all times.
- Mark emergency eyewashes and showers with a highly visible sign.
- Require the area around emergency eyewashes and showers to be well lighted and visible.
- Where portable eyewash units are used, a process shall be in place to change the water and clean the unit, as required by the manufacturer's instructions.
- Require emergency showers and shower/eyewash combinations connected to a self-contained water supply to deliver a minimum 20 gallons (85 liters) per minute for 15 minutes.

- Require emergency showers and shower/eyewash combinations permanently connected to a potable water supply to deliver at least 30 gallons (127.5 liters) per minute continuously.
- Require emergency eyewashes to be capable of delivering to the eyes not less than 0.4 gallon (1.5 liters) per minute for 15 minutes.

4.8 Be prepared to clean up spills of corrosive and reactive materials.

4.8.1 Have a written spill response plan in place before materials are stored on site.

4.8.2 Have commercial spill kits available for cleanup of small quantities of materials. At a minimum, kits should contain appropriate protective clothing (including full-body suits, gloves, and boots) and spill control equipment (including absorbents, pillows, shovels, containers, etc.).

4.8.3 Where necessary, confirm that appropriate respiratory protection equipment is provided to spill responders. For additional information, see *S3AM-123-PR1 Respiratory Protection*.

4.8.4 Clean up or respond to spills promptly.

4.8.5 Confirm that personnel responding to a spill have been trained in the hazards associated with the spilled material, as well as use of the spill control equipment, including PPE required for the task.

4.8.6 Do not use combustible organic materials such as sawdust, excelsior, wood chips and shavings, paper, rags, or burlap bags to absorb or clean up spills.

4.9 Develop a waste management plan and procedures, including procedures for collection, storage, labeling, pick-up and transport, and final disposal.

4.10 Dispose of corrosive and reactive materials appropriately.

4.10.1 Segregate organic acids, inorganic acids, and basic wastes.

4.10.2 Contract hazardous waste disposal services should be obtained, as necessary, to dispose of waste materials. All waste shall be appropriately packaged for off-site transportation, if applicable.

4.10.3 Wastes shall be marked, labeled, and shipped in accordance with regulatory requirements. For additional information, see *S3AM-116-PR1 Hazardous Materials Shipping*.

4.11 Inspect corrosive and reactive storage and use areas periodically.

4.11.1 Inspect office, laboratory, and project settings quarterly.

4.11.2 Use the inspection sheet provided as *S3AM-125-FM1 Corrosive & Reactive Materials Inspection* or equivalent, to inspect sites.

5.0 Records

The following information will be maintained in the location or project file:

5.1 Completed Corrosive and Reactive Material Inspection Sheets.

5.2 Worker Right-to-Know training documentation.

5.3 Written Spill Response Plan.

5.4 Waste Management Plan.

5.5 Documentation of training for spill response personnel.

5.6 Documentation of hazard communication training for personnel exposed to corrosive and/or reactive materials.

6.0 Attachments

6.1 S3AM-125-FM1 Corrosive & Reactive Materials Inspection

Americas

Excavation

S3AM-303-PR1

1.0 Purpose and Scope

1.1 To evaluate all excavation operations to provide proper protective systems for employee protection from associated hazards.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

2.0 Terms and Definitions

2.1 **Benching (Benching system)** – One or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels to protect employee from cave-ins.

2.2 **Cave-in (collapse)** – The separation of a mass of soil or rock material from the side of an excavation or the loss of soil from under a trench shield or support system and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

2.3 **Competent person** – Person, who, by way of training, knowledge, and/or experience, is capable of classifying soils and is also capable of identifying existing and predictable hazards in excavation/trenching work area and who has the authority to take prompt corrective measures to eliminate them. The person shall also be familiar with the requirements in the regulation.

2.4 **Excavation** – A manmade cut, cavity, trench, or depression in an earth surface formed by earth removal. Examples include trenches, tunnels, shafts, caissons and open cut holes.

2.5 **Faces (or sides) –** The vertical or inclined earth surfaces formed as a result of excavation work.

2.6 **Failure** – A structural member's integrity and supporti e capabilities is compromised, causing a brea age, displacement, or permanent deformation.

2.7 **Hazardous Atmosphere** – An atmosphere that by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen-deficient, toxic, or otherwise harmful may cause death, illness, or injury.

2.8 **Protective Systems** – Devices or methods in protecting employees in an excavation from cave-ins, a collapse or falling material. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

2.9 **Ramp** – An inclined walking or working surface that is used to gain access to one point from another and is constructed from earth or from structural materials such as steel or wood.

2.10 **Professional Engineer** – A registered engineer who can authorize any state of work by his professional designation. A **Professional Engineer** registered in the State, Province, or territory is deemed to be a registered professional engineer within the meaning of this standard when appro ing designs for manufactured protecti e systems or tabulated data to be used in interstate commerce.

2.11 **Shield (Shield system)** – A structure that is able to withstand the forces imposed on it by a cave-in and thereby protects employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either pre-manufactured or job-built. Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

2.12 **Shoring (Shoring system) –** A structure such as a metal hydraulic, mechanical, or timber shoring system that supports the sides of an excavation and that is designed to prevent cave-ins.

2.13 **Sloping (Sloping system)** – An alternative to shoring is trench sloping. This means that the trench walls are cut back to decrease the possibility of cave-ins. The angle of incline required to prevent a cave-in varies with such factors as soil type, environmental conditions of exposure, and application of surcharge loads.

2.14 **Stable rock** – A natural solid mineral material that can be excavated with vertical side wall; unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against cave-in or movement by rock bolts or by another protective system that has been designed by a **Professional Engineer**.

2.15 **Support system** – A structure such as underpinning, bracing, or shoring that provides support to an adjacent structure, underground installation, or the sides of an excavation.

2.16 **Trench** – An open narrow excavation made below the surface of the ground. In general, the depth is greater than the width, but the width (measured at the bottom) is often not greater than 15 feet (4.57 meters). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.57 meters) or less (measured at the bottom of the excavation), the excavation is also considered a trench.

2.17 **Trench Box –** A trench box is a unit of shoring that is an engineered shoring system capable of protecting workers in case of cave-in of trench walls. The space between the trench wall and the trench box shall be backfilled.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-202-PR1 Competent Person Designation

3.3 S3AM-218-PR1 Permit to Work

3.4 S3AM-322-PR1 Overhead Lines

3.5 S3AM-331-PR1 Underground Utilities

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers**

- Shall confirm that all projects under their direct control or authority and which involve excavations or trenching are conducted in a safe and efficient manner and in accordance with the requirements of this procedure and local legislation.
- Shall confirm that all projects under their direct control or authority have a written Safe Work Plan (SWP)/Health and Safety Plan (HASP) prepared for the activity.
- Confirm the applicable *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* or equivalent has been completed and is reviewed prior to commencing any excavation activities.

4.1.2 **Professional Engineer**

- The professional status and the actual practice of professional engineering is legally defined and protected by law. In some jurisdictions, only licensed engineers (sometimes called registered engineers) are permitted to "practice engineering.
- For the purposes of this procedure, determination of soil condition and the safe management of the shoring, sloping or benching may require consultation, specifications and/or design by a Professional Engineer.

4.1.3 **Competent Person**

- Shall be present during all work that involves entry by AECOM personnel into trenches or excavations greater than 5 feet (1.52 meters) in depth (as above).
- Does not have to be an AECOM employee; however, an AECOM competent person shall be qualified per *S3AM-202-PR1 Competent Person Designation*.
- Shall identify prompt corrective measures to eliminate recognized present or anticipated hazards.
- The competent person shall be identified in the SH&E Plan for the location or project, and the Task Hazard Assessment for the particular task.
- The competent person:
  - Will determine the maximum allowable slope for the walls of the trench or excavation.
  - Will classify the soil in the trench or excavation in accordance with the requirements specified in the applicable legislation prior to determining that a maximum allowable slope, other than 34 degrees with the horizontal is selected.
  - Will inspect the excavation or trench on a daily basis when the potential for employee exposure to the hazards of the trench or excavation exists (*S3AM-303-FM1 Daily Excavation Checklist*).

4.1.4 **Employees**

- Maintain appropriate training for the excavation and the applicable tasks, and competency in the associated procedures (e.g. communication, rescue, etc.) and use of the necessary personal protective equipment (PPE). Refer to *S3AM-003-PR1 SH&E Training* and *S3AM-208-PR1 Personal Protective Equipment.*
- Know the location specific Emergency Response Plan and be able to recognize the potential for real hazards associated with the Excavation.
- Refrain from making any attempt to enter an excavation without approval and first meeting the requirements of this procedure and the applicable SH&E Plan (SWP)/Health and Task Hazard Assessment (THA).

4.2 Restrictions

4.2.1 Because of their inherent dangers, entry into trenches and excavations shall not be performed if there are means other than entry to perform the work. Where entry into trenches and excavations is necessary, strict adherence to the procedures specified below is extremely important. Whenever there are questions regarding the safety of trench or excavation entry, contact shall be made with the Competent Person or the SH&E Manager.

4.2.2 No one shall enter any trench or excavation until the walls have been adequately cut back or temporary protective structures have been installed unless the trench or excavation is shallower than stabilized.

4.2.3 Excavation work shall be completed and inspected in accordance with the written instructions of a qualified professional and in accordance with jurisdictional legislative regulations.

4.3 Excavation and Trenching Permit

4.3.1 If required by the applicable jurisdiction, confirm notification of the proposed excavation is provided within the required timeframe to the appropriate agencies or governing bodies prior to commencing excavation (e.g. California – CAL/ASHA Excavation Permit for the construction of trenches or excavations that are 5 feet (1.5 meters) or deeper that will be entered; Manitoba WHS Branch notification in order to obtain registration number, etc.).

4.3.2 An Excavation and Trenching Permit (*S3AM-303-FM2 Excavation & Trenching Permit* or equivalent) shall be completed prior to all excavation or trenching activities

4.3.3 The Excavation and Trenching Permit shall be completed and signed by all applicable parties as indicated on the permit. The Project Manager shall determine which signatures are required.

4.3.4 Excavation and Trenching Permits may be valid for up to one week; however the permit shall be reviewed at the beginning of each shift.

4.3.5 Refer also to *S3AM-218-PR1 Permit to Work* for additional guidance related to Safe Work Permits.

4.4 Planning and Preparation

4.4.1 Prior to beginning any excavation work at a site, the location of all underground and overhead utilities shall be identified and work locations will be carefully planned to avoid any potential for inadvertent contact with them.

4.4.2 Clearance, including hand exposure, of underground utilities shall be completed in accordance with *S3AM-331-PR1 Underground Utilities*. The associated *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* or equivalent shall be available and reviewed with all employees expected to be involved in the excavation prior to commencing any excavation activities.

4.4.3 Identify any overhead power lines and de-energize or protect by other appropriate means. Refer to *S3AM-322-PR1 Overhead Lines*.

4.5 Excavation Requirements

4.5.1 A Professional Engineer shall be engaged if specified by the applicable jurisdiction and as appropriate to the soil conditions and proposed excavation considerations (e.g. wall slope, shoring requirements, load calculations, etc.).

4.5.2 All personnel involved in the excavation activities shall be appropriately trained to their respective activities and associated hazards. Refer to *S3AM-003-PR1 SH&E Training*.

4.5.3 All personnel involved in the excavation activities shall wear the required PPE, including reflective clothing if mobile equipment or vehicular traffic. Refer to *S3AM-208-PR1 Personal Protective Equipment.*

4.5.4 The Task Hazard Assessment (THA) or Safe Work Plan (SWP) identifying applicable hazards and appropriate control measures shall be completed and clearly communicated to all involved personnel as well as to any concurrent operations potentially affected. The work environment shall be monitored for changing conditions and the THA / SWP updated accordingly.

4.5.5 Excavation shall be conducted in a manner that minimizes environmental impact.

4.5.6 Excavated (spoil) material shall be kept at least 3.2 feet (1 meter) from the edge of the excavation, or further if local regulations are more stringent.

- Excavated (spoil) material shall be piled in a manner to prevent sloughing of loose material. Various jurisdictions provide specific spoil pile sloping requirements.

4.5.7 If the walls of an excavation or trench are not sloped or cutback, barriers shall be placed around the perimeter. The barrier shall be at least 3.6 feet (1.10 meters) in height.

4.5.8 If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations shall be monitored regularly to confirm proper operation.

4.5.9 If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Excavations subject to runoff from heavy rains will require regular inspections.

4.5.10 All excavations shall be appropriately secured at the end of the day to prevent unauthorized entry or inadvertent entry into the excavation. This may require a protective covering, barriers, fencing, signage or other measures appropriate to the excavation and associated conditions.

4.5.11 Backfill trenches as soon as reasonably possible after work is complete.

4.6 Soils Classifications

4.6.1 Soil classification shall be conducted to confirm appropriate measures are taken to protect workers and to secure excavation walls. Measures may include, but are not limited to:

- Sloping, shoring or shielding.
- Relocation of equipment or materials.
- Scheduling to minimize concurrent operations.

4.6.2 Soil characteristics evaluated when classifying include, but are not limited to:

- Cohesiveness / compaction / compressive strengths (e.g. fissured, hardpan, fractured rock, etc.).
- Composition (sand, clay, gravel, layered, etc.).
- Moisture content / submersion.
- Compaction.
- Exposure to vibration (e.g. traffic, pile driving, etc.).
- Previous disturbances.

4.6.3 Consult the applicable jurisdictional requirements as classification methods, definitions and terms can vary. In general classifications or types include:

- Stable soil that is dense and heavy and consists primarily of clay.
- Soil with a medium level of stability and generally includes soils such as silt, sandy loam, and medium clay.
- Unstable soil which generally includes gravel, loamy sand, and soft clay.

4.7 Protective System Requirements

4.7.1 Protective systems shall be used to protect workers entering an excavation when there is a potential for cave in, and is required when:

- An excavation is greater than 4 feet (1.22 meters) in depth and is not entirely in stable rock.
- A worker is required to be closer to a trench wall than the height of the trench wall.
- A worker will approach closer to the side or edge of the excavation that the distance equal to the depth of the excavation.

4.7.2 The protective system may include sloping the excavation walls, shoring the excavation walls, and/or installing a shielding system. The protective system(s) chosen shall have the capacity to resist, without failure, all loads to be applied to the system.

4.7.3 Slope angle, or type of shoring or shielding shall be determined by:

- Soil classification – including structure, strength, moisture content.
- Depth of the excavation
- Weather and environmental conditions.
- Anticipated duration of excavation activities.
- Loading of soil and soil stress (e.g. proximity of structures, location of equipment, stored material, anticipated vibration, etc.)

Factor	Description / Examples
Soil Structure and Strength	Proper classification of soil is necessary in order to select appropriate protection methods. Trench walls, at first glance, may appear to have strength, particularly if rock is encountered. Fractures in the rock can develop because of construction and soil strength may fail when subjected to undercutting or high-energy impacts. Irregular slopes on stratified soils that appear stable can fail if lower materials do not have adequate strength.
Excavation Depth	Jurisdictional requirements may specify the type of protective methods that are required at given depths. Additionally, consultation of a professional engineer may be necessary.
Soil Moisture Content	Soil may be moist even though the weather has been dry. Care shall be taken and appropriate protection methods employed if the soil appears to be moist.
Weather and Humidity	These can have a significant impact on excavation wall stability and effectiveness of protection methods. Frozen stable soil may collapse if warm mild weather persists. Percolation of water into the soil can increase the load on shoring due to the increased weight and mobility of saturated soils. Frozen ground does not preclude the need to appropriately slope, shore or shield unless the freezing process is designed and approved by a Professional Engineer.
Loading and Soil Stress	Stress can originate from many sources. Heavy machinery passing close to the excavation creates vibrations that decrease the soil strength and can result in wall collapse or shoring failure if it is inadequate to these conditions. Stationary equipment at the edges of the excavation can transmit loads and additional stresses to the excavation wall and method of protection.
Trench Depth and Width	These directly influence the choice of materials and the spacing of support bracing. The shoring requirements of a wide and deep trench differ substantially from those of a narrower trench.
Erosion Time	If excavations are to be left for extended periods, different methods of protection may be required and shoring materials may have to be increased.

4.7.4 If an excavation may affect the stability of an adjacent building or structure, precautions shall be taken to prevent damage to the structure. The precautions shall be specified in writing by a Professional Engineer.

4.7.5 All sloping, shielding, or shoring shall be conducted in accordance with applicable Federal, State, Provincial, Territorial or Legislative regulations.

4.7.6 Exceptions. Each individual in an excavation shall be protected from cave-ins and trench collapse by an adequate protective system except when:

- Excavations are made entirely in stable rock.
- Excavations are less than 4 feet (1.22 meters) in depth and an examination of the excavation by a Competent Person reveals no indication of a potential cave-in.

4.7.7 The depth of the excavation or trench is to be measured at its greatest vertical dimension. Be aware that crouching or kneeling in a trench that is less than 3 feet (0.91 meter) in depth may still pose significant hazard for the employee involved.

4.7.8 onsult the applicable urisdiction's requirements concerning the standards that protective systems shall meet; this may include design and certification by a Professional Engineer.

4.7.9 A Professional Engineer can properly assess the need for and the type of shoring required for specific applications. Shoring may not be needed in all cases, but failure to recognize the need for shoring can be catastrophic.

4.8 Use of Sloping as a Means of Protection

4.8.1 Sloping the walls of the trench or excavation is the preferred, and typically simplest, means of protecting employees who shall enter trenches or excavations which are greater than 4 feet (1.22 meters) in depth or where there is danger of collapse.

4.8.2 If sloping is used as the means of protection, the trench or excavation walls shall be sloped back so that the ratio of the horizontal distance to the vertical rise (H:V ratio) of the sloped wall or degree from horizontal is appropriate to the soil type and in compliance with jurisdictional requirements.

4.8.3 In many cases, determining the maximum allowable slope may allow the use of a steeper slope, which will result in a narrower excavation. However, determination of soil classification is complicated and requires that the Competent Person be familiar with the manual and visual tests. Since incorrect soil classification may result in the use of a steeper, and potentially unsafe, slope, it

is recommended that an angle of 34 degrees (or less given specific jurisdictional requirements and unstable soil types) with the horizontal typically be selected.

4.9 Use of Shoring or Shielding as a Means of Protection

4.9.1 Where sloping the walls of the trench or excavation is unfeasible (e.g., when there are dimensional constraints or adjacent structures), the use of shoring or shield systems (e.g., trench boxes) may be necessary.

4.9.2 Soil classification is required. The excavation shall comply with one of the four options below:

- The soil shall be classified and the timber shoring be constructed in accordance with applicable legislative regulations.
- Other protective systems meeting applicable legislative regulations shall be utilized (e.g., shield systems, trench jacks, aluminum hydraulic shoring, etc.) and the manufacturer's data shall be explicitly followed.
- A protective system meeting applicable legislative regulations shall be utilized based on tabulated data which has been approved by a Professional Engineer.
- A protective system meeting applicable jurisdictional requirements and designed by a Professional Engineer shall be utilized and installed in accordance with the engineer’s written plans.

4.9.3 In all cases listed above, the SH&E Manager shall be contacted before proceeding.

4.9.4 Workers shall be protected whenever shoring is being installed or removed.

4.9.5 Shoring, stringers or bracing shall be installed from the top of the trench or excavation down. Removal shall be completed from the bottom up unless conditions exist that would make doing so unsafe. A removal method shall be developed that does not require worker entry.

4.9.6 Check hydraulic shoring once per shift at a minimum (leaking hoses and/or cylinders, broken connections, cracked nipples, bent bases, other damaged or defective parts) and more frequently as required.

4.9.7 Hydraulic or pneumatic trench jacks shall have a means of ensuring that they will not collapse in the event of loss of internal pressure.

4.9.8 Shielding and Trench Boxes differ from shoring in that their design is intended primarily to protect workers from cave-ins and similar incidents. They may be used in combination with sloping and benching.

- The excavated area between the outside of the trench box and the face of the trench should be as small as possible and may be backfilled to prevent lateral movement of the shield.
- The box shall extend at least 18 inches (0.45m) above the surrounding area, or as specified by the applicable jurisdiction, if there is sloping toward excavation. This can be accomplished by providing a benched area adjacent to the box.
- Earth excavation below the shield is permitted only if:
  - The excavation does not exceed a depth of 2ft (0.61m) below the shield,
  - The shield is capable of withstanding the forces calculated for the full depth of the trench, and
  - There are no indications while the trench is open of possible loss of soil from behind or below the bottom of the support system.
- A shield shall not be subjected to loads exceeding those for which it was designed to withstand.

4.9.9 Bell-bottom pier holes that are to be entered by workers shall be designed and supported according to written instructions of a registered professional engineer.

- Employees entering bell-bottom pier holes, or other similar deep and confined footing excavations, should wear a harness with a retrieval line securely attached to it.
    - Retrieval lines shall not be used to handle materials.
    - Rescue equipment shall be individually attended at all times while the employee wearing the retrieval line is in the excavation.

4.10 Work Around the Trench/Excavation

4.10.1 Structural ramps used for excavation access or egress of equipment shall be constructed in accordance with jurisdictional requirements and the instructions or designs of an individual competent and qualified in structural design.

4.10.2 If the ramp has an open side, it shall have a curb or a restraining device.

4.10.3 Confirm equipment placement does not compromise the integrity of the excavation wall and optimizes visibility of work zone and any contact hazards (spoil placement should also take these into consideration). Use wheel chocking or barricades as necessary to prevent encroachment of edge.

4.10.4 If the appropriate setback of equipment is not possible confirm appropriate blocking or matting is used to disperse weight. These requirements may need to be determined by a professional engineer.

4.10.5 While workers are in a trench, an aboveground observer or spotter shall be present to warn of earth movements and to advise equipment operators of the presence and location of those in the trench so as to avoid vibrating equipment near trenches or excavations.

4.10.6 If there is a danger of a worker or equipment falling into an excavation, or whenever the edge is not clearly visible, identify the trench or excavation perimeter with visual markers (e.g., barricade tape, wooden railings, stop logs, etc). If the trench or excavation is 4 feet (1.22 meters) or greater in depth, the visual barrier shall be a minimum of 6 feet (1.83 meters) from the edge.

4.10.7 Personnel shall notify workers of the excavation through flagging, marking, safeguards, or other appropriate and effective means.

4.10.8 If walkways are permitted over excavations or trenches (e.g. trench over 6 feet [1.8 meters] in depth and wider than 30 inches [76 centimeters]), the installation shall be in such a manner as to not compromise the stability of the excavation.

4.10.9 Walkways shall be equipped with guardrails and constructed in accordance with jurisdictional requirements.

4.10.10 If vehicle crossings over excavations are required, they shall be designed by and installed under the direction of a Professional Engineer.

4.10.11 Precautions shall be taken to isolate or remove loose rocks, trees, or other materials that may slide, roll, or fall into the trench and onto workers prior to entry by workers into an excavation.

4.10.12 While operating heavy equipment in the work area, the equipment operator shall maintain communication with a designated signal person through either direct voice contact or approved standard hand signals.

4.10.13 When mobile equipment is operated adjacent to an excavation or when such equipment is required to approach the edge of an excavation and the operator does not have a clear and direct view of the edge of the excavation, a warning system such as barricades, hand or mechanical signals, or stop logs shall be used. If possible, the grade should be away from the excavation.

4.10.14 All site personnel should maintain a safe distance and remain clear of the swing of operating excavation equipment.

4.10.15 Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles

being loaded or unloaded when the vehicles are equipped to provide adequate protection for the operator during loading and unloading operations.

4.10.16 All materials such as pipe, rebar, etc., shall be kept out of traffic lanes and access ways. Materials and equipment shall be stored in a designated area so as not to endanger personnel at any time.

4.10.17 A flagman with roadwork, signs, cones, and high-level warning signs shall be provided when it is necessary to control normal vehicular traffic due to vehicles, such as end-dumps, entering, or leaving the site.

4.11 Work Within the Trench/Excavation

4.11.1 Personnel shall not be permitted on the faces of sloped or benched excavations at levels above other workers unless those workers at lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment.

4.11.2 Employees shall not work in excavations in which there is accumulated water or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and retrieval line.

4.11.3 A stairway, ladder, ramp, or other safe means of egress shall be located in excavations or trenches that are 4 feet (1.22 meters) or more in depth so as to minimize lateral travel for employees. Jurisdictional maximum lateral travel distances vary between 25 feet (7.6 meters) and 49 feet (15 meters). In the absence of jurisdictional specification, travel distance shall not exceed 25 feet (7.6 meters). Ladders should extend at least 3 feet (0.91 meters) above the trench top.

4.11.4 Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person. Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design and shall be constructed in accordance with the design.

4.11.5 Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent displacement. Structural members used for ramps and runways shall be of uniform thickness. Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping. Structural ramps used in lieu of steps shall be provided with cleats or other surface treatments on the top surface to prevent slipping.

4.12 Confined Spaces and Hazardous Atmospheres

4.12.1 An excavation may contain hazardous gases, vapors, dusts, fumes or an oxygen deficient or enriched atmosphere.

- To prevent exposure to harmful levels of atmospheric contaminants, the hazard assessment shall evaluate atmospheric hazards when workers are required to enter trenches and excavations:
    - Greater than 4 feet (1.22 meters) in depth in which a hazardous atmosphere exists, or could reasonably be expected to exist, such as in excavations in landfill areas, where equipment is exhausting nearby, or where hazardous substances are stored nearby.
    - Less than 4 feet (1.22 meters) in depth if workers could be exposed to a hazardous atmosphere (e.g. crouching).
- Appropriate atmospheric testing is necessary to accurately identify these hazards. Ongoing atmospheric monitoring, use of attendants and rescue equipment may be necessary to address the identified hazards.

4.12.2 Confined spaces may exist in excavations where there is limited access or egress and in which a hazardous gas, vapor, dust, or fume or an oxygen-deficient atmosphere may occur. Confined

space entry shall be performed in accordance with the requirements specified in *S3AM-301-PR1 Confined Spaces*. Consult the applicable jurisdictional requirements as the excavation may or may not be subject to confined space requirements.

4.12.3 Adequate precautions, such as mechanical ventilation or appropriate respiratory protection, shall be taken prior to entry into trenches and excavations in which hazardous atmospheres exist or could reasonably be expected to exist.

4.12.4 When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted as often as necessary to confirm that the atmosphere remains safe. Atmospheric testing will be conducted in the anticipated breathing zone of the work area to determine oxygen content, combustible gas, and toxic gases and vapors, if applicable.

4.12.5 Appropriate respiratory protection shall be donned prior to entry into any trench or excavation in which airborne levels of toxic substances are present at concentrations in excess of their Threshold Limit Value/Occupational Exposure Limit or Permissible Exposure Limit.

4.12.6 Confirm appropriate emergency response measures are in place as necessary, including but not limited to:

- Location Specific Emergency Response Plan shall include procedures applicable to the potential emergencies the excavation work may present.
- Communication methods shall be established.
- Equipment such as spill kits, breathing apparatus, and retrieval equipment, shall be readily available.
- Where hazardous atmospheres are present rescue equipment shall be attended when workers have entered the excavation.

4.13 Stability of Adjacent Structures

4.13.1 Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to confirm the stability of such structures for the protection of employees.

4.13.2 Excavation below the level of the base or footing of any foundation or retaining wall that could reasonably be expected to pose a hazard to employees shall not be permitted except when:

- A support system, such as underpinning, is provided to confirm the safety of employees and the stability of the structure; or
- The excavation is in stable rock; or
- A Professional Engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity; or
- A Professional Engineer has approved the determination that such excavation work will not pose a hazard to employees.

4.13.3 In addition, sidewalks, pavements, and secondary structures shall not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

4.14 Inspections

4.14.1 Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a Competent Person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. Refer to *S3AM-303-FM1 Daily Excavation Checklist.*

4.14.2 An inspection shall be conducted by the Competent Person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard-

increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.

4.14.3 Where the Competent Person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to confirm their safety and the permit reissued or revised.

4.15 Backfilling

4.15.1 Perform any required notifications within the necessary timeframes prior to backfilling.

4.15.2 Confirm accurate classification of soil types of backfill material and absence of signs of contamination, discoloration and smell.

4.15.3 Confirm the re-establishment of the original soil integrity using the original material (if suitable) or designated fill material(s). A small cap of material on top of the ditch/hole should be left to allow for sloughing and settling of material.

4.15.4 Backfilling shall be done with care to prevent damage to any exposed utilities or facilities.

4.15.5 A spotter may be necessary to avoid encroachment (e.g. working around other equipment, traveling under overhead lines, working in close conjunction to underground facilities and other workers, compromised line of vision) and to watch for any rocks falling into the excavation, which may damage exposed facilities. If fill contains rocks or hard material, a shield or alternate fill material may be used to protect the facilities

4.15.6 Confirm piping or facilities are properly supported prior to backfilling.

4.15.7 If shoring was used, remove from the bottom up.

4.15.8 If a trench box has been used it should be placed no more than abo e the base of the excavation or a sub-trench bed containing the pipe.

4.15.9 Appropriate measures shall be taken to confirm proper backfilling and compaction of the soil below the trench box. Removing and reinserting the trench box multiple times may be necessary to accomplish this.

4.15.10 Dragging of a trench box shall only be permitted if it will not damage facility or disturb the backfill, otherwise it shall be lifted vertically. No worker shall occupy a trench box while it is being moved.

4.15.11 If compaction is required confirm the appropriate method is employed and compaction testing is conducted in a manner that does not damage any facilities or pipelines in the excavation.

4.15.12 Final grading and cover of the ground disturbance should confirm corrosion control. Original state of the area and access shall be considered in completion of backfilling.

4.15.13 Any excess excavation material shall be properly disposed of.

5.0 Records

5.1 Completed Daily Excavation Checklist, Permits and applicable notifications shall be retained in the project files for +1 year.

6.0 Attachments

6.1 S3AM-303-FM1 Daily Excavation Checklist

6.2 S3AM-303-FM2 Excavation & Trenching Permit

Americas

Heavy Equipment

S3AM-309-PR1

1.0 Purpose and Scope

1.1 Outline the safe working requirements for working with and near heavy equipment and heavy equipment operation.

1.2 Military related vehicles and equipment (e.g. tanks) are not covered under this standard.

1.3 This procedure applies to all AECOM Americas-based employees and operations.

2.0 Terms and Definitions

2.1 **Heavy equipment** –All excavating equipment (e.g. scrapers, loaders, crawler or wheel tractors, excavators, backhoes, bulldozers, graders, agricultural and industrial tractors, etc.), cranes, lift trucks, drills, etc. This may include off-highway trucks (e.g. dump truck, heavy haul truck, etc.). For requirements related to crew trucks refer to *S3AM-005-PR1 Driving*.

2.2 **Operator** – Any person who operates the controls while the heavy equipment is in motion or the engine is running.

2.3 **Ground personnel/workers** – Personnel performing work on the ground around heavy equipment (note: operators are considered ground personnel when outside of the equipment cab).

3.0 References

3.1 S3AM-005-PR1 Driving

3.2 S3AM-202-PR1 Competent Person Designation

3.3 S3AM-213-PR1 Subcontractor Management

3.4 S3AM-303-PR1 Excavation

3.5 S3AM-322-PR1 Overhead Lines

3.6 S3AM-325-PR1 Lockout Tagout

3.7 S3AM-331-PR1 Underground Utilities & Subsurface Installation Clearance

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers / Supervisors**

- Responsible for confirming all equipment is in good working order and all equipment operators are verified as qualified on the piece of machinery they are assigned.
- As applicable, review as-built drawings.
- Maintain operation manuals at the site for each piece of equipment that is present on the site and in use.
- Maintain a list of operators for the project, and the specific equipment that they are authorized to operate.
- Prohibit equipment from being operated by any personnel who have not been specifically authorized to operate it.

- Confirm an equipment maintenance inventory is maintained, schedules adhered to and appropriate inspections of equipment are conducted.
- Confirm subcontractors are properly pre-qualified in accordance with *S3AM-213-PR1 Subcontractor Management.*
- Require that subcontractor employees follow established safety procedures in operation, inspection, and maintenance of vehicles and equipment.
- Inform AECOM and subcontractor machinery operators about applicable local regulations restricting the consecutive minutes of engine idling time allowed.
- Confirm subcontractor machinery and mechanized equipment is approved for use in accordance with the requirements of *S3AM-309-FM1 Approval of Machinery & Mechanized Equipment*.
- Confirm that all rented equipment bears any required current certification marks and arrives in proper wor ing order with the manufacturer's operating manual before acceptance from the supplier.
- Confirm that AECOM and subcontractor machinery and mechanized equipment is certified, as applicable, in accordance with manufacturer specifications and/or regulatory requirements.
- isually obser e the subcontractors' ehicles and equipment, for any unsafe conditions or practices. Equipment or operation not in compliance with applicable safety standards is prohibited.

4.1.2 **Employees / Ground Personnel**

- Confirm that all rented equipment arri es in proper wor ing order with the manufacturer's operating manual before acceptance from the supplier.
- Ground personnel when working in the vicinity of heavy equipment shall have received training, and comply with the applicable rules of engagement.

4.1.3 **Operators (of heavy equipment)**

- Operate the equipment safely, maintain full control of the equipment, and comply with manufacturer's operation manual and the laws governing the operation of the equipment.
- Inspect equipment and immediately report defects and conditions affecting the safe operation of the equipment to the appropriate Supervisor.
- Trainees may operate equipment in accordance with jurisdictional requirements and under the direct supervision of a trainer.

4.2 Communication

4.2.1 Communication between site Managers / Supervisors, heavy equipment Operators, and site Employees / Ground Personnel is a key method of preventing serious injury or death during heavy equipment operations.

4.2.2 Managers shall confirm the Industrial site or project specific SH&E Plan is developed and communicated to all affected and involved employees. Refer to *S3AM-209-PR1 Risk Assessment & Management*.

4.2.3 Task Hazard Assessments and Daily Tailgate meetings shall be conducted in accordance with *S3AM-209-PR1 Risk Assessment & Management.*

4.2.4 Concerning worksites in which other employers control concurrent operations and SH&E issues related to the worksite, the manager shall coordinate with those conducting concurrent operations to confirm appropriate control measures are in place to protect employees from the hazards associated with activities to be performed.

- Coordination shall occur prior to work commencing, periodically thereafter, and as necessary given changes in scope and/or working conditions.
- Affected employees (including managers and supervisors) shall seek to participate in all site SH&E meetings related to concurrent operations.

4.2.5 The following points outline the communication requirements during heavy equipment operations:

- Site Supervisors/t Managers shall confirm that all operators are notified/informed of when, where, and how many ground personnel will be working on site.
- Site Supervisors/ Managers shall inform all ground personnel before changes are made in the locations of designated work areas.
- Prior to work initiating on site, the Site Supervisor/ Manager is to confirm all operators and ground personnel are trained on the hand signals that will be used to communicate between operators and ground personnel.
- Ground Personnel working around heavy equipment operations are to maintain eye contact with operators to the greatest extent possible (always face equipment). Never approach equipment from a blind spot or angle.
- All heavy equipment whose backup view can be obstructed shall be equipped with reverse warning devices (e.g., backup alarms) that can be significantly heard over equipment and other background noise. Reverse signaling lights shall be in working order.
- When feasible, two-way radios shall be used to verify the location of nearby ground personnel.
- When an operator cannot adequately survey the working or traveling zone, a signal person shall use a standard set of hand signals to provide directions. Flags or other high visibility devices may be used to highlight these signals.

4.3 Ground Personnel

4.3.1 Ground clearance around heavy equipment may significantly reduce hazards posed during heavy equipment operations.

4.3.2 The following points outline the clearance requirements during heavy equipment operations:

- Ground Personnel shall always yield to heavy equipment.
- Ground Personnel shall maintain a suitable buffer area of clearance from all active heavy equipment.
- A task hazard assessment that identifies any special precautions shall be completed and communicated to all AECOM personnel associated with or affected by the activity.
- Site Supervisors/ Managers shall designate areas of heavy equipment operation and confirm that all ground personnel are aware of designated areas.
    - Designated areas shall include work zone boundaries and travel routes for heavy equipment.
    - Travel routes shall be set up to reduce crossing of heavy equipment paths and to keep heavy equipment away from ground personnel.
    - Work zone boundaries shall consider line of fire hazards related to the equipment and associated activities. Refer also to *S3AM-309-ATT2 Operator Line of Sight.*
    - If working near heavy equipment, Ground Personnel shall stay clear of loads to be lifted or suspended loads, and out of the travel and swing areas (excavators, all-terrain forklifts, hoists, etc.) of all heavy equipment.
    - During winch use, all swampers or other personnel will remain outside the whip area of the winch line or tow cable.

- At a minimum, employees shall maintain a distance of at least two pile lengths from where piles are being cut and dropped, other than in situations where cut piles are being guided to the ground utilizing mechanical means (e.g., pile driver and shackle) to control the direction and speed of fall of the cut pile.

- When feasible, Site Supervisors/ Managers shall set up physical barriers (e.g., caution tape, orange cones, concrete jersey barriers) around designated areas and confirm that unauthorized ground personnel do not enter such areas.
- Operators shall stop work whenever unauthorized personnel or equipment enter the designated area and only resume when the area has been cleared.
- Operators shall only move equipment when aware of the location of all workers and when the travel path is clear.
- Ground Personnel shall never stand between two pieces of operating heavy equipment or other objects (e.g., steel support beams, trees, buildings, etc.).
- Ground Personnel shall never stand directly below heavy equipment located on higher ground unless it can be verified ground stability is not a factor and grade of slope is such that it would not contribute to equipment tip-over.
- Ground Personnel may only enter the swing area, work area or path of travel of any operating equipment when:
  - hey ha e attracted the operator's attention and established eye contact, and
  - The operator has idled the equipment down, placed it in neutral, grounded engaging tools, set brakes and communicated entry is permitted.
- Employees shall keep all extremities, hair, tools, and loose clothing away from pinch points and other moving parts on heavy equipment.
- Employees shall not talk, text, or otherwise use a cell phone while standing or walking on a roadway or other heavy equipment path.

4.3.3 At a minimum, all Ground Personnel and Operators outside of heavy equipment shall wear the following:

- High visibility safety vest (fluorescent background material and retro-reflective striping) meeting jurisdictional requirements that is visible from all angles.
  - Background material: should be fluorescent yellow-green, fluorescent orange-red or fluorescent red.
  - Combined-performance retro-reflective material (e.g. the stripes): should be fluorescent yellow-green, fluorescent orange-red or fluorescent red - and shall be in contrast (that is, have a distinct color difference) to the background material.
  - Hazards may require high visibility garments that cover torso, legs and arms.
  - Confirm that vest is not faded or covered with outer garments, dirt, etc.
- American National Standards Institute/Canadian Standards Association- (ANSI/CSA-) approved hard hat
- ANSI/CSA-approved safety glasses with side shields
- At a minimum, CSA or ASTM approved, high-cut min. , puncture, impact and compression resistant footwear.
- ANSI/CSA-approved hearing protection as needed
- Appropriate work clothes (e.g., full-length jeans/trousers and a sleeved shirt; no tank, crew tops or other loose clothing permitted).

4.4 Prior to work commencing

4.4.1 All heavy equipment will be inspected pre-shift and then regularly as required with the details of the inspection recorded in a log book.

- Roll-over protection systems (ROPS) and appropriate overhead protection (Fall Object Protection FOP) shall be in place given the specific equipment requirements. Utilize equipment with enclosed cabs where feasible or accessible.
    - Where use of equipment with enclosed cabs is not feasible or said equipment is not accessible, operators shall use any additional personal protective equipment determined as necessary (e.g. goggles, additional hearing protection, etc.).
- Equipment operated in hazardous atmosphere environments shall be equipped with the proper safety equipment (e.g., spark arrestors, positive air shut off, etc.).
- peration of equipment that has or had cab glass per the manufacturer's specifications that is crac ed bro en obstructing the operator's iew or missing is prohibited.
- A locking device shall be provided that will prevent the accidental separation of towed and towing vehicles on every fifth-wheel mechanism and two-bar arrangement.
- Trip handles for tailgates of dump trucks and heavy equipment shall be arranged so that when dumping, the operator will be in the clear.
- The Operator will report defects and conditions affecting the safe operation of the equipment to the Site Supervisor or employer. Any repair or adjustment necessary for the safe operation of the equipment will be made before the equipment is used.
- Exposed moving parts on heavy equipment (belts, gears, shafts, pulleys, sprockets, spindles, drums, fan belts, flywheels, chains, or other reciprocating, rotating or moving parts) which are a hazard to the operator or to other workers will be guarded.
    - If a part will be exposed for proper function it will be guarded as much as is practicable consistent with the intended function of the component.

4.4.2 An approved 4A40BC fire extinguisher shall be present on all heavy equipment. An approved 4A40BC fire extinguisher of appropriate rating shall be present and readily accessible on all heavy equipment.

- Fire extinguishers shall be inspected by the operator prior to heavy equipment operation each shift. Monthly and annual inspections shall be documented.

4.4.3 All Operators shall inspect the area adjacent to the machine prior to starting.

- Evaluate ground conditions, concurrent operations and obstructions to identify approved routes of travel and work areas.
- As applicable, check that there is sufficient swing room and that the outriggers are adequately supported on solid and stable ground

4.4.4 Managers / Supervisors shall inform the operators of the equipment that AECOM employees are in the area and inquire if there are any restricted areas or specific rules or requirements. In some industrial facilities, heavy equipment has the right of way'.

4.4.5 Where the Operator will not have a full view of the path of travel, a signal person will be used on the ground that has a full view of the load, the operator, and the path.

4.4.6 All heavy equipment with limited visibility (operator cannot directly or by mirror or other effective device see immediately behind the machine) operated around workers or on a construction site:

- Shall have an audible back-up alarm installed that functions automatically when the vehicle or equipment is put into rear motion.

- All bi-directional equipment shall be equipped with a horn, distinguishable from the surrounding noise level, which shall be operated as needed when the machine is moving in either direction.
- Backing up or movement in both directions for bidirectional equipment shall occur only when a signal person communicates that it is safe to do so if alarms or horns are not feasible.

4.5 Operation

4.5.1 The Operator of heavy equipment is the only worker permitted to ride the equipment unless the equipment is equipped by the manufacturer for passengers. Manufacturer operator's manual shall be complied with.

4.5.2 A person will not operate heavy equipment unless the person has received adequate instruction and training in the safe use of the equipment, and has demonstrated to a qualified supervisor or instructor competency in operating the equipment.

- Oilers, apprentices, and other operators will not be allowed to operate equipment unless authorized by the Manager.

4.5.3 The Operator of heavy equipment will operate the equipment safely, maintain full control of the equipment, and comply with the manufacturer's operator manual and the laws go erning the operation of the equipment.

- Operation of company-owned, leased, or rented vehicles or equipment while under the influence of alcohol or illegal drugs or otherwise impaired is prohibited.
- Do not operate any equipment beyond its safe load or operational limits.
- Operator shall not talk on, text, or otherwise use mobile phones while operating heavy equipment.
- Never use bucket teeth or boom for lifting or moving heavy objects.

4.5.4 When heavy equipment is used for lifting or hoisting or similar operations there shall be a permanently affixed notation stating the safe working load capacity of the equipment and the notation shall be kept legible and clearly visible to the operator.

4.5.5 A Supervisor or Manager will not knowingly operate or permit a worker to operate heavy equipment which is, or could create, an undue hazard to the health or safety of any person. Where compliance is refused, the Manager or his or her designate should be notified immediately.

4.5.6 The Operator of heavy equipment will not leave the controls unattended unless the equipment has been secured against inadvertent movement.

- The Operator is not to leave suspended load, machine or part or extension unattended, unless it has been immobilized and secured against inadvertent movement.
- Turn off heavy equipment, place gear in neutral and set parking brake prior to leaving vehicle unattended.
- Buckets and blades are to be placed on the ground and with hydraulic gears in neutral when not in use.
- Brakes shall be set and, as necessary, wheels chocked or equivalent (as applicable) when not in use.

4.5.7 The Operator will maintain the cab, floor and deck of heavy equipment free of material, tools or other objects which could create a tripping hazard, interfere with the operation of controls, or be a hazard to the operator or other occupants in the event of an accident.

4.5.8 If heavy equipment has seat belts required by law or manufacturer's specifications, the Operator and passengers will use the belts whenever the equipment is in motion, or engaged in an operation which could cause the equipment to become unstable.

- Seat belts shall be maintained in functional condition, and replaced when necessary to ensure proper performance.

4.5.9 All vehicles transporting material or equipment on public roads shall comply with local laws pertaining to weight, height, length, and width. Obtain any permits required for these loads.

4.5.10 Never jump on to or off of a piece of heavy equipment, always maintain 3-points of contact at a minimum.

4.5.11 Never exit heavy equipment while it is in motion.

4.5.12 Do not ride with arms or legs outside of the truck body of equipment cab.

- Never ride on the outside of a piece of heavy equipment (e.g. in a standing position on the body, on running boards, or seated on side fenders, cabs, cab shields, rear of truck bed, on the load, bucket, etc.).

4.5.13 Have vehicle headlights on at all times when driving in the area.

4.5.14 Park motor vehicles off the haul roads, or away from the work areas.

4.5.15 Do not wear loose clothing or jewelry where there is a danger of entanglement in rotating equipment.

4.5.16 Do not enter the swing area of machines such as cranes, heavy drill rigs, or excavators, without first making eye contact with the operator, and receiving permission to do so. Refer to *S3AM-309-ATT2 Operator Line of Sight.*

4.5.17 Stay out of the blind areas around heavy equipment and never assume that the equipment operators have seen you or are aware of your presence.

4.5.18 Maintain a distance of at least 2 feet (60 centimeters) between the counterweight of swing machines and the nearest obstacle. If this distance cannot be maintained, a spotter shall observe and be in constant communication with the operator to prevent contact.

4.5.19 Vibrations from moving traffic or heavy equipment can cause excavations or spoil piles to become unstable.

- Excavation activity shall be conducted according to *SOP S3AM-303-PR1 Excavation*.
- Equipment not involved in the excavating activity or not required to be in the vicinity shall keep clear. Equipment that shall operate in the vicinity shall maintain appropriate setback distances from edges of excavations or spoil piles.

4.5.20 All heavy equipment shall be operated in a safe manner that will not endanger persons or property.

- When ascending or descending grades in excess of 5 percent, loaded equipment shall be driven with the load upgrade.
- When operating an electric-powered, remote controlled, hydraulic device used for demolishing concrete structures and refractory linings as well as excavating, refer to the *S3AM-309-ATT1 Brokk 180* for more specifics.

4.5.21 All heavy equipment shall be operated at safe speeds. Do not drive any vehicle at a speed greater than is reasonable and safe for weather conditions, traffic, intersections, width, and character of the roadway, type of motor vehicles, and any other existing condition.

4.5.22 Always move heavy equipment up and down the face of a slope. Never move equipment across the face of a slope.

4.5.23 Slow down and stay as far away as possible while operating near steep slopes, shoulders, ditches, cuts, or excavations.

4.5.24 When feasible, Operators shall tra el with the load trailing , if the load obstructs the forward iew of the operator.

4.5.25 Slow down and sound horn when approaching a blind curve or intersection. Signal people equipped with 2-way radio communications may be required to adequately control traffic.

4.5.26 All haulage equipment / trucks, whose payload is loaded by means of cranes, power shovels, loaders, or similar equipment, shall have a cable shield and/or canopy adequate to protect the operator from shifting or falling material. If protection is not available for the operator, the operator shall leave the vehicle and wait in a designated safe location until it is loaded..

4.5.27 Equipment shall be shut down prior to and during fueling.

- Confirm proper grounding/ bonding between equipment and fuel vehicle prior to fueling operations.
- During fuel operations confirm fuel nozzle remains in contact with the tank.
- Do not smoke, use electrical devices or have an open flame present while fueling.
- Fuel shall not be carried in or on heavy equipment, except in permanent fuel tanks or approved safety cans.

4.5.28 Site vehicles will be parked in a designated parking location away from heavy equipment.

4.5.29 perators shall ne er push pull stuc or bro en-down equipment unless a spotter determines that the area is cleared of all personnel around and underneath the equipment.

4.5.30 If designated for work in contaminated areas/zones, equipment shall be kept in the exclusion zone until work or the shift has been completed. Equipment will be decontaminated within designated decontamination areas.

4.5.31 Equipment left unattended at night adjacent to travelled roadways shall have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, to identify the location of that equipment, and shall not be closer than 6 feet (1.8m) (or the regulatory requirement for the work location) to the active roadway.

4.5.32 Rubber / pneumatic-tired earthmoving haulage equipment shall be equipped with fenders on all wheels. Mud flaps may be used in lieu of fenders whenever motor vehicle equipment is not designed for fenders.

4.5.33 Lift trucks shall have the rated capacity clearly posted on the vehicle, and the ratings are not to be exceeded.

4.5.34 Steering or spinner knobs shall not be attached to steering wheels.

4.5.35 High-lift rider industrial trucks shall be equipped with overhead guards.

4.5.36 All hot surfaces of equipment, including exhaust pipes or other lines, that present a possible injury or fire hazard, shall be guarded or insulated.

4.5.37 All equipment having a charging skip shall be provided with guards on both sides and open end of the skip area to prevent persons from walking under the skip while it is elevated.

4.5.38 Platforms, foot walks, steps, handholds, guardrails, and toeboards shall be designed, constructed, and installed on machinery and equipment to provide safe footing and access ways.

4.5.39 Substantial overhead protection shall be provided for the operators of fork lifts and similar equipment.

4.5.40 In an effort to reduce air emissions, fuel costs, and run-time hours (that can impact equipment warranty), operators shall limit heavy equipment engine idling to not more than five consecutive minutes. Local regulations at the location of the vehicle operation could require less than five consecutive minutes idling time. The idling limit does not apply to:

- Idling when queuing.
- Idling to verify that the vehicle is in safe operating condition.

- Idling for testing, servicing, repairing or diagnostic purposes.
- Idling necessary to accomplish work for which the vehicle was designed (cranes, man-lifts, forklifts, etc.)
- Idling required to bring equipment/vehicle to operating temperature, as specified by the manufacturer. Engine heaters shall be used for cold weather starting to avoid engine idling where feasible.
- Idling necessary to ensure safe operation of the vehicle.
- Idling to keep equipment (including windows) clear of ice and snow.
- Idling to provide air conditioning or heat to ensure the health and safety of the operator, but only when seated inside the equipment or vehicle.

4.6 Utilities

4.6.1 When contacted by heavy equipment, aboveground and underground utilities may cause severe injuries or death as a result of electrocution, explosion, etc. Refer to the *S3AM-322-PR1 Overhead Lines* procedure for more specifics.

4.6.2 The following outline the requirements while performing heavy equipment operations that may lead to contact with aboveground or underground utilities:

- Always be aware of surrounding utilities.
- Confirm all equipment (e.g., dump trailers, loaders, excavators, etc.) is lowered prior to moving underneath aboveground utilities.
- Confirm utilities are cleared and identified prior to beginning any earthmoving operation. Contact the local utility service providers for clearance prior to performing work. Confirm documentation of the contact is made; date, number; contact name, organization, etc. Refer to *SOP S3AM-303-PR1 Excavation* and *S3AM-331-PR1 Underground Utilities & Subsurface Installation Clearance.*

4.7 Training

4.7.1 The Operator or other qualified supervisor will provide all on-site personnel with an orientation to the heavy equipment and its associated hazards and controls.

4.7.2 Only designated, qualified personnel shall operate heavy equipment.

4.7.3 Operators shall have all appropriate jurisdictional licenses or training to operate a designated piece of heavy equipment.

4.7.4 Operators shall be evaluated through documented experience and routine monitoring of activities unless the equipment is operated by an AECOM operator in which case a practical evaluation is required. Operators shall be knowledgeable and competent in the operation of a designated piece of heavy equipment.

4.8 Inspection and Maintenance

4.8.1 Maintenance records for any service, repair or modification which affects the safe performance of the equipment will be maintained and be reasonably available to the operator and maintenance personnel regulatory agencies upon request during work hours.

4.8.2 Maintenance records will be maintained on the site or project for heavy equipment.

4.8.3 Conduct maintenance as prescribed by the manufacturer in the Operation Manual for each piece of equipment.

4.8.4 Servicing, maintenance and repair of heavy equipment will not be done when the equipment is operating.

- Lockout and tagout safety procedures are followed. Refer to *S3AM-325-PR1 Lockout Tagout*.

- Motors are turned off, unless required for performing maintenance or repair.
- All ground-engaging tools are grounded or securely blocked.
- Controls are set in a neutral position and brakes are set.
- Electrically driven equipment is installed with provision for tagging and locking out the controls while under repair.
- Manufacturer's requirements for maintenance and repair are followed.
- If continued operation is essential to the process, a safe means of protection shall be provided.
- Provide and use a safety tire rack, cage, or equivalent protection when inflating, mounting, or dismounting tires installed on split rims, or rims equipped with locking rings or similar devices.

4.8.5 All heavy equipment shall have a documented inspection and if necessary, repaired prior to use.

- Operators shall not operate heavy equipment that has not been cleared for use.
- All machinery and mechanized equipment will be verified to be in safe operating condition (refer to *S3AM-309-FM1 Approval of Machinery & Mechanized Equipment*) by a competent person (refer to *S3AM-202-PR1 Competent Person Designation*) within seven days prior to operation on a new site or project. Clearance is valid for up to one year for the given site or project.
- As applicable, all machinery and mechanized equipment shall be inspected / certified and tested at appropriate intervals as required by the manufacturer and/or regulatory requirements.

4.8.6 All hea y equipment shall be inspected at a minimum to the manufacturer's recommendations prior to each work shift. All defects shall be reported to the Supervisor/ Manager immediately.

- Defective heavy equipment shall be immediately tagged and taken out of service until repaired.
- Inspection, maintenance, service and repair records shall be maintained at the site. If a manufacturer's or company-specific inspection checklist is not provided, use *S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist*.
- Records shall be made available for review upon request. Note: Documents may be electronically stored in the project files.

4.9 Fueling and batteries

4.9.1 A well-ventilated area shall be used for refueling.

4.9.2 Only the type and quality of fuel recommended by the engine manufacturer shall be used.

4.9.3 Fuel tanks shall not be filled while the engine is running. All electrical switches shall be turned off.

4.9.4 If there is potential to spill fuel on hot surfaces, the surfaces shall be permitted to cool down prior to fueling. Any spillage shall be cleaned before starting engine.

4.9.5 Spilled fuel shall be cleaned with cotton rags or cloths and disposed of in the proper receptacle; do not use wool or metallic cloth.

4.9.6 Open flames, lighted smoking materials, sparking equipment or any other type of ignition source shall remain a minimum of ' . m from the fueling area and or fuel source. his clearance shall be increased if required or conditions warrant.

4.9.7 Heaters in carrier cabs shall be turned off when refueling the carrier or the drill rig.

4.9.8 Portable containers to be filled shall be placed directly on the ground or be properly grounded prior to filling to prevent creation of a static charge. Portable fuel containers shall not be filled completely to allow expansion of the fuel during temperature changes.

4.9.9 Control electrostatic hazards.

- Before activating fuel pump, touch some part of vehicle / equipment to de-energize any static electricity that may be present.
- The fuel nozzle shall be kept in contact with the tank being filled to prevent static sparks from igniting the fuel.
- Fuel containers and transfer hoses shall be kept in contact with a metal surface during travel to prevent build-up of a static charge.

4.9.10 Portable fuel containers shall not travel in the vehicle or carrier cab with personnel.

4.9.11 Batteries shall be serviced in a ventilated area while wearing appropriate Personal Protective Equipment.

4.9.12 When a battery is removed from a vehicle or service unit, the battery shall be disconnected ground post first. Consult the SDS applicable to the battery and/or contents for additional information including; handling, precautions, and first aid measures.

- Spilled battery acid shall be immediately flushed off the skin with a continuous supply of water. Battery storage or maintenance areas shall have readily accessible eye wash stations.
- Should battery acid get into the eyes, the eyes shall be flushed immediately with copious amounts of water and medical attention shall be sought immediately.

