K Ply Site

Engineering Design Report

Prepared for

Port of Port Angeles
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K Ply Site Engineer Design Report

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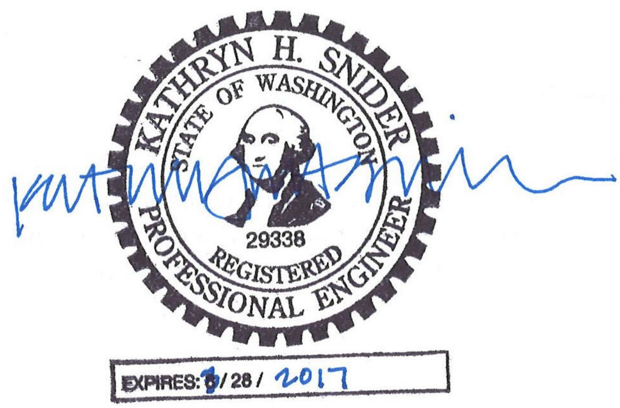

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List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
ARAR	Applicable, Relevant, or Appropriate Regulation
AO	Agreed Order
bgs	Below ground surface
BMP	Best Management Practice
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CAP	Cleanup Action Plan
COC	Contaminant of Concern
CPOC	Conditional point of compliance
CUL	Cleanup Level
CY	Cubic yards
DRO	Diesel-range organics
EDR	Engineering Design Report
GRO	Gasoline-range organics
HASP	Health and Safety Plan
LEKT	Lower Elwha Klallam Tribe
LNAPL	Light non-aqueous phase liquid
MIDP	Monitoring and Inadvertent Discovery Plan
MTCA	Model Toxics Control Act
NOC	Notice of Construction
NPDES	National Pollutant Discharge Elimination System
ORC-A	Oxy-hydroxide-based oxygen-releasing compound Advanced Pellets
ORCAA	Olympic Region Clean Air Agency
ORO	Oil-range organics
PCP	Pentachlorophenol
PID	Photoionization detector
POC	Point of compliance
Port	Port of Port Angeles
PPE	Personal protective equipment

Acronym/ Abbreviation	Definition
PVC	Polyvinyl chloride
RL	Remediation level
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SEPA	State Environmental Policy Act
Site	K Ply Site
SWPPP	Stormwater Pollution Prevention Plan
TAP	Toxic air pollutants
WAC	Washington Administrative Code

1.0 Introduction

This Engineering Design Report (EDR) was prepared per the requirements of Washington Administrative Code (WAC) 173-340-400(4)(a) and describes the engineering concepts and design criteria for the cleanup action selected by the Washington State Department of Ecology (Ecology) for the K Ply Site (Site) as detailed in the Cleanup Action Plan (CAP) for the Site (Ecology 2015). The Site was formerly a plywood mill and is located at 439 W. Marine Drive in Port Angeles, Washington (Figure 1.1). The Site is being cleaned up under the authority of the Model Toxics Control Act (MTCA), Chapter 70.105D of the Revised Code of Washington, administered by Ecology under the MTCA Cleanup Regulation, WAC 173-340, and under Agreed Order (AO) No. DE 11302 between Ecology and the Port, effective May 2015.

This EDR was developed using information presented in the CAP and the Remedial Investigation/Feasibility Study (RI/FS; Floyd|Snider 2015) prepared by Floyd|Snider on behalf of the Port of Port Angeles (Port) in accordance with AO No. DE 9546 between Ecology and the Port.

1.1 PURPOSE AND OBJECTIVES OF THIS REPORT

The objective of this document is to satisfy MTCA requirements and provide an engineering design that will be used as the basis for developing the plans and specifications for the remedial construction phase of this project, as well as to provide sufficient detail to implement the post-construction activities. The CAP identified six distinct cleanup areas at the Site that will be addressed as part of the remedial action, including two primary cleanup areas and four minor cleanup areas (refer to Figure 1.2). These primary cleanup areas include the following:

- The Gasoline Area extends from the alley to the northern boundary of the Site. Gasoline is present in soil and groundwater at concentrations greater than Site cleanup levels (CULs) throughout this area. Remediation will consist of excavation and bioremediation.
- The Hydraulic Oil Area is located in the vicinity of the former hydraulic presses. Hydraulic oil is present as a light non-aqueous phase liquid (LNAPL) in this area and hydraulic oil contamination is also present in soil and groundwater as oil-range organics (ORO) at concentrations greater than CULs. Remediation will consist of excavation and bioremediation.

The minor cleanup areas include the Stack Area, the Hog Fuel Storage Area, the Pentachlorophenol (PCP) Area, and the Log Pond Fill Area, and consist of the following:

- The Stack Area is the area near the former mill stack where dioxins were detected in two surface soil samples. Remediation will consist of excavation.
- The Hog Fuel Storage Area is the area where shallow diesel-range organics (DRO) and gasoline-range organics (GRO) soil contamination was observed near the former hog fuel pile. Remediation will consist of excavation.

- The PCP Area is the area beneath the former mill where PCP was detected in surface soil. This area lies on top of gasoline-impacted soil within the Gasoline Area. Remediation will consist of excavation.
- The Log Pond Fill Area is the area of the former log pond where ORO concentrations exceeded the CUL. The contamination associated with the Log Pond Fill Area is limited to a single exceedance found in one location in deeper soils representative of the bottom of the former log pond. As presented in the CAP, once the log debarking tenant that currently operates at the location vacates the Site, the extent of contamination around the single exceedance of total petroleum hydrocarbons (TPHs) will be further defined to determine the specific area of the former log pond that require institutional controls due to this exceedance.

The majority of the remedial construction consists of excavation with off-site disposal and/or ex-situ treatment and backfill of excavated soils.[1] There are multiple excavation areas and the extent of excavation in these areas is based on the extent of cleanup areas as defined by MTCA. To simplify the terminology that will be used in the construction documents, the excavation areas have been numbered. Both the excavation area number and the excavation area name that was used in the CAP are used in this document, but the emphasis will remain with the terminology that was used in the CAP: Excavation Area 1 refers to the Stack Area; Excavation Areas 2 and 3 refer to the Hog Fuel Storage Area; Excavation Area 4 refers to the PCP Area, Excavation Area 5 refers to the Concrete Pad Excavation Area; and Excavation Area 6 refers to the Bulkhead Excavation Area in the CAP).

The Concrete Pad and Bulkhead Excavation Areas are generally located within the Gasoline and Hydraulic Oil Areas, respectively. However, the Bulkhead Excavation Area addresses comingled impacts from the Gasoline and Hydraulic Oil Areas. These excavation areas are illustrated on Figure 1.2.

Design criteria have been developed for this project based on the criteria described in the CAP. Design criteria that address soil contamination and LNAPL include the following:

- Soil removal in each of the excavation areas shall be completed to achieve the groundwater and soil CULs or remediation levels (RLs) specified in the CAP.
- LNAPL accumulations on the water table shall be removed, to the extent practicable.
- Inhalation exposure shall be prevented in potential future buildings constructed over soil or groundwater contamination with volatile contaminants of concern (COCs) present at concentrations that may pose a risk for vapor intrusion.

[1] The ex-situ soil treatment pricing offered by the winning bidder for this project will determine the degree to which this technology will be used.

Design criteria that address groundwater contamination include the following:

- Bioremediation amendments shall be applied to soil following excavation to promote biodegradation of residual contamination.
- Bioremediation amendments shall be injected to groundwater in plume areas lying outside of excavation limits to promote biodegradation of COCs.
- Bioremediation amendment infiltration galleries shall be installed to deliver bioremediation amendments to groundwater following excavation and following compliance groundwater monitoring. Bioremediation amendment infiltration galleries shall be compatible with the selected amendment and application rate.
- The groundwater monitoring program shall be able to confirm the effectiveness of the site cleanup.

Design criteria for the general completion of the project include the following:

- Remediation work shall comply with Applicable, Relevant, or Appropriate Regulations (ARARs).
- Remediation work shall comply with appropriate industry, professional engineering, and technical standards.
- Following remediation, the Site shall be left in a state that is suitable for redevelopment for marine trades activities (boat building and maintenance).

1.2 ROLES AND RESPONSIBILITIES

The Port, the Port's consultant, the selected contractor and their subcontractors, and Ecology will be involved as part of the project. The Port is the contracting party and is ultimately responsible for the performance of the work. The Port will also fill the role of the Certified Erosion and Sediment Control Lead (CESCL) for Best Management Practices (BMPs) and stormwater compliance inspections. The Port's consultant will ensure that implementation of the EDR is satisfactory, will provide remedial construction oversight, will provide all sampling required and discussed in this report, and will document the performance of the remedial construction. The contractor and their subcontractors will be responsible for all remedial construction site work including implementation of the temporary erosion and sediment control (TESC), shoring, excavation, off-site disposal, site security, and other responsibilities to implement the selected remedial action. Ecology will provide review and approval of reports as described herein.

1.3 DOCUMENT ORGANIZATION

The remainder of this EDR is organized as follows:

- **Section 2.0.** Presents a description of the Site and a brief summary from the CAP describing the COCs and CULs for the Site.
- **Section 3.0.** Presents the design for the remedial construction activities at the Site. This includes permitting, site preparation, excavation, soil handling and disposal or treatment, and application of biological amendments.
- **Section 4.0.** Presents the monitoring that will be conducted as part of the remedial construction, including confirmational sampling.
- **Section 5.0.** Presents the health and safety components that will be followed as part of the remedial construction.
- **Section 6.0.** Presents the site schedule.
- **Section 7.0.** Presents a discussion of the reporting that will be completed as part of the remedial construction.
- **Section 8.0.** Presents the references for this document.

2.0 Site Description and Summary of Environmental Conditions

2.1 SITE DESCRIPTION

The Site is located on level ground directly west of downtown Port Angeles. It is bounded by West Marine Drive to the south, Port Angeles Harbor to the north, the Valley Creek Estuary to the east, and the Marine Trades Area Site to the west. To the north of the Site are approximately 4.7 acres of aquatic land (tidelands and filled tidelands) owned by Washington State Department of Natural Resources and managed by the Port within the Port Management Agreement Parcel 2.

The Site is zoned as "Industrial Heavy" by the City of Port Angeles and is approximately 18.6 acres in size and entirely owned by the Port. The eastern portion of the Site is leased to a private company that uses the property for log debarking and storage. The western half is currently unutilized.

A unique feature of the Site is buried wood piles and a bulkhead that are present along the modern day shoreline. The piles are all that remain of what originally was an elevated railroad trestle that ran along tidelands. Additionally, a wooden two to three step bulkhead consisting of additional piles with horizontal wooden lagging is present north of the trestle. The bulkhead was constructed to allow the Site to be hydraulically filled to current grade. The outer face of the bulkhead was then armored with a riprap slope, which is still in place. For the remainder of this document, this feature of the Site will be referred to as the riprap slope.

The primary historical operation at the Site was plywood manufacture. Site-wide operations included log storage, log rafting (in the harbor), hog fuel burning, log debarking, log peeling, pressing and gluing, steam drying, site maintenance, and other miscellaneous operations. Environmental contamination was first documented in the late 1980s and partial cleanup actions were undertaken by ITT Rayonier, one of the former plywood mill owners. The presence of the mill building overlying nearly all of the known soil and groundwater contamination hindered investigation and cleanup efforts. The mill was demolished by the Port as part of an Interim Cleanup Action to allow for a more comprehensive RI/FS and to support future site cleanup. A more thorough description of site background, prior operations, general history, previous investigations, and physical setting is provided in the RI/FS.

2.2 SITE GEOLOGY AND HYDROGEOLOGY

The RI/FS and CAP provide a detailed description of the Site geology and hydrogeology. The following summary, which is relevant to remedial design, can be found in the RI/FS.

The primary geologic units at the Site generally consist of native beach deposits overlain by dredge fill. This dredged fill material consists of sand and silty sand in some areas with abundant shell fragments and occasional lenses of silt. The thickness of the dredged fill beneath the Site is generally in the range of 12 to 16 feet.

A shallow, unconfined aquifer is present beneath the Site that first occurs in the dredged fill and beach deposits. Groundwater is generally encountered at approximately 10 feet below ground surface (bgs) in the footprint of the former K Ply mill building and slightly lower in the area of the log pond and debarker operations. Groundwater elevation is highly variable along the shoreline due to tidal effects. Mixing of groundwater with marine waters occurs within the riprap slope that extends from ground surface to an elevation of -5 feet mean lower low water.

Tidal influence is strongest on groundwater level elevations near the shoreline and decreases in effect inland. The tidal influence, if large enough, can temporarily reverse the flow of groundwater to the harbor but these effects are limited and do not impact the overall net horizontal gradient, which drives groundwater flow to the north into the Harbor.

2.3 CONTAMINANTS OF CONCERN

The primary COCs detected at the Site are gasoline and hydraulic oil, found in both soil and groundwater. Contaminant detections are generally limited to the footprint of the former K Ply mill building with some benzene/GRO migration in groundwater west of the former mill footprint into S. Cedar Street that continues to the shoreline. There are also some localized and shallow areas of dioxin/furan and PCP soil contamination within the Site. Figures 2.1 through 2.5 present the current COC conditions at the Site.

2.4 CLEANUP LEVELS

The CULs, RLs, and points of compliance (POC) relevant to the remedial action are for soil and groundwater. These CULs, presented in Table 2.1, are copied from the CAP. Refer to the CAP for a more thorough description of these CULs.

2.4.1 Soil Cleanup Levels

The CULs for soil are presented in Table 2.1 for benzene, toluene, ethylbenzene, and xylenes (BTEX), GRO, ORO, DRO, PCP, and dioxins/furans. In addition to CULs, a RL is presented that will be used only for excavation of smear zone soil in the Concrete Pad Excavation Area.

Table 2.1
Soil Cleanup Levels

Contaminant of Concern	Cleanup Level[1] (mg/kg)	Concrete Pad Excavation Area Smear Zone Remediation Level[2] (mg/kg)
DRO	2,000	-
GRO	30	3,000
ORO	2,000	-
Benzene	0.3	10
Toluene	7	-
Ethylbenzene	6	-
Xylenes	9	-
PCP	330	-
Dioxins/Furans	0.00059	-

Notes:
- \- A RL is not defined for the indicated COC.
- 1 The CULs are applicable to the entire site.
- 2 RLs will be used in the Concrete Pad Excavation Area (Excavation Area 5) only and will only be applicable to soils at or below the water table.

Abbreviation:
mg/kg Milligrams per kilogram

2.4.2 Point of Compliance for Soil

The POC for soil to protect groundwater is soil throughout the Site.

2.4.3 Groundwater Cleanup Levels

Contaminated groundwater at the Site is considered non-potable due to its proximity to marine waters. CULs are based on protection of surface water. Final groundwater CULs are presented in Table 2.2.

Table 2.2
Groundwater Cleanup Levels

Contaminant of Concern	Cleanup Level (µg/L)
ORO	500
DRO	500
GRO	800
Benzene	51

Abbreviation:
µg/L Micrograms per liter

2.4.4 Groundwater Point of Compliance

A conditional point of compliance (CPOC) is being applied to the Site for groundwater at the downgradient property boundary given that sources of hazardous substances extend all the way to the bulkhead. Specifically, the groundwater CPOC is set to be immediately landward of the top of the riprap slope, as this is the closest practical monitoring location where groundwater discharges to surface water.

3.0 Remedial Action Construction Activities

3.1 PERMITTING

This remedial action is being conducted under an AO with Ecology under MTCA and, therefore, is exempt from certain procedural and permitting requirements of select Washington laws and regulations and all local permits (WAC 173-340-710(9)(b)). However, implementation of the cleanup action must comply with the substantive requirements of any otherwise applicable permits. This remedial action will meet the substantive requirements for applicable regulations and standards, and will comply with all action-, chemical-, and location-specific ARARs as identified in the CAP.

The Port has prepared a State Environmental Policy Act (SEPA) checklist as part of the CAP and has undergone the public review process. Ecology is the lead agency for the SEPA review and has provided a determination on the checklist.

The remedial construction requires a National Pollutant Discharge Elimination System (NPDES) Stormwater Construction Permit, administered by Ecology to control discharge of pollutants from construction activities. The Port has maintained the NPDES Stormwater Construction Permit that was obtained for the mill demolition. Remediation activities will be conducted under this existing permit. An updated Stormwater Pollution Prevention Plan (SWPPP) has been prepared that identifies how stormwater will be managed during construction and is included in Appendix A.

If ex-situ thermal treatment is determined to be cost-effective and ultimately used, an air permit will be obtained from the local air permitting authority (Olympic Region Clean Air Agency [ORCAA]). Permit approval by ORCAA of Notice of Construction (NOC) application is required prior to constructing, installing, or establishing any new source of air pollution that will emit criteria air pollutants. MTCA sites are subject to substantive requirements for Toxic Air Pollutants (TAPs), and ORCAA is responsible for verifying compliance with the substantive requirements for TAPs. ORCAA will provide a detailed list of the air-related information that will need to be submitted in the NOC application to ORCAA should ex-situ soil treatment be utilized.

Local permitting requirements for remedial construction fall within the City of Port Angeles jurisdiction. The applicable requirements for the work were discussed by the Port and the City of Port Angeles, and it was determined that the planned work is exempt from land use permit requirements. However, the cleanup action will comply with the applicable substantive requirements under the City of Port Angeles' Shoreline Management Act Program and Chapter 15.28 Clearing, Grading, Filling and Drainage Regulations of the municipal code.

3.2 SITE PREPARATION AND UTILITY REMOVAL

The first construction activity that will be conducted at the Site is site preparation. These activities will be conducted to stabilize the surface conditions, install temporary erosion and sediment control BMPs, and address the surface contamination. It will be necessary for these activities to occur prior to the start of the excavation activities in order to maximize the contractor's usable space on-site (for stockpiling, etc.) and to ensure that surface and subsurface contamination is handled in an appropriate manner.

3.2.1 Site Preparation

Prior to the start of the excavation activities, the following activities will be conducted (in no particular order):

- **Site Security:** A perimeter fence currently exists at the Site and prevents access to the Site by unauthorized persons. This fence will be maintained for the duration of the work. There are three existing access gates to the Site, as shown in Figure 3.1 that will be used by the contractor. A fourth existing access gate will be maintained to allow access for the log debarker tenant. The alley will remain open for use by the log debarker.
- **Monitoring and Extraction Well Decommissioning and Removal:** Several wells will be decommissioned or removed as part of the project because they are located within or immediately adjacent to excavation areas. There are also other, newer monitoring wells that are located outside of the excavation areas but will interfere with construction traffic and so are likely to be damaged. These wells require decommissioning by a licensed driller. Figure 3.1 shows the location of wells that will be removed.
- **Stormwater Control:** The current site topography slopes away from the riprap slope such that stormwater does not sheet flow into the harbor. The majority of stormwater at the Site infiltrates. Additionally, some stormwater is channelized to a stormwater conveyance ditch located in the northcentral area of the Site. The stormwater conveyance ditch allows for settling and biofiltration of stormwater prior to discharge to the harbor. This discharge point is regulated under the Port's current NPDES Stormwater Construction General Permit. This ditch and outfall point will be maintained as part of the project.

  During construction, the Site will be graded to ensure that site stormwater infiltrates or flows to the stormwater conveyance ditch.
- **Demolition and Crushing of Concrete Structures:** A number of concrete structures that were foundations and slab flooring to the historical mill operations still exist. All of the concrete structures within the work area will be demolished. These include the loading dock concrete pad, the dryer concrete pad, the Bamford/8-foot lathe building, and other miscellaneous concrete structures as shown on Figure 3.2. There are also a number of piles of concrete rubble that were left following demolition. Approximately 3,500 cubic yards (CY) of concrete exists at the Site. This concrete will be demolished, crushed to fragments 6 inches or less in size (6-inch minus), and stockpiled on-site prior to the start of remedial construction.

  The concrete has been tested for Resource Conservation and Recovery Act 8 metals (refer to Section 3.3.6) and the metals results indicate that the concentrations are less than standard MTCA Method A CULs and the concrete is suitable for backfill. Concrete that does not have significant visible staining will be crushed and reused on-site as backfill, where geotechnically suitable. Concrete that is stained (e.g., with petroleum) will be pressure washed or steam cleaned prior to being used as backfill. Wash water will be collected via vacuum and appropriately disposed of.

- **Site Clearing and Grubbing:** A limited amount of site clearing and grubbing will be conducted to remove the potentially unsuitable surface material and debris in accordance with the Geotechnical Report recommendations (Appendix B). All debris and unsuitable clear and grub materials will be transported off-site for ultimate disposal at a licensed Subtitle D solid waste landfill.
- **Staging and Stockpile Areas:** Current asphalt surfaces will be maintained for the majority of the project, and will be used for staging and stockpiling purposes (refer to Figure 3.1). Additional detail on stockpile BMPs and requirements are discussed in Sections 3.3, 3.4, and 3.5.

3.2.2 Utility Protection, Abandonment, or Removal

Two active storm sewer lines and overhead power lines will be protected during cleanup activities (refer to Figure 3.1). The storm sewer lines that will require protection include a lateral line that runs in the alley immediately south of the concrete pad and the lateral lines that are directed toward the Site from the trunk line in S. Cedar Street. These pipes will not be encountered during the excavation, but the catch basins will be identified by the contractor and protected with catch basin inserts or other equivalent BMPs to ensure soil does not enter the storm system.

The overhead power lines at the Site are live and serve the log debarker. These power lines will be flagged by the contractor to ensure they are not hit.

Figure 3.1 shows the location of the remaining historical utilities at the Site. All underground utilities within the Site are no longer active, with the exception of the active utilities discussed above.

Former Pipeline 8 runs from the Peninsula Fuels property under the alley, concrete pad, and western portion of the Site to Terminal 1. The entire length of Pipeline 8 that is lying within the Site boundary will be removed as part of the project. Gasoline-contaminated water was found in these pipes during RI/FS field work. The water will be recovered and disposed of prior to the pipes being removed.

3.2.3 Erosion and Sediment Controls

Erosion and sediment control BMPs will be installed and maintained for the duration of the project. These will be installed to prevent off-site migration of contamination via dust, trackout, or stormwater and for general environmental control. These BMPs are discussed in greater detail in the SWPPP (Appendix A). The following BMPs, or equivalent, will be used:

- Apply water to dry soils as necessary to suppress airborne dust.
- Finalize the SWPPP (attached as Appendix A) to be specific to the contractor personnel and construction methods planned. The SWPPP identifies the BMPs for preventing contaminated soils at the Site from entering the stormwater drainage systems.

- Use erosion control devices to prevent contaminated soils from migrating off-site (e.g., soil piles will be covered with plastic and sandbagged).
- Maintain excavation equipment in good working order. The contractor must immediately clean up any contaminated soil resulting from any spilled hydraulic oils or other hazardous materials.
- Minimize equipment traffic through the excavation area to prevent contaminated soils from being transported via track-off to other parts of the Site, or off-site.
- Establish specific truck haul routes before beginning off-site transport of contaminated soil and use on-site truck routes that minimize or prevent traffic over contaminated areas.
- Locate loading areas for contaminated soil in, or at the edge of, the stockpile location(s).
- Ensure that soil transported off-site does not contain free liquids.
- Load trucks in a manner that prevents the spilling, tracking, or dispersal of contaminated soils, and cover loads prior to exiting the Site during times of heavy rain, or if the soil being transported has considerable odor, or is excessively dry and will generate dust on public highways.
- Remove soil from the wheels of vehicles before they exit the Site (i.e., wheel wash).

In addition to these BMPs, a Spill Protection, Containment, and Countermeasures Plan was prepared to detail how to prevent spills of petroleum products or hazardous materials from occurring or provide efficient and timely cleanup response if a spill occurs during the remedial action construction activities. A draft copy of the Spill Protection, Containment, and Countermeasures Plan is included as Appendix C. The final copy will be produced following contractor selection and input.

3.3 CONTAMINATED SOIL EXCAVATION

3.3.1 General

Excavation of contaminated soil and clean overburden soil will occur within Excavation Areas 1 through 6 (refer to Figure 3.2 and 3.3). Excavation will occur in both the vadose zone and smear zone. The total excavation volume is expected to be approximately 50,000 CY, of which 15,700 CY is estimated to be contaminated at levels greater than CULs or RLs. The remainder of soil that will be excavated is overburden lying on top of contaminated soil.

3.3.2 Removal of Dioxin-Contaminated Surface Soil

The top 6 inches of dioxin-containing surface soil in the currently unpaved Stack Area will be scraped off and consolidated using standard construction techniques. This area is also referred to as Excavation Area 1.

This soil will be used as backfill at depths below 5 feet bgs and above the water table. Approximately 1,200 CY of soil will be removed, stockpiled, and reused. This soil will be excavated prior to the other excavation areas and the soil will be stockpiled on-site until it is needed for backfill. The stockpile will be covered with plastic and bermed.

3.3.3 Removal of Miscellaneous Surface Debris

In select areas of the Site and within the footprint of the former mill building, there is miscellaneous surface material/contamination that will be removed prior to the start of mass excavation. This surface debris includes miscellaneous trash and building materials, hardened resin, and a hardened black material. The hardened resin is primarily located in the area where the former plywood presses where located. The hardened black material is primarily located in a small area just north of the loading dock concrete pad. Analytical testing has been conducted on both the hardened black material and the resin and they are suitable for disposal at a licensed Subtitle D solid waste landfill.

This surface contamination will be removed by scraping the ground surface to remove the material. This surface material/contamination and any soil that is removed as a result will be disposed of at a licensed Subtitle D solid waste landfill.

3.3.4 Hog Fuel Storage Area (Excavation Areas 2 and 3)

The Hog Fuel Storage Area comprises Excavation Area 2 and Excavation Area 3 (refer to Figure 3.3). Overburden from 0 to 8 feet bgs will be excavated from Excavation Area 2 (the western area) followed by excavation of contaminated soil at a depth between 8 and 12 feet bgs. Sampling during the RI did not indicate contamination in overburden soils in Area 2. If this is confirmed during excavation via field screening, then this soil will be classified as “presumed clean.” If field indications suggest contamination in overburden soils, then this soil will be classified as “contaminated.” Digging will continue until there are no field indications of contamination in either smear or overburden soils. The contamination in Excavation Area 3 (the eastern area) is located in soils directly below the ground surface. This contaminated soil will be excavated from 0 to 4 feet bgs. Presumed clean overburden soil will be stockpiled, tested, and used as backfill, if suitable. Contaminated soil will be disposed of off-site at a licensed Subtitle D solid waste landfill or treated on-site and used as backfill. Approximately 200 CY of contaminated soil will be excavated from these areas using standard construction equipment.

3.3.5 PCP Area (Excavation Area 4)

The PCP Area comprises Excavation Area 4. The PCP-contaminated soil in this area is currently in compliance with industrial CULs, but will be incidentally excavated because it is at the surface (0 to 4 feet bgs) and overlies gasoline-contaminated soil that will be excavated. The PCP-contaminated soil that is excavated will be disposed of off-site at a licensed Subtitle D solid waste landfill. Approximately 50 CY of contaminated soil will be excavated in this area.

3.3.6 Concrete Pad and Bulkhead Excavation Areas (Excavation Areas 5 and 6)

3.3.6.1 Presumed Clean Overburden Soil

A substantial amount of presumed clean overburden soil lies on top of contaminated soil in Excavation Areas 5 and 6. This presumed clean overburden soil will be removed to allow access to the underlying contaminated smear zone soil. During excavation, presumed clean overburden soil will be field-screened using olfactory, visual (staining or sheen), and photoionization detector (PID) methods so as to prevent comingling with underlying contaminated soil. In some places, shallow soil from 4 to 6 feet bgs exhibits grey staining, but is free of odor, PID response, and hydrocarbon contamination. Soil with these characteristics will be considered presumed clean overburden soil and like all other presumed clean soil, will be subject to verification testing before backfilling. Presumed clean overburden soil will be segregated from suspected contaminated soil (i.e., soil with odor, sheen, or PID response) and stockpiled separately on-site. Stockpiled overburden soil will be sampled and analyzed for the site COCs to confirm that concentrations are less than applicable CULs prior to using the soil as backfill. Details of stockpile sampling are in Section 3.4.

The structural fill soil located underneath the former loading dock concrete pad is also considered overburden and is expected to be suitable for re-use as backfill following stockpiling and testing.

3.3.6.2 Soil Removal in Concrete Pad Excavation Area (Excavation Area 5)

Excavation Area 5 is the southern portion of the primary excavation and is contaminated with GRO in vadose zone and smear zone soil. There is a concrete pad covering much of this area that will be demolished prior to excavation.

Soil in the vadose zone (soil generally above 8 feet bgs) in Excavation Area 5 will be excavated until site CULs for soil are achieved. Smear zone soil (soil generally between 8 and 12 feet bgs) will be excavated until site RLs for soil are achieved, which is expected to be by a depth of approximately 12 feet bgs. The excavation depth of 12 feet bgs is based on the depth of contamination from RI/FS findings and generally corresponds with a depth of 2 feet below the water table. The depth of contamination was verified by gridding this area into cells as part of the supplemental remedial design soil sampling described in Appendix D. As part of this sampling, soil samples were collected in every grid every foot beginning at the first foot above the planned excavation depth and continuing below the planned excavation depth of 12 feet bgs for 3 additional feet, equivalent to 5 feet below the water table. Figure 3.4 shows the location of all soil samples collected. In general, these results confirmed the RI/FS findings of the vertical depth of contamination to be no greater than 12 feet bgs except for two grids, D11 and D15. In these two grids, xylene and/or ethylbenzene contamination extends an additional foot deeper at concentrations greater than CULs. No additional excavation or treatment is proposed in these grids because: (1) these exceedances are located well upgradient of the bulkhead; (2) these exceedances are relatively minor in concentration; and (3) removal will not measurably improve groundwater quality. Pre-excavation soil sampling results are summarized in the Remedial Design Data Collection Report (refer to Appendix D).

The objective of using a RL for smear zone soils in Excavation Area 5 is to remove the soil with the greatest GRO and benzene concentrations that are a primary source of groundwater contamination. Following excavation, some contamination will remain in the smear zone at concentrations greater than CULs but less than RLs. The extent of this contamination will be characterized following excavation and addressed through monitored natural attenuation and bioremediation until soil CULs are achieved.

In general, to prevent soil sloughing, the sidewalls in Excavation Area 5 will be sloped at an approximate slope of 1.5H to 1V in dry soil and at 3H to 1V slope in saturated soil. The excavation area shown on Figure 3.3 represents the minimum base of the excavation area. This area may expand depending on the results of confirmational sampling.

The volume of contaminated soil that will be excavated from Excavation Area 5 is estimated to be approximately 4,800 CY in the smear zone and 3,100 CY in the vadose zone. The contaminated soil that is excavated will be disposed of off-site at a licensed Subtitle D solid waste landfill.

A historical sewer line runs through the center of the Site (refer to Figure 3.1) and may intersect Excavation Area 5. Where this line is encountered during the excavation, the section that is encountered will be removed and the open ends that are left in place will be plugged with grout.

3.3.6.3 Soil Removal in Bulkhead Excavation Area (Excavation Area 6)

The Bulkhead Excavation Area, or Excavation Area 6, is the northern portion of the primary excavation and is contaminated with hydraulic oil and GRO in vadose zone and smear zone soil. Excavation will continue until the CULs are achieved for the site COCs in the vadose zone (soil generally above 8 feet bgs). As in the Concrete Pad Excavation Area, smear zone soil (soil generally between 8 and 12 feet bgs) will be excavated until CULs are achieved, which is expected to occur at an excavation depth of 12 feet bgs, which is approximately 2 feet below the water table. The depth of contamination was verified as part of the supplemental remedial design soil sampling. As part of this sampling, soil samples were collected every foot below the water table to a depth 4 to 5 feet below the water table across a gridded pattern to determine the vertical extent of contamination. Figure 3.4 shows the location of these grids. The results are summarized in the Remedial Design Data Collection Report (refer to Appendix D). Results generally confirmed the depth of contamination identified in the RI/FS. Vertically, contamination generally extends as deep as 1 to 2 feet below the water table, except for five grids in primarily the Hydraulic Oil Area. For these five grids (D5, C6, E6, F6, and D7), contaminants, primarily ORO, extend as deep as 2 feet below the planned excavation depth at elevated concentrations. Removal of an extra 1 to 2 feet of soil below the planned excavation depth of 12 feet bgs (equivalent to removal of up to 4 feet of soil below the water table) will be necessary in these grids to achieve soil CULs. In order to successfully remove ORO-contaminated soil this far below the water table, dewatering may be necessary for some or all of the additional over-excavation. The need for dewatering and the means and methods of dewatering will be left up to the contractor. Disposal of water following treatment will be to the sanitary sewer under permit (refer to Appendix E and Section 3.3.6.5).

Removal of contaminated soil in the Bulkhead Excavation Area and replacement with clean backfill will create a zone of clean soil for contaminated groundwater to flow through prior to discharge to the harbor. It is expected that this clean zone, with subsequent bioremediation amendments, will create optimum conditions for bioremediation to treat any residually contaminated groundwater that enters from the residually contaminated smear zone soil left in place upgradient (refer to Appendix F).

Excavation in the Bulkhead Excavation Area will also remove hydraulic oil-contaminated soil that contains LNAPL. There is an estimated 10,000 gallons of LNAPL contained in the soil that will be excavated from the Bulkhead Excavation Area. If the LNAPL drains into the excavation bottom that contains ponded groundwater, the LNAPL will be removed with either adsorbent pads or boom or alternatively a vacuum truck concurrent with excavation. In no case will the excavation be backfilled prior to removal of sheen to the degree practicable.

With the exception of the north wall, the sidewalls in the Bulkhead Excavation Area will be sloped at an approximate slope of 1.5H to 1V in dry soil and at 3H to 1V in saturated soil. Because of the location of the harbor, to maintain the integrity of the riprap slope, and to maximize the removal of contaminated soil, the north wall will need to be shored to allow for a straight wall excavation(refer to Appendix B, Geotechnical Report). The shored area is shown on Figure 3.3.

It is estimated that approximately 5,400 CY of contaminated soil from the smear zone and LNAPL area and 2,100 CY of contaminated soil (including 300 CY of GRO-only contaminated soil) from the vadose zone will be excavated from the Bulkhead Excavation Area. The contaminated soil that is excavated will either be disposed of off-site at a licensed Subtitle D solid waste landfill or treated on-site and used as backfill (as described in Appendix E).

3.3.6.4 Soil Excavation and Handling

Excavation in all of the excavation areas will be conducted using standard construction equipment. Contaminated soil that is stockpiled on-site prior to loading for off-site transport or treatment will be placed on pavement, graded, if necessary, to prevent sloughing, and covered with plastic sheeting when not being worked. Odor-suppression foam will be used as needed during excavation activities to suppress strong gasoline odors that are noticeable beyond the Site perimeter.

3.3.6.5 Excavation of Smear Zone Soil below the Water Table

A portion of the contaminated soil in the smear zone lies below the groundwater surface. Attempts will be made to excavate these smear zone soils at low tide when excavation is conducted close to the shoreline. Overall, however, it is anticipated that it will be possible to dig no more than 2 feet into the saturated zone without sloughing and loss of control. Dewatering is not anticipated to be necessary to remove contaminated soil down to this planned 2-foot depth but may be used as a contingency measure in the five grids in the Bulkhead Excavation Area, as described in Section 3.3.6.3. If dewatering is used, the water, along with other wastewater generated from site activities, including some collected stormwater, would be run through a water treatment system prior to discharge to the sanitary sewer under a minor industrial use discharge authorization from the City of Port Angeles to remove turbidity, oil sheen, BTEX, and TPH, and other parameters in accordance with the discharge permit and associated engineering report (refer to Appendix E).

To minimize stability problems below the water table, excavation side slopes will be 3H:1V or flatter and excavation areas will be backfilled iteratively as they are excavated so that areas below the water table are filled by the end of each day's work shift.

When excavation occurs in the smear zone, water-saturated soil will be encountered. To the extent practicable, this saturated soil will be stockpiled or "benched" within the excavation area to allow for water to drain freely. Water is expected to drain relatively rapidly given the sandy nature of the smear zone soil. All soil loaded onto trucks for off-site transport, whether from stockpiles or direct loading from the bench, must meet paint filter test requirements (USEPA Method SW 846-9095)

Once excavated, the excavation hole will fill with groundwater until backfilled. Crushed concrete or quarry spalls will likely need to be placed on the excavation bottom (along with bioamendments; refer to Section 3.6) following excavation of smear zone soil to create a stable and dry working surface for machinery to complete excavation and backfill activities in the remaining smear zone excavation areas.

3.4 STOCKPILE MANAGEMENT

Stockpiles will likely be necessary for some fraction of excavated materials and will be segregated based on the end disposal or treatment of that soil. Stockpiles are anticipated to include crushed concrete, woody debris, other debris, presumed clean overburden soil, dioxin-contaminated soil, PCP-contaminated soil, and petroleum-contaminated soil. These stockpiles will be maintained as separate stockpiles, as appropriate, to ensure material is disposed in the correct location. Presumed clean soil stockpiles will be tested (one sample for every 500 CY) and will be used for backfill after receipt of analytical results has confirmed that they meet site CULs; soil field screening and stockpile sampling protocols are presented in the Sampling and Analysis Plan (SAP; Appendix G). Once a stockpile of 500 CY is created, it will not be allowed to be mixed with other soil until analytical results are available to confirm its designation. Stockpile soil sample results will be available 48 to 72 hours after sample collection. Stockpiles containing contaminated material (dioxin-, PCP-, and petroleum-contaminated soil and other solid waste) will be bermed for management of free liquids, if encountered. They will also be covered with plastic sheeting when they are not being worked. Water that drains from the stockpiles containing contaminated material will be collected, treated, and properly disposed of to the sanitary sewer. Section 3.5 describes the disposal or backfill designation for these materials.

3.5 DISPOSAL AND TREATMENT OF WASTES

Table 3.1 identifies the wastes and stockpiles that are expected to be generated at the Site, and the preferred option for disposing or handling the waste and any special testing requirements.

Table 3.1
Wastes and Stockpiles

Waste/Stockpile	Disposal, Treatment, or Backfill Option	Stockpile Management Requirements
Crushed Concrete	Clean concrete will be used on-site as backfill. Stained concrete will be pressure washed or steam cleaned and used as backfill.	Not applicable.
Untreated or Unpainted Lumber, Logs, or Bark Free of Soil, Nails, and Decay	Disposed of off-site at a recycling facility or licensed Subtitle D solid waste landfill.	Not applicable.
Wood Piling/Decayed Wood	Disposed of off-site at a licensed Subtitle D solid waste landfill.	Not applicable.
Scrap Steel	Recycled off-site at a scrap metal recycler or disposed of at a licensed Subtitle D solid waste landfill. Pipeline 8 sections to be drained of water and rinsed before disposing.	Not applicable.
Clean Overburden Soil	Used on-site as backfill after receipt of stockpile sampling results.	Not applicable.
Solid Waste and Surface Debris	Disposed of off-site at a licensed Subtitle D solid waste landfill.	Not applicable.
PCP-Contaminated Soil	Disposed of off-site at a licensed Subtitle D solid waste landfill.	Cover until disposed of.
Dioxin-Contaminated Soil	Used on-site as backfill at depths deeper than 5 feet and above the water table or disposed of off-site at a licensed Subtitle D solid waste landfill.	Cover until backfilled.
Petroleum-Contaminated Soil	Treated on-site or disposed of off-site at a licensed Subtitle D solid waste landfill.	Cover until disposed of or treated. Collect water seepage from stockpiles and treat prior to disposal to sanitary sewer.
LNAPL Containing Soil	This includes LNAPL that is entrained in soil that is excavated. Treated on-site or disposed of off-site at a licensed Subtitle D solid waste landfill.	Cover until disposed of or treated. Collect water seepage from stockpiles and treat prior to disposal to sanitary sewer.
LNAPL as Free Liquid	This includes liquid waste that seeps out of stockpiled soil and LNAPL that is vacuumed from ponded water. Hauled off-site as liquid for treatment and disposal at a licensed facility.	Collect in temporary tanks. Off-site transport and treatment.

3.5.1 Off-Site Disposal

Contaminated soil and other material that is hauled off-site will be disposed of at a facility that is permitted to accept the waste. The final disposal facilities for contaminated soil and other wastes will be determined by the contractor; however, chemical testing of these materials has confirmed that the characteristics of the materials meet the necessary criteria to be disposed of at a licensed Subtitle D solid waste landfill as non-hazardous waste.

Trucks transporting contaminated soil from the Site will comply with all applicable regulations and local ordinances.

3.6 BACKFILL AND FINAL GRADING

The excavation areas will be backfilled with a variety of fill types, including clean overburden soil, thermally treated soil, clean imported backfill, crushed concrete and/or quarry spalls, and the dioxin-contaminated soil. Backfilling generally applies to the Hog Fuel Area (Excavation Area 2), the Concrete Pad Excavation Area (Excavation Area 5), and the Bulkhead Excavation Area (Excavation Area 6).

It is anticipated that the finished final surface will be a compacted gravel that allows for travel and movement of heavy equipment as well as infiltration of stormwater. Therefore, the areas of the Site that are backfilled and compacted will be geotechnically capable of addressing the expected loads from interim boat transport and storage activities, or similar (refer to the Geotechnical Report in Appendix B). Future site use is uncertain at this time, but is anticipated to consist of a heavy pavement section, high bay metal frame buildings, and/or boat transport activities similar to current marine uses west of the Site.

The first material that will be used to backfill the Concrete Pad and Bulkhead Excavation Areas (Excavation Areas 5 and 6), where the base of excavation is at or below the water table, will be crushed concrete and/or imported quarry spalls. This material is anticipated to have a maximum particle size of about 6 inches and contains a variety of smaller particle sizes as well. As described below, a bioremediation amendment will be added to the crushed concrete and/or imported quarry spalls that are placed as backfill up to the water table. Use of crushed concrete and quarry spalls with some admixed clean soil in these areas will provide a stable working surface for the contractor and a base on top of which additional backfill can be compacted. The variety of particle sizes in the crushed concrete will be compacted by heavy equipment that will be working on the surface. This will create a well-compacted backfill section, with voids being filled by the finer particles as mechanical compaction occurs and later, with even finer particles as stormwater infiltration occurs. In this manner, the backfilled section will not create a preferential pathway for groundwater contamination to flow, especially considering that the sandy fill soils at the water table that it replaces are of relatively high permeability.

Following placement of the crushed concrete and/or quarry spalls, clean overburden soil and/or the clean thermally treated soil will be used as backfill. The dioxin-contaminated soil will be used as backfill at a depth below 5 feet but not below 8 feet (i.e., above the water table). The backfilled soil will be compacted to the specification outlined in the Geotechnical Report included as Appendix B.

If excavated contaminated soil is not treated on-site and is instead hauled off-site for disposal at a landfill, clean fill will be imported and used as backfill.

The final surface of the backfilled areas will be filled to an elevation that allows for the future placement of a pavement section, which will be completed during future site redevelopment.

3.7 GROUNDWATER TREATMENT

In addition to contaminant source removal via excavation, groundwater at the Site will be treated using bioremediation amendments. Bioremediation amendments will be applied to groundwater using up to three different methods: (1) direct placement in the excavation areas concurrent with backfilling; (2) Geoprobe injections of a bioremediation amendment under S. Cedar Street; and (3) future injections of a bioremediation amendment via infiltration galleries.

3.7.1 Biological Amendment Application

A bioremediation amendment will be used in the Concrete Pad and Bulkhead Excavation Areas to stimulate the aerobic biodegradation of residual petroleum contamination in groundwater following excavation activities. The bioremediation amendment will supply supplemental oxygen and nutrients to naturally occurring hydrocarbon-degrading bacteria. This action will ensure CULs in groundwater are met within a reasonable timeframe at the CPOC.

The bioremediation amendment that has been selected is the calcium oxy-hydroxide-based oxygen-releasing compound Advanced Pellets (ORC-A) manufactured by REGENESIS.[2] The available oxygen produced will accelerate aerobic biodegradation processes up to 100 times faster than their naturally occurring rates. In addition to oxygen, the pellets contain nutrients (nitrogen, phosphorous, and potassium), which are beneficial to the growth of aerobic bacteria. Calculations that support the ability of ORC-A to treat hydrocarbon-contaminated groundwater within the excavation areas are presented in Appendix F, along with more details from the manufacturer on the product itself. ORC-A will be applied in material used as backfill below the water table, and only within the footprint of the excavation areas. After the soil has been excavated to meet either CULs or RLs, and prior to backfilling, ORC-A will be broadcast to the backfill as it is being placed per the manufacturer’s instructions (refer to Appendix F). Following application and upon contact with groundwater, the ORC-A will produce a controlled-release of molecular oxygen (up to 17 percent by weight) for up to 1 year.

In this fashion, approximately 16,750 pounds of ORC-A will be applied evenly over a thickness of 2 feet (bridging the water table) of the clean backfill throughout the 74,000-square-foot area of excavation. This is equivalent to a rate of approximately 3 pounds per CY of clean backfill.

[2] The selected contractor may choose to apply a competing product other than ORC-A if equivalent in oxygen-releasing capacity and other factors.

Floyd|Snider has coordinated with REGENESIS who has provided supplemental design information contained in Appendix F. The contractor will be responsible for the purchase, shipping, and application of the ORC-A.

3.7.2 Installation of Bioremediation Amendment Gallery

Infiltration galleries will be installed in the Concrete Pad and Bulkhead Excavation Areas prior to backfilling. These infiltration galleries will allow for future application of an oxygen-supplying amendment (such as a dilute hydrogen peroxide solution) if groundwater monitoring indicates that the groundwater CULs are not being attained at the CPOC.

Five parallel infiltration galleries will be placed at a depth of approximately 1 foot above the water table. The infiltration galleries will be installed at locations approximately 100 to 200 feet apart in the excavation area (refer to Figure 3.5) in order to provide a distribution network for additional electron acceptors and nutrients throughout the contaminated groundwater area. The infiltration galleries will be constructed of 6-inch-diameter polyvinyl chloride (PVC) and will be perforated to allow for the infiltration to the water table of an aqueous solution of bioamendments. The pipe will be wrapped in a filter fabric to prevent soil clogging and will be embedded in pea gravel. The pipes will be gently sloped (0.5 percent) at each end to a low central point to ensure that the bioremediation amendment that is injected reaches the entire length of the gallery. There will be PVC risers on either side of the infiltration gallery that will be used to inject the bioremediation amendment. These will be temporarily capped until site redevelopment. In the future, when the grade at the Site is finished, utility structures will be placed around the infiltration gallery risers to protect the risers. Figure 3.5 shows a plan of the infiltration gallery.

3.7.3 S. Cedar Street Benzene Plume Bioremediation Injections

As shown in Figure 2.5, there is a plume of GRO and benzene in groundwater beneath S. Cedar Street and extending toward Terminal 1. This plume will be treated with bioremediation through a series of Geoprobe injections. This will occur throughout a plume area of approximately 1 acre (roughly corresponding to benzene concentrations greater than 500 µg/L, as shown on Figure 3.6).

The first set of injections will be concurrent with excavation activities. A Geoprobe rig will drive a temporary injection point to a depth of 15 feet, after which the rod will be retracted to expose the injection point to the aquifer. The hollow interior of the push rod that is connected to the injection point will be used to directly inject a slurry mixture of ORC-A into aquifer via the injection points. The slurry mixture will be formed by mixing the ORC-A powder with water according the manufacturer's (REGENESIS) instructions (refer to Appendix F). An estimated 2,250 pounds of ORC-A (one 25-pound bag per borehole) will be injected into the upper 5 feet of the aquifer (where the plume lies) across seven rows lying 50 feet apart and oriented transverse to the plume axis. The spacing between injection points along each row will be 10 feet; therefore, a total of 90 injection points will be laid out in a 10-foot by 50-foot array. The layout for injection points is shown of Figure 3.6. Due to utilities under S. Cedar Street, not all 90 injection points will be able to be completed on the idealized 10-foot by 50-foot array and may need to be offset by several feet to avoid hitting utilities.

3.7.4 Future Bioremediation to Treat Groundwater

Following the completion of the excavation and backfilling and the initial injection of bioremediation amendments under S. Cedar Street, an assessment of groundwater conditions site-wide will be performed to monitor treatment effectiveness and determine if additional in situ biotreatment of groundwater is necessary.

Given that the ORC-A has an expected life time of up to 1 year, the need for additional treatment will be decided after 1 year of post-injection monitoring. Field redox parameters (pH, temperature, dissolved oxygen, oxidation-reduction potential, turbidity) for groundwater will be collected during monitoring and the samples will be analyzed for GRO, DRO, ORO, BTEX, and total and dissolved iron and manganese to assess redox conditions. Refer to Appendix G for additional details of the post-excavation groundwater monitoring plan.

If results indicate the need for post-excavation groundwater treatment, it would be adaptive based on lessons learned from the excavation and initial response of the system to the ORC-A applications in both S. Cedar Street and in the excavation areas. The treatment could include application of biological amendments via the infiltration gallery delivery system or, if very isolated, via additional in situ injections using a Geoprobe.

Table 3.2 describes a conceptual level approach to these follow-on injections based on various magnitudes of contaminant concentration and dissolved oxygen content in the groundwater. Design for future injections of bioremediation amendments would be documented in an engineering design report addendum after consultation with Ecology.

Table 3.2
Conceptual Application of Follow-On Bioremediation Injections

	Groundwater monitoring indicates low dissolved oxygen levels and reducing conditions.	*Groundwater monitoring indicates high dissolved oxygen levels and oxidizing conditions.*
Groundwater monitoring indicates low contamination levels.	Low to moderate bioremediation application.	No further bioremediation unless conditions change.
Groundwater monitoring indicates high contamination levels.	Aggressive bioremediation application, may include switching to alternative electron acceptors (e.g., nitrate, sulfate).	Further monitoring and possible additional source treatment and/or bioaugmentation (addition of cultured petroleum degrading bacteria).