4.9.13 When installing a battery, the battery shall be connected ground post last.

4.9.14 When charging a battery, cell caps shall be loosened prior to charging to permit gas to escape.

4.9.15 When charging a battery, the power source shall be turned off to the battery before either connecting or disconnecting charger loads to the battery posts.

4.9.16 To avoid battery explosions, the cells shall be filled with electrolytes. A flashlight (not an open flame) shall be used to check water electrolyte levels. Avoid creating sparks around batteries by shorting across a battery terminal. Lighted smoking materials and flames shall be kept at least a minimum of 35 feet (10.7 meters) away from battery-charging stations.

5.0 Records

5.1 Inspection, maintenance, service and repair records shall be maintained with the equipment.

6.0 Attachments

6.1 S3AM-309-ATT1 Brokk180 Safety Card

6.2 S3AM-309-ATT2 Operator Line of Sight

6.3 S3AM-309-FM1 Approval of Machinery & Mechanized Equipment

6.4 S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist

6.5 S3AM-309-FM3 Rubber Tire Backhoe Operator Skill Evaluation

6.6 S3AM-309-FM4 Scraper Operator Skill Evaluation

6.7 S3AM-309-FM5 Bull Dozer Operator Skill Evaluation

6.8 S3AM-309-FM6 Dump Truck Operator Skill Evaluation

6.9 S3AM-309-FM7 Roller Compactor Operator Skill Evaluation

6.10 S3AM-309-FM8 Front End Loader Operator Skill Evaluation

6.11 S3AM-309-FM9 Grader Operator Skill Evaluation

6.12 S3AM-309-FM 10 Excavator Operator Skill Evaluation

6.13 S3AM-309-FM11 Water Truck Operator Skill Evaluation

6.14 S3AM-309-FM12 Heavy Equipment Maintenance Inventory

6.15 S3AM-309-FM13 Heavy Equipment Inspection Report

Americas

Wildlife, Plants & Insects

S3AM-313-PR1

1.0 Purpose and Scope

1.1 Communicates the requirements and precautions to be taken by AECOM employees to protect against the biological hazards associated with insects, arachnids, snakes, poisonous plants, and other animals referred to herein collecti ely as biological ha ards .

1.2 This procedure applies to all AECOM Americas-based employees and operations.

2.0 Terms and Definitions

2.1 **Field Work –** Any activity conducted at a site that contains brush, overgrown grass, leaf litter, poisonous plants, or is located near mosquito breeding areas and includes work in structures where animals might exist that harbor fleas or ticks or where spiders and mites could be present. Field work includes, but is not limited to, Phase I, Phase II, Operations Monitoring & Maintenance, biological surveys, and other work that meets the definition of field work.

2.2 **Poisonous** – Capable of harming or killing by or as if by poison; toxic or venomous.

2.3 **Phase I Environmental Site Assessment –** Investigation of real property to determine the possibility of contamination, based on visual observation and property history, but no physical testing. Under new Environmental Protection Agency regulations that went into effect on November 1, 2006, a Phase I, as it is called for short, will be mandatory for all investors who wish to take advantage of Comprehensive Environmental Response, Compensation, and Liability Act defenses that will shield them from liability for future cleanup, should that pro e necessary. he new hase rules, called All Appropriate nquiry or AA , also require more investigation than previously mandated. Investors can expect to see dramatic price increases over prior experiences.

2.4 **Phase II Environmental Site Assessment** – Investigation of real property through physical samplings and analyses to determine the nature and extent of contamination and, if indicated, a description of the recommended remediation method.

3.0 References

3.1 RS2-001-PR1 Firearms Standard

3.2 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.3 S3AM-008-PR1 Fitness for Duty

3.4 S3AM-113-PR1 Heat Stress

3.5 S3AM-208-PR1 Personal Protective Equipment

3.6 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers / Supervisors**

- Responsible for managing field work.
- Work with employees to see that a Task Hazard Analysis (THA) for the work to be conducted has been performed prior to the beginning of the field work and that it includes an assessment of potential biological hazards.

- Implement control measures at the location to reduce the potential for employees to be exposed to injuries and illnesses from biological hazards while working.
- If the exposures cannot be eliminated or managed with engineering controls, approve the use and cost of Personal Protective Equipment (PPE) and protective repellents and lotions and confirm that exposed employees have and use these products.

4.1.2 **SH&E Manager**

- Confirm training and guidance is provided to employees consistent with this procedure.
- During the performance of site visits, assess the precautions being taken against biological hazards for compliance with this procedure.
- Assist AECOM personnel in identifying hazards and selecting appropriate control measures.
- As applicable, review and approve relevant SH&E Plans for locations that have biological hazards.

4.1.3 **Employees**

- Participate in required training related this procedure.
- Participate in the development of THAs for the task, identify control measures to limit exposure and request PPE, repellents, and protective lotions identified by this procedure.
- Update the applicable THA when a new, unaccounted for biological hazard is identified. Employee shall stop work to identify appropriate elimination or control measures (and obtain any necessary guidance) before continuing work.
- Obtain approval from Managers and/or Supervisors to purchase selected PPE prior to purchasing.
- Implement the precautions appropriate to prevent exposure to the hazardous wildlife, insects and plants.
- Observe requirements for reporting (e.g. tick bites, skin irritations, etc.) as detailed within the procedure and attachments.

4.2 Training

4.2.1 Employees shall be trained to recognize organisms that represent a threat in the regions in which they work – experienced field staff shall provide on the job training to assist staff with hazard recognition.

4.2.2 Employees shall be properly trained to the anticipated tasks and the associated required PPE.

4.3 Overview

4.3.1 The procedures discussed below are detailed because these hazards have historically posed the most significant risk to AECOM employees. Note that this discussion is not a fully encompassing list of hazards. As part of the SH&E Plan and THA developed by the AECOM personnel, in accordance with *S3AM-209-PR1 Risk Assessment & Management*, additional consideration shall be given to other biological hazards.

4.3.2 Departments of Public Health local to the worksite, as well as the Centers for Disease Control (CDC) can serve as a resource for identifying biological hazards not discussed in this procedure.

4.3.3 If additional biological hazards are identified, employees should stop work and contact the SH&E Manager to discuss the hazards and identify effective control measures. Those control measures shall be implemented at the location prior to restarting work.

4.4 Employee Sensitivity

4.4.1 Sensitivity to toxins generated by plants, insects and animals varies according to dosage and the ability of the victim to process the toxin; therefore, it is difficult to predict whether a reaction will

occur, or how severe the reaction will be. Employees should be aware that there are a large number of organisms capable of causing serious irritations and allergic reactions. Some reactions will only erupt if a secondary exposure to sunlight occurs. Depending on the severity of the reaction, the result can be severe scarring, blindness or even death.

4.4.2 Employees also need to consider whether they are sensitive to the use of insect repellents.

4.5 Planning and Hazard Assessment

4.5.1 AECOM personnel shall confirm that the potential for exposure to specific biological hazards are assessed prior to the commencement of work and that the procedures specified by this procedure are integrated into the THA planning process and conveyed to employees conducting the field work. This information shall be communicated in the location-specific SH&E plan, the THA, pre-project kickoff meetings, and tailgate meetings at the location.

4.5.2 It is important to note that the precautions to be taken by employees to decrease the risk of exposure to biological hazards can directly increase the risk of heat-related illness due to thermal stresses. Therefore, heat stress monitoring and precautions shall be included as a critical component of the task-specific THA in accordance with *S3AM-511-PR1 Heat Stress.*

4.5.3 During the preparation of the location-specific SH&E plan and task specific THA, Managers, Supervisors, and employees shall determine what biological hazards might be encountered during the task or operations and shall prescribe the precautions to be taken to reduce the potential for exposure and the severity of resulting illnesses. Consideration will be given to conditions such as weather, proximity to breeding areas, host animals, and published information discussing the presence of the hazards.

4.5.4 It should be assumed that at least one of the biological hazards exists whenever working on undeveloped property. This can include insect activity any time that local temperatures exceed 40 degrees Fahrenheit (4.5 degrees Celsius) for a period of more than 24 hours. The stubble and roots of poisonous plants can be a hazard any time of year, including when some plants are dormant or mown.

4.5.5 The hazard assessments shall also consider the additional hazards posed by vegetative clearing such as the increased risk of coming in contact with poison ivy, oak or sumac and hazards associated with the use of tools and equipment to remove vegetation.

4.5.6 Employees in the field where biological hazards exist shall not enter the hazard areas unless they are wearing the appropriate protective clothing, repellents, and barrier creams specified below. If the hazard is recognized in the field but was not adequately assessed during the THA, the field staff shall stop work and not proceed until the THA has been amended and approved and protective measures implemented.

4.5.7 Employees who have severe allergic reactions are strongly recommended to notify their Manager, field Supervisor and co-workers of the potential for a reaction and demonstrate what medication they might need, where they keep it and how it is administered.

4.5.8 A decision flow chart and table for determining the potential for biological hazards in the Americas has been provided in *S3AM-313-ATT1 Biological Hazard Assessment Flow Chart.*

4.5.9 Restrictions:

- No firearms or weapons are allowed to be used without express permission by the Region Executive and Chief Resilience Officer, refer to the *RS2-001-PR1 Firearms Standard*.
- No weapons related work shall occur without an assessment that includes appropriate hazard control measures and training.
- Staff with life-threatening reactions shall not undertake work in areas infested with the allergen e.g., wasps, poison i y , unless precautions are met which satisfy a medical practitioner's requirements. Refer to *S3AM-008-PR1 Fitness for Duty*.

4.5.10 Precautions

- Be aware of the potential irritants in your area and know how to recognize them.
- Modify activities to avoid encounters (diurnal rhythms, seasonal rhythms).
- Avoid wearing perfume and cologne and strong smelling deodorants, lotions, soaps, and shampoos.
- hen wor ing in areas where there may be small insects that hitchhi e e.g., tic s, spiders, scorpions), it is recommended that clothes are turned inside out and shaken at the end of day; do not wear same clothes two days in a row.
- Staff should always be aware of where they are placing their hands, or where they are sitting in order to avoid contact with potential toxins. Avoid reaching into areas where visibility is limited.

4.6 Wildlife Hazards (Wild Animals, Reptiles and Birds)

4.6.1 Employees shall not work alone in areas where the risk of an encounter with dangerous wildlife is high. Wildlife handling shall only be completed under direct supervision of an experienced individual. Refer to the following work instructions for more specifics:

- *S3AM-313-ATT13 Alligators*
- *S3AM-313-ATT9 Large Carnivores & Ungulates*
- *S3AM-313-ATT10 Bear Safety*
- *S3AM-313-ATT11 Small Mammals*
- *S3AM-313-ATT12 Snakes & Scorpions*

4.7 Ticks, Spiders and other Insects

4.7.1 Insects for which precautionary measures should be taken include but are not limited to: mosquitoes (potential carriers of disease aside from dermatitis), black flies, wasps, bees, ticks, fire ants and European fire ants.

4.7.2 Employees with known allergies to insect stings should consult their personal physician for advice on any immediate medications that they should carry with them. Epi-pens[1] shall be carried at all times in the field by employees who are aware that anaphylactic shock is a possibility for them AECOM highly recommends that employees with known allergies inform their co-workers of the allergy and the location of the medications they might carry for the allergy.

4.7.3 Habitat Avoidance, Elimination and/or Control

- The most effective method to manage worker safety and health is to eliminate, avoid and/or control hazards. Clearing the location of brush, high grass and foliage reduces the potential for exposure to biological hazards. Clearing will not eliminate the exposure to flying insects and there might be an increased exposure to ticks and spiders during the clearing process.
- Projects such as subsurface environmental assessment or remediation are often candidates for brush and overgrown grass to be cleared. In these instances, the Manager shall either request that the client eliminate vegetation, or request approval from the client to have vegetation clearing added to the scope of work.
    - It should be noted that vegetation clearance may unintentionally serve to spread noxious and poisonous plant materials around the site.
    - As applicable, measures should be taken to prevent spread, such as but not limited to, confirming equipment and materials are not placed on affected areas, and equipment is decontaminated after use and before removal from site.

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[1] Epi-pens must be prescribed by a personal physician. Renew epi-pens on a regular schedule to ensure effectiveness and make sure your field companions know where it is and how to use it if you cannot self-administer the dose.

- When work shall be conducted in areas that cannot or may not be cleared of foliage, personal precautions and protective measures shall be prescribed.
- Mosquitoes breed in stagnant water and typically only travel a quarter mile (less than half a kilometer) from their breeding site. Whenever possible, stagnant water should be drained to eliminate breeding areas. Managers and client site managers should be contacted to determine whether water can be drained and the most appropriate method for draining containers, containment areas, and other objects of standing water.
- If water cannot be drained, products similar to Mosquito Dunks® can be placed in the water to control mosquitoes. Once wet, the Mosquito Dunks® kill the immature, aquatic stage of the mosquito. The active ingredient is a beneficial organism that is lethal to mosquito larvae, but harmless to fish, humans, and other animals. Mosquito Dunks® provide long-term protection for 30 days or more.

4.7.4 Ticks

- Ticks can be encountered when walking in tall grass or shrubs. They crawl up clothing searching for exposed skin where they will attach themselves. The most serious concern is a possibility of contracting a disease.
- Data from the CDC indicates that tick-borne diseases have become increasingly prevalent. At the same time, tick repellents have become both safe and effective so it is possible to prevent the vast majority of bites and, therefore, most related illnesses. The use of permethrin is strongly advised.
- The most common and severe tick-borne illnesses in the U.S. are Lyme disease, Ehrlichiosis, and Rocky Mountain spotted fever. A summary table listing CDC informational resources for these diseases is provided in *S3AM-313-ATT2 Ticks* along with a listing of CDC information resources and maps showing the distribution of common tick-borne diseases in the U.S.
- When working in areas where ticks may occur, it is recommended that clothes are turned inside out and shaken at the end of day; do not wear the same clothes two days in a row.
- Employees should conduct a thorough full body tick check upon exiting the field. Shower within two hours of coming indoors to help wash away loose ticks. Clothes should be laundered in hot water or tumble dry clothes in a dryer on high heat for 10 minutes to kill ticks.
- To remove ticks that are embedded in skin, utilize a tick key. Alternatively use tweezers or fingers to carefully grasp the tick as close to the skin as possible and pull slowly upward, avoiding twisting or crushing the tick. Do not try to burn or smother the tick. Cleanse the bite area with soap and water, alcohol, or household antiseptic. Note the date and location of the bite and save the tick in a secure container such as an empty pill vial or film canister. A bit of moistened paper towel placed inside the container will keep ticks from drying out. Follow AECOM incident reporting guidelines to report the tick bite within 4 hours and notify the Manager or Supervisor.
- Familiarize yourself with the characteristic bulls-eye pattern of Lyme disease infection surrounding the bite. If you notice this type of pattern or rash resulting from a tick bite, immediately report the issue to your supervisor and follow the incident reporting requirements for your business group.
- If you experience symptoms such as fever, headache, fatigue, and a skin rash, you should immediately visit a medical practitioner as Lyme disease is treated easily with antibiotics in the early stages, but can spread to the heart, joints, and nervous system if left untreated.

4.7.5 Chiggers

- Chiggers are mite larvae, approximately ½ millimeter in size, and typically invisible to the naked eye. While chiggers are not known to carry infectious diseases, their bites and resulting rashes and itching can lead to dermatitis and a secondary infection.

- Chiggers are typically active from the last hard freeze in the winter or spring to the first hard freeze. They are active all year in the Gulf Coast and tropical areas.

4.7.6 Spiders

- Spiders can be found in derelict buildings, sheltered areas, basements, storage areas, well heads and even on open ground. Spiders can be found year round in sheltered areas and are often present in well heads and valve boxes.
- Most spider bites produce wounds with localized inflammation and swelling. The Black Widow and Brown Recluse spiders in the U.S. and others outside the U.S. inject a toxin that causes extensive tissue damage and intense pain.
- Additional information on spider identification can be found in attachment *S3AM-313-ATT3 Poisonous Spider Identification*.

4.7.7 Mosquitoes

- When a mosquito bites, it injects an enzyme that breaks down blood capillaries and acts as an anticoagulant. The enzymes induce an immune response in the host that results in itching and local inflammation. The tendency to scratch the bite sites can lead to secondary infections.
- CDC data indicates that mosquito-borne illnesses, including the strains of encephalitis, are a health risk. At least one of the Encephalitis strains listed below is known to exist in every area of the U.S. and in many other countries as well:
    - Eastern Equine encephalitis
    - Western Equine encephalitis
    - West Nile Virus
    - St. Louis encephalitis
    - La Crosse encephalitis
- Mosquitoes can transmit the West Nile Virus and other forms of encephalitis after becoming infected by feeding on the blood of birds which carry the virus.
- Most people infected with the virus experience no symptoms or they have flu-like symptoms. Sometimes though, the virus can cause severe illness, resulting in hospitalization and even death, so proper precautions should be taken. Consult a medical practitioner if you suspect you have West Nile Virus. Other diseases including Dengue Fever and Malaria are spread by mosquitoes in the sub-tropic and tropical parts of the world. See *S3AM-313-ATT4 Mosquito Borne Diseases* for information on the locations where mosquito borne diseases are known to be present.

4.7.8 Bees, Wasps and Hornets

- Wasps and bees will cause a painful sting to anyone if they are harassed. They are of most concern for individuals with allergic reactions who can go into anaphylactic shock. Also, instances where an individual is exposed to multiple stings can cause a serious health concern for anyone. These insects are most likely to sting when their hive or nest is threatened.
- Bees, hornets, and wasps may be found in derelict buildings, sheltered areas, behind covers or lids and even on open ground. Other protective measures are not normally effective against aggressive, flying insects. Be aware of the potential areas for these types of insects, approach these locations cautiously. Avoid reaching into areas where visibility is limited.
- If you see a nest in the area you are working in stop work. Contact the Manager or Site Supervisor for procedures to have the nest removed.
- If stung by a wasp, bee or hornet, notify a co-worker or someone who can help should you have an allergic reaction. Stay calm and treat the area with ice or cold water. Follow AECOM incident reporting guidelines to report the sting within 4 hours and notify the Manager or

Supervisor immediately. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or sting, or any swelling or numbness beyond the site of the bite or sting.

4.7.9 Fire Ants

- The fire ant (southern and western U.S.) and the European fire ant (northeastern U.S. and eastern Canada) is often very abundant where it is established. It is very aggressive and commonly climbs up clothing and stings unprovoked when it comes into contact with skin. Painful irritations will persist for an hour or more.

4.7.10 Personal Protective Equipment (PPE)

- Chemically-treated field clothing, full-length clothing, or Tyvek® coveralls.
- Gloves shall also be worn consistent with the recommendations of the site-specific SWP and/or THA to minimize hand exposure.
- Where ticks, chiggers, and spiders are presumed to exist, the Tyvek® or chemically treated clothing will be taped to the work boots.
- See *S3AM-313-ATT2 Ticks* for configuration of clothing for protection against ticks and insects.
- Application of insect repellent to clothing and/or exposed skin. Oil of lemon eucalyptus, DEET, and Permethrin have been recommended by the CDC for effective protection against mosquitoes that may carry the West Nile virus and related diseases.
- Note that DEET will reduce the effectiveness of Fire Resistance Clothing (FRC) and should not be applied to this clothing. If working in FRC, employees can use Permethrin as it has been shown not to reduce the effectiveness of FRC. Permethrin will need to be applied to FRC well in advance of the planned work. If permethrin is unavailable employees can apply DEET to their skin and let dry prior to putting FRC on.
    - Oil of Lemon Eucalyptus is a plant-based insect repellent on the market as Repel Lemon Eucalyptus. The products have been proven to be effective against mosquitoes, deer ticks, and no-see-ums for up to six hours. Derived from Oil of Lemon Eucalyptus, this non-greasy lotion or spray has a pleasant scent and is not known to be toxic to humans. The spray or lotions will be effective for approximately two to six hours and should be reapplied every two hours to sustain protection. Lemon Eucalyptus products cannot be applied to fire retardant clothing.
    - Permethrin is an insecticide with repellent properties registered with the Environmental Protection Agency and recommended by the CDC.
        - Permethrin is highly effective in preventing tick bites when applied to clothing, but is not effective when applied directly to the skin. Two options are available for Permethrin treatment of clothing worn during field work: 1) pre-treatment of fabric by the clothing manufacturer; or 2) manual treatment of their personal clothing using Permethrin spray in accordance with recommendations manufacturers recommendations. This will likely require treatment at home or the office prior to field mobilization. Caution should be used when applying Permethrin as it is highly toxic to fish and house cats. AECOM strongly recommends the first option (employees obtaining pre-treated clothing) to avoid the time required, potential risk, and housekeeping issues involved with manually treating the clothing with spray. Purchase pre-treated clothing in accordance with *S3AM-208-PR1 Personal Protective Equipment* and with the approval of your Supervisor or Manager.
        - The Permethrin pre-treatment is odorless and retains its effectiveness for approximately 25 washings. After 25 washings, the pre-treated clothing will be considered no longer effective and removed from service. Clothing that has been manually treated by employees will be considered effective for five wash cycles.

- Also, use of clothing that has been pre-treated with Permethrin offers a reduction in the use and application of other insect repellents that shall be applied directly to the skin. Supervisor or Manager approval is required prior to purchase.
- If the employee opts not to utilize chemically pre-treated clothing while potentially exposed to insects, spiders and/or ticks, they shall either: 1) wear Tyvek® coveralls taped to the boots, or 2) wear full-length clothing consisting of long-legged pants and long-sleeved shirts treated with an insect repellent containing Permethrin, DEET, or an oil of lemon eucalyptus to their work clothing.

- Safety Data Sheets (SDS) for the repellents, lotions, and cleansers discussed in this Procedure are not required because the repellents, lotion, and clothing are consumer products used in the manner intended for the general public. Although not required, a SDS should be obtained for the products used and placed into the office SDS library and site-specific safety plan.

4.8 Poisonous Plants

4.8.1 Habitat Avoidance, Elimination and/or Control

- If poisonous plants are identified in the work area, employees will mark the plants using either flags or marking paint, and discuss what the specific indicator will be to signal to other employees to avoid the designated area. If employees decide to use ground-marking paint to identify poisonous plants, they should discuss this tactic with the Manager (and Client as appropriate) for approval.
- If removal of the plants is considered, it should be subcontracted to a professional landscaping service that is capable and experienced in removing the plant. If herbicides are considered for use, a discussion shall need to occur with the Manager (and Client as appropriate) to determine whether it is acceptable to apply herbicides at the work site. Application of herbicides may require a license.
- Employees shall not attempt to physically remove poisonous plants from the work area unless a clearing procedure, including PPE, is prepared in advance and approved by the SH&E Manager. The clearing procedure should be included in the SH&E Plan and THA and the required PPE specified.

4.8.2 Poisonous plants that employees should recognize and take precautions to avoid include: poison sumac, poison ivy (terrestrial and climbing), poison oak, giant hogweed[2] (or giant cow parsnip), wild parsnip, de il's club and stinging nettle. Many others are extremely poisonous to eat (e.g., poison hemlock; water parsnip) – do not eat anything that has not been identified. Refer to *S3AM-313-ATT5 Plants of Concern* for information on locations where some of these poisonous plants are found in the U.S.

- Of the toxic plants in the cashew family, poison ivy (*Rhus radicans*) is most widespread. It grows in a variety of forms such as a low sprawling shrub, dense ground cover, or a thick woody vine that grows high into the tree canopy. Poison oak (*Rhus diversiloba*) is typically a low shrub in drier soils. Both of these plants have leaves of three and white berries. Poison sumac (*Rhus vernix*) is a tall shrub that is less prolific in distribution. It grows in wet areas, has a compound leaf with a red leaf stem (rachis), and white berries. All of these plants possess urushiol oils in all parts of the plant. Touching the plant causes an itchy skin rash that can show up within 4-72 hours following contact. People have a wide range of reactions including swelling, itching, rash and bumps, patches or blisters.
- Uroshiol oil can also transfer onto clothing and equipment. The oil can remain active on surfaces for up to 5 years and can be transferred to your skin.
- Wild parsnip is found throughout the U.S. and contains a poison that produces a rash similar to poison oak and ivy. Unlike poison oak and ivy, the active oil will not be present on unbroken

[2] Phytodermatisi producer: keep skin covered and wash well after exposure

leaves. See *S3AM-313-ATT6 Wild Parsnip Identification* for additional information and photos of wild parsnip.

- Several plants in the carrot family contain toxic sap that causes severe dermatitis if it comes into contact with skin that is then exposed to sunlight. The most serious reaction is caused by the giant hogweed (*Heracleum mantegazzianum*), a plant that is spreading in southern Ontario and is also present in southwestern British Columbia. The plant is enormous, attaining up to 16 feet (5 meters) in height, which it does in one growing season. Contact causes painful blistering that can cause permanent disfigurement. It is to be avoided. Similar but less serious reactions can be caused by meadow parsnip (*Pastinaca sativa*) and cow parsnip (*Heracleum lanatum*). Meadow parsnip can be very abundant on disturbed sites.
- Nettles, particularly stinging nettle (*Urtica dioica*) and wood nettle (*Laportea canadensis*) contain urticating hairs on the leaves and stems that cause sharp pain or itchiness on contact with skin. The irritation is immediate and normally lasts no more than an hour and there are no lasting consequences.
- Some plants contain abundant stiff spines that can present a safety hazard, particularly if one is to fall into them. These include the cactus (*Opuntia spp.*), devils club (*Oplopanax horridum*), and prickly-ash (*Zanthoxylon americanum*).

4.8.3 A large number of plants are not harmful to touch but may contain poisonous berries or foliage that could cause serious complications or death if they are ingested. It goes without saying to not eat any berries or plants if you are unsure of their identity.

- Remember that in the fall and winter the hazard still exists in the form of stubble and roots.

4.8.4 Personal Protective Equipment (PPE)

- Employees conducting clearing, grubbing, or similarly disturbing work activities in areas where poisonous plants exist shall wear long-sleeve clothing or Tyvek® coveralls, and disposable cotton, leather or synthetic gloves. Employees shall not touch exposed skin (neck and face) with potentially contaminated gloves. Tyvek® and gloves worn to protect from exposure to poisonous plants shall be treated as contaminated, removed from the body in a manner that the contamination is not spread, and placed in plastic bags for disposal.
- Personal clothing that has been exposed to poisonous plants shall be decontaminated with a poisonous plant cleanser such as Tecnu® or removed in a careful manner, bagged and washed separately from other clothing to remove urushiol.
- Work boots will be decontaminated with either soap and water or a cleansing agent such as Tecnu® cleanser.
- If foliage is being cleared and includes poisonous plants, exposed skin shall be treated with a dermal barrier cream such as ecnu ’s a n y Armor or n iroderm’s y loc and either a full-face respirator or a half-face respirator (with goggles) fitted with a P-100 (HEPA) dust filter.

4.9 Bird Droppings and Biological Soil Hazards

4.9.1 Work in any area where pigeons or other flying animals (e.g. bats) may nest requires a written statement from the client which states the potential for, and extent of, accumulation of excrement on/in the structure from pigeons or other winged animals.

4.9.2 Substantial accumulations of droppings can pose physical and health risks as slippery surfaces (if wet) and if the material is disturbed and becomes airborne, it can be inhaled or ingested if personal hygiene practices are not implemented. Inhalation of airborne droppings can cause diseases such as histoplasmosis. Exposure to surfaces with bird droppings shall be safeguarded by implementing proper work practices, training employees for awareness and using PPE. See *S3AM-313-ATT8 Bird Droppings*.

4.9.3 Tularemia is a problem with contaminated soil in some locations. Tularemia is a disease of animals and humans caused by the bacterium *Francisella tularensis*. Rabbits, hares, and rodents are

especially susceptible and often die in large numbers during outbreaks. Workers can contract Tularemia through tick and deer fly bites, but also through inhalation of contaminated aerosols or agricultural dusts. Check work areas for carcasses before disturbing the ground (e.g. mowing, brushing, grubbing, excavation, etc.).

4.10 Personal Hygiene and Body Checks

4.10.1 Tick-borne diseases typically require that the tick be imbedded for four hours to begin disease transfer. The oils from poisonous plants can take up to 4 hours after exposure to penetrate the skin and react with the live proteins under the skin.

4.10.2 It is recommended that exposed skin be checked frequently for the presence of ticks, insects, rashes, or discolorations. External clothing should also be checked for the presence of ticks and insects; these should be retained for identification and to determine if medical treatment is needed.

4.10.3 Employees shall shower as soon as practical after working in the field and examine their bodies for the presence of ticks, insect bites, rashes, or swollen areas. If imbedded ticks are found, they should be removed using the technique described in *S3AM-313-ATT2 Ticks*.

4.11 Employees shall immediately notify their Manager or Supervisor of the presence of an imbedded tick, bee, wasp or hornet sting, other insect bite, rash, or any abnormal reaction. Reporting shall occur within 4 hours for a significant incident and 24 hours for all other SH&E incidents, and in accordance with *S3AM-004-PR Incident Reporting, Notifications & Investigation.*

4.12 The Manager or Supervisor shall forward the report to the SH&E Manager for follow up.

5.0 Records

None

6.0 Attachments

6.1 S3AM-313-ATT1 Biological Hazard Assessment Flow Chart

6.2 S3AM-313-ATT2 Ticks

6.3 S3AM-313-ATT3 Poisonous Spider Identification

6.4 S3AM-313-ATT4 Mosquito Borne Diseases

6.5 S3AM-313-ATT5 Plants of Concern

6.6 S3AM-313-ATT6 Wild Parsnip Identification

6.7 S3AM-313-ATT7 Alligators

6.8 S3AM-313-ATT8 Bird Droppings

6.9 S3AM-313-ATT9 Large Carnivores & Ungulates

6.10 S3AM-313-ATT10 Bear Safety

6.11 S3AM-313-ATT11 Small Mammals

6.12 S3AM-313-ATT12 Snakes & Scorpions

Americas

Material Storage

S3AM-316-PR1

1.0 Purpose and Scope

1.1 This procedure applies to all AECOM Americas-based employees and operations where materials are stored and used. Note that this standard does not address manual material handling (e.g., manual lifting, lowering, pushing, pulling, carrying, holding, or restraining). Information on manual material handling can be found in *S3AM-014-PR1 Manual Lifting*.

1.2 The purpose of this standard is to ensure the safety of AECOM personnel during the storage of materials.

2.0 Terms and Definitions

2.1 None

3.0 References

3.1 S3AM-014-PR1 Manual Lifting

3.2 S3AM-115-PR1 Hazardous Materials Communication

4.0 Procedure

4.1 Implementation of this standard is the responsibility of the Manager directing activities of the facility, site, or project location.

4.2 Employees shall be properly trained and follow the established procedures applicable to the material stored.

4.3 General

4.3.1 Consult additional applicable jurisdictional requirements and AECOM procedures for specific tasks, materials, and equipment involved in material storage operations.

4.3.2 Storage areas should be specifically designated and be clearly marked. Aisles should be clearly marked, be of ample width for the type of storage, and be kept free from obstacles and trash.

4.3.3 Store materials in a manner that prevents damage or deterioration to the material and in a configuration that is safe and provides for the optimal and efficient use of storage space.

4.3.4 Material must not be stacked within 18 inches of the sprinkler heads Material should be kept well clear of light fittings, heating pipes and ceilings.

4.3.5 Ensure that stacks are stable and self-supporting.

- Stack symmetrically.
- Base areas and heights of stacks should be kept as small as circumstances permit. The ratio of height to base dimensions of large stacks should be correctly proportioned so that failure of part or whole of the stack does not occur.
- Experience has shown that the height to base ratio of an unsupported stack should not exceed 3 to 1.
- As most stacks are erected by visual alignment, a slight error in calculation near the base can easily result in a barely noticeable overhang, with a resultant loss of stability.
- Where effective banding and shrink wrapping can be achieved, the ratio of height to base can be safely increased to 4 to 1.

- Stable construction of the stack is entirely dependent upon the following factors:
  - Safe relation of height to dimension of base;
  - Sound interlocking of the material;
  - Contents of the cartons;
  - Shape of articles

4.3.6 Post maximum safe loads for all floors above grade in pounds per square foot.

4.3.7 As applicable, stack, rack, block, interlock, band or shrink-wrap, or otherwise secure all materials to be stored in tiers to prevent sliding, falling, or collapse.

4.3.8 De-stacking is largely the reverse process of stacking. Most accidents involving the collapse of stacked materials occur during de-stacking. The prime cause of this is haphazard removal. All stacking and de-stacking should be carried out under competent supervision. Basic rules for breaking down stacks are:

- One person should be responsible for the manner in which the stack is reduced;
- The stack should be taken down tier by tier and;
- As there is a high tripping hazard in the working area of a stack, tidiness and systematic work methods are essential.

4.3.9 Keep aisles, passageways, and other access ways clear to provide for the free and safe movement of material-handling equipment or employees. Mark all permanent aisles.

4.3.10 Segregate and label non-compatible materials. Refer to *S3AM-117-PR1 Hazardous Materials Communication*.

4.3.11 When loads swing freely, confirm non-compatible materials are segregated. Do not lift loads or swing over the heads of persons; it is not permitted to walk under a load. Wear hardhats in these areas.

4.3.12 Do not place material stored inside buildings under construction within 6 feet (1.8 meters) of any hoistway or inside floor openings, or within 10 feet (3 meters) of any exterior wall lower than the top of the material stored.

4.3.13 Pallets should be of sound construction, and be of adequate strength for the loads and conditions under which they are used. Where pallet loads are stacked tier on tier, the unit loads must be able to support the weight above.

4.3.14 Stacks, shelving and other fixtures for holding or storing materials should be so laid out and designed that there is sufficient access for safe loading and unloading by either manual or mechanical means

4.4 Stacking Frames

4.4.1 Conduct a visual inspection of the stacking frames prior to loading for damage (e.g., bent, twisted, broken or excessive rust). Remove from service any stacking frames that fall into any of these categories.

4.4.2 Several pallets can be loaded on a stacking frame provided they are stable and will not fall.

4.4.3 If more than one (1) pallet is placed on a stacking frame and materials are unstable or appear to be capable of falling, the pallets will be shrink-wrapped or banded together or stored in another storage location.

4.4.4 Do not exceed the maximum load of the stacking frame. Be sure to include the weight of the stacking frame in the maximum load calculation.

4.4.5 Material on a stacking frame will not extend above the top rail if another stacking frame is to be placed on top of the lower frame.

- The highest or top stacking frame may have material that extends above the top rails, but the pallet itself must be below the top rails and the material secured.

4.4.6 Stacking frames will only be stacked high enough for forklift forks to be able to reach and remove one (1) frame at a time. At no time will they be stacked higher than five (5) high regardless of the dimensions of the stacking frame. Material placed on the top rack will be banded or shrink wrapped (if applicable).

4.4.7 Do not mix stacking frames manufactured by different companies (e.g., a UNICOR with a Nestainer or other manufacturer).

- Stacking frames of different colors can be intermingled but will be of the same dimensions and manufacturer (e.g., UNICOR to UNICOR, Nestainer to Nestainer).

4.4.8 The 1st (lowest) stacking frame will have the greatest amount of weight. The subsequent frames will, if possible, have less weight than the frame immediately below it. This is to avoid top heaviness.

4.4.9 When picking up a stacking frame, ensure the MHE forks are securely seated into the two (2) stirrups of the frame. When traveling, maintain a clear field of vision and travel in reverse if vision is obstructed by the load. Sound your horn at all intersections and blind spots.

4.4.10 Transport one (1) loaded stacking frame at a time.

4.4.11 When traveling with a pallet, keep load as low as possible. Do not bulldoze pallets or stacking frames.

4.5 Bagged Materials

4.5.1 Provide bags of cement and lime stacked over ten bags high with restraining walls of appropriate strength.

4.5.2 Stack cement, lime, and similar materials in bags so that the mouths of the outside bags are facing the center of the stack.

4.5.3 During un-stacking, keep the entire top of the stack nearly level, and maintain the necessary setback.

4.5.4 Warn employees handling cement or lime about skin burns, and ensure that goggles, gloves, and clothing that fits snugly about the neck and wrists are worn.

4.5.5 Lime must be stored to prevent a premature slaking action that may cause fire.

4.6 Bricks and Blocks

4.6.1 Brick stacks must not exceed 7 feet (2.1 meters), and they should be tapered back starting at 4 feet (1.2 meters).

4.6.2 Always stack bricks on planks, asphalt, or concrete, and never on uneven or soft surfaces.

4.6.3 Keep the top of brick stacks level and maintain the taper during un-stacking operations.

4.6.4 Stack blocks in tiers on solid, level surfaces, and taper back over the 6-foot (1.8-meter) level.

4.7 Lumber

4.7.1 When stacking lumber, place cross strips on stacks more than 4 feet (1.2 meters) high.

4.7.2 Remove all nails from used lumber before stacking, unless the lumber is to be burned or hauled away without further handling.

4.7.3 Stack lumber on level and solidly supported sills to be stable and self-supporting.

4.7.4 Do not stack lumber more than 16 feet (4.9 meters) high.

4.8 Reinforcing and Structural Steel

4.8.1 Store steel rods in separate stacks according to length and size.

4.8.2 Carefully stack structural steel to prevent the danger of members sliding off, or the stack toppling over.

4.8.3 Never store “I” beams with the webs vertical.

4.9 Foundation Bolts

4.9.1 Stack bolts in separate stacks according to length and size.

4.10 Corrugated and Flat Iron

4.10.1 Stack corrugated and flat iron flat, and not more than 4 feet (1.2 meters) high.

4.10.2 Place spacing strips between bundles.

4.11 Pipes, Poles, and other Cylindrical Material

4.11.1 Stack and block cylindrical material in such a way to keep the material from spreading or toppling.

4.11.2 Do not stack pipes higher than 5 feet (1.5 meters) unless racked.

4.11.3 When removing pipe or other material larger than 2 inches (5 centimeters) in diameter from storage, and where stacked pipe runs in one direction and is more than one pipe high, employees will be instructed to approach the stack from the ends, not from the sides.

4.12 Sand, Gravel, and Crushed Stone

4.12.1 While removing sand, gravel, and crushed stone from stockpiles, ensure there are no overhanging or vertical faces at any time.

4.12.2 Do not store material dumped against walls or partitions to a height that will endanger the stability or exceed the resisting strength of such walls and partitions.

5.0 Records

5.1 No documentation maintenance is required.

6.0 Attachments

6.1 None

Americas

Drilling, Boring & Direct Push Probing

S3AM-321-PR1

1.0 Purpose and Scope

1.1 This document provides procedures designed to help prevent injuries to personnel working on the project and pedestrians, property damage, and adverse environmental impact as a result of potential hazards associated with drilling, boring and direct-push probing. These hazards include, but are not limited to, encountering underground utilities, subsurface installations, rotating equipment and potential overhead hazards.

1.2 This procedure provides the minimum requirements to be followed when drilling, boring, and probing work are performed.

1.3 This procedure applies to all Americas-based employees and operations.

1.4 The Manager is responsible for meeting all the requirements in this procedure.

1.5 AECOM's clients may have specific procedures which shall be followed to identify and map utility and subsurface structures on their properties or facilities. Provided the client's procedures meet or exceed those of AECOM, approval shall be obtained from the Manager and the SH&E Manager to follow the client's procedures.

2.0 Terms and Definitions

2.1 **Underground Utilities –** All utility systems located beneath grade level, including, but not limited to, gas, electrical, water, compressed air, sewage, signaling, and communications, etc.

2.2 **Ground Disturbance (GD) –** Any indentation, interruption, intrusion, excavation, construction, or other activity in the earth's surface as a result of work that results in the penetration of the ground.

2.3 **Intrusive Activities –** Examples: Excavation of soil borings, installations of monitoring wells, installation of soil gas sampling probes, excavation of test pits / trenches or other man-made cuts, cavity, trench, or depression in an earth surface formed by earth removal.

2.4 **Subsurface Installations –** Examples: Subterranean tunnels, underground parking garages, and other structures beneath the surface.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-118-PR1 Hearing Conservation

3.3 S3AM-208-PR1 Personal Protection Equipment

3.4 S3AM-209-PR1 Risk Assessment & Management

3.5 S3AM-213-PR1 Subcontractor Management

3.6 S3AM-305-PR1 Hand & Power Tools

3.7 S3AM-306-PR1 Highway and Road Work

3.8 S3AM-322-PR1 Overhead Lines

3.9 S3AM-322-FM1 Overhead Electrical Lines Acknowledgement

3.10 S3AM-325-PR1 Lockout Tagout

3.11 S3AM-326-PR1 Machine Guarding

3.12 S3AM-331-PR1 Underground Utilities

3.13 S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Confirm the development of the project SH&E Plan and compliance with this procedure.
- Confirm the appropriate equipment and materials are available to conduct the drilling, boring or direct-push operations.
- Confirm compliance with *S3AM-331-PR1 Underground Utilities.*
- Review the *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* prior to authorizing work to proceed.
- Confirm that employees conducting drilling, boring or direct-push probing possess any required training, registrations or certifications.
- Confirm all employees involved and affected by the task review the SH&E Plan, *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* and Task Hazard Assessment (THA) prior to work commencing.
- Confirm an equipment maintenance inventory is maintained, schedules adhered to and appropriate inspections of equipment are conducted.
- Provide authorization (with the concurrence of the Site Supervisor and SH&E Manager) for work to resume if interrupted due to unexpected conditions or events.

4.1.2 **Safety, Health & Environment (SH&E) Manager**

- Assist AECOM management as needed by providing guidance and clarification as to issues that may arise.
- Review the project SH&E Plan to confirm compliance with jurisdictional regulations**.** Provide technical guidance as needed when a variance is pursued related to this procedure. Confirm variance process meets requirements identified in *S2-001-SM1 Global SH&E Management System Manual*.

4.1.3 **Employees**

- Maintain training as appropriate to the work to be completed (e.g., ground disturbance, lockout tagout, equipment operation, etc.). Refer to *S3AM-003-PR1 SH&E Training.*
- Review the SH&E Plan, *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* and Task Hazard Assessment (THA) prior to work commencing.
- As appropriate to the anticipated or encountered hazards and as addressed in the applicable planning documentation, utilize appropriate personal protective equipment (PPE) and applicable training, practices and operating procedures.
- Immediately notify the Manager of any unanticipated conditions or events. If assigned equipment, perform appropriate inspections and confirmations of maintenance and / or repairs.

4.2 Training

4.2.1 All on-site employees involved with drilling, boring, and direct-push probing shall be trained, at a minimum, in these procedures and in the procedures of *S3AM-331-PR1 Underground Utilities*.

4.2.2 All operators and assistants shall have the appropriate safety training based on the SH&E Training Matrix and any additional training assessments developed at the business group**,** and be versed in the equipment to be utilized.

- Refer to *S3AM-003-PR1 SH&E Training.*

- This training may include, but is not limited to, Excavation / Trenching (Ground Disturbance), HAZWOPER, Petroleum Safety Training (or Construction Safety Training), and H2S Alive as appropriate.
- Only qualified personnel shall operate and inspect equipment.

4.2.3 All on-site Employees involved with drilling, boring, and direct-push probing activities shall be provided with on-site orientation of the drill rig and its operation.

4.2.4 All Employees involved with drilling, boring and direct-push probing activities at a client site shall receive the applicable client-required training**.**

4.3 Planning

4.3.1 SH&E Plan – At a minimum, a SH&E plan that includes a pre-job hazard assessment shall be prepared and communicated to all involved personnel prior to any drilling, boring, and direct-push probing activities. Refer to *S3AM-209-PR1 Risk Assessment & Management*.

- Assessment shall include both overhead and subsurface utilities and installations. Refer to *S3AM-322-PR1 Overhead Lines* and *S3AM-331-PR1 Underground Utilities*.
- The SH&E Plan will address any required environmental monitoring including gas monitoring, dust, noise, metals, radiation or other monitoring as may be appropriate for site conditions.
- All SH&E Plan requirements will be followed by the project team.
- The location specific emergency response plan shall be in place, contain procedures applicable to the potential emergencies presented by the operations, and be reviewed with all personnel potentially affected.

4.3.2 A Task Hazard Assessment (THA) shall be completed before every assigned task at the work location. The focus of the analysis shall be on the specific assigned task and the evaluation of risks and assignment of control measures based on actual work conditions.

4.3.3 *S3AM-321- ATT2 Pre-Drilling, Boring & Direct-Push Probing Flow Chart* summarizes the key Pre-Drilling, Boring, and Direct-push probing requirements addressed in this procedure.

4.3.4 Procedures and documentation as detailed in *S3AM-322-PR1 Overhead Lines* and *S3AM-331-PR1 Underground Utilities* shall be completed prior to any intrusive subsurface work.

- The locations of subsurface and overhead utilities and subsurface installations will be investigated, documented, mapped on a site plan and evidenced with appropriate surface markings.
- A site walk shall be conducted by the project team / site Manager and any other appropriate personnel, with the objectives of reviewing all planned intrusive activity locations, the locations of subsurface and overhead utilities and the potential for subsurface installations, to determine the appropriate utility clearance activities, and to observe other physical hazards.
- All proposed subsurface activities will be reviewed in comparison to subsurface and overhead utilities and subsurface installations and adjustments made as necessary.
- Appropriate clearance activities shall confirm location(s) of identified underground utilities and subsurface structures. Review the applicable completed *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist.*
- Site Walks should be repeated as necessary following the clearance of subsurface utilities and installations to confirm hazards are clearly identified.

4.3.5 Confirm drilling location(s) and / or bore entry and bore exit points are adequately identified on the worksite to enable appropriate equipment positioning.

4.4 Permits, Notifications and Access Agreements

4.4.1 Any required notifications shall be provided within the appropriate timeframe to the applicable organization (e.g. owner, agency, governing body, etc.).

4.4.2 All applicable permits (e.g. client, government, working near rail road, etc.) will be identified, obtained, and adhered to.

4.4.3 Access agreements will be obtained and adhered to as necessary.

4.5 Pre-Qualifying and Re-Qualifying Drilling Subcontractors

4.5.1 All drilling subcontractors will be properly pre-qualified in accordance with *S3AM-213-PR1 Subcontractor Management*.

4.5.2 The qualifications of the drilling crew performing the work will be evaluated prior to each mobilization and each day by AECOM's on-site representative to assure that their safety performance, training, qualifications, equipment, processes, and approaches reflect AECOM standards for excellence.

4.5.3 All drilling subcontractor equipment will be properly maintained and properly equipped, and the drilling subcontractor will verify their equipment is fully functional as a normal part of their daily and pre-work routine. Refer to *S3AM-321-FM1 Daily Drilling, Boring & Direct Push Equipment Inspection.*

4.6 General Health and Safety

4.6.1 Personal Protective Equipment – Refer to the *S3AM-208-PR1 Personal Protection Equipment* for best practices. These requirements may be modified or expanded in the SH&E Plan. Clothing shall be close fitting and comfortable without loose ends, straps, draw strings, belts, or otherwise unfastened parts that might catch on some rotating or translating component of the rig.

- Depending upon the hazards present, additional PPE may be required such as fire retardant clothing, specific hearing protection, respiratory protective equipment and chemical protective clothing.
- If the location has potential for underground electrical utilities to be present, workers shall ensure footwear has additional protection of shock resistant soles required (white rectangle with omega symbol).

4.6.2 Hearing Conservation – Hearing conservation program requirements may apply when working around operating equipment. Refer to *S3AM-118-PR1 Hearing Conservation*.

- Each worker shall wear noise-reducing ear protectors around operating equipment or during elevated noise levels. Distance from the elevated noise level is the primary measure of control for non-essential drilling personnel.

4.7 Drilling, Boring and Direct Push Equipment Maintenance and Inspections

4.7.1 All equipment will be inspected prior to the initiation of operations and daily during operations using the *S3AM-321-FM1 Daily Drilling, Boring & Direct-Push Equipment Inspection*. This inspection is the responsibility of the operator who will provide written documentation of the inspection prior to the start of drilling each day.

- Equipment that is deemed defective will immediately be repaired by a qualified person, or, if repair is not practicable, tagged "Out of Service" and sent for repairs or discarded.

4.7.2 Managers shall confirm an accurate inventory of the equipment within their operation requiring scheduled maintenance is developed. Using applicable regulations, industry standards, best practices, and manufacturer's recommendations, a maintenance schedule shall be developed with defined responsibility, required actions, and frequency. Refer to *S3AM-321-FM2 Drilling, Boring, & Direct-Push Equipment Maintenance Inventory.*

4.7.3 The maintenance program for equipment shall:

- Adhere to applicable regulations, standards, and manufacturers' specifications;
- Provide for service by appropriately qualified maintenance personnel; and,
- Require maintenance schedules and records of maintenance.

4.7.4 Employees or operators who are assigned equipment are required to review maintenance schedules for that equipment and will confirm that required maintenance has occurred or see that it is undertaken.

4.8 General Requirements

4.8.1 Excluding geoprobe activities, set up any sample tables and general work areas for employees at a safe distance from the rig.

- The recommended safe distance is the height of the fully extended mast plus 5 feet (1.5 meters), and no less than 30 feet (9.1 meters) from the rig.
- An increase to this distance may be required due to noise exposure hazards. Refer to *S3AM-118-PR1Hearing Conservation.*

4.8.2 Operation of the drilling, boring or direct-push equipment shall be restricted to the designated operator except to activate the emergency shut-off as required.

- All rotary drilling equipment shall have an emergency shut off / kill switch. The location of the switch and operation should be reviewed with all involved Employees.

4.8.3 Sit-on direct push rigs are not permitted on AECOM worksites unless the rig has been modified (in accordance with manufacturer's requirements) to be operated by remote control or the rig has been manufactured with a rollover protection system and seat belt.

4.8.4 Consult jurisdictional regulations as use of J-hooks and cat-heads may be prohibited. Examples:

- 29 CFR 1926 requires derricks and cranes to use hooks with self-closing latches and permits the use of J-hooks only for a task unrelated to this procedure (setting trusses).
- British Columbia and Saskatchewan prohibit the use of friction cat-heads**.**

4.9 Identifying the Work Area

4.9.1 Ensure the work area is adequately identified:

- Including zone around the drilling, boring, or direct push equipment, as well as fluid equipment, entry point, exit point and any excavated areas.
- Utilize barricades, signage, pylons, snow fence, etc. as appropriate.
- Implement traffic control as necessary.
- Coordinate with concurrent operations to identify their associated hazards and controls, and communicate those associated with AECOM tasks.

4.9.2 When operating near public vehicular and pedestrian traffic, the on-site personnel shall take every precaution necessary to see that the work zone is properly established, identified, and isolated from both moving traffic and passer-by pedestrians (refer to *S3AM-306-PR1 Highway and Road Work*).

4.9.3 All traffic control devices shall be installed, placed, and maintained in accordance with a Traffic Control Plan, client specifications, and / or the Manual of Uniform Traffic Control Devices and Manual of Uniform Traffic Control Devices for Canada in Canada. Traffic control devices shall consist of and not be limited to

- Directional and informational signage;
- High visibility barricades, cones, or barrels;
- Lighting; and
- Other equipment and devices as required.

4.10 Clearing Work Areas

4.10.1 In addition to any minimum requirements the drilling subcontractor may have, prior to set up, adequate site clearing and leveling shall be performed to accommodate the rig and supplies and provide a safe working area.

4.10.2 Clearing the site includes clearing the intended drilling area obstacles and of underground utilities in accordance with *S3AM-331-PR1 Underground Utilities*.

4.10.3 Drilling or probing shall not commence when tree limbs, unstable ground, or site obstructions cause unsafe tool handling conditions.

- The cleared / levelled area should be large enough to accommodate the rig and supplies.
- If the rig is positioned on a steep grade and levelling of the ground is impossible or impractical, the wheel of the transport vehicle shall be blocked and other means employed of preventing the rig from moving or toppling over.

4.11 Drilling Activities

4.11.1 Federal / State / Provincial / Territorial regulations that govern drill rig operations and exposed moving parts shall be adhered to.

4.11.2 All applicable client on-site safety procedures shall be understood and adhered to.

4.11.3 Minimum approach distances (MAD) from subsurface and overhead utilities and subsurface installations will be established including 5 feet (1.5 meters) from any subsurface utility, 7 feet (2.1 meters) from the pad surrounding any underground storage tanks, and 10 feet (3 meters) from any overhead energized electrical line (or further depending on line voltage). These approach distances are a minimum; government regulations and utility requirements may dictate a greater set back distance and should be confirmed.

4.11.4 Verify that equipment / energy is isolated when lockout is required:

- Refer to operator's manual and *S3AM-325-PR1 Lockout Tagout*.
- Ensure stop switch is activated.
- Driller is out of the seat.
- Test controls to ensure they do not engage.

4.11.5 In addition to any identified minimum requirements (as applicable, client, drilling subcontractor), the following safety measures shall be taken during drilling, boring or probing operations on site:

- The operator and helper shall be present during all active rig operations.
- Site personnel shall remain within visual contact of the rig operator.
- Hard hats, approved safety boots, safety glasses, and hearing protection shall be worn in the work zone (minimum, the radius around the rig equal to the height of the drill rig mast) of a rig.
- Gas monitoring shall be conducted as appropriate.
- Hands, feet and other body parts shall be kept away from moving parts, (e.g. hoisted, rotating, pushing, etc.) including augers, drill rods and reamers.
- When observing drilling, stand upwind of the drill rig to prevent potential exposure to vapors that may be emitted from the borehole.
- The emergency shut-off switch on the rig shall be identified to site personnel and tested on a daily basis by the operator.
- Unauthorized personnel shall be kept outside of the established work zone.
- Rig crew and other worksite personnel shall not use a cell phone while operating the drill rig or other equipment or within the rig work zone.
- Do not drive the rig from hole to hole with the mast (derrick) in the raised position.
- Before raising the mast (derrick) look up to check for overhead obstructions. Refer to *S3AM-322-PR1 Overhead Lines*.

- Before raising the mast (derrick), all rig personnel (with the exception of the operator) and visitors should be cleared from the areas immediately to the rear and the sides of the mast. All rig personnel and visitors should be informed that the mast is being raised prior to raising it.
- Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig shall be first levelled and stabilized with levelling jacks and / or solid cribbing.
    - The drill rig shall be releveled if it settles after initial set up.
    - Lower the mast (derrick) only when the levelling jacks are down, and do not raise the levelling jack pads until the mast (derrick) is lowered completely.
- After the rig has been positioned to begin drilling, all brakes and / or locks shall be set before drilling begins.
- The operator of a rig shall only operate a drill rig from the position of the controls. The rig shall not be in operation if the operator of the rig leaves the area of the controls.
- Throwing or dropping tools shall not be permitted. All tools shall be carefully passed by hand between personnel or a hoist line should be used.
- If it is necessary to operate the rig within an enclosed area, make certain that exhaust fumes are conducted out of the area.
    - Exhaust fumes can be toxic and some cannot be detected by smell.
    - Air monitoring and, as necessary, noise monitoring shall be conducted.
- Clean mud and grease from boots before mounting a rig platform and use hand holds and railings. Watch for slippery ground when dismounting from the platform.
- During freezing weather, do not touch any metal parts of the rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.
- All unattended bore holes shall be adequately covered or otherwise protected to prevent rig personnel, site visitors, or animals from stepping or falling into the hole. All open bore holes shall be covered, protected, or backfilled adequately and according to Federal / State / Provincial / Territorial or local regulations on completion of the drilling project.
- When using a ladder on a rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending and descending. Always use adequate fall protection and a full body harness when climbing above 6 feet (1.8 meters) of the ground. Do not attempt to use one or both hands to carry a tool while on a ladder. Use a hoist line and a tool “bucket” or a safety hook to raise or lower hand tools.

4.12 Drilling Fluid

4.12.1 Ensure drilling fluid is appropriate to the soil type and conditions to be encountered to enable smooth drilling.

4.12.2 Drilling fluid used in the boring process shall be contained at the entry and, as applicable, exit locations until recycled or removed from the site.