3.8 LOG POND SOIL CHARACTERIZATION

Additional sampling and characterization in the Log Pond Fill Area is needed to better delineate the boundary of the contamination found in one RI sample location. However, because this area is currently occupied by a log debarker tenant, a thorough investigation was not possible during the RI and will not be possible until the log debarker lease is terminated. Within 3 months of the termination of the current log debarking tenant, a Log Pond Fill Area investigation work plan will be developed and submitted to Ecology for review. This is anticipated to be in Summer 2016. Once the Log Pond Fill Area is vacant, a supplemental investigation of this area will be conducted. The results of that investigation will lead to a more detailed map of where contamination in the former log pond occurs that would be managed under institutional controls. A soil management plan will be developed that will incorporate these data and will specify how future work for redevelopment will be conducted in the Log Pond Fill Area, which may or may not disturb contaminated soils.

3.9 INSTITUTIONAL CONTROLS

Soil remaining within the Gasoline and Hydraulic Oil Areas that has COC concentrations greater than CULs will occur primarily in smear zone soils lying outside of the Concrete Pad Excavation Area as the soils within the Concrete Pad Excavation Area are subject to excavation to meet RLs, not CULs. Soil contamination concentrations greater than CULs that is not excavated, regardless of location on the Site, will be subject to institutional controls.

Per the CAP, institutional controls in the form of limited use/notification restrictions may be necessary in areas where soil or groundwater concentrations exceed applicable MTCA Method A or B CULs (e.g., for petroleum-related contaminants) and in areas where MTCA Method C is the applicable CUL (e.g., backfilled dioxin-containing soil). Institutional controls will require that a vapor intrusion assessment is conducted for new buildings constructed on the Site. Institutional controls at the Site will include the following:

- An Environmental Covenant indicating that industrial CULs were applied at the Site and that the future uses of the property need to be consistent with industrial uses and CULs.
- Prohibition on withdrawal of groundwater except for monitoring purposes.
- Implementation of an Ecology-approved soil management plan specifying soil management procedures for future excavation and health and safety requirements for subsurface work in areas where contamination concentrations greater than CULs remain. These procedures will be applicable to any future site redevelopment or maintenance that involves removal or disturbance of subsurface material. The soil management plan will be prepared for Ecology approval concurrent with remedial design and will include specifications for the following:
    - Methods to identify and assess areas where soil COCs remains at concentrations greater than the CUL (such as in the Log Pond Fill Area or smear zone soils that remain at levels greater than site CULs)

- Health and safety requirements for working in and handling site soils.
- BMPs for soil stockpiling, dust control, and erosion control. Requirements for off-site disposal and associated recordkeeping.
- Requirements for Ecology notification and reporting.

Institutional controls will also be necessary to require additional testing and analysis to evaluate the actual risk of vapor intrusion into potential future buildings constructed at the Site where contamination remains and what, if any, remedial measures may be necessary (such as a vapor barrier). The Environmental Covenant must include the following requirements regarding vapor intrusion and indoor air:

- A vapor intrusion assessment must be performed on any part of the property consistent with current Ecology guidance or regulation prior to the construction of buildings on-site. If the assessment indicates no soil or groundwater contamination in or near future building areas, then no further action is necessary. However, if building will occur over areas of residual groundwater or soil contamination, then a more detailed assessment of the potential vapor intrusion must be performed, which may lead to the need for mitigation.
- In areas of vapor intrusion risk, only slab-on-grade buildings without basements shall be allowed to be constructed. Prior to construction, Ecology shall review and approve any proposed engineering plans for engineered controls and/or mitigation systems (such as vapor barriers and sub-slab depressurization systems).
- Land use is to remain industrial.

4.0 Monitoring and Reporting

4.1 COMPLIANCE MONITORING REQUIREMENTS

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

4.1.1 Protection Monitoring

Protection monitoring will be conducted during both remedy construction and operation and maintenance activities to confirm the protection of human health and the environment. Protection monitoring requirements will be described in a Health and Safety Plan (HASP) addressing worker activities during remedy construction and in a soil management plan regarding future management of residually contaminated soil disturbed during site construction or maintenance. Protection monitoring will also be required of stormwater leaving the Site. Stormwater that leaves the Site boundary will be tested during rainfall events for GRO/BTEX in accordance with the procedures specified in Appendix G. If testing indicates exceedances of GRO/BTEX levels in stormwater, then additional stormwater BMPs will be implemented to prevent further exceedances. Monitoring of treated wastewater will also occur prior to discharge to the sanitary sewer, per the terms of the sewer permit (Appendix E).

4.1.2 Performance Monitoring

Performance monitoring (also commonly referred to as confirmational monitoring) will be conducted by the Port's consultant during remedy construction. Performance monitoring consists of the following:

- Soil sampling, which has already been conducted prior to construction of the excavation bottom. This was done prior to excavation given the difficulty of sampling post-excavation in expected ponded areas of groundwater. This sampling was used to ensure that the depth to which soil is planned to be removed is adequate to achieve the applicable CULs or RLs. A gridded approach to sampling was utilized, with one confirmational boring for approximately every 1,600 square feet of excavation area (40 by 40 feet), resulting in approximately 50 total borings over two field events. A layout of soil confirmational samples is shown on Figures 3.4 and 4.1. At each boring, soil samples were collected by spilt spoon samples driven at 1-foot intervals to 5 feet below the water table. Design data sampling activities and sample results are described in Appendix D and in Sections 3.3.6.2 and 3.3.6.3.
- Soil sampling will be conducted during construction to ensure that the remaining soil in the sidewalls following excavation meets applicable CULs or RLs. This will consist of the collection of soil samples from excavation sidewalls lying above the water table. A lineal spacing approach to sampling will be utilized, with one sidewall sample collected for every 40 lineal feet of excavation perimeter. A conceptual layout of soil

confirmational samples with this spacing is shown on Figure 4.1. The SAP (Appendix G) contains details as to how these samples will be collected and analyzed.

- Soil sampling of any imported fill material will occur if chemical analytical data are not supplied by the source of the material. The SAP (Appendix G) contains details as to how these samples will be collected and analyzed.
- Soil sampling of "presumed clean" stockpiles of overburden soil will also occur to determine suitability for backfilling. Approximately 35,000 CY of overburden soil will be excavated. One sample will be collected for every 500 CY of stockpiled overburden soil, which translates to a total of 70 samples to be collected. The SAP (Appendix G) contains details as to how these samples will be collected and analyzed.
- Olfactory, visual, and PID screening of overburden soil prior to stockpiling will be performed to prevent comingling of clean overburden stockpiles with contaminated soil. Details on the field screening are presented in Section 3.3.6 and the SAP (Appendix G).
- Quality control monitoring for construction activities will be conducted, such as surveys to confirm excavation extent and backfill acceptance testing (i.e., imported backfill shall not contain contaminant concentrations greater than MTCA Method A CULs) and compaction testing, and surveying.

Performance monitoring will also be conducted on groundwater to assess how the bioremediation of groundwater is progressing. Groundwater performance monitoring is discussed in further detail in Appendix G.

4.1.3 Confirmational Monitoring

Confirmational monitoring activities will be conducted following completion of the remedy and will consist of the following:

- After completion of the excavation activities, and re-installation of wells, quarterly confirmational monitoring will be conducted for a minimum of 2 years after remedy implementation to confirm long-term remedy effectiveness and also assess the performance of the bioremediation of groundwater. Figure 4.2 shows the post-excavation groundwater monitoring network. Groundwater confirmational monitoring will be required as long as soil COC contamination at concentrations greater than CULs remains. A reduction in sampling frequency to semi-annual may occur after this initial 2-year period if results are stable or decreasing. Confirmational monitoring will be conducted until groundwater meets CULs at the CPOC over four consecutive monitoring events, following which sampling will occur at a minimum frequency of every 18 months to confirm groundwater is still in compliance. The long-term groundwater monitoring plan may be modified in the future based on sampling results, in coordination with Ecology. Figure 4.2 shows the location of the proposed groundwater monitoring wells. All wells will initially be tested for GRO, BTEX, and DRO. The long-term groundwater monitoring plan is presented in further detail in the SAP (Appendix G).

- Long-term soil monitoring sampling of soil will be performed once every 5 years to confirm that monitored natural attenuation in areas of residually contaminated soils is effective. The objective of this sampling will be to define the current limits of soil greater than CULs and average concentrations of COCs within these areas, which is expected to diminish over time. This plan may be modified in the future based on sampling results, in coordination with Ecology. The long-term soil monitoring plan is presented in further detail in the SAP (Appendix G).

4.2 CULTURAL RESOURCES

The Site is located near Tumwater Creek and is in close proximity to one of the three documented Klallam villages in the harbor area. The project area is approximately 1 mile from the *Tse-whit-zen* village site and another documented Klallam village site at the mouth of Ennis Creek. Cultural resource protocols for monitoring during all ground-disturbing activities throughout remediation will be implemented in compliance with federal, state, and local laws and regulations in accordance with the new AO. In addition, the Port, the City of Port Angeles, and the Lower Elwha Klallam Tribe (LEKT) have an agreement that all ground-disturbing activities in the area between the bluff to the south and the shoreline behind which the K Ply mill is located require monitoring of site work by an archaeologist.

A Settlement Agreement between the Port, the City of Port Angeles, and the LEKT, and a LEKT Monitoring and Inadvertent Discovery Plan (MIDP) outline protocols in the event that human remains or other archaeological deposits are discovered; however, this MIDP is general to the Settlement Agreement. The Washington State Department of Archaeology and Historic Preservation has reviewed this MIDP and has requested that a project-specific MIDP be prepared for the project (refer to Appendix H). Prior to cleanup, the Port, the City of Port Angeles, and the LEKT will be provided the scope of work and project-specific MIDP for review and comment, and will be notified of the construction schedule.

An archaeologist will monitor ground-disturbing activities during remedial construction, primarily excavation. All field observations will be recorded in a field notebook, and photographs will be taken of each monitored location and the general work area. A cultural resources monitoring report will be completed and included as part of the construction completion report.

Of note, a Native American midden was uncovered in 2011 during the installation of a culvert into the harbor in the Valley Creek stream bank, adjacent to the Valley Creek Estuary Park. The Valley Creek stream bank borders the K Ply log sorting yard on the east. Derek Beery from the City of Port Angeles was present at the time of the discovery and asked Bill White with the LEKT to confirm that the material was a deposited midden, which he did. The original location of the dredged/redeposited sediments was unknown, and that redeposited midden can still contain artifacts and other items of importance to the LEKT.

5.0 Health and Safety

5.1 HEALTH AND SAFETY

The project work described in this EDR will comply with the health and safety standards prescribed by the Occupational Safety and Health Act and the Washington Department of Occupational Safety and Health. A project-specific HASP covering the work to be done by the Project Consulting Engineer and their representatives is attached as Appendix I. The selected contractor will also prepare a HASP for their specific activities after contract award and prior to mobilization. Emergency contact information will be provided in the HASPs. Copies of the HASPs will be on-site at all times, and visitors entering the work area will be required to review and sign the project-specific HASP.

In general, however, chemical exposure hazards are primarily exposure to petroleum-contaminated soil and groundwater. Potential routes of exposure include inhalation, ingestion, dermal contact, and eye contact. Physical hazards and recommended preventative measures are identified in the HASP including falling, lifting, electrical, mechanical, noise, heat stress, cold stress, sunburn, biohazards, and traffic hazards. Work activities may generate visible dust and controls will be used to minimize worker exposure to dust with contamination or to prevent dust from leaving the Site. Water may be used to suppress any dust clouds generated during work activities.

All work involving heavy equipment, including injection boring advancement, will proceed in modified Level D personal protective equipment (PPE), including hard hat, steel-toed boots, hearing protection, eye protection, gloves, and protective high-visibility work clothing. For all work involving potential exposure to soil or groundwater, workers will wear nitrile gloves and Level D PPE.

All personnel will be trained in the proper use of PPE. The level of protection may be upgraded by the Health and Safety Officer or Site Supervisor if warranted by conditions present in the work area; Site monitoring protocols are described in further detail in the HASP (Appendix I). As an alternative, work may be temporarily suspended in order to implement appropriate engineering controls. The Health and Safety Officer will periodically inspect equipment such as gloves and hard hats for defects.

Appropriate site control measures will be maintained in all work areas to limit access during and after work hours. These include the site perimeter fence. Site perimeter air monitoring will also be conducted to ensure that populated areas adjacent to the Site are not affected by work involving contaminated soil. If noticeable odors are evident at the perimeter of the site, then the contractor will be required to use odor-suppressing foam to control off-site odors. Site monitoring protocols are presented in further detail in the HASP, which also contains a Material Safety Data Sheet for the foam that will be used (Appendix I).

5.2 DECONTAMINATION PROCEDURES

Decontamination procedures will be strictly followed to prevent spread of contaminated soil and groundwater. All construction equipment will be decontaminated prior to leaving the Site. Equipment and vehicle decontamination generally consists of sweeping (if dry) and/or pressure washing with detergent solution followed by a potable water rinse.

Equipment decontamination wash water will be contained such that it does not flow onto uncontaminated portions of the Site. If decontamination wash water is collected in a containment area it will be managed according to the procedures for handling and disposal of contaminated groundwater.

6.0 Schedule

A general schedule for implementation of the cleanup action was provided in the CAP (reproduced in Table 6.1). Following selection of the contractor, a construction schedule will be provided that will detail dates for the construction phase of the project including the following activities:

- Mobilization
- Site Preparation
- Overburden Removal
- Contaminated Soil Removal
- Backfilling
- Demobilization
- ORC-A Injections along S. Cedar Street

Table 6.1
Cleanup Action Implementation Schedule

Action	Due By/ Triggering Event	Notes
AO Signed by Ecology and CAP Finalized	Completion of the public comment period and addressing of public comments.	Ecology to endeavor to address public comments within 30 days of the end of the public comment period.
Draft EDR	60 days after signature of AO and finalization of CAP	Ecology to endeavor to provide comments within 30 days. Some field activities are expected to be necessary as part of design. EDR includes all environmental work items including soil and groundwater compliance monitoring plans and HASPs.
Final EDR	30 days after receipt of Ecology's comments	Ecology to endeavor to review and approve within 30 days.
Develop Construction Plans and Specifications	Submittal of the EDR	

Action	Due By/ Triggering Event	Notes
Bid Period	Following finalization of the construction documents	Bid period is a public bid process and will take approximately 30 days.
Begin Construction	Within 120 days of approval of EDR	Construction is assumes to take 8 to 12 weeks and will include all excavation activities and the addition of bioremediation amendments in excavation areas and initial biotreatment of the S. Cedar Street benzene plume.
Installation of Compliance Monitoring Wells and Post-Construction Assessment of Groundwater	Within 3 months following complete of construction activities	Installation of 10 wells may be necessary to complete the monitoring network.
Draft Construction Completion Report	90 days following construction completion	Includes soil management plan.
Draft Log Pond Fill Area Investigation Work Plan	3 months prior to termination of lease with current log debarking tenant	Work plan objective is to better define soil conditions and extent of contamination in Log Pond Fill Area.
Supplemental Investigation of Log Pond Fill Area	60 days following removal of log debarker site infrastructure	Assumes 2-day investigation by Geoprobe or test pits in late 2016.
Draft of Environmental Covenant	30 days following approval of construction completion report	Draft to be provided by Port for Ecology review and approval.
Environmental Covenant Recorded	10 days following approval by Ecology	

Action	Due By/ Triggering Event	Notes
Quarterly Groundwater Monitoring and Reporting	Begins within 14 days of well installation following construction	Minimum 2 years of quarterly sampling is required.
Long-Term Groundwater Monitoring	Following initial 2 years of quarterly monitoring	Semi-annual sampling terminates following achievement of groundwater CULs and in transitions to long-term monitoring in accordance with the compliance monitoring plan.
Quarterly Progress Reports	2015−2017	Quarterly progress report for first 2 years only.
Annual Reports	2017 until CULs are met	Yearly report to summarize all site activities; includes all groundwater and soil sampling conducted during each year as well as performance monitoring data for the remedial action. Includes recommendations for following year.
5-Year Review Report	Every 5 years following date of construction completion	Ecology conducts 5-year review.

7.0 Reporting

A draft construction completion report will be prepared and submitted to Ecology within 90 days following completion of the remedial construction. Information provided in the construction completion will include the following:

- Soil management plan
- Description of remedial activities, including deviations from this EDR
- Photo-documentation of construction activities and the finished construction
- Information on the lateral and vertical limits of all excavations, including maps illustrating excavation areas and other pertinent information
- Detailed sampling and analysis information, including location, matrix, analytical methods, and data quality review findings for the performance and confirmational monitoring
- Demonstration from the performance monitoring data that soil CULs were achieved
- Stockpile soil profiling and disposal documentation, including quantities of soil removed and disposed of, and landfill certificates of disposal
- Copies of weekly construction notes and/or reports

Relevant laboratory analytical data collected during the emergency action will also be uploaded to Ecology's Environmental Information Management database (within 60 days after it has been validated).

8.0 References

Floyd|Snider. 2015. *Remedial Investigation/Feasibility Study Work Plan*. Prepared for the Port of Port Angeles. September.

Washington State Department of Ecology (Ecology). 2015. *K Ply Site Cleanup Action Plan.* Toxics Cleanup Program. Olympia, Washington. March.

_____. 2011. *Guidance for Remediation of Petroleum Contaminated Sites*. Toxics Cleanup Program. Olympia, Washington. September.

K Ply Site

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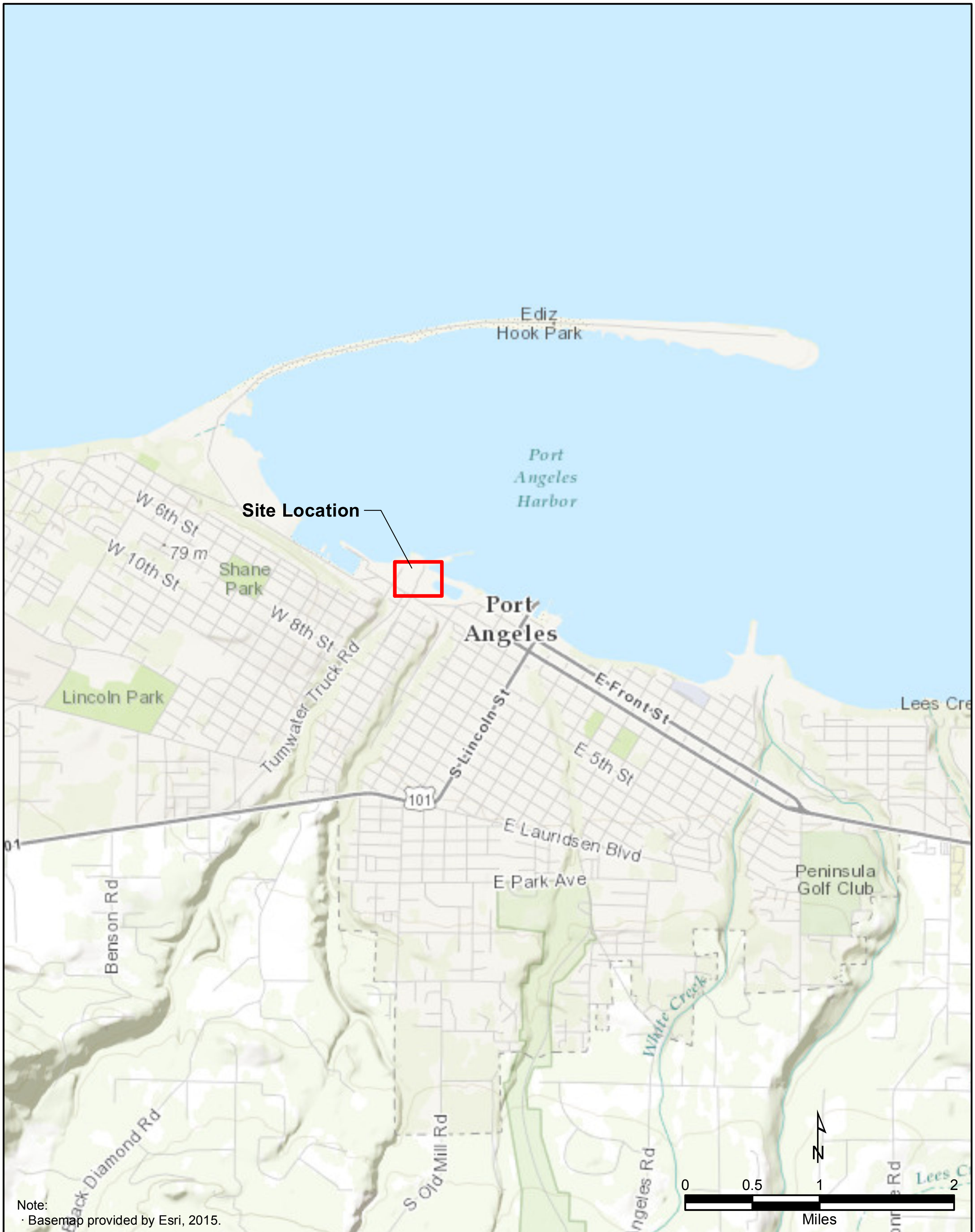
Figures



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Port Angeles, Washington

Figure 1.1
Vicinity Map

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4/19/2015

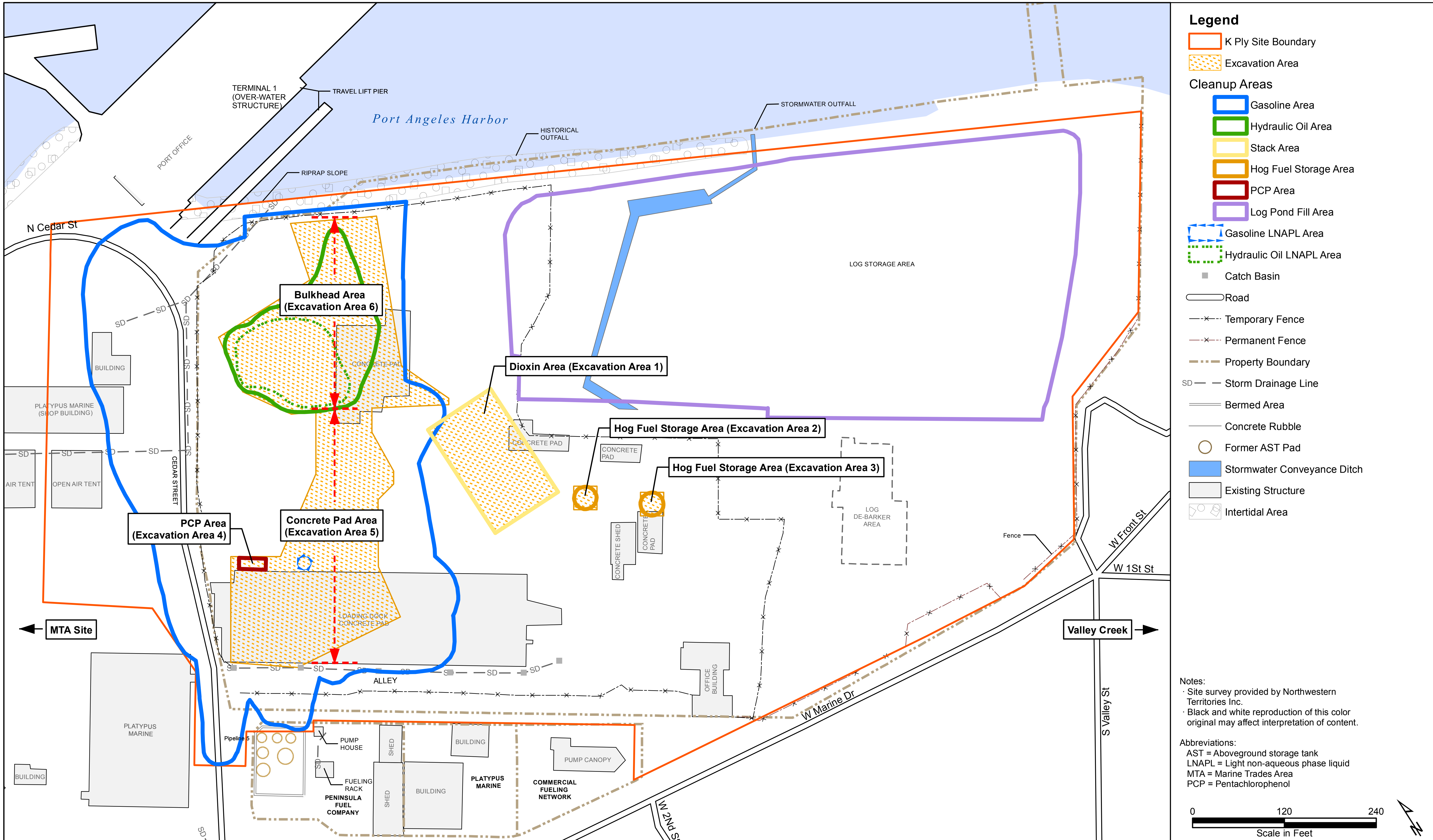

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Figure 1.2
Site Boundary, Excavation Areas, and Cleanup Areas

I:\GIS\Projects\PPA_KPLY\MXD\EngineeringDesignReport\Figure 1.2 - Site Boundary and Cleanup Areas.mxd
5/28/2015

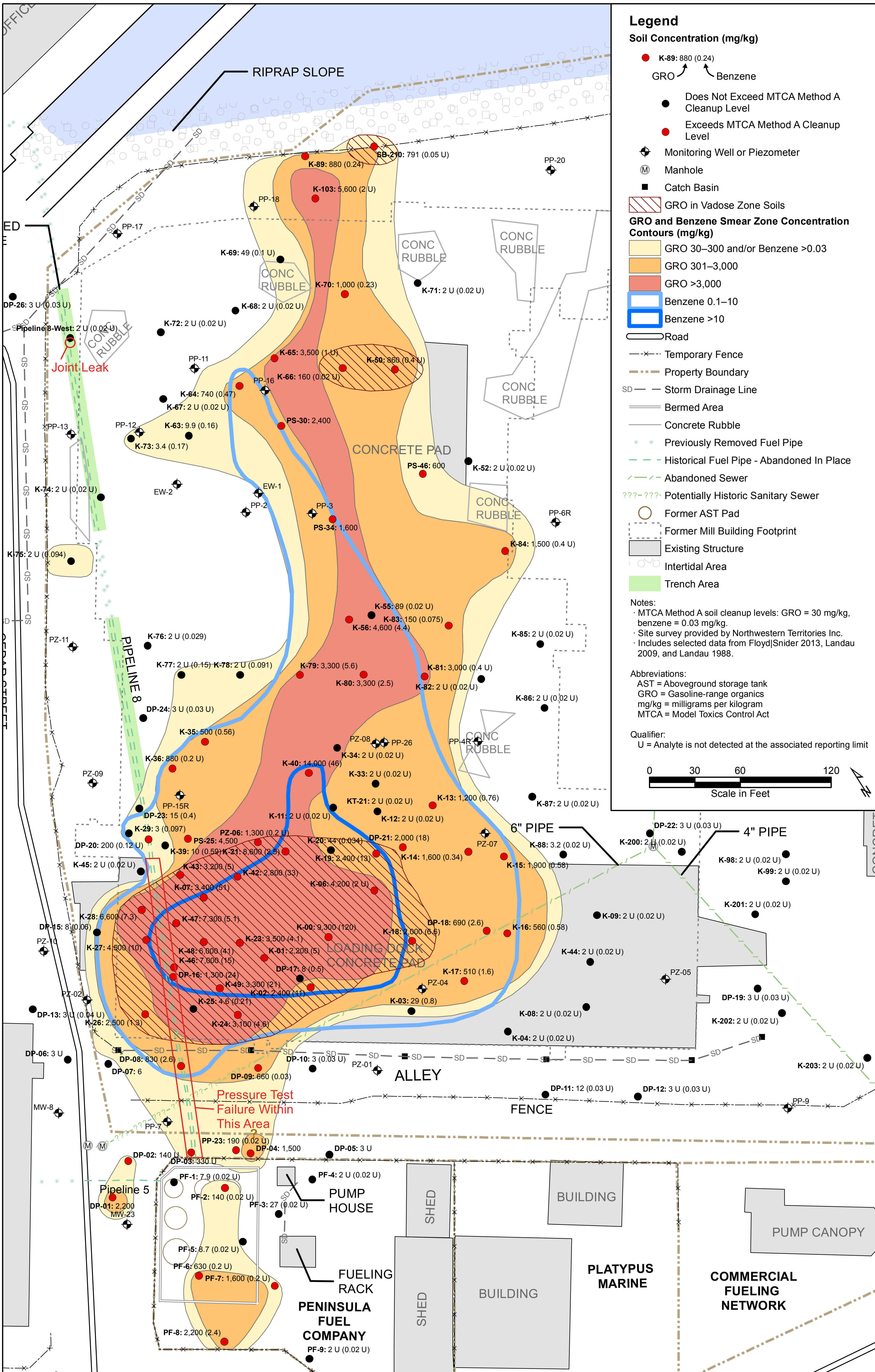

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Figure 2.1
GRO and Benzene Results in Soil

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4/20/2015

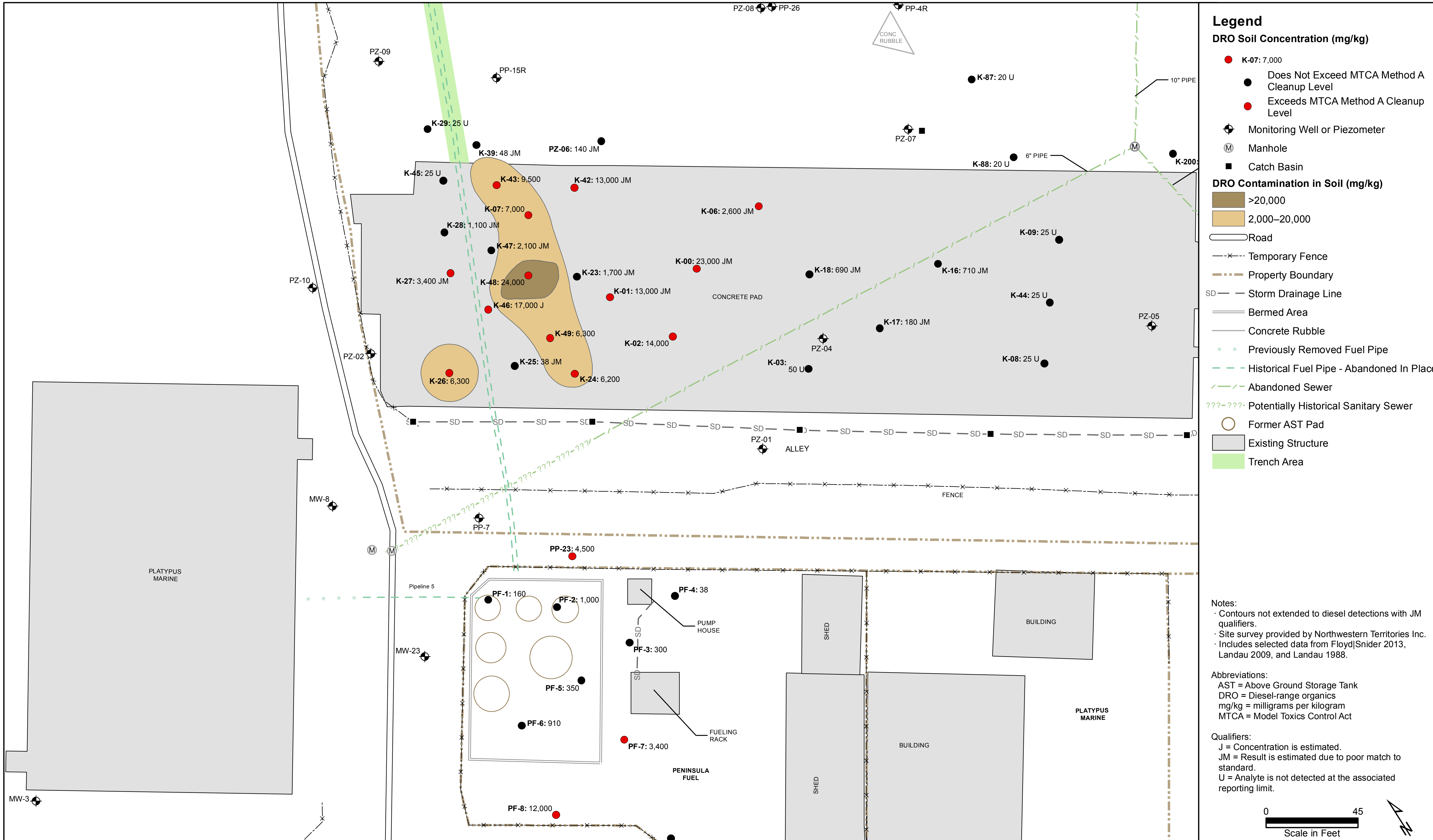

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Figure 2.2
DRO Results in Soil

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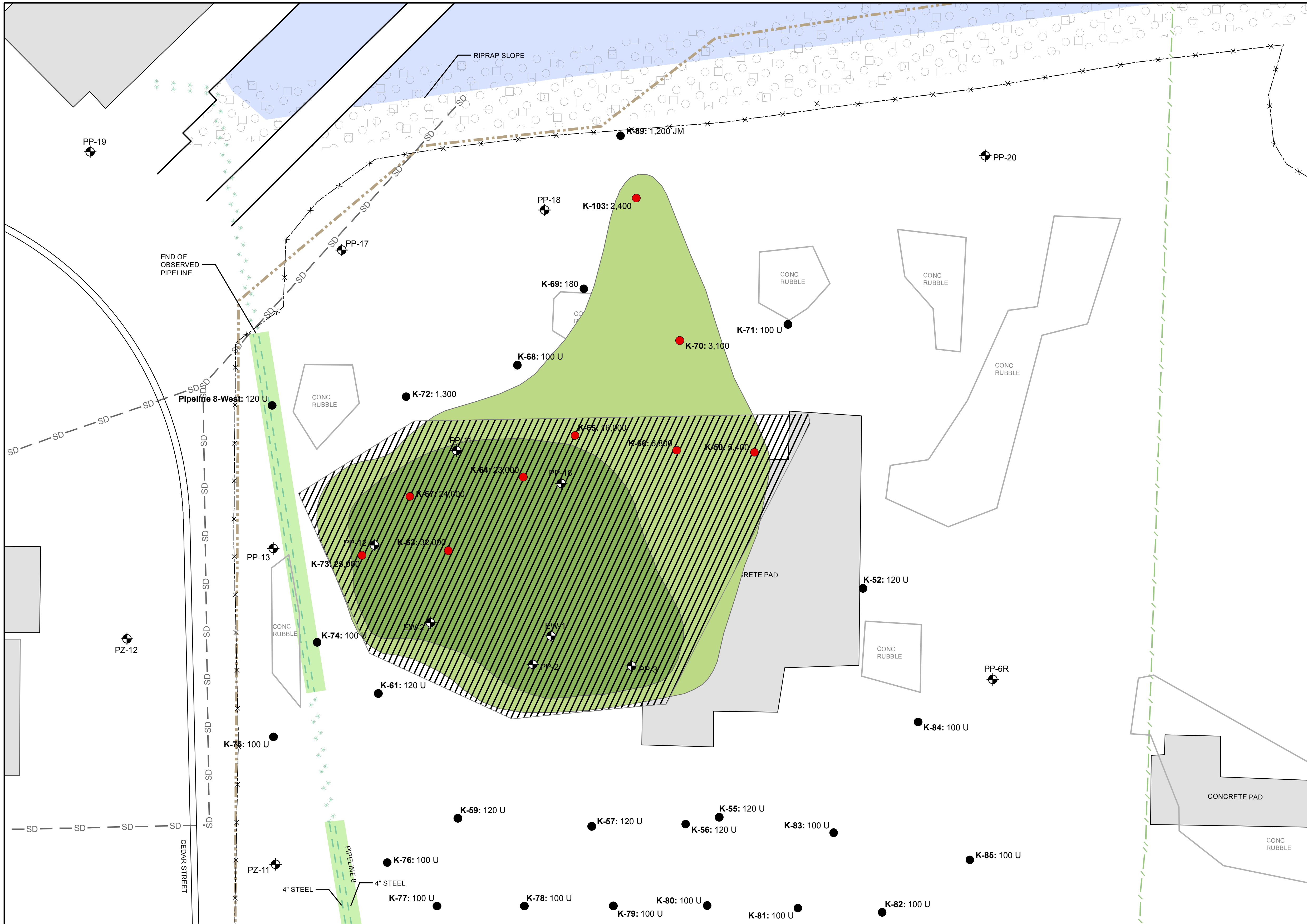
4/20/2015



Legend

ORO Soil Concentration (mg/kg)

- K-103: 24,000
- Does Not Exceed MTCA Method A Cleanup Level
- Exceeds MTCA Method A Cleanup Level
- Monitoring Well or Piezometer
- Catch Basin

ORO Contamination in Soil (mg/kg)

- 2,000–20,000
- > 20,000 (and/or LNAPL observed)
- Vadose Zone Excavation Area
- Road
- Temporary Fence
- Permanent Fence
- Property Boundary
- Storm Drainage Line
- Bermed Area
- Concrete Rubble
- Previously Removed Fuel Pipe
- Historical Fuel Pipe - Abandoned In Place
- Abandoned Sewer
- Potentially Historical Sanitary Sewer
- Existing Structure
- Intertidal Area
- Trench Area

Notes:
- Site survey provided by Northwestern Territories Inc.
- Includes selected data from Floyd|Snider 2013, Landau 2009, and Landau 1988

Abbreviations:
LNAPL = Light non-aqueous phase liquid
mg/kg = Milligrams/kilogram
MTCA = Model Toxics Control Act
ORO = Oil-range organics

Qualifiers:
JM = Result is estimated due to poor match to standard
U = Analyte is not detected at the associated reporting limit

0 45
Scale in Feet

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Figure 2.3
ORO Results in Soil

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4/20/2015

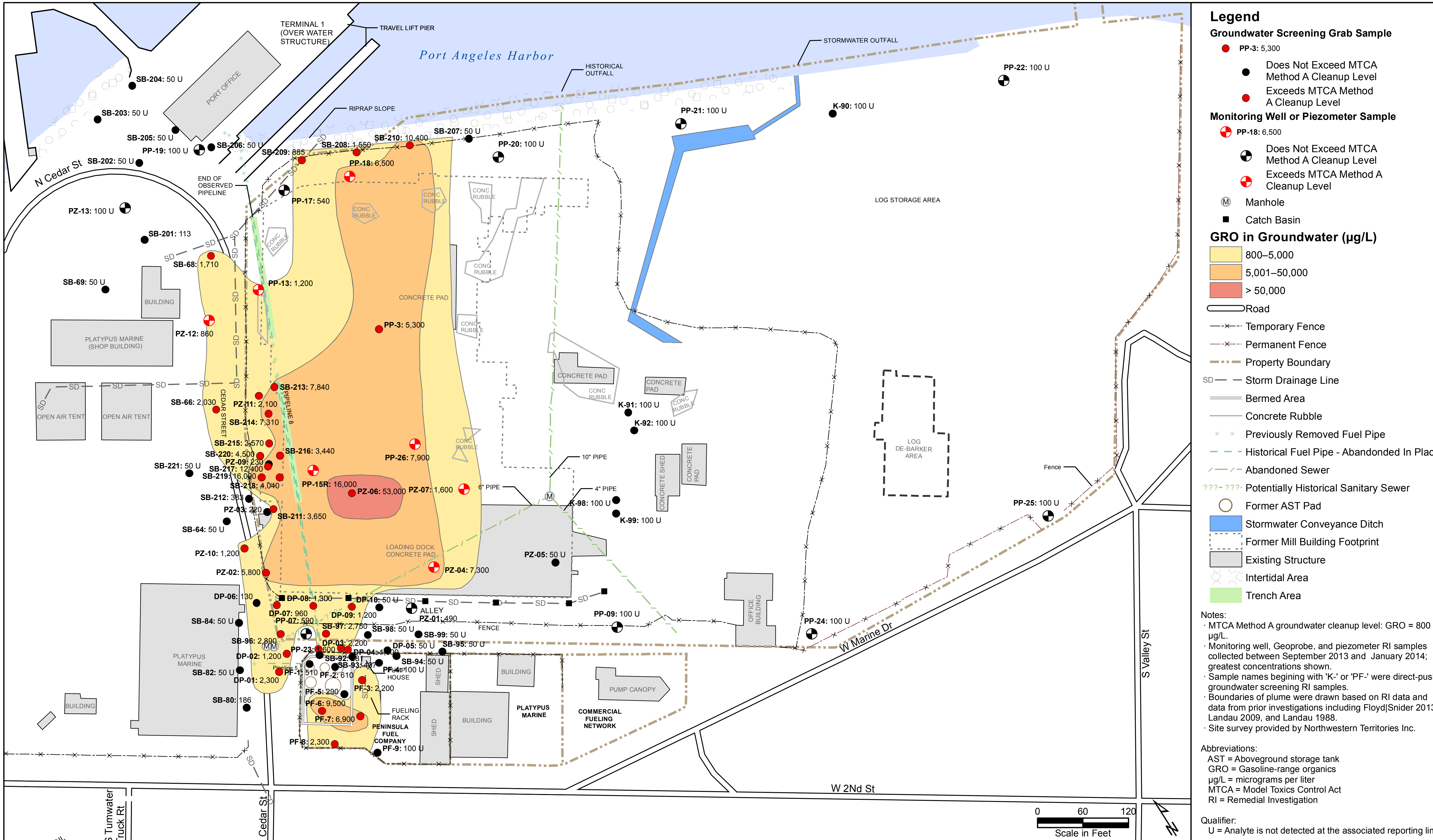

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Figure 2.4
GRO Results in Groundwater

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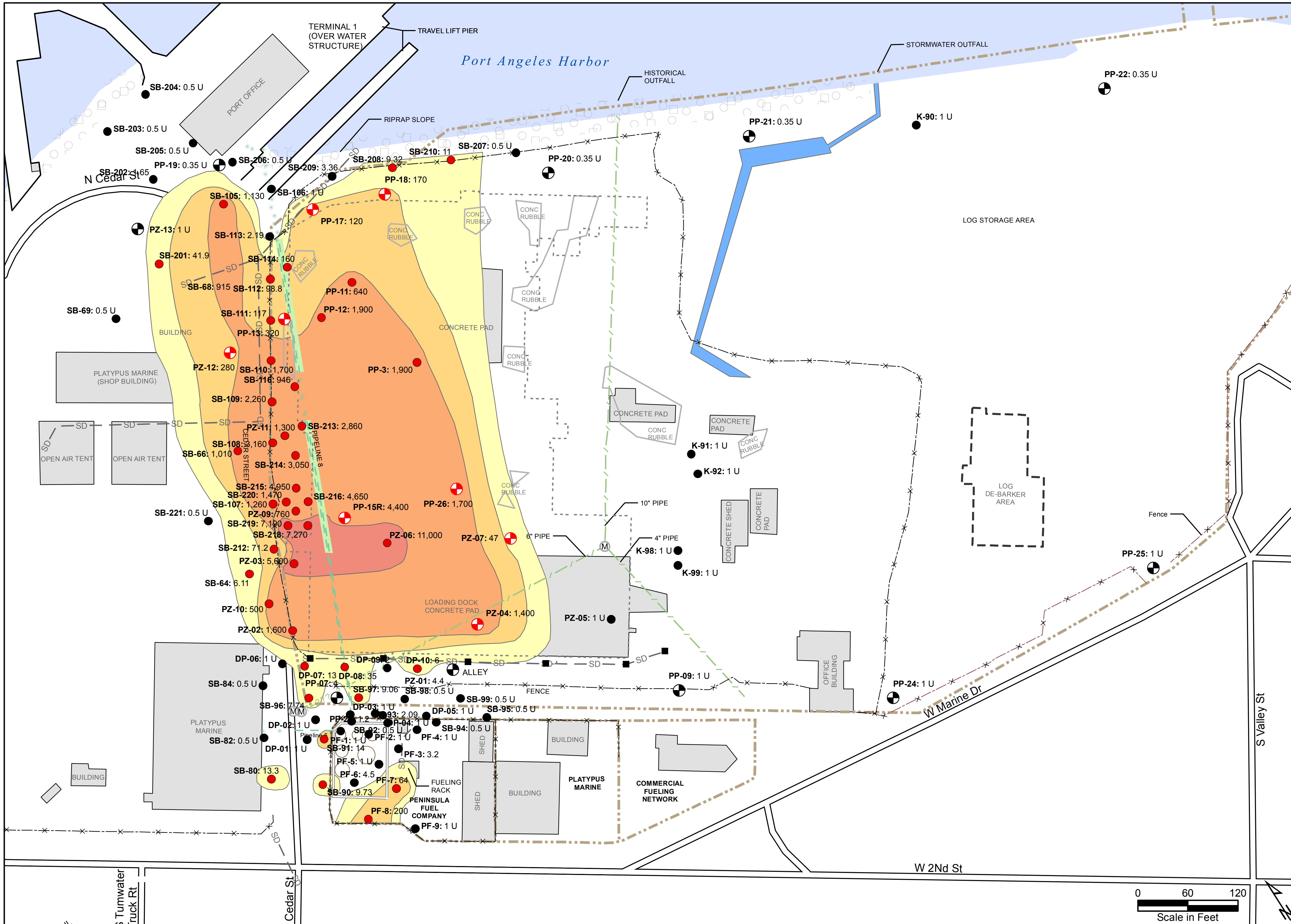
4/20/2015



Legend

Groundwater Screening Grab Sample

PP-11: 640

- Does Not Exceed MTCA Method A Cleanup Level
- Exceeds MTCA Method A Cleanup Level

Monitoring Well or Piezometer Sample

PP-26: 17,000

- Does Not Exceed MTCA Method A Cleanup Level
- Exceeds MTCA Method A Cleanup Level
- Manhole
- Catch Basin

Benzene in Groundwater (µg/L)

- 5–50
- 51–500
- 501–5,000
- >5,000
- Road
- Temporary Fence
- Permanent Fence
- Property Boundary
- Storm Drainage Line
- Bermed Area
- Concrete Rubble
- Previously Removed Fuel Pipe
- Historical Fuel Pipe - Abandoned In Place
- Abandoned Sewer
- Potentially Historical Sanitary Sewer
- Former AST Pad
- Stormwater Conveyance Ditch
- Former Mill Building Footprint
- Existing Structure
- Intertidal Area
- Trench Area

Notes:

- MTCA Method A groundwater cleanup level: benzene = 5 µg/L.
- Monitoring well, Geoprobe, and piezometer RI samples collected between September 2013 and January 2014; greatest concentrations shown.
- Sample names begining with 'K-' or 'PF-' were direct-push groundwater screening RI samples.
- Boundaries of plume were drawn based on RI data and data from prior investigations including Floyd|Snider 2013, Landau 2009, and Landau 1988.
- Site survey provided by Northwestern Territories Inc.

Abbreviations:

AST = Aboveground storage tank
µg/L = Micrograms per liter
MTCA = Model Toxics Control Act
RI = Remedial Investigation

Qualifier:

U = Analyte is not detected at the associated reporting limit.

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Figure 2.5
Benzene Results in Groundwater

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4/20/2015

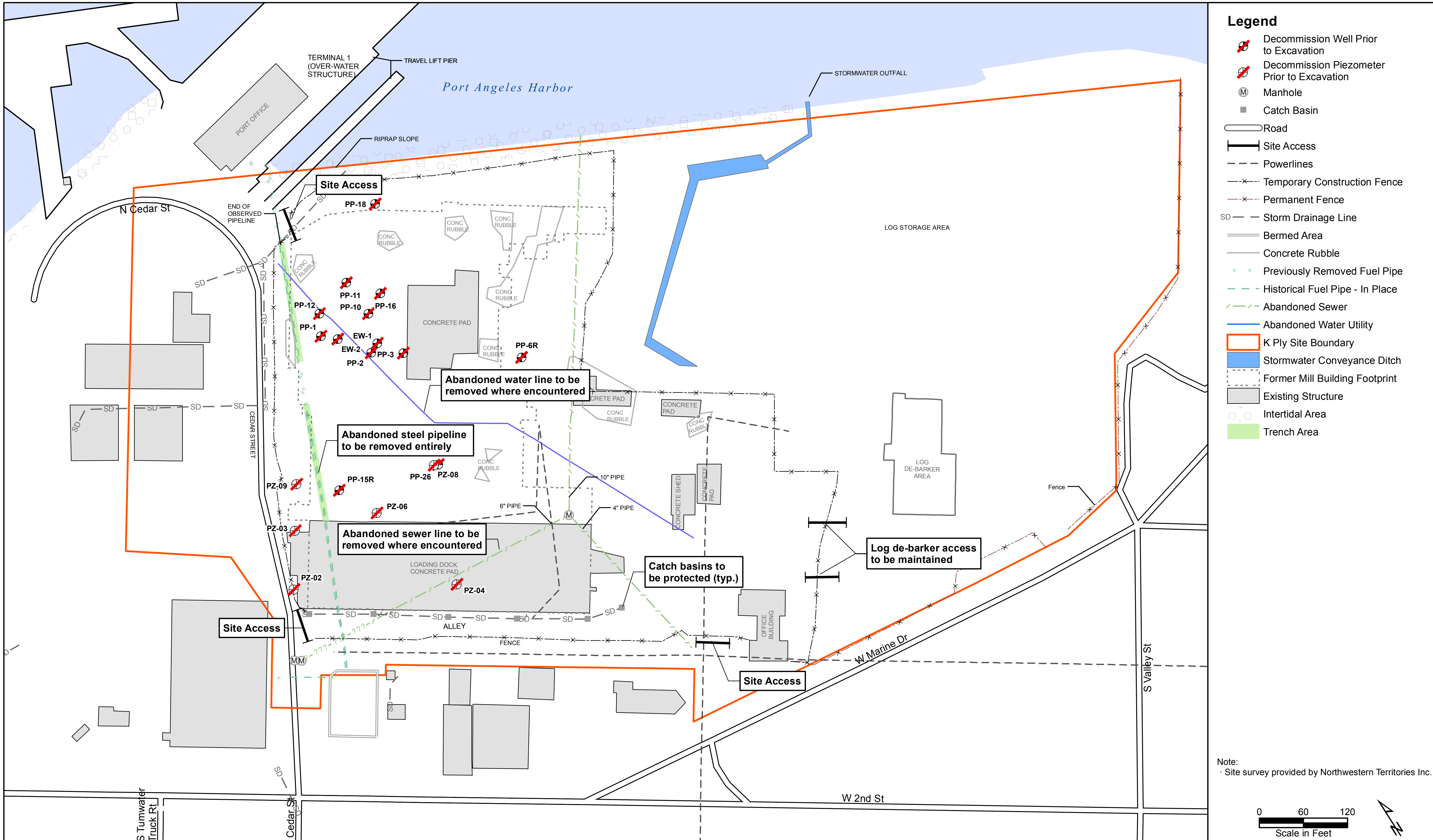

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Figure 3.1
Site Map, Access, Utilites, and Wells to be Decomissioned

I:\GIS\Projects\PPA_KPLY\MXD\EngineeringDesignReport\Figure 3.1 - Site Map, Access, and Utilites.mxd
6/9/2015

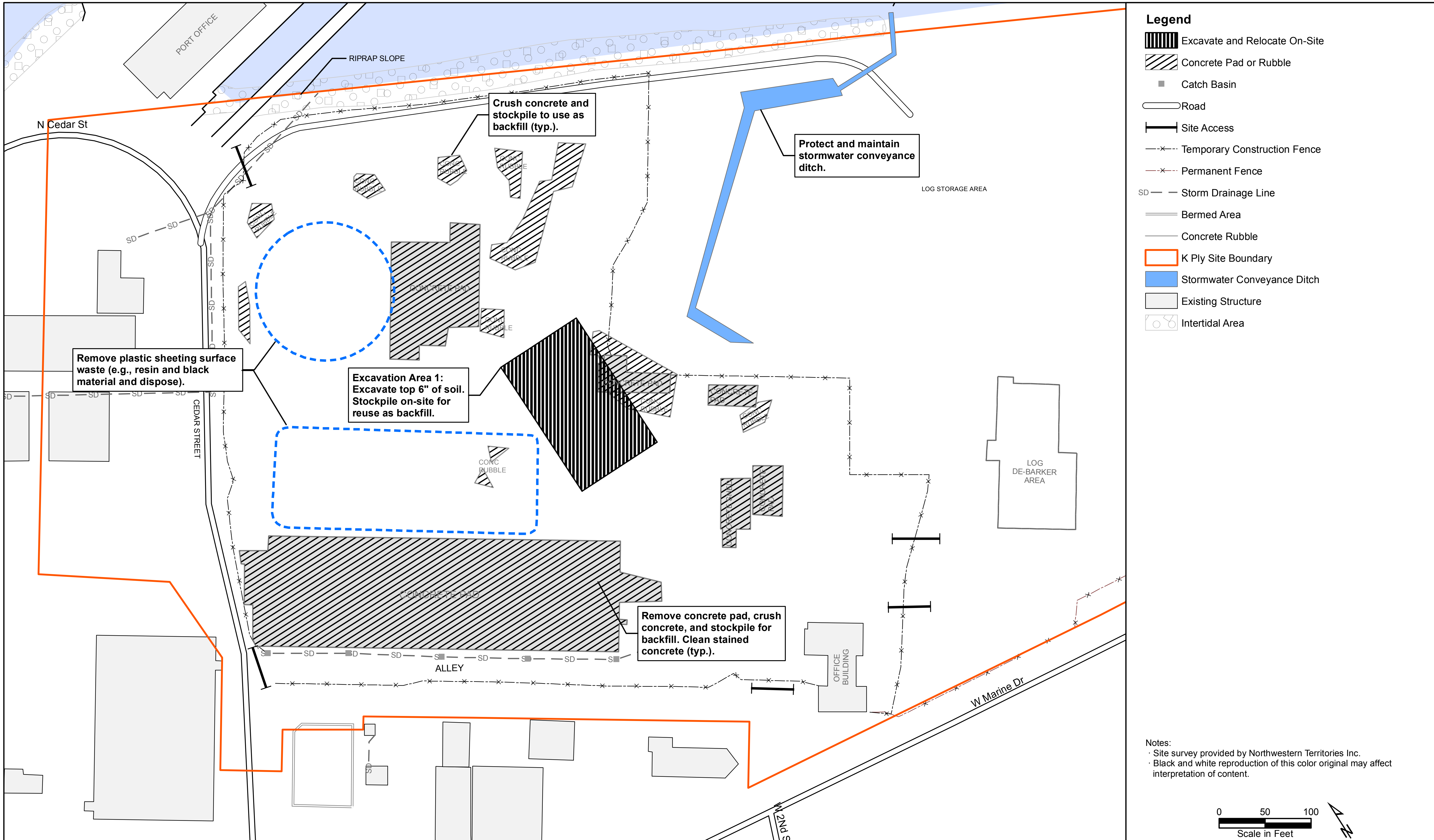

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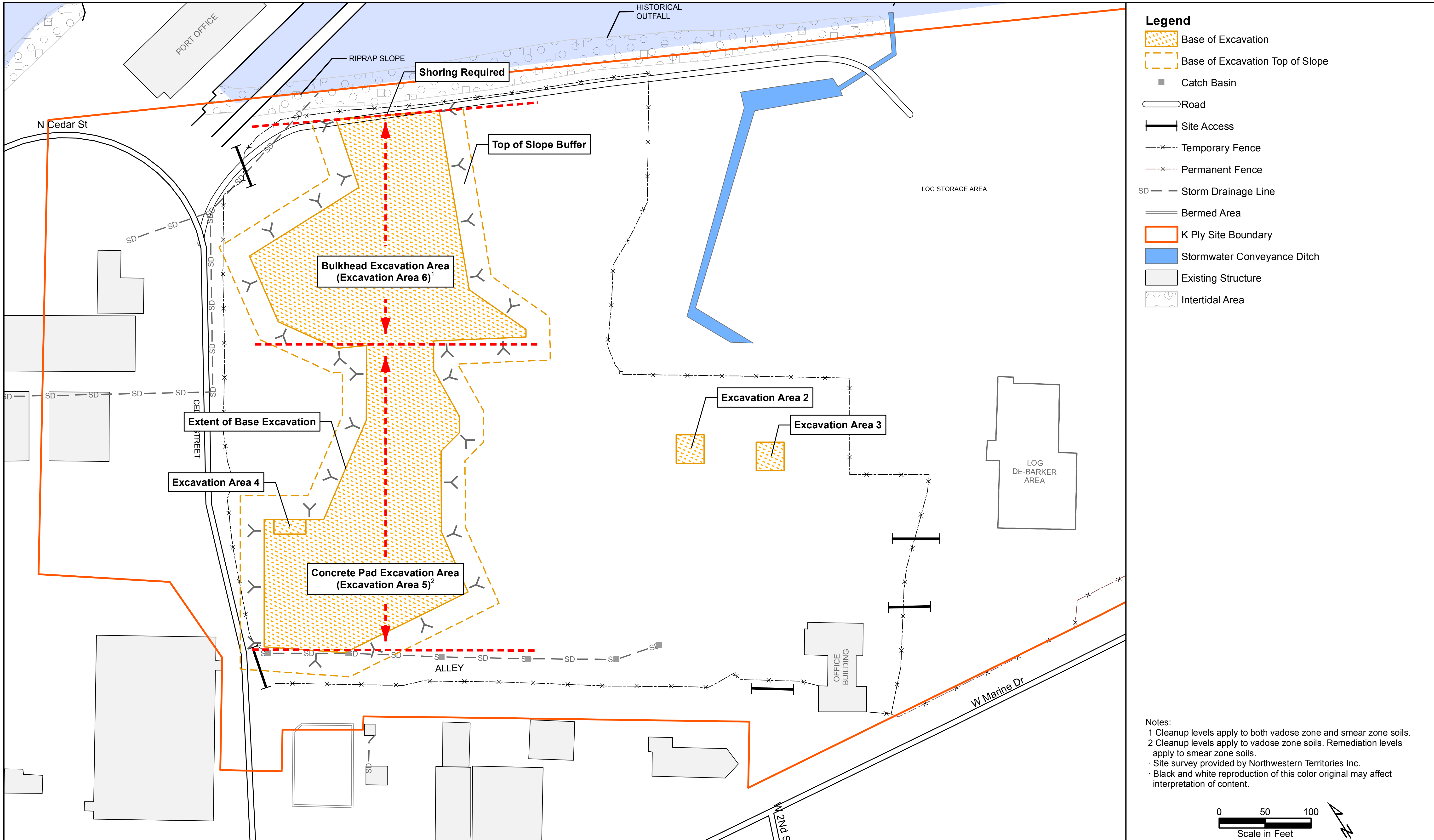
Figure 3.2
Site Preparation, Surface Excavation, and Concrete Demolition

I:\GIS\Projects\PPA_KPLY\MXD\EngineeringDesignReport\Figure 3.2 - Site Preparation, Surface Excavation, and Concrete Demolition.mxd
5/28/2015



Notes:
1 Cleanup levels apply to both vadose zone and smear zone soils.
2 Cleanup levels apply to vadose zone soils. Remediation levels apply to smear zone soils.
· Site survey provided by Northwestern Territories Inc.
· Black and white reproduction of this color original may affect interpretation of content.

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Figure 3.3
Excavation Plan

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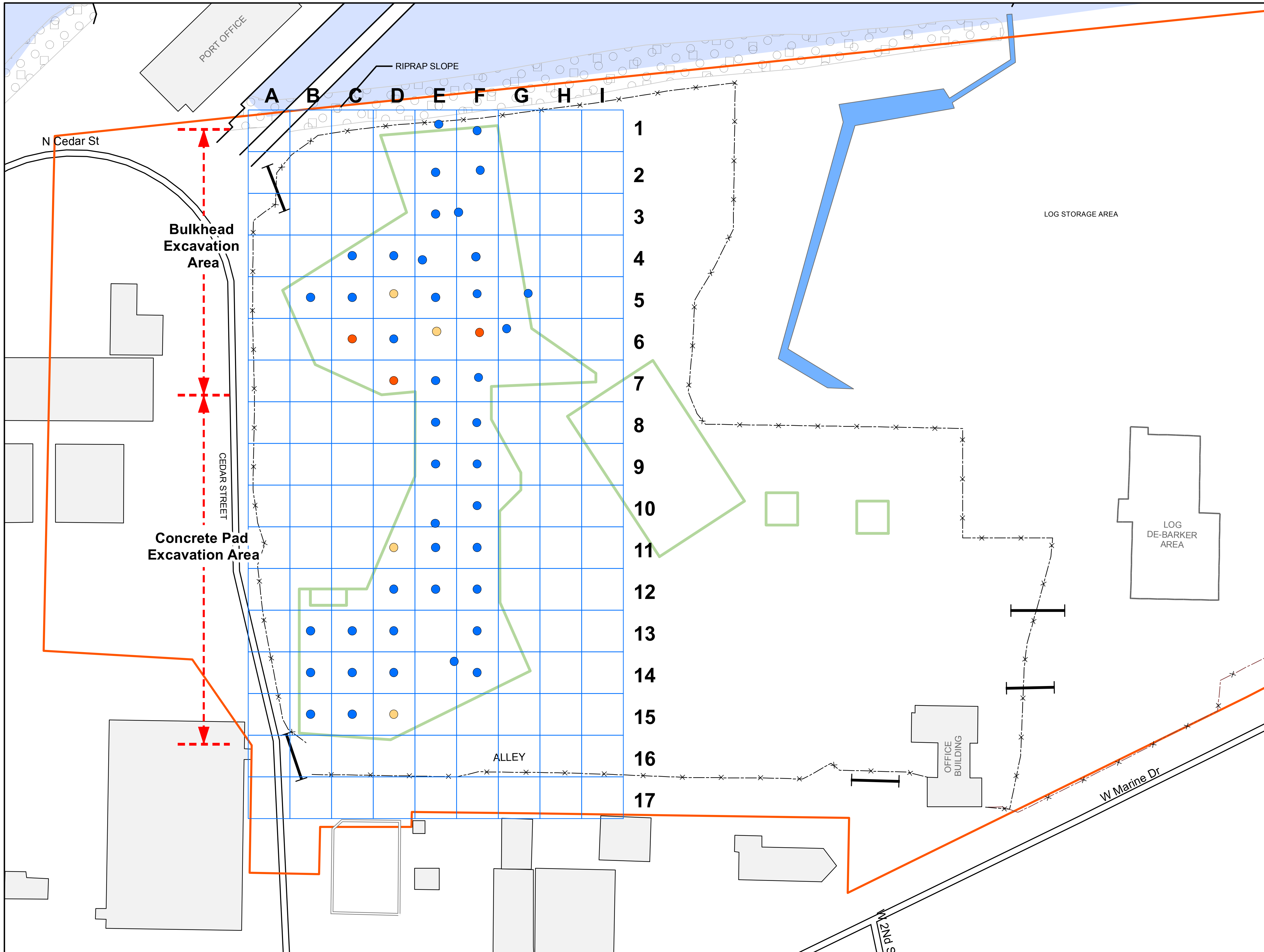
5/22/2015



Legend

- Excavation Bottom Sample (All COCs less than CLs or RLs at Base of Excavation)
- Excavation Bottom Sample (At Least One COC Exceeds CL at 1 Foot Below Base of Excavation)
- Excavation Bottom Sample (At Least One COC Exceeds CL at 2 Feet Below Base of Excavation)
- Confirmational Sample Grid
- Excavation Area
- K Ply Site Boundary
- Road
- Site Access
- Temporary Fence
- Permanent Fence
- Bermed Area
- Stormwater Conveyance Ditch
- Existing Structure
- Intertidal Area

Notes:
- Site survey provided by Northwestern Territories Inc.
- Black and white reproduction of this color original may affect interpretation of content.

Abbreviations:
CL = Cleanup Level
COC = Contaminant of Concern
RL = Remediation Level

0 50 100
Scale in Feet

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Figure 3.4
Remedial Design Soil Sample Results

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7/10/2015

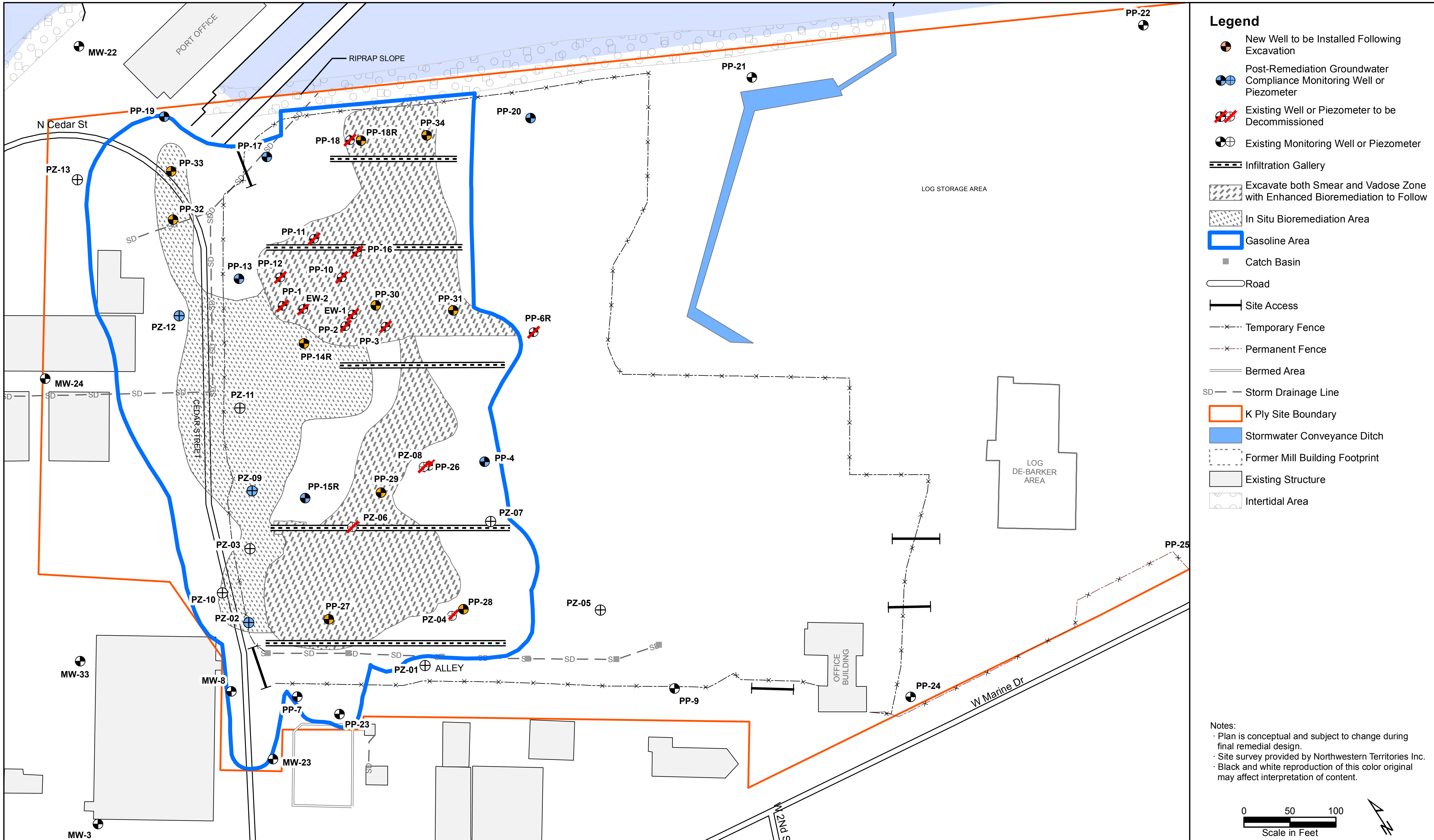

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Figure 3.5
Infiltration Gallery Layout

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7/9/2015

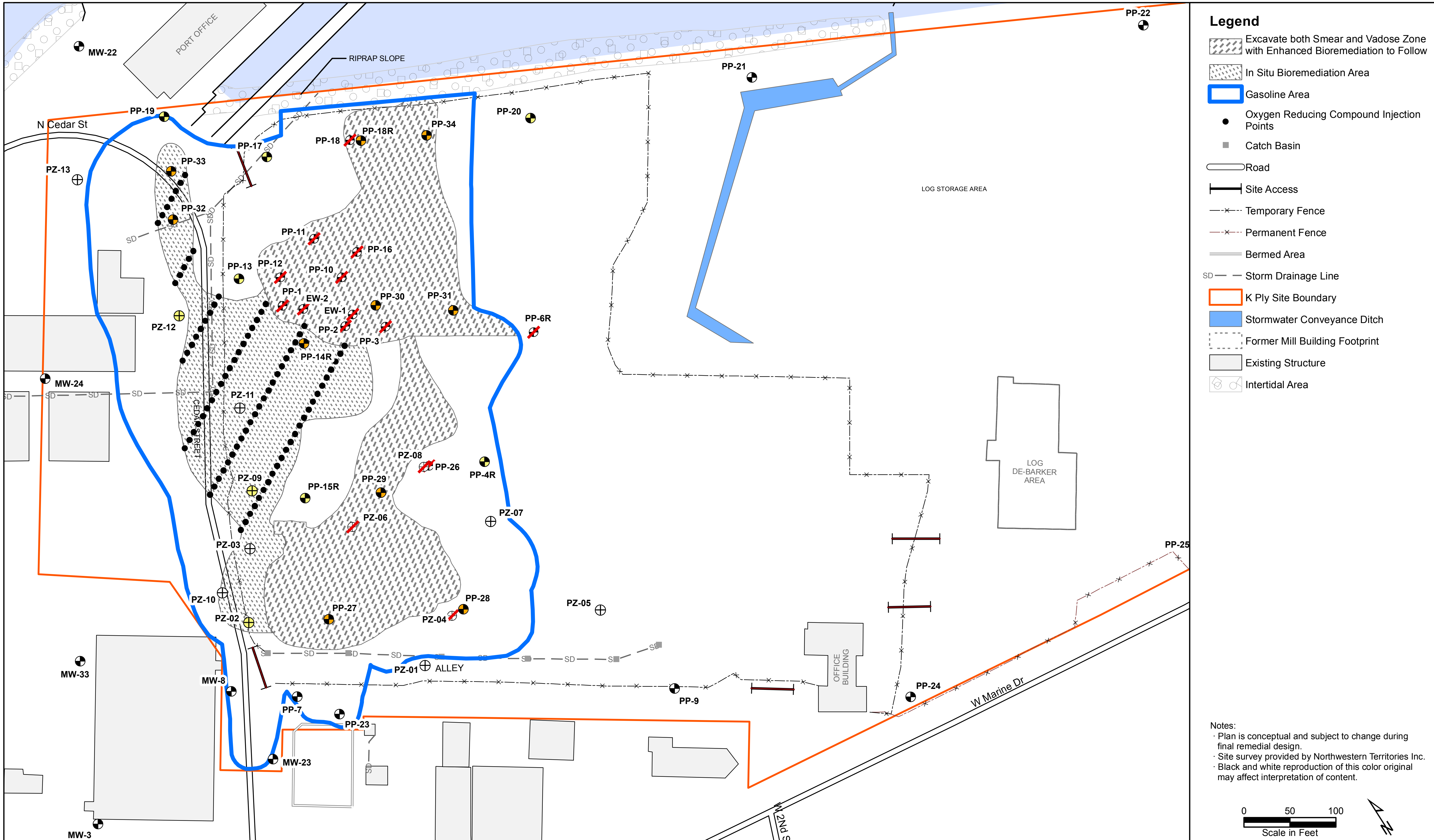

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Figure 3.6
Oxygen-Releasing Compound Injection Point Layout

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7/9/2015

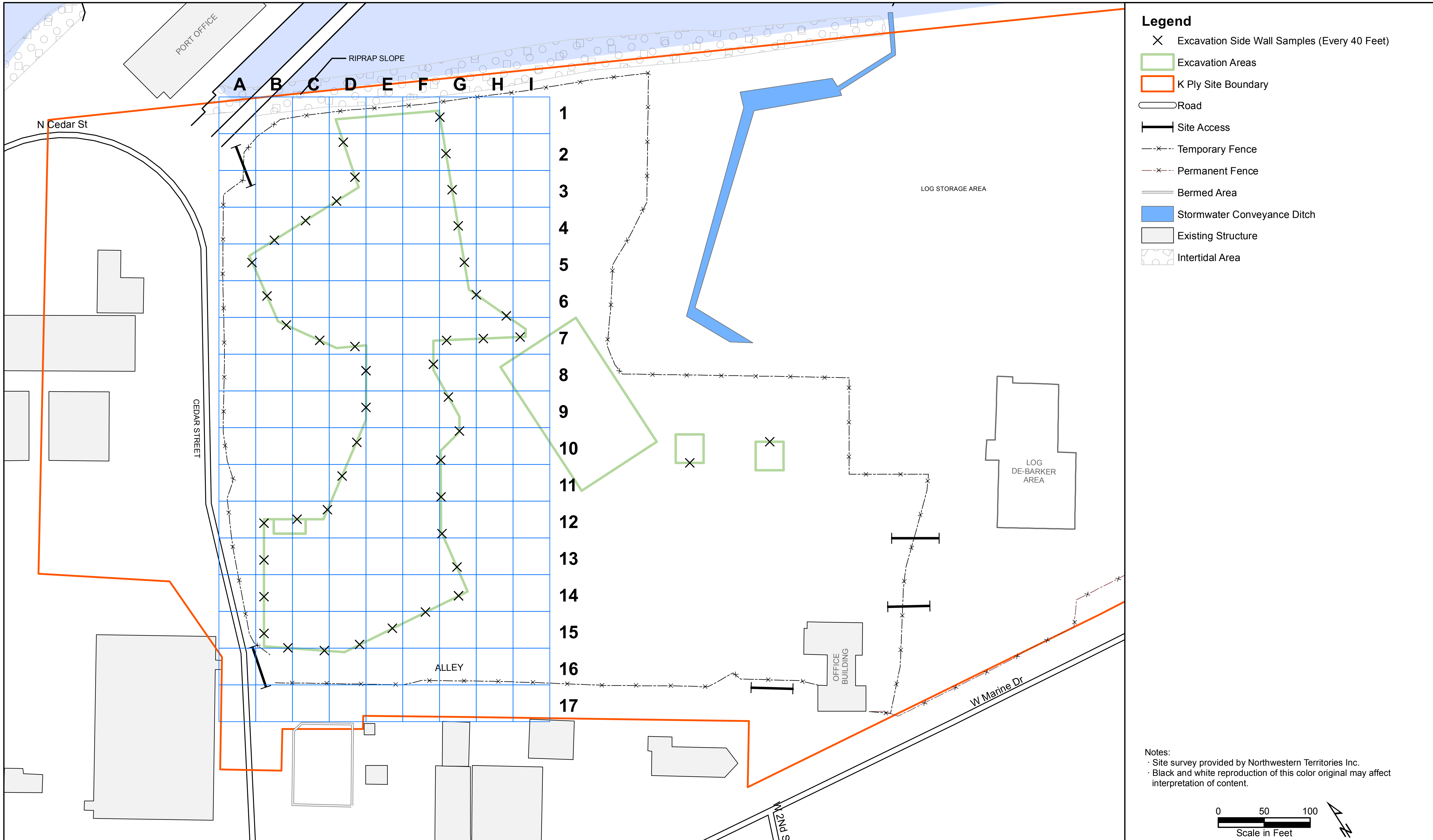

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Figure 4.1
Sidewall Confirmational Sampling Locations

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7/15/2015

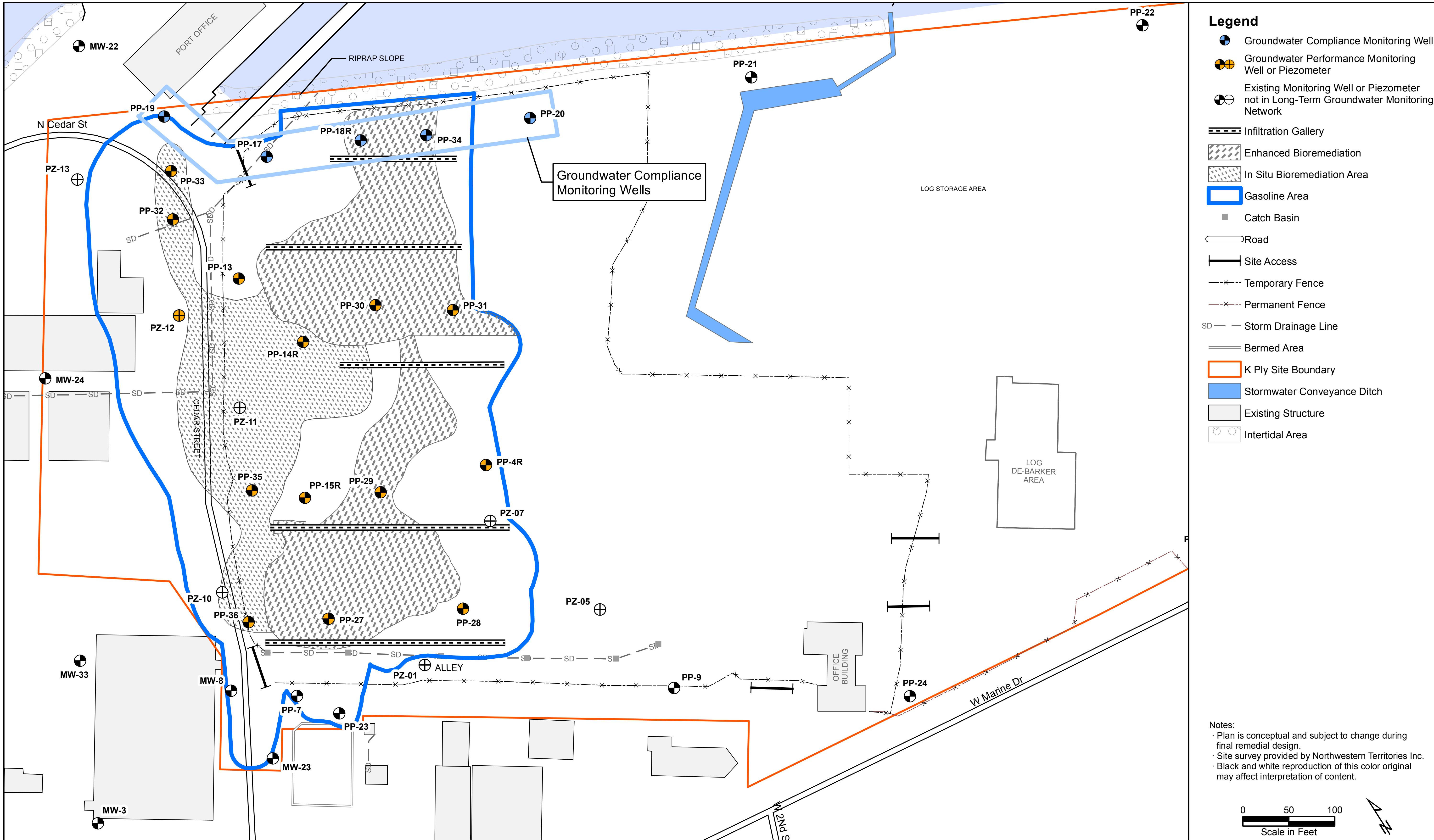

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Figure 4.2
Long-Term Groundwater Monitoring Well Network

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6/9/2015

K Ply Site

Engineering Design Report

Appendix A
Stormwater Pollution Prevention Plan

Construction Stormwater General Permit

Stormwater Pollution Prevention Plan (SWPPP)

For

Port of Port Angeles – K PLY Remediation Project

Prepared for:
The Washington State Department of Ecology
Southwest Regional Office
300 Desmond Drive
Lacey, WA 98503

Permittee / Owner	Developer	Operator / Contractor
Port of Port Angeles 338 West First Street Port Angeles, WA 98362	Port of Port Angeles 338 West First Street Port Angeles, WA 98362	ERRG 15333 NE 90th Street Redmond, WA 98052

Project Site Location
Former K Ply Mill Site
439 Marine Drive
Port Angeles, WA 98363

Certified Erosion and Sediment Control Lead (CESCL)

Name	Organization	Contact Phone Number
Jesse Waknitz	Port of Port Angeles	360-460-1364

SWPPP Prepared By

Name	Organization	Contact Phone Number
Jesse Waknitz	Port of Port Angeles	360-460-1364

SWPPP Preparation Date
5/22/2015

Project Construction Dates

Activity / Phase	Start Date	End Date
Environmental Remediation	August 3, 2015	October 20, 2015

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List of Appendices

Appendix/Glossary

List of Acronyms and Abbreviations

Acronym / Abbreviation	Explanation
303(d)	Section of the Clean Water Act pertaining to Impaired Waterbodies
BFO	Bellingham Field Office of the Department of Ecology
BMP(s)	Best Management Practice(s)
CESCL	Certified Erosion and Sediment Control Lead
CO_2	Carbon Dioxide
CRO	Central Regional Office of the Department of Ecology
CSWGP	Construction Stormwater General Permit
CWA	Clean Water Act
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ERO	Eastern Regional Office of the Department of Ecology
ERTS	Environmental Report Tracking System
ESC	Erosion and Sediment Control
GULD	General Use Level Designation
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
NWRO	Northwest Regional Office of the Department of Ecology
pH	Power of Hydrogen
RCW	Revised Code of Washington
SPCC	Spill Prevention, Control, and Countermeasure
su	Standard Units
SWMMEW	Stormwater Management Manual for Eastern Washington
SWMMWW	Stormwater Management Manual for Western Washington
SWPPP	Stormwater Pollution Prevention Plan
SWRO	Southwest Regional Office of the Department of Ecology
TESC	Temporary Erosion and Sediment Control
TMDL	Total Maximum Daily Load
VFO	Vancouver Field Office of the Department of Ecology
WAC	Washington Administrative Code
WSDOT	Washington Department of Transportation
WWHM	Western Washington Hydrology Model

1 Project Information

Project/Site Name: K PLY Site
Street/Location: 439 Marine Drive
City: Port Angeles State: WA Zip code: 98363
Subdivision: NA
Receiving waterbody: Port Angeles Harbor

1.1 Existing Conditions

Total acreage (including support activities such as off-site equipment staging yards, material storage areas, borrow areas).

Total acreage: 10 acres
Disturbed acreage: **6 Acres**
Existing structures: None
Landscape topography: Flat
Drainage patterns: To south, west and east parameters of the site
Existing Vegetation: Sparse scotch broom
Critical Areas (wetlands, streams, high erosion risk, steep or difficult to stabilize slopes): Not Applicable

List of known impairments for 303(d) listed or Total Maximum Daily Load (TMDL) for the receiving waterbody: The eastern Port Angeles Harbor is listed for dissolved oxygen per the Dept. of Ecology online mapper.

Table 1 includes a list of suspected and/or known contaminants associated with the construction activity.

Table 1 – Summary of Site Pollutant Constituents

Constituent (Pollutant)	Location	Depth	Max Concentrations mg/kg
Gasoline Range Organics	See Site RI/FS	2 to 10	14,000
Diesel Range Organics	See Site RI/FS	2 to 10	24,000
Oil Range Organics	See Site RI/FS	2 to 10	32,000
Dioxins/furans	See Site RI/FS	At Surface	0.000222
Pentachlorophenol (PCP)	See Site RI/FS	At Surface	230
Benzene	See Site RI/FS	2 to 10	120
Ethylbenzene	See Site RI/FS	2 to 10	170
Toluene	See Site RI/FS	2 to 10	180
Xylenes	See Site RI/FS	2 to 10	600

1.2 Proposed Construction Activities

Description of site development

Environmental Site Clean-up: The Site was formerly a plywood mill and is located at 439 W. Marine Drive in Port Angeles, Washington.The Site is being cleaned up under the authority of the Model Toxics Control Act (MTCA), Chapter 70.105D of the Revised Code of Washington, administered by Ecology under the MTCA Cleanup Regulation, WAC 173-340, and under Agreed Order (AO) No. DE 11302 between Ecology and the Port, effective May 2015.

Description of construction activities (example: site preparation, demolition, excavation):

Proposed cleanup activities at the site include: (1) Source control excavation of 15,000 cubic yards of petroleum impacted soil and 19,000 cubic yards of cleanup overburden, followed by transport of the contaminated soil to a disposal facility. Overburden will also be used on-site as backfill or removed off-site. (2) After excavation and prior to backfilling, a bioremediation amendment (such as oxygen release compound (ORC) in powder or spray form) will be directly applied to the open pit, mixed as necessary with the excavator bucket, and then covered with cleanup back fill as described above. (3) Infiltration galleries will be installed in the excavation areas prior to backfilling allowing for future application of a bioremediation amendment. (4) Follow up treatment includes treating groundwater using enhanced bioremediation agents, compliance monitoring of soil and groundwater, and institutional controls. (5) In the area of the former mill stack dioxins were detected, but below site specific cleanup levels. However, the top 6 inches of surface soil in this area will be scraped off and consolidated using standard construction techniques. The soil will be relocated on-site at depths greater than 5 feet below ground surface. (6) Approximately 200 CY of soil from the Hog Fuel Storage Area will be excavated and sent off-site for disposal.

Description of site drainage including flow from and onto adjacent properties. Must be consistent with Site Map in Appendix A:

The existing 10 acre site is located along Marine Drive and consists of a former plywood production site. To the east of the site is an operating log storage and debarking facility and Valley Creek, which is a type 3 stream; Port Angeles Harbor borders the site to the North, Platypus Marine to the West, and Marine Drive to the South.

With the exception of the grade break down into Port Angeles Harbor, the site contains relatively flat, gently sloping terrain with slopes around 1 percent. Elevations on-site range from 20' (NAVD 88) near the south portion of the site, to 0' at the north edge which is on the waterfront.

There are three existing stormwater basins on-site. In the main paved production area, stormwater is collected through an antiquated system of catch basins and routed into an existing swale. This stormwater swale eventually outfalls directly to Port Angeles Harbor.

Runoff from the center of the site ponds and infiltrates into the sandy fill material found in the former mill building footprint. Runoff on the east side and south side of the former main mill building footprint is discharged into a stormwater tightline that runs along the eastern portion of the building. It is assumed that the series of catch basins along the south and east sides of the main mill building all discharge directly into Port Angeles Harbor via an existing 12" ductile iron pipe below the travel lift pier.

Description of final stabilization (example: extent of revegetation, paving, landscaping):
The excavation footprint will be backfilled with clean suitable material. The final surface of the backfilled areas will be filled to an elevation that allows for the future placement of a pavement section, which will be completed during future site redevelopment. Future site development will occur in 2016.

***Contaminated Site Information*:**
Proposed activities regarding contaminated soils or groundwater (example: on-site treatment system, authorized sanitary sewer discharge):
Contaminated stormwater, wheel wash water, decon water, dewatering, and contaminated stockpile runoff will be collected, treated, and discharged to the sanitary sewer (City Approval / Permit in-process). This water may also be collected and treated/disposed at an off-site facility. Stormwater in the paved area of the site, where there is potential to come into contact with contaminated soil, will be collected by routing the water to the catch basins at the south end of the site. These catch basins are connected. The effluent from the last catch basin will be blocked and the water will be pumped from this catch basin to the wastewater treatment system, as detailed on the attached site plan (Appendix A).

Stormwater generated in the center of the site at Excavation Areas 1, 4, 5, and 6 will flow over land and infiltrate in the sandy fill found in the footprint of the former mill building as detailed on the attached site plan. The current grade of the site will be maintained to allow for water to flow toward the center of the site.

2 Construction Stormwater Best Management Practices (BMPs)

2.1 The 12 Elements

2.1.1 Element 1: Preserve Vegetation / Mark Clearing Limits

To protect adjacent properties and to reduce the area of soil exposed to construction, the limits of construction will be clearly marked before land-disturbing activities begin. In general, natural vegetation and in place dredge fill material shall be retained in an undisturbed state to the maximum extent possible. The BMPs relevant to marking the clearing limits that will be applied for this project include:

List and describe BMPs: Temporary chain link fence will be used to mark construction limits along with a silt fence (BMP C233) along the western, northern, and eastern boundary of the site.

Installation Schedules: Chain link fence already in-place. Silt fence to be installed just after mobilization to the site in early August.

Inspection and Maintenance plan: The contractor will visually inspect the chain link fence and silt fence daily and make repairs as needed. Owner CESCL will inspect on a weekly basis.

Responsible Staff: Contractor and Owner CESCL

2.1.2 Element 2: Establish Construction Access

Construction access or activities occurring on unpaved areas shall be minimized, yet where necessary, access points shall be stabilized to minimize the tracking of sediment onto public roads, and wheel washing, street sweeping, and street cleaning shall be employed to prevent sediment from entering state waters. All wash wastewater shall be controlled on site. The specific BMPs related to establishing construction access that will be used on this project include:

List and describe BMPs: A wheel wash (BMP C106) will be installed at southern exist of site.

Installation Schedules: Wheel wash to be installed just after mobilization to the site in early August.

Inspection and Maintenance plan: The contractor will visually inspect the wheel wash daily and make repairs as needed. Owner CESCL will inspect on a weekly basis.

Responsible Staff: Contractor and owner CESCL

2.1.3 Element 3: Control Flow Rates

No flow control facilities will be constructed as a part of the project. This project will not increase the impervious area at the Site.

Will you construct stormwater retention and/or detention facilities?
☐ Yes ☒ No

Will you use permanent infiltration ponds or other low impact development (example: rain gardens, bio-retention, porous pavement) to control flow during construction?
☐ Yes ☒ No

List and describe BMPs: Not Applicable

Installation Schedules: Not Applicable

Inspection and Maintenance plan: Not Applicable

Responsible Staff: Not Applicable

2.1.4 Element 4: Install Sediment Controls

All stormwater runoff from disturbed areas shall pass through an appropriate sediment removal BMP before leaving the construction site or being infiltrated on-site. The specific BMPs to be used for controlling sediment on this project include:

List and describe BMPs: Silt Fence (BMP C233) - A silt fence will be installed on the east, north and west parameter of the project site to prevent sediment from entering Port Angeles Harbor and adjacent properties. Storm Drain Inlet Protection (BMP C220) - Storm drain inlet catch basin filters will be installed in existing basins. See location of silt fence and inserts on TESC Plan.

Installation Schedules: Silt fence and inserts to be installed just after mobilization to the site in early August

Inspection and Maintenance plan: The contractor will visually inspect silt fence and catch basin inserts daily and make repairs as needed. Owner CESCL will inspect on a weekly basis.

Responsible Staff: Contractor and Owner CESCL

2.1.5 Element 5: Stabilize Soils

Exposed and unworked soils shall be stabilized with the application of effective BMPs to prevent erosion throughout the life of the project. The specific BMPs for soil stabilization that shall be used on this project include plastic covering (BMP C123) of overburden and contaminated soil stockpiles at the site.

West of the Cascade Mountains Crest

Season	Dates	Number of Days Soils Can be Left Exposed
During the Dry Season	May 1 – September 30	7 days
During the Wet Season	October 1 – April 30	2 days

Soils must be stabilized at the end of the shift before a holiday or weekend if needed based on the weather forecast.

Anticipated project dates: Start date: August 3, 2015 End date: October 30, 2015

Will you construct during the wet season?
☒ Yes ☐ No

List and describe BMPs: • Plastic Covering (BMP C123) – Cover overburden and contaminated soil stock piles with plastic sheeting. The contaminated soil stockpiles will be placed on asphalt and surrounded with a berm constructed of straw bales. This berm will be utilized as containment to collect potentially contaminated stormwater prior to treatment and discharge to the sanitary sewer.

Installation Schedules: Uncontaminated overburden soil stockpiles will be covered as needed to prevent runoff per the schedule listed above. Contaminated soil stockpiles will be covered prior to the end of that day's work.

Inspection and Maintenance plan: The contractor will visually inspect plastic covers/sheeting and containment berms daily and make repairs as needed. Owner CESCL will inspect on a weekly basis.

Responsible Staff: Contractor and Owner CESCL

2.1.6 Element 6: Protect Slopes

Will steep slopes be present at the site during construction?
☐ Yes ☒ No

List and describe BMPs: Not applicable. The Project will not produce any steep slopes. Soil stockpiles will be protected with plastic sheeting.

Installation Schedules: Not applicable.

Inspection and Maintenance plan: Not applicable.

Responsible Staff: Not applicable.

2.1.7 Element 7: Protect Drain Inlets

All storm drain inlets and culverts made operable during construction shall be protected to prevent unfiltered or untreated water from entering the drainage conveyance system. However, the first priority is to keep all access roads clean of sediment and keep street wash water separate from entering storm drains until treatment can be provided. Storm Drain Inlet Protection (BMP C220) will be implemented for all drainage inlets and culverts that could potentially be impacted by sediment-laden runoff on and near the project site. The following inlet protection measures will be applied on this project:

List and describe BMPs: Storm Drain Inlet Protection (BMP C220) - Storm drain inlet catch basin filters will be installed in existing basins. See location of silt fence and inserts on TESC Plan.

Installation Schedules: Inserts to be installed just after mobilization to the site in early August

Inspection and Maintenance plan: The contractor will visually inspect catch basin inserts daily and make repairs as needed. Owner CESCL will inspect on a weekly basis.

Responsible Staff: Contractor and Owner CESCL

2.1.8 Element 8: Stabilize Channels and Outlets

To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit, the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed the Stormwater Management Manual for Western Washington Volume II. Dated December 2014, after the first sign that existing BMPs are ineffective or failing.

The project site is located west of the Cascade Mountain Crest. As such, all temporary on-site conveyance channels shall be designed, constructed, and stabilized to prevent erosion from the expected peak 10 minute velocity of flow from a Type 1A, 10-year, 24-hour recurrence interval storm for the developed condition. Alternatively, the 10-year, 1-hour peak flow rate indicated by an approved continuous runoff simulation model, increased by a factor of 1.6, shall be used. Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent streambanks, slopes, and downstream reaches shall be provided at the outlets of all conveyance systems

Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches, will be installed at the outlets of all conveyance systems.

List and describe BMPs: A check dam (BMP C207) is currently installed at the end of the existing site drainage swale

Installation Schedules: Not Applicable

Inspection and Maintenance plan: Owner CESCL will inspect on a weekly basis.

Responsible Staff: Owner CESCL.

2.1.9 Element 9: Control Pollutants

The following pollutants are anticipated to be present on-site:

Table 2 – Pollutants

Pollutant (List pollutants and source, if applicable)
Suspended Solids
Petroleum (Gasoline, Oil, Diesel and BTEX)
PCP
Dioxins

All pollutants, including contaminated soil and groundwater, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well-organized, and free of debris. If required, BMPs to be implemented to control specific sources of pollutants are discussed below.

List and describe BMPs:

- All vehicles, equipment, and petroleum product storage/dispensing areas will be inspected regularly to detect any leaks or spills, and to identify maintenance needs to prevent leaks or spills.
- On-site fueling tanks and petroleum product storage containers shall include secondary containment.
- Spill prevention measures, such as drip pans, will be used when conducting maintenance and repair of vehicles or equipment.
- In order to perform emergency repairs on site, temporary plastic will be placed beneath and, if raining, over the vehicle.
- Contaminated surfaces shall be cleaned immediately following any discharge or spill incident.
- Construction water contaminated with petroleum hydrocarbons will be collected and batch treated onsite for disposal to sanitary sewer, or collected for disposal at an approved off-site location.

Installation Schedules: As needed for spill response and equipment maintenance BMPs.
A stormwater treatment system will be installed prior to the discharge of any contaminated wastewater.

Inspection and Maintenance plan: The contractor will visually inspect site and make improvements/repairs as needed. Owner CESCL will inspect on a weekly basis.

Responsible Staff: Contractor and Owner CESCL

Will maintenance, fueling, and/or repair of heavy equipment and vehicles occur on-site?
☒ Yes ☐ No

List and describe BMPs: See Above

Installation Schedules: See Above

Inspection and Maintenance plan: See Above

Responsible Staff: See Above

Will wheel wash or tire bath system BMPs be used during construction?
☒ Yes ☐ No

Construction wheel wash water will be collected and batch treated onsite for disposal to sanitary sewer or at approved off-site location. Approval letter/permit from City of Port Angeles POTW is in-process.

Installation Schedules: Prior to installation of wheel wash.

Inspection and Maintenance plan: The contractor will visually inspect site and make improvements/repairs as needed. Owner CESCL will inspect on a weekly basis.

Responsible Staff: Contractor and Owner CESCL

Will pH-modifying sources be present on-site?
☒ Yes ☐ No

Table 3 – pH-Modifying Sources

☐	None
☐	Bulk cement
☐	Cement kiln dust
☐	Fly ash
☐	Other cementitious materials
☐	New concrete washing or curing waters
☐	Waste streams generated from concrete grinding and sawing
☐	Exposed aggregate processes
☐	Dewatering concrete vaults
☐	Concrete pumping and mixer washout waters
☒	Recycled concrete
☐	Other (i.e., calcium lignosulfate) [please describe:]

List and describe BMPs: Plastic Covering (BMP C123) will be installed on crushed concrete stockpiles at the site.

Installation Schedules: Prior to beginning the excavation work the concrete will be crushed on-site (June to July 2015) and then the stockpiles will be covered with plastic.

Inspection and Maintenance plan: Owner CESCL will inspect on a weekly basis.

Responsible Staff: Owner CESCL.

2.1.10 Element 10: Control Dewatering

Dewatering water at the site may be contaminated with petroleum hydrocarbons.

Table 4 – Dewatering BMPs

☐	Infiltration
☒	Transport off-site in a vehicle (vacuum truck for legal disposal)
☐	Ecology-approved on-site chemical treatment or other suitable treatment technologies
☒	Sanitary or combined sewer discharge with local sewer district approval (last resort)
☐	Use of sedimentation bag with discharge to ditch or swale (small volumes of localized dewatering)

List and describe BMPs: Water designated for off-site disposal will be transported off-site in a vehicle or vacuum truck for legal disposal. Sanitary sewer discharge will be treated on-site with chemical treatment prior to discharge. Chemical treatment will include use of an oil/water separator to remove free product and TPH. Treatment for turbidity and total suspended solids will be accomplished through settling, a bag filter, and a filter composed of organo-clay and activated carbon. Discharge of water to sanitary sewer will only be with prior local sewer district approval and will meet City of Port Angeles discharge limits.

Installation Schedules: Prior to discharge

Inspection and Maintenance plan: The contractor will visually inspect site and make improvements/repairs as needed. Owner CESCL will inspect on a weekly basis.

Responsible Staff: Owner CESCL

2.1.11 Element 11: Maintain BMPs

This section is a list of permit requirements and does not have to be filled out.

All temporary and permanent Erosion and Sediment Control (ESC) BMPs shall be maintained and repaired as needed to ensure continued performance of their intended function.

Maintenance and repair shall be conducted in accordance with each particular BMP specification (see *Volume II of the SWMMWW or Chapter 7 of the SWMMEW*).

Visual monitoring of all BMPs installed at the site will be conducted at least once every calendar week and within 24 hours of any stormwater or non-stormwater discharge from the site. If the site becomes inactive and is temporarily stabilized, the inspection frequency may be reduced to once every calendar month.

All temporary ESC BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed.

Trapped sediment shall be stabilized on-site or removed. Disturbed soil resulting from removal of either BMPs or vegetation shall be permanently stabilized.

Additionally, protection must be provided for all BMPs installed for the permanent control of stormwater from sediment and compaction. BMPs that are to remain in place following completion of construction shall be examined and restored to full operating condition. If sediment enters these BMPs during construction, the sediment shall be removed and the facility shall be returned to conditions specified in the construction documents.

2.1.12 Element 12: Manage the Project

The project will be managed based on the following principles:

- Projects will be phased to the maximum extent practicable and seasonal work limitations will be taken into account.
- Inspection and monitoring:
  - Inspection, maintenance, and repair of all BMPs will occur as needed to ensure performance of their intended function.
  - Site inspections and monitoring will be conducted in accordance with Special Condition S4 of the CSWGP. Sampling locations are indicated on the Site Map. Sampling station(s) are located in accordance with applicable requirements of the CSWGP.
- Maintain an updated SWPPP.
  - The SWPPP will be updated, maintained, and implemented in accordance with Special Conditions S3, S4, and S9 of the CSWGP.

As site work progresses the SWPPP will be modified routinely to reflect changing site conditions. The SWPPP will be reviewed monthly to ensure the content is current.