4.12.3 Confirm drilling fluid does not enter roadways, streams, municipal storm or sanitary sewer lines, and / or any other drainage system or body of water.

4.12.4 Monitor drilling equipment and fluid equipment for any leakage or spills. Confirm appropriate containment is in place and adequate spill response supplies are available.

4.12.5 It is important to monitor fluid flow and pressure gauges when drilling with any tooling, but it is essential when drilling with a mud motor (pump placed in the drill string to provide additional power to the bit while drilling).

4.13 Unanticipated Concrete / Debris or Void

4.13.1 The presence of subsurface installations and utilities requires special care when obstructions / refusal and voids are encountered and when unexpected absence of soil recovery occurs during

drilling operations. Other indicators of subsurface installations and utilities are the presence of warning tape, pea gravel, sand, non-indigenous material, bentonite, red concrete (indicative of electrical duct banks) and any departure from native soil or backfill.

4.13.2 If unanticipated concrete / debris is encountered and / or if a void is encountered, drilling will be immediately discontinued and the Manager notified. Drilling may only proceed with Manager or SH&E Manager approval.

4.14 Use of Manual Slide Hammer

4.14.1 The following health and safety procedures should be followed when using a manual slide hammer to install shallow injection points, drive point piezometers, and drill tools:

- Only use a manual slide hammer that either attaches directly to the point / piezometer being driven or that incorporates a cap on the point / piezometer / drill tool that prevents the slide hammer from slipping off the point / piezometer / drill tool.
- Always grasp the manual slide hammer (handles if equipped with handles) with both hands while driving the point / piezometer / drill tool.
- Never allow hands or feet to get between the manual slide hammer and the drive plate or anvil.

4.15 Use of Augers

4.15.1 The following general health and safety procedures should be followed when supervising borings with continuous flight hollow-stem augers:

- Never place hands or fingers under the bottom of an auger section when it is being hoisted over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.
- When augers are rotating, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason.
- Use a long-handled shovel to move auger cuttings away from a rotating auger. Never use hands or feet to move cuttings away from a rotating auger.
- Do not attempt to remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.
- Loud noises may occur while driving split spoons. At minimum hearing protection shall be worn when driving split spoons.
- When pulling / lifting augers, a clevis pin or other closed device shall be used. Use of J-hooks is prohibited.

4.16 Attaching and Breaking Rods

4.16.1 Do not use manual tools (e.g., pipe wrenches) in combination with rotation of the drill stem. Manual tools are not designed for the load, and may break.

- The use of such tools creates a significant impact hazard for those in the work area, because they rotate with the drill stem. Manual tool use in combination with a rotating drill stem to attach or break rods is therefore prohibited.
- Manual tools may be used if the drill stem is isolated / positively disengaged.
- Mechanical means of rod separation that are permitted include:
  - Opposing hydraulic controls.
  - Rod locking devices or machine's power vice.
  - Hydraulic breakout tools.
  - Hydraulic foot clamps.

4.16.2 Rod box changes present severe crushing hazards. Operators shall ensure all crew members are clear of the machine and hoisting equipment while they are changing rod boxes.

4.17 Rotary, Sonic and Core Drilling

4.17.1 In addition to the health and safety procedures identified above, the following general health and safety procedures should be followed when supervising borings with rotary, sonic and core drilling:

- Drill rods should not be braked during lowering into the hole with drill rod chuck jaws. Drill rods should not be held or lowered into the hole with pipe wrenches.
- If a string of drill rods are accidentally or inadvertently released into the hole, do not attempt to grab the falling rods with your hands or a wrench.
- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use hands to clean drilling fluids from drill rods.
- When drill rods are rotating, stay clear of the rotating components of the drill rig. Never reach behind or around a rotating drill rod for any reason.
- Use a long-handled shovel to move cuttings away from the top of the borehole. Never use hands or feet to move cuttings away from the borehole.
- If work shall progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough-surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Keep away from area where drill rods are being moved or raised to the rig. Do not stand in the area where a drill rod will fall or slide if it should be dropped.
- Loud noises may occur during drilling. Hearing protection shall be worn.

4.18 Direct-push

4.18.1 The following general health and safety procedures should be followed when supervising drilling borings with direct-push drilling:

- Loud noise may occur during direct-push drilling. Appropriate hearing protection shall be worn.
- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a suitable rod wiper. Do not use hands to clean drilling fluids from drill rods.
- If work shall progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough-surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

4.19 Horizontal Directional Drilling

4.19.1 During surface to surface operations a 16.4’ (5 meters) safe zone shall be established and identified at both the entry and exit locations; no personnel are permitted to be within this zone unless the drill is locked out and the operator is out of the seat.

4.19.2 Machine shall be locked out before entering an excavation, changing tools, adding or removing drill stem or doing any other work on tools or the drill stem at the exit end of the bore.

4.19.3 A tracking head shall be installed on the drill stem:

4.19.4 Assemble drill head using components appropriate to the soil conditions to be encountered (e.g. nozzle, bit, beacon housing, etc.).

4.19.5 Ensure all personnel are clear of the bore entry point (outside of identified work zone).

4.19.6 At all times two way communication will be maintained at entrance and exit points using two way radios or equally effective communication means. If at any time communication is lost, all work will be stopped until communication is re-established

4.19.7 Locate drill head with tracking device at least every half-length of pipe. Adjust direction as necessary to follow the intended bore path.

4.19.8 Any drilling fluid returning to the surface shall be cleaned up promptly.

4.19.9 Drill pipe should exit the bore at an angle of 5 to 10° from the ground surface.

4.19.10 Turn off fluid flow as soon as drill head emerges.

4.19.11 Lockout machine and remove drill head using appropriate breakout tools.

4.19.12 Select and attach a reamer that allows the return of drilling fluids and cuttings, to reduce frictional pullback forces, and to allow for bend radius of the pipe. Reamer shall be:

- The smaller of 1.5 times the outside diameter (O.D.) or 12 inches (300mm) larger than the diameter of the product pipe.
- A diameter less than 1.5 times the diameter of the product may be necessary in collapsing soil formations.
- Reamed diameter may need to be increased by up to 25% if substantial swelling of the soil is expected to occur.

4.19.13 All personnel shall clear the trench or the designated surface zone (16.4 feet [5 meters]) once the reamer is attached. Operator shall only reverse lockout and commence pullback when communication is received from personnel on exit hole side and operator has confirmed the message.

4.19.14 Personnel on exit hole side shall ensure reamer is pulled the entire way back to the exit hole.

- If rotation is started when drill rod and reamer are away from the exit hole, very fast sideways movement of the rod and reamer can occur.
- Larger reamers and longer lengths of exposed drill rod increase the speed and distance of this movement.

4.19.15 If working with trailing drill stem, swivels shall be verified as lubricated and rotating freely by hand prior to use:

- A freely moving swivel prevents trailing drill stem or product from rotating / whipping.
- If the swivel does not move freely by hand it shall be removed from service and repaired or replaced.
- Only use swivels with limited articulation to prevent whipping or cranking action between the reamer and trailing drill pipe or product.

4.19.16 It is important to clean and lubricate the tool and drill stem joint threads before each use.

4.19.17 Any individual drill pipes that are bent or damaged shall be immediately taken out of service.

4.19.18 Occasionally change the order of the lead drill pipe (i.e. move the lead pipe to the end of the stem, or other pipe rotation procedures) to extend drill stem life.

4.19.19 Operator should avoid stalling the pipe rotation to avoid stress damage from shock loading.

4.20 Drilling at Potential MEC / UXO Sites

4.20.1 If the project site is suspected of containing munitions and explosives of concern (MEC) or unexploded ordnance (UXO), the UXO team will conduct a reconnaissance and MEC / UXO avoidance to provide clear access routes to each site before drilling crews enter the area. The following procedures will be implemented:

- Drilling operations on an MEC / UXO site will not be conducted until a complete plan for the site is prepared and approved by the AECOM UXO Safety Officer. MEC / UXO avoidance shall be conducted during drilling operations on known or suspect MEC / UXO sites.
- The UXO team will identify and distinctly mark the boundaries of a clear approach path for the drilling crews, vehicles, and equipment to enter the site. This path will be, at a minimum, twice the width of the widest vehicle. No personnel will be allowed outside any marked boundary.
- If MEC / UXO is encountered on the ground surface, the UXO team will clearly mark the area where it is found, report it to the proper authorities, and divert the approach path around it.
- The UXO team will conduct an access survey using the appropriate geophysical instrument over the approach path for avoidance of MEC / UXO that may be in the subsurface. If a magnetic anomaly is encountered, it will be assumed to be MEC / UXO, and the approach path will be diverted around the anomaly. UXO personnel only will operate the appropriate geophysical instrument and identify MEC / UXO.
- An incremental geophysical survey of the drill-hole location(s) will be initially accomplished by the UXO team using a hand auger to install a pilot hole. If MEC / UXO is encountered or an anomaly cannot be positively identified as inert material, Hazardous, Toxic, and Radioactive Waste (HTRW) sampling personnel will select a new drill-hole location.
- Once the surface of a drilling site has been cleared and a pilot hole established as described above, the drilling contractor will be notified that the site is available for subsurface drilling.

4.21 Movement and Transport of Drilling, Boring or Direct-Push Equipment

4.21.1 Personnel transporting equipment shall be properly licensed and shall operate the vehicle according to Federal / State / Provincial / Territorial, and local regulations. Refer to *S3AM-005-PR1 Driving* and *S3AM-320-PR1 Commercial Motor Vehicles*.

4.21.2 Confirm the traveling height (overhead clearance), width, length and weight of the equipment with the carrier. Identify highway and bridge load, width and overhead limits, to confirm these limits are not exceeded and with adequate margin.

4.21.3 Allow for overhang of any drilling, boring or direct-push equipment when cornering or approaching other vehicles or structures.

4.21.4 Be aware that the canopies of service stations and motels are often too low for equipment loaded on a trailer to clear

4.21.5 Watch for low hanging electrical lines, particularly at the entrances to drilling sites or restaurants, motels, other commercial sites.

4.21.6 Never travel on a street, road, or highway with any part of the drilling, boring or direct-push equipment in a raised or partially raised position.

4.21.7 Remove all ignition keys if rig is left unattended unless client requirements specify that the keys remain in the ignition switch at all times.

4.21.8 Before moving a rig on location, the operator shall do the following:

- To the extent practical, walk the planned route of travel and inspect it for depressions, gullies, ruts, and other obstacles.
- Check the brakes of the truck / carrier, especially if the terrain along the route of travel is rough or sloped.
- Discharge all passengers before moving on rough or steep terrain.

4.21.9 Engage the front axle (on 4x4, 6x6, etc., vehicles) before traversing rough or steep terrain

4.21.10 Driving drill rigs along the sides of hills or embankments should be avoided; however, if side-hill travel becomes necessary, the operator shall conservatively evaluate the ability of the rig to remain upright while on the hill or embankment. The possibility shall be considered that the presence of

drilling tools on the rig may reduce the ability of the rig to remain upright (raises the center of mass of the rig).

4.21.11 Logs, ditches, road curbs, and other long and horizontal obstacles should be approached and driven over squarely, not at an angle.

4.21.12 When close lateral or overhead clearance is encountered, or when backing up, the driver of the rig shall be guided by another person on the ground.

4.21.13 Loads on the drill rig and truck shall be properly stored while the truck is moving, and the mast shall be in the fully lowered position.

4.22 Loading and Unloading

4.22.1 Consult applicable manufacturer's recommendations for loading and unloading of the equipment.

4.22.2 Use ramps of adequate design that are solid and substantial enough to bear the weight of the rig with carrier, including tools.

4.22.3 Load and unload on level ground.

4.22.4 Use the assistance of someone on the ground as a guide.

4.22.5 Check the brakes on the rig carrier before approaching loading ramps.

4.22.6 Distribute the weight of the rig, carrier, and tools on the trailer so that the center of weight is approximately on the centerline of the trailer and so that some of the trailer load is transferred to the height of the pulling vehicle. Refer to the trailer manufacturer's weight distribution recommendations.

4.22.7 The rig and tools should be secured to the hauling vehicle with ties, chains, and / or load binders of adequate capacity.

5.0 Records

5.1 All employee training files shall be maintained in accordance with *S3AM-003PR1 SH&E Training*.

5.2 Completed inspections and maintenance inventories shall be maintained the site or project files.

6.0 Attachments

6.1 S3AM-321-ATT1 Core Drilling Machine

6.2 S3AM-321-ATT2 Pre-Drilling, Boring, & Direct-Push Probing Flow Chart

6.3 S3AM-321-FM1 Daily Drilling, Boring & Direct-Push Equipment Inspection

6.4 S3AM-321-FM2 Drilling, Boring & Direct-Push Equipment Maintenance Inventory

Americas

Underground Utilities

S3AM-331-PR1

1.0 Purpose and Scope

1.1 Provides procedures designed to help prevent injuries to personnel working on the location and pedestrians, property damage, and adverse environmental impact as a result of potential hazards associated with encountering underground utilities, subsurface installations, and potential overhead hazards.

1.2 Provides the minimum requirements to be followed for underground work (e.g., excavations, drilling, boring, and probing work) to ensure that underground installations, and subsurface structures, are identified properly before work commences.

1.3 This procedure applies to all Americas-based employees and operations.

1.4 The Manager is responsible for meeting all the requirements in this procedure.

1.5 A M's clients may ha e specific procedures which shall be followed to identify and map utility and subsurface structures on their properties or facilities. ro ided the client's procedures meet or exceed those of A M, appro al shall be obtained from the Manager and the Manager to follow the client's procedures.

2.0 Terms and Definitions

2.1 **Underground Utilities –** All utility systems located beneath grade level, including, but not limited to, gas, electrical, water, compressed air, sewage, signaling and communications, etc.

2.2 **Clearance** – includes the following:

- The positive locating of underground utilities or subsurface installations in or near the work area.
- A signed statement by an appropriate representative attesting to the location of underground utilities and/or the positive de-energizing (including lockout) and testing of electrical utilities.

2.3 **Ground Disturbance (GD) –** Any indentation, interruption, intrusion, excavation, construction, or other acti ity in the earth's surface as a result of wor that results in the penetration of the ground.

2.4 **Hand Clearance Zone –** The area on either side of the locate marks of a utility that shall be maintained in order to expose the utility through the use of non-destructive ground disturbance techniques acceptable to the owner of the buried utility. Visual exposure is required before mechanical excavation equipment may be used.

2.5 **Intrusive Activities –** Examples: Excavation of soil borings, installations of monitoring wells, installation of soil gas sampling probes, excavation of test pits/trenches or other man-made cuts, cavity, trench or depression in an earth surface formed by earth removal.

2.6 **Non-Destructive Ground Disturbance Technique –** A safe and acceptable excavation method that is used to visually expose an underground utility without causing damage. Non-destructive ground disturbance techniques may include, but are not limited to:

- Hand digging.
- Use of non-conductive tools.
- Hydro-vacuum.

2.7 **Subsurface Installation –** Examples: Subterranean tunnels, underground parking garages and other structures beneath the surface.

2.8 **Utility Strikes –** Unplanned contact with utilities resulting in damage to the utility or its protective coating.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-303-PR1 Excavation

3.3 S3AM-321-PR1 Drilling, Boring & Direct-Push Probing

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Administer this procedure and the development of the SH&E Plan.
- Confirm the appropriate equipment and materials are available to conduct the underground utility and/or subsurface installation clearance.
- Confirm all employees involved and affected by the task review the SH&E Plan and Task Hazard Assessment (THA) prior to work commencing
- Authorize work to proceed using the *S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist*.
- Confirm that employees conducting underground utilities and subsurface clearance processes possess all required training, registrations or certifications.
- Provide authorization (with the concurrence of the Site Supervisor and SH&E Manager) for work to resume if interrupted due to unexpected conditions or events.

4.1.2 **Safety, Health & Environment (SH&E) Manager**

- Assist AECOM management as needed by providing guidance and clarification as to issues that may arise.
- Review the SH&E Plan to confirm compliance with jurisdictional regulations. Provide technical guidance as needed when a variance is pursued related to this procedure.

4.1.3 **Employees**

- Maintain training as appropriate to the work to be completed (e.g. ground disturbance, lockout tagout, equipment operation, etc.). Refer to *S3AM-003-PR1 SH&E Training*.
- Review the SH&E Plan and Task Hazard Assessment (THA) prior to work commencing.
- As appropriate to the anticipated or encountered hazards and as addressed in the applicable planning documentation, utilize appropriate personal protective equipment (PPE) and applicable training, practices and operating procedures.
- Immediately notify the Manager of any unanticipated conditions or events. If assigned equipment, perform appropriate inspections and confirmations of maintenance and/or repairs.

4.2 Training

4.2.1 All on-site employees involved with the underground utility and subsurface identification and associated clearance process shall be trained, at a minimum, in these procedures.

4.2.2 Employees shall complete all required training associated with their tasks in accordance with the SH&E Training Matrix and any training assessments developed at the business group.

- Refer to *S3AM-003-PR1 SH&E Training.*
- This training may include, but is not limited to, Excavation / Trenching (Ground Disturbance), HAZWOPER, Petroleum Safety Training (or Construction Safety Training), and H2S Alive as appropriate.

4.2.3 As applicable, employees shall receive client-required training.

4.3 Planning

4.3.1 Health and Safety Plan – At a minimum, a SH&E Plan and task hazard assessments (THAs) shall be prepared prior to any underground utilities and subsurface installations clearance activities.

- The SH&E Plan will address any required environmental monitoring including gas monitoring, dust, noise, metals, radiation or other monitoring as may be appropriate for site conditions.
- Employees shall comply with all SH&E Plan requirements.
- The location specific emergency response plan shall be in place, contain procedures applicable to the potential emergencies presented by the operations, and be reviewed with all personnel potentially affected.

4.3.2 *S3AM-331-ATT2 Underground Utilities & Subsurface Installation Clearance Flow Chart* provides a summary of the key requirements addressed in this procedure.

4.3.3 Underground utilities and subsurface installations shall be investigated as being present, including the following, but not limited to:

- Steam, gas and electric.
- Sewer and water.
- Subterranean tunnels.
- Fibre optics (note: routine geophysical surveys will not identify fibre optic cables).
- Traffic control cables.

4.3.4 Location of underground utilities and subsurface installations will be confirmed by cross-referencing available information:

- Maps, as-built drawings and issued for construction (IFC) drawings.
- Plot plans, permits, crossing/encroachment agreements.
- One-Call information, locator and provided surveys.
- Private utility information, locator and provided surveys (e.g. ground penetrating radar (GPR), electromagnetic, etc.).
- Owner supplied documentation.
- Site walks.

4.3.5 As applicable, emergency shut-off locations of utilities shall be verified before work activities commence.

4.3.6 Jurisdictional, land owner, client and utility owner requirements shall be consulted to determine the minimum search zone dimensions and appropriate clearance distances.

4.3.7 As necessary and if possible, adjust locations of excavations or intrusive subsurface work away from subsurface utilities and installations

4.3.8 Prior to any excavation or intrusive subsurface work, the *S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist* shall be completed. The form shall be reviewed and signed by the Manager.

- If the answer to any question in Part 1 of the chec list is o or A , no ground disturbance may take place without review by the Manager, in consultation with SH&E Manager, of the circumstances related to the particular item. The Manager shall initial beside each o or A item to indicate re iew and authori ation.

4.4 Permits, Notifications and Access Agreements

4.4.1 Any required notifications shall be provided within the appropriate timeframe to the applicable organization (e.g. owner, utility company, agency, governing body, etc.).

4.4.2 All applicable permits (e.g. client, government, working near rail road, etc.) will be identified, obtained, and adhered to.

4.4.3 All access agreements will be obtained and adhered to.

4.5 Locating Underground Utilities and Subsurface Installations

4.5.1 Utilize the appropriate call/click-before-you-dig provider. Refer to *S3AM-331-ATT1 One-Call System*.

4.5.2 Federal tate ro incial erritorial and other ne all pro iders shall be contacted at least two working days and no more than ten working days prior to commencing the ground disturbance. Jurisdictional requirements shall be consulted to verify the appropriate advance notice. (e.g. 24 hours, two full working days, three to ten business days, etc.).

4.5.3 If the location of proposed excavation or intrusive subsurface work cannot be clearly and adequately identified, the route and/or area of the proposed ground disturbance shall be identified using white flags, paint or stakes prior to the arrival of the locator. Consult jurisdictional requirements as white-lining may be a mandatory requirement on all ground disturbances.

4.5.4 One Call providers shall appropriately identify and mark the subsurface utilities or installations, or otherwise provide written notification they do not have any facilities near the proposed subsurface/intrusive locations.

4.5.5 Confirm all circuits were on during subsurface checks if the checks were for identifying energized lines (e.g. circuits on timers or light sensing switches).

4.5.6 Areas that have a high density of sub-surface facilities may require a secondary locate by another independent locator to verify locations identified by the first locator.

4.6 Private Utility Locating

4.6.1 One Call services may not be available in various non-urban locations. Private utility locating companies shall be utilized to identify and located any underground utilities or subsurface installations.

4.6.2 Be aware urban areas (e.g. city or town) may have subsurface installations (e.g. underground garages) and utilities (e.g. public water, sewer, and gas pipelines) that are not covered by one-call systems.

- These subsurface installations and utilities require additional investigation and diligence beyond the one-call system.
- Additional investigation and diligence beyond the one-call system is also recommended for non-urban areas.

4.6.3 In urban areas, private utility locating companies shall be called to identify and locate, through geophysical surveys and other means, the presence of private utilities installed by the property owner (e.g. irrigation systems) and to verify the presence of public utilities on the properties.

- Hand clearing is required in urban areas.

4.6.4 Hand clearing is also recommended for non-urban areas and may be required by the given jurisdiction.

4.6.5 Warning tape, pea gravel, sand, non-indigenous material, bentonite, red concrete (indicative of electrical duct banks) and any departure from native soil or backfill may be evidence of the presence of subsurface installations and utilities.

4.7 Surface Markings

4.7.1 Once the underground installation has been identified, proper surface markings shall be made in accordance with the guidelines from the One-Call System (refer to S3AM-331-ATT1), guidance contained in this procedure or as contract-specified.

4.7.2 Color-coded surface marks (paints or similar coatings) shall be used to indicate the type, location, and route of buried installations. Additionally, to increase visibility, color-coded vertical markers (temporary stakes or flags) shall supplement surface marks.

4.7.3 All marks and markers shall indicate the name, initials, or logo of the company that owns or operates the installation and the width of the installation if it is greater than 2 inches.

4.7.4 If the surface over the buried installation is to be removed, supplemental offset marking shall be used. Offset markings shall be on a uniform alignment and shall clearly indicate that the actual installation is a specific distance away.

4.7.5 Locate marks shall be re-verified as per jurisdictional requirements or no later than 14 days after the previous locate was completed, whichever interval is shorter. These locate time intervals shall be maintained for the duration of the ground disturbance.

- If the work is interrupted during the determined lifespan or work does not commence during the applicable lifespan, a new locate shall be performed.
- Jurisdictional provisions may allow for an extension to the lifespan of the locate marks, however certain conditions may need to be met. (e.g. activities uninterrupted)
- If locate marks are moved or destroyed the location of the buried facilities shall be re-established.

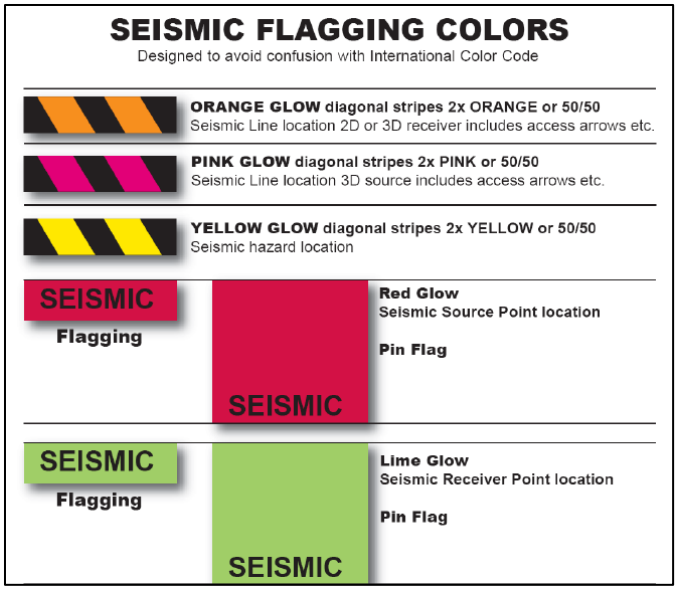
4.8 Uniform Color Coding

4.8.1 The colors and corresponding installation type are as follows unless otherwise contract-specified:

AMERICAN PUBLIC WORKS ASSOCIATION – APWA
Color Coding for Marking of Buried Facilities

White	Proposed Ground Disturbance Area
Pink	Temporary Survey Markings
Red	Electric Power Lines, Cables, Conduit and Lighting Cables
Yellow	Gas, Oil, Steam, Petroleum Lines or Gaseous Materials
Orange	Conduit, Cable, Communication, Alarm or Signal Lines
Blue	Potable Water
Green	Sewer, Storm Sewer and Drain Lines
Purple	Reclaimed Water, Irrigation and Slurry Lines (non-potable)

Canadian Association of Geophysical Contractors



4.9 Identification and Mapping of Utility and Subsurface Structures

4.9.1 The locations of subsurface utilities and subsurface installations shall be investigated, documented, and shown on a site plan (a scaled site plan shall be used when feasible). Refer to *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist.*

4.9.2 Documentation of utility and subsurface installation identification (calling one call, responses from utilities) along with the scaled site plan shall be available on the worksite at all times of intrusive activities.

4.10 Site Walk

4.10.1 A site walk shall be conducted by the AECOM Manager and any other appropriate personnel with the objectives of reviewing all planned intrusive activity locations, the locations of subsurface and overhead utilities, overhead obstructions, and the potential for subsurface installations, to determine the appropriate utility clearance activities, and to observe other physical hazards.

- Walk the area at least 50 feet (15.2 meters) from perimeter of the site to observe physical hazards.
- Walk the area of at least 50 feet (15.2 meters) radius from each proposed subsurface intrusion location.
- If possible, particularly at urban and industrial sites, the client/property owner or an individual knowledgeable about the site and site utilities will attend the site walk.
- Add discovered items/issues to map for use in location confirmation.

4.10.2 The Site Walk further supplements the Identification and Mapping of Utility and Subsurface Structures procedure. Site Walks should be repeated as necessary following the Identification and Mapping of Utility and Subsurface Structures as visual verification of the hazards. Examples include:

- Proposed location(s) does not lie on a line connecting two similar manhole covers (e.g. sanitary sewer or storm drain).
- Proposed subsurface location(s) has not subsided, been excavated and patched, nor gives the appearance it may be covering a former trench (e.g. linear cracks, sagging curbs, linear re-pavements, etc.).
- Proposed subsurface location(s) does not lie on a line with any water, gas, electrical meters, utility cleanouts, or other utility boxes in the surrounding areas.

4.11 Proposed Subsurface Investigation Locations

4.11.1 All proposed subsurface locations will be reviewed in comparison to subsurface and overhead utilities and subsurface installations and adjustments made as necessary.

4.11.2 Minimum set back distances from subsurface and overhead utilities and subsurface installations will be established including 5 feet (1.5 meters) from any subsurface utility, 7 feet (2.1 meters) from the pad surrounding any underground storage tanks, and 10 feet (3 meters) from any overhead energized electrical line (or further depending on line voltage). These set back distances are a minimum; government regulations and utility requirements may dictate a greater set back distance.

4.12 Utility Clearance Investigation Location Confirmation

4.12.1 As applicable, all client on-site safety procedures shall be understood and adhered to.

4.12.2 Hand exposure or non-destructive ground disturbance techniques to expose an underground utility or subsurface installation are necessary to accurately determine size, location and alignment prior to mechanical excavation or intrusive subsurface work in the vicinity of that utility or installation.

4.12.3 Non-destructive ground disturbance techniques shall be acceptable to the owner of the buried utility (i.e. hydro-vacuum temperature or pressure).

4.12.4 Hydro-vacuum or air-knife require proper grounding equipment at sites where the subsurface may contain flammable gases, liquids, or vapors

4.12.5 Jurisdictional, land owner, client and utility owner requirements shall be consulted to determine the distance of the hand exposure zone, and what requirements, when met, may allow mechanical excavation within these zones.

4.12.6 At a minimum, all underground utilities and subsurface installations within a 5 feet (1.5 meter) radius of the work site shall be identified and physically located (seen) before use of mechanical excavation equipment is permitted. Jurisdictional, client, land owner and utility owner requirements shall be consulted as the required hand exposure radius may be larger.

4.12.7 In urban areas, proposed subsurface locations will be hand cleared to 5 feet (1.5 meters) (soil borings and wells) or 12 inches (30 centimeters) (soil gas sampling probes) using non-mechanical methods.

- In non-urban areas, hand clearing should be conducted if possible and shall be conducted as required by the given jurisdiction.
- Hand clearance should be extended if locations of deep utilities and structures are not known.
- Hand exposure or non-destructive ground disturbance techniques should extend a minimum of 24 inches (60 centimeters) below the intended ground disturbance depth to minimize the hazard of mechanical equipment contact with any utility or installation.

4.12.8 Mechanical equipment and attachment dimensions shall be considered when establishing the zone in which all underground utilities and subsurface installations are physically located (seen) prior to the use of that equipment. The radius may require expanding to maintain safe distances when using large equipment.

4.13 Utility Strikes

4.13.1 Utility strikes shall be reported in accordance with *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*.

4.13.2 All damaged utilities shall be repaired by a qualified and/or licensed professional.

5.0 Records

5.1 Retain completed *S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist* and documents related the clearance process (e.g. Utility Owner communication, etc.) in the site or project files.

5.2 Documentation of employee training completed shall be retained in accordance with *S3AM-003-PR1 SH&E Training*.

6.0 Attachments

6.1 S3AM-331-ATT1 One-Call System

6.2 S3AM-331-ATT2 Underground Utilities & Subsurface Installation Flow Chart

6.3 S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist

Attachment C
Safety Data Sheets (SDSs)

Fisher Scientific

Part of Thermo Fisher Scientific

SAFETY DATA SHEET

Revision Date 10-Feb-2015 **Revision Number** 1

1. Identification

Product Name **Benzo[a]pyrene, 98%**

Cat No. : **AC105600010; AC105601000**

Synonyms Benzo[def]chrysene.; 3,4-Benzopyrene; 3,4-Benzpyrene

Recommended Use Laboratory chemicals.

Uses advised against No Information available

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Entity / Business Name
Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Sensitization	Category 1
Germ Cell Mutagenicity	Category 1A
Carcinogenicity	Category 1A
Reproductive Toxicity	Category 1A

Label Elements

Signal Word
Danger

Hazard Statements
May cause an allergic skin reaction
May cause genetic defects
May cause cancer
May damage fertility or the unborn child

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Avoid breathing dust/fume/gas/mist/vapors/spray
Contaminated work clothing should not be allowed out of the workplace
Wear protective gloves
Response
IF exposed or concerned: Get medical attention/advice
Skin
IF ON SKIN: Wash with plenty of soap and water
If skin irritation or rash occurs: Get medical advice/attention
Wash contaminated clothing before reuse
Storage
Store locked up
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Very toxic to aquatic life with long lasting effects

3. Composition / information on ingredients

Component	CAS-No	Weight %
Benzo[a]pyrene	50-32-8	> 96

4. First-aid measures

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes.

Inhalation Move to fresh air.

Ingestion Do not induce vomiting.

Most important symptoms/effects May cause allergic skin reaction. Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Unsuitable Extinguishing Media No information available

Flash Point
Method - No information available

Autoignition Temperature No information available
Explosion Limits

Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products
None known
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	0	0	N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment.
Environmental Precautions	See Section 12 for additional ecological information. Avoid release to the environment. Collect spillage.

Methods for Containment and Clean Up No information available.

7. Handling and storage

Handling Ensure adequate ventilation.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Benzo[a]pyrene		TWA: 0.2 mg/m^3	

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Benzo[a]pyrene	TWA: 0.005 mg/m^3		TWA:

Legend

OSHA - Occupational Safety and Health Administration

Engineering Measures Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Powder Solid
Appearance	Dark yellow
Odor	aromatic
Odor Threshold	No information available
pH	
Melting Point/Range	175 179 °C
Boiling Point/Range	°C @ 760 mmHg
Flash Point	
Evaporation Rate	No information available
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	No information available
Relative Density	No information available
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	C20H12
Molecular Weight	252.31

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products.

Incompatible Materials Strong oxidizing agents

Hazardous Decomposition Products None under normal use conditions

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Component Information

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Benzo[a]pyrene	50-32-8	Group 1	Reasonably Anticipated	A2	X	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
Endocrine Disruptor Information No information available

Component	EU - Endocrine Disrupters Candidate List	EU - Endocrine Disruptors - Evaluated Substances	Japan - Endocrine Disruptor Information
Benzo[a]pyrene	Group III Chemical	Not applicable	Not applicable

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity
Do not empty into drains.

Persistence and Degradability No information available
Bioaccumulation/ Accumulation No information available.

Mobility No information available.

Component	log Pow
Benzo[a]pyrene	6.06

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Benzo[a]pyrene - 50-32-8	U022	-

14. Transport information

DOT
UN-No UN3077
Proper Shipping Name ENVIRONMENTALLY HAZARDOUS SUBSTANCE,SOLID, N.O.S.
Hazard Class 9
Packing Group III

TDG
UN-No UN3077
Proper Shipping Name ENVIRONMENTALLY HAZARDOUS SUBSTANCE,SOLID, N.O.S.
Hazard Class 9
Packing Group III

IATA
UN-No UN3077
Proper Shipping Name ENVIRONMENTALLY HAZARDOUS SUBSTANCE,SOLID, N.O.S.
Hazard Class 9
Packing Group III

IMDG/IMO
UN-No UN3077

Proper Shipping Name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE,SOLID, N.O.S.
Hazard Class	9
Packing Group	III

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Benzo[a]pyrene	X	X	-	200-028-5	-		X	-	-	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Benzo[a]pyrene	50-32-8	> 96	0.1

SARA 311/312 Hazardous Categorization

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Benzo[a]pyrene	-	-	X	X

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA
Not applicable

Component	Hazardous Substances RQs	CERCLA EHS RQs
Benzo[a]pyrene	1 lb	-

California Proposition 65 This product does not contain any Proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Benzo[a]pyrene	50-32-8	Carcinogen	0.06 µg/day	Carcinogen

State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Benzo[a]pyrene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): N
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

Canada
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class D2A Very toxic materials

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Revision Date 10-Feb-2015
Print Date 10-Feb-2015
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

Disclaimer
The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of SDS

Safety Data Sheet

Material Name: Diesel Fuel, All Types

SDS No. 9909
US GHS

Synonyms: Ultra Low Sulfur Diesel; Low Sulfur Diesel; No. 2 Diesel; Motor Vehicle Diesel Fuel; Non-Road Diesel Fuel; Locomotive/Marine Diesel Fuel

* * * Section 1 - Product and Company Identification * * *

Manufacturer Information

Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

Phone: 732-750-6000 Corporate EHS
Emergency # 800-424-9300 CHEMTREC
www.hess.com (Environment, Health, Safety Internet Website)

* * * Section 2 - Hazards Identification * * *

GHS Classification:

Flammable Liquids - Category 3
Skin Corrosion/Irritation – Category 2
Germ Cell Mutagenicity – Category 2
Carcinogenicity - Category 2
Specific Target Organ Toxicity (Single Exposure) - Category 3 (respiratory irritation, narcosis)
Aspiration Hazard – Category 1
Hazardous to the Aquatic Environment, Acute Hazard – Category 3

GHS LABEL ELEMENTS

Symbol(s)

Signal Word

DANGER

Hazard Statements

Flammable liquid and vapor.
Causes skin irritation.
Suspected of causing genetic defects.
Suspected of causing cancer.
May cause respiratory irritation.
May cause drowsiness or dizziness.
May be fatal if swallowed and enters airways.
Harmful to aquatic life.

Precautionary Statements

Prevention

Keep away from heat/sparks/open flames/hot surfaces. No smoking
Keep container tightly closed.
Ground/bond container and receiving equipment.

Use explosion-proof electrical/ventilating/lighting/equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Wear protective gloves/protective clothing/eye protection/face protection.
Wash hands and forearms thoroughly after handling.
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Avoid breathing fume/mist/vapours/spray.

Response

In case of fire: Use water spray, fog or foam to extinguish.
IF ON SKIN (or hair): Wash with plenty of soap and water. Remove/Take off immediately all contaminated clothing and wash it before reuse. If skin irritation occurs: Get medical advice/attention.
IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a poison center/doctor if you feel unwell.
If swallowed: Immediately call a poison center or doctor. Do NOT induce vomiting.
IF exposed or concerned: Get medical advice/attention.

Storage

Store in a well-ventilated place. Keep cool.
Keep container tightly closed.
Store locked up.

Disposal

Dispose of contents/container in accordance with local/regional/national/international regulations.

* * * Section 3 - Composition / Information on Ingredients * * *

CAS #	Component	Percent
68476-34-6	Fuels, diesel, no. 2	100
91-20-3	Naphthalene	<0.1

A complex mixture of hydrocarbons with carbon numbers in the range C9 and higher.

* * * Section 4 - First Aid Measures * * *

First Aid: Eyes

In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

First Aid: Skin

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or with waterless hand cleanser. Obtain medical attention if irritation or redness develops. Thermal burns require immediate medical attention depending on the severity and the area of the body burned.

First Aid: Ingestion

DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

First Aid: Inhalation

Remove person to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

* * * Section 5 - Fire Fighting Measures * * *

General Fire Hazards

See Section 9 for Flammability Properties.

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

Hazardous Combustion Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

Extinguishing Media

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, and other gaseous agents.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

Unsuitable Extinguishing Media

None

Fire Fighting Equipment/Instructions

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment. Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing. Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

* * * Section 6 - Accidental Release Measures * * *

Recovery and Neutralization

Carefully contain and stop the source of the spill, if safe to do so.

Materials and Methods for Clean-Up

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal. Caution, flammable vapors may accumulate in closed containers.

Emergency Measures

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Personal Precautions and Protective Equipment

Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

Environmental Precautions

Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Prevention of Secondary Hazards

None

* * * Section 7 - Handling and Storage * * *

Handling Procedures

Handle as a combustible liquid. Keep away from heat, sparks, excessive temperatures and open flame! No smoking or open flame in storage, use or handling areas. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents."

Storage Procedures

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks."

Incompatibilities

Keep away from strong oxidizers.

* * * Section 8 - Exposure Controls / Personal Protection * * *

Component Exposure Limits

Fuels, diesel, no. 2 (68476-34-6)

ACGIH: 100 mg/m3 TWA (inhalable fraction and vapor, as total hydrocarbons, listed under Diesel fuel)
Skin - potential significant contribution to overall exposure by the cutaneous route (listed under Diesel fuel)

Naphthalene (91-20-3)

ACGIH: 10 ppm TWA
15 ppm STEL
Skin - potential significant contribution to overall exposure by the cutaneous route
OSHA: 10 ppm TWA; 50 mg/m3 TWA
NIOSH: 10 ppm TWA; 50 mg/m3 TWA
15 ppm STEL; 75 mg/m3 STEL

Engineering Measures

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

Personal Protective Equipment: Respiratory

A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

Personal Protective Equipment: Hands

Gloves constructed of nitrile, neoprene, or PVC are recommended.

Personal Protective Equipment: Eyes

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

Personal Protective Equipment: Skin and Body

Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

* * * Section 9 - Physical & Chemical Properties * * *

Appearance:	Clear, straw-yellow.	**Odor:**	Mild, petroleum distillate odor
Physical State:	Liquid	**pH:**	ND
Vapor Pressure:	0.009 psia @ 70 °F (21 °C)	**Vapor Density:**	>1.0
Boiling Point:	320 to 690 °F (160 to 366 °C)	**Melting Point:**	ND
Solubility (H2O):	Negligible	**Specific Gravity:**	0.83-0.876 @ 60°F (16°C)
Evaporation Rate:	Slow; varies with conditions	**VOC:**	ND
Percent Volatile:	100%	**Octanol/H2O Coeff.:**	ND
Flash Point:	>125 °F (>52 °C) minimum	**Flash Point Method:**	PMCC
Upper Flammability Limit (UFL):	7.5	**Lower Flammability Limit (LFL):**	0.6
Burning Rate:	ND	**Auto Ignition:**	494°F (257°C)

* * * Section 10 - Chemical Stability & Reactivity Information * * *

Chemical Stability

This is a stable material.

Hazardous Reaction Potential

Will not occur.

Conditions to Avoid

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources.

Incompatible Products

Keep away from strong oxidizers.

Hazardous Decomposition Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

* * * Section 11 - Toxicological Information * * *

Acute Toxicity

A: General Product Information

Harmful if swallowed.

B: Component Analysis - LD50/LC50

Naphthalene (91-20-3)

Inhalation LC50 Rat >340 mg/m3 1 h; Oral LD50 Rat 490 mg/kg; Dermal LD50 Rat >2500 mg/kg; Dermal LD50 Rabbit >20 g/kg

Potential Health Effects: Skin Corrosion Property/Stimulativeness

Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are repeatedly exposed.

Potential Health Effects: Eye Critical Damage/ Stimulativeness

Contact with eyes may cause mild irritation.

Potential Health Effects: Ingestion

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

Potential Health Effects: Inhalation

Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

Respiratory Organs Sensitization/Skin Sensitization

This product is not reported to have any skin sensitization effects.

Generative Cell Mutagenicity

This material has been positive in a mutagenicity study.

Carcinogenicity

A: General Product Information

Suspected of causing cancer.

Studies have shown that similar products produce skin tumors in laboratory animals following repeated applications without washing or removal. The significance of this finding to human exposure has not been determined. Other studies with active skin carcinogens have shown that washing the animal's skin with soap and water between applications reduced tumor formation.

B: Component Carcinogenicity

Fuels, diesel, no. 2 (68476-34-6)

ACGIH: A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans (listed under Diesel fuel)

Naphthalene (91-20-3)

ACGIH: A4 - Not Classifiable as a Human Carcinogen
NTP: Reasonably Anticipated To Be A Human Carcinogen (Possible Select Carcinogen)
IARC: Monograph 82 [2002] (Group 2B (possibly carcinogenic to humans))

Reproductive Toxicity

This product is not reported to have any reproductive toxicity effects.

Specified Target Organ General Toxicity: Single Exposure

This product is not reported to have any specific target organ general toxicity single exposure effects.

Specified Target Organ General Toxicity: Repeated Exposure

This product is not reported to have any specific target organ general toxicity repeat exposure effects.

Aspiration Respiratory Organs Hazard

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

* * * Section 12 - Ecological Information * * *

Ecotoxicity

A: General Product Information

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations.

B: Component Analysis - Ecotoxicity - Aquatic Toxicity

Fuels, diesel, no. 2 (68476-34-6)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	35 mg/L [flow-through]	

Naphthalene (91-20-3)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	5.74-6.44 mg/L [flow-through]	
96 Hr LC50 Oncorhynchus mykiss	1.6 mg/L [flow-through]	
96 Hr LC50 Oncorhynchus mykiss	0.91-2.82 mg/L [static]	
96 Hr LC50 Pimephales promelas	1.99 mg/L [static]	

96 Hr LC50 Lepomis macrochirus	31.0265 mg/L [static]
72 Hr EC50 Skeletonema costatum	0.4 mg/L
48 Hr LC50 Daphnia magna	2.16 mg/L
48 Hr EC50 Daphnia magna	1.96 mg/L [Flow through]
48 Hr EC50 Daphnia magna	1.09 - 3.4 mg/L [Static]

Persistence/Degradability
No information available.

Bioaccumulation
No information available.

Mobility in Soil
No information available.

* * * Section 13 - Disposal Considerations * * *

Waste Disposal Instructions
See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment recommendations.

Disposal of Contaminated Containers or Packaging
Dispose of contents/container in accordance with local/regional/national/international regulations.

* * * Section 14 - Transportation Information * * *

DOT Information
Shipping Name: Diesel Fuel
NA #: 1993 **Hazard Class:** 3 **Packing Group:** III
Placard:

* * * Section 15 - Regulatory Information * * *

Regulatory Information

Component Analysis

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Naphthalene (91-20-3)

CERCLA: 100 lb final RQ; 45.4 kg final RQ

SARA Section 311/312 – Hazard Classes

Acute Health	Chronic Health	Fire	Sudden Release of Pressure	Reactive
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product may contain listed chemicals below the de minimis levels which therefore are not subject to the supplier notification requirements of Section 313 of the Emergency Planning and Community Right- To-Know Act (EPCRA) of 1986 and of 40 CFR 372. If you may be required to report releases of chemicals listed in 40 CFR 372.28, you may contact Hess Corporate Safety if you require additional information regarding this product.

State Regulations

Component Analysis - State

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Fuels, diesel, no. 2	68476-34-6	No	No	No	Yes	No	No
Naphthalene	91-20-3	Yes	Yes	Yes	Yes	Yes	No

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains a chemical known to the state of California to cause cancer.

Component Analysis - WHMIS IDL

No components are listed in the WHMIS IDL.

Additional Regulatory Information

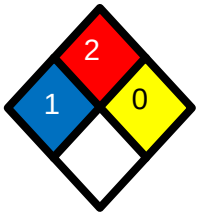
Component Analysis - Inventory

Component	CAS #	TSCA	CAN	EEC
Fuels, diesel, no. 2	68476-34-6	Yes	DSL	EINECS
Naphthalene	91-20-3	Yes	DSL	EINECS

* * * Section 16 - Other Information * * *

NFPA® Hazard Rating

Health	1
Fire	2
Reactivity	0



HMIS® Hazard Rating

Health	1*	Slight
Fire	2	Moderate
Physical	0	Minimal
		*Chronic

Key/Legend

ACGIH = American Conference of Governmental Industrial Hygienists; ADG = Australian Code for the Transport of Dangerous Goods by Road and Rail; ADR/RID = European Agreement of Dangerous Goods by Road/Rail; AS = Standards Australia; DFG = Deutsche Forschungsgemeinschaft; DOT = Department of Transportation; DSL = Domestic Substances List; EEC = European Economic Community; EINECS = European Inventory of Existing Commercial Chemical Substances; ELINCS = European List of Notified Chemical Substances; EU = European Union; HMIS = Hazardous Materials Identification System; IARC = International Agency for Research on Cancer; IMO = International Maritime Organization; IATA = International Air Transport Association; MAK = Maximum Concentration Value in the Workplace; NDSL = Non-Domestic Substances List; NFPA = National Fire Protection Association; NOHSC = National Occupational Health & Safety Commission; NTP = National Toxicology Program; STEL = Short-term Exposure Limit; TDG = Transportation of Dangerous Goods; TLV = Threshold Limit Value; TSCA = Toxic Substances Control Act; TWA = Time Weighted Average

Literature References

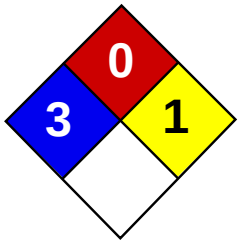
None

Other Information

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

End of Sheet



Material Safety Data Sheet
Hydrochloric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hydrochloric acid

Catalog Codes: SLH1462, SLH3154

CAS#: Mixture.

RTECS: MW4025000

TSCA: TSCA 8(b) inventory: Hydrochloric acid

CI#: Not applicable.

Synonym: Hydrochloric Acid; Muriatic Acid

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Hydrogen chloride	7647-01-0	20-38
Water	7732-18-5	62-80

Toxicological Data on Ingredients: Hydrogen chloride: GAS (LC50): Acute: 4701 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth. Repeated or prolonged exposure to the substance can produce target

organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of metals

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Non combustible. Calcium carbide reacts with hydrogen chloride gas with incandescence. Uranium phosphide reacts with hydrochloric acid to release spontaneously flammable phosphine. Rubidium acetylene carbides burns with slightly warm hydrochloric acid. Lithium silicide in contact with hydrogen chloride becomes incandescent. When dilute hydrochloric acid is used, gas spontaneously flammable in air is evolved. Magnesium boride treated with concentrated hydrochloric acid produces spontaneously flammble gas. Cesium acetylene carbide burns hydrogen chloride gas. Cesium carbide ignites in contact with hydrochloric acid unless acid is dilute. Reacts with most metals to produce flammable Hydrodgen gas.

Special Remarks on Explosion Hazards:

Hydrogen chloride in contact with the following can cause an explosion, ignition on contact, or other violent/vigorous reaction: Acetic anhydride AgClO + CCl4 Alcohols + hydrogen cyanide, Aluminum Aluminum-titanium alloys (with HCl vapor), 2-Amino ethanol, Ammonium hydroxide, Calcium carbide Ca3P2 Chlorine + dinitroanilines (evolves gas), Chlorosulfonic acid Cesium carbide Cesium acetylene carbide, 1,1-Difluoroethylene Ethylene diamine Ethylene imine, Fluorine, HClO4 Hexalithium disilicide H2SO4 Metal acetylides or carbides, Magnesium boride, Mercuric sulfate, Oleum, Potassium permanganate, beta-Propiolactone Propylene oxide Rubidium carbide, Rubidium, acetylene carbide Sodium (with aqueous HCl), Sodium hydroxide Sodium tetraselenium, Sulfonic acid, Tetraselenium tetranitride, U3P4 , Vinyl acetate. Silver perchlorate with carbon tetrachloride in the presence of hydrochloric acid produces trichloromethyl perchlorate which detonates at 40 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
CEIL: 5 (ppm) from OSHA (PEL) [United States] CEIL: 7 (mg/m3) from OSHA (PEL) [United States] CEIL: 5 from NIOSH CEIL: 7 (mg/m3) from NIOSH TWA: 1 STEL: 5 (ppm) [United Kingdom (UK)] TWA: 2 STEL: 8 (mg/m3) [United Kingdom (UK)]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Pungent. Irritating (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point:
108.58 C @ 760 mm Hg (for 20.22% HCl in water) 83 C @ 760 mm Hg (for 31% HCl in water) 50.5 C (for 37% HCl in water)

Melting Point:
-62.25°C (-80°F) (20.69% HCl in water) -46.2 C (31.24% HCl in water) -25.4 C (39.17% HCl in water)

Critical Temperature: Not available.

Specific Gravity:
1.1- 1.19 (Water = 1) 1.10 (20%and 22% HCl solutions) 1.12 (24% HCl solution) 1.15 (29.57% HCl solution) 1.16 (32% HCl solution) 1.19 (37% and 38%HCl solutions)

Vapor Pressure: 16 kPa (@ 20°C) average

Vapor Density: 1.267 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.25 to 10 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility: Soluble in cold water, hot water, diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, water

Incompatibility with various substances:
Highly reactive with metals. Reactive with oxidizing agents, organic materials, alkalis, water.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper, of stainless steel(304), of stainless steel(316). Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Reacts with water especially when water is added to the product. Absorption of gaseous hydrogen chloride on mercuric sulfate becomes violent @ 125 deg. C. Sodium reacts very violently with gaseous hydrogen chloride. Calcium phosphide and hydrochloric acid undergo very energetic reaction. It reacts with oxidizers releasing chlorine gas. Incompatible with, alkali metals, carbides, borides, metal oxides, vinyl acetate, acetylides, sulphides, phosphides, cyanides, carbonates. Reacts with most metals to produce flammable Hydrogen gas. Reacts violently (moderate reaction with heat of evolution) with water especially when water is added to the product. Isolate hydrogen chloride from heat, direct sunlight, alkalies (reacts vigorously), organic materials, and oxidizers (especially nitric acid and chlorates), amines, metals, copper and alloys (e.g. brass), hydroxides, zinc (galvanized materials), lithium silicide (incandescence), sulfuric acid(increase in temperature and pressure) Hydrogen chloride gas is emitted when this product is in contact with sulfuric acid. Adsorption of Hydrochloric Acid onto silicon dioxide results in exothmeric reaction. Hydrogen chloride causes aldehydes and epoxides to violently polymerize. Hydrogen chloride or Hydrochloric Acid in contact with the folloiwng can cause explosion or ignition on contact or

Special Remarks on Corrosivity:

Highly corrosive. Incompatible with copper and copper alloys. It attacks nearly all metals (mercury, gold, platinium, tantalum, silver, and certain alloys are exceptions). It is one of the most corrosive of the nonoxidizing acids in contact with copper alloys. No corrosivity data on zinc, steel. Severe Corrosive effect on brass and bronze

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
Acute oral toxicity (LD50): 900 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 1108 ppm, 1 hours [Mouse]. Acute toxicity of the vapor (LC50): 3124 ppm, 1 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. May cause damage to the following organs: kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, . Hazardous in case of eye contact (corrosive), of inhalation (lung corrosive).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Doses (LDL/LCL) LDL [Man] -Route: Oral; 2857 ug/kg LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (fetoxicity). May affect genetic material.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Corrosive. Causes severe skin irritation and burns. Eyes: Corrosive. Causes severe eye irritation/conjuntivitis, burns, corneal necrosis. Inhalation: May be fatal if inhaled. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract. Inhalation of hydrochloric acid fumes produces nose, throat, and larryngeal burning, and irritation, pain and inflammation, coughing, sneezing, choking sensation, hoarseness, laryngeal spasms, upper respiratory tract edema, chest pains, as well has headache, and palpitations. Inhalation of high concentrations can result in corrosive burns, necrosis of bronchial epithelium, constriction of the larynx and bronchi, nasospetal perforation, glottal closure, occur, particularly if exposure is prolonged. May affect the liver. Ingestion: May be fatal if swallowed. Causes irritation and burning, ulceration, or perforation of the gastrointestinal tract and resultant peritonitis, gastric hemorrhage and infection. Can also cause nausea, vomitting (with "coffee ground" emesis), diarrhea, thirst, difficulty swallowing, salivation, chills, fever, uneasiness, shock, strictures and stenosis (esophogeal, gastric, pyloric). May affect behavior (excitement), the cardiovascular system (weak rapid pulse, tachycardia), respiration (shallow respiration), and urinary system (kidneys- renal failure, nephritis). Acute exposure via inhalation or ingestion can also cause erosion of tooth enamel. Chronic Potential Health Effects: dyspnea, bronchitis. Chemical pneumonitis and pulmonary edema can also

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Hydrochloric acid, solution UNNA: 1789 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Hydrochloric acid Illinois toxic substances disclosure to employee act: Hydrochloric acid Illinois chemical safety act: Hydrochloric acid New York release reporting list: Hydrochloric acid Rhode Island RTK hazardous substances: Hydrochloric acid Pennsylvania RTK: Hydrochloric acid Minnesota: Hydrochloric acid Massachusetts RTK: Hydrochloric acid Massachusetts spill list: Hydrochloric acid New Jersey: Hydrochloric acid New Jersey spill list: Hydrochloric acid Louisiana RTK reporting list: Hydrochloric acid Louisiana spill reporting: Hydrochloric acid California Director's List of Hazardous Substances: Hydrochloric acid TSCA 8(b) inventory: Hydrochloric acid TSCA 4(a) proposed test rules: Hydrochloric acid SARA 302/304/311/312 extremely hazardous substances: Hydrochloric acid SARA 313 toxic chemical notification and release reporting: Hydrochloric acid CERCLA: Hazardous substances.: Hydrochloric acid: 5000 lbs. (2268 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):
R34- Causes burns. R37- Irritating to respiratory system. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 1

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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SAFETY DATA SHEET

N-Hexane

Section 1. Identification

GHS product identifier : N-Hexane

Chemical name : n-hexane

Other means of identification : Hexane; Hexane (n-Hexane)

Product use : Synthetic/Analytical chemistry.

Synonym : Hexane; Hexane (n-Hexane)

SDS # : 001060

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

Emergency telephone number (with hours of operation) : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE LIQUIDS - Category 2
TOXIC TO REPRODUCTION (Fertility) - Category 2
TOXIC TO REPRODUCTION (Unborn child) - Category 2
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 2
AQUATIC HAZARD (LONG-TERM) - Category 2

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : Highly flammable liquid and vapor.
May form explosive mixtures with air.
Suspected of damaging fertility or the unborn child.
May cause drowsiness and dizziness.
May cause damage to organs through prolonged or repeated exposure.
Toxic to aquatic life with long lasting effects.