Table 5 – Management

☒	Design the project to fit the existing topography, soils, and drainage patterns
☐	Emphasize erosion control rather than sediment control
☒	Minimize the extent and duration of the area exposed
☐	Keep runoff velocities low
☒	Retain sediment on-site
☒	Thoroughly monitor site and maintain all ESC measures
☒	Schedule major earthwork during the dry season
☐	Other (please describe)

Table 6 – BMP Implementation Schedule

Phase of Construction Project	Stormwater BMPs	Date	Wet/Dry Season
[Insert construction activity]	[Insert BMP]	[MM/DD/YYYY]	[Insert Season]
Mobilize equipment on site:	NA	08/03/2015	DRY
Mobilize and store all ESC and soil stabilization products:	NA	08/03/2015	DRY
Install silt fence:	Silt Fence	08/6/2015	DRY
Install catch basin inserts	Catch Basin Inserts	8/6/2015	DRY
Install wheel wash	Wheel Wash	8/6/2015	DRY
Block Catch Basins	Block Catch Basins and Catch Basin Effluent	8/6/2015	DRY
Install and setup Stormwater Treatment System	Stormwater Treatment	8/6/2015	DRY
Begin soil excavation	Plastic Sheeting	8/7/2015 & as needed throughout the project	DRY/WET
Complete construction	NA	10/20/2015	WET

3 Pollution Prevention Team

Table 7 – Team Information

Title	Name(s)	Phone Number
Certified Erosion and Sediment Control Lead (CESCL)	Jesse Waknitz – Port Environmental Manager	360-460-1364
Resident Engineer	Chris Hartman – Port Director of Engineering	360-460-3586
Emergency Ecology Contact	Doug Stolz – Ecology Responder Lead	360-407-6377
Emergency Permittee/ Owner Contact	Jesse Waknitz – Port Environmental Manager	360-460-1364
Non-Emergency Owner Contact	Jesse Waknitz – Port Environmental Manager	360-460-1364
Monitoring Personnel	Jesse Waknitz – Port Environmental Manager	360-460-1364
Ecology Regional Office	Southwest Region - Joyce Smith	360-407-6858

4 Monitoring and Sampling Requirements

Monitoring includes visual inspection, sampling for water quality parameters of concern, and documentation of the inspection and sampling findings in a site log book. A site log book will be maintained for all on-site construction activities and will include:

- A record of the implementation of the SWPPP and other permit requirements
- Site inspections
- Stormwater sampling data

File a blank form under Appendix D.

The site log book must be maintained on-site within reasonable access to the site and be made available upon request to Ecology or the local jurisdiction.

Numeric effluent limits may be required for certain discharges to 303(d) listed waterbodies. See CSWGP Special Condition S8 and Section 5 of this template.

4.1 Site Inspection

Site inspections will be conducted at least once every calendar week and within 24 hours following any discharge from the site. For sites that are temporarily stabilized and inactive, the required frequency is reduced to once per calendar month.

The discharge point(s) are indicated on the Site Map (see Appendix A) and in accordance with the applicable requirements of the CSWGP.

4.2 Stormwater Quality Sampling

4.2.1 Turbidity Sampling

Requirements include calibrated turbidity meter or transparency tube to sample site discharges for compliance with the CSWGP. Sampling will be conducted at all discharge points at least once per calendar week.

Method for sampling turbidity:

Table 8 – Turbidity Sampling Method

☒	Turbidity Meter/Turbidimeter (required for disturbances 5 acres or greater in size)
☐	Transparency Tube (option for disturbances less than 1 acre and up to 5 acres in size)

The benchmark for turbidity value is 25 nephelometric turbidity units (NTU) and a transparency less than 33 centimeters.

If the discharge's turbidity is 26 to 249 NTU **or** the transparency is less than 33 cm but equal to or greater than 6 cm, the following steps will be conducted:

1. Review the SWPPP for compliance with Special Condition S9. Make appropriate revisions within 7 days of the date the discharge exceeded the benchmark.
2. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible. Address the problems within 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period.
3. Document BMP implementation and maintenance in the site log book.

If the turbidity exceeds 250 NTU **<u>or</u>** the transparency is 6 cm or less at any time, the following steps will be conducted:

1. Telephone the applicable Ecology Region's Environmental Report Tracking System (ERTS) number within 24 hours.
    - **Central Region** (Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima): (509) 575-2490
    - **Eastern Region** (Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman): (509) 329-3400
    - **Northwest Region** (King, Kitsap, Island, San Juan, Skagit, Snohomish, Whatcom): (425) 649-7000
    - **Southwest Region** (Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Lewis, Mason, Pacific, Pierce, Skamania, Thurston, Wahkiakum,): (360) 407-6300
2. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible. Address the problems within 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period
3. Document BMP implementation and maintenance in the site log book.
4. Continue to sample discharges daily until one of the following is true:
    - Turbidity is 25 NTU (or lower).
    - Transparency is 33 cm (or greater).
    - Compliance with the water quality limit for turbidity is achieved.
        - 1 - 5 NTU over background turbidity, if background is less than 50 NTU
        - 1% - 10% over background turbidity, if background is 50 NTU or greater
    - The discharge stops or is eliminated.

4.2.2 pH Sampling

pH monitoring is required for “Significant concrete work” (i.e., greater than 1000 cubic yards poured or recycled concrete over the life of the project). The use of engineered soils (soil amendments including but not limited to Portland cement-treated base [CTB], cement kiln dust [CKD] or fly ash) also requires pH monitoring.

For significant concrete work, pH sampling will start the first day concrete is poured and continue until it is cured, typically three (3) weeks after the last pour.

For engineered soils, pH sampling begins when engineered soils are first exposed to precipitation and continues until the area is fully stabilized.

If the measured pH is 8.5 or greater, the following measures will be taken:

1. Prevent high pH water from entering storm sewer systems or surface water.
2. Adjust or neutralize the high pH water to the range of 6.5 to 8.5 su using appropriate technology such as carbon dioxide (CO_2) sparging (liquid or dry ice).
3. Written approval will be obtained from Ecology prior to the use of chemical treatment other than CO_2 sparging or dry ice.

Method for sampling pH:

Table 9 – pH Sampling Method

☐	pH meter
☐	pH test kit
☒	Wide range pH indicator paper

5 Discharges to 303(d) or Total Maximum Daily Load (TMDL) Waterbodies

5.1 303(d) Listed Waterbodies

Is the receiving water 303(d) (Category 5) listed for turbidity, fine sediment, phosphorus, or pH?
☐ Yes ☒ No

List the impairment(s):

Not Applicable

5.2 TMDL Waterbodies

Waste Load Allocation for CWSGP discharges:

List and describe BMPs:

Not Applicable

Discharges to TMDL receiving waterbodies will meet in-stream water quality criteria at the point of discharge.

The Construction Stormwater General Permit Proposed New Discharge to an Impaired Water Body form is included in Appendix F.

6 Reporting and Record Keeping

6.1 Record Keeping

6.1.1 Site Log Book

A site log book will be maintained for all on-site construction activities and will include:

- A record of the implementation of the SWPPP and other permit requirements
- Site inspections
- Sample logs

6.1.2 Records Retention

Records will be retained during the life of the project and for a minimum of three (3) years following the termination of permit coverage in accordance with Special Condition S5.C of the CSWGP.

Permit documentation to be retained on-site:

- CSWGP
- Permit Coverage Letter
- SWPPP
- Site Log Book

Permit documentation will be provided within 14 days of receipt of a written request from Ecology. A copy of the SWPPP or access to the SWPPP will be provided to the public when requested in writing in accordance with Special Condition S5.G.2.b of the CSWGP.

6.1.3 Updating the SWPPP

The SWPPP will be modified if:

- Found ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site.
- There is a change in design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the State.

The SWPPP will be modified within seven (7) days if inspection(s) or investigation(s) determine additional or modified BMPs are necessary for compliance. An updated timeline for BMP implementation will be prepared.

6.2 Reporting

6.2.1 Discharge Monitoring Reports

Cumulative soil disturbance is one (1) acre or larger; therefore, Discharge Monitoring Reports (DMRs) will be submitted to Ecology monthly. If there was no discharge during a given monitoring period the DMR will be submitted as required, reporting "No Discharge." The DMR due date is fifteen (15) days following the end of each calendar month.

DMRs will be reported online through Ecology's WQWebDMR System.

6.2.2 Notification of Noncompliance

If any of the terms and conditions of the permit is not met, and the resulting noncompliance may cause a threat to human health or the environment, the following actions will be taken:

1. Ecology will be immediately notified of the failure to comply by calling the applicable Regional office ERTS phone number (Regional office numbers listed below).
2. Immediate action will be taken to prevent the discharge/pollution or otherwise stop or correct the noncompliance. If applicable, sampling and analysis of any noncompliance will be repeated immediately and the results submitted to Ecology within five (5) days of becoming aware of the violation.
3. A detailed written report describing the noncompliance will be submitted to Ecology within five (5) days, unless requested earlier by Ecology.

Specific information to be included in the noncompliance report is found in Special Condition S5.F.3 of the CSWGP.

Anytime turbidity sampling indicates turbidity is 250 NTUs or greater, or water transparency is 6 cm or less, the Ecology Regional office will be notified by phone within 24 hours of analysis as required by Special Condition S5.A of the CSWGP.

- **Central Region** at (509) 575-2490 for Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, or Yakima County
- **Eastern Region** at (509) 329-3400 for Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, or Whitman County
- **Northwest Region** at (425) 649-7000 for Island, King, Kitsap, San Juan, Skagit, Snohomish, or Whatcom County
- **Southwest Region** at (360) 407-6300 for Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Lewis, Mason, Pacific, Pierce, Skamania, Thurston, or Wahkiakum

Include the following information:

1. Your name and phone number
2. Permit number
3. City / County of project
4. Sample results
5. Date / Time of call
6. Date / Time of sample
7. Project name

In accordance with Special Condition S4.D.5.b of the CSWGP, the Ecology Regional office will be notified if chemical treatment other than CO_2 sparging is planned for adjustment of high pH water.

A. Site Map

The site map must meet the requirements of Special Condition S9.E of the CSWGP

B. BMP Detail

Insert BMPs specification sheets here.
Download BMPs from the Ecology Construction Stormwater website at:
http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html
Select Resources and Guidance to find the links to the Stormwater Manuals.

C. Correspondence

Ecology
EPA
Local Government

D. Site Inspection Form

Create your own or download Ecology's template:
http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html
Select Permit, Forms and Application to find the link to the Construction Stormwater Site Inspection Form.

E. Construction Stormwater General Permit (CSWGP)

Download the CSWGP:
http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html

F. 303(d) List Waterbodies / TMDL Waterbodies Information

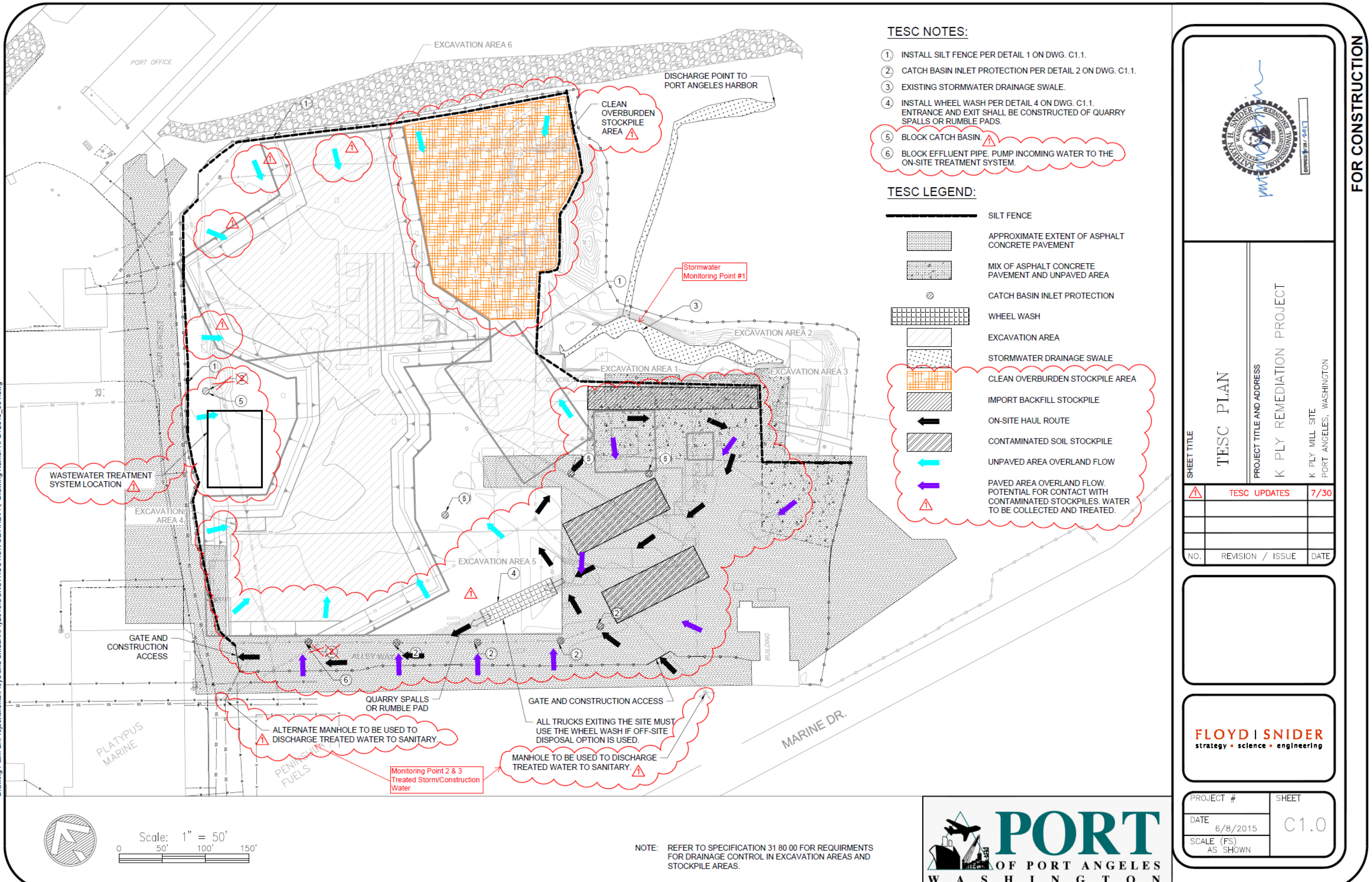
Proposed New Discharge to an Impaired Water Body form
SWPPP Addendum addressing impairment

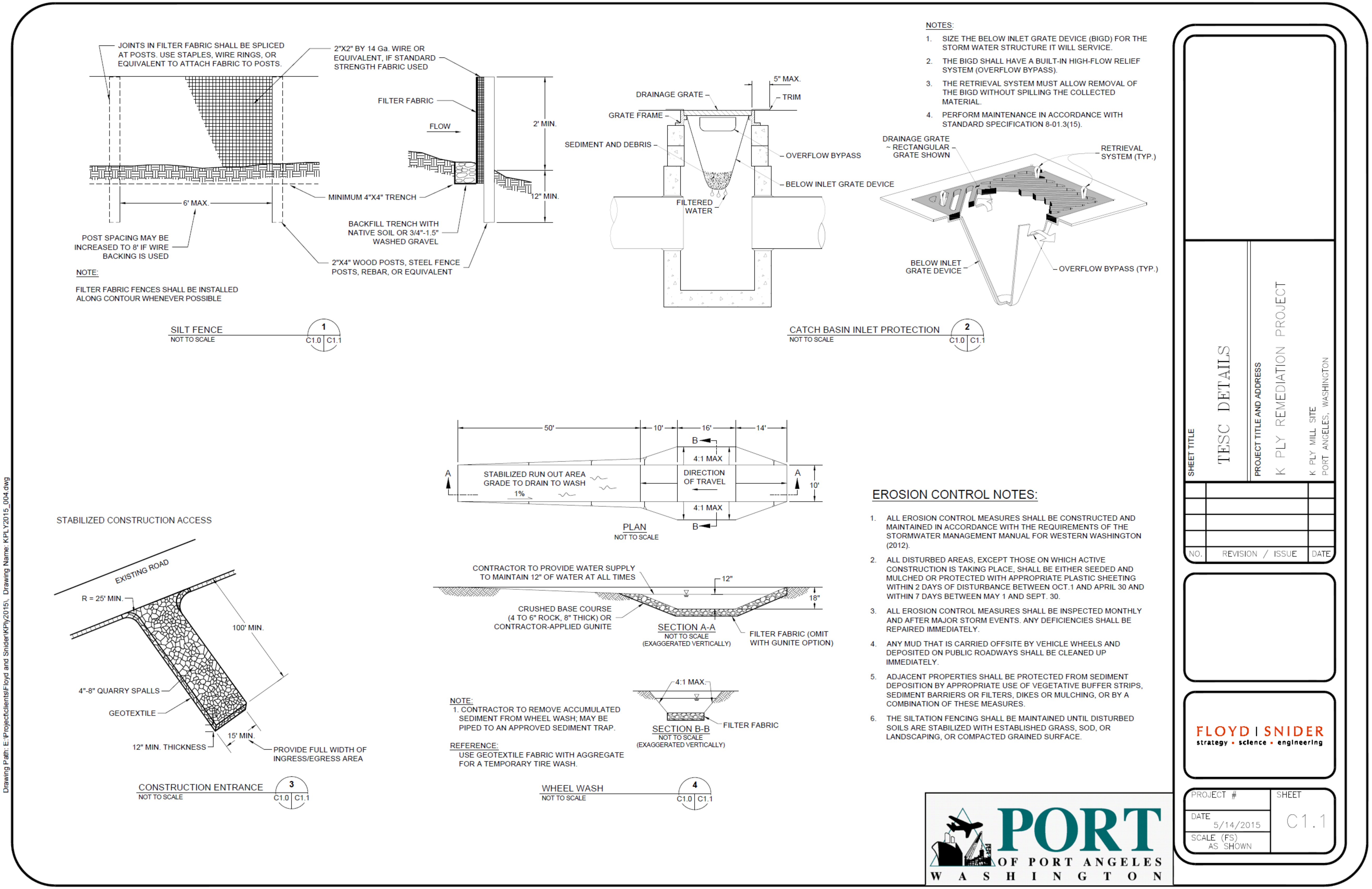
G. Contaminated Site Information

Administrative Order
Sanitary Discharge Permit
Soil Management Plan
Soil and Groundwater Reports
Maps and Figures Depicting Contamination

H. Engineering Calculations

Appendix A – Site Map

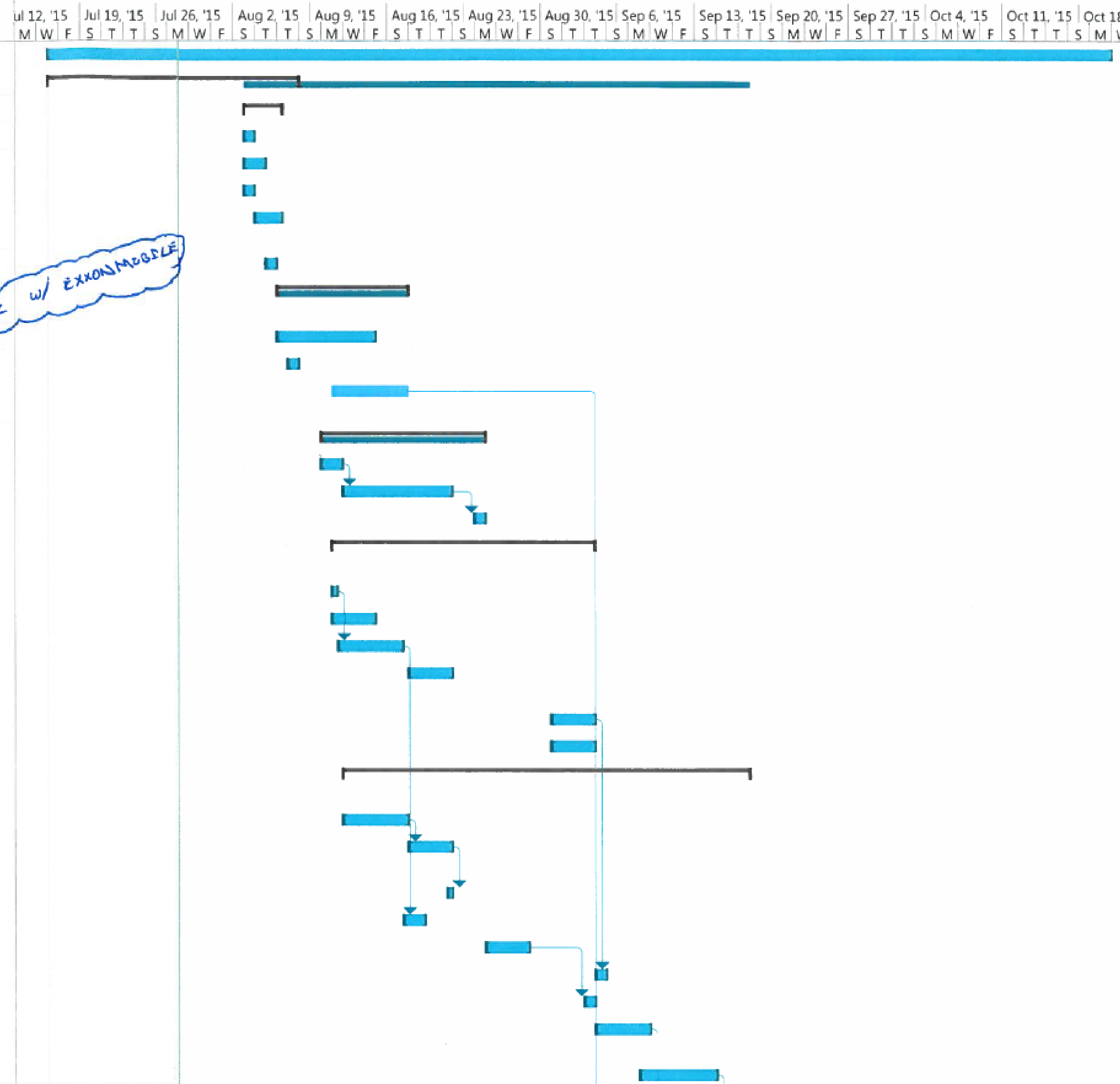



JOINTS IN FILTER FABRIC SHALL BE SPLICED AT POSTS. USE STAPLES, WIRE RINGS, OR EQUIVALENT TO ATTACH FABRIC TO POSTS.
2"X2" BY 14 Ga. WIRE OR EQUIVALENT, IF STANDARD STRENGTH FABRIC USED
FILTER FABRIC
FLOW
2' MIN.
12" MIN.
MINIMUM 4"X4" TRENCH
6' MAX.
BACKFILL TRENCH WITH NATIVE SOIL OR 3/4"-1.5" WASHED GRAVEL
POST SPACING MAY BE INCREASED TO 8' IF WIRE BACKING IS USED
2"X4" WOOD POSTS, STEEL FENCE POSTS, REBAR, OR EQUIVALENT
NOTE:
FILTER FABRIC FENCES SHALL BE INSTALLED ALONG CONTOUR WHENEVER POSSIBLE
SILT FENCE
NOT TO SCALE
1
C1.0 C1.1
DRAINAGE GRATE
5" MAX.
TRIM
GRATE FRAME
SEDIMENT AND DEBRIS
OVERFLOW BYPASS
BELOW INLET GRATE DEVICE
FILTERED WATER
NOTES:
1. SIZE THE BELOW INLET GRATE DEVICE (BIGD) FOR THE STORM WATER STRUCTURE IT WILL SERVICE.
2. THE BIGD SHALL HAVE A BUILT-IN HIGH-FLOW RELIEF SYSTEM (OVERFLOW BYPASS).
3. THE RETRIEVAL SYSTEM MUST ALLOW REMOVAL OF THE BIGD WITHOUT SPILLING THE COLLECTED MATERIAL.
4. PERFORM MAINTENANCE IN ACCORDANCE WITH STANDARD SPECIFICATION 8-01.3(15).
DRAINAGE GRATE – RECTANGULAR – GRATE SHOWN
RETRIEVAL SYSTEM (TYP.)
BELOW INLET GRATE DEVICE
OVERFLOW BYPASS (TYP.)
CATCH BASIN INLET PROTECTION
NOT TO SCALE
2
C1.0 C1.1
50'
10'
16'
14'
B
4:1 MAX
A
STABILIZED RUN OUT AREA GRADE TO DRAIN TO WASH
1%
DIRECTION OF TRAVEL
10'
PLAN
NOT TO SCALE
STABILIZED CONSTRUCTION ACCESS
EXISTING ROAD
R = 25' MIN.
100' MIN.
4"-8" QUARRY SPALLS
GEOTEXTILE
15' MIN.
12" MIN. THICKNESS
PROVIDE FULL WIDTH OF INGRESS/EGRESS AREA
CONSTRUCTION ENTRANCE
NOT TO SCALE
3
C1.0 C1.1
CONTRACTOR TO PROVIDE WATER SUPPLY TO MAINTAIN 12" OF WATER AT ALL TIMES
12"
18"
CRUSHED BASE COURSE (4 TO 6" ROCK, 8" THICK) OR CONTRACTOR-APPLIED GUNITE
SECTION A-A
NOT TO SCALE
(EXAGGERATED VERTICALLY)
FILTER FABRIC (OMIT WITH GUNITE OPTION)
4:1 MAX.
NOTE:
1. CONTRACTOR TO REMOVE ACCUMULATED SEDIMENT FROM WHEEL WASH; MAY BE PIPED TO AN APPROVED SEDIMENT TRAP.
REFERENCE:
USE GEOTEXTILE FABRIC WITH AGGREGATE FOR A TEMPORARY TIRE WASH.
SECTION B-B
NOT TO SCALE
(EXAGGERATED VERTICALLY)
FILTER FABRIC
WHEEL WASH
NOT TO SCALE
4
C1.0 C1.1
EROSION CONTROL NOTES:
1. ALL EROSION CONTROL MEASURES SHALL BE CONSTRUCTED AND MAINTAINED IN ACCORDANCE WITH THE REQUIREMENTS OF THE STORMWATER MANAGEMENT MANUAL FOR WESTERN WASHINGTON (2012).
2. ALL DISTURBED AREAS, EXCEPT THOSE ON WHICH ACTIVE CONSTRUCTION IS TAKING PLACE, SHALL BE EITHER SEEDED AND MULCHED OR PROTECTED WITH APPROPRIATE PLASTIC SHEETING WITHIN 2 DAYS OF DISTURBANCE BETWEEN OCT.1 AND APRIL 30 AND WITHIN 7 DAYS BETWEEN MAY 1 AND SEPT. 30.
3. ALL EROSION CONTROL MEASURES SHALL BE INSPECTED MONTHLY AND AFTER MAJOR STORM EVENTS. ANY DEFICIENCIES SHALL BE REPAIRED IMMEDIATELY.
4. ANY MUD THAT IS CARRIED OFFSITE BY VEHICLE WHEELS AND DEPOSITED ON PUBLIC ROADWAYS SHALL BE CLEANED UP IMMEDIATELY.
5. ADJACENT PROPERTIES SHALL BE PROTECTED FROM SEDIMENT DEPOSITION BY APPROPRIATE USE OF VEGETATIVE BUFFER STRIPS, SEDIMENT BARRIERS OR FILTERS, DIKES OR MULCHING, OR BY A COMBINATION OF THESE MEASURES.
6. THE SILTATION FENCING SHALL BE MAINTAINED UNTIL DISTURBED SOILS ARE STABILIZED WITH ESTABLISHED GRASS, SOD, OR LANDSCAPING, OR COMPACTED GRAINED SURFACE.
Drawing Path: E:\Projects\clients\Floyd and Snider\KPly2015\ Drawing Name: KPLY2015_004.dwg
PORT OF PORT ANGELES WASHINGTON
SHEET TITLE
TESC DETAILS
PROJECT TITLE AND ADDRESS
K PLY REMEDIATION PROJECT
K PLY MILL SITE
PORT ANGELES, WASHINGTON
NO. REVISION / ISSUE DATE
FLOYD | SNIDER
strategy • science • engineering
PROJECT #
SHEET
DATE 5/14/2015
C1.1
SCALE (FS) AS SHOWN

Project Schedule

Port to Port Angeles - K Ply Remediation
ERRG Project No. - 2015-068

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		**Rollup**	**69 days**	**Thu 7/16/15**	**Tue 10/20/15**	
2		**Planning Documents/Submittals**	**17 days**	**Thu 7/16/15**	**Fri 8/7/15**	
3		**Mobilization/Site Setup/BMPs**	**3.5 days**	**Mon 8/3/15**	**Thu 8/6/15**	
4		Utility Locates	1 day	Mon 8/3/15	Mon 8/3/15	
5		Site Surveys	2 days	Mon 8/3/15	Tue 8/4/15	
6		Move-In Heavy Equipment	1 day	Mon 8/3/15	Mon 8/3/15	
7		BMPs Install, Silt Fence/Wheel Wash	2.5 days	Tue 8/4/15	Thu 8/6/15	
8		Sample Import Material Source	1 day	Wed 8/5/15	Wed 8/5/15	
9		**Dispose of Surface Waste/ Track Removal**	**8 days**	**Thu 8/6/15**	**Mon 8/17/15**	
10		Stockpile CDL/Track Waste	7 days	Thu 8/6/15	Fri 8/14/15	
11		Excavate & Remove Pipeline 8	1 day	Fri 8/7/15	Fri 8/7/15	* COORDINATE w/ EXXONMOBILE
12		Off-Site Trans and Disposal, CDL/RR	5 days	Tue 8/11/15	Mon 8/17/15	
13		**Install Sheet Pile Shoring**	**11 days**	**Mon 8/10/15**	**Mon 8/24/15**	
14		Axis Crane Move-In	2 days	Mon 8/10/15	Tue 8/11/15	
15		Install Sheet Pile shoring	8 days	Wed 8/12/15	Fri 8/21/15	14
16		Axis Crane Move-Out	1 day	Mon 8/24/15	Mon 8/24/15	15
17		**Excavation/Stockpile Clean Over-Burden**	**18 days**	**Tue 8/11/15**	**Thu 9/3/15**	
18		Excavation/Stockpile Area 2	0.5 days	Tue 8/11/15	Tue 8/11/15	
19		Floyd/Snider Sample Overburden	4 days	Tue 8/11/15	Fri 8/14/15	
20		Excavation/Stockpile Area 5	4 days	Tue 8/11/15	Mon 8/17/15	18
21		Floyd/Snider Sample Overburden	4 days	Tue 8/18/15	Fri 8/21/15	
22		Excavate Overburden Area 6	4 days	Mon 8/31/15	Thu 9/3/15	
23		Sample Overburden Area 6	4 days	Mon 8/31/15	Thu 9/3/15	
24		**Excavation Contaminated Soil/Backfill Area**	**27 days**	**Wed 8/12/15**	**Thu 9/17/15**	
25		Excavation Area 1, 2, 3,& 4	4 days	Wed 8/12/15	Mon 8/17/15	
26		Floyd/Snider Confirmation Sampling, 3 Day TAT	4 days	Tue 8/18/15	Fri 8/21/15	25
27		Survey Area 1, 2, 3 & 4 Excavation	0.5 days	Fri 8/21/15	Fri 8/21/15	26
28		Backfill Area 1,2 & 3	2 days	Mon 8/17/15	Wed 8/19/15	20
29		Excavation Area 5	4 days	Tue 8/25/15	Fri 8/28/15	
30		Confirmation Sampling Area 5	1 day	Fri 9/4/15	Fri 9/4/15	22
31		Survey Area 5	1 day	Thu 9/3/15	Thu 9/3/15	29
32		Backfill Area 5 Above Groundwater	3 days	Fri 9/4/15	Tue 9/8/15	
33		Excavation Area 6	5 days	Tue 9/8/15	Mon 9/14/15	



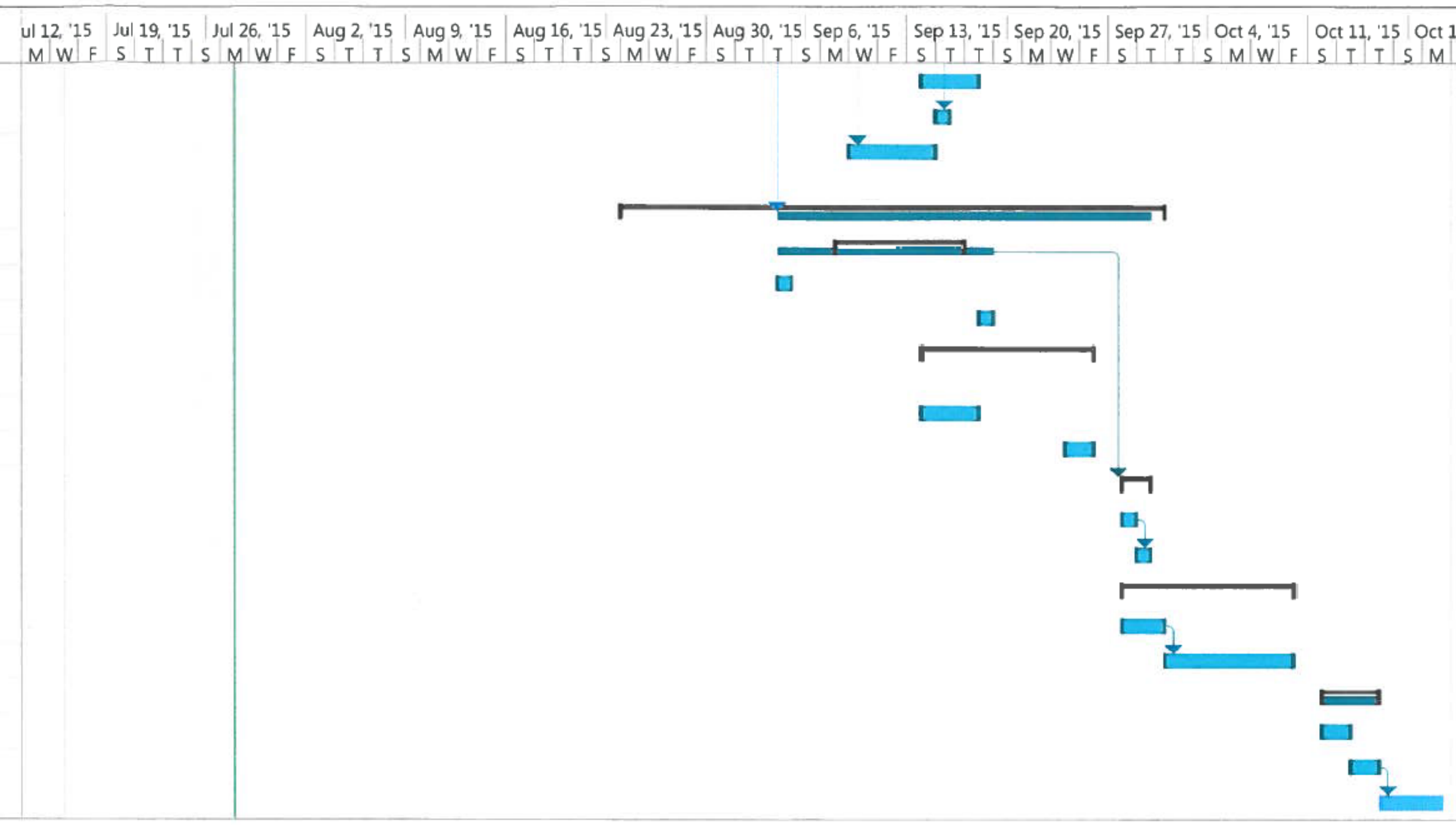
Project: K-Ply Project Schedule.
Date: Tue 7/28/15

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

Project Schedule

Port to Port Angeles - K Ply Remediation
ERRG Project No. - 2015-068

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
34		Confirmation Sampling Area 6	4 days	Mon 9/14/15	Thu 9/17/15	
35		Survey Area 6	1 day	Tue 9/15/15	Tue 9/15/15	33
36		Backfill Area 6 Above Groundwater	4 days	Wed 9/9/15	Mon 9/14/15	32
37		**T&D of Contaminated Material**	**28 days**	**Mon 8/24/15**	**Wed 9/30/15**	**12FS-15 days**
38		**Install Bioamendment**	**7 days**	**Tue 9/8/15**	**Wed 9/16/15**	
39		Area 5	1 day	Fri 9/4/15	Fri 9/4/15	
40		Area 6	1 day	Fri 9/18/15	Fri 9/18/15	
41		**Place and Compact Fill/Prior IG Install**	**10 days**	**Mon 9/14/15**	**Fri 9/25/15**	
42		Area 5	4 days	Mon 9/14/15	Thu 9/17/15	
43		Area 6	2 days	Thu 9/24/15	Fri 9/25/15	
44		**Install Infiltration Galleries**	**2 days**	**Mon 9/28/15**	**Tue 9/29/15**	**38**
45		Area 5	1 day	Mon 9/28/15	Mon 9/28/15	
46		Area 6	1 day	Tue 9/29/15	Tue 9/29/15	45
47		**Place and Compact Fill**	**10 days**	**Mon 9/28/15**	**Fri 10/9/15**	
48		Area 5 Backfill	3 days	Mon 9/28/15	Wed 9/30/15	
49		Area 6 Backfill	7 days	Thu 10/1/15	Fri 10/9/15	48
50		**Site Restoration**	**4 days**	**Mon 10/12/15**	**Thu 10/15/15**	
51		Install Bollards	2 days	Mon 10/12/15	Tue 10/13/15	
52		Remove BMPs	2 days	Wed 10/14/15	Thu 10/15/15	
53		**Demob**	**2.5 days**	**Fri 10/16/15**	**Tue 10/20/15**	**52**



Project: K-Ply Project Schedule.
Date: Tue 7/28/15

Task	Project Summary	Manual Task	Start-only
Split	Inactive Task	Duration-only	Finish-only
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks
Summary	Inactive Summary	Manual Summary	External Milestone
Deadline	Progress	Manual Progress	

Page 2

K Ply Site

Engineering Design Report

Appendix B
Geotechnical Report

DRAFT

Geotechnical Engineering Report

K Ply Site Cleanup

Port Angeles, Washington

Prepared for

Floyd Snider

May 19, 2015
19128-00

HARTCROWSER

www.hartcrowser.com

DRAFT

Geotechnical Engineering Report

K Ply Site Cleanup

Port Angeles, Washington

Prepared for

Floyd Snider

May 19, 2015
19128-00

Prepared by

Hart Crowser, Inc.

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APPENDIX D
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INTRODUCTION

This report summarizes the results of our subsurface investigations and provides geotechnical engineering recommendations for the K Ply site cleanup at the Port of Port Angeles (Port). The Port is planning to develop the property for use by marine trade tenants. Figure 1 shows the project vicinity, and Figure 2 shows the location of test pit explorations Hart Crowser, Inc., completed for this study and others completed for past studies.

This report contains the following sections:

- Introduction;
- Purpose, Scope, and Limitations of this Report;
- Project Understanding;
- Subsurface Conditions;
- Geotechnical Engineering Design Recommendations; and
- Recommended Additional Geotechnical Services.

Tables, figures, and appendices follow the main body of the report. Appendix A presents geotechnical exploration logs from our field work at the site. Appendix B provides geotechnical laboratory testing results. Appendix C presents additional explorations performed by others. Appendix D contains historical bulkhead, railroad trestle, berm, and dredging plans and photos.

PURPOSE, SCOPE, AND LIMITATIONS OF THIS REPORT

Purpose

The purpose of our work was to:

- Assess subsurface conditions;
- Develop earthwork design recommendations; and
- Provide geotechnical recommendations and consulting, primarily for the remediation area.

Scope

Our scope of work included the following:

- Perform field explorations at the project site;
- Conduct geotechnical laboratory tests of selected soil samples collected during our explorations;
- Develop geotechnical design recommendations for the remediation area;

- Prepare this report; and
- Provide consultation and review of plans and specifications.

The subsurface investigation program for this study consisted of seventeen test pits. Geotechnical laboratory test results were used to classify site soils and to estimate their geotechnical engineering properties.

Use of This Report

We completed this work in general accordance with our proposal dated March 12, 2015. Our report is for the exclusive use of Floyd Snider, the Port, and their design consultants for specific application to the subject project and site. We completed this study in accordance with generally accepted geotechnical practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. We make no other warranty, expressed or implied.

PROJECT UNDERSTANDING

The Site

The project site is northwest of downtown Port Angeles, Washington, near Terminals 1 and 3 at Port Angeles Harbor. The site is bordered by the Marine Trades Area site to the west, the Valley Creek Estuary to the east, and West Marine Drive to the south, and Port Angeles Harbor to the north (Figure 1).

The general site layout is shown on Figure 2. Site grades are generally level, with a low area at the west and south edge of the former log pond area and a raised mound just east of the west edge of the former log pond. The current work is focused on the site remediation area, including the proposed excavation boundaries on the western side of the site, as shown on Figure 3. The eastern half of the site is currently occupied by a log storage and processing tenant.

Several mostly demolished structures are still on the site from the former Pen Ply North Mill Building, and there are several concrete pads, walls, and foundations, as shown on Figure 2. The largest concrete pads are near the southwest corner and the north central portion; they are elevated about 3 to 4 feet above grade and filled with fill soil and/or pea gravel. The larger pad is partly supported with steel beams and piers on isolated concrete footings with a section of train rails underneath it. Four smaller concrete pads are on the east side of the site.

Plastic sheeting covers an area west of the north central concrete pad and another area north of the southwestern concrete pad. Concrete rubble is stockpiled in several areas across the site (Figure 2).

The old log pond was approximately east of the storm drain running north–south (Figure 2) and north of the old Bamford Lathe. The location of the old log pond, Bamford Lathe, and other historical site features is on Figure 2.3 of the remedial investigation/feasibility study (RI/FS) by Floyd Snider (2014). The log pond is described in more detail in the Site Geology section of this report.

The north side of the site is bounded by a riprap slope at 22 to 30 degrees from horizontal leading to the harbor. According to historical plans, the slope is a soil fill berm with a 2H:1V slope on the south side and a 30-degree (from horizontal) riprap slope on the north side. The riprap slope appears to have been constructed with a two- to three-tiered wood bulkhead with wood deadman anchors and lagging, but the wood is no longer visible. A former railroad trestle of timber piles (about 15 feet wide) is within this berm. The trestle pile bents are spaced approximately 15 feet apart on center, and consist of about six timber piles spaced 2 feet on center. These historical site features are shown in the historical plans and photos in Appendix D.

Proposed Cleanup Actions and Future Site Development

The current project consists of remediation of the western part of the site (Figure 3). Cleanup activities generally consist of demolishing concrete structures and pads, crushing demolished concrete and concrete debris piles, removing soil with concentrations of contaminants of concern (COCs) above cleanup levels (CULs), bioremediating impacted soil and groundwater, and possibly conducting thermal desorption of impacted soil. Soil with concentrations of COCs below CULs overlies impacted soil (soil with concentrations of COC above CULs) over much of the remedial excavation area.

The entire site, including the log storage/processing area, is intended to be used by future tenants and would be developed to suit their needs. At this time the specific future tenant use of the property is unknown, but is expected to consist of maritime trade use similar to the use west of the site. The property west of the site includes high bay metal frame buildings and pavement sections to support mobile ship cranes (up to a 500-ton travel lift). At this point, we understand that the Port would like to be able to use the site for heavy equipment traffic and storage before final development by future tenants. Specific pavement and building loads, sizes, and locations will be needed to perform design-level geotechnical analysis and provide recommendations.

SUBSURFACE CONDITIONS

Subsurface information in this report uses data collected during our explorations, as well as data from past explorations. Our current exploration program consisted of 17 test pits excavated to depths of about 3 to 13 feet below ground surface (bgs) between March 25, 2015, and March 27, 2015. The test pits were excavated to the depths at which impacted soil is anticipated to extend, unless caving soil prevented excavation to these depths. TP-7 was excavated through a 10-foot pile/mound of wood waste and was continued adjacent to the pile down to 9 feet bgs. The locations of the current test pits along with the explorations from previous studies we used in our analyses are shown on Figure 2.

Subsurface conditions presented herein were determined from samples collected from discrete test pit locations in the field. Subsurface conditions at other locations may vary. The nature and extent of any such variations may not become apparent until construction activities have begun. Logs of test pits and laboratory test results are in Appendices A and B, respectively.

Geologic History

Regional Geology

Site geology generally consists of Holocene artificial fill and modified land (Qf) made up of hydraulic fill, log pond, and riprap slope protection, underlain by Quaternary alluvium (Qa), which consists of unconsolidated alluvial clay, silt, sand, gravel and cobble deposits. Beneath the Qa deposits, Pleistocene continental glacial drift (Qgd) exists. This unit consists of till and outwash clay, silt, sand, gravel, cobbles, and boulders deposited by glaciers.

Site Geology

The site geologic history is outlined in Floyd Snider's 2014 RI/FS and cleanup action plan (CAP) documents. The site was originally a tidal flat. The railroad timber trestle, current timber bulkhead, and riprap slope and soil berm were built first along the north side of the site. The inland area of the site was filled with hydraulic fill dredged from the harbor in 1926. The log pond (to the east of the filled area) was built by the Port in 1941. Rock fill was initially placed along the rail trestle. Between 1946 and 1988, the pond was periodically filled with soil and rock material, with some wood debris. The remainder of the log pond was filled in 1996 with approximately 130,000 cubic yards of various types of soil fill.

Generalized Subsurface Soil Conditions

Most of the soil encountered in our test pits was hydraulic fill. Previous soil explorations show that the thickness of hydraulic fill ranges from 12 to 20 feet bgs at the site. The soil within the hydraulic fill can be further grouped into general engineering soil units (ESU) for ease of discussion. Different samples from the same test pit had different characteristics. The following subsections describe in general the ESUs encountered. Table 1 provides a summary of the ESUs, and typical ranges of gravel, sand, and fines content encountered in our test pit explorations.

Table 1 – ESU Summary

ESU[a]	USCS	% Gravel	% Sand	% Fines	Soil Description
1	SP, SM	0 to 1.3	63.1 to 77.9	22.1 to 36.9	Moist to wet, gray to brown, silty to very silty, fine to medium Sand, scattered shell fragments and occasional fine sandy silt layers.
2A	SP, SW, SP-SM, SW-SM, GP, GP-GM	12.9 to 64	27.3 to 85	2.1 to 13.4	Damp to wet, gray to dark brown and red-brown to light brown, trace silt to slightly silty, gravelly to very gravelly Sand to sandy Gravel, scattered shell fragments.
2B	SP, SW, SW-SM	1.6 to 4.8	89.6 to 98.8	1.5 to 8.8	Moist to wet, dark gray to gray-brown, clean to slightly silty, trace gravel, fine to medium Sand.
3	ML	0.3	9.8	89.9	Moist to wet, brown to gray Silt to slightly sandy Silt, mottled, scattered wood fragments.
4A[a,b]	NA	No tests	No tests	No tests	Moist to wet, dark brown, primarily wood debris and organic material, little soil matrix (Wood Waste).
4B[b]	SM, GM	29.2 to 45.9	38.8 to 53.1	15.4 to 17.7	Moist, dark gray-brown to brown, trace silt to silty, sandy Gravel and trace gravel to gravelly Sand, trace cobble and quarry spalls, frequent organic content and wood chips.

Notes:

a. ESU 4A is based on visual classification by volume basis since wood debris is lighter than aggregates. Colors are consistent with the colors used on Figure 3. See Fill Selection, Placement, and Compaction section for more information about suitability of ESU for reuse as backfill.

b. Two organic material content (wood debris or decaying plant material) tests were performed on a sample from ESU 4A (50%) and a sample from ESU 4B (16%). However, the organic material content results from these tests from ESU do not appear to be representative of the actual wood debris content found by visual classifications and suggested by the elevated moisture content of samples from ESU 4.

ESU 1

ESU 1 consists of silty to very silty, fine to medium Sand, with scattered shell fragments and occasional fine sandy silt layers. This unit was encountered in TP-5, TP-8 through TP-11, and TP-15 through TP-18. The thickness of this layer varies between 1 and 10 feet thick.

A similar unit was encountered in test pits TP-6 and TP-7 near the old log pond fill area. However, these soils consisted of substantial organic material and wood debris and may represent a material similar to wood waste.

ESU 2

We encountered ESU 2 in all our test pits except TP-6, TP-7, and TP-11. ESU 2 is similar to ESU 1, but contains less than 15 percent fines. We subdivided ESU 2 into ESU 2A and ESU 2B. ESU 2A generally consists of clean to slightly silty, trace gravel to gravelly, fine to medium Sand. ESU 2B generally consists of trace silt to slightly silty, gravelly to very gravelly Sand to sandy Gravel. Both subunits contain scattered shell fragments.

ESU 3

We encountered ESU 3 in the southern half of the project site in TP-10, TP-15, TP-16, and TP-17. This ESU generally consisted of Silt to slightly sandy Silt with scattered wood fragments.

ESU 4

We encountered a large amount of wood and wood debris near the old log pond fill area (TP-6, TP-7, and TP-12). ESU 4 encompasses wood waste and soils with substantial wood and organic debris. This layer was subdivided into two material types: ESU 4A and ESU 4B. **ESU 4A** is made up of wood waste fill that contains greater than 50 percent wood, by volume, based on visual observations. **ESU 4B** consists of silty, gravelly Sand to very sandy Gravel with substantial organic material and wood debris, as well as scattered brick and asphalt debris.

Groundwater

At the time we completed our test pit explorations, water levels (ponded water) were observed in TP-6, TP-7, TP-12, and TP-16 at depths of from 2 to 9 feet bgs (elevations 1 to 8 NAVD 88). Groundwater seepage was observed in TP-5, TP-6, TP-9, TP-10, TP-1, and TP-16 at depths of 2 to 10 feet bgs. Test pits TP-6, TP-7, TP-12 were at lower and higher ground surface elevations than other test pits, in abundant wood debris, and closer to the swale near the former log pond so may represent different groundwater conditions than the remedial excavation area. Test pit exploration logs indicate the location and amount of seepage at each location; entries range from *very slight seepage* to *seepage*.

Our explorations and previous studies indicate groundwater elevations, at time of exploration, vary from about 1 to 8 feet. Water level measurements for the remedial excavation area average about elevation 5 to 6 feet NAVD 88, based on discussion with Floyd Snider. We understand of the proposed remedial excavation depth will be limited to about 2 or 3 feet below the groundwater level.

Groundwater levels were observed at the times and under the conditions stated on the exploration logs in Appendix A. Groundwater levels fluctuate seasonally and typically are higher during the winter and early spring because of precipitation; they also fluctuate because of tides in the harbor.

GEOTECHNICAL ENGINEERING DESIGN RECOMMENDATIONS

This section presents our conclusions and recommendations for the geotechnical aspects of design and construction on the project site. We developed our recommendations using our current understanding of the project, the subsurface conditions encountered by our explorations at discrete locations, and our laboratory tests. The nature and extent of variations between the explorations may not become evident until construction begins. If variations become evident, it will be necessary to reevaluate the recommendations of this report. If the nature or location of the proposed work is different than we have assumed, we should be notified so we can confirm our recommendations.

Site Preparation

Initial preparation should consist of demolishing existing foundations, removing debris, removing pavements, stripping any surface vegetation, and removing concrete rubble and plastic sheeting in the excavation areas. In general, site preparation in areas outside of the top of excavation shown on Figure 3 should be limited during this phase of site development. Site preparation within the remedial excavation and backfill area should include the following procedures:

- Remove all visible organic material (sod, humus, roots, wood debris/waste, and/or other decaying plant material), debris, and other deleterious materials from subgrade areas. This material should be segregated and stockpiled separate from possible backfill material. For planning purposes, we estimate the stripping depth will be generally less than 3 inches, depending on the amount of root material and organic matter at specific locations. This stripping depth should be reviewed and confirmed or adjusted during construction.

- In loose, soft, or wet subgrade areas, clean material with a high gravel content may be necessary to provide a firm base for backfill soils, as discussed in the Fill Selection, Placement, and Compaction section. In particularly poor soils, a separation geotextile (WSDOT 9-33.2(1) Table 3) may also be necessary to provide a firm base so overlying soils can be compacted adequately.

- If any abandoned underground utilities are encountered, they should be removed and completely grouted, or their ends should be sealed to prevent piping of soil or water into the utility pipe. Piping of water or soil into such cavities could create voids that could lead to surface settlement.

If parts of the site outside the remedial excavation area are used for Port maritime activities prior to final site development, the Port may want to consider doing the following:

- Proof roll areas with a heavy vibratory compactor or fully loaded dump truck to identify and delineate any soft or loose areas. A geotechnical engineer from Hart Crowser should verify suitable subgrade conditions prior to subsequent earthwork activities.

- Either recompact or overexcavate and replace areas of the exposed subgrade observed to be soft to loose, wet, or yielding as described in the Fill Selection, Placement, and Compaction section.

Temporary Shoring

The north edge of the cleanup/remedial excavation extends to near the shoreline (Figure 3). The remedial excavation limit is at south side of the existing dirt road south of the crest of the riprap covered shoreline slope, which is approximately the south edge of the timber trestle. In this area installation of a temporary shoring system will be needed to allow excavation of most of the contaminated soil to a depth a few feet below the water level and to avoid a breach of the remaining soil and riprap slope between remedial excavation and the harbor. Several options for temporary shoring are feasible, such as sheet piles or a slide-rail shoring system, as described below.

Cantilevered Sheet Pile Shoring

Cantilevered sheet piles consist of installing sheet piles, typically with a vibratory hammer, to a depth below the base of excavation enough to fix the embedded part of the sheet to resist lateral earth and water pressures. Sheet piles often have to be embedded about two times the exposed excavation depth, as determined by the shoring designer considering construction sequencing, means, and methods. Available site environmental explorations generally do not extend as deep as the sheet piles are expected to be embedded, so there is some risk that subsurface conditions could restrict embedment depth, although that is not anticipated for the alluvial soils that underlie the hydraulic fill. Sheet piles are expected to be more expensive than a slide rail shoring system, but would not hinder excavation work as much as the horizontal struts of a slide rail system would.

Slide Rail Shoring

Slide rail shoring[1] consists of a system of telescoping panels, corner posts, spreader posts (linear rails), roller beams, and spreader beams. Corner posts are designed to hold multiple telescoping panels (typically 1 to 3 panels), allowing for deep excavations. Installation consists of six steps:

- An initial pilot cut is excavated;
- Panels and corner posts with horizontal struts are set into place by an excavator sequentially;
- Excavation continues inside the shoring;
- Outer panels are pushed to the bottom of the excavation with the excavator;
- Excavation is deepened by installing a second set of panels into tracks inside the outer panels; and
- As the excavation continues, the inside panels and the corner posts are pushed down until the bottom of the excavation is reached.

When the bottom of the excavation is reached, the excavation is backfilled to a depth the contractor’s engineer determines will keep the shoreline stable while excavating/backfilling on the landward side of the slide rail shoring. The inner panels are extracted as backfilling and compaction has started from the bottom up. After backfilling on the landward side of the shoring, the slide rail system can be removed.

Contractor-Designed Shoring

We recommend that the contractor provide the temporary shoring design as a pre-construction submittal (stamped by a professional engineer licensed in Washington State) since the contractor’s

[1] http://www.efficiencyproduction.com/slide-rail-systems, http://www.pro-tecequipment.com/products/slide-rail

excavation and possible dewatering means and methods will control several of the design parameters. We recommend Hart Crowser review the shoring design submittal.

Shoring Design Recommendations

Lateral earth pressures for the shoring design depend on the type of shoring and its ability to deform. If the top of the shoring is allowed to deform on the order of 0.001 to 0.002 times the shoring height, and if no settlement-sensitive structures or utilities are within the zone of deformation, the shoring system may be designed using active earth pressures. This is known as a y*ielding wall*. If settlement-sensitive structures or utilities exist within the potential zone of deformation, or where the shoring system is too stiff to allow sufficient lateral movement to develop an active condition, at-rest earth pressures should be used to design the shoring system. This is known as a *non-yielding wall*. For this project, settlement-sensitive structures or utilities are not known to exist in the area where the shoring wall is needed, so active earth pressures have been assumed.

We recommend the following for shoring design:

- Use lateral earth pressure information on Figure 4 to design either cantilevered sheet pile shoring or slide rail shoring.

  - Active pressures act over the sheet pile width or slide rail panel width above the base of excavation. Below the base of excavation, active pressures act over the sheet pile width or twice the slide rail post width.

  - Passive pressures act over the sheet pile width or twice the slide rail post width below the base of excavation.

- Calculate additional lateral pressures from minor surcharge loads (e.g., traffic surcharge, light construction equipment, and small material stockpiles) by including an equivalent of 2 feet of soil, or additional 2 feet of shored height (H) on Figure 4. Add these loads to the loads calculated for the shoring walls. Large surcharges (from, for example cranes, large material stockpiles, heavy construction equipment) are not included in the earth pressures on Figure 4, but we can provide methods to calculate large surcharge loads if needed.

- For slide rail shoring, the contractor’s shoring engineer must create excavation and backfilling sequencing criteria that keep the shoreline stable and are compatible with the contractor’s excavation methods. This sequencing criteria should be a pre-construction submittal for Hart Crowser review.

- The contractor’s shoring engineer should submit means and methods to prevent heave or quick soil conditions at the base of the excavation caused by different water levels across the shoring wall to maintain a stable base of excavation.

Shoring Deflection and Monitoring

Typical deflections for an excavation shoring system will likely be about 1 inch or less (vertically and horizontally) at the top of the wall and less than 1/4 inch 15 feet back from the wall face. The performance of the shoring system should be monitored using optical survey measurements of horizontal and vertical movements. Hart Crowser can provide more detailed monitoring recommendations prior to construction of the shoring system.

Temporary Excavation Slopes

General Considerations

This section presents general design recommendations for temporary cut and temporary and fill slopes. Recommended slopes for cut and fill sections depend on the:

- Type, density, and strength of the soil;
- Presence and amount of any water or seepage;
- Time that the sloped soils remain exposed to weather;
- Depth of the cut or the height of the fill;
- Surcharge loads (from, e.g., construction equipment, soil, or construction material stockpiles) adjacent to the slopes;
- Care and methods used by the contractor; and
- Other factors.

We make the following general recommendations for cut and fill slopes:

- Prepare all fill subgrade areas in accordance with the recommendations in the Fill Selection, Placement, and Compaction section.

- Because of the variety of factors affecting slope stability and the possibility for these factors to change with time, it is difficult to accurately predict the actual stability of slopes prior to construction. It is critical to verify that the subsurface conditions at the time of construction match our design assumptions. Therefore, we strongly recommend that Hart Crowser be on site during construction to evaluate critical slopes and seepage conditions in slopes.

- The contractor should be responsible for verifying all existing utility locations, if any, for coordinating the excavation work as necessary, and for preventing/addressing potential excavation impacts on existing nearby structures and roadways, if any.

- Normal construction equipment should be kept at least 5 feet (horizontal) from the top of slopes. However, larger heavy equipment (e.g., cranes) may have to be kept farther from the top of slopes; this should be evaluated on a case-by-case basis. The final decision about appropriate setback requirements for construction equipment should be the responsibility of the contractor.

- The contractor will need to take precautions to minimize temporary slope erosion from rainfall and potential dangers from loose, rolling cobbles or boulders until permanent erosion control measures are established.

- The contractor should be responsible for maintaining excavation subgrades to excavated depth and lateral extent during backfilling operations. The contractor should be responsible for removing displaced soil (loose or soft soil that sloughs) greater than 1 foot above the base of excavation or subgrade that occurs during backfilling.

Temporary Cut Slopes

Occupational Safety and Health Administration (OSHA) classifies the granular fill and native subsurface materials at the site as Type C. Therefore, we recommend constructing excavations in accordance with all local, state, and federal safety requirements assuming Type C soil conditions. For planning purposes, we recommend sloping temporary cuts at no steeper than 1.5 horizontal to 1 vertical (1.5H:1V) in the fill soils, where these slopes would not be at the same location as flatter permanent slopes. These slopes assume that groundwater is lower than the bottom of the excavation. Groundwater conditions encountered at the time of construction may dictate that flatter slopes will be necessary, especially near the base of excavation, which is anticipated to be at most a few feet below water. A 3H:1V slope may be more realistic in the granular soil below the water surface. Localized sloughing may occur during construction, and the exposed slope face will probably need to be protected from surface erosion.

Because of the variables involved, actual slope values required for stability in temporary cut areas can only be estimated prior to construction. We recommend that stability of the temporary slopes used for construction be the responsibility of the contractor, since the contractor is in control of the construction operation and is continuously at the site to observe the nature and condition of the subsurface.

Fill Selection, Placement, and Compaction

The remedial excavation will be backfilled with a combination of non-impacted on-site soil, thermally treated soil, and/or import soil with concentrations of COCs below CULs. Factors that affect which material types are suitable for backfill are:

- Soil type;
- Soil moisture content;
- Groundwater depth;
- Depth of contaminated soil;
- Final use of the backfilled area; and
- Whether contaminated soil will be thermally treated to remove contamination (which also dries the soil).

There are several options for selecting backfill material type, layer thickness, compaction, and depth. The following sections give general backfill recommendations; summarize the factors that determine suitability of different types of import and on-site soil for reuse as backfill, and describe a preliminary backfill cross section. We categorized reusable on-site soil and import soil as either common borrow fill or select fill and provide our recommendations for these backfill types in subsequent sections.

General Recommendations for Fill Selection, Placement, and Compaction

This section provides our general recommendations for fill material selection, placement, and compaction. Subsequent sections include recommendations for specific backfill types.

Reuse of On-Site Soil as Fill

On-site excavated soil can often be used as backfill depending on its characteristics, location of placement, and intended use. The suitability of excavated site soil for use as either common borrow fill or select fill depends on the gradation and on the moisture content of the soil when it is placed. As the amount of fines (the portion passing the U.S. No. 200 sieve based on the minus 3/4-inch fraction) increases, the soil becomes increasingly sensitive to small changes in moisture content, and adequate compaction becomes more difficult to achieve. Soil containing more than about 5 percent fines cannot be consistently compacted to a dense non-yielding condition when the water content is greater than about 2 percent above or below optimum. To be reusable, on-site soil must also be free of organic material (humus, plant roots, or other decaying plant material), construction debris, and other deleterious material.

Placement and Compaction of Fill

We recommend the following for placement and compaction of the different types of fill:

- Fill should be compacted using equipment suitable for the soil and the area being compacted. Each lift of material placed should be uniformly compacted to the density indicated for the specific material. The compaction equipment may be of any type, provided it can compact each lift to the specified density.

- Laboratory tests should be performed on representative samples of any soil to be used as fill at least 3 days prior to use to determine optimum moisture content and maximum dry density (in accordance with ASTM D1557), natural moisture content (ASTM D2216), and gradation (ASTM D698).

    - The moisture and density compaction characteristics of ESUs 1, 2A, and 2B have been determined and are presented on Figures B-14 to B-16. If a soil that does not match the gradation of these ESUs is to be used as fill, representative samples should be obtained and moisture density testing completed as soon as possible.

- The compacted densities of all lifts with a specified relative percent compaction should be verified by testing (ASTM D6938 or other method approved by Hart Crowser) by a qualified geotechnical engineer. The frequency of fill density testing should be about every 5,000 square feet per lift, or as determined by the geotechnical engineer.

- The contractor may need to moisten or aerate material to achieve the required specified percent compaction and/or moisture content.
- Place fill with a loose lift thickness of less than 12 inches prior to compaction.
- All soil should be compacted as indicated herein. If the specified compaction with the maximum lift thicknesses cannot be attained, the lift thickness should be reduced and/or heavier compaction equipment should be used.
- Concrete and/or rocks greater than half the loose lift thickness in any dimension should be removed before compaction, unless specified elsewhere. Garbage, debris, pieces of wood larger than 4 inches in any dimension, and other deleterious material should be removed and disposed of appropriately before compaction.
- Large non-contaminated concrete debris greater than half the loose lift thickness may be incorporated into backfill if placed so voids do not occur between concrete pieces. Large unfilled voids could result in overlying soil “piping” into these voids due to water flow, which could lead to large settlements at the surface. Soil would need to be placed and compacted between and around the concrete pieces so no voids are created, and a qualified geotechnical engineer would need to observe and confirm that soil was placed and compacted around the concrete pieces appropriately.
- Lifts should be a uniform thickness, sloped to drain, and even across the entire width of the fill surface. The surfaces should be shaped to uniform cross sections and ruts and holes should be eliminated.
- All import fill material must be free of contamination according to chemical criteria that will be included in project specifications.
- Specific fill types below should be referred to for specific material and compaction requirements.
- In loose, soft, or wet subgrade areas, clean material (less than 5 percent passing a US No. 200 sieve based on the minus 3/4-inch fraction) with a gravel content (material coarser than a US No. 4 sieve) of at least 30 to 35 percent may be necessary to provide a firm base for backfill soils.

Select Fill

Select fill is on-site or import fill that can be compacted to the relative percent compaction specified in this section. It can generally be used just below the pavement section to achieve a higher compaction and at the base of the excavation if backfill will be placed in a few feet of water, as shown on Figure 5.

Reuse of Site Soil as Select Fill

The suitability of the excavated site soil for compacted select fill depends on the gradation and moisture content of the soil when it is placed, as previously indicated. In general, we have determined that the on-site soil silt content (percent fines or minus US No. 200 fraction) ranges from 2 to 90 percent. Therefore, some on-site soil will be more moisture-sensitive than others. For planning purposes, soil with fines content above 15 percent is generally not suitable for use as select fill unless the moisture content when compacted is as recommended in the Placement and Compaction of Select Fill section, which may require moisture conditioning/drying. However, soil with more than 15 percent fines may be suitable to use as common borrow fill. Soil to be used as select fill above water with less than 15 percent fines must be compacted at a moisture content that allows the specified compaction to be achieved.

Select fill to be used below the water level should have less than 5 percent passing a US No. 200 sieve (i.e., fines) based on the minus 3/4-inch fraction. At least 30 percent of the material should be larger than 3/4 inch to provide a firm base for backfill soils. The select fill could consist of recycled concrete or quarry spalls less than 6 inches in diameter meeting the fines criteria above. Contractor-proposed alternate materials that meet the intent of this requirement, as determined by Hart Crowser, may also be feasible.

Selection of Import Select Fill

We recommend using a clean, well-graded gravelly sand or sandy gravel with less than 5 percent passing the U.S. No. 200 sieve by mass (based on the 3/4-inch fraction) for import select fill placed during wet weather periods. The specified compaction may be difficult to achieve for material containing more than about 5 percent fines if the material is wet or becomes wet during rainy weather. During dry weather, import soil can contain more than 15 percent by weight passing the U.S. No. 200 mesh sieve (based on the minus 3/4-inch fraction), provided it is compacted at a moisture content as recommended below.

Placement and Compaction of Select Fill

We recommend the following for placement and compaction of select fill:

- Use the section titled "Soil Suitability and Preliminary Backfill Cross Section" and Table 2 to guide reuse of on-site soil as select fill.
- Select fill may consist of either imported soil or on-site soils, as previously described, that are free of organics, if suitable moisture content is achieved at the time of compaction.
- Beneath permanent pavement sections, select fill should be compacted to a minimum of 95 percent of the modified Proctor (ASTM D 1557) maximum dry density.
- Moisture content should be maintained within 2 percent of the optimum (ASTM D1557).
- Because the project site is underlain by loose granular silty soil that will be excavated and reused as backfill as much as possible, deeper backfill can be compacted less than select fill (see Common Borrow Fill section). Therefore, the select fill section should extend about 4 feet below the proposed pavement section and should be compacted as indicated in Figure 5. A thick select fill layer is needed to bridge over the soft/loose underlying soils.

- Select fill above water should be placed and compacted in even lifts with a loose thickness no greater than 10 inches. If small, hand-operated compaction equipment is used to compact select fill, fill lifts should not exceed 6 to 8 inches in loose thickness.

- Select fill placed at the base of excavation below water should be placed in loose lift thicknesses of less than 2 feet, and should be compacted by tamping or compressing with a trackhoe bucket to a firm condition.

- Select fill should only be placed on firm, non-yielding subgrade soils. Whether the subgrade soils are firm and non-yielding should be determined in the field by Hart Crowser. For bid planning purposes, the contractor can assume that the soil is firm and non-yielding if it is proof rolled with a loaded dump truck and does not show wheel ruts deeper than about 2 inches or does not yield more than about 2 inches from passes with a heavy smooth drum vibratory roller.

Common Borrow Fill

Common borrow fill can either be excavated on the site or be imported. Most soils can be used as common borrow fill provided they can be compacted enough so that earthwork equipment can drive over them. Our recommendations have less stringent compaction requirements for common borrow fill than for other types of fill, so that on-site common borrow fill can be re-used deeper in the backfill section, where the relative compaction is less important for supporting the surface pavement section. Figure 5 illustrates where common borrow fill can be placed. Common borrow fill can generally be used just below the upper select fill and above the lower select fill, but not directly under structures or pavements.

Reuse of Site Soil as Common Borrow Fill

On-site soil's suitability for use as compacted common borrow fill depends on the silt content, moisture content of the soil when it is compacted, and absence of abundant organic material, as previously indicated. On-site soil silt content (percent fines, or minus US No. 200 fraction) ranges from 2 to 90 percent and on-site soil with higher silt content that is used as common fill will be more moisture-sensitive. For planning purposes, soil with fines content above 15 percent is suitable for use as common borrow if the moisture content when compacted is as recommended in the Placement and Compaction of Common Borrow Fill section; moisture conditioning/drying may be needed to achieve the recommended moisture content. However, soil that is thermally treated is drier and it may be possible to mix it with soil that is wetter than optimum; using this mixture would likely allow more on-site silty soil to be used as common fill.

Provided that organic material such as wood debris and decaying pant material is not included, it should be possible to reuse most on-site soil with more than 15 percent fines/silt as common borrow fill if its moisture content is near the optimum, if moisture-conditioning is feasible during extended dry weather periods, if soil wetter than optimum can be mixed with more granular soil, or if wet soil can be mixed with dryer soil. It may be necessary to cover stockpiles of common borrow fill to protect them from rain.

Selection of Import Common Borrow Fill

Common borrow fill may be imported from almost any source that is free of contamination and abundant organic material. Common borrow fill should be free of debris, and should not be significantly above the optimum water content (see next section).

Placement and Compaction of On-Site and Import Common Borrow Fill

For the most part, common borrow fill should be placed and compacted using the same methods as for select fill. We recommend the following for placement and compaction of common borrow fill:

- Use the section titled "Soil Suitability and Preliminary Backfill Cross Section" (below) and Table 2 to guide reuse of on-site soil as common borrow fill.
- Place common borrow fill in loose lift thicknesses less than 12 inches.
- Maintain moisture content within 3 to 4 percent of the optimum moisture content (ASTM D1557).
- Immediately beneath select fill, attempt to compact common borrow fill to a minimum of 90 percent of the modified Proctor (ASTM D 1557) maximum dry density.
- Placement of common borrow fill will likely be best suited to periods of dry weather, as this material is likely to be moisture-sensitive.

Soil Suitability and Preliminary Backfill Cross Section

This section summarizes tables and figures related to the suitability of on-site soil for reuse as backfill, and discusses the preliminary backfill cross section shown on Figure 5.

Table 1 (above) summarizes the different on-site soil ESUs gradations, and lab results in Appendix B provide more specific gradation and moisture density compaction characteristics. Table 2 summarizes the suitability of different ESUs for use as either select fill or common borrow fill, depending on whether thermal treatment dries out soil with higher silt content.

Highlights from the tables are:

- ESUs 2A and 2B contain less than about 15 percent fines and should be suitable for use as select fill whether or not they are thermally treated, if they are compacted at an appropriate moisture content (within about plus or minus two percent of optimum moisture content).
- ESUs 1 and 3 contain more than 15 percent fines and should be suitable for use as common borrow fill; if not dried by thermal treatment, they could only be used as select fill if compacted at the appropriate moisture content.
- ESUs 4A and 4B appear to contain too much wood debris and organic material to be used as fill, since those components will decay with time and result in significant settlement.

- The moisture and density compaction characteristics of ESUs 1, 2A, and 2B presented on Figures B-14 to B-16 indicate that (1) ESU 2A is about 3 percent dry of the optimum moisture content and might need some water to achieve optimal compaction; ESU 2B is about 7 percent wet of optimum moisture and needs to be dried to achieve optimal compaction; and ESU 1 is about 8 percent wet of optimum moisture and needs to be dried to achieve optimal compaction.

Figure 3 graphically illustrates the different soil ESUs on one side of the test pit stick logs and the depth of contamination on the other side of the stick log. This figure indicates that:

- In the north half of the excavation area, ESU 2 overlies the contamination and should generally be suitable for reuse as select fill.

- In the south half of the excavation area, ESUs 1 and 3 overlie the contamination and should generally be suitable for reuse as common borrow fill.

Figure 5 presents a preliminary backfill cross section based on site, environmental, and soil factors discussed in this report. This figure indicates the following.

- The backfill material type, location, thickness, and required compaction.

- Which backfill types should be suitable to use above and below the water surface.

- The anticipated depths of remedial excavation.

- Anticipated subgrade conditions needed to support a pavement section that would be determined in by future tenant specific site use and loading conditions.

- Figure 5 may need to be revised once the design team finalizes volumes of excavation, contaminated soil, and submerged fill to stabilize the base of excavation.

- The top part of the select fill compacted to 95 percent may need to be crushed rock to provide a tight surface for interim travel lift use if interim grades cannot be raised to include a portion of the crushed rock pavement section, as discussed in the next section.

Table 2 – Backfill Suitability

ESU	Geotechnical Suitability with Thermal Treatment[a]	Geotechnical Suitability without Thermal Treatment
1	Suitable for common borrow and select fill[b]	Suitable for common borrow fill[b]
2A	Suitable for common borrow and select fill[b]	Suitable for common borrow and select fill[b]
2B	Suitable for common borrow and select fill[b]	Suitable for common borrow and select fill[b]
3	Suitable for common borrow and select fill[b]	Suitable for common borrow fill[b]
4A	Not suitable for fill	Not suitable for fill
4B	Not suitable for fill	Not suitable for fill

Notes:

a. Suitability for reuse as backfill requires both geotechnical and environmental suitability.

b. Geotechnically suitable for reuse if placed above the water surface.

We understand that project specifications will allow either off-site disposal of contaminated soil or thermal treatment. In thermal treatment, the impacted soil is heated to remove contaminants so it can be reused as backfill. Moisture-conditioning and/or thermal treatment would allow soils that contain more than 15 percent fines to be used as backfill, provided that these soils are placed above water and assuming they are at the proper moisture content.

Pavement Sections

We recommend constructing all pavement sections over a subgrade surface consisting of a minimum of 4 feet of soil compacted as shown on Figure 5 for the remedial excavation area. Areas outside the remedial excavation area are outside the scope of this report and will be addressed during a later phase of the work. However, we recommend proof rolling the areas outside the remediation area after remedial backfilling to identify and recompact loose/soft spots, as recommended in the Site Preparation section. We recommend Hart Crowser observe proof rolling of all pavement support.

The typical recommended pavement section shown on Figure 5 does not include asphalt and crushed rock thicknesses, since final future tenant use and loads are not known. However, typical pavement sections are:

- Heavy port pavement for cargo storage areas that will contain large, heavily loaded forklifts or other heavy-wheeled equipment: – 8 inches of asphalt over 12 inches of crushed rock, over 2 feet of well compacted structural fill.
- Typical commercial loading area with heavy truck traffic – 3 inches of asphalt over 6 inches of crushed rock, over 2 feet of well compacted structural fill.
- Typical lightly loaded passenger car parking – 2 inches of asphalt over 4 inches of crushed rock, over 2 feet of well compacted structural fill.

RECOMMENDED ADDITIONAL GEOTECHNICAL SERVICES

This section summarizes our additional geotechnical input to the design and construction process. This input is to help determine compliance with the design concepts, plans, specifications, or recommendations, and to allow design changes if subsurface conditions differ from those anticipated before the start of construction. If Hart Crowser is not retained for geotechnical construction support items, it is important to select a qualified geotechnical engineer who is familiar with site conditions, the construction plans, the geotechnical design assumptions, and the construction specifications. Selection of another geotechnical engineering consultant for construction services could result in difficulties from lack of continuity between the design and construction phases of the work.

Design Services

We recommend the following:

- Consult with Hart Crowser during the remainder of the pre-construction design phase of the project so that we can refine or confirm our recommendations as more information about the project requirements becomes available, or if project elements differ from the assumptions presented herein.

- Have Hart Crower review design plans and specifications to confirm that geotechnical recommendations were properly interpreted and implemented.

- Have Hart Crowser review geotechnical aspects of contractor submittals to confirm that our geotechnical engineering recommendations were properly interpreted and implemented during construction.

Construction Services

During the construction phase of the project, we recommend that Hart Crowser assist with the following:

- Observe site preparation activities, including clearing and grubbing;
- Observe general excavation activities;
- Observe fill selection, placement, and compaction, as requested by the Port;
- Work with the Port and contractor to assess different soil backfill section combinations to optimize reusing on-site soil based on field construction observations;
- Assess subgrade conditions prior to placing fill;
- Review contractor submittals and requests for information; and
- Address other geotechnical engineering considerations that may arise during the course of construction.

The purpose of these observations is to determine compliance with the design concepts, specifications, or recommendations and to allow design changes if subsurface conditions differ from those anticipated prior to the start of construction.

REFERENCES

Washington State Department of Ecology, 2014, K Ply Site, Cleanup Action Plan, Port Angeles, Washington. November.

Floyd|Snider, 2014, Remedial Investigation/Feasibility Study, Agency Review Draft, Port Angeles, Washington. May 21.

Floyd|Snider, 2014, Draft Cleanup Action Plan, Port Angeles, Washington. November 13.

Port of Port Angeles, Historic Plans, Various Dates. See Appendix D.

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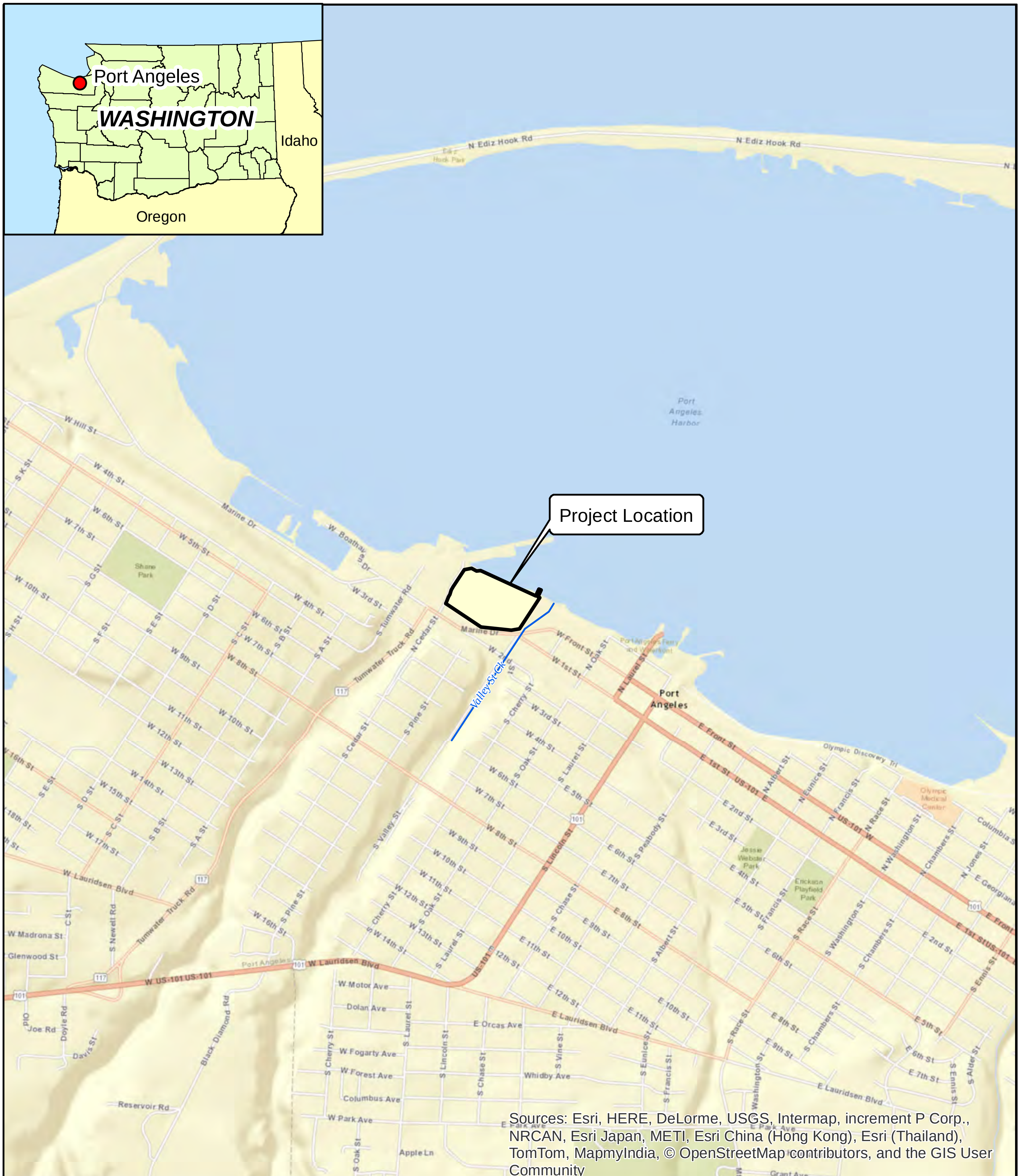

K Ply Site Remediation
Port Angeles, Washington

Vicinity Map

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HARTCROWSER

Figure
1

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Legend

- PP-20 ● Existing monitoring well (Floyd Snider 2014)
- TP-1 Test pit
- Concrete debris pile
- Concrete pads
- Drain
- Fence
- Overhead power lines
- Plastic cover areas
- Sanitary sewer
- Storm drain
- 16 Topo contours
- Water line
- Wood fence

Notes:
1. Feature locations are approximate.
2. Vertical datum is NAVD88.

Reference: Aerial imagery (computer file) (07/05/2013). Google Earth, (April 6, 2015). Topographic base from AutoCAD files named "POPA1501-01.dwg" and "KPLY2013_007.dwg," provided by Floyd Snider, dated April 1, 2015 and July 3, 2013.

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Scale in Feet

KPly Site Remediation
Port Angeles, Washington

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HARTCROWSER

Figure

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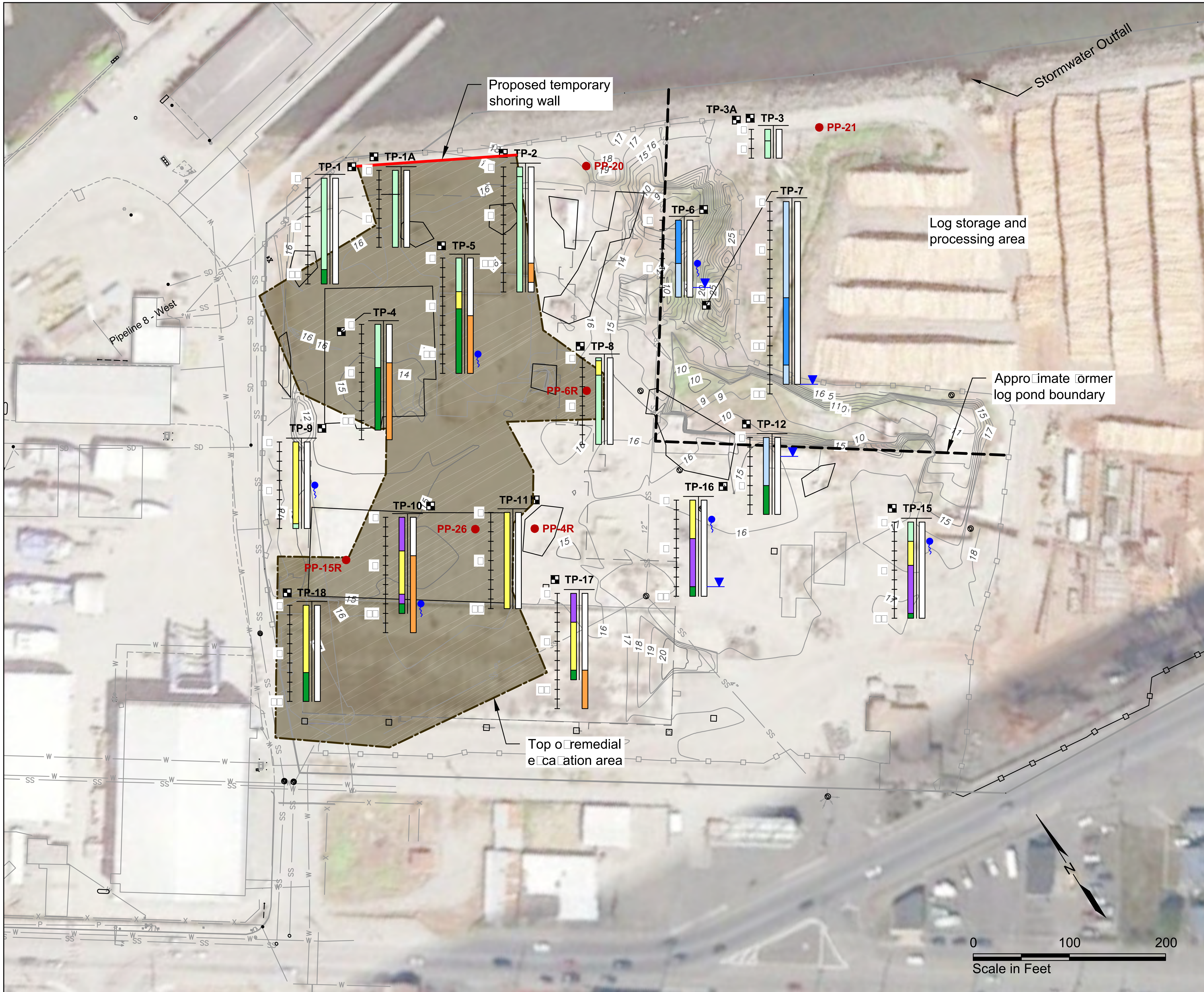

Legend

PP-20 ● Existing monitoring well (Floyd Snider, 2014)

TP-10 Test pit

Groundwater depth

Contamination zone

Seepage depth

Engineering soil unit (ESU, see text)

ESU 1 - Silty to very silty Sand

ESU 2A - silty, gravelly Sand to sandy Gravel

ESU 2B - silty Sand

ESU 3 - Silt to sandy Silt

ESU 4A - Wood debris with silt, sand, and gravel

ESU 4B - silty, sandy Gravel to gravelly Sand with substantial wood debris

Contamination above cleanup levels provided by Floyd Snider

Notes
1. Feature locations are approximate.
2. Vertical datum is NAVD88.
3. Approximate log pond boundary was taken from Figure 2.3, RIFS (Floyd Snider, May 21, 2014).
4. Environmental cleanup boundary provided by Floyd Snider, dated 4/22/15.
5. ESUs 2A and 2B are generally geotechnically suitable for backfill reuse. See report text.

Reference: Aerial imagery (computer file) (07/05/2013). Google Earth, (April 6, 2015) Topographic base from AutoCAD files provided by Floyd Snider, dated April 1, 2015.

KPly Site Remediation
Port Angeles, Washington

ESU and C[illegible]

19128-00

5/15

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Figure

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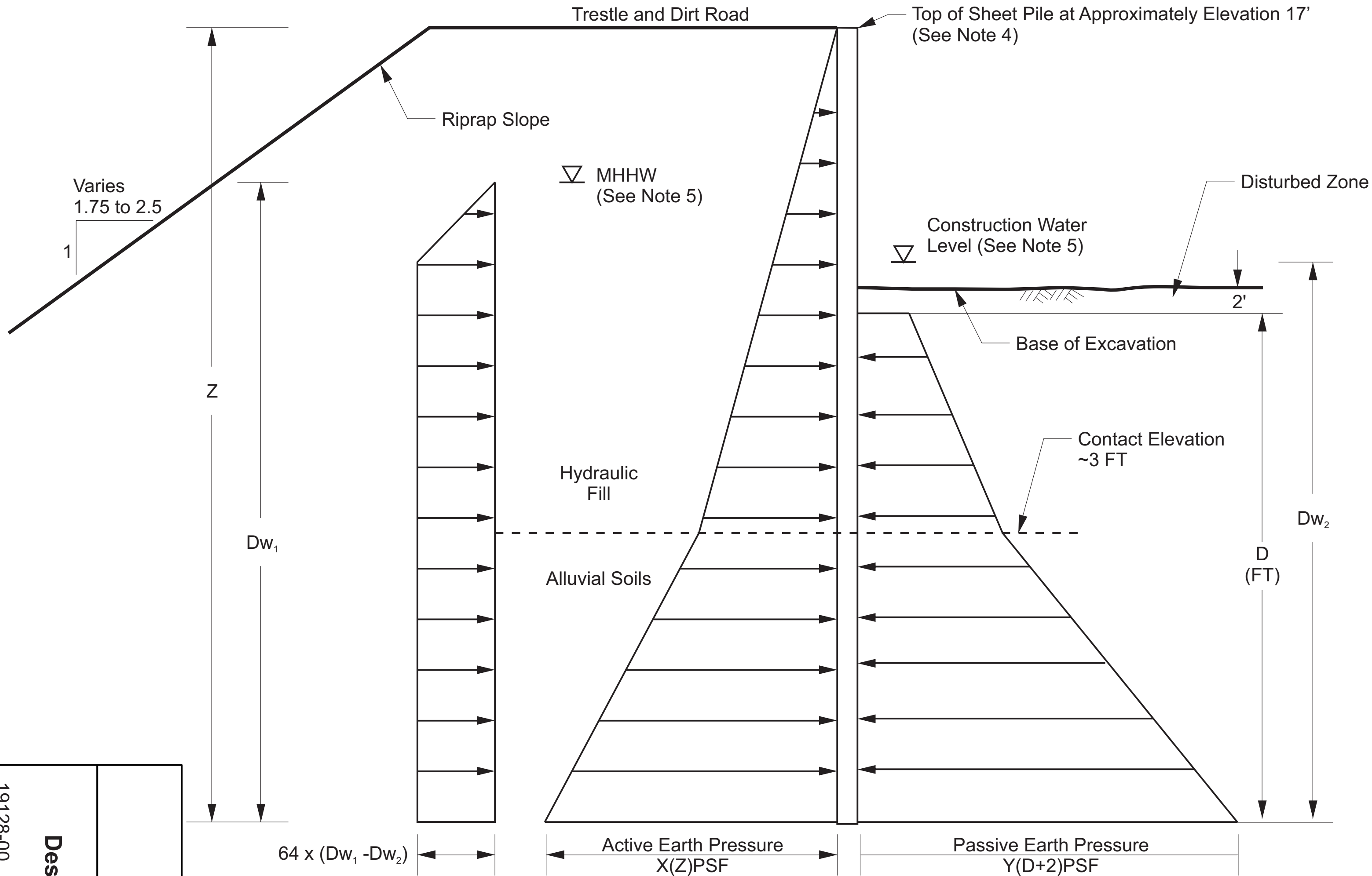

Soil Type	Active Conditions (X)		Ultimate Passive (Y)	
	Above GWT	Below GWT	Above GWT	Below GWT
Hydraulic Fill	35	15	260	110
Alluvial Soil	32	15	640	300

Notes:
1. Use a factor of safety of 1.5 to calculate allowable passive pressures when determining sheet pile embedment.
2. Determine lateral pressures based on this figure, location of wall, and depth of soil contact/soil density from on-site explorations.
3. Maximum excavation depth, H, is 14 feet.
4. Top of sheet pile wall should be at least elevation +17 to provide temporary protection against potential extreme high tides and/or storm surges during excavation.
5. Design sheet pile wall to accommodate different water level across wall. Groundwater level waterward of wall can be assumed not to exceed MHHW = +7. Contractor should determine design water level inside excavation based on available groundwater level data, construction excavation, and dewatering means and methods used, and should control water levels to those assumed in sheet pile design.
6. All dimensions in feet and all elevations relative to NAVD88 datum.
7. Lateral earth pressures due to surcharge loads from adjacent equipment, soil/material stockpiles, etc. are neither anticipated nor included in this figure. If present, they should be added to lateral pressures shown here.

Not to Scale

Kply Site Remediation
Port Angeles, Washington

Design of Temporary Cantilever Sheet Pile Shoring

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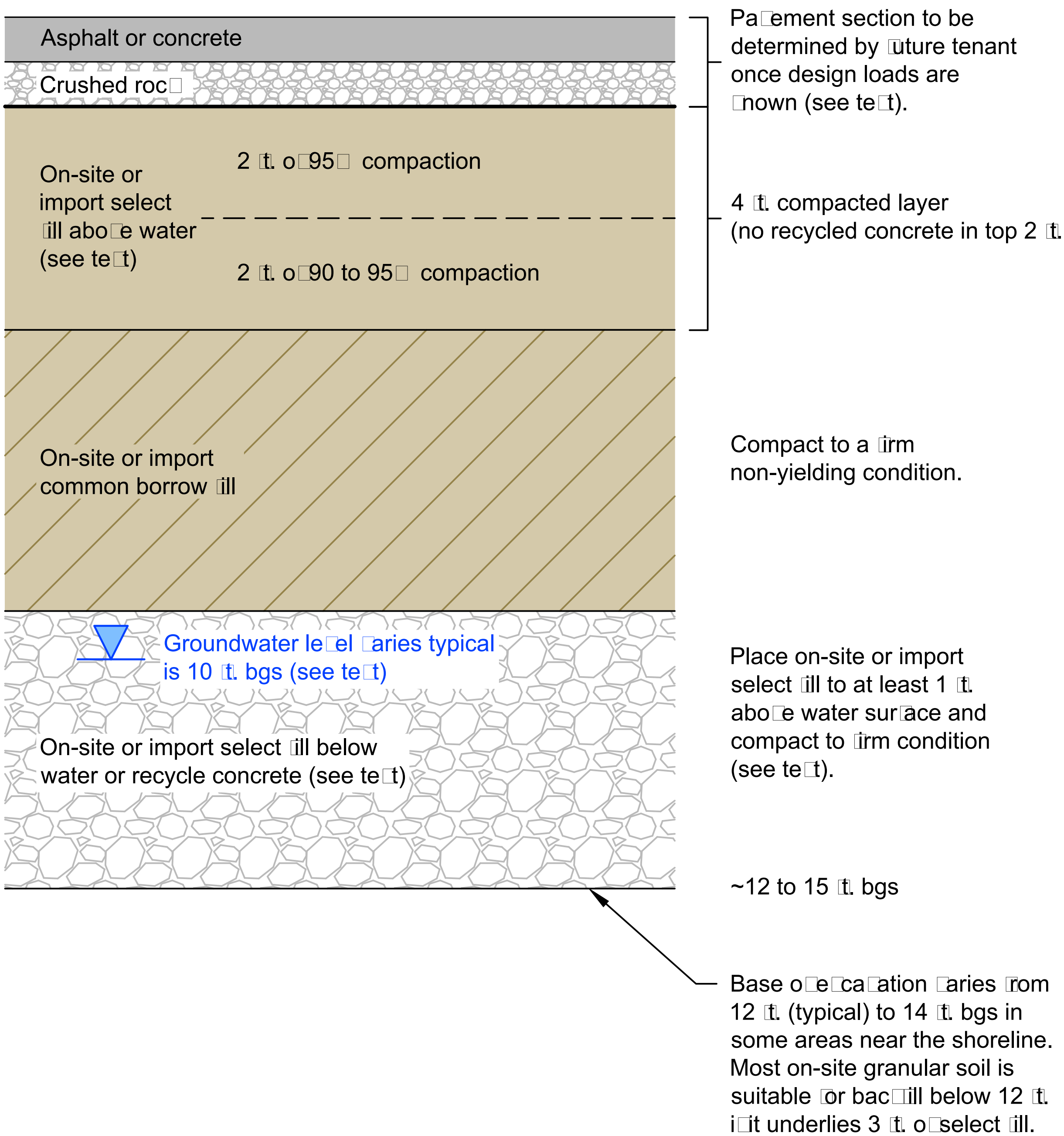
Figure **4**



NOT TO SCALE

KPly Site Remediation
Port Angeles, Washington

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Figure [illegible]

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APPENDIX A
Field Exploration Methods and Analysis

APPENDIX A
FIELD EXPLORATION METHODS AND ANALYSIS

This appendix documents the process Hart Crowser used to determine the nature and quality of the soil and groundwater underlying the project site.

Explorations and Their Locations

Subsurface explorations for this project include 17 excavation test pits. The text pit logs in this appendix show our interpretation of the drilling (probing/excavation), sampling, and testing data. The logs indicate the depth where the soils change (the change might be gradual). In the field, we classified the samples taken from the explorations according to the methods on Figure A-1 – Key to Exploration Logs. This figure's legend explains the symbols and abbreviations used in the logs.

Excavation of Test Pits

Seventeen test pits, designated TP-1, TP-1A, TP-2 through TP-12, and TP-15 through TP-18, were excavated across the site from March 25 to March 27, 2015, with a backhoe subcontracted by the Port. TP-13 and TP-14 were not excavated since they were located in an inaccessible water-filled area. The sides of test pits offer direct observation of the subgrade soils. The test pits were located by and excavated under the direction of an engineering geologist from Hart Crowser. Our geologist observed the soil exposed in the test pits, reported the findings on a field log, and took representative samples of soil types for testing at Hart Crowser's laboratory. Groundwater levels or seepage was noted during excavation. Estimated soil density/consistency (in parentheses on the test pit logs) were determined visually, since in-place density cannot be measured in the laboratory.

The test pit logs are on Figures A-2 through A-10. The soils types were separated into ESUs based on their usability as backfill. The ESU summary is in the main body of this report in Table 1.

Locations of Test Pits

Figure 2 (main report text) shows the location of explorations, located by hand taping or pacing from existing physical features. The ground surface elevations at these locations were interpreted from elevations shown on drawings provided by Northwestern Territories, Inc. (NTI), dated February, 2015. The accuracy of exploration location and elevation are determined by the method used.