Precautionary statements

General : Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand.

Section 2. Hazards identification

Prevention : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use personal protective equipment as required. Wear protective gloves. Wear eye or face protection. Keep away from heat, sparks, open flames and hot surfaces. - No smoking. Use explosion-proof electrical, ventilating, lighting and all material-handling equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Keep container tightly closed. Use only outdoors or in a well-ventilated area. Avoid release to the environment. Do not breathe vapor. Wash hands thoroughly after handling.

Response : Collect spillage. Get medical attention if you feel unwell. IF exposed or concerned: Get medical attention. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or physician if you feel unwell. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.

Storage : Store locked up. Store in a well-ventilated place. Keep cool.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : n-hexane

Other means of identification : Hexane; Hexane (n-Hexane)

CAS number/other identifiers

CAS number : 110-54-3

Product code : 001060

Ingredient name	%	CAS number
n-hexane	100	110-54-3

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention following exposure or if feeling unwell.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If necessary, call a poison center or physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Section 4. First aid measures

Skin contact : Wash contaminated skin with soap and water. Remove contaminated clothing and shoes. Continue to rinse for at least 10 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Get medical attention. If necessary, call a poison center or physician. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Causes eye irritation.

Inhalation : Can cause central nervous system (CNS) depression. May cause drowsiness and dizziness.

Skin contact : No known significant effects or critical hazards.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : Can cause central nervous system (CNS) depression. May be irritating to mouth, throat and stomach.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
irritation
watering
redness

Inhalation : Adverse symptoms may include the following:
nausea or vomiting
headache
drowsiness/fatigue
dizziness/vertigo
unconsciousness
reduced fetal weight
increase in fetal deaths
skeletal malformations

Skin contact : Adverse symptoms may include the following:
reduced fetal weight
increase in fetal deaths
skeletal malformations

Ingestion : Adverse symptoms may include the following:
reduced fetal weight
increase in fetal deaths
skeletal malformations

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Section 4. First aid measures

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use dry chemical, CO_2, water spray (fog) or foam.

Unsuitable extinguishing media : Do not use water jet.

Specific hazards arising from the chemical : Highly flammable liquid and vapor. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. The vapor/gas is heavier than air and will spread along the ground. Vapors may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. Runoff to sewer may create fire or explosion hazard. This material is toxic to aquatic life with long lasting effects. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. Collect spillage.

Methods and materials for containment and cleaning up

Section 6. Accidental release measures

Small spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Avoid exposure - obtain special instructions before use. Avoid exposure during pregnancy. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not breathe vapor or mist. Do not ingest. Avoid release to the environment. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Take precautionary measures against electrostatic discharges. Empty containers retain product residue and can be hazardous. Do not reuse container.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Section 8. Exposure controls/personal protection

Ingredient name	Exposure limits
n-hexane	**ACGIH TLV (United States, 3/2012).** **Absorbed through skin.** TWA: 50 ppm 8 hours. **NIOSH REL (United States, 1/2013).** TWA: 180 mg/m³ 10 hours. TWA: 50 ppm 10 hours. **OSHA PEL (United States, 6/2010).** TWA: 1800 mg/m³ 8 hours. TWA: 500 ppm 8 hours. **OSHA PEL 1989 (United States, 3/1989).** TWA: 180 mg/m³ 8 hours. TWA: 50 ppm 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Liquid. [COLORLESS LIQUID WITH A MILD GASOLINE-LIKE ODOR]

Color : Colorless.

Molecular weight : 86.18 g/mole

Molecular formula : C6-H14

Boiling/condensation point : 68.73°C (155.7°F)

Melting/freezing point : -95.35°C (-139.6°F)

Critical temperature : 234.25°C (453.6°F)

Odor : Characteristic.

Odor threshold : Not available.

pH : Not available.

Flash point : Closed cup: -22°C (-7.6°F)

Burning time : Not applicable.

Burning rate : Not applicable.

Evaporation rate : 6.82 (butyl acetate = 1)

Flammability (solid, gas) : Extremely flammable in the presence of the following materials or conditions: oxidizing materials.

Lower and upper explosive (flammable) limits : Lower: 1.1%
Upper: 7.5%

Vapor pressure : 17 kPa (127.510360216 mm Hg) [room temperature]

Vapor density : 3 (Air = 1)

Specific Volume (ft ^{3}/lb) : 1.5138

Gas Density (lb/ft ^{3}) : 0.6606 (25°C / 77 to °F)

Relative density : 0.7

Solubility : Not available.

Solubility in water : 0.0098 g/l

Partition coefficient: n-octanol/water : 4

Auto-ignition temperature : 225°C (437°F)

Decomposition temperature : Not available.

SADT : Not available.

Viscosity : Dynamic (room temperature): 0.3 mPa·s (0.3 cP)

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow vapor to accumulate in low or confined areas.

Section 10. Stability and reactivity

Incompatibility with various substances : Extremely reactive or incompatible with the following materials: oxidizing materials.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
n-hexane	LC50 Inhalation Gas. LC50 Inhalation Vapor LD50 Oral	Rat Rat Rat	48000 ppm 96000 ppm 15840 mg/kg	4 hours 1 hours -

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
n-hexane	Eyes - Mild irritant	Rabbit	-	10 milligrams	-

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Name	Category	Route of exposure	Target organs
n-hexane	Category 3	Not applicable.	Narcotic effects

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
n-hexane	Category 2	Not determined	Not determined

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Section 11. Toxicological information

Eye contact : Causes eye irritation.

Inhalation : Can cause central nervous system (CNS) depression. May cause drowsiness and dizziness.

Skin contact : No known significant effects or critical hazards.

Ingestion : Can cause central nervous system (CNS) depression. May be irritating to mouth, throat and stomach.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : Adverse symptoms may include the following:
irritation
watering
redness

Inhalation : Adverse symptoms may include the following:
nausea or vomiting
headache
drowsiness/fatigue
dizziness/vertigo
unconsciousness
reduced fetal weight
increase in fetal deaths
skeletal malformations

Skin contact : Adverse symptoms may include the following:
reduced fetal weight
increase in fetal deaths
skeletal malformations

Ingestion : Adverse symptoms may include the following:
reduced fetal weight
increase in fetal deaths
skeletal malformations

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : May cause damage to organs through prolonged or repeated exposure.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : Suspected of damaging fertility.

Numerical measures of toxicity

Acute toxicity estimates

Section 11. Toxicological information

Not available.

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
n-hexane	Acute LC50 113000 µg/l Fresh water	Fish - Oreochromis mossambicus	96 hours

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
n-hexane	4	501.187	high

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapor from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1208	UN1208	UN1208	UN1208	UN1208
UN proper shipping name	Hexanes	Hexanes	Hexanes	Hexanes	Hexanes
Transport hazard class(es)	3 	3 	3 	3  	3 

Section 14. Transport information

Packing group	II	II	II	II	II
Environment	No.	No.	No.	Yes.	No.
Additional information	**Reportable quantity** 5000 lbs / 2270 kg [907.77 gal / 3436.3 L] Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.	**Explosive Limit and Limited Quantity Index** 1 **Passenger Carrying Ship Index** Forbidden **Passenger Carrying Road or Rail Index** 5	-	The marine pollutant mark is not required when transported in sizes of ≤5 L or ≤5 kg.	The environmentally hazardous substance mark may appear if required by other transportation regulations.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

United States inventory (TSCA 8b): This material is listed or exempted.

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Fire hazard
Immediate (acute) health hazard
Delayed (chronic) health hazard

Composition/information on ingredients

Section 15. Regulatory information

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
n-hexane	100	Yes.	No.	No.	Yes.	Yes.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	n-hexane	110-54-3	100
Supplier notification	n-hexane	110-54-3	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : This material is listed.

New York : This material is listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

Canada inventory : This material is listed or exempted.

International regulations

International lists : **Australia inventory (AICS)**: This material is listed or exempted.
China inventory (IECSC): This material is listed or exempted.
Japan inventory: This material is listed or exempted.
Korea inventory: This material is listed or exempted.
Malaysia Inventory (EHS Register): Not determined.
New Zealand Inventory of Chemicals (NZIoC): This material is listed or exempted.
Philippines inventory (PICCS): This material is listed or exempted.
Taiwan inventory (CSNN): Not determined.

Chemical Weapons Convention List Schedule I Chemicals : Not listed

Chemical Weapons Convention List Schedule II Chemicals : Not listed

Chemical Weapons Convention List Schedule III Chemicals : Not listed

Canada

WHMIS (Canada) : Class B-2: Flammable liquid
Class D-2A: Material causing other toxic effects (Very toxic).
Class D-2B: Material causing other toxic effects (Toxic).

CEPA Toxic substances: This material is not listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

Canada Label requirements : Class B-2: Flammable liquid
Class D-2A: Material causing other toxic effects (Very toxic).
Class D-2B: Material causing other toxic effects (Toxic).

Hazardous Material Information System (U.S.A.)

Health	*	2
Flammability		3
Physical hazards		0

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)

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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

History

Date of printing : 5/20/2015.

Date of issue/Date of revision : 5/20/2015.

Date of previous issue : 10/16/2014.

Version : 0.03

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United NationsACGIH – American Conference of Governmental Industrial Hygienists
AIHA – American Industrial Hygiene Association
CAS – Chemical Abstract Services
CEPA – Canadian Environmental Protection Act
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act (EPA)

Section 16. Other information

CFR – United States Code of Federal Regulations
CPR – Controlled Products Regulations
DSL – Domestic Substances List
GWP – Global Warming Potential
IARC – International Agency for Research on Cancer
ICAO – International Civil Aviation Organisation
Inh – Inhalation
LC – Lethal concentration
LD – Lethal dosage
NDSL – Non-Domestic Substances List
NIOSH – National Institute for Occupational Safety and Health
TDG – Canadian Transportation of Dangerous Goods Act and Regulations
TLV – Threshold Limit Value
TSCA – Toxic Substances Control Act
WEEL – Workplace Environmental Exposure Level
WHMIS – Canadian Workplace Hazardous Material Information System

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

SAFETY DATA SHEET

Isobutylene

Section 1. Identification

GHS product identifier : Isobutylene

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

Product use : Synthetic/Analytical chemistry.

Synonym : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

SDS # : 001031

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Liquefied gas

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
May cause frostbite.
May displace oxygen and cause rapid suffocation.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach suspected leak area with caution.

Prevention : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

Response : Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage : Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise classified : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

CAS number/other identifiers

CAS number : 115-11-7

Product code : 001031

Ingredient name	%	CAS number
Isobutylene	100	115-11-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Section 4. First aid measures

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Isobutylene	**ACGIH TLV (United States, 3/2015).** TWA: 250 ppm 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Section 8. Exposure controls/personal protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [Liquefied compressed gas.]

Color : Colorless.

Molecular weight : 56.12 g/mole

Molecular formula : C4-H8

Boiling/condensation point : -6.9°C (19.6°F)

Melting/freezing point : -140.7°C (-221.3°F)

Critical temperature : 144.75°C (292.6°F)

Odor : Characteristic.

Odor threshold : Not available.

pH : Not available.

Flash point : Closed cup: -76.1°C (-105°F)

Burning time : Not applicable.

Burning rate : Not applicable.

Evaporation rate : Not available.

Flammability (solid, gas) : Extremely flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and oxidizing materials.

Lower and upper explosive (flammable) limits : Lower: 1.8%
Upper: 9.6%

Vapor pressure : 24.3 (psig)

Vapor density : 1.94 (Air = 1)

Specific Volume (ft^3/lb) : 6.6845

Gas Density (lb/ft^3) : 0.1496 (25°C / 77 to °F)

Relative density : Not applicable.

Solubility : Not available.

Solubility in water : 0.263 g/l

Partition coefficient: n-octanol/water : 2.34

Auto-ignition temperature : 465°C (869°F)

Decomposition temperature : Not available.

SADT : Not available.

Section 9. Physical and chemical properties

Viscosity : Not applicable.

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

Incompatible materials : Oxidizers

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Isobutylene	LC50 Inhalation Vapor	Rat	550000 mg/m³	4 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Section 11. Toxicological information

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Isobutylene	2.34	-	low

Section 12. Ecological information

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1055	UN1055	UN1055	UN1055	UN1055
UN proper shipping name	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE
Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 
Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	**Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: Forbidden. **Cargo aircraft** Quantity limitation: 150 kg **Special provisions** 19, T50	Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2). **Explosive Limit and Limited Quantity Index** 0.125 **ERAP Index** 3000 **Passenger Carrying Ship Index** Forbidden **Passenger Carrying Road or Rail Index** Forbidden **Special provisions** 29	-	-	**Passenger and Cargo Aircraft**Quantity limitation: 0 Forbidden **Cargo Aircraft Only** Quantity limitation: 150 kg

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Section 14. Transport information

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

United States inventory (TSCA 8b): This material is listed or exempted.

Clean Air Act (CAA) 112 regulated flammable substances: isobutylene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Fire hazard
Sudden release of pressure

Composition/information on ingredients

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
Isobutylene	100	Yes.	Yes.	No.	No.	No.

State regulations

Massachusetts : This material is listed.

New York : This material is not listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

International regulations

International lists

National inventory

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Europe : This material is listed or exempted.

Japan : This material is listed or exempted.

Malaysia : Not determined.

Section 15. Regulatory information

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Taiwan : This material is listed or exempted.

Canada

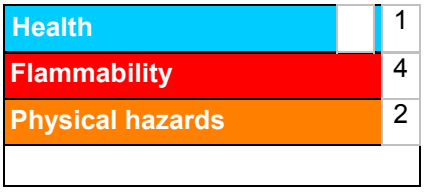
WHMIS (Canada) : Class A: Compressed gas.
Class B-1: Flammable gas.

CEPA Toxic substances: This material is not listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.
Class B-1: Flammable gas.

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)

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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
Flam. Gas 1, H220 Press. Gas Liq. Gas, H280	Expert judgment Expert judgment

History

Date of printing : 7/11/2016

Date of issue/Date of revision : 7/11/2016

Date of previous issue : No previous validation

Section 16. Other information

Version : 0.01

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

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1. PRODUCT AND COMPANY IDENTIFICATION

Product Name:	METHANOL
Product Code:	MeOH
Product Type	Chemical Solvent
Company:	Philippine Prosperity Chemicals, Inc.
Office Address:	U1201 Picadilly Star Building 4th Ave. cor 27th St. Fort Bonifacio Global City, Taguig
Plant Addresses:	(1) LMG Bulk Terminal – Pinamucan, Batangas (2) Nagtahan Terminal Inc. – Pandacan, Manila (3) PPCI In-land Bulk Terminal – Guiguinto, Bulacan
Contact Numbers:	Tel: (632) 621-3104 to 09 Fax: (632) 659-6874
Emergency Numbers:	Mobile: 0917.5845496 / 0917.5845509

2. COMPOSITION/INFORMATION ON INGREDIENTS

Substance Formal Name:	Methanol
Substance Chemical Formula:	CH_3OH
Common name:	Methyl Alcohol
Synonyms:	Methyl hydrate, wood alcohol, pyroxylic spirit, methyl hydroxide, carbinol, monohydroxy methane, wood naptha
Chemical Abstract Service Registry Number (CAS RNs):	67-56-1

3. HAZARDS IDENTIFICATION

Emergency overview:	Warning! Flammable liquid! May cause skin irritation. May cause central nervous system depression. May be absorbed through the skin. May cause kidney damage. May cause respiratory and digestive tract irritation. May be fatal or cause blindness if swallowed. May cause fetal effects. Causes severe eye irritation and possible injury. Target Organs: Kidneys, central nervous system, eyes.
Human Health Hazards:	
Inhalation:	Sign and symptoms of acute poisoning include the following: slight irritation of the nose and eyes; head feels hot and face is flushed; excitability and talkativeness; drunken behavior; staggering and lack of coordination; headache; mental confusion and visual disturbance; tiredness.
Ingestion:	Signs and symptoms of acute poisoning are gastrointestinal irritation; head feels hot and face is flushed; excitability and talkativeness; drunken behavior; staggering and lack of coordination; headache; mental confusion and visual

Ingestion:	disturbance; tiredness.
Skin Contact:	Direct skin contact with methanol may cause irritation, dermatitis, erythema and scaling. Methanol is highly volatile and will produce a feeling of cold. Alcohols remove oils form the skin, which becomes dry and eventually develops cracks or dermatitis. Methanol which can be absorbed by the skin which causes headache, fatigue and reduction of visual accuracy.
Eye Contact:	Methanol can seriously impair vision and may cause blindness. Immediate signs and symptoms include the following: vapors are slightly uncomfortable and splashes very irritating; irritation with painful burning or stinging sensation; watering of eyes; inflammation of the eyelids; eyes are sensitive to and painful in the light.
Chronic Exposure:	Methanol is slowly eliminated from the body; hence repeated exposures may result in toxic levels in the blood and tissues. Due to its slow elimination, methanol should be regarded as a cumulative poison. Though single exposures to fumes may cause no harmful effect, daily exposure may result in the accumulation of sufficient methanol in the body to cause illness.
Aggravation of Pre-existing Conditions:	Persons with pre-existing skin disorders or eye problems or impaired liver or kidney function may be more susceptible to the effects of the substance.

4. FIRST AID MEASURES

Inhalation:	Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Obtain medical attention immediately.
Ingestion:	Obtain medical attention immediately. Do not induce vomiting unless directed to do so by a medical personnel. Never give anything by mouth to an unconscious person.
Skin Contact:	Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. If persistent irritation occurs, obtain medical attention. Wash clothing before reuse.
Eye Contact:	Immediately flush eyes with gentle but large stream of water for at least 15 minutes, lifting lower and upper eyelids occasionally. If persistent irritation occurs, obtain medical attention.

5. Fire Fighting Measure

Fire:	Flammable liquid! Flash point: 12 °C (53.6 °F) Auto ignition temperature: 385 °C (725 °F) Flammable limits in air based on pure MeOH % by volume: Lower Flammable Limit: 6.0; Upper Flammable Limit: 36.0
Explosion:	Vapor-air mixtures are explosive within flammable limits at normal temperature. Vapors can flow along surfaces to distant ignition source and flash back. Contact with strong oxidizers may cause fire. Sensitive to static discharge.

Extinguishing media:	Dry chemical, alcohol-resistant foam or carbon dioxide. Water spray may only be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.
Unsuitable extinguishing media:	Do not use a solid stream or jet of water, since the stream will scatter and spread the fire.
Special Information:	All storage areas should be provided with adequate firefighting facilities and equipment. The liquid produces a vapor that forms explosive mixtures with air especially in conditions at above flash point temperatures. In the event of a fire, contact the nearest fire station. For the company's own firefighters, they should wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full face piece operated in the pressure demand or other positive pressure mode.
Special Remarks on Fire and Explosion Hazards:	Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition, it emits acrid smoke and irritating fumes. Explosive when mixed with Chloroform + sodium methoxide and diethyl zinc. It boils violently and explodes. CAUTION: MAY BURN WITH NEAR INVISIBLE FLAME

6. ACCIDENTAL CONTROL MEASURES

Personal precautions:	Avoid contact with skin and eyes. Ventilate area of leak or spill thoroughly. Do not breathe vapor. Remove all heat or ignition sources. Evacuate the area of all non-essential personnel. Shut off leaks, if possible without personal risk.
Personal protection:	Wear appropriate personal protective equipment (PPE) as specified in Section 8.
Environmental precautions:	Contain and recover liquid when possible with an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand or earth) and place in a chemical waste container. Do not use combustible materials such as saw dust. Use non-sparking tools and equipment. Prevent from spreading or entering into drains, ditches, rivers and other waterways by using sand, earth or other appropriate barriers.
Clean-up methods - small spillage:	Remove all ignition sources and ventilate area. Evacuate all non-essential personnel. Stop leak if without risk. Dilute with water and mop up, or absorb with an inert dry material and place in a sealable container. Label and seal waste containers for product recovery or appropriate disposal (see Section 13).
Clean-up methods – large spillage:	For large liquid spills (say more than a drum), remove all ignition sources. Evacuate all non-essential personnel. Stop leak if possible and without risk. Do not flush away residues with water. Blanket spill with alcohol resistant foam to limit evaporation or dike area to contain spill and absorb with earth, sand or other non-combustible material. Transfer to a labeled, sealable container for product recovery or proper

Clean-up methods – large spillage:	disposal. Wear appropriate protective clothing to minimize contact with skin. Allow residues to evaporate or soak up with a suitable absorbent material and dispose safely and appropriately (see Section 13).

7. HANDLING AND STORAGE

Handling:	Protect self against physical damage. Avoid contact with skin, eyes and clothing. Do not breathe vapor. Use only in well ventilated areas.
Handling temperature:	Ambient.
Storage:	Keep container tightly closed in a cool, dry and well-ventilated place. Outside or detached storage is preferred. Separate from oxidizing materials. Storage and use areas should be No Smoking areas. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.
Storage temperature:	Ambient. Warning! At normal condition, a flammable / explosive vapor-air mixture forms.
Product transfer:	Metal containers should be bonded and grounded for transfers to avoid static sparks.
Recommended materials:	For containers or container linings, use mild steel or stainless steel. Refer to appropriate sources or compatibility charts if using internal coating materials.
Unsuitable materials:	Anhydrous methanol is corrosive at ambient temperatures for lead, nickel, cast iron and high silicon iron. Coatings of copper (or copper alloys), zinc (including galvanized steel), or aluminum are unsuitable for storage
Other Information:	Methanol is available from PPCI in bulk and in drums. Details are available upon request.

8. EXPOSURE CONTROL / PERSONAL PROTECTION

Engineering Control Measure / Ventilation System:	A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Occupational Exposure Standards:	American Conference of Governmental Industrial Hygienist (ACGIH)
Limit type:	Threshold Limit Value (TLV) - the level of exposure that the typical worker can experience without an unreasonable risk of disease or injury.
Value and Unit:	200 Parts per million (ppm)

Respiratory protection:	Where local exhaust ventilation is not practicable, wear a full face-piece or a double cartridge respirator with organic vapor canister NPF 400. It may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face-piece positive-pressure, air-supplied respirator. **WARNING:** Air purifying respirators do not protect workers in oxygen-deficient atmospheres.
Hand protection:	PVC gloves, chemical resistant gloves or nitrile gloves.
Eye protection:	Use chemical safety goggles with side shields or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.
Body Protection:	Wear impervious protective clothing such as one-piece overall, including safety shoes or boots, gloves, laboratory coat, apron or any appropriate cotton-made clothing to prevent skin contact.
Specific Hygiene Measures:	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Clear, colorless liquid
Odor:	Slight alcohol-like
Initial boiling point:	64.5 °C (148 °F)
Freezing point:	-97.6 °C (-143.68 °F)
Vapor Pressure:	12.8 kPa @ 20 °C
Specific Gravity:	0.792 @ 20 °C
Solubility:	Completely miscible in water
Dynamic viscosity:	0.54 centipoise (cP) @ 25 °C
Vapor density (air=1):	1.10
Flash point:	12 °C
Auto-ignition temperature:	385 °C
Upper flammable limit in air:	36.0 % (v/v)
Lower flammable limit in air:	6.0 % (v/v)
Molecular weight:	32.04 g/mole
Evaporation rate, (NBAC = 1):	4.10

10. STABILITY AND REACTIVITY

Stability:	Stable under normal temperature and pressure for use and storage. Hygroscopic.
Conditions to avoid:	Heat, flames, ignition sources and incompatibles. Slowly decomposed by moisture.
Special Remarks on Reactivity	Can react vigorously with oxidizers. Violent reaction with alkyl aluminum salts, acetyl bromide, chloroform + sodium methoxide, chromic anhydride, cyanuric chloride, lead perchlorate, phosphorous trioxide, nitric acid. Exothermic reaction with sodium hydroxide + chloroform. Incompatible with beryllium dihydride, metals (potassium and magnesium), oxidants (barium perchlorate, bromine, sodium hypochlorite, chlorine, hydrogen peroxide), potassium tert-butoxide, carbon tetrachloride, alkali metals, metals (aluminum, potassium magnesium, zinc), and dichloromethane. Rapid autocatalytic dissolution of aluminum, magnesium or zinc in 9:1 methanol + carbon tetrachloride - sufficiently vigorous to be rated as potentially hazardous.
Hazardous decomposition products:	Carbon dioxide and carbon monoxide may form when heated to decomposition.

11. TOXICOLOGICAL INFORMATIONS

Basis for assessment:	Information given is based on product data.
Oral rat, LD_{50}	5,628 mg/kg
Inhalation rat, LC_{50}	64,000 ppm /4 Hours
Skin rabbit, LD_{50}	15,800 mg/kg
Eye irritation:	Severe irritant. (Refer to Section 3)
Skin irritation:	Moderate irritant. (Refer to Section 3)
Organs Affected by Long-term Exposure	Repeated exposure to methanol vapor may be manifested by conjunctivitis, headache, giddiness, insomnia, gastric disturbances, and bilateral blindness.
Chronic Human effects:	Passes through the placental barrier. May affect genetic material. May cause birth defects and adverse reproductive effects (paternal and maternal effects and fetotoxicity) base on animal studies.

12. ECOLOGICAL INFORMATION

Basis for assessment:	Information given is based on product data.
Environmental Fate:	
Water:	Methanol in fresh or salt water may have serious effects on aquatic life. A study on methanol's toxic effects on sewage sludge bacteria reported little effect on digestion at 0.1% while 0.5% methanol retarded digestion. Methanol will be broken down into carbon dioxide and water.
Soil:	Highly Mobile. Should be removed readily from soils by volatilization and biodegradation.

Air:	This material is expected to be readily degraded by reaction with photochemical-produced hydroxyl radicals and expected to have a half-life between 1 and 10 days. This material may be removed from the atmosphere to a moderate extent by wet deposition.
Bioaccumulation:	The bioconcentration factor (BCF) for MeOH can be estimated to be <10. This indicates that it will not bioconcentrate in aquatic organisms and bioaccumulate.
Environmental Toxicity:	Dangerous to aquatic life in high concentrations.

13. Disposal Considerations

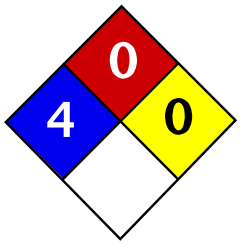
Precautions:	Refer to Sections 7 before handling the product or containers.
Waste disposal:	Whatever MeOH cannot be saved for recovery or treating, it should be managed in an appropriate and approved waste disposal facility. Care should in any case be taken to ensure disposal is compliant with statutory or regulatory requirements and local environmental laws.
Product disposal:	This product is not suitable for disposal by either landfill or via local sewers, drains, natural streams or rivers. The following advice only applies to the product as supplied. Processing, use or contamination of this product may change the waste management options.
Container disposal:	Drain container thoroughly. After draining, vent in a safe place away from sparks and fire. Residues may cause an explosion hazard. Do not pressure cut, weld, braze, solder, drill, grind or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. Send to drum handlers that clean, recondition or metal reclaimer. Disposal of container and unused contents must be in accordance to local regulatory requirements and environmental laws.

14. TRANSPORT INFORMATION

UN Number:	1230
Hazard Class:	3 (Flammable Liquid)
Proper shipping name:	Methanol
Packing Group:	II (Flash point = 12 °C)

15. OTHER INFORMATION

Philippine Prosperity Chemicals, Inc. provides the information contained herein in good faith and was obtained from sources which we believe are reliable**.** However, the information is provided without any warranty. The condition or methods of handling storage, use and disposal are beyond our control and may be beyond our knowledge. For this and any other reasons, we don't assume responsibility and disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use and disposal of the product. This document is intended only as a guideline to the appropriate precautionary handling of the material by properly trained personnel using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose.



Material Safety Data Sheet
Nitric acid, 65% MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nitric acid, 65%

Catalog Codes: SLN2161

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Water; Nitric acid, fuming

CI#: Not applicable.

Synonym: Nitric Acid, 65%

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Water	7732-18-5	35
Nitric acid, fuming	7697-37-2	65

Toxicological Data on Ingredients: Nitric acid, fuming: VAPOR (LC50): Acute: 244 ppm 0.5 hours [Rat]. 344 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.

MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to lungs, mucous membranes, upper respiratory tract, skin, eyes, teeth.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of combustible materials

Explosion Hazards in Presence of Various Substances:
Explosive in presence of reducing materials, of organic materials, of metals, of alkalis.
Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Flammable in presence of cellulose or other combustible materials.
Phosphine, hydrogen sulfide, selenide all ignite when fuming nitric acid is dripped into gas.
(Nitric Acid, fuming)

Special Remarks on Explosion Hazards:
Reacts exlposively with metallic powders, carbides, cyanides, sulfides, alkalies and turpentine.
Can react explosively with many reducing agents.
Arsine, phosphine, tetraborane all oxidized explosively in presence of nitric acid.
Cesium and rubidium acetylides explode in contact with nitric acid.
Explosive reaction with Nitric Acid + Nitrobenzene + water.
Detonation with Nitric Acid + 4-Methylcyclohexane.
(Nitric acid, fuming)

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Oxidizing material. Poisonous liquid.
Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Keep away from heat. Keep away from sources of ignition. Keep away from combustible material.. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers. Do not store above 23°C (73.4°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be

used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 2 STEL: 4 (ppm) from ACGIH (TLV) [United States]
TWA: 2 STEL: 4 from OSHA (PEL) [United States]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Acrid. Disagreeable and choking. (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point: 121°C (249.8°F)

Melting Point: -41.6°C (-42.9°F)

Critical Temperature: Not available.

Specific Gravity: 1.408 (Water = 1)

Vapor Pressure: 6 kPa (@ 20°C)

Vapor Density: 2.5 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.29 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:
Easily soluble in cold water, hot water.
Soluble in diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances:
Highly reactive with alkalis.
Reactive with reducing agents, combustible materials, organic materials, metals, acids.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper.
Non-corrosive in presence of glass, of stainless steel(304), of stainless steel(316), of brass.

Special Remarks on Reactivity:
A strong oxidizer.
Reacts violently with alcohol, organic material, turpene, charcoal.
Violent reaction with Nitric acid + Acetone and Sulfuric acid.
Nitric Acid will react with water or steam to produce heat and toxic, corrosive and flammable vapors.
(Nitric acid, fuming)

Special Remarks on Corrosivity:
In presence of traces of oxides, it attacks all base metals except aluminum and special chromium steels.
It will attack some forms of plastics, rubber, and coatings.
No corrosive effect on bronze.
No corrosivity data for zinc, and steel

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans:
Contains material which may cause damage to the following organs: lungs, mucous membranes, upper respiratory tract, skin, eyes, teeth.

Other Toxic Effects on Humans:
Extremely hazardous in case of inhalation (lung corrosive).
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (corrosive), of ingestion, .

Special Remarks on Toxicity to Animals: LDL - Lowest Published Lethal Dose [Human] - Route: Oral; Dose: 430 mg/kg (Nitric acid, fuming)

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (effects on newborn and fetotoxicity) based on animal data. (Nitric acid, fuming)

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Severely irritates skin. Causes skin burns and may cause deep and penetrating ulcers of the skin with a characteristic yellow to brownish discoloration. May be fatal if absorbed through skin.
Eyes: Severely irritates eyes. Causes eye burns. May cause irreversible eye injury.
Ingestion: May be fatal if swallowed. Causes serious gastrointestinal tract irritation or burns with nausea, vomiting, severe abdominal pain, and possible "coffee grounds" appearance of the vomitus . May cause perforation of the digestive tract.
Inhalation: May be fatal if inhaled. Vapor is extremely hazardous. Vapor may cause nitrous gas poisoning. Effects may be delayed. May cause irritation of the mucous membranes and respiratory tract with burning pain in the nose and throat, coughing, sneezing, wheezing, shortness of breath and pulmonary edema. Other symptoms may include nausea, and vomiting.
Chronic Potential Health Effects:
Repeated inhalation may produce changes in pulmonary function and/or chronic bronchitis. It may also affect behavior (headache, dizziness, drowsiness, muscle contaction or spasticity, weakness, loss of coordinaton, mental confusion), and urinary system (kidney faillure, decreased urinary output after several hours of

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Nitric acid UNNA: 2031 PG: II

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
New York release reporting list: Nitric acid, fuming
Rhode Island RTK hazardous substances: Nitric acid, fuming
Pennsylvania RTK: Nitric acid, fuming
Florida: Nitric acid, fuming
Minnesota: Nitric acid, fuming
Massachusetts RTK: Nitric acid, fuming
New Jersey: Nitric acid, fuming
TSCA 8(b) inventory: Water; Nitric acid, fuming
SARA 302/304/311/312 extremely hazardous substances: Nitric acid, fuming
SARA 313 toxic chemical notification and release reporting: Nitric acid, fuming 65%
CERCLA: Hazardous substances.: Nitric acid, fuming: 1000 lbs. (453.6 kg);

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).
CLASS E: Corrosive liquid.

DSCL (EEC):
R8- Contact with combustible material
may cause fire.
R35- Causes severe burns.
S23- Do not breathe gas/fumes/vapour/spray
[***]

S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S36- Wear suitable protective clothing.
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 4

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Full suit.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 10:59 AM

Last Updated: 11/06/2008 12:00 PM

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

1 Identification of the substance/mixture and of the supplier

1.1 Product identifier

Trade Name: Alconox
Synonyms:
Product number: Alconox

1.2 Application of the substance / the mixture : Cleaning material/Detergent

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer
Alconox, Inc.
30 Glenn Street
White Plains, NY 10603
1-914-948-4040

Supplier
Not Applicable

Emergency telephone number:
ChemTel Inc
North America: 1-800-255-3924
International: 01-813-248-0585

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments.

Hazard-determining components of labeling:
Tetrasodium Pyrophosphate
Sodium tripolyphosphate
Sodium Alkylbenzene Sulfonate

2.2 Label elements:

Skin irritation, category 2.
Eye irritation, category 2A.

Hazard pictograms:

Signal word: Warning

Hazard statements:
H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

Additional information: None.

Hazard description

Hazards Not Otherwise Classified (HNOC): None

Information concerning particular hazards for humans and environment:

The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

Classification system:

The classification is according to EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments, and extended by company and literature data. The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

3 Composition/information on ingredients

3.1 Chemical characterization : None

3.2 Description : None

3.3 Hazardous components (percentages by weight)

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	12-28
CAS number: 68081-81-2	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	8-22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	2-16

3.4 Additional Information : None.

4 First aid measures

4.1 Description of first aid measures

General information: None.

After inhalation:

Maintain an unobstructed airway.

Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:

Wash affected area with soap and water.

Seek medical attention if symptoms develop or persist.

After eye contact:

Rinse/flush exposed eye(s) gently using water for 15-20 minutes.

Remove contact lens(es) if able to do so during rinsing.

Seek medical attention if irritation persists or if concerned.

After swallowing:

Rinse mouth thoroughly.

Seek medical attention if irritation, discomfort, or vomiting persists.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

4.2 Most important symptoms and effects, both acute and delayed

None

4.3 Indication of any immediate medical attention and special treatment needed:

No additional information.

5 Firefighting measures

5.1 Extinguishing media

Suitable extinguishing agents:

Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition.

For safety reasons unsuitable extinguishing agents : None

5.2 Special hazards arising from the substance or mixture :

Thermal decomposition can lead to release of irritating gases and vapors.

5.3 Advice for firefighters

Protective equipment:

Wear protective eye wear, gloves and clothing.
Refer to Section 8.

5.4 Additional information :

Avoid inhaling gases, fumes, dust, mist, vapor and aerosols.
Avoid contact with skin, eyes and clothing.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures :

Ensure adequate ventilation.
Ensure air handling systems are operational.

6.2 Environmental precautions :

Should not be released into the environment.
Prevent from reaching drains, sewer or waterway.

6.3 Methods and material for containment and cleaning up :

Wear protective eye wear, gloves and clothing.

6.4 Reference to other sections : None

7 Handling and storage

7.1 Precautions for safe handling :

Avoid breathing mist or vapor.
Do not eat, drink, smoke or use personal products when handling chemical substances.

7.2 Conditions for safe storage, including any incompatibilities :

Store in a cool, well-ventilated area.

7.3 Specific end use(s):

No additional information.

Safety Data Sheet

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Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

8 Exposure controls/personal protection

8.1 Control parameters :

7722-88-5, Tetrasodium Pyrophosphate, OSHA TWA 5 mg/m3.

8.2 Exposure controls

Appropriate engineering controls:

Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.

Respiratory protection:

Not needed under normal conditions.

Protection of skin:

Select glove material impermeable and resistant to the substance.

Eye protection:

Safety goggles or glasses, or appropriate eye protection.

General hygienic measures:

Wash hands before breaks and at the end of work.
Avoid contact with skin, eyes and clothing.

9 Physical and chemical properties

Appearance (physical state, color):	White and cream colored flakes - powder	**Explosion limit lower**: **Explosion limit upper**:	Not determined or not available. Not determined or not available.
Odor:	Not determined or not available.	**Vapor pressure at 20°C**:	Not determined or not available.
Odor threshold:	Not determined or not available.	**Vapor density**:	Not determined or not available.
pH-value:	9.5 (aqueous solution)	**Relative density**:	Not determined or not available.
Melting/Freezing point:	Not determined or not available.	**Solubilities**:	Not determined or not available.
Boiling point/Boiling range:	Not determined or not available.	**Partition coefficient (n-octanol/water)**:	Not determined or not available.
Flash point (closed cup):	Not determined or not available.	**Auto/Self-ignition temperature**:	Not determined or not available.
Evaporation rate:	Not determined or not available.	**Decomposition temperature**:	Not determined or not available.

Safety Data Sheet

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Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

Flammability (solid, gaseous):	Not determined or not available.	**Viscosity**:	a. Kinematic: Not determined or not available. b. Dynamic: Not determined or not available.
Density at 20°C:	Not determined or not available.		

10 Stability and reactivity

10.1 Reactivity : None

10.2 Chemical stability : None

10.3 Possibility hazardous reactions : None

10.4 Conditions to avoid : None

10.5 Incompatible materials : None

10.6 Hazardous decomposition products : None

11 Toxicological information

11.1 Information on toxicological effects :

Acute Toxicity:

Oral:

: LD50 > 5000 mg/kg oral rat - Product .

Chronic Toxicity: No additional information.

Skin corrosion/irritation:

Sodium Alkylbenzene Sulfonate: Causes skin irritation. .

Serious eye damage/irritation:

Sodium Alkylbenzene Sulfonate: Causes serious eye irritation .

Tetrasodium Pyrophosphate: Rabbit - Risk of serious damage to eyes .

Respiratory or skin sensitization: No additional information.

Carcinogenicity: No additional information.

IARC (International Agency for Research on Cancer): None of the ingredients are listed.

NTP (National Toxicology Program): None of the ingredients are listed.

Germ cell mutagenicity: No additional information.

Reproductive toxicity: No additional information.

STOT-single and repeated exposure: No additional information.

Additional toxicological information: No additional information.

12 Ecological information

Safety Data Sheet

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Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

12.1 Toxicity:

Sodium Alkylbenzene Sulfonate: Fish, LC50 1.67 mg/l, 96 hours.
Sodium Alkylbenzene Sulfonate: Aquatic invertebrates, EC50 Daphnia 2.4 mg/l, 48 hours.
Sodium Alkylbenzene Sulfonate: Aquatic Plants, EC50 Algae 29 mg/l, 96 hours.
Tetrasodium Pyrophosphate: Fish, LC50 - other fish - 1,380 mg/l - 96 h.
Tetrasodium Pyrophosphate: Aquatic invertebrates, EC50 - Daphnia magna (Water flea) - 391 mg/l - 48 h.

12.2 Persistence and degradability: No additional information.

12.3 Bioaccumulative potential: No additional information.

12.4 Mobility in soil: No additional information.

General notes: No additional information.

12.5 Results of PBT and vPvB assessment:

PBT: No additional information.

vPvB: No additional information.

12.6 Other adverse effects: No additional information.

13 Disposal considerations

13.1 Waste treatment methods (consult local, regional and national authorities for proper disposal)

Relevant Information:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities. (US 40CFR262.11).

14 Transport information

14.1 UN Number: None
ADR, ADN, DOT, IMDG, IATA

14.2 UN Proper shipping name: None
ADR, ADN, DOT, IMDG, IATA

14.3 Transport hazard classes:
ADR, ADN, DOT, IMDG, IATA

Class: None
Label: None
LTD. QTY: None

US DOT
Limited Quantity Exception: None

Bulk:
RQ (if applicable): None
Proper shipping Name: None
Hazard Class: None
Packing Group: None
Marine Pollutant (if applicable): No additional information.

Non Bulk:
RQ (if applicable): None
Proper shipping Name: None
Hazard Class: None
Packing Group: None
Marine Pollutant (if applicable): No additional information.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

	Comments: None	**Comments:** None
14.4	**Packing group:** ADR, ADN, DOT, IMDG, IATA	None
14.5	**Environmental hazards** :	None
14.6	**Special precautions for user:**	None
	Danger code (Kemler):	None
	EMS number:	None
	Segregation groups:	None
14.7	**Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code:** Not applicable.	
14.8	**Transport/Additional information:**	
	Transport category:	None
	Tunnel restriction code:	None
	UN "Model Regulation":	None

15 Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture.

North American

SARA

Section 313 (specific toxic chemical listings): None of the ingredients are listed.
Section 302 (extremely hazardous substances): None of the ingredients are listed.

CERCLA (Comprehensive Environmental Response, Clean up and Liability Act) Reportable

Spill Quantity: None of the ingredients are listed.

TSCA (Toxic Substances Control Act):

Inventory: All ingredients are listed.
Rules and Orders: Not applicable.

Proposition 65 (California):

Chemicals known to cause cancer: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for females: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for males: None of the ingredients are listed.

Chemicals known to cause developmental toxicity: None of the ingredients are listed.

Canadian

Canadian Domestic Substances List (DSL):
All ingredients are listed.

EU

REACH Article 57 (SVHC): None of the ingredients are listed.

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Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

Germany MAK: Not classified.

Asia Pacific

Australia

Australian Inventory of Chemical Substances (AICS): All ingredients are listed.

China

Inventory of Existing Chemical Substances in China (IECSC): All ingredients are listed.

Japan

Inventory of Existing and New Chemical Substances (ENCS): All ingredients are listed.

Korea

Existing Chemicals List (ECL): All ingredients are listed.

New Zealand

New Zealand Inventory of Chemicals (NZOIC): All ingredients are listed.

Philippines

Philippine Inventory of Chemicals and Chemical Substances (PICCS): All ingredients are listed.

Taiwan

Taiwan Chemical Substance Inventory (TSCI): All ingredients are listed.

16 Other information

Abbreviations and Acronyms: None

Summary of Phrases

Hazard statements:

H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:

P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Manufacturer Statement:

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

NFPA: 1-0-0

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

HMIS: 1-0-0

Attachment D
Site Orientation

Site Orientation

AECOM will conduct a site safety briefing for a person's initial visit to the Site. The briefing will be conducted:

- Prior to the start of work;
- For any new AECOM or subconsultant personnel; and
- At each mobilization, or whenever there is a change in task or significant change in task location.

All personnel working on the project who have received the site briefing (including the HASP review) will sign the Personal Acknowledgement located at the end of the HASP. Visitors may receive a shortened version to address the hazards specific to their visit.

The following items, at minimum, will be discussed during the site safety briefing:

- Contents of this HASP
- The Emergency Response Plan
- Contractor SH&E Management expectations
- Injury management, including notification and hospital and occupational clinic locations
- The AECOM 4-Sight program
- Stop Work authority
- The JSAs (Attachment E) for the tasks that will be performed on a given job
- Completion of a THA each day (Attachment E)
- Types of hazards at the Site and means for minimizing exposure to them
- Instructions for new operations to be conducted and safe work practices
- PPE that must be used
- Lone worker check-in procedures
- Emergency evacuation routes, muster points, and location and use of emergency equipment

These meetings must be documented and maintained in the project files.

Attachment E
Project/Task-Specific Pre-Job Hazard Assessments or Job Safety Analysis

Project/Task-Specific Pre-Job Hazard Assessments or Job Safety Analysis

This appendix includes the following:

- Pre-Job Hazard Assessment for each discrete task being performed during the project
- Blank Daily THA
- Daily Tailgate Forms*

One copy of the THA/Tailgate MUST be prepared at the start of each shift and signed by all staff involved in the operation. The THA should be consulted and updated throughout the day if conditions change.

*Client required equivalents may be substituted.

Americas

Pre-Job Hazard Assessment

S3NA-209-FM4

Location: 1919 Portland Avenue **Date:** December 17, 2018

Prepared By: Anders Utter **Approved By:** Click here to enter text.

Principal Activities	Potential Safety/Health Hazards	Initial Risk Rating	Control Measures	Final Risk Rating
List principle activities involved in the scope of work	Identify each safety or health hazard		Identify engineering and administrative controls and any specific PPE that is required	
ACTIVITY 1 – All Onsite Activities	Slips/Trips/Falls	6	Be aware of surroundings, practice good housekeeping	4
	Heat/Cold stress	6	Wear appropriate attire for the weather, monitor onsite workers for signs of heat/cold stress and ensure necessary breaks are taken	4
	Biological Hazards	6	Use insect repellant if necessary, check areas for signs of snakes, spiders, poisonous plants, ticks, and mosquitos	2
	Working Alone/Site Intruder	15	• Follow the “Buddy System”. Contractors can act as your buddy • Maintain routine (at least hourly) check ins with contractor personnel. • Inform contractor if going anywhere other than the field office. • Check-in and Check-out with supervisor via email, text, or phone call when arriving on job site and when arriving back home at end of shift. • Do not confront intruders and notify property owner. Stop all work until intruder has left the site. If intruder confronts you walk away and call police.	4
	Hazardous noise levels; noise >85 dB	6	• Increase distance between you and the equipment making the noise • Staff exposed noise levels in excess of 85 dBA must wear hearing protection rated for >27 Noise Reduction Rating. • A general rule is when talking with someone within 3 feet, if you need to raise your voice above a normal talking level, it is >85 dBA	1

Principal Activities	Potential Safety/Health Hazards	Initial Risk Rating	Control Measures	Final Risk Rating
ACTIVITY 2 – Utility Locate.	Explosion/electrocution	20-25	Contact public utility locate and have utilities marked out around the site. Oversee a private onsite utility locate. Review locations against construction drawings and known utilities. Clear upper eight feet of intended drilling locations with an air knife/vacuum truck.	4
	Click here to enter text.	#	Click here to enter text.	#
	Click here to enter text.	#	Click here to enter text.	#
	Click here to enter text.	#		#
	Click here to enter text.	#	Click here to enter text.	#
ACTIVITY 3 – Drilling Equipment Set-up	Drill rig setup/movement	15-20	Keep safe and clear distance from drill rig while operator is maneuvering. Stay in line of sight of drill operator and use designated hand signals to communicate. Set up sampling equipment outside of drill rig work zone.	4
	Pinch Points	10-15	Review pinch points on drill rig with driller prior to setup. Be aware of pinch points when setting up sample receipt area.	3
	Click here to enter text.	#	Click here to enter text.	#
	Click here to enter text.	#	Click here to enter text.	#
	Click here to enter text.	#	Click here to enter text.	#
ACTIVITY 4 – Rotosonic Drilling Operation	Flying Debris	6	Keep safe and clear distance from drill stem (>10 ft)	2
	Pinch Points	10-15	Keep hands/feet away from drill rig at all times	4
	Struck By/Line of fire of heavy/mobile equipment (Working Near)	15-20	• Perform a Daily Task Hazard Assessment to identify potential struck by and line of fire hazards. • Keep constant watch of activities occurring around you • Notify operators, site superintendents of your presence onsite • Ground personnel shall always yield to and stay alert at the location and activities of equipment. • Do not approach active areas unless the operators' have given permission. • Do not ride on contractor mobile equipment (even for a short distance). • Remain outside the line of fire of all heavy equipment activities (e.g. cables, ropes, potential fall path, etc.)	4

Principal Activities	Potential Safety/Health Hazards	Initial Risk Rating	Control Measures	Final Risk Rating
	Hazardous noise levels; noise >85 dB	6	• Increase distance between you and the equipment making the noise • Staff exposed noise levels in excess of 85 dBA must wear hearing protection rated for >27 Noise Reduction Rating. • A general rule is when talking with someone within 3 feet, if you need to raise your voice above a normal talking level, it is >85 dBA	1
	Injury due to Underground Utilities/Ground Disturbance	9	• Confirm with the contractor that utility markings have been identified • Do not dig until all underground lines (within 100 feet of work area) have been located and marked. Expose all lines (within 15 feet) by hand before excavating.	2
ACTIVITY 5 – Soil and Groundwater Sample Collection	Pinch Points	10-15	Use hand signals to communicate with drillers, don't walk toward drill stem while operating without getting driller's attention.	4
	Back/Knee Strain	6	Use proper lifting techniques to move coolers, place soil core samples on an elevated surface to avoid bending	2
	Chemical Exposure	9	Wear appropriate PPE, use disposable nitrile gloves while handling core/samples	2
	Line of Fire Injuries	9	Stay out of work zone when possible	3
	Slips Trips and Falls	6	Be aware of surroundings	4
ACTIVITY 6 – Backfilling Soil Borings/Debris and Waste Management	Back Strain	6	Avoid lifting more than one bag of bentonite at a time, use proper lifting techniques. Take breaks as necessary.	2
	Spills/Chemical Exposure	10-12	Use a drum dolly or lift to move any drums onsite	4
	Regulatory Infractions	9	Ensure that all soil cuttings and decontamination water are properly contained and labeled	2
	Back Strain	6	Use a drum dolly or lift to move any drums onsite	2
	Pinch Points	8	Be aware of pinch points when putting lid on a barrel	2
ACTIVITY 7 – Soil Excavation/Solidification	Struck By/Line of fire of heavy/mobile equipment (Working Near)	15-20	• Perform a Daily Task Hazard Assessment to identify potential struck by and line of fire hazards. • Keep constant watch of activities occurring around you	4

Principal Activities	Potential Safety/Health Hazards	Initial Risk Rating	Control Measures	Final Risk Rating
			• Notify operators, site superintendents of your presence onsite • Ground personnel shall always yield to and stay alert at the location and activities of equipment. • Do not approach active areas unless the operators' have given permission. • Do not ride on contractor mobile equipment (even for a short distance). • Remain outside the line of fire of all heavy equipment activities (e.g. cables, ropes, potential fall path, etc.)	
	Injury due to Underground Utilities/Ground Disturbance	9	• Confirm with the contractor that utility markings have been identified • Do not dig until all underground lines (within 100 feet of work area) have been located and marked. Expose all lines (within 15 feet) by hand before excavating.	2
	Chemical exposure	9	Decontaminate equipment prior to use, wear proper PPE	2
	Hazardous noise levels; noise >85 dB	6	• Increase distance between you and the equipment making the noise • Staff exposed noise levels in excess of 85 dBA must wear hearing protection rated for >27 Noise Reduction Rating. • A general rule is when talking with someone within 3 feet, if you need to raise your voice above a normal talking level, it is >85 dBA	1
	Click here to enter text.	#	Click here to enter text.	#
ACTIVITY 8 – Mobilization/Demobilization	Back Strain From Loading/Unloading Equipment	8	Avoid lifting heavy or awkward objects without help	2
	Pinch Points	8	Avoid lifting heavy or awkward objects without help	2
	Chemical Exposure	8	Ensure all equipment has been decontaminated prior to repacking. Wear all appropriate PPE.	2
	Motor Vehicle Operation	9	Complete AECOM training requirements. No cell phone use while driving (including hands free devices). • Complete a pre-use visual inspection. • Conduct a pre-trip assessment to check for	4

Principal Activities	Potential Safety/Health Hazards	Initial Risk Rating	Control Measures	Final Risk Rating
			traffic and weather conditions • Be aware of road conditions and drive only to your comfort level. Maintain a safe distance from moving vehicles/equipment, • Make visual contact with drivers and operators. • Stage activities away from vehicles and paths of travel. • All personnel working around traffic must review a site specific traffic control plan	
	Unsecured Equipment		Secure all equipment using appropriate tools for the job	
ACTIVITY 9 – Click here to enter text.	Click here to enter text.	#	Click here to enter text.	#
	Click here to enter text.	#	Click here to enter text.	#
	Click here to enter text.	#	Click here to enter text.	#
	Click here to enter text.	#	Click here to enter text.	#
	Click here to enter text.	#	Click here to enter text.	#

SPECIAL REQUIREMENTS

Step #	Equipment to be Used	Inspection requirements	Training Requirements
	List equipment to be used in work activity	List inspection/permit requirements for work activity	List training requirements including hazard communication
1.	Line Locating Equipment	To be determined by qualified line finder	To be determined by qualified line finder
2.	Air Knife/Vac Truck	To be determined by driller subcontractor	To be determined by driller subcontractor
3.	Rotosonic Drilling Equipment	To be determined by driller subcontractor	To be determined by driller subcontractor
4.	Photo Ionization Detector	Calibration – daily in accordance with the manufacturer's instructions	Training in proper instrument use in accordance with the manufacturer's instructions
5.	Motor Vehicle	Click here to enter text.	Click here to enter text.
6.	Cell Phones	Click here to enter text.	Click here to enter text.
7.	Hand truck or cart	Click here to enter text.	Click here to enter text.
8.	Sampling Equipment and Containers	Click here to enter text.	Click here to enter text.
9.	Click here to enter text.	Click here to enter text.	Click here to enter text.

INSTRUCTIONS AND RISK MATRIX

Hazard Evaluation – Identify principle steps of the task. Identify potential safety/health hazards for each step and determine initial risk rating using the matrix provided below. Identify control measures including PPE for each hazard. Re-evaluate hazard potential and assign a final risk rating. If the final risk rating is a 5-9 (medium risk) or 10-25 (high risk), additional hazard controls shall be identified and applied until the final risk rating is reduced to 4 or below. The final risk rating cannot be reduced to 4 or lower, additional approvals are needed before the activity can begin. Add additional rows as required to cover all major steps/aspects of the activity.

Special Requirements – Identify equipment to be used including specific PPE required. Identify inspection requirements such as competent person, permit issue, documented task hazard analysis, etc. Identify training requirements such as hazard communication, scaffold user, fall protection, etc.

High ⟵ ⟶ Low

Probability	Severity				
	5 - Catastrophic	4 - Critical	3 - Major	2 - Moderate	1 - Minor
5 - Frequent	25	20	15	10	5
4 - Probable	20	16	12	8	4
3 - Occasional	15	12	9	6	3
2 - Remote	10	8	6	4	2
1 - Improbable	5	4	3	2	1

High ↕ Low

10-25 (red) are high risk, 5-9 (yellow) are medium risk, and 1-4 (green) are low risk

Severity – Potential Consequences				
	People	**Property Damage**	**Environmental Impact**	**Public Image/Reputation**
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost/Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

Probability		
Frequent	Expected to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur during task/activity	1/1,000
Improbable	Highly unlikely to occur, but possible during task/activity	1/10,000

Risk Rating (Probability x Severity)	Risk Acceptance Authority
1 to 4 (Low)	Risk is tolerable, manage at local level
5 to 9 (Medium)	Risk requires approval by Operations Lead/Supervisor & SH&E Manager
10 to 25 (High)	Risk requires the approval of the Operations Manager & SH&E Director

AECOM

Americas

Task Hazard Assessment

S3AM-209-FM6

Customer	**Permit No.**
Location	**Job No.**
Description of Task	**Date**

Basic Task Steps (explain how the task will be carried out)	**Hazards** (identify all hazards and potential hazards)	**Risk** (initial)	**Precautions** (describe how that hazard will be controlled)	**Risk** (final)	**Initials**
			Highest Risk Index		

Review and attach to Tailgate Meeting as required. Number and attach additional pages if necessary.

Worker/Visitor acknowledgement and review of this content on back of this document.