Key to Exploration Logs

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits and probes is estimated based on visual observation and is presented parenthetically on the logs.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance (N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 to 4	Very soft	0 to 2	<0.125
Loose	4 to 10	Soft	2 to 4	0.125 to 0.25
Medium dense	10 to 30	Medium stiff	4 to 8	0.25 to 0.5
Dense	30 to 50	Stiff	8 to 15	0.5 to 1.0
Very dense	>50	Very stiff	15 to 30	1.0 to 2.0
		Hard	>30	>2.0

Sampling Test Symbols

- 1.5" I.D. Split Spoon
- Grab (Jar)
- 3.0" I.D. Split Spoon
- Shelby Tube (Pushed)
- Bag
- Cuttings
- Core Run

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

Moisture

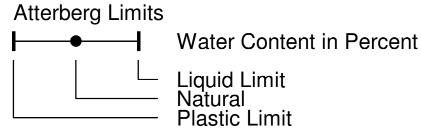
Dry	Little perceptible moisture
Damp	Some perceptible moisture, likely below optimum
Moist	Likely near optimum moisture content
Wet	Much perceptible moisture, likely above optimum

Minor Constituents

Minor Constituents	Estimated Percentage
Trace	<5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Laboratory Test Symbols

GS	Grain Size Classification
CN	Consolidation
UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits



PID	Photoionization Detector Reading
CA	Chemical Analysis
DT	In Situ Density in PCF
OT	Tests by Others

Groundwater Indicators

- Groundwater Level on Date or (ATD) At Time of Drilling
- Groundwater Seepage (Test Pits)

Sample Key

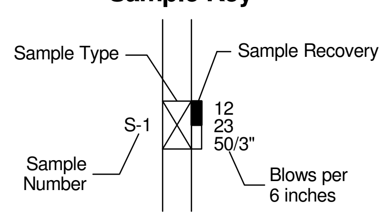


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Figure A-1

Test Pit Log TP- 1

Location: Lat: 48.124095° Long: -123.442391°
Approximate Ground Surface Elevation: 17 Feet
Logged By: B. McDonald   Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
SW-SM	Sod over (medium dense), moist, brown, slightly silty, very gravelly SAND with occasional scattered cobble.	0				
SP GP	(Loose), moist, gray-brown, gravelly SAND to sandy GRAVEL with scattered shell fragments and occasional rootlets.		S-1	5		GS
			S-2	3		
	Minor sidewall caving observed.	5				
	Becomes fine to medium SAND.		S-3	4		
	Cedar wood fragments (approximately 4-5" wide by 12" long) from 7.5 to 8 feet.		S-4	5		
SP	(Loose), moist, gray-brown SAND with trace gravel and silt.	10	S-5	6		GS
	Bottom of Test Pit at 11.0 Feet. Started 03/26/15. Completed 03/26/15.					
		15				
		20				

Test Pit Log TP- 1A

Location: Lat: 48.124079° Long: -123.442315°
Approximate Ground Surface Elevation: 17 Feet
Logged By: B. McDonald   Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
GP	(Dense), moist, dark gray-brown, sandy GRAVEL with quarry spalls and scattered cobble and trace silt.	0	S-1	4		
SP	(Loose), damp to moist, gray-brown, gravelly SAND with shell fragments.		S-2	7		
	Vertical pile exposed. Six pile bents at 15' on center.	5				
	Creosol wood fragment (possible tie or cross brace).					
	Bottom of Test Pit at 8.0 Feet. Started 03/26/15. Completed 03/26/15.					
		10				
		15				
		20				

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

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Figure A-2

Test Pit Log TP- 2

Location: Lat: 48.123914° Long: -123.441803°
Approximate Ground Surface Elevation: 18 Feet
Logged By: B. McDonald   Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions
GP	(Dense), moist, gray to gray-brown, sandy GRAVEL with cobble, quarry spalls, and scattered wood debris.
GP-GM	(Medium dense), moist, dark gray-brown, slightly silty, sandy GRAVEL to gravelly SAND.
SW-SM	(Loose), moist, gray, slightly silty, very gravelly SAND with scattered cobble, abundant shell fragments, stratified. Sidewall caving observed.
SW	(Loose), moist, gray, gravelly SAND with trace silt and scattered shell fragments. Increased moisture on silt, scattered brown silt layers. Adjacent well measured water at 11.5 feet. No free water observed in excavation.
SP GP	(Loose), moist to wet, dark gray, gravelly SAND to sandy GRAVEL, strong TPH-like odor.

Bottom of Test Pit at 13.0 Feet.
Started 03/25/15.
Completed 03/25/15.

Depth in Feet: 0, 5, 10, 15, 20

Sample	Water Content in Percent	PID	LAB TESTS
S-1	4		GS
S-2	7		
S-3	7		GS
S-4	5		GS
S-5	8		

Test Pit Log TP- 3

Location: Lat: 48.123652° Long: -123.440816°
Approximate Ground Surface Elevation: 16 Feet
Logged By: B. McDonald   Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions
GP-GM	(Dense), moist, brown to gray, silty, sandy GRAVEL with quarry spalls and cobble.
SM	(Medium dense), moist, red-brown, silty, gravelly SAND, oxidized, with scattered timber (milled debris). Track tie encountered at 2.6 feet. Track width under mill building is 4.9 feet. Pile encountered under tie.

Bottom of Test Pit at 3.0 Feet.
Started 03/26/15.
Completed 03/26/15.

Depth in Feet: 0, 5, 10, 15, 20

Sample	Water Content in Percent	PID	LAB TESTS
S-1	7		
S-2	6		GS

NEW TEST PIT LOG 1912800-TP.GPJ HC_CORP.GDT 5/6/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
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4. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

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Figure A-3

Test Pit Log TP- 4

Location: Lat: 48.123702° Long: -123.442778°
Approximate Ground Surface Elevation: 16 Feet
Logged By: B. McDonald   Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
SP-SM	(Loose), moist, brown, slightly silty, gravelly SAND with abundant shell fragments.	0				
			S-1	8		GS
	Occasional gray, fine sandy, silt interbeds, oxidized.		S-2	27		
SP	(Loose), moist, gray, fine to medium SAND with trace gravel and silt, and numerous silty fine sand zones.	5				
	Possible hydraulic oil encountered.					
	Scattered shell fragments.					
		10	S-3	12		GS
	Bottom of Test Pit at 11.0 Feet. Started 03/25/15. Completed 03/25/15.					
		15				
		20				

Test Pit Log TP- 5

Location: Lat: 48.123773° Long: -123.442227°
Approximate Ground Surface Elevation: 16 Feet
Logged By: B. McDonald   Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
SP-SM	(Loose), moist, gray-brown, slightly silty, very gravelly SAND with abundant shell fragments.	0				
	Sidewall caving observed.		S-1	8		GS
SM	(Loose), moist, brown, silty, fine to medium SAND, with trace gravel, scattered shell fragments, and occasional, fine sandy SILT, oxidized.		S-2	18		GS
SM	(Loose), moist, dark gray, fine SAND with zones of very silty fine sand, and areas of fine to coarse sand.	5				
	Zone of strong TPH-like odor.					
	Becomes fine to medium SAND.					
	Slight seepage at 10 feet. Zone of strong TPH-like odor.	10	S-3	7		
	Free water observed at bottom of test pit.					
	Bottom of Test Pit at 12.0 Feet. Started 03/25/15. Completed 03/25/15.					
		15				
		20				

NEW TEST PIT LOG 1912800-TP.GPJ HC_CORP.GDT 5/6/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

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Figure A-4

Test Pit Log TP- 6

Location: Lat: 48.123491° Long: -123.441182°
Approximate Ground Surface Elevation: 11 Feet
Logged By: B. McDonald Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
SM	Sod over (loose), moist to wet, dark brown, silty, gravelly SAND with substantial organic material and wood debris. Occasional construction related debris (wire, asphalt roofing). Timber pile observed at 2 feet.	0	S-1	42		GS
	Moist to wet, dark brown, primarily Wood debris and organic content. (Wood waste) Slight seepage observed at 4.5 feet. Zones with very little soil matrix and primarily wood debris. Creosol odor, sheen on water with scattered oil nodules.	5	S-2	84		
	Bottom of Test Pit at 8.0 Feet. Started 03/26/15. Completed 03/26/15.	10				
		15				
		20				

ATD

Test Pit Log TP- 7

Location: Lat: 48.123251° Long: -123.441374°
Approximate Ground Surface Elevation: 20 Feet
Logged By: B. McDonald Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
SM	(Loose), moist to wet, brown to dark brown, silty, gravelly SAND with substantial WOOD and organic material, ash-type material, and occasional brick and asphalt. (Berm Material, see Site Plan)	0	S-1	41		
GM	Sod over (loose), moist to wet, brown to dark brown, silty, very sandy GRAVEL with substantial wood and organic material, scattered brick and asphalt debris, cobble, and assorted metal.	10	S-2	25		GS
	Moist to wet, dark brown, primarily Wood debris and organic material. (Wood waste)	15	S-3	42		
	Bottom of Test Pit at 19.0 Feet. Started 03/26/15. Completed 03/26/15.	20				

ATD

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3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
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Figure A-5

Test Pit Log TP- 8

Location: Lat: 48.123328° Long: -123.441927°
Approximate Ground Surface Elevation: 16 Feet
Logged By: B. McDonald Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions	Sample	Water Content in Percent	PID	LAB TESTS
GP	Reinforced straw mat over (loose), moist, brown, sandy GRAVEL with scattered organic material and wood fragments.	S-1	7		
SM	(Loose), moist, gray-brown, very silty, fine to medium SAND, stratified.	S-2	18		GS
SP	(Loose), moist, gray to light brown, very gravelly SAND with trace silt and shell fragments. Three bag samples collected. Sidewall caving observed.	Bulk S-3	4 4		CBR, Proctor GS
		S-4	4		

Bottom of Test Pit at 9.0 Feet.
Started 03/26/15.
Completed 03/26/15.

Test Pit Log TP- 9

Location: Lat: 48.123490° Long: -123.443055°
Approximate Ground Surface Elevation: 15 Feet
Logged By: B. McDonald Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions	Sample	Water Content in Percent	PID	LAB TESTS
SM	(Loose), moist, gray-brown, silty to very silty, fine SAND with scattered wood debris in the upper 1.5 feet.	S-1	17	<0.1	
	Stratification observed from 3 to 4.5 feet.	S-2	20	<0.1	GS
SM	(Loose), moist to wet, gray to dark gray, silty, fine to medium SAND, scattered shell fragments, hydrogen sulfide odor. Slight seepage observed at 4.5 feet. Sidewall caving observed.	S-3	26	0.6	
SP	(Loose), moist to wet, dark gray, gravelly, fine to medium SAND, with trace silt and shell fragments.	S-4	8	3.1	GS

Bottom of Test Pit at 9.0 Feet.
Started 03/26/15.
Completed 03/26/15.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log TP-10

Location: Lat: 48.123144° Long: -123.442817°
Approximate Ground Surface Elevation: 15 Feet
Logged By: B. McDonald Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
ML	(Medium stiff), moist to wet, brown, fine sandy SILT, zones of mottling.	0	S-1	31		
SM/ML	(Loose), moist to wet, gray, very silty, fine SAND to fine sandy SILT. Sidewall caving observed. Very strong TPH-like odor from 3.5 feet.	5				
ML	(Soft), wet, gray SILT and fine sandy SILT.					
SP	(Loose), moist to wet, dark gray SAND. Slight seepage observed at 9 feet.	10				
	Bottom of Test Pit at 10.0 Feet. Started 03/25/15. Completed 03/25/15.	15				
		20				

Test Pit Log TP-11

Location: Lat: 48.123011° Long: -123.442418°
Approximate Ground Surface Elevation: 16 Feet
Logged By: B. McDonald Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
SM	(Loose), moist, gray-brown, silty, gravelly SAND with shell fragments and occasional silt zones.	0	S-1	11		
SM	(Loose), moist, brown, very silty, fine SAND, mottled. Large segments of bark, stratified.		S-2	23	<0.1	GS
SM	(Loose), moist, gray, silty, fine SAND. Zones of fine sandy SILT, occasional small wood fragments and shell fragments. Moist to wet below 5 feet. Sidewall caving observed. Slight TPH-like odor. Three bag samples collected.	5	S-3 / Bulk	23 / 25	<0.1	CBR, Proctor GS
			S-4	26	<0.1	
	Bottom of Test Pit at 10.0 Feet. Started 03/26/15. Completed 03/26/15.	10				
		15				
		20				

NEW TEST PIT LOG 1912800-TP.GPJ HC_CORP.GDT 5/6/15

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2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
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4. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

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Figure A-7

Test Pit Log TP-12

Location: Lat: 48.122900° Long: -123.441477°
Approximate Ground Surface Elevation: 10 Feet
Logged By: B. McDonald   Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
SM ML		(Loose), moist to wet, dark brown, very silty, fine SAND to fine sandy SILT with substantial roots, wood fragments, and organic material. (Wood Waste) Sidewall caving observed. Large wood (milled 4x12"), occasional concrete debris, and old footing. Hydrogen sulfide odor.	0 (ATD)	S-1	277	<0.1	OC
SP		(Loose), wet, dark gray, fine to medium SAND, with trace gravel and silt, scattered wood debris, zones of gray silt and brown, fine to medium sand.	5	S-2	19	<0.1	GS
		Bottom of Test Pit at 8.0 Feet. Started 03/27/15. Completed 03/27/15.	10				
			15				
			20				

Test Pit Log TP-15

Location: Lat: 48.122485° Long: -123.441117°
Approximate Ground Surface Elevation: 17 Feet
Logged By: B. McDonald   Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
GP		(Medium dense), moist, dark gray-brown, sandy GRAVEL, trace scattered small wood fragments.	0	S-1	7	<0.1	
SM		(Loose), moist, dark gray, slightly gravelly, very silty SAND.		S-2	19	<0.1	GS
ML		(Soft), moist, gray SILT and fine sandy SILT with scattered wood fragments.	5	S-3	43	<0.1	
SP		(Loose), moist to wet, dark gray, fine to medium SAND with trace gravel and scattered shell fragments.	10	S-4	9	<0.1	
		Bottom of Test Pit at 10.0 Feet. Started 03/27/15. Completed 03/27/15.					
			15				
			20				

NEW TEST PIT LOG 1912800-TP.GPJ HC_CORP.GDT 5/6/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

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Figure A-8

Test Pit Log TP-16

Location: Lat: 48.122779° Long: -123.441688°
Approximate Ground Surface Elevation: 15 Feet
Logged By: B. McDonald Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
SP SM	(Very loose to loose), moist, gray-brown, very silty, fine SAND and fine sandy SILT, substantial reinforced concrete segments and assorted metal debris. Moderate seepage at 2 feet.	0	S-1	30		
ML	(Soft), moist, dark gray SILT and fine sandy SILT. Sidewall caving observed.	5	S-2	52		AL
SW-SM	(Loose), wet, dark gray, slightly silty, fine to medium SAND with trace gravel and scattered shell fragments. Three bag samples collected.	ATD 10	Bulk S-3	18 23	0.2	CBR, Proctor GS
	Bottom of Test Pit at 10.0 Feet. Started 03/27/15. Completed 03/27/15.	15 20				

Test Pit Log TP-17

Location: Lat: 48.122786° Long: -123.442513°
Approximate Ground Surface Elevation: 16 Feet
Logged By: B. McDonald Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
ML	4 inches of Asphalt over (loose), moist, brown, slightly sandy SILT, mottled with zones of fine sandy SILT, stratified.	0	S-1	38	<0.1	GS
SM/ML	(Loose), moist to wet, gray, very silty, fine SAND with fine sandy SILT zones, trace scattered wood fragments, stratified. Sidewall caving observed.	5	S-2	37	<0.1	
SP	(Loose), moist to wet, dark gray, fine to medium SAND with scattered shell and wood fragments.		S-3	22	<0.1	
	Bottom of Test Pit at 9.0 Feet. Started 03/26/15. Completed 03/26/15.	10 15 20				

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

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Figure A-9

Test Pit Log TP-18

Location: Lat: 48.123132° Long: -123.443531°
Approximate Ground Surface Elevation: 16 Feet
Logged By: B. McDonald   Reviewed By: C. Valdez

Horizontal Datum: NAD 83
Vertical Datum: NAVD 88

USCS Class	Soil Descriptions	Sample	Water Content in Percent	PID	LAB TESTS
SM	Sod over (loose), moist, brown, silty, gravelly SAND, scattered small roots, occasional wood and glass debris.	S-1	14	<0.1	
		S-2	20	<0.1	
	Becomes fine SAND with mottled zones.				
SM	(Loose), moist, gray, very silty, fine SAND, micaceous with frequent SILT and fine sandy SILT zones. Sidewall caving observed.	S-3	29	<0.1	GS
SP	(Loose), moist, gray SAND. TPH-like odor observed.			70	

Bottom of Test Pit at 10.0 Feet.
Started 03/25/15.
Completed 03/25/15.

NEW TEST PIT LOG 1912800-TP.GPJ HC_CORP.GDT 5/6/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

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Figure A-10

APPENDIX B
Laboratory Testing Program

APPENDIX B
LABORATORY TESTING PROGRAM

Laboratory testing evaluated the basic index testing and geotechnical engineering properties of the site soils. Both disturbed and relatively undisturbed samples were tested. The tests performed and the procedures followed are outlined below.

Soil Classification

Field Observation and Laboratory Analysis

Soil samples from the explorations were visually classified in the field and then taken to our laboratory, where the classifications were verified in a relatively controlled laboratory environment. Field and laboratory observations included density/consistency, moisture condition, organic content, and grain size and plasticity estimates.

The classifications of selected samples were checked by laboratory tests such as Atterberg limits determinations and grain size analyses. Soil was classified in general accordance with the Unified Soil Classification (USC) system, ASTM D2487, as presented on Figure B-1.

Grain Size Analysis

Grain size distribution was analyzed for representative samples in general accordance with ASTM D422. Wet sieve analysis was used to determine the size distribution greater than the U.S. No. 200 mesh sieve. The size distribution for particles smaller than the No. 200 mesh sieve was determined by the hydrometer method for a selected number of samples. The results of the tests are presented as curves on Figures B-2 through B-9 (plots of percent finer by weight versus grain size) and summarized in Table B-1.

Water Content Determination

Water content was determined for most samples recovered in the explorations in general accordance with ASTM D2216, as soon as possible following the samples' arrival in our laboratory. Water content was not determined for very small samples or samples for which large gravel content would result in unrepresentative values. The results of these tests are plotted at the respective sample depth on the exploration logs. In addition, water contents are routinely determined for samples subjected to other testing. These are also presented on the exploration logs and in Table B-1.

Atterberg Limits

We determined Atterberg limits for selected fine-grained soil samples. The liquid limit and plastic limit were determined in general accordance with ASTM D4318-84. The results of the Atterberg limits analyses and the plasticity characteristics are summarized in the Liquid and Plastic Limits Test Report, Figure B-10. This relates the plasticity index (liquid limit minus the plastic limit) to the liquid limit. The results of the Atterberg limits tests are shown graphically on the boring logs as well as where applicable on figures presenting various other test results. The Atterberg limits are presented in Table B-1.

Moisture-Density Relationship

Moisture-density tests were performed in general accordance with ASTM D1557 (modified Proctor test). The test results plotted in terms of dry density versus water content determined a maximum dry density and optimum moisture content. The data have been incorporated into the California bearing ratio (CBR) test results referred to in the following section and are presented on Figures B-14 to B-16.

California Bearing Ratio Test

The CBR test evaluates the relative quality and support characteristic of subgrade soils. The test was performed in general accordance with ASTM D1883. Representative portions of the sample were compacted in a mold in general accordance with ASTM D1557 to provide a moisture-density relationship curve. Following compaction, a 15-pound surcharge was applied to the sample in the mold, which was then totally immersed in water and allowed to soak for 72 to 96 hours, during which time it was monitored for swell. At the end of this period the sample was removed from the water and drained. A vertical load was applied to the surcharged soil with a penetration piston at a constant rate of strain. The applied vertical load was measured at selected penetration depths. CBR test results and moisture-density relationships plotted in terms of water content versus corrected CBR and dry density, respectively, are presented on Figures B-11 to B-13.

Organic Content (OC)

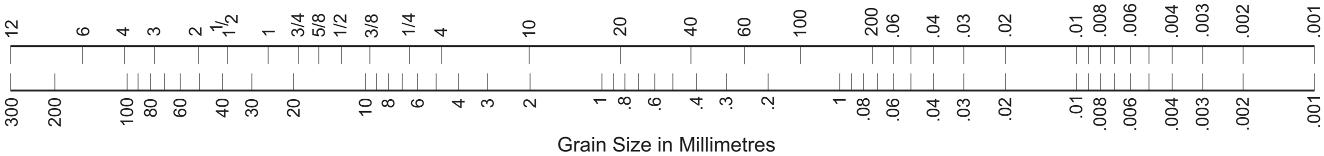
Two organic content tests were performed in general accordance with ASTM D2974 Method C; results are in Table B-2.

Table B-2 – Organic Content Results

Test Pit	Sample Number	Depth in Feet	OC [a] in Mass Percent
TP-6	S-1	1.0	50.0
TP-12	S-1	1.0	16.0

Unified Soil Classification (USC) System
Soil Grain Size

Size of Opening In Inches	Number of Mesh per Inch (US Standard)	Grain Size in Millimetres



COBBLES	GRAVEL	SAND	SILT and CLAY
Coarse-Grained Soils			Fine-Grained Soils

Coarse-Grained Soils

G W	G P	G M	G C	S W	S P	S M	S C
Clean GRAVEL <5% fines		GRAVEL with >12% fines		Clean SAND <5% fines		SAND with >12% fines	
GRAVEL >50% coarse fraction larger than No. 4				SAND >50% coarse fraction smaller than No. 4			
Coarse-Grained Soils >50% larger than No. 200 sieve							

G W and S W $\left(\frac{D_{60}}{D_{10}}\right)$ >4 for G W, >6 for S W & $1 \le \left(\frac{(D_{30})^2}{D_{10} \times D_{60}}\right) \le 3$

G P and S P Clean GRAVEL or SAND not meeting requirements for G W and S W

G M and S M Atterberg limits below A line with PI <4

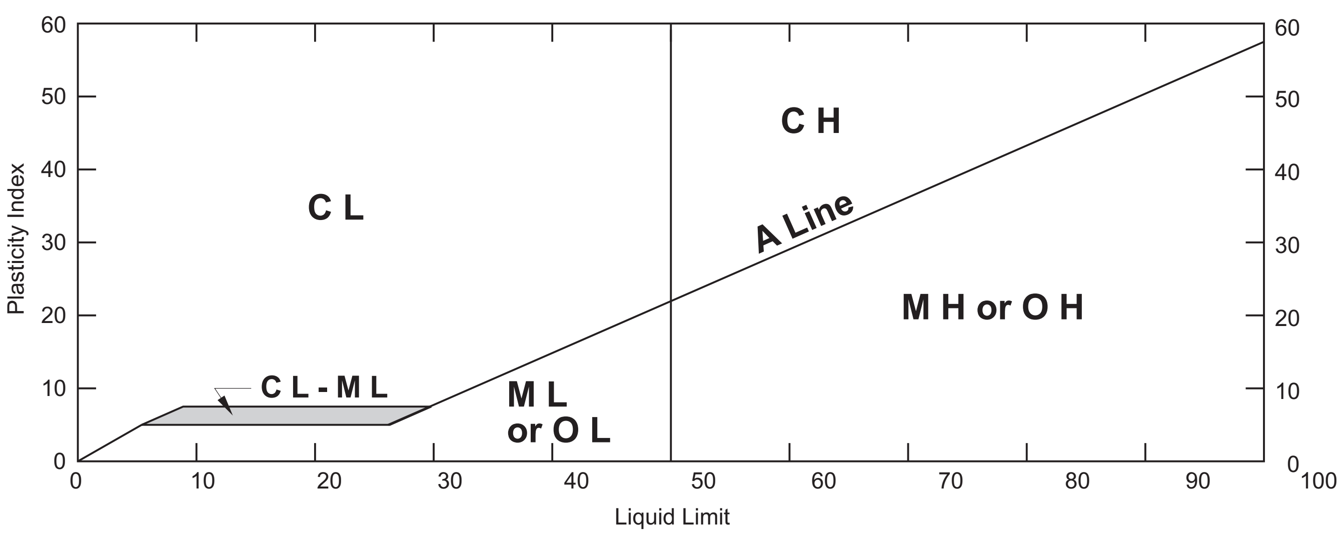
G C and S C Atterberg limits above A Line with PI >7

* Coarse-grained soils with percentage of fines between 5 and 12 are considered borderline cases requiring use of dual symbols.

D_{10}, D_{30}, and D_{60} are the particles diameter of which 10, 30, and 60 percent, respectively, of the soil weight are finer.

Fine-Grained Soils

M L	C L	O L	M H	C H	O H	Pt
SILT	CLAY	Organic	SILT	CLAY	Organic	Highly Organic Soils
Soils with Liquid Limit <50%			Soils with Liquid Limit >50%			
Fine-Grained Soils >50% smaller than No. 200 sieve						



SRF Grain Size (B-1).cdr 3/06

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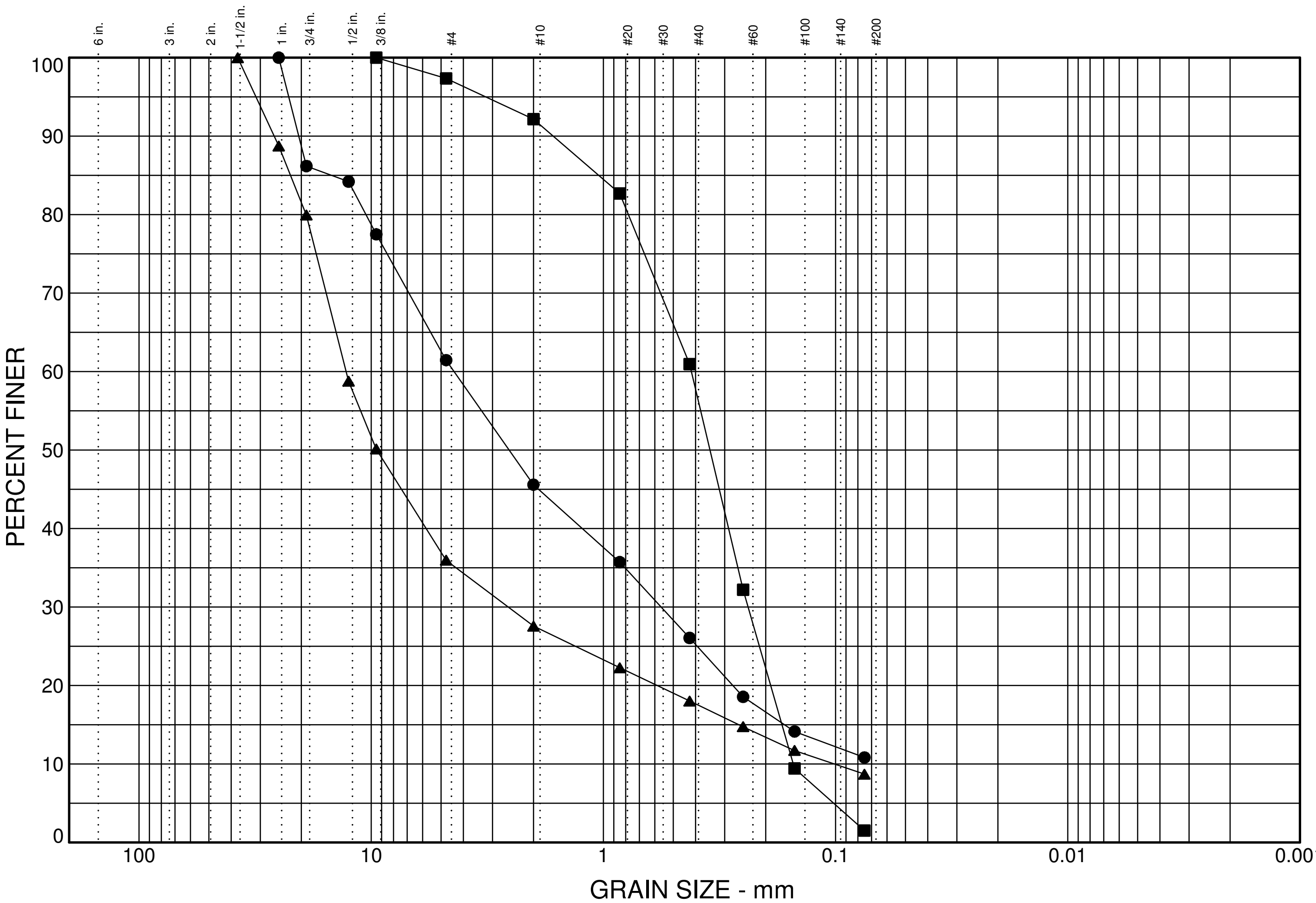
Figure B-1

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	38.5	50.6	10.8	
■	0.0	2.6	95.8	1.5	
▲	0.0	64.0	27.3	8.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			14.776	4.386	2.543	0.564	0.166		1.15	69.57
■			1.048	0.418	0.347	0.238	0.17	0.152	0.89	2.75
▲			22.24	12.807	9.437	2.57	0.26	0.101	5.11	126.89

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● slightly silty, very gravelly SAND	SW-SM	4.9%
■ SAND, trace gravel and silt	SP	6.1%
▲ slightly silty, sandy GRAVEL	GP-GM	4.0%

Remarks:

●

■

▲

Project: K-Ply

Client:

● Source: TP- 1 Sample No.: S-1 Depth: 2.0 to 3.0
■ Source: TP- 1 Sample No.: S-5 Depth: 10.0 to 11.0
▲ Source: TP- 2 Sample No.: S-1 Depth: 1.0 to 2.0

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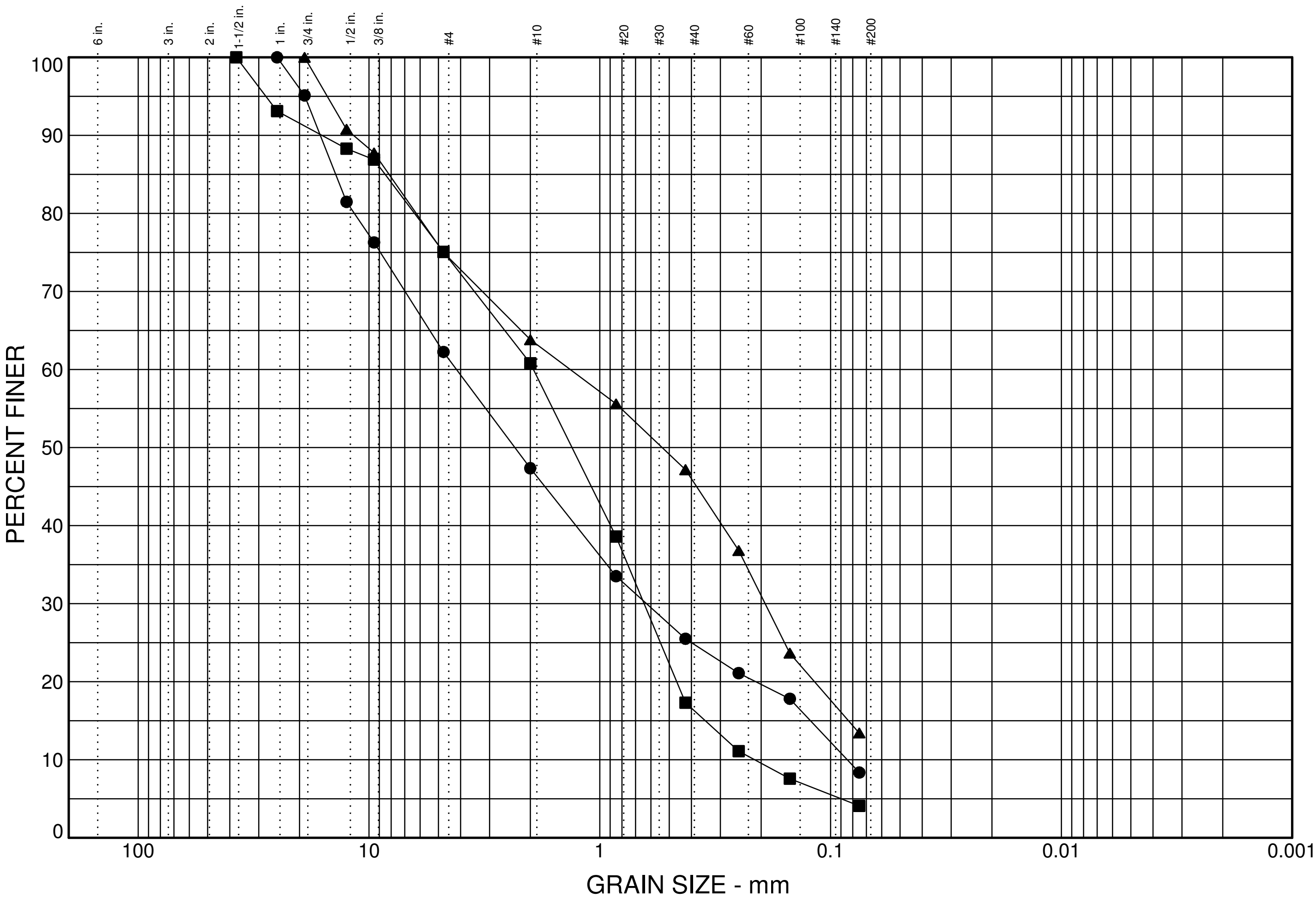
Figure B-2

GRAIN SIZE 1912800-TP.GPJ HC_CORP.GDT 5/4/15

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	37.7	53.9	8.4	
■	0.0	24.9	71.0	4.1	
▲	0.0	25.0	61.6	13.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			13.923	4.166	2.332	0.627	0.122	0.085	1.12	49.28
■			8.497	1.939	1.319	0.643	0.349	0.213	1.00	9.11
▲			8.176	1.343	0.536	0.192	0.083			

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● slightly silty, very gravelly SAND	SW-SM	6.6%
■ gravelly SAND, trace silt	SW	4.7%
▲ silty gravelly, SAND	SM	6.2%

Remarks:

●

■

▲

Project: K-Ply

Client:

● Source: TP- 2	Sample No.: S-3	Depth: 3.0 to 3.8
■ Source: TP- 2	Sample No.: S-4	Depth: 5.0 to 5.8
▲ Source: TP- 3	Sample No.: S-2	Depth: 1.5 to 2.3

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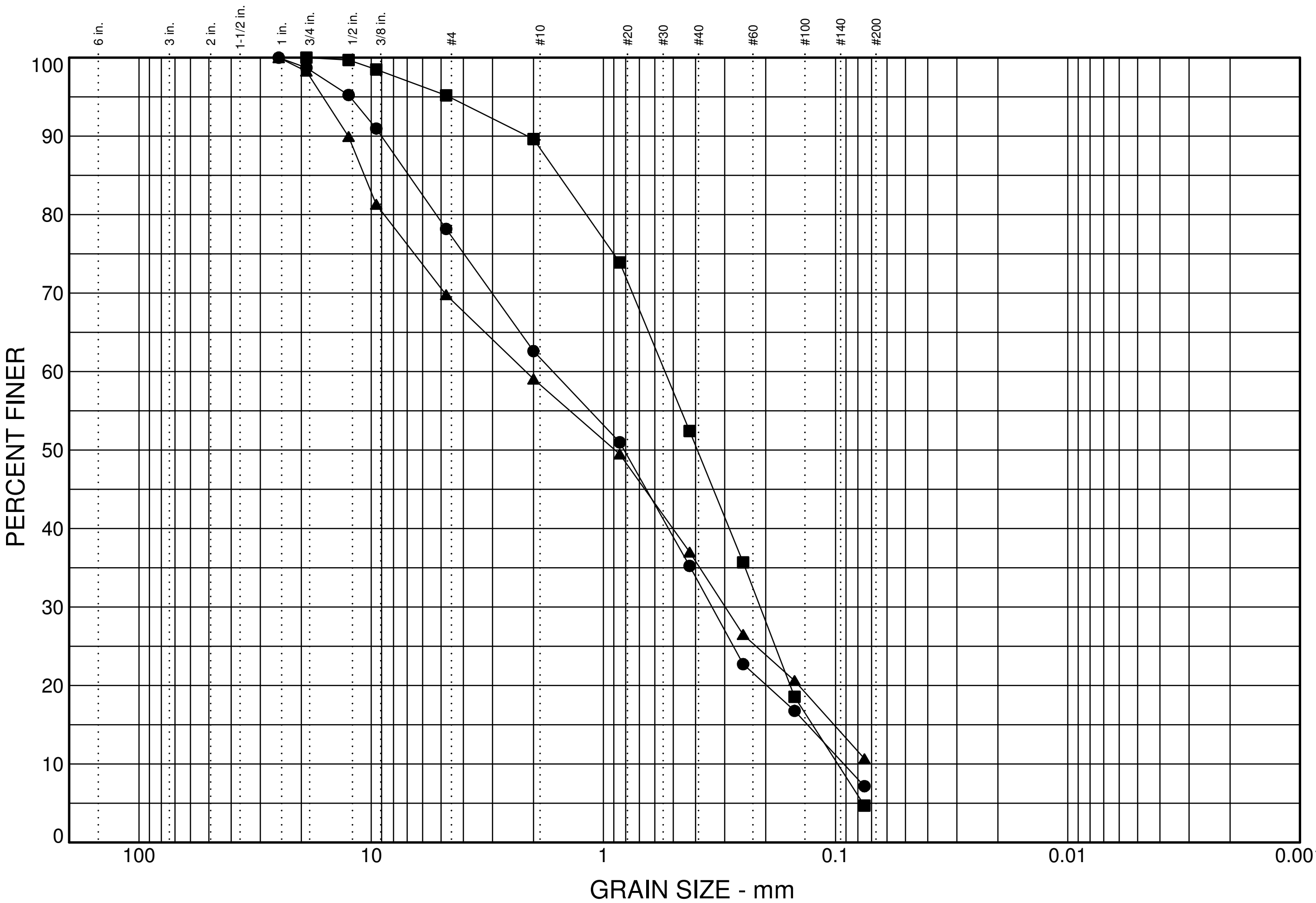
Figure B-3

GRAIN SIZE 1912800-TP.GPJ HC_CORP.GDT 5/4/15

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	21.8	71.0	7.2	
■	0.0	4.8	90.5	4.7	
▲	0.0	30.2	59.1	10.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			6.875	1.65	0.814	0.34	0.132	0.092	0.76	17.95
■			1.555	0.543	0.393	0.211	0.125	0.098	0.84	5.55
▲			10.683	2.157	0.889	0.298	0.101		0.58	30.14

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● slightly silty, gravelly SAND	SP-SM	8.0%
■ SAND, trace gravel and silt	SP	11.9%
▲ slightly silty, very gravelly SAND	SP-SM	7.8%

Remarks:
●

■

▲

Project: K-Ply

Client:

● Source: TP- 4	Sample No.: S-1	Depth: 1.0 to 3.0
■ Source: TP- 4	Sample No.: S-3	Depth: 9.0 to 11.0
▲ Source: TP- 5	Sample No.: S-1	Depth: 1.0 to 3.0

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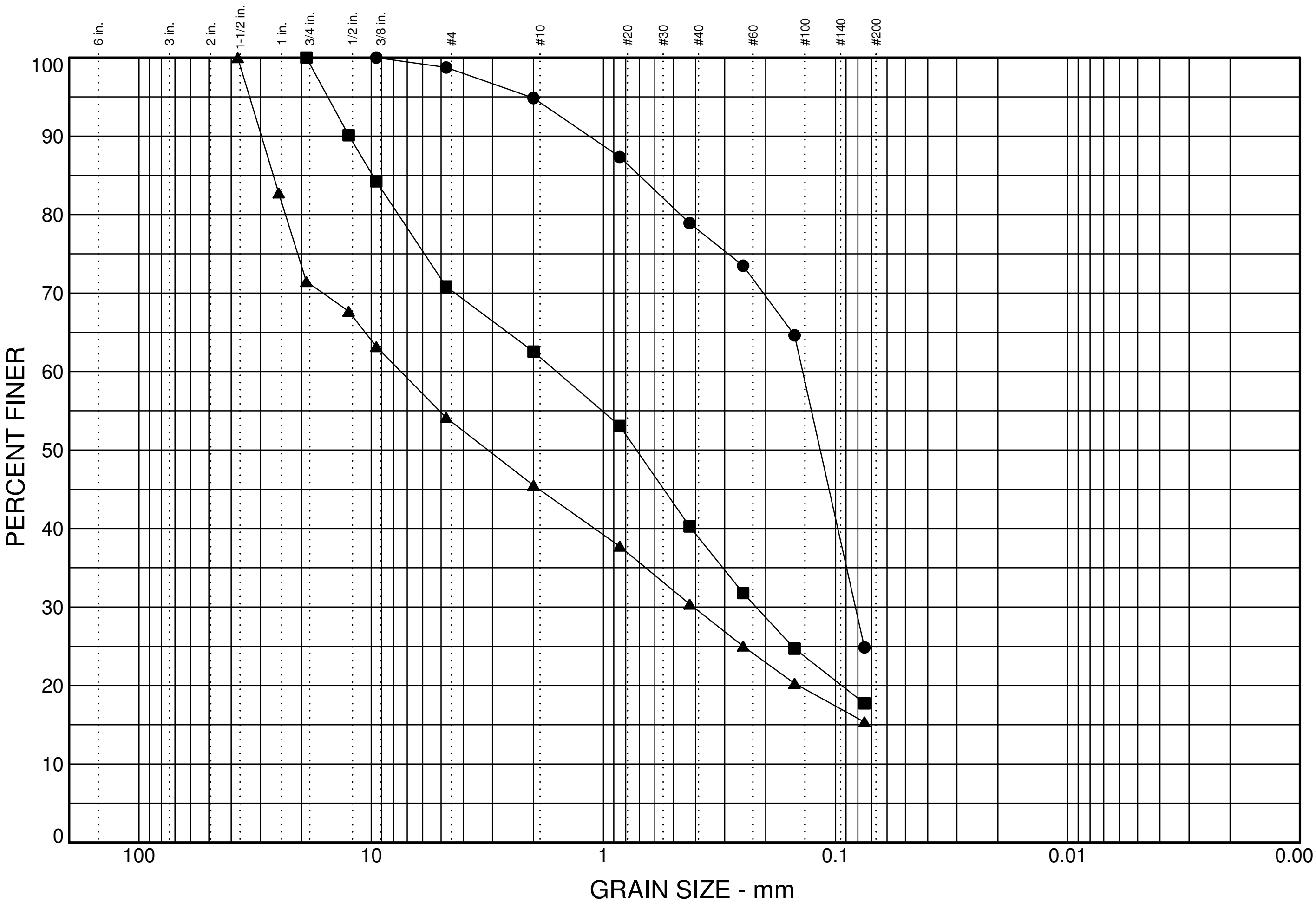
Figure B-4

GRAIN SIZE 1912800-TP.GPJ HC_CORP.GDT 5/4/15

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	1.3	73.9	24.9	
■	0.0	29.2	53.1	17.7	
▲	0.0	45.9	38.8	15.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.701	0.138	0.116	0.082				
■			9.832	1.589	0.719	0.22				
▲			26.357	7.441	3.136	0.41				

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● silty SAND, trace gravel	SM	18.1%
■ silty, gravelly SAND	SM	42.4%
▲ silty, very sandy GRAVEL	GM	24.8%

Remarks:
●

■

▲

Project: K-Ply

Client:

● Source: TP- 5 Sample No.: S-2 Depth: 3.5 to 4.5
■ Source: TP- 6 Sample No.: S-1 Depth: 1.0 to 2.0
▲ Source: TP- 7 Sample No.: S-2 Depth: 14.0 to 15.0

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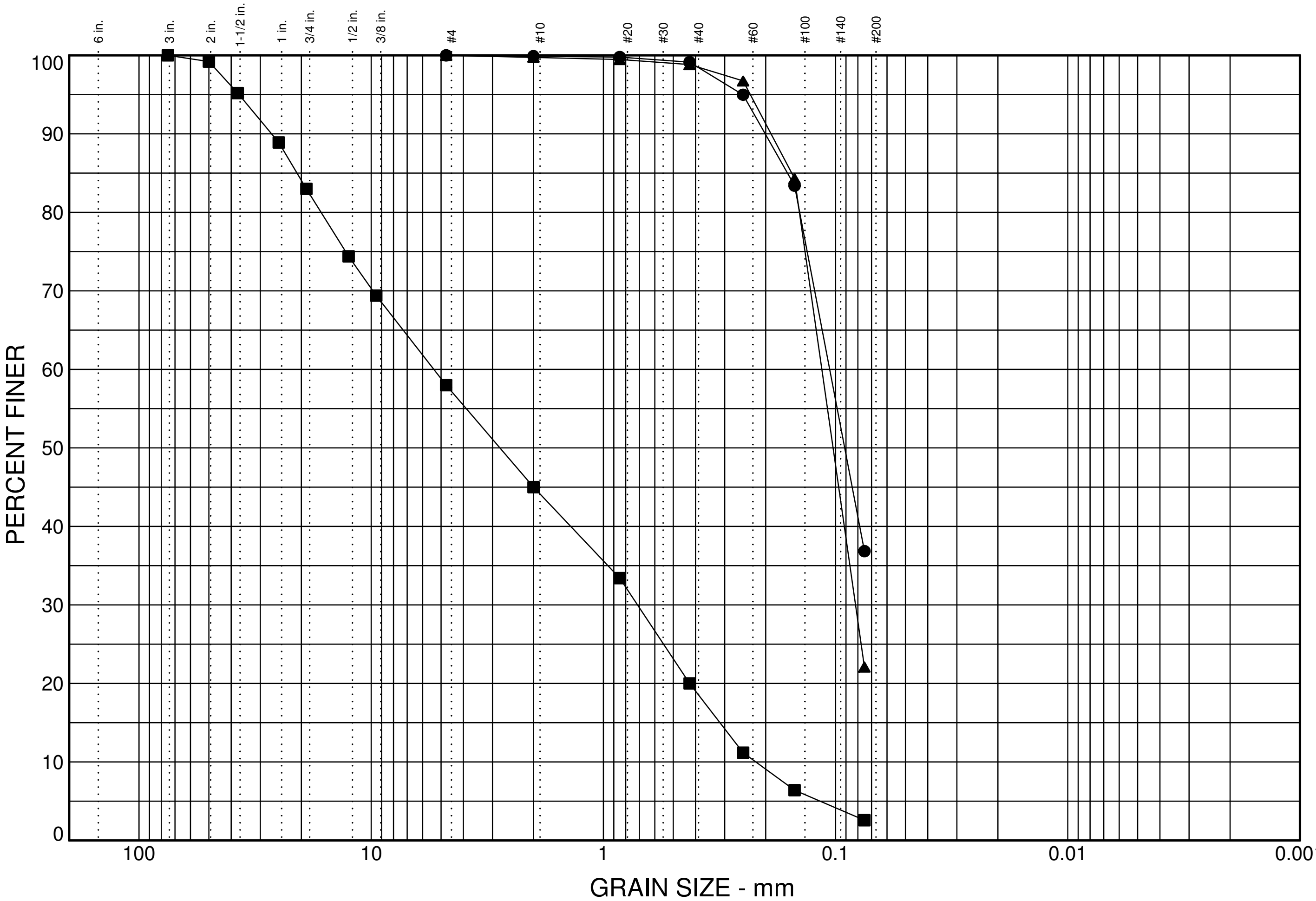
Figure B-5

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	63.1	36.9	
■	0.0	42.0	55.4	2.6	
▲	0.0	0.0	77.9	22.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.161	0.106	0.091					
■			20.852	5.364	2.789	0.713	0.314	0.22	0.43	24.38
▲			0.154	0.114	0.102	0.082				

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● very silty SAND	SM	18.4%
■ very gravelly SAND, trace silt	SP	3.8%
▲ silty SAND	SM	19.9%

Remarks:
●

■

▲

Project: K-Ply

Client:

● Source: TP- 8 Sample No.: S-2 Depth: 1.0 to 2.0
■ Source: TP- 8 Sample No.: Bulk Depth: 2.5 to 3.5
▲ Source: TP- 9 Sample No.: S-2 Depth: 3.0 to 4.0

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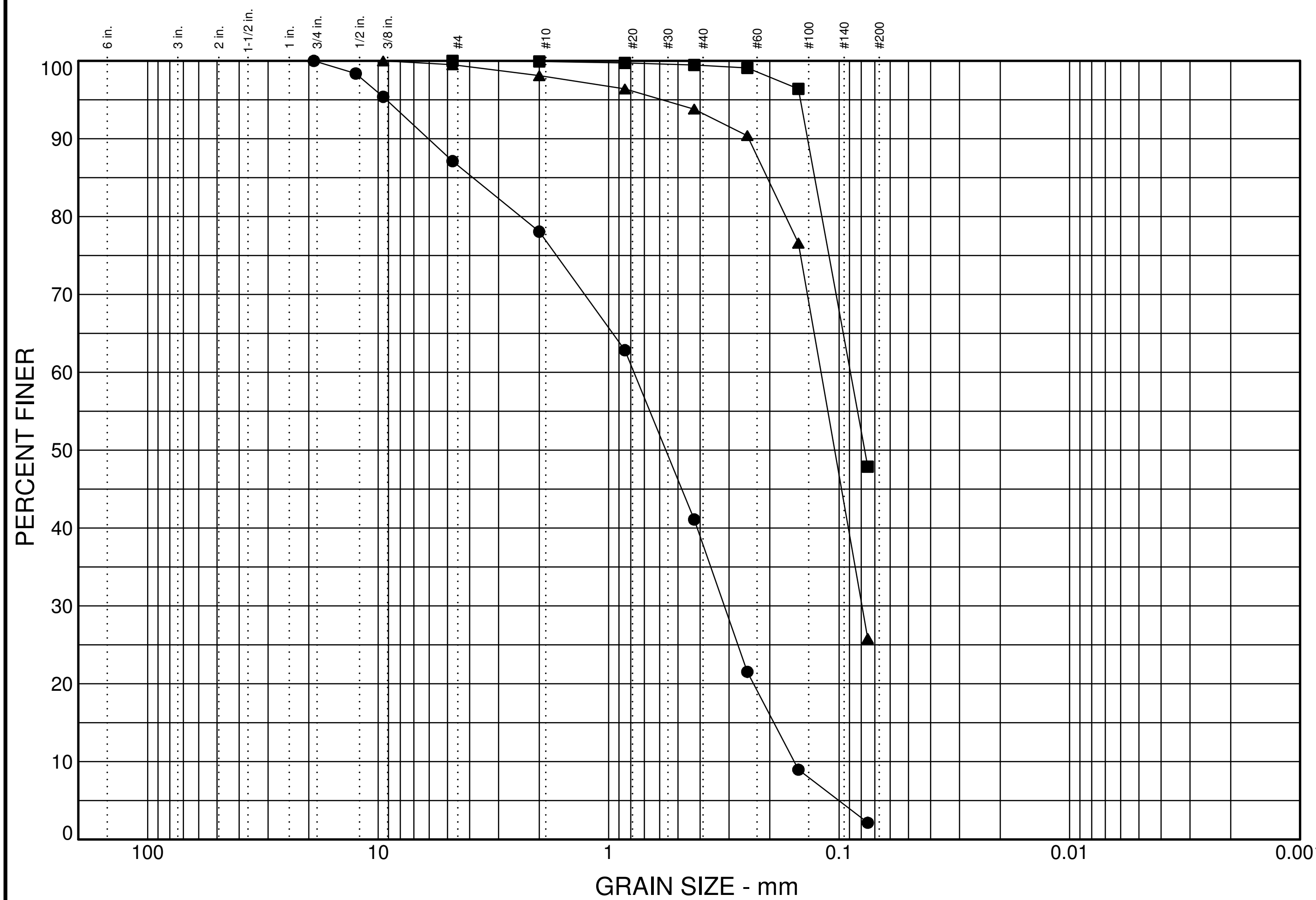
Figure B-6

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	12.9	85.0	2.1	
■	0.0	0.0	52.1	47.9	
▲	0.0	0.5	73.7	25.8	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			3.879	0.776	0.564	0.315	0.192	0.156	0.81	4.96
■			0.127	0.089	0.077					
▲			0.205	0.12	0.104	0.079				