Risk Matrix on Reverse

Originator _____ (Print Name) _____ (Signature)

Supervisor _____ (Print Name) _____ (Signature)

THIS FORM IS TO BE KEPT ON JOB SITE.

AECOM

WORKER SIGN ON

NAME (Please Print) SIGNATURE

I participated in the development and understand the content of this Task Hazard Assessment.

VISITOR SIGN ON

NAME (Please Print) SIGNATURE TIME

Risk Rating Matrix

Probability	Severity				
	5 - Catastrophic	4 – Critical	3 – Major	2 – Moderate	1 - Minor
5 – Frequent	25	20	15	10	5
4 – Probable	20	16	12	8	4
3 – Occasional	15	12	9	6	3
2 – Remote	10	8	6	4	2
1 - Improbable	5	4	3	2	1

Risk Rating (Probability x Severity)	Risk Acceptance Authority
1 to 4 (Low)	Risk is tolerable, manage at local level
5 to 9 (Medium)	Risk requires approval by Operations Lead/Supervisor & Safety Manager
10 to 25 (High)	Risk requires the approval of the Operations Manager & Safety Director

Severity – Potential Consequences				
	People	Property Damage	Environmental Impact	Public Image/Reputation
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost/Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

Probability		
Frequent	Expected to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur during task/activity	1/1,000
Improbable	Highly unlikely to occur, but possible during task/activity	1/10,000

Task Hazard Assessment Follow-Up/Review.

First Break **Initial**

Lunch Break **Initial**

Second Break **Initial**

Emergency Meeting / Assembly Area

Emergency Contact #

Emergency Radio Channel

Area is safe and housekeeping completed at the end of task/shift.

Supervisor (print name)

Signature

AECOM

Americas

Daily Tailgate Meeting

S3AM-209-FM5

Job Location:		Date:	
AECOM Site Supervisor:		Person Conducting Tailgate Meeting:	
AECOM Site Supervisor Phone:		AECOM Safety Officer Name & Phone:	

List activities to be performed today:	

Muster Point:		Spill Kit Location:	
First Aid Kit Location:		Fire Extinguisher Location:	

Have all personnel reviewed and understand the site-specific safety plan?	☐ Yes ☐ No*
Are current Pre-Job Hazard Assessments in place for each of the tasks to be performed today and understood by all?	☐ Yes ☐ No*
Does each subcontractor have hazard assessments (e.g., THA, JSA, JHA) for their activities?	☐ Yes ☐ No* ☐ N/A
Are any required permits in place for the applicable tasks to be performed today and understood by all? Identify required permits and permit #s:	☐ Yes ☐ No* ☐ N/A
Have all members of the work team confirmed understanding of the work, hazards, and controls/ mitigation?	☐ Yes ☐ No*
Have work areas been properly cordoned-off to protect workers, site staff, and the public?	☐ Yes ☐ No* ☐ N/A
Have equipment checks been completed, documented, and reviewed?	☐ Yes ☐ No* ☐ N/A
Do all site workers understand injury/ intervention reporting requirements including immediately notifying the AECOM Site Supervisor of any injury near miss, unsafe condition or hazard observation?	☐ Yes ☐ No*

** if No, then work cannot be performed until corrective action is completed and documented.*

Topics covered in today's tailgate meeting:	

Other Items Discussed Today:	**Stop Work Authority & Obligation**
	* All employees will stop the job any time anyone is concerned or uncertain about safety. * All employees will stop the job if anyone identifies a hazard or additional mitigation not recorded on the THA. * All employees will be alerted to any changes in personnel or conditions at the worksite. * All employees will stop the job and reassess a task, hazards, and mitigations, and then amend the THA as needed.

SITE WORKERS (including AECOM Contractors and Subcontractors): By signing here, you are stating the following:

* You have been involved in reviewing the THAs and understand the hazards and control measures associated with each task you are about to perform.
* You understand the permit to work requirements applicable to the work you are about to perform (if it includes permitted activities).
* You are aware that no tasks or work (that is not risk-assessed) is to be performed.
* You are aware of your authority and obligation to 'Stop Work'.

I arrived and departed fit for duty:

* You are physically and mentally fit for duty.
* You are not under the influence of any type of medication, drugs, or alcohol that could affect your ability to work safely.
* You are aware of your responsibility to immediately report any illness, injury (regardless of where or when it occurred), or fatigue issue you may have to the AECOM Supervisor.
* You signed-out uninjured unless you have otherwise informed the AECOM Supervisor.

Print Name & Company	Signature	Initials & Sign In Time	Initials & Sign Out Time
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit

(Attach additional Site Worker sign-in/out sheets if needed)

SITE VISITOR / SITE REPRESENTATIVE

Name	Company Name	Arrival Time	Departure Time	Signature

To be completed once activities for the day have been concluded:

Were there any Incidents, Near Misses or Observations?	☐ Yes ☐ No	If yes, details:
Were there any 'Stop Work' interventions?	☐ Yes ☐ No	If yes, details:
Were there any areas for improvement noted?	☐ Yes ☐ No	If yes, details:
At the conclusion of the day, the job site is being left in a safe condition and there were no reports of injury or first aid.	☐ Yes ☐ No	AECOM Supervisor Signature:

Attachment F
Operational Security Plan

Operational Security Plan

1.0 Purpose and Scope

1.1 The purpose is to establish a standard for the physical security and resiliency of all AECOM employees working at Tacoma Metals property located.

1.2 This provides the minimum criteria to be followed and applies to all employees.

2.0 Terms and Definitions

2.1 **Disruptive Event** (Event): Any event that takes AECOM outside its normal business operations and decision process, with the potential to impact the business and brand.

2.2 **On site intruder:** An individual who enters the site without proper authorization and will not leave the site.

2.3 **Active Shooter:** An individual actively engageing in killing or attempting to kill people in a populated area.

3.0 References

3.1 AECOM Security and Resilience Policy

3.2 Physical Resilience Standard, RS2-002-PR1

3.3 Identification Badge Guidelines

4.0 Procedure

4.1 On site Intruder

4.1.1 Individual Response Options

4.1.1.1 Stop all work

4.1.1.2 With a co-worker walk up to the intruder and ask them to leave the site

1) Allow the agitated individual plenty of personal space.
2) Avoid touching the individual.
3) Convey empathy by acknowledging the individual's feelings. Make eye contact "soft eyes". Look friendly, your mood is contagious.
4) Never approach a violent individual alone or approach unexpectedly from behind.
5) The presence of three to four staff members may be enough to reassure the individual that you will not let him lose control.
6) Give simple, positive directions. Repeat phrase over with calm, slow voice pattern.
7) Give the individual control by offering him alternatives (example: walking, talking).
8) If assault is imminent, quick coordinated action is essential. Stay in step-stance so you can move out of the way quickly.
9) Approach individual in a calm, self-assured manner so as not to communicate your anxiety or fear. Maintain calm, flexible attitude.
10) Attempt to calm the person without risking bodily harm to yourself.

11) Ensure protection for yourself and your staff (example: door nearby for withdrawal)
12) Utilize restraint, only as a last resort.
13) Never approach a violent individual alone or approach unexpectedly from behind.
14) The presence of three to four staff members may be enough to reassure the individual that you will not let him lose control.
15) Give simple, positive directions. Repeat phrase over with calm, slow voice pattern.
16) Give the individual control by offering him alternatives (example: walking, talking).
17) If assault is imminent, quick coordinated action is essential. Stay in step-stance so you can move out of the way quickly.
18) Approach individual in a calm, self-assured manner so as not to communicate your anxiety or fear. Maintain calm, flexible attitude.
19) Attempt to calm the person without risking bodily harm to yourself.
20) Ensure protection for yourself and your staff (example: walk away) Utilize restraint, only as a last resort

4.1.2 If the intruder has a firearm see Active Shooter Guidance (GRG-040-RP4)

4.2 Information to provide Call Centers/Operators

4.2.1 Location of intruder

4.2.2 Physical description of intruder

4.2.3 If the intruder has weapons let them know

5.0 Security Measures

5.1 Physical Control Measures

5.1.1 Fencing/Gates

5.1.1.1 A six foot tall galvanized fence with three string barb wire will surround the property.

5.2 Personnel Control Measures

5.2.1 AECOM Identity (ID) Card(s)

5.2.1.1 All personnel will check in with site supervisor and provide proof of identity and reason for visit.

5.2.1.2 PM will notify site supervisor in advance of site visitors.

5.2.2 New Employee(s)

5.2.2.1 New employees will go through a site orientation prior to working at the site.

5.2.3 Visitors to the Facility

5.2.3.1 Visitors will notify the PM and site supervisor prior to arriving at the facility.

5.2.4 Weapons Standard

5.2.4.1 All firearms are prohibited on AECOM property.

5.3 Vehicle Control Measures

5.3.1 Standards

5.3.1.1 Only authorized vehicles will be allowed on site inside the gated area.

5.3.1.2 When vehicle (vendor or visitor) arrives at site, occupant must call in and wait for a site representative to open the gate and escort them in.

6.0 Appendices

6.1 Appendix A Disruptive Event Response Checklist

6.2 Appendix B Incident Tracking Log

6.3 Appendix C Active Shooter Guidance

7.0 Records

7.1 None.

Disruptive Event Response Checklist

GRG-007-OR4

Assess

- Assess who, what, where and when.
- Preserve life and assess the safety of the employees.
- Evaluate the safety and security of facilities and project sites.
- Initial assessment of impact to AECOM's people, assets and reputation.
- Call for emergency response as appropriate.

Report

- Communicate from Local level to Region, Geography and Enterprise.
- Utilize AECOM's incoming global security emergency number +44 203 475 4852.
- Utilize AECOM's local relevant office outgoing messaging service for event specific information.

Convene

- Mobilize Local, Region and Geography Resilience Teams.
- Utilize Response Protocols to guide response plan development and ongoing Resilience Team management.
- Appoint a person to make entries in event management log.

Execute

- Make security of employees an immediate priority.
- Mobilize ancillary resources, as necessary.
- Communicate with our employees, clients and other stakeholders.
- Manage project and contract risks; limit uncertainties.
- Evaluate work environment for project delivery.
- Determine purchasing requirements and financial needs.

Resolve

- Finish administrative documentation requirements.
- Return to normal business operations.
- Conduct lessons learned debrief.

Response Protocol

Task	Action
Roles and Responsibilities	Confirm respective roles and responsibilities for the Resilience Team and other required teams.
Facts	What do you know as true? And how was it confirmed?
Assumptions	What do you believe has occurred? What is the source of information?
Scenarios	Worst case and most likely (do not discount anything).
Priorities	Establish priorities including information requirements and immediate actions
Response Options	Consider the range of options available. What needs to be done NOW and what can WAIT?
Objectives	Set objectives (i.e., indicators must we achieve to solve the problem and return to normal operations/business).
Stakeholders	Identify the full range of stakeholders and prioritize according to the risk/interest/influence they each have.
Key Messages	Establish the messages which must and should be conveyed to stakeholders. Establish communication timeline.
Review	Review key points. Confirm next assessment time.

AECOM

Incident Tracking Log

GRG-008-IR4

Prepare an Incident Tracking Log to record incidents, occurrences, messages, directions or orders received, together with follow-up actions that are specific to an incident at a project or office site. Incident Tracking Logs will be saved in the Resilience Team collaboration folders on the Resilience SharePoint within the corresponding Region Resilience Team workspace.

Incident Tracking Log					
Resilience Event Name			Page No. **1**	No. of Pages	
AECOM Project or Office and Street Address		**Period Covered**			
		From		**To**	
		Hour	Date	Hour	Date

Item	Time	Incident, Occurrence, Messages, Directions or Orders, Etc.	Action Taken	Initial
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Typed Name of Report Preparer	**Signature and Date**

Active Shooter Guidance

1.0 Purpose and Scope

1.1 The purpose is to establish guidelines to protect against, mitigate, respond to, and recover from active shooter events. AECOM is committed to enhancing preparedness through a "whole community" approach by collaborating with a broad range of government and private partners in order to gain a better understanding of the behaviors, tactics and other indicators that could point to potential violent activity and the best ways to mitigate or prevent that activity.

1.2 In conjunction with government agencies, AECOM has adopted and implemented guidance for identifying dangerous behaviors and responding to critical and emergent situations.

2.0 Terms and Definitions

2.1 **Active Shooter:** An individual actively engaged in killing or attempting to kill people in a populated area.

3.0 References

3.1 AECOM Security and Resilience Policy

3.2 Physical Resilience Standard, RS2-002-PR1

3.3 Disruptive Event Response Standard, RS2-001-PR1

3.4 Facility Security Procedure, GRG-026-RP4

4.0 Procedure

4.1 Individual Response Options

4.1.1 There is no pattern or method to how active shooter situations unfold. By their very nature, they are unpredictable and evolve quickly. Because active shooter situations are often over before law enforcement can respond, individuals must be prepared both mentally and physically to deal with an active shooter situation. Knowing what to do can save lives.

4.1.2 Run

4.1.2.1 Have an escape route and escape plan in mind.

4.1.2.2 Leave your belongings behind.

4.1.2.3 Evacuate regardless of whether others agree to follow.

4.1.2.4 Help others escape if possible.

4.1.2.5 Do not attempt to move the wounded.

4.1.2.6 Prevent others from entering an area where the active shooter may be.

4.1.2.7 Keep your hands visible.

4.1.3 Hide

4.1.3.1 Hide in an area out of the shooter's view

4.1.3.2 Lock door or block entry to your hiding place

4.1.3.3 Silence your mobile device completely – do not place on vibrate mode.

4.1.3.4 Remain quiet.

4.1.4 Fight

4.1.4.1 Fight as a last resort and only when your life is in imminent danger.

4.1.4.2 Attempt to incapacitate the shooter.

4.1.4.3 Act with as much physical aggression as possible.

4.1.4.4 Improvise weapons or throw items at the active shooter.

4.1.4.5 Commit to your actions. Your life depends on it.

4.2 Information to provide Emergency Call Centers / Operators

4.2.1 Location of active shooter.

4.2.2 Number of shooters.

4.2.3 Physical description of shooters.

4.2.4 Number and type of weapons shooter has.

4.2.5 Number of potential victims at location.

4.3 Actions to Take When Law Enforcement Arrives

4.3.1 Drop items in your hands, i.e., bags, jackets, etc.

4.3.2 Raise hands and spread fingers. Keep hands visible at all times.

4.3.3 Avoid quick movements toward officers, such as holding on to them for safety.

4.3.4 Avoid pointing, screaming or yelling.

4.3.5 Do not ask questions when evacuating.

5.0 Records

5.1 None.

6.0 Attachments

6.1 Attachment A – Options for Consideration – Active Shooter Training Video, U.S. Department of Homeland Security

https://www.youtube.com/watch?v=oI5EoWBRYmo&feature=youtu.be

6.2 Attachment B – Run – Hide – Fight Video, Ready Houston, Houston Office of Emergency Management

https://www.youtube.com/watch?v=5VcSwejU2D0

6.3 Attachment C –IS-907: Active Shooter: What Can You Do, FEMA Independent Study

http://training.fema.gov/is/courseoverview.aspx?code=IS-907

6.4 Handouts and Posters (Reference documents printed on following pages)

6.4.1 Active Shooter Event Quick Reference Guide

6.4.2 Active Shooter: How to Respond

6.4.3 Active Shooter Pocket Card

6.4.4 Active Shooter Pocket Card, printable

6.4.5 Active Shooter Pamphlet

6.4.6 How to Respond When an Active Shooter is in Your Vicinity


Active Shooter Tent Card_042914.pdf


active_shooter_pocket_card_508.pdf


active_shooter_poster_508.pdf


ActiveShooter_Pocket_printable.pdf


active-shooter-how-to-respond-508.pdf


active-shooter-pamphlet-508.pdf

Attachment A

Active Shooter Event

Quick Reference Guide

When law enforcement arrives:

- Remain calm and follow instructions
- Drop items in your hands (i.e., bags, jackets)
- Raise hands and spread fingers
- Keep hands visible at all times
- Avoid quick movements toward officers, such as holding on to them for safety
- Avoid pointing, screaming or yelling
- Do not ask questions when evacuating

Information to provide to 911 operators:

- Location of the active shooter
- Number of shooters
- Physical description of shooters
- Number and type of weapons shooter has
- Number of potential victims at location

For questions or additional assistance contact:

Your local FBI Office:

FBI Headquarters National Press Office: (202) 324-3691

Federal Bureau of Investigation
935 Pennsylvania Avenue, NW
Washington, DC 20535

U.S. Department of Justice
Federal Bureau of Investigation

ACTIVE SHOOTER EVENT

QUICK REFERENCE GUIDE

An active shooter is an individual actively engaged in killing or attempting to kill people in a confined and populated area.

- *Victims are selected at random*
- *Event is unpredictable and evolves quickly*
- *Knowing what to do can save lives*

ACTIVE SHOOTER EVENTS

When an Active Shooter is in your vicinity, you must be prepared both mentally and physically to deal with the situation.

You have three options:

1 RUN

- Have an escape route and plan in mind
- Leave your belongings behind
- Evacuate regardless of whether others agree to follow
- Help others escape, if possible
- Do not attempt to move the wounded
- Prevent others from entering an area where the active shooter may be
- Keep your hands visible
- Call 911 when you are safe

2 HIDE

- Hide in an area out of the shooter's view
- Lock door or block entry to your hiding place
- Silence your cell phone (including vibrate mode) and remain quiet

FIGHT 3

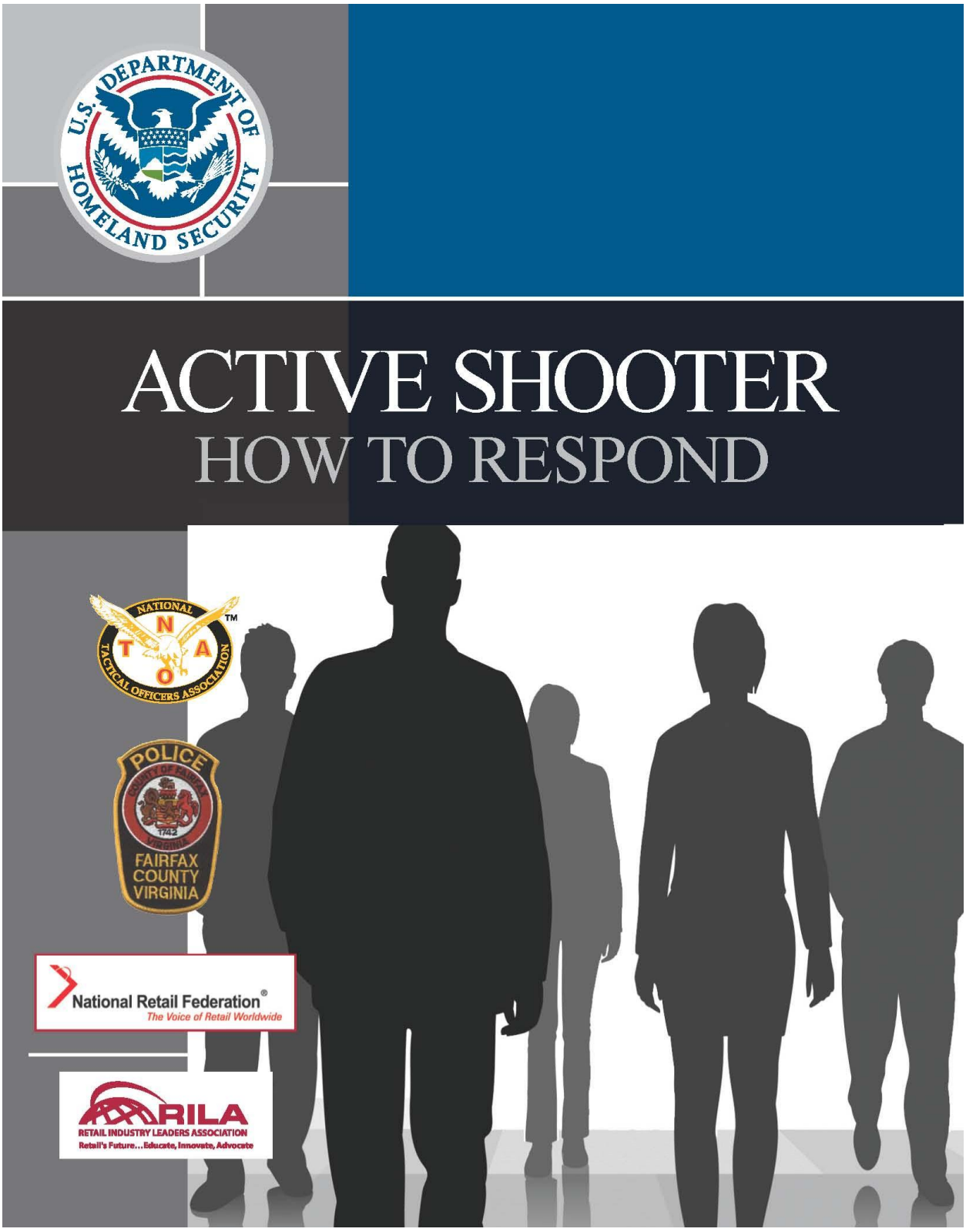
- Fight as a last resort and only when your life is in imminent danger
- Attempt to incapacitate the shooter
- Act with as much physical aggression as possible
- Improvise weapons or throw items at the active shooter
- Commit to your actions. . . your life depends on it

The first officers to arrive on scene will not stop to help the injured. Expect rescue teams to follow initial officers. These rescue teams will treat and remove the injured.

Once you have reached a safe location, you will likely be held in that area by law enforcement until the situation is under control, and all witnesses have been identified and questioned. Do not leave the area until law enforcement authorities have instructed you to do so.

Attachment B

Active Shooter: How to Respond


U.S. DEPARTMENT OF HOMELAND SECURITY
ACTIVE SHOOTER
HOW TO RESPOND
NATIONAL TACTICAL OFFICERS ASSOCIATION
POLICE
FAIRFAX COUNTY VIRGINIA
National Retail Federation
The Voice of Retail Worldwide
RILA
RETAIL INDUSTRY LEADERS ASSOCIATION
Retail's Future...Educate, Innovate, Advocate

Emergency Numbers

Emergency Services: 9 -1 -1

Local Emergency Information Line: _____

Local Police Department: _____

Local Fire Department: _____

Local Hospital: _____

Local FBI Field Office: _____

Facility Security: _____

Facility Address: _____

_____

_____

_____

Floor: _____ Suite/Room: _____

Office #: _____ Ext. _____

PROFILE OF AN ACTIVE SHOOTER

An Active Shooter is an individual actively engaged in killing or attempting to kill people in a confined and populated area; in most cases, active shooters use firearms(s) and there is no pattern or method to their selection of victims.

Active shooter situations are unpredictable and evolve quickly. Typically, the immediate deployment of law enforcement is required to stop the shooting and mitigate harm to victims.

Because active shooter situations are often over within 10 to 15 minutes, before law enforcement arrives on the scene, individuals must be prepared both mentally and physically to deal with an active shooter situation.

Good practices for coping with an active shooter situation

- Be aware of your environment and any possible dangers
- Take note of the two nearest exits in any facility you visit
- If you are in an office, stay there and secure the door
- If you are in a hallway, get into a room and secure the door
- As a last resort, attempt to take the active shooter down. When the shooter is at close range and you cannot flee, your chance of survival is much greater if you try to incapacitate him/her.

CALL 911
WHEN IT IS SAFE TO DO SO!

HOW TO RESPOND WHEN AN ACTIVE SHOOTER IS IN YOUR VICINITY

Quickly determine the most reasonable way to protect your own life. Remember that customers and clients are likely to follow the lead of employees and managers during an active shooter situation.

1. RUN

If there is an accessible escape path, attempt to evacuate the premises. Be sure to:

- Have an escape route and plan in mind
- Evacuate regardless of whether others agree to follow
- Leave your belongings behind
- Help others escape, if possible
- Prevent individuals from entering an area where the active shooter may be
- Keep your hands visible
- Follow the instructions of any police officers
- Do not attempt to move wounded people
- Call 911 when you are safe

2. HIDE

If evacuation is not possible, find a place to hide where the active shooter is less likely to find you.

Your hiding place should:

- Be out of the active shooter's view
- Provide protection if shots are fired in your direction (i.e., an office with a closed and locked door)
- Not trap you or restrict your options for movement

To prevent an active shooter from entering your hiding place:

- Lock the door
- Blockade the door with heavy furniture

If the active shooter is nearby:

- Lock the door
- Silence your cell phone and/or pager
- Turn off any source of noise (i.e., radios, televisions)
- Hide behind large items (i.e., cabinets, desks)
- Remain quiet

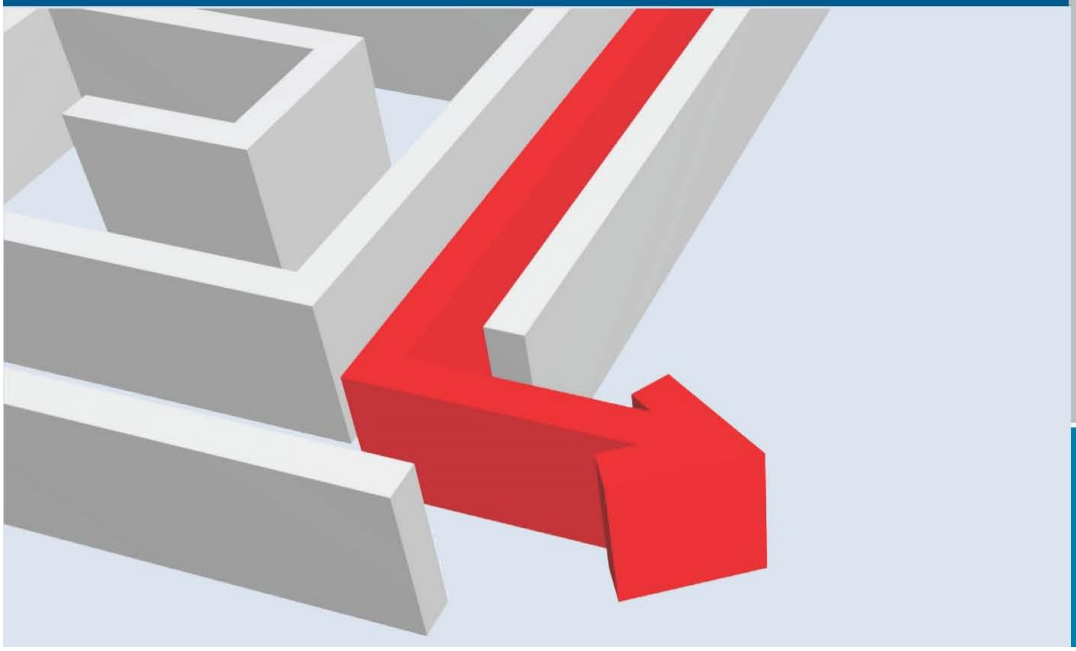
If evacuation and hiding out are not possible:

- Remain calm
- Dial 911, if possible, to alert police to the active shooter's location
- If you cannot speak, leave the line open and allow the dispatcher to listen

3. FIGHT

As a last resort, and only when your life is in imminent danger, attempt to disrupt and/or incapacitate the active shooter by:

- Acting as aggressively as possible against him/her
- Throwing items and improvising weapons
- Yelling
- Committing to your actions



HOW TO RESPOND WHEN LAW ENFORCEMENT ARRIVES

Law enforcement's purpose is to stop the active shooter as soon as possible. Officers will proceed directly to the area in which the last shots were heard.

- Officers usually arrive in teams of four (4)
- Officers may wear regular patrol uniforms or external bulletproof vests, Kevlar helmets, and other tactical equipment
- Officers may be armed with rifles, shotguns, handguns
- Officers may use pepper spray or tear gas to control the situation
- Officers may shout commands, and may push individuals to the ground for their safety

How to react when law enforcement arrives:

- Remain calm, and follow officers' instructions
- Put down any items in your hands (i.e., bags, jackets)
- Immediately raise hands and spread fingers
- Keep hands visible at all times
- Avoid making quick movements toward officers such as holding on to them for safety
- Avoid pointing, screaming and/or yelling
- Do not stop to ask officers for help or direction when evacuating, just proceed in the direction from which officers are entering the premises

Information to provide to law enforcement or 911 operator:

- Location of the active shooter
- Number of shooters, if more than one
- Physical description of shooter/s
- Number and type of weapons held by the shooter/s
- Number of potential victims at the location

The first officers to arrive to the scene will not stop to help injured persons. Expect rescue teams comprised of additional officers and emergency medical personnel to follow the initial officers. These rescue teams will treat and remove any injured persons. They may also call upon able-bodied individuals to assist in removing the wounded from the premises.

Once you have reached a safe location or an assembly point, you will likely be held in that area by law enforcement until the situation is under control, and all witnesses have been identified and questioned. Do not leave until law enforcement authorities have instructed you to do so.

TRAINING YOUR STAFF FOR AN ACTIVE SHOOTER SITUATION

To best prepare your staff for an active shooter situation, create an Emergency Action Plan (EAP), and conduct training exercises. Together, the EAP and training exercises will prepare your staff to effectively respond and help minimize loss of life.

Components of an Emergency Action Plan (EAP)

Create the EAP with input from several stakeholders including your human resources department, your training department (if one exists), facility owners / operators, your property manager, and local law enforcement and/or emergency responders. An effective EAP includes:

- A preferred method for reporting fires and other emergencies
- An evacuation policy and procedure
- Emergency escape procedures and route assignments (i.e., floor plans, safe areas)
- Contact information for, and responsibilities of individuals to be contacted under the EAP
- Information concerning local area hospitals (i.e., name, telephone number, and distance from your location)
- An emergency notification system to alert various parties of an emergency including:
  - Individuals at remote locations within premises
  - Local law enforcement
  - Local area hospitals

Components of Training Exercises

The most effective way to train your staff to respond to an active shooter situation is to conduct mock active shooter training exercises. Local law enforcement is an excellent resource in designing training exercises.

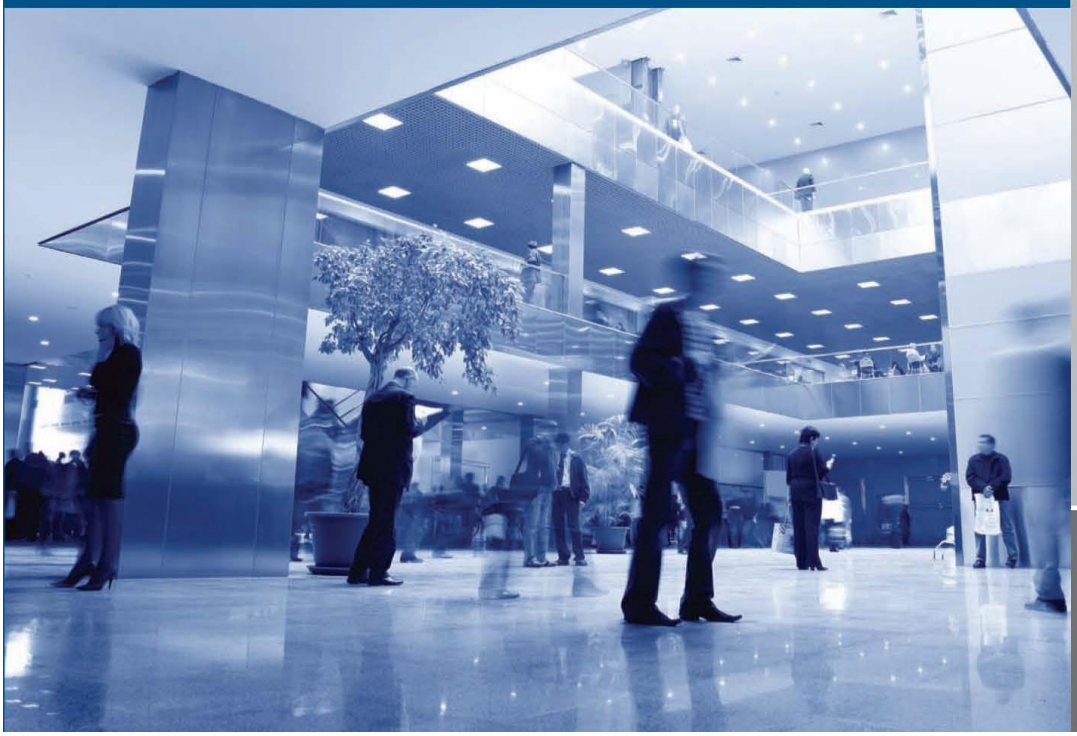
- Recognizing the sound of gunshots
- Reacting quickly when gunshots are heard and/or when a shooting is witnessed:
  - Run
  - Hide
  - Fight the shooter as a last resort
- Calling 911
- Reacting when law enforcement arrives
- Adopting the survival mind set during times of crisis

Additional Ways to Prepare For and Prevent an Active Shooter Situation

- Preparedness
  - Ensure that your facility has at least two evacuation routes
  - Post evacuation routes in conspicuous locations throughout your facility
  - Include local law enforcement and first responders during training exercises
  - Encourage law enforcement, emergency responders, SWAT teams, K-9 teams, and bomb squads to train for an active shooter scenario at your location

- Prevention
  - Foster a respectful workplace
  - Be aware of indications of workplace violence and take remedial actions accordingly

For more information on creating an EAP contact the U.S. Department of Labor, Occupational Health and Safety Administration, www.osha.gov.



PREPARING FOR AND MANAGING AN ACTIVE SHOOTER SITUATION

Your human resources department and facility managers should engage in planning for emergency situations, including an active shooter scenario. Planning for emergency situations will help to mitigate the likelihood of an incident by establishing the mechanisms described below.

Human Resources' Responsibilities

- Conduct effective employee screening and background checks
- Create a system for reporting signs of potentially violent behavior
- Make counseling services available to employees
- Develop an EAP which includes policies and procedures for dealing with an active shooter situation, as well as after action planning

Facility Manager Responsibilities

- Institute access controls (i.e., keys, security system pass codes)
- Distribute critical items to appropriate managers / employees, including:
  - Floor plans
  - Keys
  - Facility personnel lists and telephone numbers
- Coordinate with the facility's security department to ensure the physical security of the location
- Assemble crisis kits containing:
  - radios
  - floor plans
  - staff roster, and staff emergency contact numbers
  - first aid kits
  - flashlights
- Place removable floor plans near entrances and exits for emergency responders
- Activate the emergency notification system when an emergency situation occurs

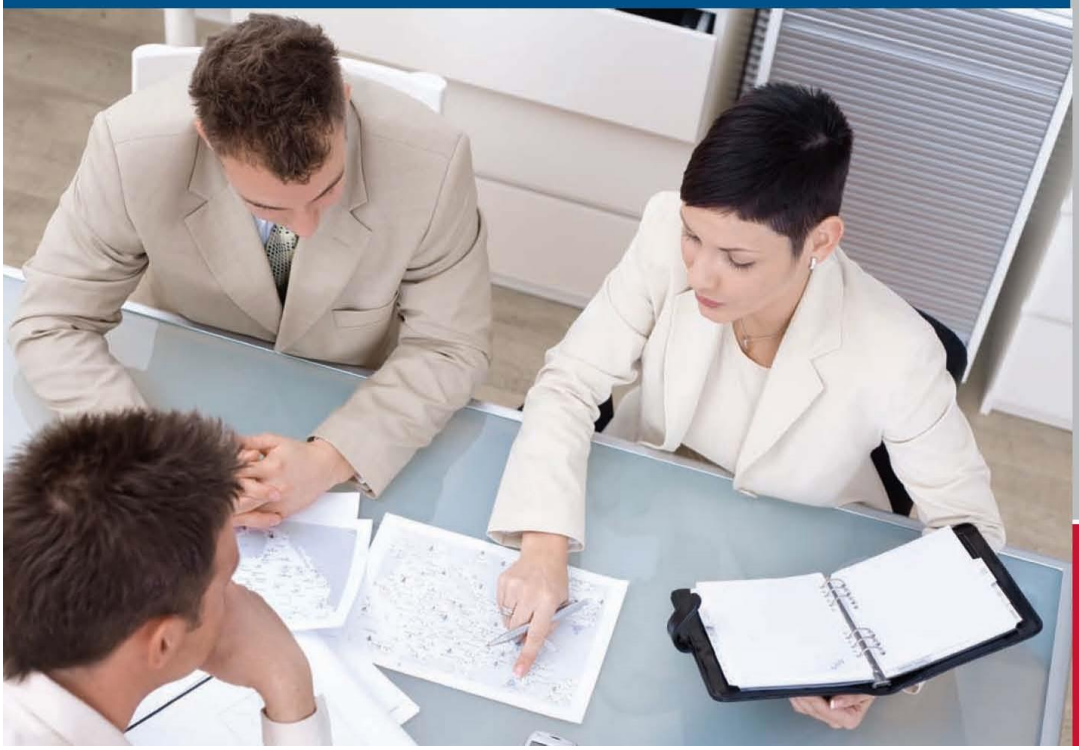
Reactions of Managers During an Active Shooter Situation

Employees and customers are likely to follow the lead of managers during an emergency situation. During an emergency, managers should be familiar with their EAP, and be prepared to:

- Take immediate action
- Remain calm
- Lock and barricade doors
- Evacuate staff and customers via a preplanned evacuation route to a safe area

Assisting Individuals with Special Needs and/or Disabilities

- Ensure that EAPs, evacuation instructions and any other relevant information address to individuals with special needs and/or disabilities
- Your building should be handicap-accessible, in compliance with ADA requirements.



RECOGNIZING POTENTIAL WORKPLACE VIOLENCE

An active shooter in your workplace may be a current or former employee, or an acquaintance of a current or former employee. Intuitive managers and coworkers may notice characteristics of potentially violent behavior in an employee. Alert your Human Resources Department if you believe an employee or coworker exhibits potentially violent behavior.

Indicators of Potential Violence by an Employee

Employees typically do not just "snap," but display indicators of potentially violent behavior over time. If these behaviors are recognized, they can often be managed and treated. Potentially violent behaviors by an employee may include one or more of the following (this list of behaviors is not comprehensive, nor is it intended as a mechanism for diagnosing violent tendencies):

- Increased use of alcohol and/or illegal drugs
- Unexplained increase in absenteeism; vague physical complaints
- Noticeable decrease in attention to appearance and hygiene
- Depression / withdrawal
- Resistance and overreaction to changes in policy and procedures
- Repeated violations of company policies
- Increased severe mood swings
- Noticeably unstable, emotional responses
- Explosive outbursts of anger or rage without provocation
- Suicidal; comments about "putting things in order"
- Behavior which is suspect of paranoia, ("everybody is against me")
- Increasingly talks of problems at home
- Escalation of domestic problems into the workplace; talk of severe financial problems
- Talk of previous incidents of violence
- Empathy with individuals committing violence
- Increase in unsolicited comments about firearms, other dangerous weapons and violent crimes

MANAGING THE CONSEQUENCES OF AN ACTIVE SHOOTER SITUATION

After the active shooter has been incapacitated and is no longer a threat, human resources and/or management should engage in post-event assessments and activities, including:

- An accounting of all individuals at a designated assembly point to determine who, if anyone, is missing and potentially injured
- Determining a method for notifying families of individuals affected by the active shooter, including notification of any casualties
- Assessing the psychological state of individuals at the scene, and referring them to health care specialists accordingly
- Identifying and filling any critical personnel or operational gaps left in the organization as a result of the active shooter

LESSONS LEARNED

To facilitate effective planning for future emergencies, it is important to analyze the recent active shooter situation and create an after action report. The analysis and reporting contained in this report is useful for:

- Serving as documentation for response activities
- Identifying successes and failures that occurred during the event
- Providing an analysis of the effectiveness of the existing EAP
- Describing and defining a plan for making improvements to the EAP

References

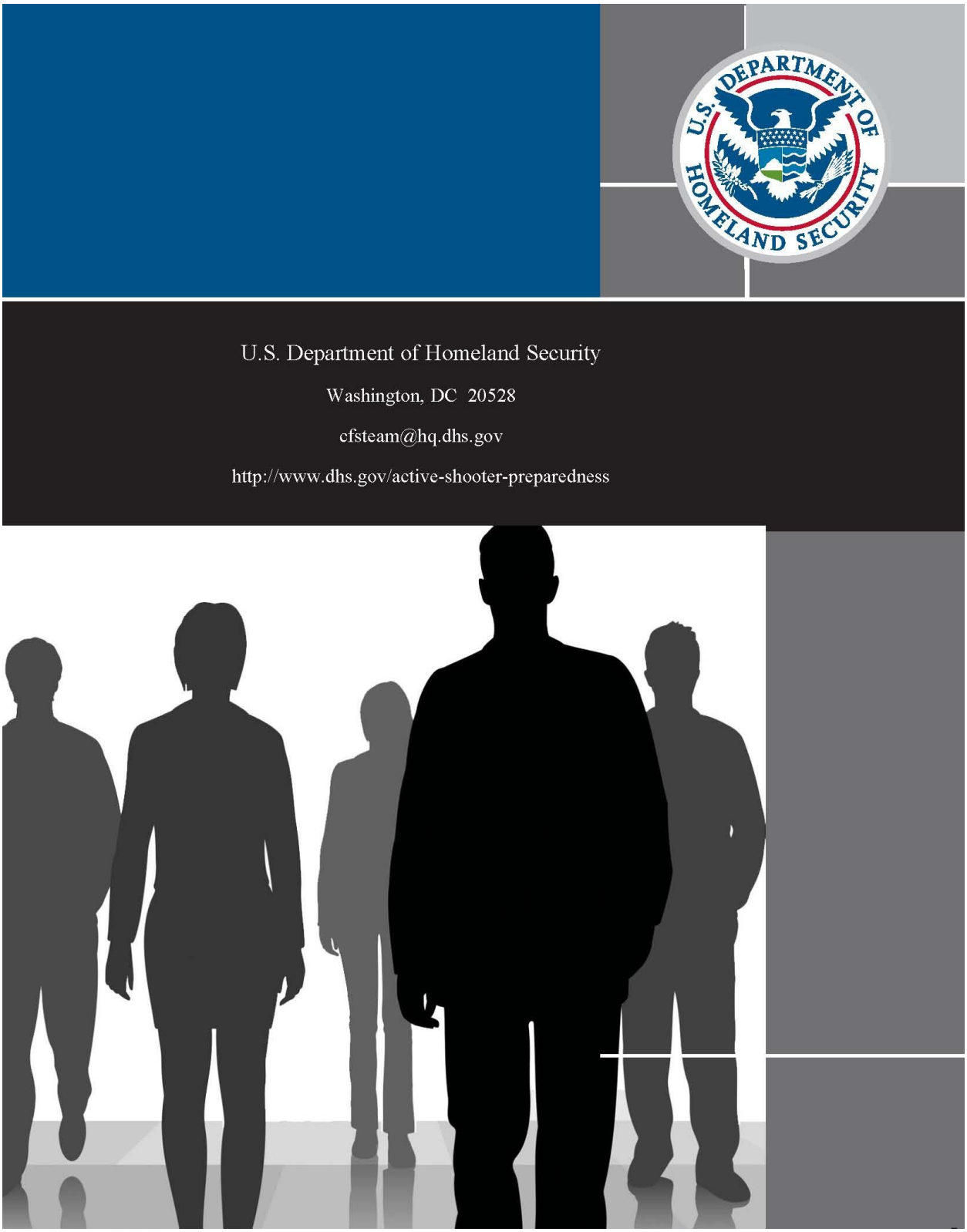
Safety Guidelines for Armed Subjects, Active Shooter Situations, Indiana University Police Department, April 2007.

Safety Tips & Guidelines Regarding Potential "Active Shooter" Incidents Occurring on Campus, University of California Police.

Shots Fired, When Lightning Strikes (DVD), Center for Personal Protection and Safety, 2007.

Workplace Violence Desk Reference, Security Management Group International, www.SMGICorp.com

How to Plan for Workplace Emergencies and Evacuations, U.S. Department of Labor, Occupational Health and Safety Administration, OSHA 3088, 2001.


U.S. Department of Homeland Security
Washington, DC 20528
cfsteam@hq.dhs.gov
http://www.dhs.gov/active-shooter-preparedness

Attachment C

Active Shooter Pocket Card

COPING

WITH AN ACTIVE SHOOTER SITUATION

- Be aware of your environment and any possible dangers
- Take note of the two nearest exits in any facility you visit
- If you are in an office, stay there and secure the door
- Attempt to take the active shooter down as a last resort

Contact your building management or human resources department for more information and training on active shooter response in your workplace.

PROFILE

OF AN ACTIVE SHOOTER

An active shooter is an individual actively engaged in killing or attempting to kill people in a confined and populated area, typically through the use of firearms.

CHARACTERISTICS

OF AN ACTIVE SHOOTER SITUATION

- Victims are selected at random
- The event is unpredictable and evolves quickly
- Law enforcement is usually required to end an active shooter situation

CALL 911 WHEN IT IS SAFE TO DO SO

HOW TO RESPOND

WHEN AN ACTIVE SHOOTER IS IN YOUR VICINITY

1. RUN

- Have an escape route and plan in mind
- Leave your belongings behind
- Keep your hands visible

2. HIDE

- Hide in an area out of the shooter's view
- Block entry to your hiding place and lock the doors
- Silence your cell phone and/or pager

3. FIGHT

- As a last resort and only when your life is in imminent danger
- Attempt to incapacitate the shooter
- Act with physical aggression and throw items at the active shooter

CALL 911 WHEN IT IS SAFE TO DO SO

HOW TO RESPOND

WHEN LAW ENFORCEMENT ARRIVES

- Remain calm and follow instructions
- Put down any items in your hands (i.e., bags, jackets)
- Raise hands and spread fingers
- Keep hands visible at all times
- Avoid quick movements toward officers such as holding on to them for safety
- Avoid pointing, screaming or yelling
- Do not stop to ask officers for help or direction when evacuating

INFORMATION

YOU SHOULD PROVIDE TO LAW ENFORCEMENT OR 911 OPERATOR

- Location of the active shooter
- Number of shooters
- Physical description of shooters
- Number and type of weapons held by shooters
- Number of potential victims at the location

Attachment D

Active Shooter Pocket Card - Printable

HOW TO RESPOND

WHEN AN ACTIVE SHOOTER IS IN YOUR VICINITY

1. Evacuate

- Have an escape route and plan in mind
- Leave your belongings behind
- Keep your hands visible

2. Hide Out

- Hide in an area out of the shooter's view
- Block entry to your hiding place and lock the doors
- Silence your cell phone and/or pager

3. Take Action

- As a last resort and only when your life is in imminent danger
- Attempt to incapacitate the shooter
- Act with physical aggression and throw items at the active shooter

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COPING
WITH AN ACTIVE SHOOTER SITUATION

- Be aware of your environment and any possible dangers
- Take note of the two nearest exits in any facility you visit
- If you are in an office, stay there and secure the door
- Attempt to take the active shooter down as a last resort

Contact your building management or human resources department for more information and training on active shooter response in your workplace.

CALL 911 WHEN IT IS SAFE TO DO SO

PROFILE
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An active shooter is an individual actively engaged in killing or attempting to kill people in a confined and populated area, typically through the use of firearms.

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Attachment E

Active Shooter Pamphlet

When law enforcement arrives:

- Remain calm and follow instructions
- Drop items in your hands (e.g., bags, jackets)
- Raise hands and spread fingers
- Keep hands visible at all times
- Avoid quick movements toward officers, such as holding on to them for safety
- Avoid pointing, screaming or yelling
- Do not ask questions when evacuating

Information to provide to 911 operations:

- Location of the active shooter
- Number of shooters
- Physical description of shooters
- Number and type of weapons shooter has
- Number of potential victims at location

ACTIVE SHOOTER EVENT

QUICK REFERENCE GUIDE

For questions or additional assistance contact:
Your local law enforcement authorities or FBI Field office :

Department of Homeland Security
3801 Nebraska Ave, NW
Washington, DC 20528

An "active shooter" is an individual who is engaged in killing or attempting to kill people in a confined and populated area; in most cases, active shooters use firearms(s) and there is no pattern or method to their selection of victims.

- ☐ *Victims are selected at random*
- ☐ *Event is unpredictable and evolves quickly*
- ☐ *Knowing what to do can save lives*

ACTIVE SHOOTER EVENTS

When an Active Shooter is in your vicinity, you must be prepared both mentally and physically to deal with the situation.

You have three options:

1 RUN

- Have an escape route and plan in mind
- Leave your belongings behind
- Evacuate regardless of whether others agree to follow
- Help others escape, if possible
- Do not attempt to move the wounded
- Prevent others from entering an area where the active shooter may be
- Keep your hands visible
- Call 911 when you are safe

2 HIDE

- Hide in an area out of the shooter's view
- Lock door or block entry to your hiding place
- Silence your cell phone (including vibrate mode) and remain quiet

3 FIGHT

- Fight as a last resort and only when your life is in imminent danger
- Attempt to incapacitate the shooter
- Act with as much physical aggression as possible
- Improvise weapons or throw items at the active shooter
- Commit to your actions . . . your life depends on it

The first officers to arrive on scene will not stop to help the injured. Expect rescue teams to follow initial officers. These rescue teams will treat and remove injured.

Once you have reached a safe location, you will likely be held in that area by law enforcement until the situation is under control, and all witnesses have been identified and questioned. Do not leave the area until law enforcement authorities have instructed you to do so.

Attachment F

How to Respond When an Active Shooter is in Your Vicinity

HOW TO RESPOND
WHEN AN ACTIVE SHOOTER IS IN YOUR VICINITY

QUICKLY DETERMINE THE MOST REASONABLE WAY TO PROTECT YOUR OWN LIFE. CUSTOMERS AND CLIENTS ARE LIKELY TO FOLLOW THE LEAD OF EMPLOYEES AND MANAGERS DURING AN ACTIVE SHOOTER SITUATION.

1. Run
- Have an escape route and plan in mind
- Leave your belongings behind
- Keep your hands visible

2. Hide
- Hide in an area out of the active shooter's view.
- Block entry to your hiding place and lock the doors

CALL 911 WHEN IT IS SAFE TO DO SO

3. Fight
- As a last resort and only when your life is in imminent danger.
- Attempt to incapacitate the active shooter
- Act with physical aggression and throw items at the active shooter

HOW TO RESPOND
WHEN LAW ENFORCEMENT ARRIVES ON THE SCENE

1. HOW YOU SHOULD REACT WHEN LAW ENFORCEMENT ARRIVES:
- Remain calm, and follow officers' instructions
- Immediately raise hands and spread fingers
- Keep hands visible at all times
- Avoid making quick movements toward officers such as attempting to hold on to them for safety
- Avoid pointing, screaming and/or yelling
- Do not stop to ask officers for help or direction when evacuating, just proceed in the direction from which officers are entering the premises

2. INFORMATION YOU SHOULD PROVIDE TO LAW ENFORCEMENT OR 911 OPERATOR:
- Location of the victims and the active shooter
- Number of shooters, if more than one
- Physical description of shooter/s
- Number and type of weapons held by the shooter/s
- Number of potential victims at the location

RECOGNIZING SIGNS
OF POTENTIAL WORKPLACE VIOLENCE

AN ACTIVE SHOOTER MAY BE A CURRENT OR FORMER EMPLOYEE. ALERT YOUR HUMAN RESOURCES DEPARTMENT IF YOU BELIEVE AN EMPLOYEE EXHIBITS POTENTIALLY VIOLENT BEHAVIOR. INDICATORS OF POTENTIALLY VIOLENT BEHAVIOR MAY INCLUDE ONE OR MORE OF THE FOLLOWING:

- Increased use of alcohol and/or illegal drugs
- Unexplained increase in absenteeism, and/or vague physical complaints
- Depression/Withdrawal
- Increased severe mood swings, and noticeably unstable or emotional responses
- Increasingly talks of problems at home
- Increase in unsolicited comments about violence, firearms, and other dangerous weapons and violent crimes

Contact your building management or human resources department
for more information and training on active shooter response in your workplace.

Appendix E
Groundwater Sampling and Analysis Plan

AECOM

Submitted to
Washington State
Department of Ecology
300 Desmond Drive
Lacey, WA 98503

Submitted by
AECOM
1111 Third Avenue
Suite 1600
Seattle, WA 98101
July 2020

Appendix E
Groundwater Sampling and Analysis Plan

Supplemental Remedial Investigation/Feasibility Study Work Plan

B36 Area, Area B, and Area D
Tacoma Metals Site
Tacoma, Washington

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List of Acronyms

GSAP	groundwater sampling and analysis plan
IDW	investigation-derived waste
QAPP	quality assurance project plan
RI/FS	remedial investigation/feasibility study
Site	Tacoma Metals Site
SOP	standard operating procedure
Work Plan	Supplemental RI/FS Work Plan

1. Introduction

This groundwater sampling and analysis plan (GSAP) has been prepared pursuant to the requirements of a minor modification to Agreed Order No. DE 97-5435 for the Tacoma Metals Site (Site), between International Paper Company and the State of Washington Department of Ecology. This GSAP is an appendix to the supplemental remedial investigation/feasibility study (RI/FS) work plan (Work Plan) and describes the groundwater monitoring to be performed for additional groundwater investigation.

1.1 Monitoring Plan Purpose

The purpose of the GSAP is to describe the groundwater monitoring procedures and requirements that will be conducted during the supplemental RI at the Site (Figure E-1).

Groundwater sampling will be conducted in existing wells and piezometers within the northwestern part of the site (Figure E-2). The data collected during this supplemental RI will be used to revise the nature and extent of contamination in groundwater, to develop and evaluate alternatives in an updated FS to address diesel-range organics/oil-range organics, carcinogenic polycyclic aromatic hydrocarbons, and total naphthalenes in groundwater beneath the City of Tacoma right-of-way and former Simpson property; and proposed alternative conditional point of compliance wells for the site. Results of the supplemental RI, and any necessary revisions to the nature and extent of contamination and/or proposed remedy, will be incorporated into a supplemental RI report and updated FS report. The supplemental RI report and updated FS report will also include conclusions and recommendations regarding RI results and an additional evaluation of FS remedial alternatives specifically in regard to site groundwater.

This GSAP includes sampling and analysis requirements for supplemental RI groundwater sampling. Quality assurance requirements are provided in the quality assurance project plan (QAPP) in Appendix G of the Work Plan.

2. Background/Site History

2.1 Site Description

The Site is generally located at 1919 Portland Avenue in Tacoma, Washington, in an industrial-zoned area (Figure E-1). The Site is bounded to the northeast by the Puyallup River, to the southeast by the Lincoln Avenue Bridge (which crosses the Puyallup River), to the southwest by Portland Avenue, and to the northwest by industrial development. The City of Tacoma right-of-way is located immediately northwest of the former Tacoma Metals property, the former Simpson property is located adjacent to and northwest of the City of Tacoma right-of-way, and the JJ Port property is located adjacent to and northwest of the former Simpson property.

The Site has a relatively level topography with an average elevation of approximately 10 feet above mean sea level, except for the JJ Port property and portions of the City of Tacoma right-of-way. The elevation drops several feet immediately adjacent to the northwest property boundary of the former Simpson property. Therefore, the elevation of the JJ Port property is typically several feet lower than the elevation of the former Simpson property. In addition, a portion of the City of Tacoma right-of-way is also several feet lower than the adjacent land. No structures are currently located on the Tacoma Metals on-property parcels, the former Simpson property, or the City of Tacoma right-of-way. However, asphalt-paved areas and some concrete foundations from former buildings remain on the Tacoma Metals on-property parcels. Two buildings are located on the JJ Port property, and the area surrounding the buildings is used for parking vehicles and storing equipment.

The flow direction in shallow groundwater at the Site is influenced by tidal fluctuations in the Puyallup River and varies between high- and low-tide cycles. At low tide, the flow direction is generally toward the Puyallup River; at high tide, the flow direction is generally toward the Site, away from the Puyallup River. The magnitude of the shallow groundwater gradient is greater during low-tide conditions than during high-tide conditions, resulting in an overall net gradient towards the Puyallup River. A localized stagnation zone was observed in the central portions of the Site at high tide, primarily in the northwest portion of the Tacoma Metals on-property parcels, where accumulation of wood debris is greatest. Depth to shallow groundwater varies with tidal levels; saturated conditions are generally encountered at approximately 10 feet below ground surface at the Site, with the exception of the JJ Port property and portions of the City of Tacoma right-of-way, where the depth to shallow groundwater is generally less because of topographic lows in these areas.