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● gravelly SAND, trace silt	SP	8.1%
■ very silty SAND	SM	23.2%
▲ silty SAND	SM	25.2%

Remarks:
●

■

▲

Project: K-Ply

Client:

● Source: TP- 9 Sample No.: S-4 Depth: 8.0 to 8.0
■ Source: TP-11 Sample No.: S-2 Depth: 1.5 to 1.5
▲ Source: TP-11 Sample No.: Bulk Depth: 5.0 to 5.0

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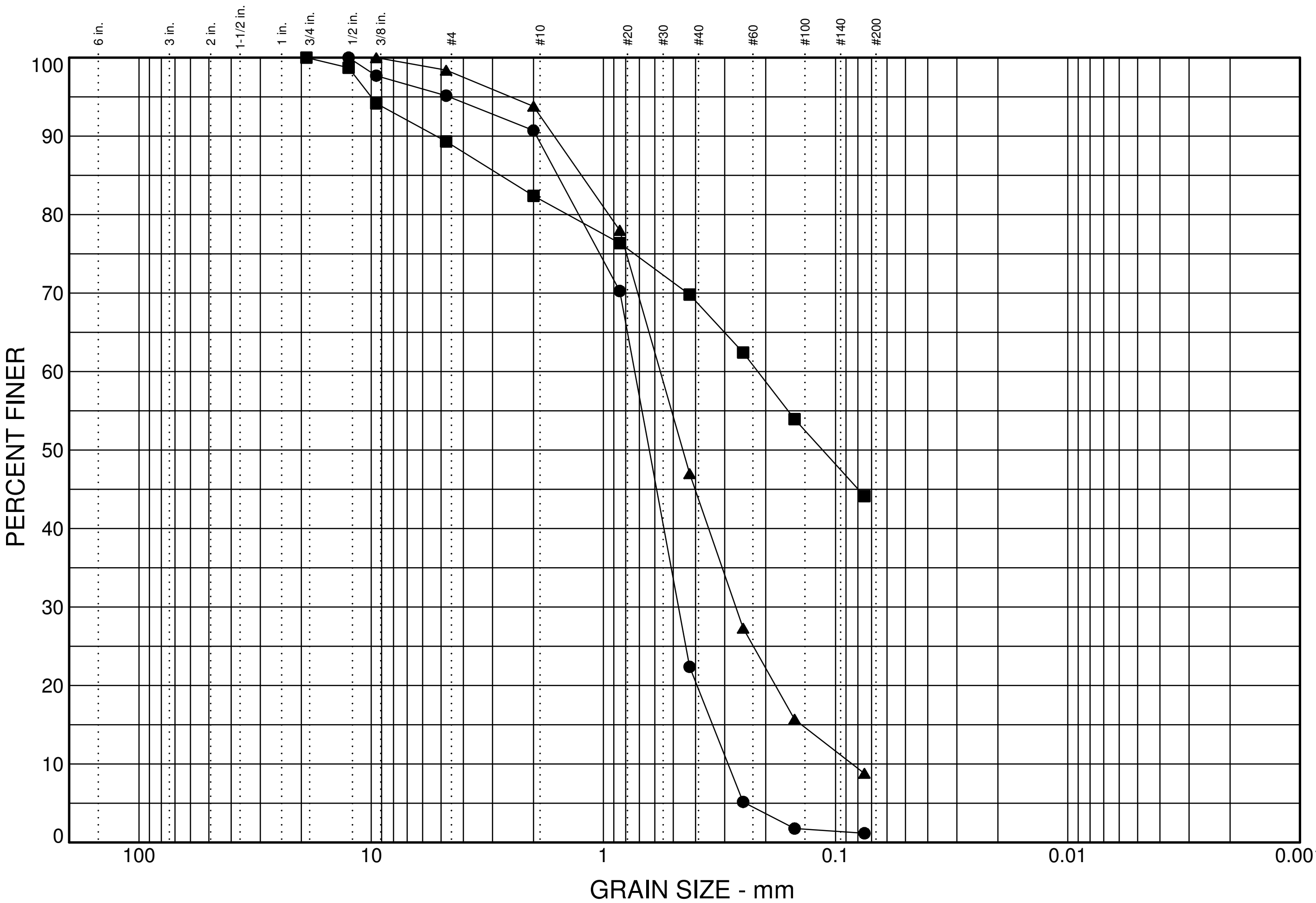
Figure B-7

GRAIN SIZE 1912800-TP.GPJ HC_CORP.GDT 5/4/15

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	4.8	94.0	1.2	
■	0.0	10.7	45.2	44.1	
▲	0.0	1.6	89.6	8.8	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			1.575	0.733	0.634	0.475	0.338	0.29	1.06	2.53
■			2.769	0.216	0.114					
▲			1.242	0.568	0.454	0.269	0.14	0.085	1.50	6.72

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● SAND, trace gravel and silt	SP	19.0%
■ slightly gravelly, very silty SAND	SM	19.2%
▲ slightly silty SAND, trace gravel	SW-SM	18.0%

Remarks:
●
■
▲

Project: K-Ply

Client:

● Source: TP-12 Sample No.: S-2 Depth: 5.0 to 5.0
■ Source: TP-15 Sample No.: S-2 Depth: 2.0 to 2.0
▲ Source: TP-16 Sample No.: Bulk Depth: 9.0 to 9.0

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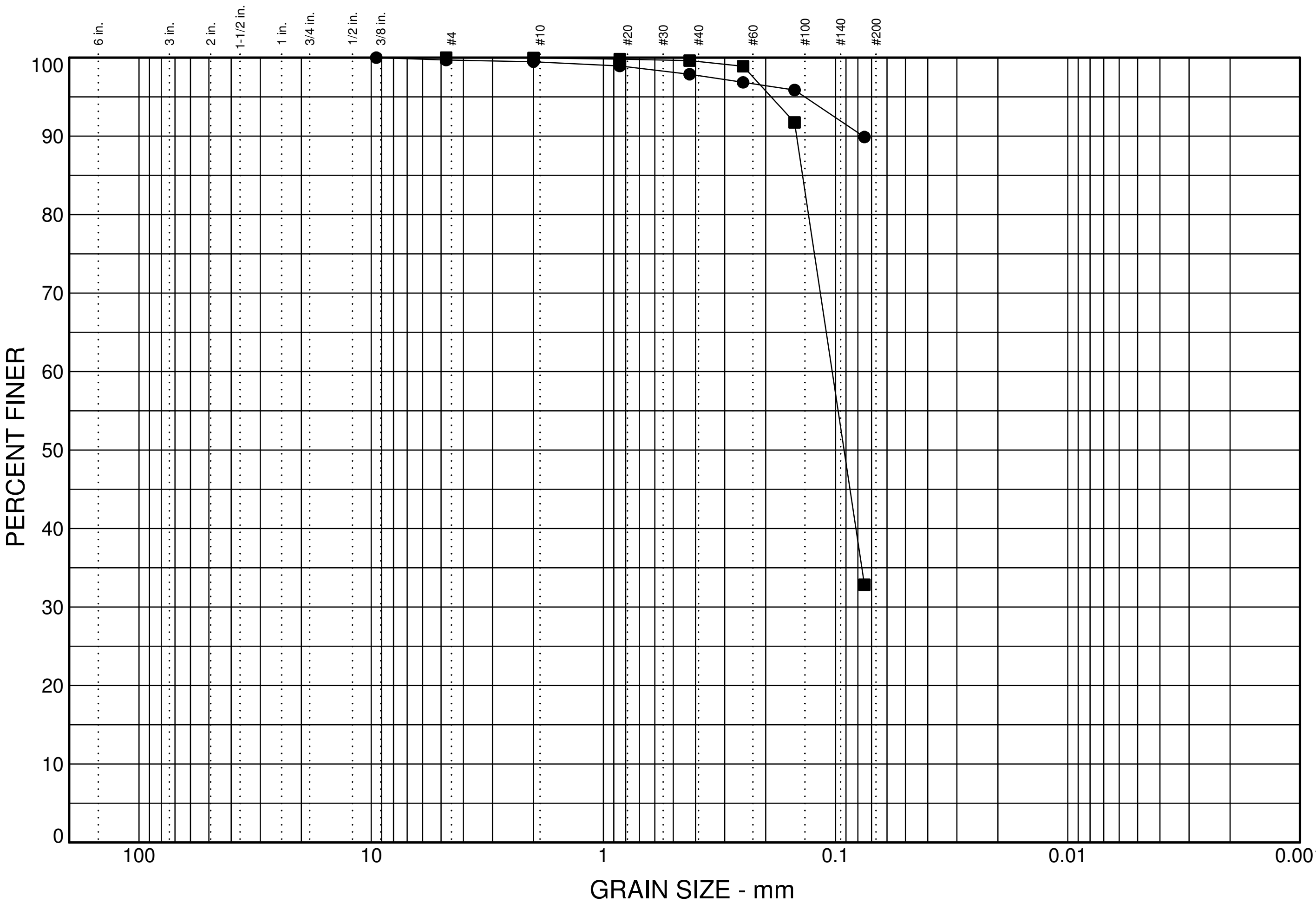
Figure B-8

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.3	9.8	89.9	
■	0.0	0.0	67.2	32.8	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●										
■			0.139	0.103	0.092					

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● slightly sandy SILT	ML	38.5%
■ very silty SAND	SM	29.2%

Remarks:

●

■

Project: K-Ply

Client:

● Source: TP-17 Sample No.: S-1 Depth: 1.0 to 2.0
■ Source: TP-18 Sample No.: S-3 Depth: 3.5 to 4.5

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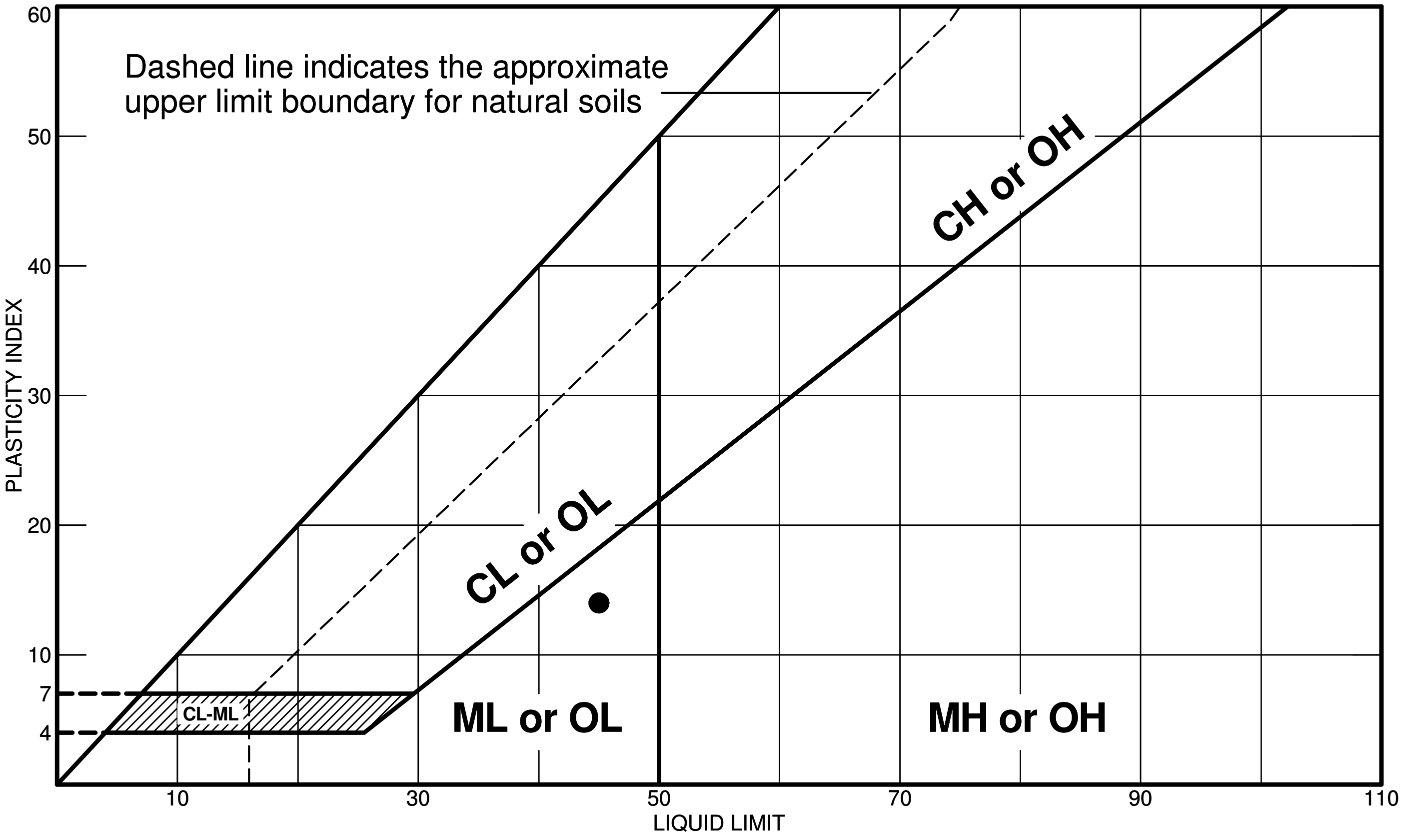
Figure B-9

GRAIN SIZE 1912800-TP.GPJ HC_CORP.GDT 5/4/15

Liquid and Plastic Limits Test Report



Location + Description	LL	PL	PI	-200	USCS
● Source: TP-16 Sample No.: S-2 Depth: 4 SILT	45	31	14		ML

Remarks:
●

Project: K-Ply

Client:

Location:

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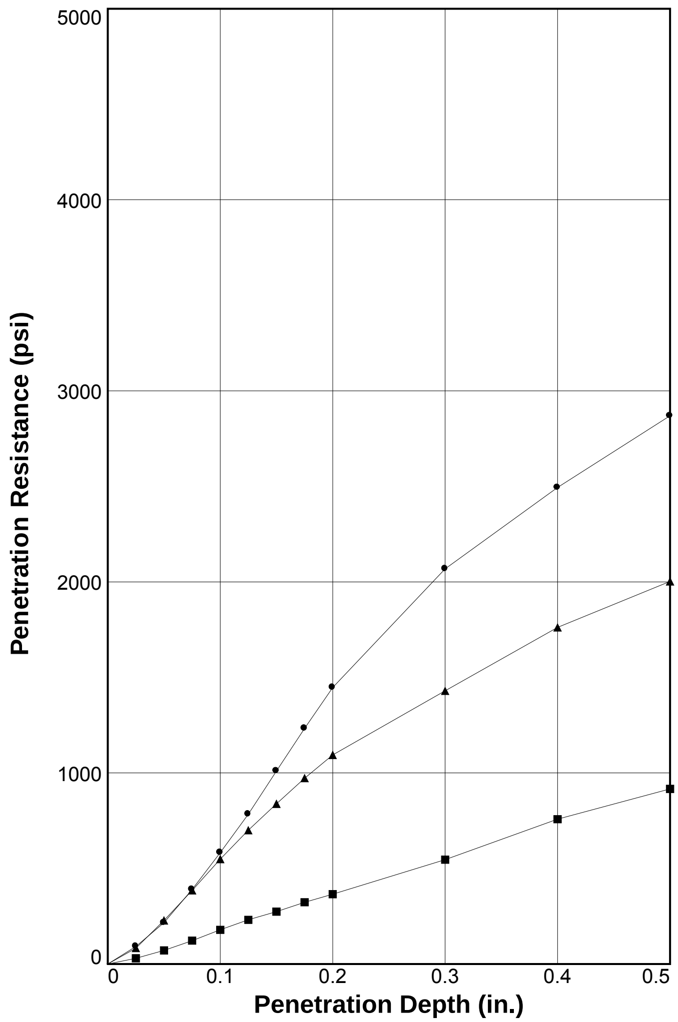
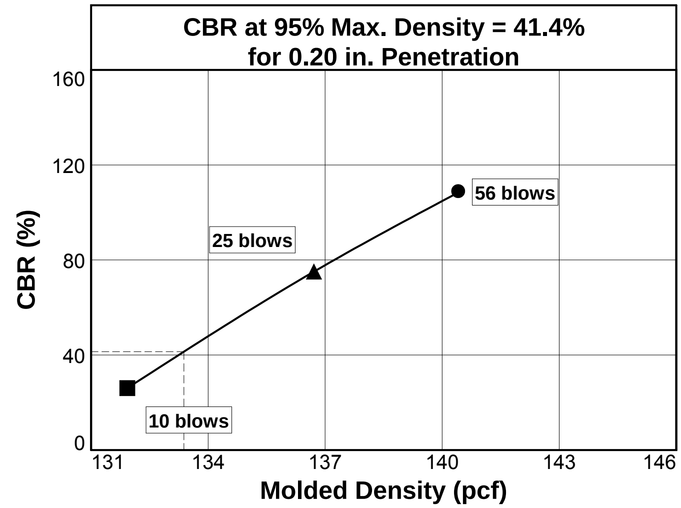
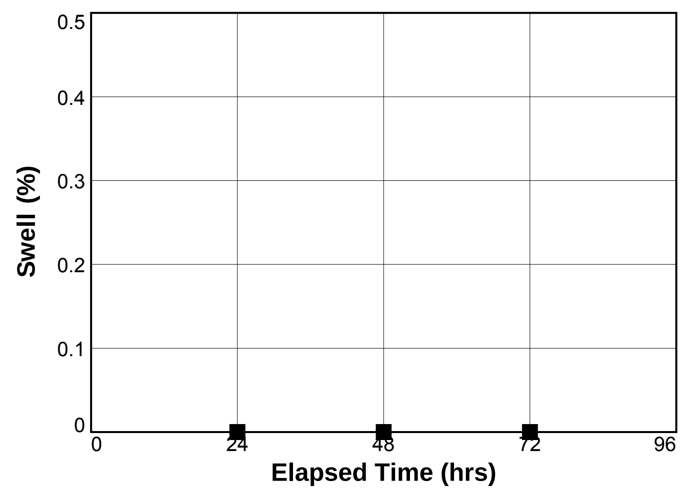
Figure B- 10

ATTERBERG LIMITS 1912800-TP.GPJ HC_CORP.GDT 5/4/15

BEARING RATIO TEST REPORT
ASTM D 1883-07







	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	140.4	100	7.2	140.4	100	7.6	82.2	108.6	0.029	10	0
2 △	136.7	97.4	6.8	136.7	97.4	7.5	60.7	75.1	0.010	10	0
3 □	131.9	93.9	6.9	131.9	94	8.1	20.9	26.1	0.014	10	0

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
very gravelly SAND, trace silt	SP	140.4	7.2	NA	NA

Project No: 19128-00

Project: K Ply

Source of Sample: TP-8 **Depth:** 2.5'

Sample Number: Bulk

Date:

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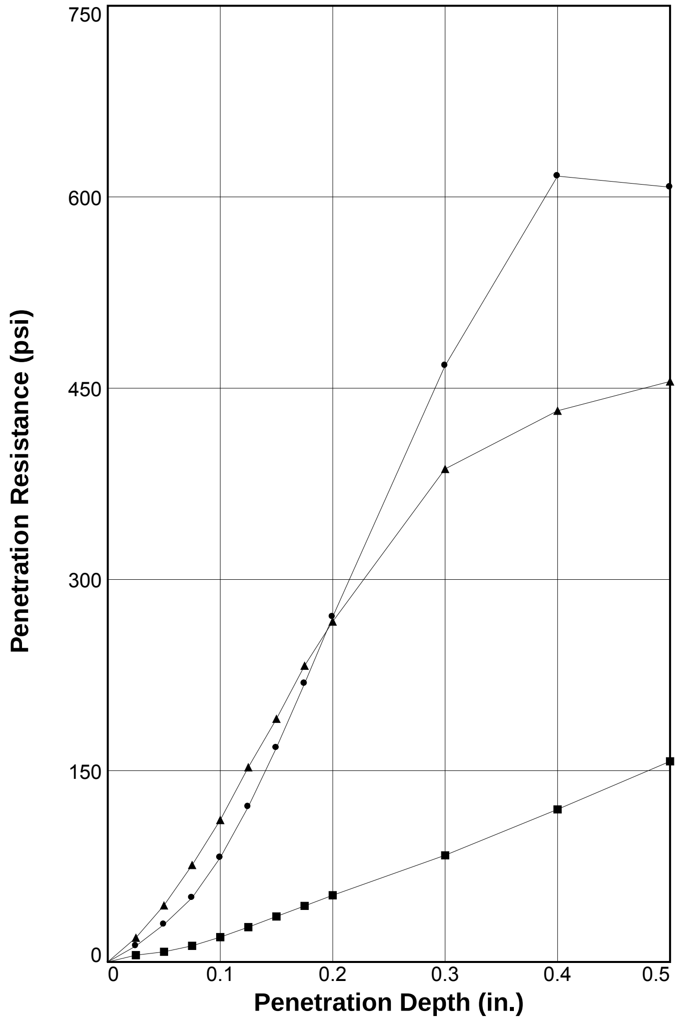
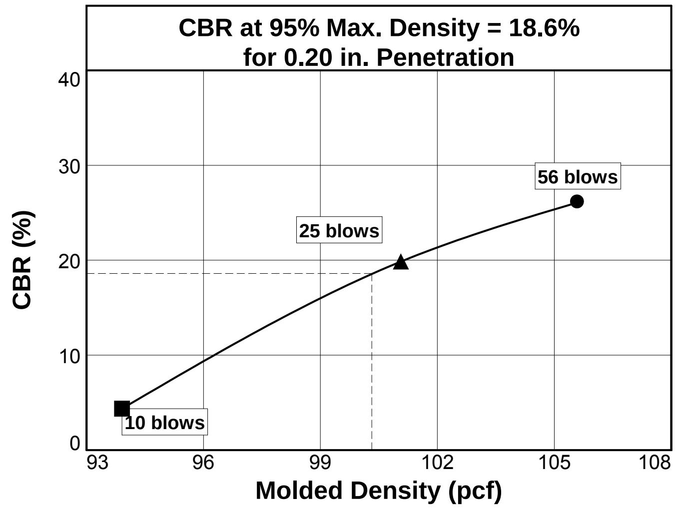
Test Description/Remarks:

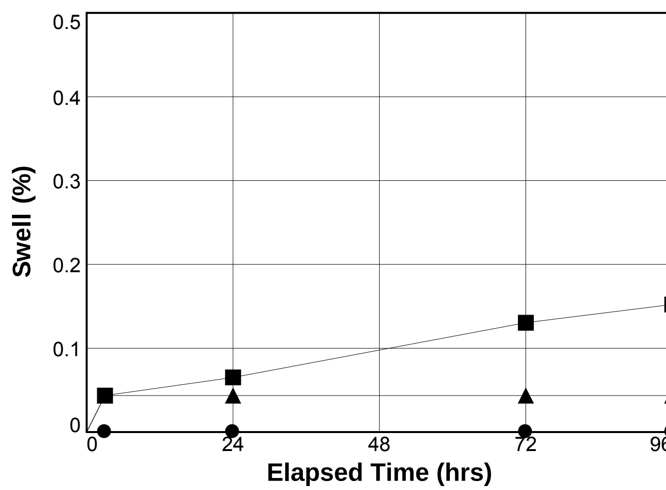
Manual rammer used for CBR compaction.

Figure B-11

BEARING RATIO TEST REPORT
ASTM D 1883-07







	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	105.6	100	17.0	105.6	100	17.7	19.1	26.1	0.061	10	0
2 △	101.1	95.7	17.0	101.0	95.7	20.0	15.4	19.9	0.026	10	0
3 □	93.9	88.9	17.0	93.8	88.8	24.3	3.3	4.4	0.042	10	0.2

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
silty SAND	SM	105.6	17.0	NA	NA

Project No: 19128-00

Project: K Ply

Source of Sample: TP-11 **Depth:** 5-6'

Sample Number: Bulk

Date: 4/2/15

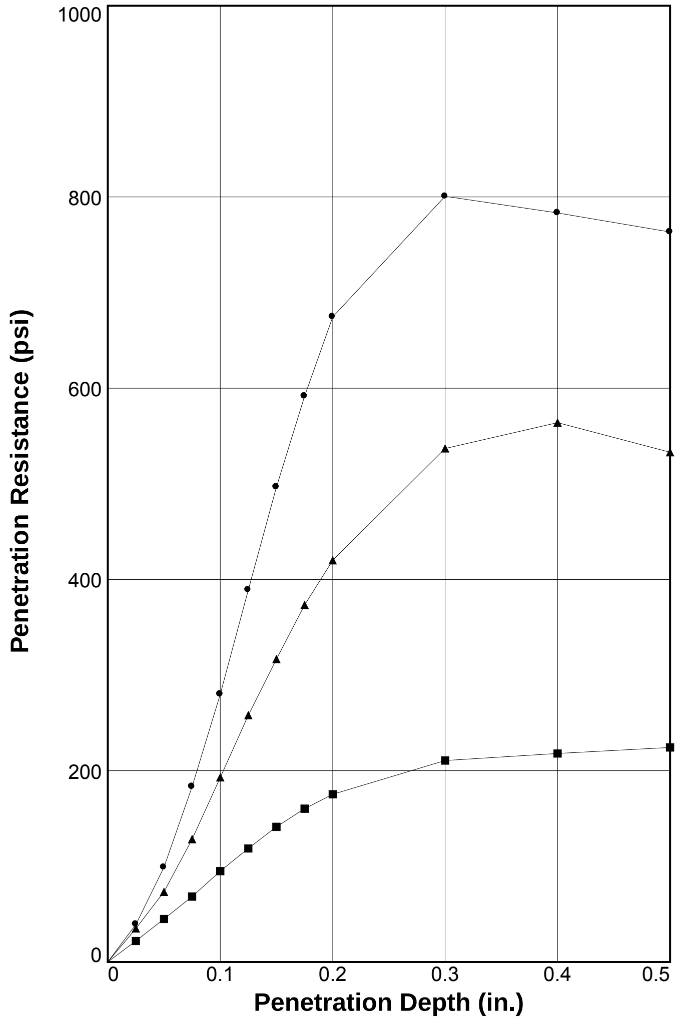
HARTCROWSER

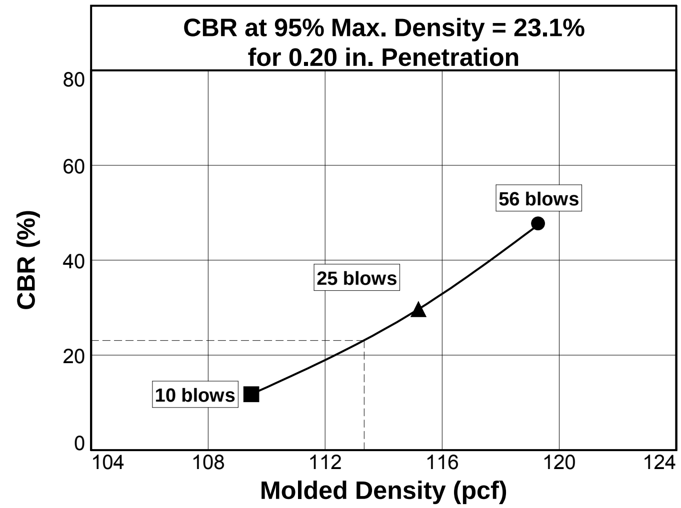
Test Description/Remarks:

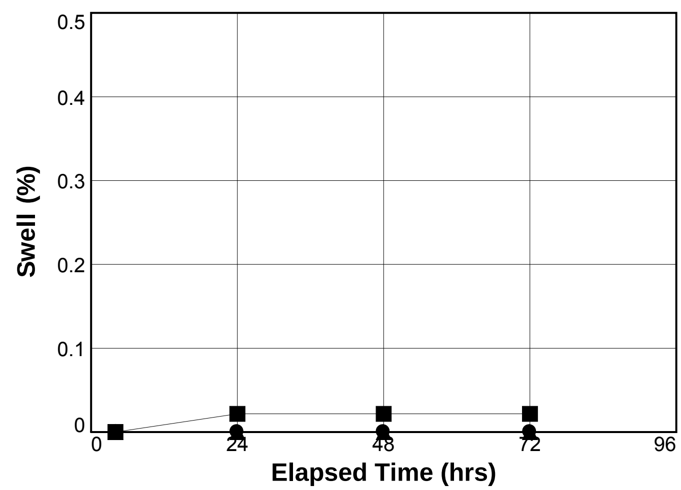
Manual rammer used for CBR compaction.

Figure B-12

BEARING RATIO TEST REPORT
ASTM D 1883-07







	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	119.3	100	11.0	119.3	100	11.3	41.4	47.6	0.031	10	0
2 △	115.2	96.6	11.0	115.2	96.6	13.2	24.9	29.7	0.022	10	0
3 □	109.5	91.8	11.0	109.5	91.7	15.4	9.8	11.8	0.003	10	0

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
slightly silty SAND, trace gravel	SW-SM	119.3	11.0	NA	NA

Project No: 19128-00

Project: K Ply

Source of Sample: TP-16 **Depth:** 9-10'

Sample Number: Bulk

Date:

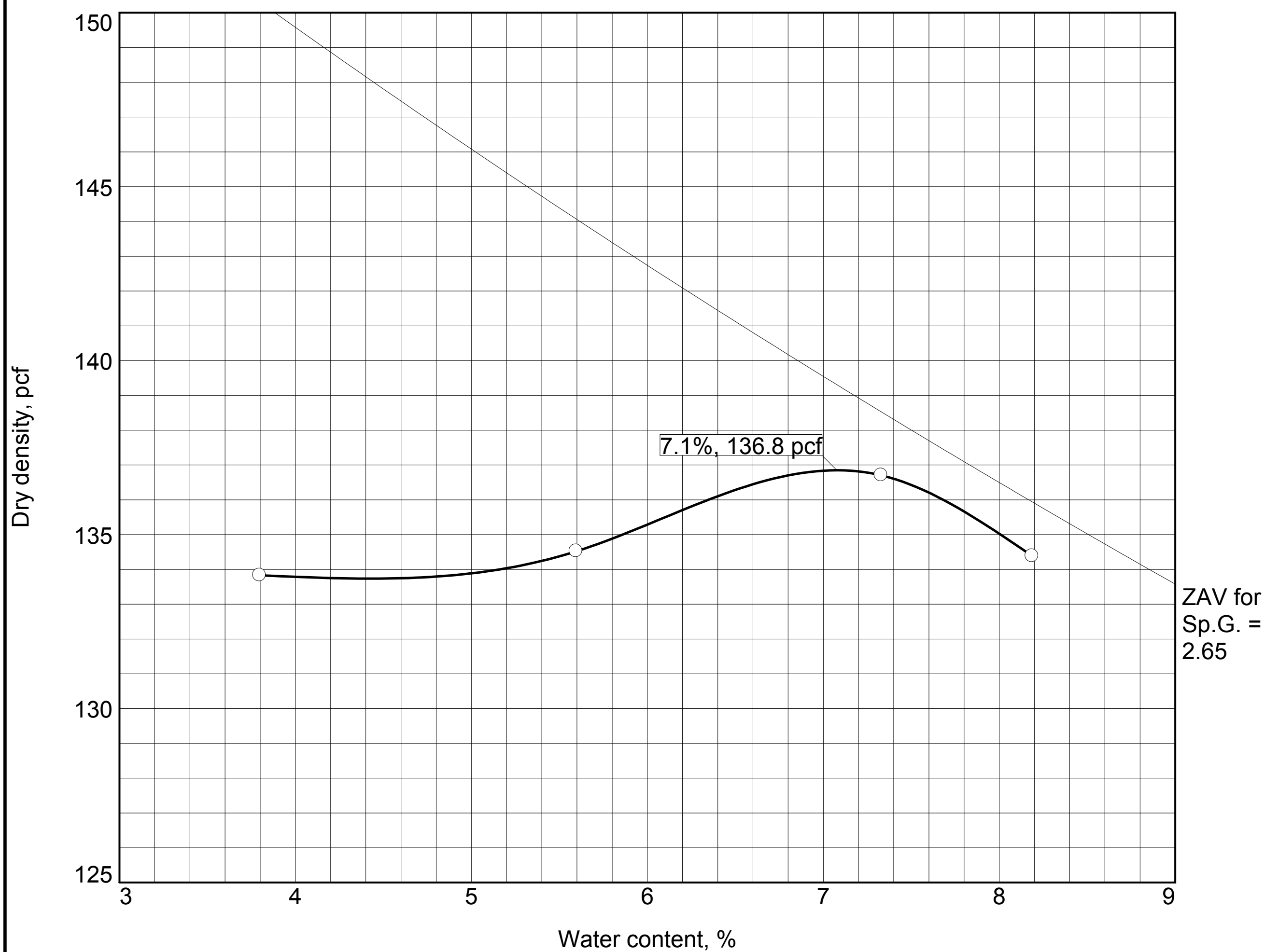
HARTCROWSER

Test Description/Remarks:

Manual rammer used for CBR compaction.

Figure B-13

COMPACTION TEST REPORT



Test specification: ASTM D 1557-02 Method C Modified
ASTM D 4718-87 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
2.5'	SP		3.8	2.65	NA	NA	17.0	2.6

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 136.8 pcf	131.8 pcf	very gravelly SAND, trace silt
Optimum moisture = 7.1 %	8.2 %	

Project No. 19128-00 **Client:**
Project: K Ply

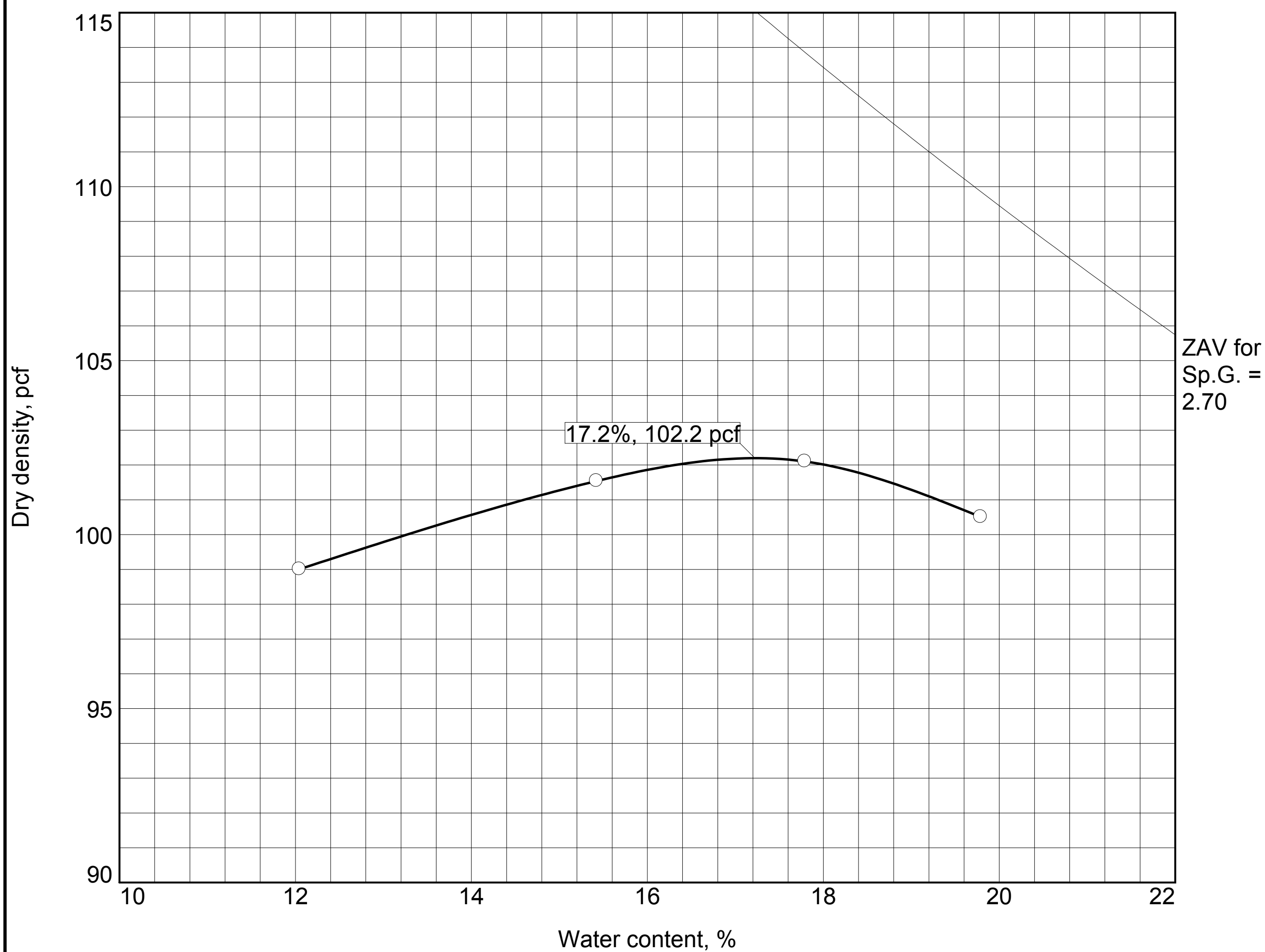
○**Source of Sample:** TP-8 **Sample Number:** Bulk

HARTCROWSER

Remarks:
Mechanical rammer used for modified proctor compaction.

Figure B-14

COMPACTION TEST REPORT



Test specification: ASTM D 1557-07 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
5-6'	SM		25.2	2.7	NA	NA	0.0	25.8

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 102.2 pcf Optimum moisture = 17.2 %	silty SAND

Project No. 19128-00 **Client:**
Project: K Ply

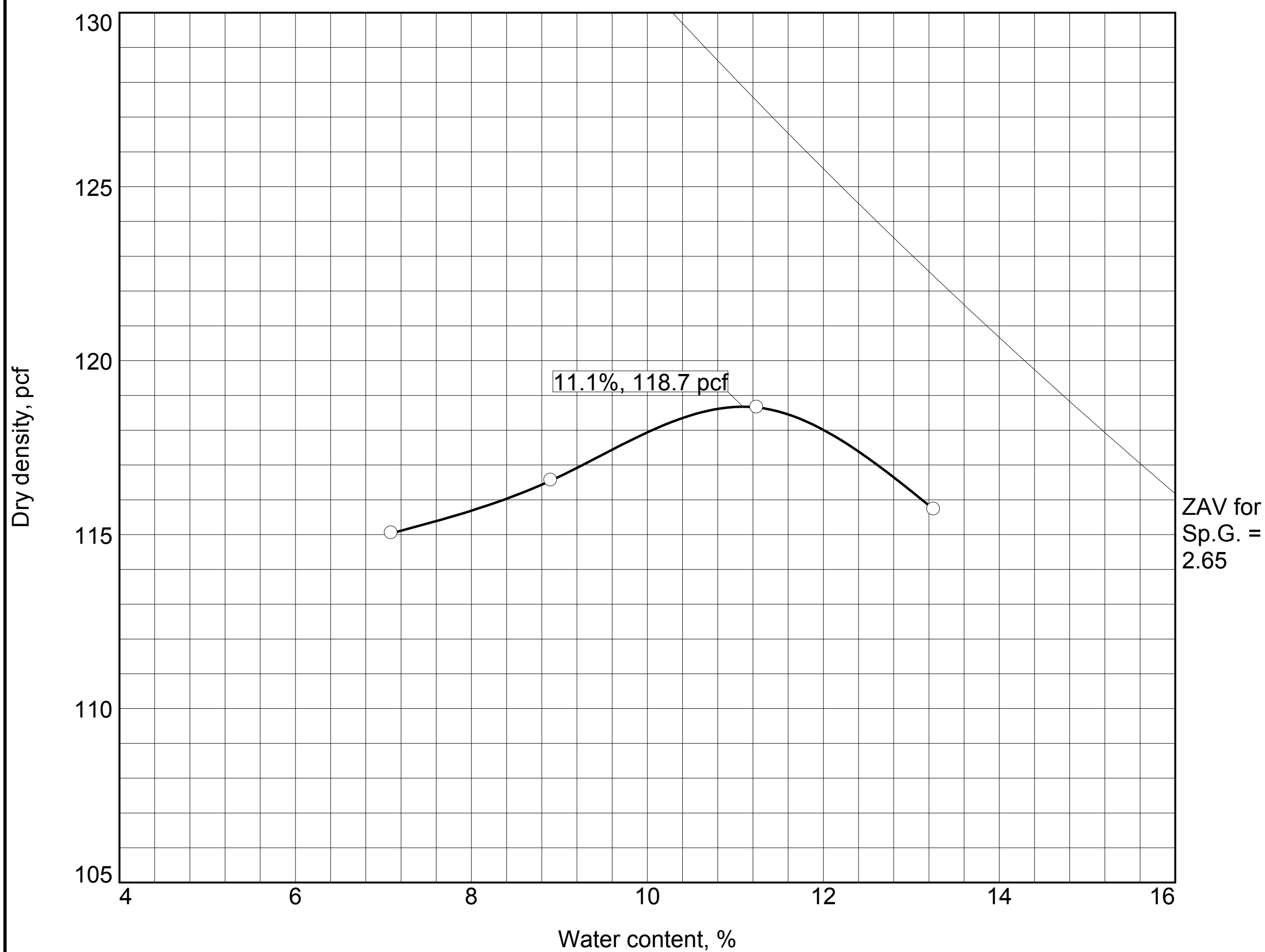
○**Source of Sample:** TP-11 **Sample Number:** Bulk

HARTCROWSER

Remarks:
Mechanical rammer used for modified proctor compaction.

Figure B-15

COMPACTION TEST REPORT



Test specification: ASTM D 1557-02 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
9-10'	SW-SM		18.0	2.65	NA	NA	0.0	8.8

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 118.7 pcf Optimum moisture = 11.1 %	slightly silty SAND, trace gravel

Project No. 19128-00 **Client:**

Project: K Ply

○**Source of Sample:** TP-16 **Sample Number:** Bulk

HARTCROWSER

Remarks:

Mechanical rammer used for modified proctor compaction.

Figure B-16

APPENDIX C
Existing Explorations by Others

APPENDIX C
EXISTING EXPLORATIONS BY OTHERS

We reviewed the following past exploration by another consultant to gain understanding of subsurface conditions in portions of the site we did not explore:

Floyd|Snider 2014. Remedial Investigation/Feasibility Study, K Ply Site, Port Angeles, Washington. March 2, 2014.

Results are included in this appendix as they were produced; they are for reference only, and Hart Crowser is not responsible for the accuracy or completeness of the information. Approximate locations of explorations by others are shown on Figure 2; actual locations may differ from those shown.

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Monitoring Well ID: PP-4R

Ground Surface Elevation: 15.74
Vertical Datum: NAVD83
Casing Elevation: 17.85
Latitude/Northing: 420417.411
Longitude/Easting: 1003289.79
Coordinate System: WA State Plane North

Installation Date: September 19, 2013
Logged By: Lisa Meoli
Drilled By: Holocene
Drill Type: 4.5" ID Hollow Stem Auger
Sample Method: 2"x18" SS Sampler
Boring Diameter: 8-inch
Boring Depth (ft bgs): 18
Groundwater ATD (ft bgs): 11

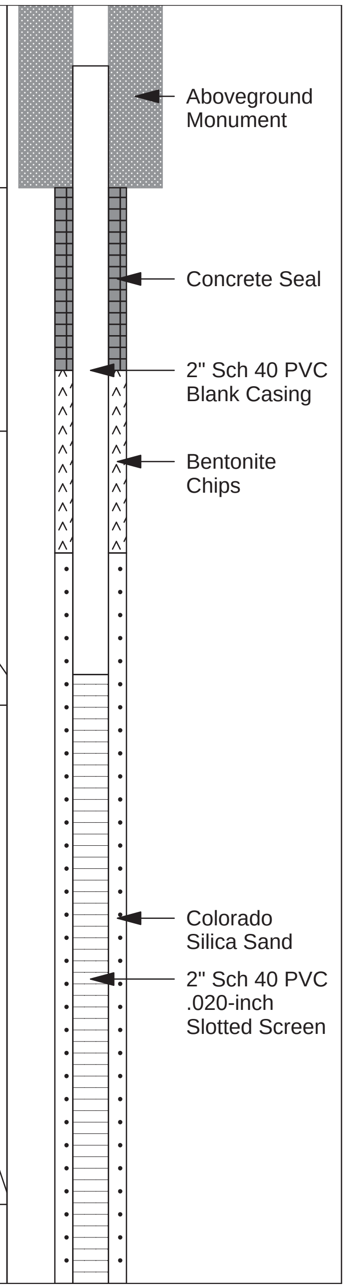
Client: Port of Port Angeles
Project: K Ply
Task Number: AO2C
Site Location: Marine Dr./Cedar St.
Port Angeles, WA

Remarks: Replacement well for PP-4. Installed directly northwest of original well location.

PID (ppm)	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS
0.0		1,1,1	3
0.0		2,1,2	5.5
0.0		2,0,1	8
0.9		2,3,2	10.5
1.8		2,1,2	13
0.2		0,1,2	15.5

DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)
0	SM	Light brown, very fine silty SAND, trace gravel, dry, no odor or staining. Grades to reddish brown at 3 feet bgs.
4	SM	Gray silty SAND with wood fragment, moist, no odor.
8	ML	Gray SILT, no odor.
9	SM	Gray, fine-medium silty SAND, moist, no odor.
		Shell fragments, wood pieces at 11 feet bgs and 13.5 feet bgs.
16	ML	Gray SILT, no odor.
17	SM	Gray, very fine silty SAND, some small rounded gravel and shell fragments at 19 feet bgs, wet, no odor.

MONITORING WELL DETAIL



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

Monitoring Well ID: PP-6R

Installation Date: September 19, 2013
Logged By: Lisa Meoli
Drilled By: Holocene
Drill Type: 4.5" ID Hollow Stem Auger
Sample Method: 2"x18" SS Sampler
Boring Diameter: 8-inch
Boring Depth (ft bgs): 18
Groundwater ATD (ft bgs): 11.5

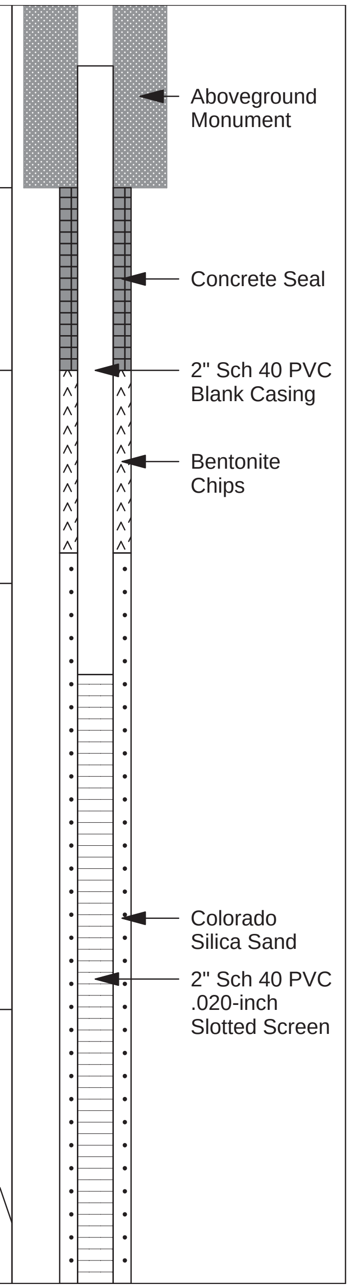
Client: Port of Port Angeles
Project: K Ply
Task Number: AO2C
Site Location: Marine Dr./Cedar St.
Port Angeles, WA

Ground Surface Elevation: 15.91
Vertical Datum: NAVD83
Casing Elevation: 18.01
Latitude/Northing: 420512.277
Longitude/Easting: 1003411.101
Coordinate System: WA State Plane North

Remarks: Replacement well for PP-6.

PID (ppm)	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)
		0–3	GW	Brown, silty sandy GRAVEL, some wood debris and concrete rubble, dry, no odor or staining.
0.0	3,5,8	3–6.5	SM	Light brown, medium-coarse silty SAND, small rounded gravel, shell fragments, loose, dry, no odor.
0.0	5,7,5			
0.1	5,7,8	6.5–13.5	SP/SM	Gray, medium SAND to silty SAND, shell fragments, moist, no odor. SILT lense at 8' bgs.
0.1	5,4,1			Same as above.
0.0	4,3,5	13.5–17	SP/SM	Gray, medium-coarse SAND, small rounded gravels, shell fragments, grading to a fine silty SAND at 14.5, wet, no odor, no sheen.
0.0	2,3,2	17–18	SM	Gray, fine-medium silty SAND, small rounded gravel at 19.5' bgs, shell fragments throughout, saturated, no odor, no sheen.

MONITORING WELL DETAIL



Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
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Monitoring Well ID: PP-15R

Ground Surface Elevation: 14.81
Vertical Datum: NAVD83
Casing Elevation: 17.72
Latitude/Northing: 420492.915
Longitude/Easting: 1003105.213
Coordinate System: WA State Plane North

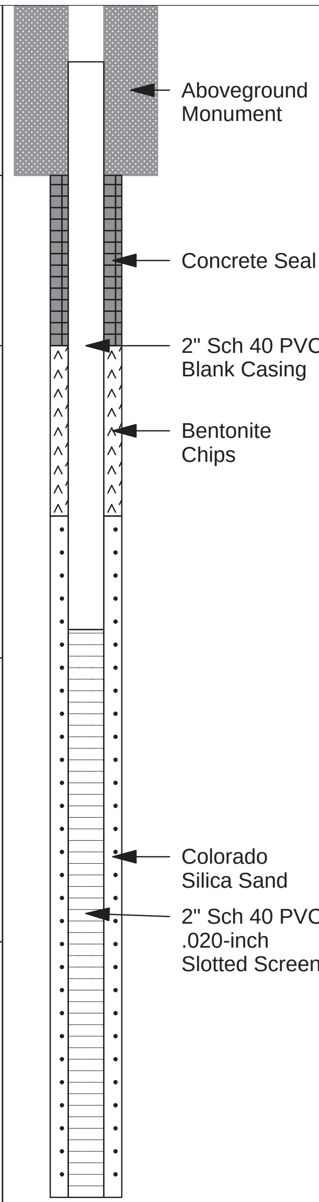
Installation Date: September 19, 2013
Logged By: Lisa Meoli
Drilled By: Holocene
Drill Type: 4.5" ID Hollow Stem Auger
Sample Method: 2"x18" SS Sampler
Boring Diameter: 8-inch
Boring Depth (ft bgs): 18
Groundwater ATD (ft bgs): 10.5

Client: Port of Port Angeles
Project: K Ply
Task Number: AO2C
Site Location: Marine Dr./Cedar St. Port Angeles, WA

Remarks: Replacement well for PP-15.