2.2 Site History

Historically, the Site has been occupied by the following industrial facilities:

- St. Paul & Tacoma Lumber mill facilities including a creosoting plant (1900s to 1930s)
- A coke manufacturing plant (early 1940s)
- A metals recycling facility (1950s to 1990s)

In addition, several modifications have been made to the Puyallup River channel adjacent to the Site.

The Site was first developed by the St. Paul & Tacoma Lumber Company in the late 1900s to early 1910s, at which time the creosoting plan was constructed. The creosoting plant appears to have been operational until the late 1920s to early 1930s. In the early 1940s, a coke manufacturing facility was constructed on the Site. The coke plant facility appears to have been used to produce metallurgical coke and coal gas (as a byproduct of the coke production process) and appears to have been operational for only a short time beginning in 1943. The creosoting plant was demolished prior to construction of the coke plant, and approximately 3 to 5 feet of fill material was placed over the Tacoma Metals on-property parcels, the City of Tacoma right-of-way, and the former Simpson property. The coke plant structures were constructed after placement of the fill layer. Most of the coke plant structures, except for part of the main building and several concrete foundation pads (three of which were located near the former creosoting plant location), appear to have been demolished in the 1950s.

Beginning in the early 1950s, a metal recycling facility began operation at the Site. The Site was used for recycling ferrous and nonferrous metals and was initially occupied by General Metals and subsequently by Tacoma Metals beginning in the early 1980s. Most of the Tacoma Metals on-property parcels appear to have been paved with asphalt by the 1970s, but an area along the northwestern property boundary remained unpaved throughout the time when metal recycling was performed. Metals recycling operations ceased in 1999, and the property was vacated. The above-ground portions of former metal recycling structures have been demolished and removed from the Site, although most of the asphalt-paved areas and some concrete foundations remain.

3. Groundwater Sampling and Analysis Plan

3.1 Sampling Objectives

This sampling and analysis plan has been developed to collect high quality environmental data. The overall goal of the GSAP is to generate data that are acceptable for use in evaluating current groundwater conditions at the Site with respect to the applicable cleanup levels and for comparison to historical data. Based upon the results of groundwater sampling, additional groundwater sampling may be proposed.

3.2 Groundwater Sampling Procedures

Groundwater will be sampled in a total of 25 monitoring wells and three piezometers that are located in the northwestern part of the Site. The location of each well is shown on Figure E-2. All groundwater samples will be collected using the procedures described in the following standard operating procedures (SOPs), which are included in Attachment A:

- Measurement of Groundwater Table Elevation in Wells and Piezometers
- Low-Flow Groundwater Sampling

3.3 Laboratory Analytical Procedures

All samples will be submitted to a Washington State accredited laboratory. Groundwater samples will be submitted for laboratory analysis in accordance with the analyte list specified in Table E-2 and summarized below:

- Benzene, toluene, ethylbenzene, and total xylenes
- Polycyclic aromatic hydrocarbons
- Polychlorinated biphenyls
- Resource Conservation and Recovery Act metals plus copper (total and dissolved)
- Total petroleum hydrocarbons as gasoline-, diesel-, and oil-range organics

3.4 Sample Identification, Preservation, Handling, and Analysis

3.4.1 Sample Identification

Each sample will be labeled with the monitoring well location followed by the date sampled. For example, the sample name for a groundwater sample collected at monitoring well MW-20 on February 1, 2019, would be “MW20-020119.”

Field duplicate samples will be labeled with the sample type (i.e., GW), "DUP" for duplicate, the duplicate number within the sequence of duplicates for the sample type, and the date. For example, the first duplicate groundwater sample will be labeled GW-DUP-1-date, the second duplicate groundwater sample will be labeled GW-DUP-2-date, etc. The field sampling personnel will record the sample locations where the duplicates are collected in the field log.

3.4.2 Sample Preservation

Sample preservation procedures are used to maintain the original character of analytes during storage and shipment. The contract laboratory will add the required chemical preservatives to the sample containers prior to delivery.

All samples will be placed in the appropriate sample container and refrigerated (on ice or ice substitute in a cooler) immediately upon sample collection to maintain the temperature at approximately 4° Celsius (2° to 6° Celsius). Ice will be

replenished as necessary to assure adequate cooling of samples during storage and shipping. The samples will be transferred to the contract laboratory as soon as practical. Sample container type, chemical preservation agent, temperature requirements, and holding times and for the analyses performed for this monitoring program are shown in the QAPP, Appendix G of the Work Plan.

3.4.3 Sample Handling

Sample handling includes sample custody procedures and sample packaging and shipping procedures, which will be performed in accordance with the Sample Custody and the Sample Packaging and Shipping SOPs (Attachment A). A sample is under an individual's custody if one or more of the following criteria are met:

- The sample is in the person's possession.
- The sample is in the person's view after being in possession.
- The sample has been locked in a secure area to prevent tampering after it was in the person's possession.

Samples will be placed in secure, on-site storage, or remain in the possession of the sampling personnel for the duration of each sampling event. Immediately after collection, during storage prior to shipment, and during shipment to the laboratory, samples will be stored in coolers on ice or ice substitute at 4° Celsius. Any temporary sample storage areas will be locked and secured to maintain sample integrity and chain-of-custody requirements.

A chain-of-custody form will be kept with each cooler. Samples will be shipped or delivered to the laboratory in time to allow for laboratory analysis within specified holding times.

3.4.4 Samples Analysis

Groundwater samples will be analyzed by US Environmental Protection Agency Methods or Washington State Methods summarized in Table E-1. The contracted analytical laboratory will supply bottles for sample collection, as appropriate. The containers will have screw-type lids to assure adequate sealing of the bottles.

The containers will be pre-cleaned and certified under chain of custody. Commercially available pre-cleaned jars are acceptable. The contract laboratory's bottle shipment documentation will record batch numbers for the bottles. With this documentation, bottles can be traced, and bottle wash analyses can be reviewed. Required sample containers and hold time criteria are provided in the QAPP in Appendix G of the Work Plan.

3.5 Decontamination and Investigation-Derived Waste

3.5.1 Decontamination

All sample collection equipment that is not dedicated or disposable will be decontaminated between each sampling location using the following steps:

- Surfactant (Alconox or equivalent) and tap water wash
- Tap water rinse
- Distilled-deionized water rinse
- Air dry

Additional details regarding decontamination procedures are provided in the Decontamination of Soil and Water Sampling Equipment SOP (Attachment A).

3.5.2 Investigation-Derived Waste

Disposable equipment (e.g., nitrile gloves, etc.) will be used once and placed in a plastic garbage bag for disposal as municipal refuse.

Water generated during sampling, including decontamination water, will be properly contained in labeled drums approved by the Department of Transportation. Investigation-derived waste (IDW) will be temporarily stored on-site at a location

designated by the property owner. The IDW will be characterized for disposal based on the results of water samples collected during the groundwater sampling event. Once characterized, the IDW will be transported off-site for proper disposal. Waste will be not be segregated by location—i.e., waste from multiple locations may be containerized within the same drum.

4. Field Documentation

Field activities, measurements, and observations will be recorded in a bound logbook on preprinted sampling forms in accordance with the Field Documentation SOP (Attachment A) and the Field Forms (Attachment B). Required sample information includes project and event identification, the sample number, information on sample location conditions, field parameters, and a description of the physical characteristics of the sample (odor or sheen for water). Alternatively, equivalent sample information will be collected in a bound field logbook. When the sampling event is complete, the final forms or logbook will be maintained in the AECOM project file.

5. References

Aspect Consulting, LLC (Aspect). 2018. Revised Draft Remedial Investigation and Feasibility Study, Tacoma Metals, Inc. Site. Prepared for Estate of Sophie Sussman. Project No. 160420. June 22, 2018.

Washington State Department of Ecology (Ecology). 2007. Model Toxics Control Act Cleanup Regulation. Chapter 173-340 WAC. October 2007.

Tables

Table E-1. Cleanup Levels for Groundwater, Tacoma Metals Site

Chemicals of Concern	Site Cleanup Levels[a] (µg/L)
Polycyclic Aromatic Hydrocarbons	
cPAHs TTEC	0.01
Total Naphthalenes	152
Volatile Organic Compounds	
Benzene	0.44
Ethylbenzene	29
Toluene	57
Total Xylenes	80
Polychlorinated Biphenyl Compounds	
Total PCBs	0.01
Total Petroleum Hydrocarbons	
GRO	800
DRO/ORO	500
Metals	
Arsenic	5
Barium	1,000
Cadmium	1.12
Chromium	120
Copper	18.8
Lead	4.6
Mercury	0.012
Selenium	5
Silver	8.8

Notes:
[a] Site cleanup levels established in the Revised Draft RI/FS (Aspect 2018).

cPAH - carcinogenic polycyclic aromatic hydrocarbons
GRO – gasoline-range organics
DRO/ORO – diesel-range organics/oil-range organics
µg/L – microgram per liter
PCB – polychlorinated biphenyl
RI/FS – remedial investigation/feasibility study
TTEC - Total Toxic Equivalent Concentration (sum of cPAH concentrations multiplied by their respective toxicity equivalency factors per WAC 173-340-708(8)(e))
WAC – Washington Administrative Code

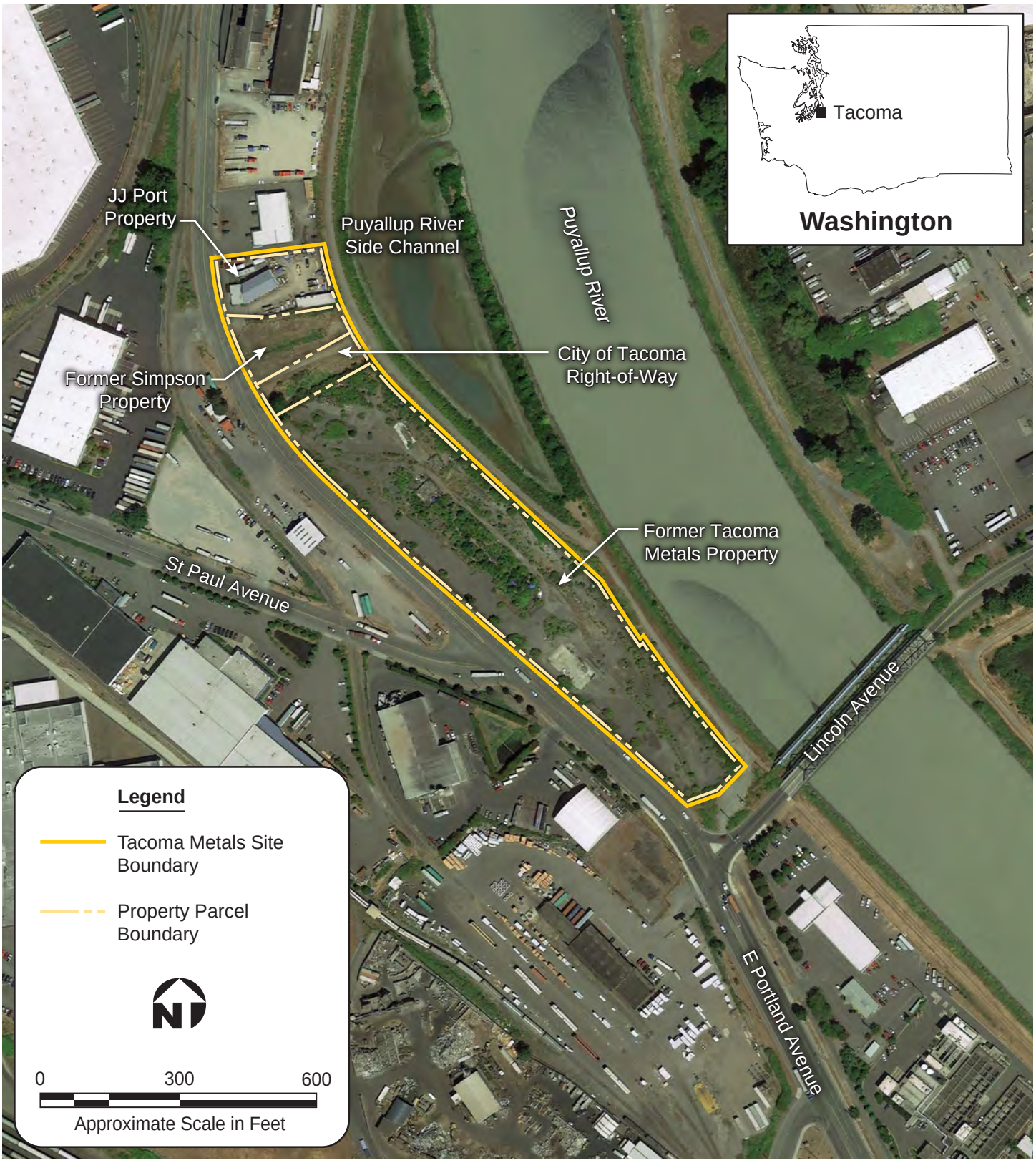
Table E-2. Groundwater Sampling Summary

Well/ Piezometer ID	Laboratory Analysis[1]				
	PAHs by EPA Method 8270D-SIM	BTEX by EPA Method 8260C	GRO by NWTPH-Gx/ DRO/ORO by NWTPH-Dx	Metals by EPA Method 6020A/ Mercury by EPA Method 7471B	PCBs by EPA Method 8082A
Monitoring Wells					
MW-7	X	X	X	X	X
MW-8R	X	X	X	X	X
MW-10	X	X	X	X	X
MW-11	X	X	X	X	X
MW-13	X	X	X	X	X
MW-14	X	X	X	X	X
MW-15	X	X	X	X	X
MW-16	X	X	X	X	X
MW-17	X	X	X	X	X
MW-18	X	X	X	X	X
MW-20	X	X	X	X	X
MW-21	X	X	X	X	X
MW-22/B12	X	X	X	X	X
MW-23	X	X	X	X	X
MW-24	X	X	X	X	X
MW-25	X	X	X	X	X
MW-26	X	X	X	X	X
MW-27	X	X	X	X	X
MW-28R	X	X	X	X	X
MW-29	X	X	X	X	X
MW-30/B35	X	X	X	X	X
MW-31/B36	X	X	X	X	X
MW-32	X	X	X	X	X
MW-33	X	X	X	X	X
MW-35	X	X	X	X	X
Piezometers					
P-1	X	X	X	X	X
P-2	X	X	X	X	X
P-3	X	X	X	X	X

[1]One field duplicate will be collected per 20 environmental samples per sample type. One field duplicate will be collected for the piezometers, as a separate sample type from the monitoring wells. In addition, one MS/MSD sample will be collected per 20 environmental samples. Triple the volume of groundwater will be required for the location where the MS/MSD sample is collected.

BTEX – benzene, toluene, ethylbenzene, and total xylenes
DRO/ORO – diesel-range organics/oil-range organics
EPA – US Environmental Protection Agency
GRO – gasoline-range organics
ID – identification
PAHs – polycyclic aromatic hydrocarbons
PCB – polychlorinated biphenyl
SIM – selected ion monitoring

Figures



Source: Google Earth Pro, imagery dated (7/10/2014)

Figure E-1

Site Location Map

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Tacoma Metals Site
Tacoma, Washington

Figure E-2

Supplemental Investigation Groundwater Sampling Locations B36 Area, Area B, and Area D

Tacoma Metals Site
Tacoma, Washington

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Attachment A
Standard Operating Procedures

AECOM

Standard Operating Procedure

Decontamination of Soil and Water Sampling Equipment

To prevent potential cross-contamination of samples, all reusable soil and water sampling equipment and pumps will be decontaminated. The lead sampler will set up the area used to decontaminate soil and water sampling equipment consisting of three stations, as described below. This area will be located upwind from the specific sampling area. The personnel performing the decontamination procedures will wear protective clothing as specified in the site-specific health and safety plan.

This standard operating procedure (SOP) describes procedures for decontaminating sampling equipment contaminated by either inorganic or organic materials. Sampling equipment used for both can combine these procedures, following the order of a detergent wash, organic solvent, acid rinse, and final water rinse. At stations where both water and soil (or other solid media) will be sampled, separate decontamination areas should be used for each medium where appropriate.

When using a drilling contractor, subsurface soil samplers (i.e., split spoons, Dames & Moore U-type samplers, core barrels, and hydraulic push-probe samplers) can be decontaminated by using a heated pressure washer (steam cleaner). The decontaminated sampler(s) (if not to be used immediately) will be stored in a plastic bag until ready for use.

1 Equipment Required to Decontaminate Inorganic-Contaminated Sampling Equipment

Equipment:

- 3-gallon plastic tubs
- 5-gallon plastic container, tap water
- 5-gallon carboy laboratory-grade distilled/deionized (DS/DI) water (organic/analyte-free)
- Properly labeled spray bottles for decontamination solvents
- Alconox® (or equivalent)
- Normal nitric acid
- Hard-bristle brushes
- Plastic sheeting, garbage bags, and aluminum foil
- Personal protective equipment as specified in the health and safety plan
- 55-gallon drum(s)
- Drum labels.

2 Procedures Used to Decontaminate Inorganic-Contaminated Sampling Equipment

The specific procedures for decontaminating inorganic-contaminated soil sampling equipment include the following:

1. At Station No. 1, first wash the contaminated equipment in a tub containing tap water mixed with a detergent such as Alconox®. Only a small volume (0.5 teaspoon) of Alconox® is necessary, and all Alconox® crystals should be completely dissolved.

2. Move the equipment to the wash tubs at Station No. 2. First, rinse the equipment with potable water, followed by rinsing equipment with 0.1 Normal nitric acid (HNO3) or similar acid, then rinse with DS/DI water.
3. At Station No. 3, place the clean equipment on plastic sheeting until reuse.

After decontaminating all the sampling equipment, the disposable gloves and used plastic from Station No. 3 will be placed in garbage bags and disposed of. The wash and rinse water from Station Nos. 1 and 2 will be containerized for proper disposal. At the end of each day, all sampling equipment will be stored in large plastic bags.

3 Equipment Required to Decontaminate Organic-Contaminated Sampling Equipment

- 3-gallon plastic tubs
- 5-gallon plastic container, tap water
- 5-gallon carboy laboratory analyte-free DS/DI water
- Properly labeled spray bottles for decontamination solvents
- Aluminum foil
- Alconox® (or equivalent)
- Hard-bristle brushes
- Pesticide-grade acetone, hexane, and methanol
- Plastic sheeting and garbage bags
- Personal protective equipment as specified in the health and safety plan.

4 Procedures Used to Decontaminate Organic-Contaminated Sampling Equipment

The specific procedures for decontaminating the organic-contaminated soil and groundwater sampling equipment include the following:

1. At Station No. 1, first wash the contaminated equipment in a tub containing tap water mixed with a detergent such as Alconox®. Only a small volume (0.5 teaspoon) of Alconox® is necessary, and all Alconox® crystals should be completely dissolved.
2. At Station No. 2, double rinse the equipment with site or DS/DI water.
3. At Station No. 3, lay the equipment on clean plastic sheeting to air dry.
4. Store the equipment in a clean location until reuse.

The disposable gloves and used plastic sheeting from Station No. 3 will be placed in garbage bags and disposed of. The wash and rinse waters from Station Nos. 1 and 2 will also be disposed of appropriately.

5 Equipment Used to Decontaminate Sampling Pump

- Submersible pumps
- Alconox® (or equivalent)
- Tap water
- Hard-bristle brushes
- Plastic sheeting and garbage bags

- 30-gallon plastic trash can or plastic overpack drum
- 55-gallon drum(s)
- Hot-water pressure washer (optional).

6 Procedures Used to Decontaminate Sampling Pumps

The specific procedures used for decontaminating sampling pumps include the following:

1. It is advisable to begin sampling with the well or surface water stations containing the lowest anticipated analyte concentration. Successive samples should be obtained from wells or stations anticipated to have increasing analyte concentrations. Use of dedicated pump equipment is preferable when feasible.
2. When pumps (e.g., submersible, bladder) are submerged below the water surface to collect water samples, they should be cleaned and flushed between uses. This cleaning process consists of an external detergent wash and rinse, or hot-water pressure washing of pump casing, tubing, and cables, followed by a flush of potable water through the pump. This flushing can be accomplished by pumping approximately 10 gallons of an Alconox® solution through the pump and then pumping approximately 10 gallons of tap water through the pump. This should be followed by rinsing the external parts of the pump intake hose and cable with a tap-water rinse and finally with a DI/DS-water rinse. The procedure should be repeated after sampling from each monitoring well location. The pump and hose should always be placed on clean polyethylene sheeting or in a plastic bag to avoid contact with the ground surface.
3. Surface pumps (e.g., peristaltic) used for well evacuation and surface water sampling need not be cleaned between well locations unless trace metal clean sampling techniques are required. However, a new length of polyethylene and Pharmed® (or equivalent) tubing must be used for each well and discarded after use.

7 Attachments

None.

AECOM

Standard Operating Procedure

Field Documentation

All information relevant to field operations must be properly documented to ensure that activities are accounted for and can be reconstructed from written records. Field documentation should include only a factual description of site-related activities. Field personnel should not include superfluous comments or speculation regarding the field activities. Several types of logbooks may be used for this purpose and should be consistently used by field crews (e.g., field logbooks, sample logbooks, field data logbooks). Logbooks will be labeled on the cover with the project name, dates of field work, and the contract number. A separate bound logbook with consecutively numbered pages will be used for each field project. Each logbook for a particular project will be numbered (e.g., *Project Name* Additional Investigation—Field Logbook *Number 2*).

The information recorded in each logbook should be written in indelible ink. All corrections should consist of a single line-out deletion, followed by the author's initials and the date. Field logbooks will be photocopied after each period in the field, and photocopies will be stored in the project files. After field activities are completed, logbooks will be stored in the permanent project file. No bound logbooks should be discarded, even if they are illegible or contain inaccuracies that require a replacement document. When not in use, all logbooks will be stored in the permanent project file.

1 Field Logbooks

The purpose of the field logbook is to document events that occur and record data measured in the field to the extent that someone not present at the site can reconstruct the activity without relying on the memory of the field crew. Each page in the field logbook will be initialed and dated by all persons making entries on that page. The author will sign and date the last page at the end of each day, and a line will be drawn through the remainder of the page. The logbooks, at a minimum, must contain the following information:

- A purpose and description of the field task
- The time and date the field work began
- The location and description of the work area, including sketches, map references, and photograph log, if appropriate
- The names and titles of field personnel and anyone present during the field work, including the times they are present
- The name, agency, and telephone number of any field contacts
- The meteorological conditions at the beginning of the field work and any changes that occur throughout the day, including the approximate time of the change
- Details of the field work performed, with a description of any deviations from the work plan, sampling and analysis plan, or standard operating procedures
- All field measurements made (unless a specific logbook or sampling form [i.e., boring log or groundwater sampling form] is available for this purpose), including the time of measurement
- Any field results not appearing in the field data logbook, including station identification and location, date, and time of measurement
- Cross-references of numbers for duplicate samples
- References to other logbooks used to record information (e.g., station log, sample log, health and safety log)

- Logbooks should include only a factual description of site-related activities. Field personnel should not include superfluous comments, speculation, or other non-factual observations regarding the field activities.

2 Sample Collection Field Forms

Appropriate sample collection field forms will be used to record the relevant sample information during a sampling event. For instructions regarding proper use of sample identifiers, sampling personnel should consult the sampling and analysis plan.

3 Sample Labels

Sample labels (tags) are designed to uniquely identify each sample, and must be affixed to each sample container used. The labels should be filled out at the time the samples are collected and should consist of the following information:

- Sample number
- Site name
- Date and time sample is collected
- Initials of the samplers
- Preservatives used, if any
- Type of analysis (e.g., 8270-SIM, NWTPH-Dx).

4 Photographs

In certain instances, photographs of sampling stations may be taken using a camera-lens system with a perspective similar to the naked eye. Photographs should include a measured scale in the picture, when practical. The following items should be recorded in the field logbook for each photograph taken:

- The photographer's name, the date, the time of the photograph, and the general direction faced (orientation)
- A brief description of the subject and the field work portrayed in the picture
- The sequential number of the photograph and the roll number on which it is contained
- If digital photographs are collected for internal use or presentation purposes, the file name, date, file location, description, orientation, and photograph should be recorded.

The slides, prints, or disks (as appropriate) and associated negatives will be placed in the project files after the film is developed. Any supporting documentation from the field logbooks will be photocopied and placed in the task files to accompany the slides, prints, or disks.

5 Equipment Calibration Records

Equipment calibration records, including instrument type and serial number, calibration supplies used, calibration methods and calibration results, date, time, and personnel performing the calibration, should be recorded in the field logbook. At a minimum, equipment used during the investigation should be calibrated daily in accordance with the manufacturers' recommendations. An example Equipment Calibration Log is included in the Field Forms included as Attachment B of the compliance monitoring plan.

6 Attachments

None.

AECOM

Standard Operating Procedure

Low-Flow Groundwater Sampling

1 Purpose

This standard operating procedure (SOP) presents the methods to be used for monitoring well purging and groundwater sampling using low-flow sampling methods. The procedures outlined in this SOP are in accordance with groundwater sampling methods recommended by the U.S. Environmental Protection Agency (EPA 1992, 1996). Details on site-specific sampling activities, site-specific field parameters, and laboratory analytes are presented in the groundwater sampling and analysis plan (GSAP). Where possible, sampling should be conducted first in areas least affected by chemicals of concern (COCs), followed by increasingly affected areas.

2 Procedure

2.1 Equipment Required

- Peristaltic pump, bladder pump, centrifugal pump, or submersible pump, as appropriate
- Appropriate power source and cords for pump (i.e., battery, generator, compressor, or inverter)
- Plastic sheeting
- Disposable polyethylene discharge tubing
- Disposable Pharmed® (or equivalent) tubing (for peristaltic pump only)
- Water quality meter (at a minimum pH, conductance, and temperature)
- New disposable or decontaminated stainless-steel bailer (for measuring free product and/or collecting samples for volatile organic compound analyses), if applicable
- 0.45-micron in-line filter or other appropriate filtering approaches (for dissolved constituents only), if applicable
- Flow-through cell
- Sample containers
- Cooler(s)
- Ice

2.2 Preparation for Sampling

Preparation for sampling includes inspecting the condition of the well, monitoring health and safety conditions, and calibrating and decontaminating sampling equipment. General procedures are presented below:

1. Make sure area around well head is clean and free of debris. If necessary, place a plastic drop cloth around well head to prevent sampling equipment from coming into contact with the ground surface.
2. Inspect condition of well (e.g., well locked, loose-fitting cap, measuring point well marked, surface casing disturbed, well casing straight, condition of concrete pad). Indicate condition of well on the Groundwater Sampling Log (See Attachment B of the GSAP).
3. Remove well cap. If the site-specific health and safety plan (HASP) identifies volatile organic compounds as potential COCs, screen well headspace and breathing-zone headspace (as specified in the HASP) for organic vapors using the appropriate field monitoring instrument (e.g., photoionization detector).

4. All equipment should be decontaminated (as specified in Section 2.3) before and after introduction to each well. Protective latex or nitrile gloves should be worn during possible water-contact or equipment-contact activities. At a minimum, gloves should be changed between each well or when introduction of potential contaminants to the well is possible.
5. Measure water level using a decontaminated electronic water level indicator. Sounding the bottom of the well using a weighted tape (i.e., for well casing volume calculations) prior to sampling is not recommended due to the potential for re-suspension of settled solids in the formation. Well depth information should be obtained initially from the well logs and then confirmed after sampling activities are complete.
6. If free-floating product is suspected (based upon historical observations), obtain a sample from the well using a bailer and observe the contents for evidence of free floating product. Alternatively, free product thickness can be measured using an oil/water interface probe.
7. Calculate the well casing volume according to Table 1 below.

Table 1. Casing Volume

Casing Diameter (inches)	Volume (gallon/linear foot)
2	0.16
4	0.65
6	1.47

8. Calibrate water quality meters for measuring field parameters as appropriate. Collect temperature, pH, specific conductance, dissolved oxygen, Eh (redox), and turbidity measurements during purging and prior to sampling; however, DO NOT immerse water quality meter probes into purge water containing free product. Record equipment calibration and maintenance in the field book and/or on the Groundwater Sampling Log (Attachment B of GSAP). Decontaminate meters between wells by rinsing with distilled water. Manage rinsate water used for these measurements in the same manner as purge water, as defined in the GSAP.

2.3 Decontamination

The purpose of decontamination of development equipment is to prevent cross-contamination between monitoring wells. The equipment should be cleaned away from the monitoring well in such a fashion that decontamination effluent can be containerized appropriately.

The decontamination procedure specified in the GSAP and described in the Decontamination of Soil and Water Sampling Equipment SOP will be used. The decontamination steps have been selected in the GSAP based partially on the types of contaminants present at the site.

2.4 Well-Purging

Monitoring wells are purged prior to collecting groundwater samples for analyses. The purpose of well purging is to remove stagnant groundwater from the well (which has interacted with air in the well casing). Field parameters (i.e., pH, temperature, and specific conductance) are measured during the purging process to verify that stagnant water has been removed and groundwater conditions are stable prior to sampling. Typically, a peristaltic pump will be used for well purging. However, a variety of pumps can be used to purge and sample the monitoring well. General procedures for purging are outlined below:

1. Lower the pump intake or intake tubing (as applicable) into the water column. The pump intake should be placed at the middle or slightly above the middle of the screened interval in confined aquifers (EPA 1996). Placement of the pump intake near the top of the water column is recommended for unconfined aquifers screened across the water table (EPA 1996).

2. Conduct purging at a rate that will minimize drawdown in the well (i.e., purge at a rate less than or equal to recharge, if possible). Recommended purge rates are generally less than 0.13 gallon/minute (0.5 liter/minute) (EPA 1996) or a rate

that results in minimal (i.e., less than 0.3 feet) of drawdown in the well. Actual purge rates will vary based on aquifer material and well construction.

3. Continue purging the well until field parameters have stabilized within 10 percent. Once field parameters have stabilized, reduce the pump rate if necessary to between 0.025 and 0.13 gallon/minute (0.1 and 0.5 liter/minute) for sampling (EPA 1992).

4. In the event that even very low purge rates result in evacuation of the well, groundwater samples for laboratory analyses should be collected as soon as sufficient groundwater accumulates in the well, regardless of field parameters or total volume purged. Note drawdown and recharge conditions on the groundwater sampling log (See Attachment B of the GSAP).

2.5 Groundwater Sampling

Groundwater sampling is conducted following proper purging of the well. Where possible, groundwater samples should be collected directly from the pump discharge at the lowest rate possible to minimize cross contamination, suspension of solids, and aeration of the sample. Both bladder pumps and submersible pumps (e.g., Grundfos®) are generally suitable for purging and sampling of all groundwater parameters. In some cases (i.e., when a peristaltic pump is used for purging), a bailer may be used to collect groundwater samples for laboratory analysis of volatile organic compounds (VOCs); however, the peristaltic pump may be suitable for collection of semivolatile organic compounds, metals, and general chemistry parameters. Bailers are generally not recommended for purging or sampling of groundwater monitoring wells due to the potential for agitating solids in and adjacent to the well.

The general procedures for groundwater sample collection are as follows:

1. Groundwater samples should be introduced directly from the pump discharge into the proper sample container and filled to capacity. Target analytes, container types, and preservatives are specified in the quality assurance project plan (QAPP), attached to the additional investigation work plan.

2. If a bailer is used to collect a groundwater sample for VOC analysis, the bailer (stainless steel, Teflon®, or disposable polyethylene) will be carefully lowered into the well, submerged into the water column, and carefully removed. A low-turbulence, bottom-emptying device will be used to transfer samples from the bailer into sample container.

3. When collecting samples for VOCs, direct flow from the pump discharge or bailer down the side of the sample container to minimize aeration. Hold caps in hand to minimize contamination of sample. Fill all VOC sample containers to the top. A positive meniscus at the top of the container will help ensure that no air is trapped inside when cap is screwed down on the container. No air bubbles should be trapped in the sample when the container is sealed.

4. In some cases, field filtration may be required. If applicable, attach a new, disposable filter cartridge (typically 0.45 micron) to the discharge line. Filtered water should be introduced directly into the appropriate sample container. Although not recommended, the laboratory can filter the samples if the samples are NOT preserved and are filtered within 24–48 hours of collection.

5. Collect quality assurance and quality control (QA/QC) samples (i.e., duplicate, equipment rinsate, trip blank, laboratory matrix spike, and laboratory matrix spike duplicate, as applicable) at the same time by filling all bottles from the same flow. The number and types of QA/QC samples are specified in the QAPP.

6. Sample bottles must be labeled with date, sample number, time, sampler's name, and type of preservative, as described in the QAPP. Sample bottles must be placed in a cooler or on ice to keep the sample cool (4 °C). Samples must be cooled continuously from time of collection to time of receipt at the laboratory.

7. Remove pump or tubing from the well. Close and lock the well. Decontaminate the sampling equipment. Purge, wash, and rinse water should be managed as specified in the GSAP.

8. Complete chain-of-custody form, package samples for shipment, and ship samples or arrange for courier to laboratory.

9. All field observations made and data generated in conjunction with the sample collection will be documented on the groundwater sampling log (Attachment B of the GSAP).

3 References

United States Environmental Protection Agency (EPA). 1992. RCRA Ground-Water Monitoring Draft Technical Guidance.

———. 1996. Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells (SOP# GW 0001).

4 Attachments

None.

AECOM

Standard Operating Procedure

Measurement of Groundwater Table Elevation in Wells and Piezometers

Depth to groundwater surface is measured using an electric water level meter. A light on the water level meter illuminates when the weighted probe tip contacts the water surface in the well and completes an electronic circuit. The measured depth to water is determined to within 0.01 foot by noting the point on the probe cable that corresponds to the measuring point (MP) at the top of the well/piezometer casing at the initial point of contact. The measuring point should be notched at the lip of the casing, either on the high side or on the north side. This standard operating procedure (SOP) describes the required equipment and the procedures used for the collection of water level data. Alternate equipment may be used if necessary, as long as the general procedures described below are followed.

1 Equipment Required

The following equipment is required for the collection of water level data:

- Electronic water-level indicator, or the equivalent
- Weighted steel measuring tape with decimal foot increments (if depth to the bottom of the well is to be determined)
- Distilled water in properly labeled spray bottle; other decontamination equipment as specified in SOP Decontamination of Soil and Water Sampling Equipment (if necessary)
- Field logbook

2 Procedures

The following steps are necessary to collect water level measurements:

1. Check the operation of the meter by turning on the indicator switch and pressing the test button.

2. Decontaminate the probe and graduated cable with distilled water. In the event that the probe is dirty, decontaminate the probe and cable with an Alconox® and water wash, followed by a distilled-water rinse.

3. Holding the water level indicator above the well casing, lower the cable gradually into the well or piezometer until the indicator contacts the water surface. The contact with water surface is indicated by the buzzer sounding and illumination of the indicator light. At this point, stop lowering the cable.

4. Note the point on the graduated cable that corresponds to the MP at the top of the casing when the electronic circuit is first completed. If necessary, grasp tape with thumb and index finger exactly at the measuring point marked at the top of the well casing. Pull tape out of well slowly and read measurement. If the cable is not graduated to hundredths of feet, use the measuring tape and measure from the point on the cable that corresponds to the MP down to the first incremental marker. Add this measurement to the marker measurement for the depth to water reading.

5. Record the depth to the water surface to the nearest 0.01 foot.

6. Draw the cable about 1 foot above the surface of the water, then lower it and repeat Steps 3 through 5. If these two readings differ by more than 0.02 foot, repeat until the measured readings stabilize. Measurements should always be taken as the indicator is lowered into the well, not as it is raised.

7. Remove the cable from the well or piezometer.

8. Record the measurement in the field log book.

9. Decontaminate the probe and graduated cable with Alconox® and tap-water wash and distilled water, as appropriate.

10. If the bottom of the well must be located (i.e., sounded), lower a weighted steel measuring tape slowly from center of borehole. Sounding the bottom of the well prior to sampling of the well is NOT recommended due to the potential for resuspension of settled solids in the formation.

11. When weight is felt to hit the bottom or tape slackens noticeably, draw tape up very slowly until it is taut again.

12. Note tape reading at level of casing top. Record this as well depth, to the nearest 0.01 foot.

3 References and Other Sources

ASTM. 1987. Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well). ASTM D4758-87. American Society for Testing and Materials, Philadelphia, PA.

4 Attachments

None.

AECOM

Standard Operating Procedure

Sample Custody

A stringent, established program of sample chain of custody will be followed during sample storage and shipping activities to account for each sample. The procedure outlined herein will be used in conjunction with Field Documentation Standard Operating Procedure (SOP), which covers the use of sample logbooks, and SOP Sample Packaging and Shipping, which covers sample packaging and shipping. Chain-of-custody record/sample analysis request forms ensure that samples are traceable from the time of collection through processing and analysis until final disposition. A sample is considered to be in a person's custody if any of the following criteria are met:

- The sample is in the person's possession.
- The sample is in the person's view after being in possession.
- The sample has been locked in a secure area to prevent tampering after it was in the person's possession.

1 Procedure

The chain-of-custody record portion of the form is the most critical because it documents sample possession from the time of collection through the final disposition of the sample. The sample analysis request portion of the form provides information to the laboratory regarding what analyses are to be performed on the samples that are shipped.

The chain-of-custody record/sample analysis request form will be completed after each field collection activity and before the samples are shipped to the laboratory. Sampling personnel are responsible for the care and custody of the samples until they are shipped. When transferring possession of the samples, the individuals relinquishing and receiving the samples must sign the chain-of-custody record/sample analysis request form(s), indicating the time and date that the transfer occurs. Copies of the forms will be made and kept by the sampler, and the originals will be included with the samples in the transfer container. The following guidelines will be followed to ensure consistent shipping procedures and to maintain the integrity of the samples:

1. Each chain-of-custody record/sample analysis request form must be appropriately signed and dated by the sampling personnel. The person who relinquishes custody of the samples must also sign this form.
2. The chain-of-custody record/sample analysis request form should not be signed until the information has been checked for inaccuracies by the lead sampler. All changes should be made by drawing a single line through the incorrect entry and initialing and dating it. Revised entries should be made in the space below the entries. On the handwritten chain-of-custody record/sample analysis request forms, spaces remaining at the bottom of the page after corrections are made should be marked out with single lines. This procedure will preclude any unauthorized additions.
3. At the bottom of each chain-of-custody record/sample analysis request form is a space for the signatures of the persons relinquishing and receiving the samples and the time and date that the transfer occurred. The time that the samples were relinquished should match exactly the time they were received by another party. Under no circumstances should there be any time when custody of the samples is undocumented.
4. If samples are sent by a commercial carrier not affiliated with the laboratory, such as Federal Express or UPS, the name of the carrier and airbill should be recorded on the chain-of-custody record/sample analysis request form. The time of transfer should be as close to the actual drop-off time as possible. After the chain-of-custody record/sample analysis request forms are signed and copied, they should be sealed inside the transfer container.
5. If errors are found after the shipment has left the custody of sampling personnel, a corrected version of the forms must be prepared and sent to all relevant parties. Minor errors can be rectified by making the change on a copy of the original with a brief explanation and signature. Errors in the signature block may require a letter of explanation.

6. Samples that are archived internally should be accompanied by a chain-of-custody record/sample analysis request form. While samples remain in the sampler's custody before being shipped, all containers will be kept in sight of sampling personnel or in a secured area to preclude tampering with the samples.

2 Attachments

Example Chain-of-Custody Record/Sample Analysis Request Form

AECOM

Standard Operating Procedure

Sample Packaging and Shipping

Specific requirements for sample packaging and shipping must be followed to ensure the proper transfer and documentation of environmental samples collected during field operations. Procedures for the careful and consistent transfer of samples from the field to the laboratory are outlined herein.

1 Equipment Required

Specific equipment or supplies necessary to properly pack and ship environmental samples include the following:

- Ice in sealed bags or Blue Ice®
- Sealable airtight bags
- Plastic garbage bags
- Coolers
- Bubble wrap
- Fiber reinforced packing tape
- Scissors
- Chain-of-custody seals
- Airbills for overnight shipment
- Chain-of-custody record/sample analysis request forms.

2 Procedure

The following steps should be followed to ensure the proper transfer of samples from the field to the laboratories:

1. Appropriately document all samples using the proper logbooks (see Field Documentation Standard Operating Procedure [SOP]) and chain-of-custody record/sample analysis request forms (example provided in Attachment to this SOP).
2. Make sure all applicable laboratory quality control sample designations have been made on the chain-of-custody record/sample analysis request forms. Samples that will be archived for future possible analysis should be clearly identified on the chain-of-custody record/sample analysis request form and should also be labeled as “Do Not Analyze: Hold and archive for possible future analysis” as some laboratories interpret “archive” to mean continue holding the residual sample after analysis.
3. Notify the laboratory contact and the project quality assurance/quality control (QA/QC) coordinator that samples will be shipped and the estimated arrival time. Send copies of all chain-of-custody record/sample analysis request forms to the QA/QC coordinator or project manager, as appropriate.
4. Samples will be placed in secure on-site storage or remain in the possession of the sampling personnel prior to shipment. Any temporary sample storage areas will be locked and secured to maintain sample integrity and chain-of-custody requirements.
5. Clean the outside of all dirty sample containers to remove any residual material that may lead to cross-contamination.
6. Fill out the chain-of-custody/sample analysis request form as described in Sample Custody SOP, and retain the back copy of the form for the project records prior to sealing the cooler. Store the signed chain-of-custody record/sample analysis

request forms in a sealable bag and tape them to the inside of the cooler lid. For a shipment containing multiple coolers, indicate on the outside of this cooler "Chain of Custody Inside."

7. Check sample containers against the chain-of-custody record/sample analysis request form to ensure all samples intended for shipment are accounted for.
8. Store each sample container in a sealable bag that allows the sample label (example provided in Attachment to this SOP) to be read. Volatile organic analyte (VOA) vials for a single sample must be encased in bubble wrap before being sealed in bags.
9. Choose the appropriate size cooler (or coolers) and line with bubble wrap.
10. Fill the cooler with the samples, separating glass containers with bubble wrap and allowing room for ice to keep the samples cold. Add enough ice or Blue Ice® to keep the samples refrigerated overnight. Ice should be enclosed in sealable plastic bags to prevent leakage. Avoid separating the samples from the ice with excess bubble wrap because it will insulate the containers from the ice. After all samples and ice have been added to the cooler, use bubble wrap to fill any empty space to keep the samples from shifting during transport.
11. If possible, consolidate all VOA samples in a single cooler, and ship them with (a) trip blank(s) in accordance with the quality assurance project plan.
12. After the cooler is sufficiently packed to prevent shifting of the containers, close the lid and seal it shut with fiber-reinforced packing tape. If the cooler has a drain at the bottom, it should be taped shut in the same manner.
13. As security against unauthorized handling of the samples, apply one or two chain-of-custody seals across the opening of the cooler lid (example provided in Attachment to this SOP). Be sure the seals are properly affixed to the cooler so they are not removed during shipment.
14. Label the cooler with destination and return addresses, and add other appropriate stickers, such as "This End Up," "Fragile," and "Handle With Care."
15. If an overnight courier is used, fill out the airbill as required and fasten it to the top of the cooler. The identification number sticker should be taped to the lid, because tracking problems can occur if a sticker is removed during shipment.

3 Attachments

Example Chain-of-Custody Record/Sample Analysis Request Form.

Chain-of-Custody Seal.

Sample Label.

CHAIN OF CUSTODY

ALS Environmental
1317 South 13th Ave., Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

SR# _____

PAGE _____ OF _____ COC# _____

PROJECT NAME
PROJECT NUMBER
PROJECT MANAGER
COMPANY NAME
ADDRESS
CITY/STATE/ZIP
E-MAIL ADDRESS
PHONE # FAX #
SAMPLER'S SIGNATURE

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☐ 8270LL☐ SIM PAH☐	Volatile Organics 624☐ 8260☐ 8021☐ BTEX☐	Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐	Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐	PCBs Aroclors☐ Congeners☐	Pesticides/Herbicides 608☐ 8081☐ 8141☐ 8151☐	Chlorophenolics - 8151M Tri☐ Tetra☐ PCP☐	Metals, Total or Dissolved (See List below)	Cyanide☐ Hex-Chrom☐	(circle) pH, Cond., Cl, SO_4, PO_4, F, NO_2, NO_3, BOD, TSS, TDS, Turb.	(circle) NH_3-N, COD, TKN, TOC, DOC, NO_2+NO_3, T-Phos	TOX 9020☐ AOX 1650☐ 506☐	Alkalinity☐ CO_3☐ HCO_3☐	Dioxins/Furans 1613☐ 8290☐	Dissolved Gases CO_2☐ RSK 175☐Methane☐Ethane☐ Ethene☐			REMARKS

REPORT REQUIREMENTS

___ I. Routine Report: Method Blank, Surrogate, as required
___ II. Report Dup., MS, MSD as required
___ III. CLP Like Summary (no raw data)
___ IV. Data Validation Report
___ V. EDD

INVOICE INFORMATION

P.O. # _____
Bill To: _____

TURNAROUND REQUIREMENTS

_____ 24 hr. _____ 48 hr.
_____ 5 day
_____ Standard (15 working days)

_____
Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

***INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: _____ (CIRCLE ONE)**

SPECIAL INSTRUCTIONS/COMMENTS:

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:		RECEIVED BY:		RELINQUISHED BY:		RECEIVED BY:	
Signature	Date/Time	Signature	Date/Time	Signature	Date/Time	Signature	Date/Time
Printed Name	Firm	Printed Name	Firm	Printed Name	Firm	Printed Name	Firm

Custody Seal

Date _____ Project _____

Signature _____ Container # ___ of ___

Custody Seal

Date _____ Project _____

Signature _____ Container # ___ of ___

COLOR IS PINK

METALS

Sample Name: _____

Date _____ Time _____ Sampler _____

Analysis **Metals** **AOX** **HARDNESS** (Circle Analysis Needed)

Field Filtered Yes/No (Circle One)

HNO_3 Preserved (Yes)

Comments:

Lab Label #5Y

USED ON PLASTIC

Sample Name: _____

Date _____ Time _____ Sampler _____

Analysis **BOD, PH, COND, Cl, Cl_2RES, F, SO_4, NO_2, NO_3, OPhos, TDS, TSS, Turb, TAN-LIG, ALK, CO_3, HCO_3, COLOR**

(Circle Analysis Needed)

Preservative: Comments:

Lab Label #1

USED ON AMBER

Sample Name: _____

Date _____ Time _____ Sampler _____

Analysis **8081 8082 8141 8151 8270 8310**

(Circle Analysis Needed)

Preservative:

Comments:

Lab Label #3

Attachment B
Field Forms

AECOM

Equipment Calibration Log

Project Name: _____ **Date:** _____
Project No: _____ **Page:** _____ **of** _____

Type Meter	Equipment (Manu.\Model)	Serial No.	Owned or Rented	Calibrated By	Date	Time	Parameter Calibrated and Calibration Standard	Calibration Pass? (Yes or No)	Comments/Notes
WQM							pH 4.0 _____ pH 7.0 _____ pH 10.0 _____ Specific Conductivity _____ uS/cm or mS/cm D.O. _____ Atm. Pressure _____ O.R.P. _____ Turbidity Standards _____		
pH/Cond.							pH 4.0 _____ pH 7.0 _____ pH 10.0 _____ Specific Conductivity _____ uS/cm or mS/cm		
Turbidity Meter							Turbidity Standards _____		
PID							Isobutylene Span Gas Concentration (ppm) _____		
Other									
Other									

AECOM

GROUNDWATER SAMPLING LOG

Project Name	Well No.
Project No.	Sampled By
Date	Weather °F

WELL INFORMATION	
Depth to water	(ft)
Depth of well:	(ft)
Well diameter:	(in)
Feet of water:	(ft)
Product thickness:	(ft)
Screen interval:	
Well condition:	

COMMENTS

PURGE DATA								
Start purge time								
Time								
DTW	(ft)							
Purge rate	(L/min)							
pH	(Units)							
Conductivity	(umhos/cm)							
Temperature	(deg C)							
D.O.	(mg/L)							
ORP	(mv)							
Turbidity	(NTU)							
Purge and sample equip.								

SAMPLE INFORMATION

Sample Number	Time	Analysis	Container	# Bottles	Preservative

Sampler Signature _____

AECOM

GROUNDWATER SAMPLING LOG (CONTINUED)

Project name
Project No.
Date

Well No.
Sampled By

Depth to water								
start purge time								
time								
DTW	(ft)							
purge rate	(L/min)							
pH	(Units)							
Well condition:	(umhos/cm)							
temperature	(deg C)							
D.O.	(mg/L)							
ORP	(mv)							
Start purge time	(NTU)							
Time								

Purge rate

Conductivity
Temperature

Turbidity
Purge and sample equip.

Sample Number Time Analysis Container # Bottles Preservative

Page _____ of _____

Sampler Signature _____

Appendix F
Soil Sampling and Analysis Plan

Submitted by
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July 2020

Appendix F
Soil Sampling and Analysis Plan

Supplemental Remedial Investigation/Feasibility Study Work Plan

B36 Area, Area B, and Area D
Tacoma Metals Site
Tacoma, Washington

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Attachment B – Field Forms

List of Acronyms and Abbreviations

AST	above-ground storage tank
bgs	below ground surface
DRO	diesel-range organics
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FID	flame ionization detector
IDW	investigation-derived waste
NAPL	non-aqueous phase liquid
ORO	oil-range organicsPAH polycyclic aromatic hydrocarbon
PID	photoionization detector
QAPP	quality assurance project plan
RI/FS	remedial investigation/feasibility study
SSAP	soil sampling and analysis plan
Site	Tacoma Metals Site
SOP	standard operating procedures
TPH	total petroleum hydrocarbons
Work Plan	Supplemental RI/FS Work Plan

1 Introduction

This soil sampling and analysis plan (SSAP), which is an appendix to the Supplemental Remedial Investigation/Feasibility Study (RI/FS) Work Plan (Work Plan), establishes site-specific field sampling procedures and quality control protocols to be implemented for sample acquisition and handling, field measurements, and submittal of samples for laboratory analysis. The purpose of the SSAP is to establish procedures that result in collected data meeting the quality objectives for the project. The procedures proposed in this plan reflect current industry standards and regulatory guidance.

This SSAP provides details regarding soil sampling methods, procedures, and analysis for the following activities at the Tacoma Metals Site (Site) (Figure F-1):

- Soil sample collection from the former Simpson property for analytical testing, focusing on previously uncharacterized areas at former historic above-ground storage tank (AST) locations and between the historic AST locations and Puyallup River Side Channel.

- Soil sample collection on the JJ Port property

The data collected during this supplemental RI will be used to develop and evaluate alternatives in the updated FS to address total petroleum hydrocarbons (TPH) as diesel-range organics (DRO)/oil-range organics (ORO), carcinogenic polycyclic aromatic hydrocarbons (PAHs), and/or total naphthalenes at depths between 20 feet and 32 feet below ground surface (bgs) that exceed respective cleanup levels within the on- and off-property area of the Site, determine if soils in the area of the former 450,000-gallon AST and northeast of that need to be addressed in the updated FS, and delineate soil contamination located on the JJ Port Property. Results of the supplemental RI, and any necessary revisions to the nature and extent of contamination and/or proposed remedy, will be presented in a supplemental RI report and updated FS report. The supplemental RI report and updated FS report will also include conclusions and recommendations regarding RI results and an additional evaluation of FS remedial alternatives specifically in regard to soil deeper than 15 feet bgs.

Site background and project information is provided in the body of the Work Plan , and also in the Interim Action Work Plan (AECOM, 2017). Additional information associated with the tasks in this SSAP is included in the health and safety plan (included as Work Plan Appendix D) and the quality assurance project plan (QAPP, included as Work Plan Appendix G). All field measurements, sample collection, and reporting associated with this work must be performed by qualified personnel trained for the tasks being performed.

2 Soil Sampling Activities

The soil sampling conducted under this SSAP will include investigation sampling at seven primary boring locations. Three borings located on the JJ-Port property (identified as 'JJP-x' on Figure F-2) will be advanced to a depth of 15 feet below ground surface, and four more, located beneath historic AST locations on the former Simpson property (identified as 'FSP-x' on Figure F-2), will be advanced to 35 feet bgs. Soil samples collected under historic AST locations will be used to further evaluate possible source areas, and samples collected on the JJ Port property will be used to delineate the extent of soil contamination on that property.

Up to nine additional "step out" soil boring locations (labeled on Figure F-2) may also be advanced in the field. This includes three potential additional locations on the JJ Port Property and six potential additional locations on the Former Simpson Property. If any of the initial seven primary boring locations exhibit characteristics of contaminated soil based on the field screening (see Section 2.2), then the closest adjacent "step out" soil boring location(s) will also be advanced and sampled. If the "step out" location(s) also exhibit characteristics of contaminated soil, then additional "step out" location(s) will be sampled, up to the nine additional "step out" soil boring locations identified on Figure F-2. The purpose of these additional "step out" borings would be to further delineate soil impacts.

The borings at the above locations will be advanced using a hydraulic push-probe drilling rig. A total of up to seven discrete soil samples will be collected from each boring at 5-foot intervals (e.g., 5, 10, 15, 20, 25, 30, and 35 feet bgs). Hollow stem auger drilling equipment may also be available to install 2-inch PVC monitoring wells at boring locations, if prior groundwater sampling results indicate a need for additional well installation.

Prior to drilling at the Site, the public "one-call" utility locating service will be notified, and a private utility locating contractor will conduct a buried utility survey to clear the proposed boring locations. The boring locations will be moved as necessary based on site constraints and the results of utility locating. Asphalt and/or concrete at the determined boring locations will be removed by the drilling contractor using saw-cutting or coring methods and removed pavement will be disposed of as construction debris.

Sections 2.1, 2.2, and 2.3 of this SSAP describe the collection of investigation soil samples. Details regarding sampling procedures are included in the standard operating procedures (SOPs) in Attachment A. Field forms required for sampling are included in Attachment B. The planned locations, depths, and analysis requirements for sampling are summarized in Table F-1.

2.1 Soil Sampling Methodology

Procedures for supplemental RI soil sampling are described in the following subsections.

2.1.1 Investigation Sampling

Soil sampling using a hydraulic push-probe drilling rig will be performed in accordance with the Soil Sampling, Logging of Soil Boreholes, and Field Classification of Soil SOPs included in Attachment A. At each boring location, continuous soil samples will be collected. Each soil sample will be immediately logged and screened upon retrieval. Screening and logging tasks are as follows:

1. Carefully open the metal core barrel of each continuous soil core.
2. Log the soil type(s) present in the core according to the unified soil classification system. Screen each core using visual and olfactory observations (see Section 2.2.1).
3. Screen each soil core using the photoionization detector (PID) or flame ionization detector (FID) and sheen test methodologies described below. Record the results on the field log (Attachment B). Note any observations regarding the presence of non-aqueous phase liquid (NAPL).

4. For each 5-foot interval of the core, collect one grab sample where there is the highest field indications of chemicals of concern based on PID, FID, sheen test screenings, and presence of NAPL.

2.2 Soil Screening Methodologies

Soil screening methodologies used in the field will include visual and olfactory observations, sheen tests, and PID or FID headspace analysis. Procedures for these screening tests are established in this subsection.

2.2.1 Visual and Olfactory Observations

Visual screening consists of inspecting the soil sample for the presence of stains indicative of residual hydrocarbons. Visual screening is generally more effective in detecting the presence of heavier, less-volatile hydrocarbons, or when hydrocarbon concentrations are high. A grey/mottled appearance or dark discoloration of the soil typically indicates the presence of hydrocarbons. Any odor noticed during the visual screening should be recorded. The specific depth of the visual or olfactory observations should be recorded on the field log.

2.2.2 Sheen Testing

Sheen testing involves immersion of the soil sample in water and observation of the water surface for signs of a sheen. A representative soil sample is placed into a clean stainless-steel or plastic pan filled with clean water with as little disturbance as possible. Visual evidence of a sheen forming on the surface of the water is classified as follows:

- **No sheen (NS)** – No visible sheen on the water surface
- **Colorless Sheen (CS)** – Light, nearly colorless sheen; spread is irregular, not rapid; film dissipates rapidly (light colorless sheens can be confused with sheens produced by organic content)
- **Heavy Sheen (HS)** – Light to heavy colorful film with iridescence; stringy, spread is rapid; sheen flows off the sample; most or all of water surface is covered with sheen.

Following the sheen test, the pan must be washed with Alconox® and tap water, followed by a tap-water rinse prior to the next sampling event. If a sheen is evident in the pan following cleaning, a solvent rinse (methanol) may be required.

2.2.3 PID and FID Headspace Testing

Headspace vapor testing consists of field analyzing a sample of air above a soil sample placed in a sample container, using either a PID or FID. The instrument measures the concentration of organic vapors within the sample container headspace in parts per million by ionizing the vapors using either a lamp or a flame. PIDs and FIDs are able to ionize different ranges of vapors, and both instruments will be used for this project to cover the widest possible spectrum of organic vapors.

The following procedures are used to detect volatile organic compounds in the headspace above a soil sample using a PID and FID:

1. Place approximately 2 tablespoons of soil/sediment sample in a pre-cleaned, 4-oz glass jar or Ziploc® bag. Close the bag or place foil over the jar opening and gently screw on the lid.
2. Allow the sample to sit for approximately 3 minutes in a warm location. Warm all samples for the project in the same manner to achieve equivalent volatilization.
3. If using a glass jar, open the sample container lid and insert the tip of the PID or FID inlet into the container through the foil, without allowing soil to contact the inlet tube. If using a Ziploc® bag, poke the PID or FID inlet tip through the bag without allowing soil to contact the inlet tube.
4. Observe and record the maximum organic vapor measurement in the field log (Attachment B).
5. Place the soil sample in a container designated for appropriate disposal of investigation-derived waste material. Decontaminate the glass jar, if used.

2.3 Sample Identification, Preservation, and Handling

This section describes the sample identification, preservation, and handling requirements for samples collected for laboratory analysis.

2.3.1 Sample Identification

Each sample will be labeled with the sampling location name, medium ("S-" for soil and "GW-" for groundwater, if necessary), depth the sample was initiated (top of sample), and date of sampling. As an example, if a soil sample is collected starting at a depth of 5 feet from soil boring JJP-1 on February 10, 2019, the sample label would be as follows: **JJP-1-S-5'-021019**.

Field duplicate samples will be labeled with the sample type (i.e., S or GW), "DUP" for duplicate, the duplicate number within the sequence of duplicates for the sample type, and the date. For example, the first duplicate soil sample will be labeled **S-DUP-1-date**, the second duplicate soil sample will be labeled **S-DUP-2-date**, etc. The field sampling personnel will record the sample locations where the duplicates are collected in the field log.

Equipment rinsate blank samples will be designated with "ER" followed by the type of sampling equipment ("S-" for soil and "GW-"for groundwater) and the day of sample collection. For example, an equipment rinsate blank accompanying subsurface soil samples collected on March 24, 2019, would be labeled **ER-S-032419**. If the decontamination blank accompanied a set of groundwater samples, it would be labeled **ER-GW-032419**.

2.3.2 Sample Preservation

Sample preservation procedures are used to maintain the original character of analytes during storage and shipment. The contract laboratory will add the required chemical preservatives to the sample containers prior to delivery. Sample container type, chemical preservation agent, temperature requirements, and holding times for the analyses performed under this SSAP are shown in the QAPP (Appendix G).

All samples will be placed in the appropriate sample container and refrigerated (on ice or ice-substitute in a cooler) immediately upon sample collection to maintain the temperature at approximately 4° Celsius (2° to 6° Celsius). Ice will be replenished as necessary to assure adequate cooling of samples during storage and shipping. The samples will be transferred to the contract laboratory as soon as practical.

2.3.3 Sample Handling

Sample handling includes sample custody procedures and sample packaging and shipping procedures, which will be performed in accordance with the Sample Custody and the Sample Packaging and Shipping SOPs (Attachment A). A sample is under an individual's custody if one or more of the following criteria are met:

- The sample is in the person’s possession
- The sample is in the person’s view after being in possession
- The sample has been locked in a secure area to prevent tampering after it was in the person’s possession

A chain-of-custody form will be kept with each cooler.

Samples collected under this SSAP are expected to be shipped to the laboratory via next-day service by a commercial common-carrier. Samples will be shipped or delivered to the laboratory in time to allow for laboratory analysis within specified holding times.

2.4 Backfilling of Boring Locations

Unless the boring location is used for a groundwater monitoring well, all borings will be backfilled following the collection of soil samples. The boring will be filled with a slurry bentonite up to the elevation of the ground surface. The boring surface will then be restored to match the surrounding surface, if necessary.

2.5 Surveying of Boring Locations

All boring locations will be marked in the field at the time of sampling with lath, pin flags, or spray paint (depending on the ground surface and current use of the area). The marking will clearly show the location name. The coordinates of all sampling locations will be documented at the time of sampling using hand-held global positioning system techniques, within the limits of accuracy of the hand-held unit. The horizontal coordinate system will be Washington State Plane North American Datum 1983. The vertical datum will be North Atlantic Vertical Datum 1988. Ground surface elevations at boring locations will be established within ± 0.5 feet.

3 Sample Analysis

Soil samples from investigation borings will be analyzed for benzene, toluene, ethylbenzene, and total xylenes by Environmental Protection Agency (EPA) Method 8260C, polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270D-SIM, TPH as gasoline-range organics by NWTPH-Gx, DRO and ORO by NWTPH-Dx, polychlorinated biphenyls by EPA Method 8082A, Resource Conservation and Recovery Act metals as well as copper (total and dissolved) by EPA Method 6020A, and mercury by EPA Method 7471B. Analysis of PAHs will include the following analytes:

- Naphthalene
- Acenaphthylene
- Acenaphthene
- Fluorene
- Phenanthrene
- Anthracene
- Fluoranthene
- Pyrene
- Benzo[a]anthracene
- Chrysene
- Benzo[b]fluoranthene
- Benzo[k]fluoranthene
- Benzo[a]pyrene
- Indeno[1,2,3-cd]pyrene
- Dibenz[a,h]anthracene
- Benzo[g,h,i]perylene
- 1-Methylnaphthalene
- 2-Methylnaphthalene

To ensure that sufficient sample volume is received by the laboratory for the specified analysis, required sample containers (including both volume and type) are shown in the QAPP (Appendix G). The contracted analytical laboratory will supply glass or plastic containers for sample collection, as appropriate. The containers will have screw-type lids to ensure adequate sealing of the bottles.

The containers will be pre-cleaned and certified under chain of custody. Commercially available pre-cleaned jars are acceptable. The contract laboratory's bottle shipment documentation will record batch numbers for the bottles. With this documentation, bottles can be traced, and bottle wash analyses can be reviewed.

4 Decontamination and Investigation-Derived Waste

4.1 Decontamination

All drilling equipment will be decontaminated between each sampling location by steam cleaning.

All sample collection equipment that is not dedicated or disposable will be decontaminated between each sampling location using the following steps:

- Surfactant (Alconox or equivalent) and tap water wash
- Tap water rinse
- Solvent rinse (i.e., hexane), to be used only if highly contaminated samples are encountered based on observed sheen, odor, or staining
- Distilled-deionized water rinse
- Air dry

Additional details regarding decontamination procedures are provided in the Decontamination of Soil and Water Sampling Equipment SOP (Attachment A).

4.2 Investigation-Derived Waste

At sampling locations with no evidence of NAPL, disposable equipment (e.g., nitrile gloves, etc.) will be used once and placed in a plastic garbage bag for disposal as municipal refuse. At sampling locations with evidence of NAPL, disposable equipment will be used once and placed in a drum for disposal along with soil and water generated from that location.

Water generated by this investigation, including decontamination water, will be properly contained in labeled 55-gallon drums approved by the Department of Transportation. Soil containing NAPL will be stored in separate containers, and other containers will contain only soil in which no NAPL was observed. Investigation-derived waste (IDW) will be temporarily stored on-site at a location designated by the property owner. The IDW will be characterized for disposal based on the results of soil samples collected during this investigation. Once characterized, the IDW will be transported off-site for proper disposal. Waste will be not be segregated by location—i.e., waste from multiple locations may be containerized within the same drum.

5 Field Documentation

Field activities, measurements, and observations will be recorded in a bound logbook or on preprinted sampling forms in accordance with the Field Documentation SOP (Attachment A). Blank field sampling forms are included in Attachment B. Required sample information includes project and event identification, the sample number, information on sample location conditions, field parameters, and a description of the physical characteristics of the sample (color, soil type, grain size, staining, odor, etc.). When the sampling event is complete, the final forms or logbook will be maintained in the AECOM project file.

6 References

Ecology 2016 Washington State Department of Ecology Guidance for Remediation of Petroleum Contaminated Sites, Toxics Cleanup Program Publication No. 10-09-057, Revised June 2016.

Tables

Table F-1. Investigation Soil Sampling Summary

Table F-1. Investigation Soil Sampling Summary, Tacoma Metals Site

Proposed Soil Boring Location ID	Planned Northing (NAD83)	Planned Easting (NAD83)	Planned Total Depth (ft bgs)	Planned Sample Collection Depth (ft bgs)	Number of Laboratory Analytical Samples[2]				
					PAHs by EPA Method 8270D SIM	BTEX by EPA Method 8260C	GRO by NWTPH Gx / DRO/ORO by NWTPH-Dx[3]	Metals by EPA Method 6010A / Mercury by EPA Method 7471B	PCBs by EPA Method 8082A
JJ Port Property Soil Investigation (Primary Locations)									
JJP-1	705571.69	1163753.62	15	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
JJP-2	705574.73	1163767.8	15	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
JJP-3	705572.65	1163779.37	15	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
JJ Port Property Soil Investigation (Stepout Locations)									
JJP-4	705588.75	1163749.51	15	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
JJP-5	705596.19	1163766.84	15	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
JJP-6	705596.14	1163781.14	15	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
Former AST Footing Soil Investigation (Primary Locations)									
FSP-1	705541.3	1163782.6	35	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
				20	1	1	1	1	1
				25	1	1	1	1	1
				30	1	1	1	1	1
				35	1	1	1	1	1
FSP-2	705506.4	1163803.0	35	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
				20	1	1	1	1	1
				25	1	1	1	1	1
				30	1	1	1	1	1
				35	1	1	1	1	1
FSP-3	705535.2	1163865.6	35	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
				20	1	1	1	1	1
				25	1	1	1	1	1
				30	1	1	1	1	1
				35	1	1	1	1	1

Table F-1. Investigation Soil Sampling Summary, Tacoma Metals Site

Proposed Soil Boring Location ID	Planned Northing (NAD83)	Planned Easting (NAD83)	Planned Total Depth (ft bgs)	Planned Sample Collection Depth (ft bgs)	Number of Laboratory Analytical Samples[2]				
					PAHs by EPA Method 8270D SIM	BTEX by EPA Method 8260C	GRO by NWTPH Gx / DRO/ORO by NWTPH-Dx[3]	Metals by EPA Method 6010A / Mercury by EPA Method 7471B	PCBs by EPA Method 8082A
FSP-4	705507.0	1163880.9	35	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
				20	1	1	1	1	1
				25	1	1	1	1	1
				30	1	1	1	1	1
				35	1	1	1	1	1
Former AST Footing Soil Investigation (Secondary Locations)									
FSP-5	705471.3	1163831.7	35	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
				20	1	1	1	1	1
				25	1	1	1	1	1
				30	1	1	1	1	1
				35	1	1	1	1	1
FSP-6	705552.31	1163876.69	35	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
				20	1	1	1	1	1
				25	1	1	1	1	1
				30	1	1	1	1	1
				35	1	1	1	1	1
FSP-7	705526.6	1163901.3	35	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
				20	1	1	1	1	1
				25	1	1	1	1	1
				30	1	1	1	1	1
				35	1	1	1	1	1
FSP-8	705569.78	1163901.83	35	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
				20	1	1	1	1	1
				25	1	1	1	1	1
				30	1	1	1	1	1
				35	1	1	1	1	1
FSP-9	705545.6	1163919.0	35	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
				20	1	1	1	1	1
				25	1	1	1	1	1
				30	1	1	1	1	1
				35	1	1	1	1	1

Table F-1. Investigation Soil Sampling Summary, Tacoma Metals Site

Proposed Soil Boring Location ID	Planned Northing (NAD83)	Planned Easting (NAD83)	Planned Total Depth (ft bgs)	Planned Sample Collection Depth (ft bgs)	Number of Laboratory Analytical Samples[2]				
					PAHs by EPA Method 8270D SIM	BTEX by EPA Method 8260C	GRO by NWTPH Gx / DRO/ORO by NWTPH-Dx[3]	Metals by EPA Method 6010A / Mercury by EPA Method 7471B	PCBs by EPA Method 8082A
FSP-10	705544.38	1163949.2	35	5	1	1	1	1	1
				10	1	1	1	1	1
				15	1	1	1	1	1
				20	1	1	1	1	1
				25	1	1	1	1	1
				30	1	1	1	1	1
				35	1	1	1	1	1
S-DUP-1-xx[4]	NA	NA	NA	NA	1	1	1	1	1
S-DUP-2-xx[4]	NA	NA	NA	NA	1	1	1	1	1
S-DUP-3-xx[4]	NA	NA	NA	NA	1	1	1	1	1
S-DUP-4-xx[4]	NA	NA	NA	NA	1	1	1	1	1
S-DUP-5-xx[4]	NA	NA	NA	NA	1	1	1	1	1
S-DUP-6-xx[4]	NA	NA	NA	NA	1	1	1	1	1
Total Soil Samples Collected Including Field Duplicates					**94**	**94**	**94**	**94**	**94**

Notes:

[1]This table only includes samples collected for laboratory analysis.

[2]Matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a rate of one per 20 samples for each analysis. Double the volume of soil will be required for the location where MS/MSD samples are collected. Field duplicate samples will also be collected and not identified to the laboratory.

[3]This includes analysis for diesel-range and oil-range organics.

[4]Field duplicates are planned for samples in both areas of the site.

AST -– aboveground storage tank
BTEX - benzene, toluene, ethylbenzene, and xylenes
DRO - diesel-range organics
EPA -– US Environmental Protection Agency
ft bgs – feet below ground surface
FSP – Former Simpson Property
GRO - gasoline-range organics
ID – identification
JJP – JJ Port Property
NA – not applicable
NAD83 – North American Datum 1983
ORO - oil-range organics
PAHs – polycyclic aromatic hydrocarbons
PCB - polychlorinated biphenyl
SIM – selected ion monitoring
TPH – total petroleum hydrocarbons
xx – date field duplicate collected

Table F-2. Site-Specific Soil Cleanup Levels, Tacoma Metals Site

Chemicals of Concern	Unpaved Shallow (to 6 feet bgs)	Unpaved Deep (6 to 15 feet bgs)	Paved Areas	Saturated Soils
All Concentrations in mg/kg				
Polycyclic Aromatic Hydrocarbons				
Total Naphthalenes	4.5	4.5	6,667	0.24
TTEC[2]	3.9	3.9	18	0.19
Volatile Organic Compounds				
Benzene	0.03	0.03	6.78	0.0017
Ethylbenzene	6	6	29,091	0.34
Toluene	4.5	4.5	23,273	0.27
Total Xylenes	14.6	14.6	145,455	0.83
Polychlorinated Biphenyl Compounds				
Total PCBs	0.65	1	5	NE
Total Petroleum Hydrocarbons				
Diesel and Oil	2,000	2,000	2,000	NE
Metals				
Arsenic	10	10	13	0.15
Barium	102	1,650	1,867	83
Cadmium	14	726	773	NE
Chromium	67[2]	25,907[2]	1,000,000[2]	24,007[2]
Copper	217	53,333	53,333	14
Lead	118	1,601	1,601	150
Mercury	5.5	13	13	0.1
Selenium	0.3	233	5,333	0.26
Silver	1,133	1,133	1,133	0.69

Notes:

[1] Site Cleanup Levels established in the Revised Draft RI/FS Report

[2] cPAH cleanup levels under MTCA are based on the calculated total toxicity of the mixture using the Toxicity Equivalency Methodology in WAC 173-340-708(8). The mixture of cPAHs shall be considered a single hazardous substance and compared to the applicable MTCA Method B or C cleanup levels for benzo(a)pyrene.

-- Not analyzed

bgs - below ground surface

cPAH - carcinogenic polycyclic aromatic hydrocarbons

mg/kg - milligram per kilogram

MTCA - Model Toxics Control Act

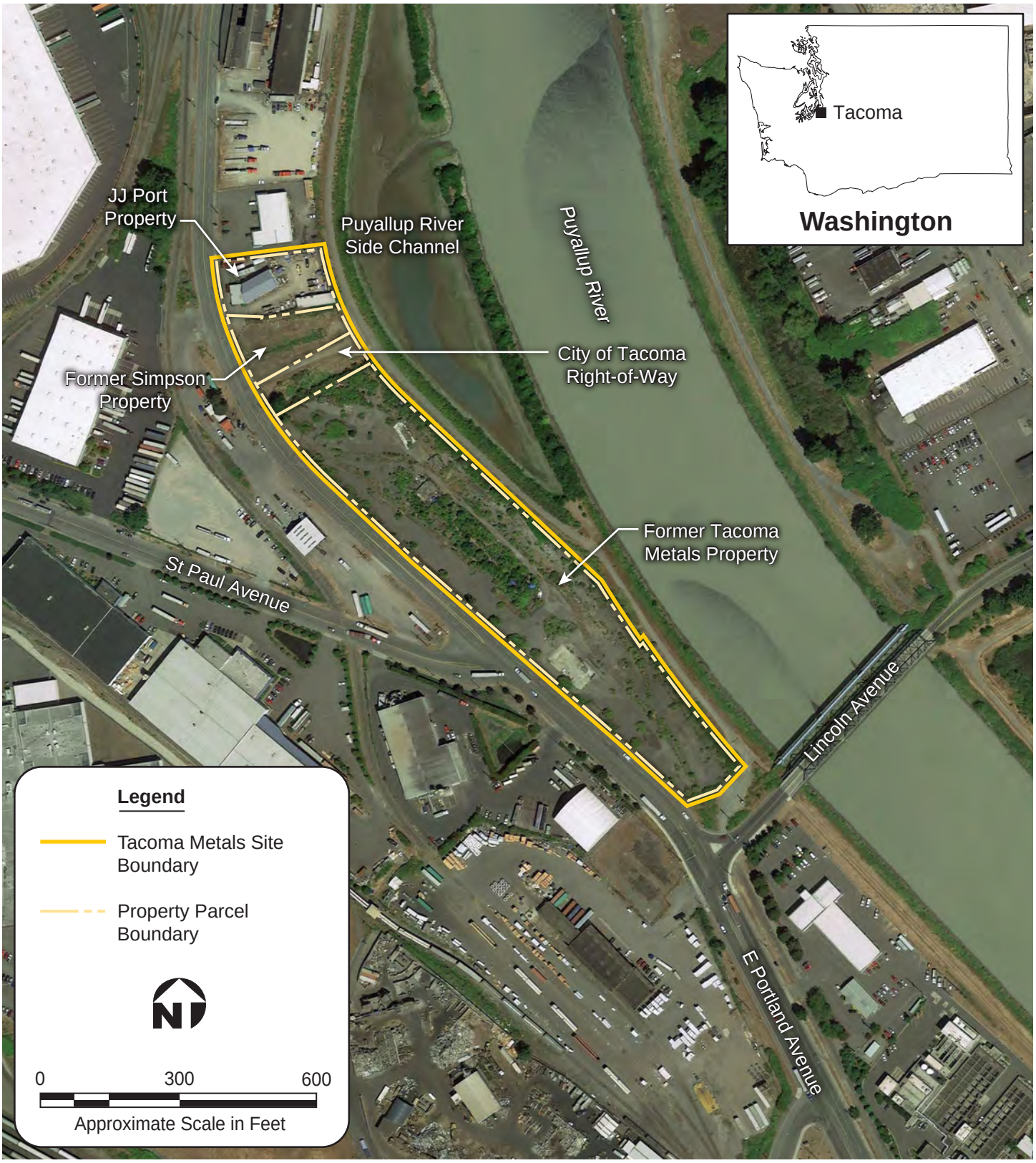
NE - not established

RI/FS - remedial investigation/feasibility study

TTEC - Total Toxic Equivalent Concentration (sum of cPAH concentrations multiplied by their respective toxicity equivalency factors per WAC 173-340-708(8)(e))

WAC - Washington Administrative Code

Figures



Source: Google Earth Pro, imagery dated (7/10/2014)

Figure F-1

Site Location Map

AECOM

Tacoma Metals Site
Tacoma, Washington

Boring	Northing	Easting
JJP-1	705571.69	1163753.62
JJP-2	705574.73	1163767.80
JJP-3	705572.65	1163779.37
JJP-4	705588.75	1163749.51
JJP-5	705596.19	1163766.84
JJP-6	705596.14	1163781.14
FSP-1	705541.30	1163782.60
FSP-2	705506.43	1163803.00
FSP-3	705535.20	1163865.61
FSP-4	705506.98	1163880.93
FSP-5	705471.32	1163831.73
FSP-6	705552.31	1163876.69
FSP-7	705526.56	1163901.28
FSP-8	705569.78	1163901.83
FSP-9	705545.61	1163919.04
FSP-10	705544.38	1163949.20

Legend

- Tacoma Metals Site Boundary
- Property Parcel Boundary
- Direct Push Soil Boring (2014)
- Previous Soil Boring Before 2014
- Monitoring Well
- Test Pit
- Proposed Primary Investigation Soil Boring Location - FSP
- Proposed Primary Investigation Soil Boring Location - JJP
- Proposed Step Out Investigation Soil Boring Location - FSP
- Proposed Step Out Investigation Soil Boring Location - JJP
- Extent of Soil Exceeding Interim Action Cleanup Levels at Depths Less Than 15 ft bgs

0 20 40

SCALE IN FEET

Figure F-2

Supplemental Investigation Proposed Soil Boring Locations B36 Area, Area B, and Area D

Tacoma Metals Site
Tacoma, Washington

AECOM

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Attachment A Standard Operating Procedures

AECOM

Standard Operating Procedure

Decontamination of Soil and Water Sampling Equipment

To prevent potential cross-contamination of samples, all reusable soil and water sampling equipment and pumps will be decontaminated. The lead sampler will set up the area used to decontaminate soil and water sampling equipment consisting of three stations, as described below. This area will be located upwind from the specific sampling area. The personnel performing the decontamination procedures will wear protective clothing as specified in the site-specific health and safety plan.

This standard operating procedure (SOP) describes procedures for decontaminating sampling equipment contaminated by either inorganic or organic materials. Sampling equipment used for both can combine these procedures, following the order of a detergent wash, organic solvent, acid rinse, and final water rinse. At stations where both water and soil (or other solid media) will be sampled, separate decontamination areas should be used for each medium where appropriate.

When using a drilling contractor, subsurface soil samplers (i.e., split spoons, Dames & Moore U-type samplers, core barrels, and hydraulic push-probe samplers) can be decontaminated by using a heated pressure washer (steam cleaner). The decontaminated sampler(s) (if not to be used immediately) will be stored in a plastic bag until ready for use.

1 Equipment Required to Decontaminate Inorganic-Contaminated Sampling Equipment

Equipment:

- 3-gallon plastic tubs
- 5-gallon plastic container, tap water
- 5-gallon carboy laboratory-grade distilled/deionized (DS/DI) water (organic/analyte-free)
- Properly labeled spray bottles for decontamination solvents
- Alconox® (or equivalent)
- Normal nitric acid
- Hard-bristle brushes
- Plastic sheeting, garbage bags, and aluminum foil
- Personal protective equipment as specified in the health and safety plan
- 55-gallon drum(s)
- Drum labels.

2 Procedures Used to Decontaminate Inorganic-Contaminated Sampling Equipment

The specific procedures for decontaminating inorganic-contaminated soil sampling equipment include the following:

1. At Station No. 1, first wash the contaminated equipment in a tub containing tap water mixed with a detergent such as Alconox®. Only a small volume (0.5 teaspoon) of Alconox® is necessary, and all Alconox® crystals should be completely dissolved.

2. Move the equipment to the wash tubs at Station No. 2. First, rinse the equipment with potable water, followed by rinsing equipment with 0.1 Normal nitric acid (HNO3) or similar acid, then rinse with DS/DI water.
3. At Station No. 3, place the clean equipment on plastic sheeting until reuse.

After decontaminating all the sampling equipment, the disposable gloves and used plastic from Station No. 3 will be placed in garbage bags and disposed of. The wash and rinse water from Station Nos. 1 and 2 will be containerized for proper disposal. At the end of each day, all sampling equipment will be stored in large plastic bags.

3 Equipment Required to Decontaminate Organic-Contaminated Sampling Equipment

- 3-gallon plastic tubs
- 5-gallon plastic container, tap water
- 5-gallon carboy laboratory analyte-free DS/DI water
- Properly labeled spray bottles for decontamination solvents
- Aluminum foil
- Alconox® (or equivalent)
- Hard-bristle brushes
- Pesticide-grade acetone, hexane, and methanol
- Plastic sheeting and garbage bags
- Personal protective equipment as specified in the health and safety plan.

4 Procedures Used to Decontaminate Organic-Contaminated Sampling Equipment

The specific procedures for decontaminating the organic-contaminated soil and groundwater sampling equipment include the following:

1. At Station No. 1, first wash the contaminated equipment in a tub containing tap water mixed with a detergent such as Alconox®. Only a small volume (0.5 teaspoon) of Alconox® is necessary, and all Alconox® crystals should be completely dissolved.
2. At Station No. 2, double rinse the equipment with site or DS/DI water.
3. At Station No. 3, lay the equipment on clean plastic sheeting to air dry.
4. Store the equipment in a clean location until reuse.

The disposable gloves and used plastic sheeting from Station No. 3 will be placed in garbage bags and disposed of. The wash and rinse waters from Station Nos. 1 and 2 will also be disposed of appropriately.

5 Equipment Used to Decontaminate Sampling Pump

- Submersible pumps
- Alconox® (or equivalent)
- Tap water
- Hard-bristle brushes
- Plastic sheeting and garbage bags

- 30-gallon plastic trash can or plastic overpack drum
- 55-gallon drum(s)
- Hot-water pressure washer (optional).

6 Procedures Used to Decontaminate Sampling Pumps

The specific procedures used for decontaminating sampling pumps include the following:

1. It is advisable to begin sampling with the well or surface water stations containing the lowest anticipated analyte concentration. Successive samples should be obtained from wells or stations anticipated to have increasing analyte concentrations. Use of dedicated pump equipment is preferable when feasible.
2. When pumps (e.g., submersible, bladder) are submerged below the water surface to collect water samples, they should be cleaned and flushed between uses. This cleaning process consists of an external detergent wash and rinse, or hot-water pressure washing of pump casing, tubing, and cables, followed by a flush of potable water through the pump. This flushing can be accomplished by pumping approximately 10 gallons of an Alconox® solution through the pump and then pumping approximately 10 gallons of tap water through the pump. This should be followed by rinsing the external parts of the pump intake hose and cable with a tap-water rinse and finally with a DI/DS-water rinse. The procedure should be repeated after sampling from each monitoring well location. The pump and hose should always be placed on clean polyethylene sheeting or in a plastic bag to avoid contact with the ground surface.
3. Surface pumps (e.g., peristaltic) used for well evacuation and surface water sampling need not be cleaned between well locations unless trace metal clean sampling techniques are required. However, a new length of polyethylene and Pharmed® (or equivalent) tubing must be used for each well and discarded after use.

7 Attachments

None.

AECOM

Standard Operating Procedure

Field Classification of Soil

This standard operating procedure (SOP) presents the field classification of soils, which has been adopted from American Society for Testing and Materials (ASTM) D-2488-84 (see Logging of Soil Boreholes SOP). ASTM D-2488-84 uses the Unified Soil Classification System (USCS) for naming soils. Field personnel are encouraged to study these procedures. Soil descriptions should be precise and comprehensive without being verbose. The overall impression of the soil should not be distorted by excessive emphasis on minor constituents. These descriptions will be used to interpret aquifer properties and other potential contaminant transport properties, rather than the exact mineralogy or tectonic environment.

Soil descriptions should be provided in the lithologic description column of the Soil Boring Log (Attachment B Field Forms) for each sample collected. If there is no difference between consecutive soil samples, subsequent descriptions can be noted as "same as above" or minor changes such as "increasing sand" or "becomes dark brown" can be added.

The format of soil descriptions for each sample or identified stratigraphic layer/soil horizon should be as follows:

1. Group symbol—The group symbol should be placed in the unified symbol column
2. USCS group name—The USCS name should be identical to the ASTM D-2488-84 Group Name with the appropriate modifiers
3. Minor components
4. Color
5. Moisture
6. Additional descriptions.

Examples of soil descriptions are provided in Table 1. The minimum elements of the soil descriptions are discussed below.

Table 1. Example of Soil Sample Descriptions

SM	Silty fine to medium SAND, trace fine gravel and occasional roots, very dark gray, moist to wet.
SW-SM	Fine to coarse SAND with silt, some fine gravel, mottled dark gray and tan, moist. Sand consists of 20 percent biotite flakes, no bedding observed.
ML	Sandy SILT, fine sand, dark gray, moist. Fractures predominantly vertical, at 1–3-inch spacing.
GW	Fine to coarse GRAVEL with 10 percent medium to coarse sand, trace woody debris, gray, moist to wet. Reddish brown staining noted within 2 feet of water table. Gravel is rounded and flat.

1 Definitions of Soil Types

Table 2 presents the USCS system. The USCS system is an engineering properties system that uses grain size to classify soils. The first major distinction is between fine-grained soils (more than 50 percent passing the No. 200 sieve [75 μm/0.029 in.]) and coarse-grained soils (more than 50 percent retained by the No. 200 sieve).

Table 2. Soil Classification System

Major Divisions			Group Symbol	Group Name
Coarse-Grained Soils	**Gravel**	Clean gravel	GW	Well-graded gravel, fine to coarse gravel
More than 50 percent retained on No. 200 sieve	More than 50 percent of coarse fraction retained on No. 4 sieve		GP	Poorly graded gravel
		Gravel with fines	GM	Silty gravel
			GC	Clayey gravel
	Sand	Clean sand	SW	Well-graded sand, fine to coarse sand
	More than 50 percent of coarse fraction passes No. 4 sieve		SP	Poorly graded sand
		Sand with fines	SM	Silty sand
			SC	Clayey sand
Fine-Grained Soils	**Silt and Clay**	Inorganic	ML	Silt
			CL	Clay
	Liquid limit <50	Organic	OL	Organic silt, organic clay
More than 50 percent passes No. 200 sieve	**Silt and Clay**	Inorganic	MH	Silt to high plasticity, elastic silt
			CH	Clay of high plasticity, fat clay
	Liquid limit ≥50	Organic	OH	Organic clay, organic silt
Highly organic soils			PT	Peat

Notes: Field classification is based on visual examination of soil in general accordance with ASTM D-2488-84.
Soil classification using laboratory tests is based on ASTM D-2487-83.
Descriptions of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and/or test data.
Liquid limit-water content of soil-water where consistency changed from plastic to liquid.

Fine-grained soils are classified as either silts or clays. Field determinations of silts and clays are based on observations of dry strength, dilatancy, toughness, and plasticity. Field procedures for these tests are included in ASTM D-2488-84. If these tests are used, the results should be included in the soil description. At least one complete round of field tests should be performed for a site if these fine-grained materials are encountered, preferably at the beginning of the field investigation. The modifiers “fat” and “lean” are used by ASTM to describe soils of high and low plasticity. The soil group symbols (e.g., CL, MH) already indicate plasticity characteristics, and these modifiers are not necessary in the description. Soils with high plasticity can be emphasized by describing them as “silty CLAY with high plasticity.” Plasticity is an important descriptor because it is often used to interpret whether an ML soil is acting as either a leaky or competent aquitard. For example, an ML soil can be dilatant/nonplastic and serve as a transport pathway, or it can be highly plastic and very impervious.

Coarse-grained soils are classified as either predominantly gravel or sand, with the No. 4 sieve (4.75 mm/0.19 in.) being the division. Modifiers are used to describe the relative amounts of fine-grained soil in a sample, as noted in Table 3 below:

Table 3. Coarse-Grained Soil Descriptions

Description	Percent Fines	Group Symbol
Gravel (sand)	<5 percent	GW, GP (SW, SP)
Gravel (sand) with silt (clay)	5–15 percent	Hyphenated names
Silt (clayey) with gravel (sand)	>15 percent	GM, GC (SM, SC)

The gradation of a coarse-grained soil is included in the specific soil name (i.e., fine to medium SAND with silt). Estimating the percent of size ranges following the group name is encouraged for mixtures of silt sand and gravel. Use of the modifiers "poorly graded" or "well graded" is not necessary because they are indicated by the group symbol.

A borderline symbol is shown with a slash (GM/SM). This symbol should be used when the soil cannot be distinctly placed in either soil group. A borderline symbol should also be used when describing interbedded soils of two or more soil group names when the thicknesses of the beds are approximately equal, such as "interbedded lenses and layers of fine sand and silt." The use of a borderline symbol should not be used indiscriminately. Every effort should be made to place the soil into a single group.

2 Minor Components

Minor components, such as cobbles, roots, and construction debris, should be preceded by the appropriate adjective reflecting relative percentages: trace (0–5 percent), few (5–10 percent), little (15–25 percent), and some (30–45 percent). The word "occasional" can be applied to random particles of a larger size than the general soil matrix (i.e., occasional cobbles, occasional brick fragments). The term "with" indicates definite characteristics regarding the percentage of secondary particle size in the soil name. It will not be used to describe minor components. If a nonsoil component exceeds 50 percent of an interval, it should be stated in place of the group name.

3 Color

The basic color of a soil, such as brown, gray, or red, must be given. The color term can be modified by adjectives such as light, dark, or mottled. Especially note staining or mottling. This information may be useful to establish water table fluctuations or contamination. The Munsell soil color chart designation is the required color standard. All color designations must be accompanied by a description of the moisture content of the soil when the color designation was made. It is generally preferable to determine color on moist samples; water may be added to the soil to achieve this moisture content.

4 Moisture Content

The degree of moisture present in the soil should be defined as dry, moist, or wet. Moisture content can be estimated from the criteria listed in Table 3 of ASTM D-2488-84.

5 Additional Descriptions

Features such as discontinuities, inclusions, joints, fissures, slickensides, bedding, laminations, root holes, soil animals, and major mineralogical components should be noted if they are observed. Anything unusual should be noted. Additional soil descriptions such as visible signs of contamination (odor and presence of product) may be made at the discretion of the project manager or as the field conditions warrant. The Soil Boring Log Form (Attachment B Field Forms) lists some optional descriptions, as does Table 13 of the ASTM standard. The reader is referred to the ASTM standard for procedures of these descriptions.

6 Contact Between Soil Types

The contact between two soil types must clearly be marked on the soil borehole log because it is very difficult to interpret borehole logs where soil sample descriptions change over a 5- or 10-ft sample interval if there is no indication of where this change occurred. If the contact is obvious and sharp, draw it in with a straight line. If it is gradational, a slanted line over the interval is appropriate. In the case where it is unclear, a dashed line over the most likely interval is used.

7 Attachments

Unified Soil Classification System Chart.

UNIFIED SOIL CLASSIFICATION
INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 3 inches and basing fractions on estimated weights)				Group Symbols	TYPICAL NAMES
Coarse-grained Soils: More Than Half Of Material Is Larger Than No 200 Sieve Size — The No 200 U.S. Standard Sieve Is About The Smallest Particle Visible To The Naked Eye	Gravels: More Than Half Of Coarse Fraction Is Larger Than No 4 Sieve Size — For Visual Classification, The 1/4" Size May Be Used As Equivalent To The No 4 Sieve Size	Clean Gravels (Little Or No Fines)	Wide range in grain size and substantial amounts of intermediate particle sizes	GW	Well-graded gravels or gravel-sand mixtures, little or no fines
			Predominately one size or a range of sizes w/some intermediate sizes missing	GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines
		Gravels With Fines (Appreciable Amount Of Fines)	Non-plastic fines (for identification procedures see ML below)	GM	Silty gravels, gravel-sand-silt mixtures
			Plastic fines (for identification procedures see CL below)	GC	Clayey gravels, gravel-sand-clay mixtures
	Sands: More Than Half Of Coarse Fraction Is Smaller Than No 4 Sieve Size	Clean Sands (Little Or No Fines)	Wide range in grain size and substantial amounts of intermediate particle sizes	SW	Well-graded sand or gravelly sands, little or no fines
			Predominately one size or a range of sizes w/some intermediate sizes missing	SP	Poorly-graded sands or gravelly sands, little or no fines
		Sands With Fines (Appreciable Amount Of Fines)	Non-plastic fines (for identification procedures see ML below)	SM	Silty sands, sand-silt mixtures
			Plastic fines (for identification procedures see CL below)	SC	Clayey sands, sand-clay mixtures

Less than 5% – SW, SP, GW, GP
More than 12% – SM, SC, GM, GC
5%-12% – Borderline cases requiring use of dual symbols

ID Procedures on Fraction Smaller Than No. 40 Sieve Size					
		Dry Strength (Crushing Characteristics)	Dilatancy (Reaction to Shaking)	Toughness (Consistency Near Plastic Limit)	
Fine-grained Soils: More Than Half Of Material Is Smaller Than No 200 Sieve Size — The No 200 U.S. Standard Sieve Is About The Smallest Particle Visible To The Naked Eye	Silts & Clays: Liquid Limit Less Than 50	None to low	Rapid to slow	None	ML — Inorganic silts, very fine sands, rock flour, silty or clayey fine sands with slight plasticity
		Medium to high	None to very slow	Medium	CL — Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		Low to medium	Slow	Low	OL — Organic silts and organic silt-clays of low plasticity
	Silts & Clays: Liquid Limit Greater Than 50	Low to medium	slow to none	Slight to medium	MH — Inorganic silts and organic silt-clays of low plasticity
		High to very high	None	High	CH — Inorganic clays of high plasticity, fat clays
		Medium to high	None to very slow	Low to medium	OH — Organic clays of medium to high plasticity, organic silts
Highly Organic Soils	Readily identified by color, odor, spongy feel and frequently by fibrous texture				PT — Peat and other highly organic soils

SOIL CLASSIFICATION

Must Include

1. Group Symbol
2. Color (Field Moisture Condition)
3. Group Name
4. Particle Size Range
5. Consistency (Soft, Hard, etc.)
6. Moisture Content (Dry, Moist, Wet)
7. Structure (Stratified, Laminated, Fissured)
8. Geologic Origin
9. Additional comments indicating soil characteristics which might affect engineering properties (organics, root holes, mica, gypsum, caving, sloughing, loss of drilling water, contamination, etc.)

May Include

10. Percentage of Boulders, Cobbles, Gravel, Sand or Fines
11. Particle Angularity (angular, rounded,etc.)
12. Particle Shape (if appropriate)
13. Maximum Particle Size
14. Hardness of Coarse Particles
15. Cementation (if present)
16. Odor (if Organic or unusual)
17. Local Name (if known)
18. Plasticity of Fines
19. Dilatancy
20. Toughness
21. Reaction with Acid

Example: SM DARK GRAY SILTY FINE SAND with trace of dark gray silty clay (wet) (loose) [FILL] (caving of borehole sides)

Clay Consistency	THUMB PENETRATION	SPT, N Blows/ft.	Undrained Shear Strength c (PSF) TORVANE	Unconfined Compressive Strength q_u (PSF) POCKET PENETROMETER
Very soft	Easily penetrated several inches by thumb. Exudes between thumb and fingers when squeezed in hand.	<2	250	500
Soft	Easily penetrated one inch by thumb. Molded by light finger pressure.	2-4	250-500	500-1000
Medium stiff	Can be penetrated over 1/4 inch by thumb with moderate effort. Molded by strong finger pressure.	4-8	500-1000	1000-2000
Stiff	Indented about 1/4 inch by thumb but penetrated only with great effort.	8-15	1000-2000	2000-4000
Very stiff	Readily indented by thumbnail.	15-30	2000-4000	4000-8000
Hard	Indented with difficulty by thumbnail.	>30	>4000	>8000

VARIATIONS IN SOIL STRATIGRAPHY

Descriptive Term	Thickness or Configuration
Parting	— 0 to 1/16 inch thickness
Seam	— 1/16 to 1/2 inch thickness
Layer	— 1/2 to 12 inch thickness
Stratum	— Greater than 12 inch thickness
Pocket	— Small, erratic deposit, usually less than 1 foot
Varved clay	— Alternating seams or layers of sand, silt and clay (laminated)
Occasional	— One or less per foot of thickness
Frequent	— More than one per foot of thickness
With	— 5 to 15 percent
Trace	— Less than 5 percent

CRITERIA FOR DESCRIBING STRUCTURE

Description	Criteria
Stratified	Alternating layers of varying material or color with layers at least 1/4 inch thick; note thickness.
Laminated	Alternating layers of varying material or color with the layers less than 1/4 millimeter thick; note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.
Homogeneous	Same color and appearance throughout.

Criteria for Describing Angularity of Coarse-grained Particles

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but having rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

Criteria for Describing Particle Shape

The particle shape shall be described as follows where length, width and thickness refer to the greatest, intermediate and least dimensions of a particle, respectively

Flat	Particles with width/thickness >3
Elongated	Particles with length/width >3
Flat & Elongated	Particles meet criteria for both flat and elongated

Criteria for Describing Moisture Content

Description	Criteria
Dry	Absence of moisture, dusty, dry to touch
Moist	Damp, but no visible water
Wet	Visible free water, usually soil is below water table

Criteria for Describing the Reaction with HCl

Description	Criteria
None	No visible reaction
weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

Criteria for Describing Cementation

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

Criteria for Describing Dry Strength

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb & a hard surface
Very High	The dry specimen cannot be broken between the thumb & a hard surface

Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

Criteria for Describing Toughness

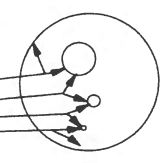
Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium thickness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness

Criteria for Describing Plasticity

Description	Criteria
Nonplastic	A 1/8-in. (3mm) thread cannot be rolled at any water content
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

Soil Type	SPT, N blows/ft	Relative Density, %	Field Test
Very loose sand	4	0-15	Easily penetrated with 1/2-in. reinforcing rod pushed by hand
Loose sand	4-10	15-35	Easily penetrated with 1/2-in. reinforcing rod pushed by hand
Medium dense sand	10-30	35-65	Penetrated a foot with 1/2-in. reinforcing rod driven with a 5-lb hammer
Dense sand	30-50	65-85	Penetrated a foot with 1/2-in. reinforcing rod driven with a 5-lb hammer
Very dense sand	50	85-100	Penetrated a few inches with 1/2-in. reinforcing rod driven with a 5-lb hammer

Material	Fraction	Sieve Size	Grain Size	Approximate Scale Size
Boulders		12 inches +	12 inches +	Larger than Basketball
Cobbles		3 in. to 12 in.	3 in. to 12 in.	Fist-sized to Basketball
Gravel	Coarse	3/4 in. to 3 in.	3/4 in. to 3 in.	Thumb-sized to Fist-sized
	Fine	No. 4 to 3/4 in.	0.19 in. to 0.75 in.	Pea-sized to thumb-sized
Sand	Coarse	No. 10 to No. 4	0.079 in. to 0.19 in.	Rock Salt to pea-sized
	Medium	No. 40 to No. 10	0.017 in. to 0.079 in.	Sugar-sized to Rock Salt
	Fine	No. 200 to No. 40	0.0029 in. to 0.017 in.	Flour-sized to Sugar-sized
Fines (silt/clay)		Passing No. 200	0.0029 in	Flour-sized and smaller



AECOM

Standard Operating Procedure

Field Documentation

All information relevant to field operations must be properly documented to ensure that activities are accounted for and can be reconstructed from written records. Field documentation should include only a factual description of site-related activities. Field personnel should not include superfluous comments or speculation regarding the field activities. Several types of logbooks may be used for this purpose and should be consistently used by field crews (e.g., field logbooks, sample logbooks, field data logbooks). Logbooks will be labeled on the cover with the project name, dates of field work, and the contract number. A separate bound logbook with consecutively numbered pages will be used for each field project. Each logbook for a particular project will be numbered (e.g., *Project Name* Additional Investigation—Field Logbook *Number 2*).

The information recorded in each logbook should be written in indelible ink. All corrections should consist of a single line-out deletion, followed by the author's initials and the date. Field logbooks will be photocopied after each period in the field, and photocopies will be stored in the project files. After field activities are completed, logbooks will be stored in the permanent project file. No bound logbooks should be discarded, even if they are illegible or contain inaccuracies that require a replacement document. When not in use, all logbooks will be stored in the permanent project file.

1 Field Logbooks

The purpose of the field logbook is to document events that occur and record data measured in the field to the extent that someone not present at the site can reconstruct the activity without relying on the memory of the field crew. Each page in the field logbook will be initialed and dated by all persons making entries on that page. The author will sign and date the last page at the end of each day, and a line will be drawn through the remainder of the page. The logbooks, at a minimum, must contain the following information:

- A purpose and description of the field task
- The time and date the field work began
- The location and description of the work area, including sketches, map references, and photograph log, if appropriate
- The names and titles of field personnel and anyone present during the field work, including the times they are present
- The name, agency, and telephone number of any field contacts
- The meteorological conditions at the beginning of the field work and any changes that occur throughout the day, including the approximate time of the change
- Details of the field work performed, with a description of any deviations from the work plan, sampling and analysis plan, or standard operating procedures
- All field measurements made (unless a specific logbook or sampling form [i.e., boring log or groundwater sampling form] is available for this purpose), including the time of measurement
- Any field results not appearing in the field data logbook, including station identification and location, date, and time of measurement
- Cross-references of numbers for duplicate samples
- References to other logbooks used to record information (e.g., station log, sample log, health and safety log)

- Logbooks should include only a factual description of site-related activities. Field personnel should not include superfluous comments, speculation, or other non-factual observations regarding the field activities.

2 Sample Collection Field Forms

Appropriate sample collection field forms will be used to record the relevant sample information during a sampling event. For instructions regarding proper use of sample identifiers, sampling personnel should consult the sampling and analysis plan.

3 Sample Labels

Sample labels (tags) are designed to uniquely identify each sample, and must be affixed to each sample container used. The labels should be filled out at the time the samples are collected and should consist of the following information:

- Sample number
- Site name
- Date and time sample is collected
- Initials of the samplers
- Preservatives used, if any
- Type of analysis (e.g., 8270-SIM, NWTPH-Dx).

4 Photographs

In certain instances, photographs of sampling stations may be taken using a camera-lens system with a perspective similar to the naked eye. Photographs should include a measured scale in the picture, when practical. The following items should be recorded in the field logbook for each photograph taken:

- The photographer's name, the date, the time of the photograph, and the general direction faced (orientation)
- A brief description of the subject and the field work portrayed in the picture
- The sequential number of the photograph and the roll number on which it is contained
- If digital photographs are collected for internal use or presentation purposes, the file name, date, file location, description, orientation, and photograph should be recorded.

The slides, prints, or disks (as appropriate) and associated negatives will be placed in the project files after the film is developed. Any supporting documentation from the field logbooks will be photocopied and placed in the task files to accompany the slides, prints, or disks.

5 Equipment Calibration Records

Equipment calibration records, including instrument type and serial number, calibration supplies used, calibration methods and calibration results, date, time, and personnel performing the calibration, should be recorded in the field logbook. At a minimum, equipment used during the investigation should be calibrated daily in accordance with the manufacturers' recommendations. An example Equipment Calibration Log is included in the Field Forms included as Attachment B of the compliance monitoring plan.

6 Attachments

None.

Standard Operating Procedure

Logging of Soil Boreholes

The following procedures for completing the Soil Boring Log (sampling and analysis plan [SAP], Attachment B Field Forms) establish the minimum information that must be recorded in the field to adequately document soil borehole advancement activities performed during field exploration. The boring log form must be filled out completely. These procedures are written for boreholes advanced using mechanical equipment. All pertinent sections should also be used for hand-augured or hand-dug boreholes.

These procedures include minor modifications to American Society for Testing and Materials (ASTM) D-2488-84 to emphasize environmental investigations as opposed to geotechnical investigations (for which the standards were written). Prior to borehole logging, ASTM D-2488-84 should be read in its entirety. All field boring logs should include information addressed in this standard operation procedure (SOP). Additionally, standards presented may need to be supplemented with additional technical descriptions or field test results.

1 Activities of the Observing Geologist during Drilling

1. Record the name of the drilling contractor, the driller, and driller's helper(s)

2. Record the type and make of the drill rig used

3. Note the weather or any special external conditions that influence the drilling (i.e., lightning storms)

4. Check the driller's daily records to verify their accuracy

5. Construct boring logs as the borehole is advanced and describe any subsurface situation encountered during drilling that could provide information on the hydrogeologic character of the subsurface

6. Note date and time of all activities associated with the drilling

7. Make certain that the drillers have a health and safety plan and perform all work in a safe manner

8. The geologist's daily record shall include, but may not be limited to, the following items:

    - Date and depth of hole at start and end of working day or shift
    - Depth of start and finish of each sampled interval
    - Depth and size of any casing used
    - Drill bit diameter, type and condition
    - Time required to advance the borehole
    - Gain or loss of water, mud, or air flush; type of cuttings
    - Standing water-level at start and end of each working period
    - Simplified description of strata
    - Total sample recovery (in inches or percent)
    - Depth of samples
    - Details of delays and breakdowns
    - Backfilling and grouting.

This list excludes any special items that may be required for contractual record purposes or for special hydrogeologic tests.

Provide the drilling start and finish dates and times. For consecutive sheets, provide, at a minimum, the job number, the boring number, and the sheet number.

2 Technical Data

Sampler Type: Provide the sampler type (e.g., SS = split spoon, DM = Dames & Moore split spoon, SPT = Standard Penetration Test, G = grab).

Depth of Casing: Enter the depth of the casing below ground surface immediately prior to sampling or collecting water level measurements.

Driven/Recovery: Provide the length that the sampler was driven and the length of sample recovered in the sampler. This column would not apply to grab samples.

Sample Number/Tag Number: Provide the sample number. The sample numbering scheme should be established prior to drilling. Consult the work plan or SAP for the sample numbering scheme. The depth of the sample is the depth to the top of the recovered sample to the nearest 0.1 ft. Samples should be obtained from the entire recovered sample. If tag number(s) for the sample container(s) are used, they should be recorded.

Blow Count: For standard split spoon samplers, record the number of blows for each 6 in. of sampler penetration or the “N” value, which is the sum of the blows in the last two 6-in. intervals. A typical blow count of 6, 12, and 14 is recorded as 6/12/14 or as an “N” of 26. Final boring logs will record “N” values. Refusal is a penetration of more than 6 in. but less than 12 in. with a total blow count of 100 or a penetration of less than 6 in. with a blow count of 50. A partial penetration of 50 blows for 4 in. is recorded as 50/4 in. For nonstandard split spoons (e.g., 5-ft spoon used for continuous sampling), total blows will be recorded.

Time: The time should be recorded during drilling in order to determine drilling speed. Time should be recorded in 24-hour mode (e.g., 3:00 p.m. = 1500 hours)

Blank Columns: One blank column is provided on the boring log. This column can be used for site-specific information, usually related to the constituents of interest (COIs) (e.g., sheen, organic vapor meter [OVM] measurements).

Interval/Depth: Use a depth scale that is appropriate for the complexity of the subsurface conditions. Generally, each major scale division = 1 foot will suffice. The boxes located to the right of the scale should be used to graphically indicate sample locations as shown in the example.

Surface Conditions: Describe the surface conditions (e.g., paved, 4-in. concrete slab, grass, natural vegetation and surface soil, oil-stained gravel).

Soil Description: The soil description and definition of soil contacts should follow the format described in SOP Field Classification of Soil.

Comments: Include all pertinent observations. Drilling observations might include drilling chatter, rod-bounce (boulder), sudden differences in drilling speed, damaged samplers, and malfunctioning equipment. Information provided by the driller should be attributed to the driller. Information on COIs might include odor, staining, color, and presence or absence of some indicator of constituents of concern.

3 Attachments

None.

AECOM

Standard Operating Procedure

Sample Custody

A stringent, established program of sample chain of custody will be followed during sample storage and shipping activities to account for each sample. The procedure outlined herein will be used in conjunction with Field Documentation Standard Operating Procedure (SOP), which covers the use of sample logbooks, and SOP Sample Packaging and Shipping, which covers sample packaging and shipping. Chain-of-custody record/sample analysis request forms ensure that samples are traceable from the time of collection through processing and analysis until final disposition. A sample is considered to be in a person's custody if any of the following criteria are met:

- The sample is in the person's possession.
- The sample is in the person's view after being in possession.
- The sample has been locked in a secure area to prevent tampering after it was in the person's possession.

1 Procedure

The chain-of-custody record portion of the form is the most critical because it documents sample possession from the time of collection through the final disposition of the sample. The sample analysis request portion of the form provides information to the laboratory regarding what analyses are to be performed on the samples that are shipped.

The chain-of-custody record/sample analysis request form will be completed after each field collection activity and before the samples are shipped to the laboratory. Sampling personnel are responsible for the care and custody of the samples until they are shipped. When transferring possession of the samples, the individuals relinquishing and receiving the samples must sign the chain-of-custody record/sample analysis request form(s), indicating the time and date that the transfer occurs. Copies of the forms will be made and kept by the sampler, and the originals will be included with the samples in the transfer container. The following guidelines will be followed to ensure consistent shipping procedures and to maintain the integrity of the samples:

1. Each chain-of-custody record/sample analysis request form must be appropriately signed and dated by the sampling personnel. The person who relinquishes custody of the samples must also sign this form.
2. The chain-of-custody record/sample analysis request form should not be signed until the information has been checked for inaccuracies by the lead sampler. All changes should be made by drawing a single line through the incorrect entry and initialing and dating it. Revised entries should be made in the space below the entries. On the handwritten chain-of-custody record/sample analysis request forms, spaces remaining at the bottom of the page after corrections are made should be marked out with single lines. This procedure will preclude any unauthorized additions.
3. At the bottom of each chain-of-custody record/sample analysis request form is a space for the signatures of the persons relinquishing and receiving the samples and the time and date that the transfer occurred. The time that the samples were relinquished should match exactly the time they were received by another party. Under no circumstances should there be any time when custody of the samples is undocumented.
4. If samples are sent by a commercial carrier not affiliated with the laboratory, such as Federal Express or UPS, the name of the carrier and airbill should be recorded on the chain-of-custody record/sample analysis request form. The time of transfer should be as close to the actual drop-off time as possible. After the chain-of-custody record/sample analysis request forms are signed and copied, they should be sealed inside the transfer container.
5. If errors are found after the shipment has left the custody of sampling personnel, a corrected version of the forms must be prepared and sent to all relevant parties. Minor errors can be rectified by making the change on a copy of the original with a brief explanation and signature. Errors in the signature block may require a letter of explanation.

6. Samples that are archived internally should be accompanied by a chain-of-custody record/sample analysis request form. While samples remain in the sampler's custody before being shipped, all containers will be kept in sight of sampling personnel or in a secured area to preclude tampering with the samples.

2 Attachments

Example Chain-of-Custody Record/Sample Analysis Request Form

AECOM

Standard Operating Procedure

Sample Packaging and Shipping

Specific requirements for sample packaging and shipping must be followed to ensure the proper transfer and documentation of environmental samples collected during field operations. Procedures for the careful and consistent transfer of samples from the field to the laboratory are outlined herein.

1 Equipment Required

Specific equipment or supplies necessary to properly pack and ship environmental samples include the following:

- Ice in sealed bags or Blue Ice®
- Sealable airtight bags
- Plastic garbage bags
- Coolers
- Bubble wrap
- Fiber reinforced packing tape
- Scissors
- Chain-of-custody seals
- Airbills for overnight shipment
- Chain-of-custody record/sample analysis request forms.

2 Procedure

The following steps should be followed to ensure the proper transfer of samples from the field to the laboratories:

1. Appropriately document all samples using the proper logbooks (see Field Documentation Standard Operating Procedure [SOP]) and chain-of-custody record/sample analysis request forms (example provided in Attachment to this SOP).
2. Make sure all applicable laboratory quality control sample designations have been made on the chain-of-custody record/sample analysis request forms. Samples that will be archived for future possible analysis should be clearly identified on the chain-of-custody record/sample analysis request form and should also be labeled as “Do Not Analyze: Hold and archive for possible future analysis” as some laboratories interpret “archive” to mean continue holding the residual sample after analysis.
3. Notify the laboratory contact and the project quality assurance/quality control (QA/QC) coordinator that samples will be shipped and the estimated arrival time. Send copies of all chain-of-custody record/sample analysis request forms to the QA/QC coordinator or project manager, as appropriate.
4. Samples will be placed in secure on-site storage or remain in the possession of the sampling personnel prior to shipment. Any temporary sample storage areas will be locked and secured to maintain sample integrity and chain-of-custody requirements.
5. Clean the outside of all dirty sample containers to remove any residual material that may lead to cross-contamination.
6. Fill out the chain-of-custody/sample analysis request form as described in Sample Custody SOP, and retain the back copy of the form for the project records prior to sealing the cooler. Store the signed chain-of-custody record/sample analysis

request forms in a sealable bag and tape them to the inside of the cooler lid. For a shipment containing multiple coolers, indicate on the outside of this cooler "Chain of Custody Inside."

7. Check sample containers against the chain-of-custody record/sample analysis request form to ensure all samples intended for shipment are accounted for.
8. Store each sample container in a sealable bag that allows the sample label (example provided in Attachment to this SOP) to be read. Volatile organic analyte (VOA) vials for a single sample must be encased in bubble wrap before being sealed in bags.
9. Choose the appropriate size cooler (or coolers) and line with bubble wrap.
10. Fill the cooler with the samples, separating glass containers with bubble wrap and allowing room for ice to keep the samples cold. Add enough ice or Blue Ice® to keep the samples refrigerated overnight. Ice should be enclosed in sealable plastic bags to prevent leakage. Avoid separating the samples from the ice with excess bubble wrap because it will insulate the containers from the ice. After all samples and ice have been added to the cooler, use bubble wrap to fill any empty space to keep the samples from shifting during transport.
11. If possible, consolidate all VOA samples in a single cooler, and ship them with (a) trip blank(s) in accordance with the quality assurance project plan.
12. After the cooler is sufficiently packed to prevent shifting of the containers, close the lid and seal it shut with fiber-reinforced packing tape. If the cooler has a drain at the bottom, it should be taped shut in the same manner.
13. As security against unauthorized handling of the samples, apply one or two chain-of-custody seals across the opening of the cooler lid (example provided in Attachment to this SOP). Be sure the seals are properly affixed to the cooler so they are not removed during shipment.
14. Label the cooler with destination and return addresses, and add other appropriate stickers, such as "This End Up," "Fragile," and "Handle With Care."
15. If an overnight courier is used, fill out the airbill as required and fasten it to the top of the cooler. The identification number sticker should be taped to the lid, because tracking problems can occur if a sticker is removed during shipment.

3 Attachments

Example Chain-of-Custody Record/Sample Analysis Request Form.

Chain-of-Custody Seal.

Sample Label.

CHAIN OF CUSTODY

ALS Environmental
1317 South 13th Ave., Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

SR# _____

PAGE _____ OF _____ COC# _____

PROJECT NAME
PROJECT NUMBER
PROJECT MANAGER
COMPANY NAME
ADDRESS
CITY/STATE/ZIP
E-MAIL ADDRESS
PHONE # FAX #
SAMPLER'S SIGNATURE

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☐ 8270LL☐ SIM PAH☐	Volatile Organics 624☐ 8260☐ 8021☐ BTEX☐	Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐	Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐	PCBs Aroclors☐ Congeners☐	Pesticides/Herbicides 608☐ 8081☐ 8141☐ 8151☐	Chlorophenolics - 8151M Tri☐ Tetra☐ PCP☐	Metals, Total or Dissolved (See List below)	Cyanide☐ Hex-Chrom☐	(circle) pH, Cond., Cl, SO_4, PO_4, F, NO_2, NO_3, BOD, TSS, TDS, Turb.	(circle) NH_3-N, COD, TKN, TOC, DOC, NO_2+NO_3, T-Phos	TOX 9020☐ AOX 1650☐ 506☐	Alkalinity☐ CO_3☐ HCO_3☐	Dioxins/Furans 1613☐ 8290☐	Dissolved Gases CO_2☐ RSK 175☐Methane☐Ethane☐ Ethene☐			REMARKS

REPORT REQUIREMENTS

___ I. Routine Report: Method Blank, Surrogate, as required
___ II. Report Dup., MS, MSD as required
___ III. CLP Like Summary (no raw data)
___ IV. Data Validation Report
___ V. EDD

INVOICE INFORMATION

P.O. # _____
Bill To: _____

TURNAROUND REQUIREMENTS

_____ 24 hr. _____ 48 hr.
_____ 5 day
_____ Standard (15 working days)

_____
Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

***INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: _____ (CIRCLE ONE)**

SPECIAL INSTRUCTIONS/COMMENTS:

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:		RECEIVED BY:		RELINQUISHED BY:		RECEIVED BY:	
Signature	Date/Time	Signature	Date/Time	Signature	Date/Time	Signature	Date/Time
Printed Name	Firm	Printed Name	Firm	Printed Name	Firm	Printed Name	Firm

Custody Seal

Date _____ Project _____

Signature _____ Container # ___ of ___

Custody Seal

Date _____ Project _____

Signature _____ Container # ___ of ___

COLOR IS PINK

METALS

Sample Name: _____

Date _____ Time _____ Sampler _____

Analysis **Metals** **AOX** **HARDNESS** (Circle Analysis Needed)

Field Filtered Yes/No (Circle One)

HNO_3 Preserved (Yes)

Comments:

Lab Label #5Y

USED ON PLASTIC

Sample Name: _____

Date _____ Time _____ Sampler _____

Analysis **BOD, PH, COND, Cl, Cl_2RES, F, SO_4, NO_2, NO_3, OPhos, TDS, TSS, Turb, TAN-LIG, ALK, CO_3, HCO_3, COLOR**

(Circle Analysis Needed)

Preservative: Comments:

Lab Label #1

USED ON AMBER

Sample Name: _____

Date _____ Time _____ Sampler _____

Analysis **8081 8082 8141 8151 8270 8310**

(Circle Analysis Needed)

Preservative:

Comments:

Lab Label #3

Standard Operating Procedure

Soil Sampling

1 Purpose

The purpose of this standard operating procedure (SOP) is to outline the methods by which soil sampling should be performed.

This procedure describes the protocols for collecting a surface or subsurface soil sample. The procedure will provide descriptions of equipment, field procedures, and documentation necessary to collect representative surface and subsurface soil samples.

2 Procedures

2.1 Surface Soil Procedures

2.1.1 Surface Soil Sampling Equipment

Equipment and materials used to collect surface soil samples include:

- Stainless steel spoon, trowel, knife, spatula
- Stainless steel bowl
- Personal protective equipment (PPE) as required by the health and safety plan (HASP)
- Decontamination equipment
- Paper towels
- Laboratory supplied sample jars
- Cooler and blue ice or ice
- Stakes for marking sampling location
- Field forms such as chain of custody, sample collection log, air monitoring log, other necessary health and safety documentation
- Field logbook

2.1.2 Surface Soil Sample Collection

The following steps describe the procedures used to collect surface soil samples:

1. Decontaminate sampling equipment.

2. Clear and remove vegetation and any surface debris such as rocks using a decontaminated trowel.

3. Don a clean pair of latex, nitrile, or surgical gloves and the appropriate level of protection as specified in the HASP.

4. Collect the surface soil sample from the top 6 inches of soil (or the depth specified in the sampling and analysis plan) using a decontaminated trowel.

5. Special separate collection procedures must be followed if the sample will be analyzed for volatile organic compounds (VOCs). The choice of sampling method/device, container type, and preservation method may be influenced by many factors, including but not limited to the following:

    - Project required detection levels
    - Expected physical and chemical properties of the soils
    - Whether samples will be preserved in the field vs. in the laboratory
    - Holding times for different preservation methods
    - Elapsed time between sample collection and laboratory delivery
    - Available shipping methods (may be limited for methanol preserved samples)
    - Any applicable State requirements

6. Homogenize the remainder of the sample in a decontaminated stainless steel bowl and fill the remainder of the pre-labeled lab jars for sample analysis.

7. Fill hole with topsoil and replace the vegetative mat over the disturbed area.

8. Record observations in the field logbook

9. Record the sampling location on a site map.

10. Decontaminate sampling device for collection of next sample.

Detailed sample collection and preservation guidance is provided in Appendix A of SW846 Method 5035A. Additional state guidance is provided in “Collecting and Preparing Soil Samples for VOC Analysis” Implementation Memorandum #5, Washington State Department of Ecology (June 2004). These collection procedures should be used for project sites in the State of Washington. For project sites in the State of Alaska that include soil sampling in petroleum contaminated sites, the procedures in “Underground Storage Tank Procedures Manual, Guidance for Treatment of Petroleum Contaminated Soil and Water and Standard Sampling Procedures” State of Alaska Department of Environmental Conservation (November, 2002) should be followed.

2.2 Subsurface Soil Procedures

Before conducting subsurface soil sampling, you may need a permit or other form of approval from regulatory agencies overseeing your site before you begin any drilling operations. This is especially true if you are working in a wetland or other sensitive area or are installing wells. Always check with utility companies to verify the locations of underground materials before beginning drilling operations.

Subsurface soil samples can be collected during drilling operations using one of several different sampling devices. Subsurface soil samples can also be collected using an alternate method such as a direct-push sampling device (e.g. Geoprobe™). Procedures for collecting subsurface soil samples are described in this section.

2.2.1 Subsurface Soil Sampling Equipment

Equipment and materials used during the collection of subsurface soil samples include:

- Drill rig, hollow-stem auger, mud rotary, or direct-push
- Sampling device (split-barrel sampler, split-spoon sampler, modified California sampler, thin-wall tub sampler, Shelby tube continuous core sampler)
- Stainless steel spoons, trowels, putty knife
- Stainless steel bowl(s)
- Measuring tape
- Laboratory supplied sample jars
- Cooler and blue ice or ice
- Decontamination equipment

- Paper towels
- PPE as required by the HASP
- Field forms such as chain of custody, sample collection log, air monitoring log, other necessary health and safety documentation
- Field logbook

2.2.2 Collection of Subsurface Soil Samples During Drilling Operations

The following procedures should be followed when collecting a subsurface soil sample during drilling operations:

1. Decontaminate all equipment including drill rig and all associated equipment, sampling devices, and stainless steel spoons and trowels.

2. Inspect, clean, and put on appropriate PPE.

3. Advance boring using selected drilling method.

4. Retrieve sample using selected sampling device. If performing the Standard Penetration Test (American Society for Testing and Materials [ASTM] D1586), record the number of blows per 6 inches.

5. Observe the soil and measure and record (1) the amount of soil recovered in the sampler, (2) the presence of any free product, (3) any unusual odors, and (4) any stratigraphic changes. Begin to form a description before disturbing the soil.

6. All sample jars should be pre-labeled with appropriate information including date, sample identification (ID), and analyses.

7. Collect a sample using a decontaminated stainless steel spoon or trowel. Special collection procedures must be followed if the sample will be analyzed for VOCs. Refer to section 2.1.2, step 5 for details. Next, place the remaining soil in a stainless steel bowl and collect a homogeneous sample to be analyzed for other parameters. After the laboratory samples are collected, fill a separate sample jar or plastic bag to be used for soil classification. If there is a change in the stratigraphy, set aside some soil from each and place into jars to be used for the soil classification. If the amount of soil is not sufficient, collect another sample immediately below the prior sample interval and homogenize the two samples prior to filling laboratory sample jars.

8. If collecting samples using Shelby Tubes (ASTM D1587), seal the ends, being careful not to disturb the sample.

9. Fill in a detailed description of the soil(s) (ASTM D2488) in the field logbook.

10. Discard any unused soil. See the project sampling and analysis plan for proper storage and disposal procedures.

11. Decontaminate sampling device for collection of next sample.

2.2.3 Procedures for Subsurface Soil Sample Collection Using Direct-Push Technology

There are several different types of direct-push technology. Some direct-push sampling devices may not be able to collect a soil sample from greater than 20 feet below ground surface.

The following procedures should be followed when collecting a subsurface soil using direct-push technology.

1. Decontaminate all equipment including sampling devices, and stainless steel spoons and trowels.

2. Inspect, clean, and put on appropriate PPE. Change latex/nitrile gloves for the collection of each sample.

3. Instruct subcontractor to set up truck-mounted equipment at a sampling location.

4. The subcontractor will advance the sample probe and extract a sample from the required depth using a decontaminated sample collection device. The sample probe will be attached to the bottom of a stainless steel rod. The rod will be pushed below ground surface with a hydraulic level attached to the truck. The predetermined depth will be reached by connecting rods together. Immediately before the sample depth is reached, the contractor will connect a handle to the rods and turn it to open the sampling depth. The device will be driven through the desired sample interval and extracted.

5. The soil will be collected in a Teflon sleeve, or other non-reactive sleeve inside the sampling device. After sample retrieval, the sleeve will be sliced open to allow access to the soil. Collect a sample using a decontaminated stainless steel spoon or trowel. Special collection procedures must be followed if the sample will be analyzed for VOCs. Refer to section 2.1.2, step 5 for details. Next, place remaining soil in a stainless steel bowl and collect a homogenous sample to be analyzed for other parameters. After the laboratory samples are collected, fill a separate sample jar or plastic bag to be used for soil classification. If there is a change in the stratigraphy, set aside some soil from each and place into jars to be used for the soil classification. If recovery is not sufficient, collect another sample immediately below the prior sample interval and homogenize the two samples prior to filling laboratory sample jars.

    a. Log the description of the soil sample in the field logbook.

    b. Decontaminate the stainless steel sample rods and sampling device between each sampling location.

2.3 Compositing Soil Samples

All samples to be composited or split should be homogenized after all aliquots have been combined. DO NOT HOMOGENIZE (MIX OR STIR) SAMPLES FOR VOLATILE COMPOUND ANALYSIS.

If a representative sample is desired over the depth of a shallow hole or if several shallow samples are to be taken to represent an area, composite the samples as follows:

1. As each sample is collected, place the soil in a decontaminated stainless steel bowl.

2. After all samples from each hole or area are collected in the bowl, stir the sample thoroughly with a decontaminated stainless steel trowel or spatula.

3. For organics analyses, a sheet of aluminum foil may be used instead of a stainless steel bowl.

2.4 Splitting Samples

Fill the sample containers for the same analyses one after another in a consistent manner (i.e., fill the first lab's container, then fill the second lab's container; then go on to the next analysis and fill the first lab's container and then the second lab's container).

2.5 QA/QC

Quality assurance/quality control (QA/QC) samples are designed to help identify potential sources of sample contamination. Different types of QA/QC samples include field blanks, rinse blanks, trip blanks, and duplicate samples. The frequency of collection and types of QA/QC samples required are indicated in the site-specific sampling plan. All QA/QC samples are labeled with QA/QC identification and sent to the laboratory with the other samples for analysis.

3 Documentation

Documentation of observations and data acquired in the field will provide information on the proper acquisition of samples and provide a permanent record. These observations and data will be recorded with black ink in a bound weatherproof field

logbook with consecutively numbered pages. Notes will be recorded daily when in the field. The soil sampling information in the field logbook will include the following as a minimum:

- Project number/name
- Date
- Weather
- Personnel on site (samplers' names, other field crew, observing personnel)
- Boring location
- Start/end time of boring
- Sample ID and depth
- Time sample is collected
- Laboratory sample ID and analytical parameters
- Air monitoring readings taken during drilling or sample collection
- Decontamination procedures
- Presence of free product or unusual observations
- Depth water was first encountered
- Depth rock was encountered
- Borehole abandonment procedures
- Sample description and standard penetration test results may be included in the field logbook, but should also be included on the boring log.

The following information should be included in the field logbook for the completion of a boring log:

- Boring location information including project number/name, location, subcontractor, date, drilling method, type of sampling device, equipment used for standard penetration test, and name of person logging information.

- For each sampling interval, the following should be noted: sampling interval number, time sample was collected, soil description, depth, amount of recovery, and information from standard penetration test. Note any changes in stratigraphy and thickness of each layer in the sample. Note the depth water was first encountered and the depth rock was encountered.

- Also, note the presence of free product, any odors, and air monitoring readings taken during drilling or sample collection, and any other observations that may be used for site characterization in the future.

- After logging is completed, note the total number of samples collected, which ones were sent for laboratory analysis, the laboratory sample IDs, and the parameters requested.

- Note any unusual changes in drilling pressure or drill rig behavior, voids, and unusual conditions encountered during drilling.

- It is important to be as thorough as possible when filling out the boring log. The log may be used to aid in future work at the site, many years down the road, and a complete log will prevent guesswork and the possibility of resampling.

4 References

ASTM Method D1586-84, Standard Method for Penetration Test and Split-Barrel Sampling of Soils

ASTM Method D1587-83, Standard Practice for Thin Walled Sampling of Soils

ASTM Method D2488, Standard Recommended Practice for Description of Soils (Visual-Manual Procedure)

ASTM D420-87, Standard Guide for Investigating and Sampling Soil and Rock

ASTM Method D1452, Standard Practice for Soil Investigation and Sampling by Auger Borings

ASTM Method D2487, Standard Test Method for Classification of Soils for Engineering Purposes

ASTM D4220-89, Standard Practice for Preserving and Transporting Soil Samples

U.S. Army Corps of Engineers (USACE). *Work Plan for CERCLA Remedial Investigation/Feasibility Study*. Appendix J, SOP 025 - Soil Sampling

EPA. 1996. Test Methods for Evaluating Solid Waste, Physical Chemical Methods. (SW-846), Third edition. December. Method 5035A, Appendix A (July 2002).

Washington State Department of Ecology, *Collecting and Preparing Soil Samples for VOC Analysis*. Implementation Memorandum #5, June, 2004.

State of Alaska Department of Environmental Conservation (ADEC), *Underground Storage Tank Procedures Manual, Guidance for Treatment of Petroleum Contaminated Soil and Water and Standard Sampling Procedures*, November, 2002.

5 Attachments

None.

Attachment B
Field Forms

ALS Environmental

800.695.7222
www.caslab.com

CHAIN of CUSTODY

Client:

Project:

Page ___ of ___

Method of Shipment

Project Manager

Telephone No.

Fax No.

Special Detection Limit/Reporting

Sample I.D.	Lab Sample No.	No. of Containers	Matrix: Soil	Matrix: Water	Matrix: Air	Matrix: Other	Prsv.: Yes	Prsv.: No	Sampling Date	Sampling Time															Turn Around Time (working days)

MARKS

Sample Received Intact: Yes No

Temperature received: Ice No ice

Relinq. by sampler (Sign & Print Name)	Date	Time	Received by (Sign & Print Name)		
Relinquished by	Date	Time	Received by		
Relinquished by	Date	Time	Received by		
Relinquished by	Date	Time	Received by laboratory	Date	Time

Lab Work No.

AECOM

Equipment Calibration Log

Project Name: _____ **Date:**
Project No: _____ **Page:** _____ **of** _____

Type Meter	Equipment (Manu.\Model)	Serial No.	Owned or Rented	Calibrated By	Date	Time	Parameter Calibrated and Calibration Standard	Calibration Pass? (Yes or No)	Comments/Notes
WQM							pH 4.0 _____ pH 7.0 _____ pH 10.0 _____ Specific Conductivity _____ uS/cm or mS/cm D.O. _____ Atm. Pressure _____ O.R.P. _____ Turbidity Standards _____		
pH/Cond.							pH 4.0 _____ pH 7.0 _____ pH 10.0 _____ Specific Conductivity _____ uS/cm or mS/cm		
Turbidity Meter							Turbidity Standards _____		
PID							Isobutylene Span Gas Concentration (ppm) _____		
Other									
Other									

AECOM

GROUNDWATER SAMPLING LOG

Project Name	Well No.
Project No.	Sampled By
Date	Weather °F

WELL INFORMATION	
Depth to water	(ft)
Depth of well:	(ft)
Well diameter:	(in)
Feet of water:	(ft)
Product thickness:	(ft)
Screen interval:	
well condition:	

COMMENTS

PURGE DATA								
start purge time								
time								
DTW	(ft)							
purge rate	(L/min)							
pH	(Units)							
conductivity	(umhos/cm)							
temperature	(deg C)							
D.O.	(mg/L)							
ORP	(mv)							
turbidity	(NTU)							
purge and sample equip.								

SAMPLE INFORMATION					
sample number	**time**	**analysis**	**container**	**# bottles**	**preservative**

Sampler Signature _____

AECOM

GROUNDWATER SAMPLING LOG (CONTINUED)

Project name _____ Well No. _____

Project No. _____ Sampled By _____

Date _____

PURGE DATA (CONTINUED FROM PAGE 1)								
start purge time								
time								
DTW	(ft)							
purge rate	(L/min)							
pH	(Units)							
conductivity	(umhos/cm)							
temperature	(deg C)							
D.O.	(mg/L)							
ORP	(mv)							
turbidity	(NTU)							
purge and sample equip.								

Sampler Signature _____

AECOM

BORING ID:

SOIL BORING LOG

Sheet of

PROJECT:	**CONTRACTOR:**	**MONUMENT:**
PROJECT NO.:	**DRILLER:**	**RISER:**
LOCATION:	**RIG TYPE:**	**SCREEN:**
TOTAL DEPTH:	**METHOD:**	**FILTER PACK:**
DATE: **TIME:** **START** **FINISH**	**Hammer/Sampler Type(s):**	**SEAL:**
		GROUT:
LOGGED BY:	**Groundwater Depth (ft.)**	**GROUND ELEV.:**

Depth (ft.)	Sample ID	Blows/6 inches	Recovery (%)	PID (ppm)	LITHOLOGIC DESCRIPTION MAIN COMPONENT, grain size, minor component, (USCS), color, consistency or apparent density, plasticity, moisture, odor/staining	Other Remarks, Tests, and Sample Times
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Comments:

AECOM

Americas

PID/FID Monitoring Report

S3AM-127-FM8

Location: _____ **Page** _____ **of** _____

Prepared By: _____ **Calibration:** _____

Model: _____ **Span Gas:** _____ **Lamp Voltage:** _____

Serial No.: _____ **Zero Gas:** _____

Date	Location and Conditions	Event No.	Sample Time hour: min	Min (ppm)	AVG (ppm)	Max (ppm)	Alarm		Comments
							Level (ppm)	Status	

Americas

Instrument Calibration Log

S3AM-127-FM10

Instrument Information	
Instrument Name:	Manufacturer:
Serial Number:	Last Service Date:
Parameter(s):	Calibration Gas:
Calibration Procedure:	
Daily Calibration Results	
Date:	Calibration Result:
Name:	Signature:
Notes:	
Date:	Calibration Result:
Name:	Signature:
Notes:	
Date:	Calibration Result:
Name:	Signature:
Notes:	
Date:	Calibration Result:
Name:	Signature:
Notes:	

Project: Job No.:

Date: Operator:

Instrument: Calibration:

Appendix G
Quality Assurance Project Plan

AECOM

Submitted to
Washington State
Department of Ecology
300 Desmond Drive
Lacey, WA 98503

Submitted by
AECOM
1111 Third Avenue
Suite 1600
Seattle, WA 98101
July 2020

Appendix G
Quality Assurance Project Plan

Supplemental Remedial Investigation/Feasibility Study Work Plan

B36 Area, Area B, and Area D
Tacoma Metals Site
Tacoma, Washington

Quality Assurance Project Plan

Supplemental Remedial Investigation/Feasibility Study Work Plan

B36 Area, Area B, and Area D
Tacoma Metals Site
Tacoma, Washington

	Approval	Date
Project Manager (AECOM)	Paul Kalina, PE	
Project QA Manager (AECOM)	Lucy Panteleeff	

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Table G-7 Sample Collection, Preservation, and Holding Time Criteria

List of Acronyms

ALS	ALS Environmental Laboratory
COC	chain-of-custody
CUL	interim action cleanup level
DQO	data quality objectives
Ecology	Washington State Department of Ecology
EDD	electronic data deliverable
EPA	United States Environmental Protection Agency
GSAP	groundwater sampling and analysis plan
International Paper	International Paper Company
MDL	method detection limit
MS/MSD	matrix spike/matrix spike duplicate
PDF	portable data format
PE	performance evaluation
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RI/FS	remedial investigation/feasibility study
RL	reporting limit
RPD	relative percent difference
SAP	sampling and analysis plan
SSAP	soil sampling and analysis plan
Site	Tacoma Metals Site
WAC	Washington Administrative Code
Work Plan	Supplemental RI/FS Work Plan

1. Project Description

This document presents the quality assurance (QA) project plan (QAPP) for the supplemental remedial investigation (RI) and updated feasibility study (FS) at the Tacoma Metals Site (Site) located in Tacoma, Washington. This QAPP has been prepared in accordance with the Washington State Department of Ecology (Ecology) publication *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Ecology 2016). The procedures outlined in this QAPP govern all aspects of chemical data collection activities to be conducted under the associated project plans (e.g., groundwater sampling and analysis plan [GSAP, Appendix E of the Supplemental RI/FS Work Plan {Work Plan}] and soil sampling and analysis plan (SSAP, Appendix F of the Work Plan). The purpose of the QAPP and associated sampling and analysis plans (SAPs) is to ensure that the data are representative of the conditions in the field and that analytical data are valid and accurately reported.

International Paper Company (International Paper) is conducting a supplemental RI, which is described in the Work Plan. The investigation consists of groundwater and soil sampling in the northwestern part of the Site. The Work Plan was developed to meet the SAP and QAPP requirements identified in Washington Administrative Code (WAC) 173-340-820 and WAC 173-340-830.

2. Project Organization and Responsibility

The project team will consist of personnel from Ecology, International Paper, AECOM and their subcontractors, and laboratory TestAmerica Laboratory, Incorporated (TA). The following paragraphs describe the major positions and responsibilities of the team, along with the approach to QA management. Key project and regulatory personnel and their responsibilities for QA activities are described below.

2.1 Project Coordinators

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(206) 438-2172 (Direct Line)
(206) 310-5097 (Cellular)
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The project coordinators will be responsible for overseeing the implementation of the sampling activities at the Site covered by this QAPP and associated Work Plan. To the maximum extent possible, all communications between Ecology and International Paper and all documents should be directed through the project coordinators. These documents include, but are not limited to, reports, QAPPs, project plans, and other correspondence concerning the activities performed pursuant to the agreed order. If Ecology or International Paper change project coordinators, written notification will be provided to Ecology or International Paper at least 10 calendar days prior to the change.

2.2 Project Manager

Paul Kalina
AECOM
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The project manager (PM) is responsible for implementation of all aspects of the Work Plan. Specific responsibilities include review and approval of revisions to QAPPs and applicable project plans, ensuring that all technical procedures are followed, reporting of deviations from the Ecology-approved project plans to the International Paper and Ecology project coordinators, and ensuring that the data collected will satisfy the Data Quality Objectives (DQOs) discussed in Section 3 of this document. In addition, the PM will provide technical review of reports.

2.3 Project QA Manager

Lucy Panteleeff
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The project QA manager is responsible for developing and managing procedures described in the QAPP, interfacing with the project laboratory and data quality personnel, reviewing QA audit reports, coordinating audit procedures, implementing necessary corrective action procedures, reviewing and evaluating analytical laboratory results, reviewing data validation reports, preparing data quality assessment summaries, and reporting to the AECOM PM.

2.4 Analytical Laboratory Project Manager

Christine Leaf
ALS Environmental Laboratory (ALS)-Kelso
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The analytical laboratory PM is responsible for reviewing and reporting all analytical data generated during the project; responding to questions or concerns regarding the quality of the data that the PMs, project QA manager, or data quality personnel may have; and implementing any corrective actions deemed necessary by these individuals with regards to laboratory operations.

2.5 Environmental Media Sampling Personnel

Various AECOM or Other Contract Personnel

The field sampling personnel are responsible for implementing the sampling and handling procedures as specified in the QAPP and/or applicable project plans, ensuring all field procedures follow the appropriate project plan, notifying the PM and project QA manager of any difficulties encountered during the field program, and implementing corrective actions to the field procedures as approved by the PM.

3. Data Quality Objectives

DQOs are qualitative and/or quantitative statements of the precision (a measure of the random error), bias (a measure of systematic error), representativeness, completeness, and comparability necessary for the data to serve the objectives of the interim action. The objectives of the sampling activities covered by this QAPP are discussed in detail in the associated project plans. During plan implementation, both field and laboratory data will be generated. The quality of the field data will be evaluated based on successful calibration of each instrument supplying the data and the stated accuracy and precision by the manufacturer. The quality of laboratory data will be evaluated based on the relative precision, bias, representativeness, completeness, and comparability of the data generated by each type of analysis. These terms are defined below:

Precision Precision is a measure of the scatter in the data due to random error. For most environmental measurements, the major sources of random error are sampling and analytical procedures. Sampling and analytical precision is expressed as the relative percent difference (RPD) of duplicates and matrix spike duplicates.

Bias Bias is a measure of the difference between the analytical result for a parameter and the true value due to systematic errors. Potential sources of systematic errors include sample collection, physical/chemical instability of samples, interference effects, calibration of the measurement system, and artificial contamination. Bias is expressed as the percent recovery of matrix spikes and/or surrogates.

Representativeness Representativeness of the environmental conditions at the time of sampling is achieved by selecting sampling locations, methods, and times so that the data sufficiently describes the site conditions that the project seeks to evaluate.

Completeness Completeness refers to the amount of valid usable data produced in the project.

Comparability Comparability refers to the ability to compare the data from the project to other data.

Project DQOs for method detection limits (MDLs) and laboratory reporting limits (RLs) are summarized in Table G-1. The analytical methods and RLs provided in Table G-1 were selected to achieve data that are equal to or below the cleanup levels (CULs) required for this project (see Work Plan, Section 3). MDLs are statistically calculated values under clean matrix conditions that should support RLs. For this project, results between the MDL and RL will be reported as estimated ('J' flagged). As methods are developed that are able to achieve lower RLs, they will be assessed for project usability and presented to Ecology for approval. Upon approval, revisions will be made to the method selections in the QAPP.

The DQOs for precision and bias are assessed based on the laboratory control limits provided in Tables G-2 through G-6. As laboratory control limits change during the project, the new control limits will be used as DQOs. Representativeness of the data collected will be ensured by using sampling procedures that represent the actual site conditions at the time of sampling. Field sampling procedures are discussed in detail in the GSAP and SSAP, Appendices E and F, respectively, of the Work Plan. In addition, representative samples will also be ensured by following proper protocols for sample handling (storage, preservation, packaging, custody, and transportation), sample documentation, and laboratory sample handling and documentation procedures.

Comparability of the data will be ensured by selecting standard United States Environmental Protection Agency (EPA) and/or Ecology analytical methodologies for sample analysis. Data will be reported from the laboratory to the AECOM in portable data format (PDF) files and electronic data deliverables (EDDs). The laboratory-provided data will be converted by ALS into a suitable database format specified by AECOM. The analytical reports will be checked by AECOM to ensure reporting accuracy. Data quality will be assessed in terms of precision, bias, representativeness, completeness, and comparability using specific data validation procedures outlined in Section 10. Results of these assessments, along with any data that is qualified, will be submitted to the project QA manager in a data review memorandum for review and, if necessary, additional assessment.

4. Sampling Procedures

Specific sampling procedures for collecting soil and groundwater are discussed in the GSAP and SSAP in Appendices E and F, respectively, of the Work Plan. The schedule for collecting samples is also presented in the Work Plan. The GSAP and SSAP describe the format for field data entry and field procedures for ensuring accuracy.

Containers, sample size, preservation, and holding times are listed in Table G-7 for groundwater and soil for each analytical method that may be used to analyze these media. Samples will be identified on waterproof labels with indelible markers according to the sample designation system described in the associated SSAP (Work Plan, Appendix F) for soil and GSAP (Work Plan, Appendix E) for groundwater. Sample custody will be tracked with a chain-of-custody (COC) form in accordance with the procedures outlined in the SSAP and GSAP. Samples will remain in the custody of the sample collector until transport to the laboratory, unless a secure storage area is available.

Pre-preserved sample containers will be provided by the analytical laboratory. Field staff will confirm the presence or absence of preservative in the appropriate containers prior to filling. Any discrepancies with preservation will be noted on the field sampling records and on the COC for laboratory information and potential action.

Sample coolers and packing materials will be supplied by the laboratory. Prior to shipping, sufficient ice will be added to the coolers to maintain the samples between 2 and 6 degrees Celsius during transit to the laboratory.

5. Analytical Procedures

The analytical procedures that may be used in the field and by the contract laboratories are outlined in Table G-1 and discussed in Sections 5.1 and 5.2 below.

5.1 Field Analytical Procedures

Groundwater samples collected from the Site will be analyzed for temperature, pH, specific conductance, dissolved oxygen, and oxidation/reduction potential in the field using portable testing equipment as described in the GSAP (Work Plan, Appendix E). Soil screening methodologies used in the field will include visual and olfactory observations, sheen tests, and photoionization detector and flame ionization detector headspace analysis as described in the SSAP (Work Plan, Appendix F). The portable instruments used for field measurements will be operated, maintained, and calibrated in accordance with the manufacturer's manual for the instrument.

5.2 Laboratory Analytical Procedures

The analytical methods, including MDLs and laboratory RLs, that will be used to analyze water and soil samples are listed in Table G-1. These methods are derived from *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 2005) and Ecology's document *Analytical Methods for Petroleum Hydrocarbons* (Ecology 1997). ALS will perform all analyses of groundwater and soil samples collected during the project in general accordance with the appropriate EPA or Ecology method. All method-required quality control (QC) analyses will be completed by the laboratory conducting the analyses/tests and reported along with the analytical and testing results.

6. Data Reduction, Review and Reporting

Data reduction is the process of converting raw data to final results. Data from direct-reading field instruments will be obtained from the instrument and recorded onto a sample collection form or other appropriate field form as described in the applicable project plan. Laboratory analytical data reduction, review, and reporting will be conducted by the laboratory in accordance with their standard operating procedures discussed in their QA manual and requirements of the appropriate project plan. Data deliverables will include the project sample results and QC results in PDF and EDD formats. The data will be submitted to AECOM electronically for data validation and database formatting as directed by the project plan or PMs. The data validation will consist of ensuring that the laboratory has met the QC control limits established for surrogate recovery, matrix spike/matrix spike duplicate (MS/MSD) recovery and RPD, sample duplicate RPDs, and that the samples were properly preserved and analyzed within the recommended holding times for each analysis. Field duplicate precision will also be assessed. Once the data have been assessed and input into the database, electronic copies of the data, including qualifications, if any, will be submitted to the AECOM PM along with the data validation reports. In conjunction with the data quality assessment, the database information will be spot checked, with the analytical results reported by the laboratory in PDF. If transcription errors are discovered by AECOM, the laboratory will be notified, and the discrepancy corrected.

Data will be summarized in Excel tables. Under certain circumstances, more than one result for the same analyte may be reported by the laboratory. For samples that have been diluted and reanalyzed in order to obtain results within the instrument calibration range, results summarized from diluted analyses (those outside of the calibration range in the original analysis) will be reported. The initial results will be reported for all other compounds within limits in the initial analysis.

As part of the data quality assessment, the initial and diluted results will be compared. If the comparison indicates a difference greater than 20 percent, the data affected will be identified in writing in the associated data validation report and/or data QA summaries. When the initial analysis is an over-dilution and the reanalysis is performed to decrease the RL, the analysis with the lower RL but within the QC criteria will be reported. For samples that are extracted and/or analyzed multiple times due to laboratory QC procedures, the most appropriate data to report will be evaluated individually during data QA. When evaluating the appropriate data to report, factors such as hold time, QC parameters, and agreement between analyses will be reviewed, and the rationale for the decision will be documented in the data validation report.

Results will be compared to applicable CULs. If a sample has multiple results reported for a compound that range from below the CUL to above the CUL, a description of the occurrence will be provided in the data review report and associated reporting documents. Data validation procedures are outlined in Section 10.

7. Quality Control Procedures

QC procedures provide the means of evaluating and controlling the precision and bias of the analytical results. Careful adherence to established procedures for sample collection, preservation, and storage will minimize errors due to sampling and sample instability.

7.1 Field QC Procedures

The types of field QC samples that will be collected during the corrective action program and their purpose in relation to the DQOs discussed in Section 3 are listed below.

7.1.1 Field Blanks

Field blanks can indicate bias in analytical results caused by artificially introduced contamination from sample containers, sampling equipment, filtration equipment, preservation reagents, transportation and storage practices, and other samples. Two kinds of field blank will be used for this project: rinsate (decontamination or equipment) blanks and trip blanks. Trip blanks will only be used when samples are analyzed for volatile organic compounds, which will occur during collection of soil and groundwater samples.

One rinsate blank should be prepared each day drilling or sampling is conducted with non-dedicated equipment or at the frequency described in the applicable project plan. This sample will consist of deionized water provided by the laboratory poured over the non-dedicated sampling equipment after the equipment has been cleaned in accordance with the procedures specified in the applicable project plan. The rinsate water will be collected in the appropriate sample jar provided by the laboratory for the type of analysis to be conducted.

One trip blank should be requested from the laboratory for each shipment of groundwater samples that includes analysis of volatile organic compounds.

7.1.2 Field Duplicates

Field duplicates are samples that are collected at the same time and location as the parent sample and are preserved, stored, and analyzed under identical conditions. Generally, the most significant source of random error is sampling procedure. The sampling error cannot be measured directly, although it may be the largest source of error in the results. Evaluation of the difference between the analytical results of field duplicates can provide an estimate of the sampling error for project samples. A good estimate of the random error due to sampling can only be made if the results of the field duplicates are significantly above the RL for a particular analysis. Hence, samples selected for duplication should be those expected to produce positive results, if possible. In addition, to provide a better estimate of the standard deviation of field duplicate results, it is important to collect several pairs of duplicates. Collection of at least one duplicate per 20 samples of a specific media (i.e., groundwater and soil) collected should provide a sufficient number of duplicates. The field duplicate RPDs should be less than 50 percent for soil samples and less than 30 percent for groundwater samples. Field duplicates will not be identified to the laboratory but will be recorded on the sample collection forms or other appropriate field forms for identification after analysis has been conducted. A list of field duplicates will be provided to the data quality personnel.

7.2 Laboratory QC Procedures

Laboratory QC samples are used to assess if analytical results are within QC limits and documented. The types of QC samples the laboratory will employ depend on the particular analytical methodology that will be used to analyze the samples. Each analytical method has required QC analyses that must meet laboratory developed acceptance limits in order for the data to be considered valid. In addition, as part of the laboratory's annual accreditation program, performance evaluation samples and MDL studies are conducted to evaluate the laboratory's capability of performing the method accurately and precisely. Specific types of QC samples and corresponding control or acceptance limits for each analyte with respect to the particular analytical methodology are presented in Tables G-2 through G-6. MS/MSDs shall be performed on project samples at a rate of one per 20 samples collected for each matrix and analysis. In some cases, this will require the collection of additional sample volume in the field. If so, project plans will specify the sample volume required.

The control limits provided in Tables G-2 through G-6 were obtained from ALS during formulation of this QAPP. In general, these control limits were statistically calculated for each analytical method and matrix in accordance with SW-846 guidance. In some cases, the control limits are defined by the analytical method. The control limits therefore represent the normal laboratory variability associated with analysis of samples from many sites and are not specific to site samples. Matrix spike, laboratory control sample, and surrogate recoveries associated with analyses of site samples are reviewed by the laboratory to assess whether the recoveries indicate an out-of-control situation and to determine if corrective action is necessary. The laboratory will document the findings of their QC review and the corrective actions performed in the case narrative for the analytical reports.

As laboratory control limits change during the project, the new control limits will be used as DQOs.

8. Performance and System Audits

Two types of audits may be conducted as needed to determine whether procedures outlined in the project plans and laboratory QA program are being followed, or to detect problems so that corrective action can be initiated. The two different types of audits are described below.

8.1 Performance Audits

In a performance audit, performance evaluation (PE) samples are submitted to the laboratory and analyzed for the purpose of evaluating the performance of the measurement or analytical procedures used by the laboratory. The PE sample consists of some type of environmental matrix (e.g., soil, water) that contains a known amount of a particular analyte(s). The laboratory analyzes the sample using routine procedures and then reports its results. ALS is an Ecology-accredited laboratory and routinely participates in performance audits of their routine procedures. Results of these audits are available from the laboratory. Review of the audit results that are part of Ecology's accreditation program may be conducted if there are questions concerning the capability of the laboratory in performing any of the series of analytical measurements being performed as part of the interim action.

Field measurement systems such as pH meters, etc. are assumed to be performing adequately if they can be successfully calibrated in accordance with the manufacturer's operating instructions and documented in the field notes.

8.2 System Audits

System audits are conducted in order to determine if the requirements described in the applicable project plan are being properly carried out. A system audit may cover the field and laboratory portions of the project. The AECOM PM, upon recommendation by the project QA manager, may request that a system audit of the field or laboratory operations be performed. Results of system audits will be reported to the PMs and project coordinators. Any corrective actions required should be implemented as discussed in Section 11.

9. Preventative Maintenance

Preventative maintenance procedures and schedule for field sampling equipment and measurement equipment will be conducted in accordance with the manufacturer's manual for each piece of equipment. Any critical spare parts or sampling equipment disposables such as small tools, disposable bailers, sample containers, and other small items should be inventoried by field personnel in order to prevent and/or minimize equipment downtime. The laboratory will be responsible for preventative maintenance of its measurement equipment.

10. Data Verification and Validation Procedures

When the results of the measurements have been obtained, the AECOM PM and project QA manager will determine whether the project DQOs have been achieved. Whether the overall project DQOs have been met will be determined by review of the analytical data validation reports generated by the data quality personnel. The responsibility of these personnel will be to ensure that the analytical DQOs have been met through review of the QC results associated with the project analytical data. Data validation reports will discuss the completeness of the data and will document the reasons for any data qualifiers that are assigned. Specific procedures to be used in the data verification and validation of project data precision, bias, and completion are discussed in this section.

In order to ensure that data is of a known and acceptable quality, all analytical data generated during this work will undergo data verification and validation. Data validation is a review of data precision and accuracy using QC summary sheet results provided by the laboratory for each data package. If outliers occur during calibration or calibration verification or other analytical problems are identified, the laboratory will contact the project QA manager to discuss the problems/outliers. Professional judgment will be used to determine necessary actions, if any. The problems/outliers will be identified, and any remedial measures implemented will be noted in the case narrative from the laboratory. Data will be evaluated, and data qualifiers assigned based on the method requirements and guidance for qualification outlined in the EPA documents *National Functional Guidelines for Organic Superfund Methods Data Review* and *National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA 2017a, 2017b). If several problems or deficiencies are encountered or specific data appear to be problematic based on the initial data review, more extensive data review will be implemented such as review of raw data. The data review consists of the following elements:

- Verification that sample numbers and analyses match the COC request
- Verification that sample preservation and holding times are met
- Verification that field and laboratory blanks were performed at the proper frequency and that no analytes were present in the blanks
- Verification that field and laboratory duplicates, matrix spikes, and laboratory control samples were run at the proper frequency and that control limits were met
- Verification that surrogate compound analyses have been performed and that results met the QC criteria
- Verification that established reporting limits have been achieved

Data validation will also include a review of the precision, bias, and completeness of analytical data. Precision will be assessed based on the RPD of MS/MSD, laboratory duplicate pairs, and/or field duplicate pairs. Calculated RPDs will be compared to the control limits, and if the RPD is within these limits, then the precision of the analysis will be assumed to meet the DQOs of the project. Bias will be reviewed by comparing the percent recoveries of surrogates, matrix spikes, and laboratory control samples to the appropriate control limits. Tables G-2 through G-6 summarize the control limits for addressing precision and bias for each analysis. The control limits provided in Tables G-2 through G-6 were provided by the laboratory during development of this QAPP. As laboratory control limits change during the project, the new control limits will be used as DQOs.

Completeness will be expressed as the percentage of the total tests (including sample and field QC results) conducted that are valid and considered usable for project objectives. Analytical results qualified as estimated based on data validation are considered usable but the reason for qualification should be considered when using the data for site assessment or remedial evaluation. Rejected data are not usable. The target completeness objective will be 90 percent. In order to be complete, the data must be of known and acceptable quality. Data completeness will be assessed during data validation.

11. Corrective Action

Evaluation of field and laboratory QC data and/or audits conducted for field operations and/or laboratory operations may indicate the need for a corrective action. Problems with analytical QC data will be addressed by the laboratory QC officer. Problems arising during field operations, however, will be addressed by the project QA manager through communication of the identified problem and a potential corrective action to the AECOM PM. The PM will then relay this information to the field personnel for implementation. The field personnel will then report back to the PM upon successful implementation of the corrective action. Ecology will be notified of variances to the QAPP or applicable project plans through written correspondence.

12. Data Quality Assessment

A data quality assessment summary section will be included in the final reports. The data quality assessment will indicate if DQOs were met and identify QA problems, if any, and the recommended and/or implemented corrective actions. Data quality assessment will also include summaries and reasons for data qualifiers assigned during the QA review. Data quality assessments will be included in the final reports for review by the project QA manager and the AECOM PM.

13. References

United States Environmental Protection Agency (EPA). 2017. National Functional Guidelines for Organic Superfund Methods Data Review. EPA Contract Laboratory Program. EPA 540-R-2017-002. January 2017.

———. 2017. National Functional Guidelines for Inorganic Superfund Methods Data Review. EPA Contract Laboratory Program. EPA 540-R-2017-001. January 2017.

———. 2005. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846). Third Edition, Final Update III-A (1986), Final Update I (1992), Final Update IIA (1993), Final Update II (1994), Final Update IIB (1995), Final Update IIIB (1998), Draft Final Update IV (2005).

Washington State Department of Ecology (Ecology). 1997. Analytical Methods for Petroleum Hydrocarbons. Publication No. ECY 97-602. June 1997.

———. 2016. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. Publication No. 01-03-003. December 2016.

Tables

Table G-1. Parameters of Interest and Overall Project Data Quality Objectives - Soil and Groundwater

Analyte	Method	MDL		RL		Site Cleanup Level	
		Soil	Water	Soil	Water	Soil	Groundwater
Total Petroleum Hydrocarbons		mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L
Gasoline Range	**Ecology NWTPH-Gx/NWTPH-Dx**	0.62	12	5	250	30	800
Diesel Range		0.79	11	25	250	2,000	500
Residual Oil Range		2.9	28	100	500	2,000	500
Polycyclic Aromatic Hydrocarbons	**EPA 8270D-SIM**	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L
1-Methylnaphthalene		0.00037	0.0035	0.005	0.02	0.24	152
2-Methylnaphthalene		0.00037	0.0023	0.005	0.02	0.24	152
Acenaphthene		0.00030	0.0044	0.005	0.02	0.19	0.01
Acenaphthylene		0.00028	0.0034	0.005	0.02	0.19	0.01
Anthracene		0.00029	0.0036	0.005	0.02	0.19	0.01
Benzo(a)anthracene [a]		0.00023	0.0026	0.005	0.02	0.19	0.01
Benzo(a)pyrene [a]		0.00038	0.0043	0.005	0.02	0.19	0.01
Benzo(b)fluoranthene [a]		0.00038	0.0041	0.005	0.02	0.19	0.01
Benzo(g,h,i)perylene		0.00040	0.0029	0.005	0.02	0.19	0.01
Benzo(k)fluoranthene [a]		0.00024	0.0030	0.005	0.02	0.19	0.01
Chrysene [a]		0.00031	0.0034	0.005	0.02	0.19	0.01
Dibenzo(a,h)anthracene [a]		0.00023	0.0025	0.005	0.02	0.19	0.01
Dibenzofuran		0.00060	0.0093	0.005	0.02	0.19	0.01
Fluoranthene		0.00063	0.0100	0.005	0.02	0.19	0.01
Fluorene		0.00057	0.0038	0.005	0.02	0.19	0.01
Indeno(1,2,3-cd)pyrene [a]		0.00036	0.0026	0.005	0.02	0.19	0.01
Naphthalene		0.00047	0.0038	0.005	0.02	0.24	152
Phenanthrene		0.00059	0.0050	0.005	0.02	0.19	0.01
Pyrene		0.00032	0.0053	0.005	0.02	0.19	0.01
cPAHs (TTEC)[a]		NA	NA	NA	NA	0.19	0.01
Volatile Organic Compounds	**EPA 8260C**	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L
Benzene		0.000054	0.062	0.005	0.5	0.0017	0.44
Ethylbenzene		0.000094	0.05	0.005	0.5	0.34	29
Toluene		0.00015	0.054	0.005	0.5	0.27	57
m,p-Xylenes		0.0001	0.11	0.005	0.5	0.83	80
o-Xylene		0.000081	0.074	0.005	0.5	0.83	80
Polychlorinated Biphenyl Compounds	**EPA 8082A**	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L
Aroclor 1016		0.0085	0.0094	0.10	0.2	0.65	0.01
Aroclor 1221		0.0085	0.0094	0.20	0.4	0.65	0.01
Aroclor 1232		0.0085	0.0094	0.10	0.2	0.65	0.01
Aroclor 1242		0.0085	0.0094	0.10	0.2	0.65	0.01
Aroclor 1248		0.0085	0.0094	0.10	0.2	0.65	0.01
Aroclor 1254		0.0085	0.0094	0.10	0.2	0.65	0.01
Aroclor 1260		0.0085	0.0094	0.10	0.2	0.65	0.01
Metal Compounds	**EPA 6020A**	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L
Arsenic		2.0	5.0	8.0	10	0.15	5
Barium		0.3	0.6	0.8	4.0	83	1,000
Cadmium		0.09	0.5	0.2	1.0	14	1.12
Chromium		0.3	0.9	0.8	4.0	67	120 (Cr^{+3})
Copper		0.4	2.0	1.0	4.0	14	18.8
Lead		0.7	5.0	2.0	10	118	4.6
Selenium		2.0	9.0	8.0	20	0.26	5
Silver		0.3	2.0	0.8	4.0	0.69	8.8
Mercury	**EPA 7471B**	0.002	0.02	0.02	0.2	0.10	0.012

Notes:

[a] cPAH cleanup levels under Model Toxics Control Act are based on the calculated total toxicity of the mixture using the Toxicity Equivalency Methodology in Washington Administrative Code 173-340-780 (8). The mixture of cPAHs shall be considered a single hazardous substance and compared to the applicable cleanup levels for benzo(a)pyrene.

µg/L - microgram per liter

cPAH - carcinogenic polycyclic aromatic hydrocarbon

Ecology - Washington Department of Ecology

EPA - US Environmental Protection Agency

MDL - method detection limit

mg/kg - milligram per kilogram

NA - not applicable or not available

RL - reporting limit

TTEC - Total Toxic Equivalent Concentration

Table G-3. Quality Control Criteria for Data Quality Assessment, Polycyclic Aromatic Hydrocarbons (EPA 8270D-SIM)

Method	Analyte	QC	Soil			Water		
			Lower Control Limit	Upper Control Limit	RPD Limit	Lower Control Limit	Upper Control Limit	RPD Limit
Surrogate Recoveries								
8270-SIM	Terphenyl-d14	Surrogate	38	113	NA	32	129	NA
LCS Recoveries								
8270-SIM	1-Methylnaphthalene	LCS	43	90	40	47	119	30
8270-SIM	2-Methylnaphthalene	LCS	43	92	40	48	120	30
8270-SIM	Acenaphthene	LCS	44	95	40	63	121	30
8270-SIM	Acenaphthylene	LCS	44	93	40	58	124	30
8270-SIM	Anthracene	LCS	46	100	40	68	127	30
8270-SIM	Benz(a)anthracene	LCS	52	105	40	74	124	30
8270-SIM	Benzo(a)pyrene	LCS	52	111	40	75	131	30
8270-SIM	Benzo(b)fluoranthene	LCS	52	114	40	73	136	30
8270-SIM	Benzo(g,h,i)perylene	LCS	45	107	40	63	127	30
8270-SIM	Benzo(k)fluoranthene	LCS	52	112	40	74	134	30
8270-SIM	Chrysene	LCS	51	110	40	74	132	30
8270-SIM	Dibenz(a,h)anthracene	LCS	44	110	40	59	135	30
8270-SIM	Dibenzofuran	LCS	44	96	40	56	132	30
8270-SIM	Fluoranthene	LCS	49	102	40	70	127	30
8270-SIM	Fluorene	LCS	45	98	40	68	121	30
8270-SIM	Indeno(1,2,3-cd)pyrene	LCS	44	117	40	63	136	30
8270-SIM	Naphthalene	LCS	42	88	40	52	115	30
8270-SIM	Phenanthrene	LCS	41	99	40	64	126	30
8270-SIM	Pyrene	LCS	48	104	40	72	127	30
Matrix Spike Recoveries								
8270-SIM	1-Methylnaphthalene	MS	43	90	40	47	119	30
8270-SIM	2-Methylnaphthalene	MS	43	92	40	48	120	30
8270-SIM	Acenaphthene	MS	44	95	40	63	121	30
8270-SIM	Acenaphthylene	MS	44	93	40	58	124	30
8270-SIM	Anthracene	MS	46	100	40	68	127	30
8270-SIM	Benz(a)anthracene	MS	52	105	40	74	124	30
8270-SIM	Benzo(a)pyrene	MS	52	111	40	75	131	30
8270-SIM	Benzo(b)fluoranthene	MS	52	114	40	73	136	30
8270-SIM	Benzo(g,h,i)perylene	MS	45	107	40	63	127	30
8270-SIM	Benzo(k)fluoranthene	MS	52	112	40	74	134	30
8270-SIM	Chrysene	MS	51	110	40	74	132	30
8270-SIM	Dibenz(a,h)anthracene	MS	44	110	40	59	135	30
8270-SIM	Dibenzofuran	MS	44	96	40	56	132	30
8270-SIM	Fluoranthene	MS	49	102	40	70	127	30
8270-SIM	Fluorene	MS	45	98	40	68	121	30
8270-SIM	Indeno(1,2,3-cd)pyrene	MS	44	117	40	63	136	30
8270-SIM	Naphthalene	MS	42	88	40	52	115	30
8270-SIM	Phenanthrene	MS	41	99	40	64	126	30
8270-SIM	Pyrene	MS	48	104	40	72	127	30

Notes:
EPA - US Environmental Protection Agency
LCS - laboratory control sample
MS - matrix spike
NA - not applicable
QC - quality control parameter
RPD - relative percent difference
SIM - selected ion monitoring

About AECOM

AECOM (NYSE: ACM) is a global provider of professional technical and management support services to a broad range of markets, including transportation, facilities, environmental, energy, water and government. With approximately 90,000 employees around the world, AECOM is a leader in all of the key markets that it serves. AECOM provides a blend of global reach, local knowledge, innovation, and collaborative technical excellence in delivering solutions that enhance and sustain the world's built, natural, and social environments. A Fortune 500 company, AECOM serves clients in more than 150 countries and has annual revenue in excess of $17 billion.

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