PID (ppm)	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)
		0–3	SM	Light brown, fine silty gravelly SAND, dry, no odor or staining.
11.6	2,1,3	3–8.5	SP	Brown, fine silty SAND, no gravel, grading to dark gray silty SAND, moist.
223	0,1,1			Strong petroleum odor at 4' and 6' bgs.
37	1,1,3	8.5–13.5	SP/SM	Dark gray silty SAND, shell framents, grading to medium SAND at 9.5', moist, slight petroleum odor.
				Wet at 10.5' bgs.
9	1,1,2			Same as above, wet, thin rootlets, no odor, no sheen.
1.1	3,2,2	13.5–19	SM	Dark gray, fine silty SAND, saturated, no odor, no sheen.
0.8	2,1,1			
0.1	1,3,4			Same as above, some small to medium rounded gravel and shell fragments, no odor, no sheen.

MONITORING WELL DETAIL



Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
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Monitoring Well ID: PP-20

Ground Surface Elevation: 17.62
Vertical Datum: NAVD83
Casing Elevation: 20.09
Latitude/Northing: 420710.608
Longitude/Easting: 1003533.372
Coordinate System: WA State Plane North

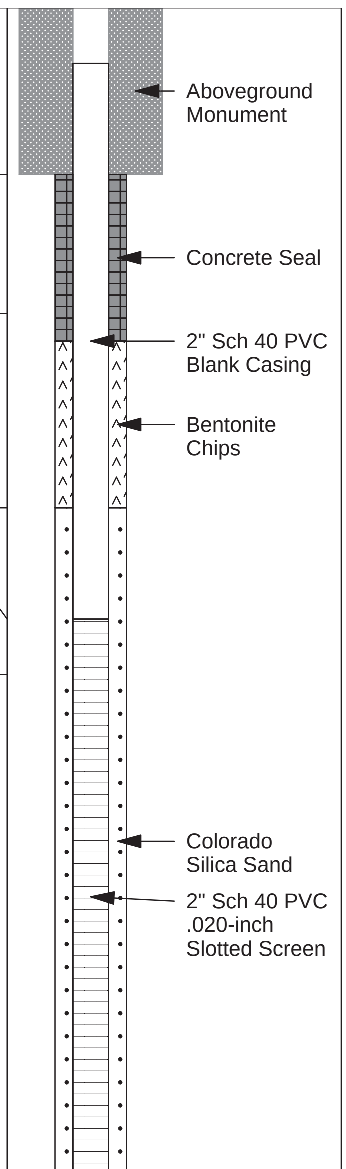
Installation Date: September 20, 2013
Logged By: Lisa Meoli
Drilled By: Holocene
Drill Type: 4.5" ID Hollow Stem Auger
Sample Method: 2"x18" SS Sampler
Boring Diameter: 8-inch
Boring Depth (ft bgs): 18
Groundwater ATD (ft bgs): 15.5

Client: Port of Port Angeles
Project: K Ply
Task Number: AO2C
Site Location: Marine Dr./Cedar St. Port Angeles, WA

Remarks: Located along the shoreline.

PID (ppm)	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)
			0	GW	Gravelly fill, demo debris, misc. debris, some vegetation.
0.0		2,1,1	3	SM	Grayish brown silty SAND with some angular gravel, dry, no odor.
0.0		1,15,18	6	GW	Reddish brown, sandy GRAVEL with wood, concrete, and metal debris, dry.
0.0		4,4,8	8	SP	Brown, medium SAND with shell fragments, grading to very fine silty SAND at 9' bgs, moist, no odor.
0.0		4,12,20	9	SM	Grayish brown, fine silty SAND, few small rounded gravel, moist, no odor.
		9,9,7	13		No recovery due to large rock, cuttings are brown fine sitly SAND and some pebbles, moist, no odor.
0.0		4,5,6	15		Grades to gray silty SAND, shell fragments, wet, no odor.
0.0		4,5,8	18		Dark gray, fine-medium silty SAND, shell fragments, rock at 19' bgs, wet, no odor.

MONITORING WELL DETAIL



Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
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Monitoring Well ID: PP-21

Ground Surface Elevation: 15.41
Vertical Datum: NAVD83
Casing Elevation: 17.26
Latitude/Northing: 420618.442
Longitude/Easting: 1003760.228
Coordinate System: WA State Plane North

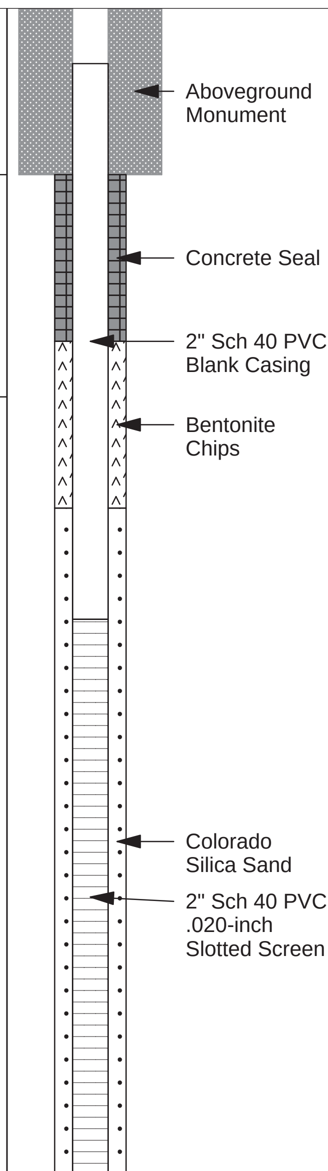
Installation Date: September 20, 2013
Logged By: Lisa Meoli
Drilled By: Holocene
Drill Type: 4.5" ID Hollow Stem Auger
Sample Method: 2"x18" SS Sampler
Boring Diameter: 8-inch
Boring Depth (ft bgs): 18
Groundwater ATD (ft bgs): 13.5

Client: Port of Port Angeles
Project: K Ply
Task Number: AO2C
Site Location: Marine Dr./Cedar St.
Port Angeles, WA

Remarks: Located along the shoreline on the log debarker property.

PID (ppm)	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)
			0	SP	Dark brown silty SAND, bark and woody debris, some small rounded gravel, dry.
0.0	2.5–4	4,22,22	3		
			4	SM	Light brown, silty SAND with some gravel, moist, no odor.
0.0	5–6.5	2,5,5	6		Reddish brown, silty SAND with some small rounded gravel, loose, moist, no odor.
0.0	7.5–9	3,3,4	8		
0.0	10–11.5	3,2,3	11		
	12.5–14	1,1,1	13.5 (groundwater)		
			14		Gray, fine silty SAND, shell fragments, few gravel, wet, no odor.
0.0	15–16.5	2,3,2	16		Dark gray, medium silty SAND, shell fragments, wet, no odor.
0.0	17.5–19	2,1,1	18		
			19		Dark gray, medium-coarse silty SAND, wet, no odor.

MONITORING WELL DETAIL



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

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Monitoring Well ID: PP-26

Ground Surface Elevation: 15.46
Vertical Datum: NAVD83
Casing Elevation: 17.96
Latitude/Northing: 420450.165
Longitude/Easting: 1003236.968
Coordinate System: WA State Plane North

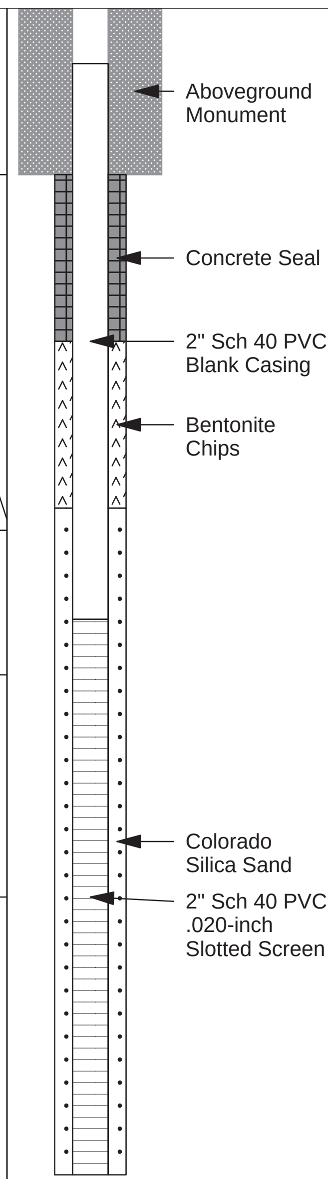
Installation Date: September 18, 2013
Logged By: Jenny Graves
Drilled By: Holocene
Drill Type: 8"-dia Hollow Stem Auger
Sample Method: 2"x18" SS Sampler
Boring Diameter: 8-inch
Boring Depth (ft bgs): 18 feet bgs
Groundwater ATD (ft bgs): 10.5

Client: Port of Port Angeles
Project: K Ply
Task Number: AO2C
Site Location: Marine Dr./Cedar St.

Remarks: North of concrete pad and approximately 60 feet west of PP-4R.

PID (ppm)	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)
			0	SM	Light brown, silty SAND, some gravel, loose, dry, no odor.
0.0		1,2,1	3		
0.4		0,1,1	6	ML	Gray SILT lense, slight odor.
			7	SM	Brown, fine-medium silty SAND.
176		0,0,4	9	SP	Gray, coarse SAND with shell fragments, wet, strong petroleum odor.
3.4		3,3,4	10.5		1-inch silt lense at 10' bgs, no odor.
0.4		3,2,1	13	SP/ML/SP	Gray, medium-coarse SAND, with some interbedded SILT, wet, woody debris, no odor.
0.1		0,1,3	16		2-inch silt lense at 16' bgs, some woody debris, no odor.
0.0		2,5,6	18		1-inch silt lense at 19' bgs, no odor.

MONITORING WELL DETAIL



Notes:
FT BGS = feet below ground surface
ppm = parts per million
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USCS = Unified Soil Classification System
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APPENDIX D
Historical Bulkhead and Railroad Trestle Plans and Photos

APPENDIX D
HISTORICAL BULKHEAD AND RAILROAD TRESTLE PLANS AND PHOTOS

The following photos of historical bulkhead and railroad trestle plans are on Figures D-1 through D-6:

- D-1 – Bulkheads Drawing (May 15 1925, Drawing No. 8)
- D-2 – Dredging & Bulkheads, Pen-Ply Area (Port Drawing No. HIS 4404
- D-3 – Plan of Pier (Port Drawing No. HIS 2540)
- D-4 – Trestle Piles Looking East
- D-5 – Trestle Piles

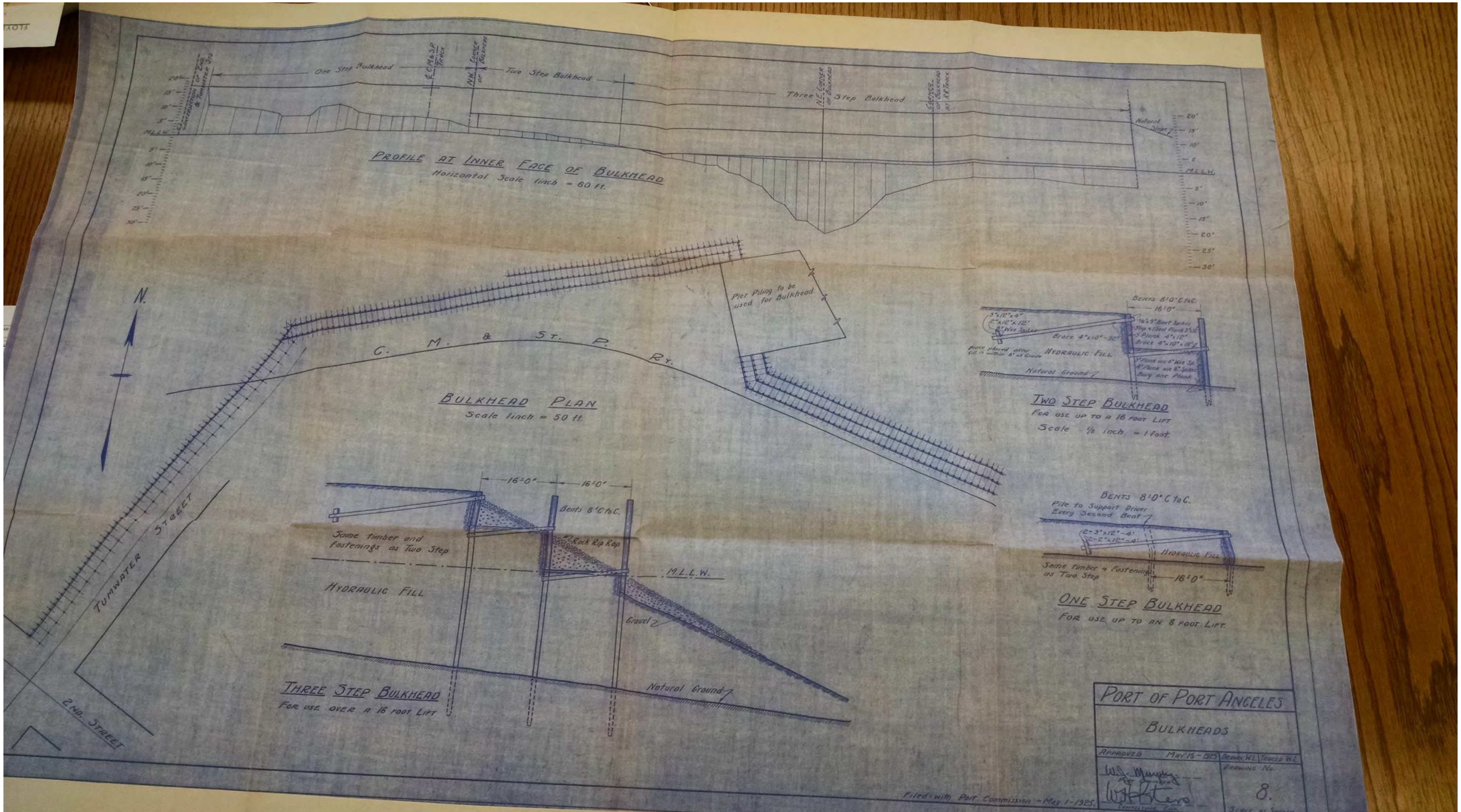

Photo D-1 – Bulkhead plan, profile, and sections (May 15 1925, Drawing No. 8).

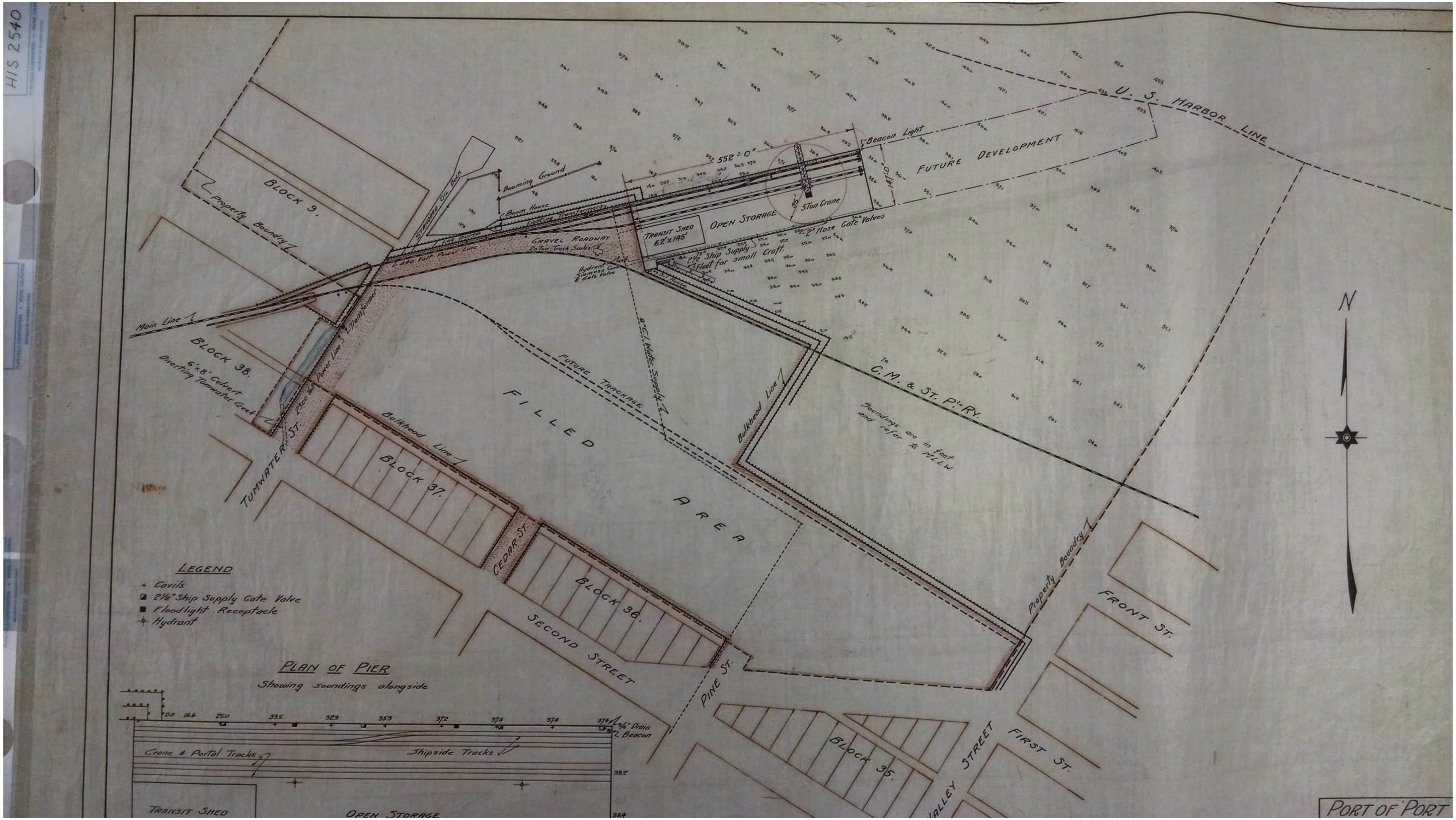

Photo D-2 – Dredging and bulkhead plan, Pen-Ply Area (Port Drawing No. HIS 4404).

Photo D-3 – Dredging plan with existing bulkhead and trestle and proposed berm and bulkhead (Port Drawing No. HIS 2540).

Photo D-4 – Trestle piles at Valley Creek estuary looking east. Bent, or pile group, spacing is about 15 feet on center. Each bent contained 5 to 6 piles spaced about 2 feet on center.

Photo D-5 – Trestle piles at Valley Creek estuary looking northwest.

K Ply Site

Engineering Design Report

Appendix C
Spill Prevention, Control, and Countermeasure Plan

Table of Contents

List of Attachments

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
CFR	Code of Federal Regulations
Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
Site	K Ply Site
SPCC	Spill Prevention, Control, and Countermeasure

Contact Information

Responsible Personnel

Contact Name	Work Phone	Cell Phone
Tom Colligan, Project Manager	(206) 292-2078	(206) 276-8527
Tucker Stevens, Project Engineer	(206) 292-2078	(406) 579-0451
Jesse Waknitz, Port of Port Angeles Site Environmental Coordinator	(360) 417-3452	(360) 460-1364
Prime Contractor Field Superintendent	TBD	TBD
Ken Preston, Floyd|Snider Field Supervisor	(206) 292-2078	(206) 331-2993

Spill Reporting

Spills into waters of the State (including ponds, ditches, seasonally dry streams, and wetlands)
Immediately call all of the following:
The National Response Center (NRC): 1 (800) 424-8802
Washington State Department of Ecology (Ecology) Southwest Regional Office: 1 (360) 407-6300
Spill to Soil (including encounters of pre-existing contamination)
Report immediately if threatening to health or environment (i.e., explosive, flammable, toxic vapors, shallow groundwater, nearby creek), otherwise within 90 days
Ecology Southwest Regional Office: 1 (360) 407-6300
Notify public works department if spill enters sanitary sewer; call the spill hotline if spills enter the stormwater system, streets, ditches, streams, and/or wetlands
City of Port Angeles Public Works Spill Reporting: 1 (360) 417-4745
Underground Storage Tank
Report within 24 hours if confirmed release of material
Ecology Southwest Regional Office: 1 (360) 407-6300 **Connie Groven, Ecology Project Manager: 1 (360) 407-6254**
Washington Emergency Management Division: 1 (800) 258-5990 or 1 (800) OILS-911

1.0 Introduction

1.1 PURPOSE

This Spill Prevention, Control, and Countermeasure (SPCC) Plan has been prepared as an appendix to the Engineering Design Report (EDR) for the cleanup action to be completed at the K Ply Site (Site), which includes excavation of contaminated soil at a former plywood mill. The purpose of the SPCC Plan is to prevent spills from occurring during the cleanup action, and to perform safe, efficient, and timely response in the event of a spill or leak (both referred to as "spills" herein). Although the scope of the cleanup action does not meet the definition of a "facility" under 40 Code of Federal Regulations [CFR] 112.2 because there is no aboveground oil storage capacity of more than 1,320 U.S. gallons, the SPCC is prepared to be consistent with the substantive requirements of 40 CFR 112 but does not need certification.

This SPCC Plan presents the minimum requirements for spill prevention, control, and countermeasures to be fulfilled by the selected contractor during the cleanup action. It may be amended or superseded entirely by a SPCC Plan prepared by the contractor, so long as the contractor's plan contains the basic elements included in this plan, or their equivalents.

The SPCC Plan should be a working document to be used during the cleanup action and a copy of the plan, including any necessary updates as work progresses, should be maintained at the Site. The plan should be used frequently in the following ways:

- As a reference for oil storage and containment system information
- As a reference for contractors performing work at the Site
- As a guide for site inspections
- As a resource during an emergency response

Additionally, in the event that the project is extended beyond the estimated schedule, the SPCC Plan must be reviewed at least once every month.

1.2 FACILITY DESCRIPTION

Facility Name	K Ply Site
Facility Location	439 Marine Drive, Port Angeles, WA
Facility Type	Environmental Cleanup Site (Currently Vacant)
Date of Initial Operation	August 2015 (anticipated)
Designated Site Environmental Coordinator	Jesse Waknitz, Port of Port Angeles

A. Scope of Work: Well abandonment; grading of ground surface to divert stormwater for infiltration or to conveyance ditch (refer to Section 1.2.2 below); demolition of concrete structures, crushing of concrete rubble; staging and minor grading for construction preparation; removal of concrete rubble and structures; minor clearing and grubbing; removal of abandoned underground fuel pipeline; removal of dioxin/furan-contaminated surface soil and surface debris, removal of clean overburden and excavation subsurface soil contaminated with gasoline, diesel, hydraulic oil, benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds, and/or pentachlorophenol; on-site treatment or trucking and off-site disposal of contaminated soil; backfilling, compaction, and grading of excavated areas.

B. Site Address: 439 Marine Drive, Port Angeles, Washington.

C. Drainage Pathways: Work area is generally flat with a slight southwestward slope away from Port Angeles Harbor, with minor drainage to permitted conveyance ditch in north-central area of Site. Paved roadways to south and west drain to catch basins.

D. Nearby Waterways: Port Angeles Harbor (adjacent to Site), Tumwater Creek (700 feet to the northwest).

1.2.1 General Facility Layout

Site boundaries and cleanup areas are shown on Figure 1.2 of the EDR. Site features including utilities and access routes are shown on Figure 3.1 of the EDR.

1.2.2 Stormwater

The Site is partially paved; however, soil removal activities will occur in unpaved areas. Paved areas will be used for equipment storage and stockpiling of contaminated soil to the extent that it is practicable to do so. The majority of stormwater infiltrates through the ground surface, except runoff from paved surfaces, which flows to a conveyance ditch in the north-central portion of the Site and discharges under the Port of Port Angeles' current National Pollutant Discharge Elimination System (NPDES) permit. During construction, the Site will be graded to ensure that stormwater infiltrates or flows to the conveyance ditch.

2.0 Potential Spill Sources and Spill Prevention Control and Countermeasure Features

Spill risks during construction are primarily related to the fueling/maintenance of construction equipment. The primary petroleum types at risk of being spilled are gasoline, diesel, and hydraulic fluid. In addition, any recovered light non-aqueous phase liquid from the Site that is stored in aboveground containers is also at risk of being spilled.

2.1 UNDERGROUND STORAGE TANKS

There are no known underground storage tanks in the immediate project vicinity.

2.2 DISCHARGE PREVENTION

The potential use of petroleum products during the project will be gasoline or diesel fuel used to power machinery and hydraulic oil used in excavation and hauling equipment. While the procedures for equipment fueling will be specific to the selected contractor, it is anticipated that mobile fueling of equipment will occur. On-site thermal treatment of contaminated soil, if used, will be electrically powered. The total oil to be stored on-site is anticipated to be minimal.

2.2.1 Spill Prevention Control and Countermeasure Features and Operating Procedures

Employees will be trained to implement spill prevention practices for work with and around oil sources. Personnel will use common sense and rely on spill prevention practices to minimize the potential for a release of oil. Fueling and oil storage procedures will be determined by the contractor.

2.2.2 Tests and Inspections

The contractor is responsible for performing maintenance of the equipment and equipment fueling systems to keep it performing in an efficient and environmentally sound manner. The equipment will be observed to ensure that no leaks are occurring.

Observation results will be recorded on a Weekly Visual Inspection Checklist; an example checklist is included in Attachment C.1. Spill response kits will be kept near all areas where equipment is being used, fueled, or stored, and will be restocked as necessary. Inspections include observations of the exterior of the equipment for signs of deterioration or spills (leaks), and inventory of spill response kit materials.

2.2.3 Training

Personnel will be trained in Hazardous Waste Operations and Emergency Response (HAZWOPER) and are knowledgeable in the operation and maintenance of oil pollution prevention equipment and pollution control laws and regulations. The contractor will also be knowledgeable in the operation and maintenance of oil pollution spill/prevention equipment.

2.2.4 Site Security

The work area will be secured with a chain link fence.

2.3 SPILL RESPONSE PROCEDURES

It is essential to prevent petroleum products, toxic chemicals, and all other non-stormwater discharges from spreading. Releases of petroleum products or toxic chemicals during the proposed excavation will warrant immediate response and cleanup. It is expected that most spills will be minor spills of fuel or hydraulic oil that will occur on unpaved soil, which will prevent them from spreading.

Spill response and notification procedures for spills, leaks, or uncontrolled releases of hazardous materials (i.e., oils or wastewater) during proposed construction are provided in Attachment C.2. Floyd|Snider personnel responsible for the handling, storage, and disposal of oil or chemicals are trained in these methods and procedures. A copy of the spill response and notification procedures is kept with each spill response kit.

Because the level of spill notification under the SPCC Rules is dependent on the volume of the material released, spills are defined below.

For this project:

- All spills greater than approximately 1 gallon to land shall be reported.
- Spills of any quantity to water shall be reported.

The Project Manager, Field Lead, or designate is responsible for completing the Spill Notification Form (refer to Attachment C.3 for an example spill notification form) and notifying the relevant external agencies (refer to Contact Information on Page C-ii of this appendix). Completed spill notification forms will be kept by the Site Environmental Coordinator.

If spills meet any of the following conditions, the U.S. Environmental Protection Agency Regional Administrator will be notified:

- Discharge from a single oil spill event exceeding 1,000 gallons.
- Discharge from two spill events within a 12-month period greater than 42 gallons.

2.4 SPILL RESPONSE KITS

Spill kits will be kept near all areas where equipment is used, fueled, or stored. This spill kit will contain, at minimum:

- Oil-absorbent pads, berms, blankets, or granules
- Oil-resistant gloves
- Detergent
- Compact first-aid kit

Additionally, oil-adsorbent booms will be made available during work near the riprap slope.

Spill kits can be used for initial control of spills from equipment reservoir failures, or incidental spill/leaks associated with the storing/handling of containerized fuel and lubricants.

In the event of a release from any storage tank or vehicle, the emphasis of initial spill response is isolation and containment with diking materials until fully cleaned up or a response contractor can be summoned. Because the Site is undergoing a cleanup for petroleum, any spills to soil will be excavated and the soil treated as petroleum-contaminated along with other site soils.

2.5 FUELING PROCEDURES

Fueling procedures, whether on- or off-site, will be determined by the contractor. The contractor will maintain a spill kit wherever fueling occurs and will continually monitor fueling operations. In the event that a spill occurs, the contractor will follow the spill handling, cleanup, and reporting procedures as outlined herein.

2.6 OPERATIONAL SPILL PROCEDURES

If a spill occurs during operational procedures associated with this project (i.e., excavation activities), the contractor will stop working and employ best management practices to stop the spill source, contain the spill, and proceed with cleanup and reporting protocols outlined in this SPCC Plan. The contractor will maintain spill kits on-site and the materials identified herein will be used to stop, contain, and clean up leaks or spills.

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Appendix C
Spill Prevention, Control, and Countermeasure Plan

Attachment C.1
Weekly Visual Inspection Checklist

Attachment C.1
Weekly Visual Inspection Checklist

Pollution Sources or Oil-Filled Operational Equipment	**Structural Integrity** (Note visible cracks, holes, excessive rust, pitting in exterior surface or supports)	**Visible Leaks/ Spills/Petroleum Sheens** (Yes/No)

Spill Kit Location	Spill Kit Contents	Date Checked
	___ Oil-Absorbent Materials (pads, berms, blankets, or granules) ___ Detergent ___ Pair of Nitrile Gloves ___ First Aid Kit	
	___ Oil-Absorbent Materials (pads, berms, blankets, or granules) ___ Detergent ___ Pair of Nitrile Gloves ___ First Aid Kit	
	___ Oil-Absorbent Materials (pads, berms, blankets, or granules) ___ Detergent ___ Pair of Nitrile Gloves ___ First Aid Kit	
	___ Oil-Absorbent Materials (pads, berms, blankets, or granules) ___ Detergent ___ Pair of Nitrile Gloves ___ First Aid Kit	
	___ Oil-Absorbent Materials (pads, berms, blankets, or granules) ___ Detergent ___ Pair of Nitrile Gloves ___ First Aid Kit	

Additional Comments:____

____

____

____

Inspected By: _____________________________________ Date: ___________ Time: ________

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Appendix C
Spill Prevention, Control, and Countermeasure Plan

Attachment C.2
Spill Response Procedures

Attachment C.2
Spill Response Procedures

PERSONNEL SAFETY

When an uncontrolled release of a hazardous substances occurs (associated with proposed construction), address the safety of all personnel and the public. Until the spilled material has been identified and controlled, do the following:

- Ensure that no one is smoking in or near the area.
- Evacuate all non-essential personnel.
- If a fire is involved or appears imminent, call for fire department for assistance: 911.
- Wear the appropriate level of personal protective equipment (oil-resistant gloves, goggles, rubber boots, and/or Tyvek coveralls) when responding to spills.

SPILLS

Aboveground Storage Tanks and Containerized Oil/Lubricant

- Quickly contain spilled fuel/oil as close to source as possible using absorbent booms and blankets provided in the spill kit located inside the loading/unloading area.
- Prevent the spilled fuel/oil from entering the stormwater catch basins by placing oil-absorbent booms around threatened inlets until all spilled fuel/oil can be cleaned up. If necessary, cover the threatened inlets with the rubber drain covers found in the spill kit.
- Place barricades, cones, or flagging a safe distance around the area. Post a watch (Floyd|Snider or contractor employee or construction flagger) at the scene (upwind) to prevent entry to the area.
- Contact the Site Environmental Coordinator or designate (refer below) to inform them of the situation within 15 minutes of any spill greater than 10 gallons.
- Once the spilled oil has been contained, quickly clean up the spilled liquid using the absorbent blankets or granules found in the spill kit.
- Collect spent absorbent material in sealed plastic garbage bags and place in nearby Dumpster. Keep Dumpster lid closed except when adding waste materials into the receptacle.
- In the event an oil spill enters one of the stormwater catch basins, remove the metal grate and insert absorbent boom and/or blankets and notify the Site Environmental Coordinator.
- The Site Environmental Coordinator or designate is responsible for making the required notifications (refer to Notification Procedures).

NOTIFICATION PROCEDURES

In case of either a minor spill (i.e., greater than 10 gallons and less than 42 gallons) or major spill (greater than 42 gallons) of oil or other hazardous substance, immediately contact one of the following (in preferred order):

Contact Name	Work Phone	Home Phone	Cell Phone
Tom Colligan	(206) 292-2078	(206) 276-8527	(206) 276-8527
Tucker Stevens	(206) 292-2078	NA	(406) 579-0451
Jesse Waknitz	(360) 417-1364	NA	(360) 460-1364
Chris Hartman	(360) 417-3422	NA	NA

One of these persons shall be available for spill emergencies at the facility either by being at the K Ply Site (during business hours) or available on an on-call basis (after business hours). These persons are responsible for coordinating all of the emergency response measures detailed in this plan. Contact information for additional Agencies required to be notified of spills to waters of the state or soils, or confirmed releases from underground storage tanks, are provided in the Contact Information section of this appendix (Spill Prevention, Control, and Countermeasures Plan).

Site Environmental Coordinator/Designate

Regulatory Agency/Spill Response Contractor	Normal Business Hours Phone
Connie Groven, Ecology	(360) 407-6254

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Appendix C
Spill Prevention, Control, and Countermeasure Plan

Attachment C.3
Spill Notification Form

Attachment C.3
Spill Notification Form

<table>
<tr><th colspan="3">Part A: Basic Spill Data</th></tr>
<tr><td colspan="2">Type of Spilled Substance:</td><td>Notification Person:</td></tr>
<tr><td colspan="2">Quantity Released:</td><td>Spill Date and Time:</td></tr>
<tr><td colspan="2" rowspan="2">Location of Spill:</td><td>Discovery Date and Time:</td></tr>
<tr><td>Spill Duration:</td></tr>
<tr><td colspan="2">Facility Name and Location:</td><td>Release to:
[ ] Outdoor Pavement
[ ] Stormwater Catch Basin
[ ] Soil
[ ] Containment
[ ] Other: ________________</td></tr>
<tr><td colspan="3">Nature of spill and any environmental or health effects:
[ ] Injuries [ ] Fatalities</td></tr>
<tr><th colspan="3">Part B: Notification Checklist</th></tr>
<tr><td>Spill Type:</td><td>Notification Date and Time:</td><td>Name of Person that Received Call:</td></tr>
<tr><td colspan="3">All measurable spills</td></tr>
<tr><td>Ecology:</td><td></td><td></td></tr>
<tr><td colspan="3">Additional contact if spill enters the sanitary sewer</td></tr>
<tr><td>City of Port Angeles</td><td></td><td></td></tr>
<tr><td colspan="3">Additional contact if spill enters waters of the State</td></tr>
<tr><td>National Response Center
1-800-424-8802</td><td></td><td></td></tr>
</table>

K Ply Site

Engineering Design Report

Appendix D
Remedial Design Data Collection Report

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List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, xylenes
COC	Contaminant of concern
Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
GRO	Gasoline-range organics
µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
MTCA	Model Toxics Control Act
NAPL	Non-aqueous phase liquid
ORO	Oil-range organics
PID	Photoionization detector
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
Site	K Ply Site
TCLP	Toxicity characteristic leaching procedure
VOC	Volatile organic compound

1.0 Introduction

This appendix presents the results of sampling conducted at the K Ply Site (Site) in March and June 2015 in order to: (1) vertically delineate the depth extent of gasoline-range organics (GRO) and oil-range organics (ORO) in Site soils; (2) determine the suitability of contaminated soils for Subtitle D landfill disposal or on-site thermal desorption treatment; (3) determine the suitability of concrete present on-site for use as excavation backfill material (after crushing); and (4) determine the geotechnical properties of site soil. The sampling was performed in accordance with a Washington State Department of Ecology (Ecology)-approved addendum to the Ecology-approved Remedial Investigation/Feasibility Study (RI/FS) Sampling and Analysis Plan (SAP), dated March 19, 2015, and the SAP included as Appendix G of the Engineering Design Report (EDR).

2.0 Sample Collection

2.1 TEST PIT EXCAVATION

Seventeen test pits, numbered TP-1 through TP-17, were advanced by Hart Crowser on March 17 and March 18, 2015. Test pits were advanced to depths ranging from 10 to 15 feet below ground surface (bgs), and samples were collected for geotechnical analyses including moisture content, grain size analysis, California bearing ratio testing for mechanical strength, and Proctor moisture/density testing. The results of test pit excavation are provided in the Geotechnical Report (Appendix B) of the EDR.

Additionally, two representative samples of ORO- and GRO-contaminated soil were collected by Floyd|Snider from TP-4 and TP-10, respectively. These samples were collected in sealed 5-gallon buckets and provided to Reterro, Inc., a vendor of on-site thermal desorption treatment technology, for bench scale testing.

2.2 CONCRETE SAMPLE COLLECTION

Representative concrete samples were collected from three areas, including the loading dock concrete pad, the concrete pad where dryers were previously located, and a concrete rubble pile at the northwest corner of the Site. Concrete samples were chipped from several locations within each area using a hammer and composited for analysis. The laboratory performed further processing of the samples, including grinding in a ball mill and sieving to separate the aggregate and fines fractions for analysis.

Both the aggregate and fines fractions of the concrete samples were analyzed for the Resource Conservation and Recovery Act (RCRA) 8 metals.

2.3 APRIL 2015 REMEDIAL DESIGN SOIL SAMPLE COLLECTION

Soil samples were collected on April 1, 2015, from seven direct-push soil borings located along the axis of the petroleum plume, from north to south (refer to Figure D.1). These borings were numbered K-301 through K-305 and K-307 through K-308.[1] All boring locations were within the most highly GRO-contaminated areas of smear zone soils that were delineated during the RI/FS. Boring K-303 was located in the area where commingled GRO contamination and ORO non-aqueous phase liquid (NAPL) are present in the smear zone.

Soils were sampled continuously using dual-cased drill rods to minimize sloughing into the borehole. Samples were screened for field indications of contamination including sheen, odor, visible NAPL, and volatile organic compound (VOC) concentrations measured with a photoionization detector (PID). The depth to the presumed water table at the time of drilling was determined by noting where free water was first present in the soil sample.

Soil samples for laboratory analysis were primarily collected to delineate the depth to which contaminated soil will be excavated during the cleanup action. The samples were collected from approximately 1-foot depth intervals within the smear zone, beginning at the depth interval in which field indications of contamination began to decrease and continuing at least 2 feet into soil with no indications of contamination. Additionally, soil samples for Subtitle D landfill suitability analysis (i.e., toxicity characteristic leaching procedure [TCLP] testing) were collected at two boring locations where the highest observed benzene and GRO concentrations at the Site had previously been detected. One additional vadose zone soil sample was collected north of the loading dock concrete pad where gray staining potentially indicative of petroleum contamination was observed, but PID readings did not indicate the presence of VOCs.

Sample recovery in the targeted depth intervals was generally not greater than 75 percent, due to the loose nature of the sandy soils in the smear zone. Sample depths assigned to samples were based on decompressing the recovered interval uniformly (i.e., if recovery was 75 percent, each 0.75 feet of recovered soil was assigned a depth interval of 1 foot), unless obvious sample loss from the core tube had occurred. Therefore, there is some uncertainty (+/- 0.5 feet) as to the actual subsurface depths of the samples. Sample recovery generally ranged from 65 to 75 percent in the targeted smear zone sample intervals. At location K-307 near the riprap slope, however, the sample recovery in the 12 to 16 feet bgs interval was only 37 percent, so there is more uncertainty at this location.

Samples collected from the upgradient portion of the Site were analyzed for GRO and benzene, toluene, ethylbenzene, and xylenes (BTEX). Samples collected from the downgradient portion of the Site were also analyzed for ORO. Additionally, as discussed above, selected soil samples collected from the most highly GRO-contaminated locations were analyzed for benzene using TCLP.

[1] Originally planned boring K-306 was not able to be completed due to time constraints.

2.4 JUNE 2015 REMEDIAL DESIGN SOIL SAMPLE COLLECTION

Additional soil samples were collected from June 22 to 24, 2015, from the Hog Fuel Storage Area (Excavation Areas 2 and 3), Concrete Pad Area (Excavation Area 5), and Bulkhead Area (Excavation Area 6). In Excavation Areas 5 and 6, samples were located on a grid with 40-foot centers (refer to Figure D.2). The samples collected during this event, in combination with the April 2015 soil sampling event described above, served to confirm/adjust the base elevation of the remedial excavation across the entire gridded excavation area.

Excavation bottom samples were collected via spilt-spoon samples using a hollow-stem auger to maximize sample recovery. Samples were collected according to the following protocols:

- In each accessible grid, the hollow-stem auger boring was advanced to 1 foot above the bottom design depth of the excavation. Vadose soils were not logged or sampled.
- Beginning at 1 foot above the bottom design depth of the excavation, three 18-inch split spoon samples (i.e., 4.5 feet total) were driven continuously using a 140-pound hammer. Samples were not collected from grid location E13 due to refusal in that area.
- The sampler was opened and the length of soil recovered as a percentage of the drive length was recorded. In situ sample depths were assigned to the recovered soil by uniformly decompressing the recovered interval (i.e., if recovery was 75 percent, each 0.75 feet of recovered soil was assigned a depth interval of 1 foot), unless obvious sample loss had occurred.
- Field indications of contamination, if present (i.e., sheen, odor, elevated PID readings or presence of NAPL) were recorded.
- Soil samples for laboratory analysis were collected from four continuous 1-foot intervals beginning at 1 foot above the bottom design depth of the excavation, consistent with the soil sample collection and handling procedures in the RI/FS SAP. All samples were collected for BTEX and GRO. Samples within the Hydraulic Oil Area were also collected for DRO.
- At three locations, deeper soil samples were collected by driving two additional cores to approximately 18 feet bgs to confirm that deeper intervals below the water table were not contaminated.

3.0 Results

3.1 SOIL SUITABILITY TESTING RESULTS

The results of soil suitability testing for landfill disposal and on-site thermal desorption treatment are discussed below. The results of soil suitability testing are presented in Table D.1.

3.1.1 Landfill Suitability Testing

The two samples presumed to be the most highly GRO-contaminated had benzene concentrations of 74 and 18 milligrams per kilogram (mg/kg), which were representative of the range of concentrations typically encountered in the most contaminated site soils. Corresponding TCLP results for benzene were 15.6 and 1.47 micrograms per liter (µg/L), less than the RCRA Regulatory Level for designation as hazardous waste of 500 µg/L.

3.1.2 Thermal Desorption Treatment Bench Testing

The two representative samples collected for thermal desorption bench testing included one predominantly sandy soil sample (denoted "coarse") and one sample of silt and sand (denoted "mix"). The results of bench testing by Reterro, Inc., for both of these samples are presented in Appendix E of the EDR.

3.2 CONCRETE SAMPLING RESULTS

RCRA 8 metals concentrations for the aggregate and fines fractions of the three concrete samples were all less than their respective Model Toxics Control Act (MTCA) Method A cleanup levels for unrestricted land use. Concrete sampling results are presented in Table D.1.

3.3 REMEDIAL DESIGN SOIL SAMPLING RESULTS

3.3.1 Analytical Results

Analytical results from the April event are presented on Table D.2 and also on Figure D.1. Soil sampling results from the June 2015 event are presented in Table D.3. The samples representing soil that is below the approximate design excavation depth of 12 feet bgs are in shaded rows in Tables D.2 and D.3.

3.3.2 Field Observations

The presumed water table at the time of drilling, indicated by saturated soils, was first encountered at estimated depths ranging from 11 feet bgs in the vicinity of the loading dock concrete pad to 13 feet bgs in the vicinity of the riprap slope. The depth to the presumed water table at the time of drilling was generally about 1 foot lower than the depth to water in nearby monitoring wells measured during several rounds of quarterly groundwater monitoring. These measurements were similar to those collected at groundwater grab sample locations during RI sampling, where the presumed water table at the time of drilling was approximately 1 foot lower than the subsequently measured static depth to water after inserting temporary well screens into the boreholes for groundwater sample collection.

Field indications of GRO, including gasoline odors and elevated PID readings, were strongest in the 2 to 3 feet of soil above the saturated soil (presumed water table) and generally dissipated within the first 1 to 2 feet of depth below the water table. Field indications of GRO contamination were not encountered in boring K-308 located at the top of the riprap slope, indicating a lack of contamination at that location[2]

Field indications of contamination were well correlated with laboratory analytical results for GRO and BTEX compounds. Low-level PID readings (i.e., less than approximately 10 to 15 parts per million by volume) and the absence of odor generally correlated to samples with GRO and BTEX concentrations less than their respective cleanup levels. Soil color alone did not appear to correlate with the presence of GRO or BTEX contamination, as the gray-colored soil sample without elevated PID readings or gasoline odor did not contain detectable amounts of either contaminant. With the exception of boring K-307, which had poor recovery below the water table and less certain in situ sample depths, soils collected from depths greater than 1 foot below the presumed water table had GRO and BTEX concentrations less than their respective site cleanup levels or remediation levels.

Field indications of ORO, including hydraulic oil odor and the presence of NAPL, were also strongest in soils above the water table at boring location K-303. NAPL was noted beginning at 4 feet bgs at this location, consistent with the area of NAPL delineated in the RI/FS. Field indications of ORO were present in some grids below 12 feet bgs to as deep as 14 feet bgs, suggesting that NAPL may be present well below the water table elevation.

3.4 DEPTH OF REMEDIAL EXCAVATION

3.4.1 Field Indications of Contamination

The results of the April and June 2015 sampling indicate that, in most locations, field indications of GRO, including gasoline odors and elevated PID readings, were strongest in the foot of soil above the bottom design depth of the excavation and generally dissipated thereafter. Low-level PID readings and the absence of odor generally correlated to samples with GRO and BTEX concentrations less than their respective cleanup levels.

Field indications of ORO, including hydraulic oil odor and the presence of NAPL, were also strongest in the foot of soil above the expected bottom design depth of approximately 12 feet bgs in the excavation areas with the exception of borings from grids C6, D5, and D7. In these locations, field indications of ORO were persistent to approximately 1 to 2 feet below the bottom design elevation of the excavation.

3.4.2 Analytical Results

Concerning the analytical results, with the exception of borings in seven grids (C6, D5, E6, D7, D11, D15, and F6), soils collected at the base of the excavation (i.e., deeper than 12 feet bgs) had concentrations less than their respective site cleanup levels or remediation levels for the analyzed contaminants of concern (COCs). Borings D5, D11, D15, and E6 had concentrations

[2] Samples from nearby RI boring K-89 encountered GRO-contaminated soils (888 mg/kg) at this location but this detection was thought to be due, in part, to chromatographic overlap from the creosote that was encountered in that location.

greater than their respective site cleanup levels or remediation levels of one or more COCs (primarily ORO or xylene) to a depth of approximately 1 foot below the bottom design depth of the excavation. Borings C6, D7, and F6 had concentrations greater than their respective site cleanup levels or remediation levels of one or more COCs (GRO or ORO) to a depth of approximately 2 feet below the bottom design depth of the excavation. These grids with exceedances of COCs below the approximate depth of excavation of 12 feet bgs are shown on Figure D.2.

4.0 Conclusions

Approximately 50 soil borings were advanced in a grid pattern within the limits of the planned excavation areas to vertically delineate the extents of contamination. Field and analytical results support the RI/FS findings that GRO and BTEX contamination generally attenuate to concentrations less than their respective site cleanup levels or remediation levels within the first 2 feet of soil below the water table observed at the time of drilling. In general, this corresponds to an excavation depth of 12 feet bgs. However, ORO contamination in some grids in the Hydraulic Oil Area extends up to 2 feet deeper than anticipated and in other grids in the Concrete Pad Area, xylene concentrations slightly greater than the cleanup level extend approximately 1 foot deeper than anticipated. Overall, the results of the soil sampling from the design base elevation of the excavation indicate that the excavation of soil 2 feet below the water table will achieve the site remedial objectives with the exception of seven grid cells, which may need additional excavation or treatment.

TCLP results for benzene from two representative samples of highly contaminated soil did not exceed the RCRA Regulatory Level concentration; therefore, excavated soil may be hauled for landfill disposal as non-hazardous waste. The three representative concrete samples had metals concentrations less than their respective MTCA Method A cleanup levels, indicating that crushed concrete may be used as excavation backfill.

K Ply Site

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Appendix D
Remedial Design Data Collection Report

Tables

Table D.1
Concrete Sampling Results

	Location	Loading Dock			Dryer Pad			Rubble			MTCA Method A CUL for Unrestricted Land Use
	Fraction	Fines	Aggregate		Fines	Aggregate		Fines	Aggregate		
Analytes	Units	14%	86%	Total	17%	83%	Total	22%	78%	Total	
Metals by USEPA 200.8											
Arsenic	mg/kg	3.88	1 U	1.40	7.21	2.48	3.28	1.68	1 U	1.15	20
Barium	mg/kg	28.3	2.17	5.83	57.2	15.5	22.59	32.5	4.39	10.57	NA
Cadmium	mg/kg	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2
Chromium	mg/kg	6.66	1 U	1.79	18.5	10.9	12.19	7.52	1.25	2.63	2,000
Lead	mg/kg	7.15	1 U	1.86	14.9	4.68	6.42	2.67	1 U	1.37	250
Mercury	mg/kg	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA
Selenium	mg/kg	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA
Silver	mg/kg	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2

Abbreviations:
CUL Cleanup Level
mg/kg Milligrams per kilogram
MTCA Model Toxics Control Act
NA Not applicable

Qualifier:
U Analyte was not detected at the given reporting limit.

Table D.2
Engineering Design Data Gaps Soil Sampling Results—April 2015

		Analyte	TCLP-Benzene by USEPA 1311[1]	BTEX by USEPA 8021B: Benzene	BTEX by USEPA 8021B: Ethylbenzene	BTEX by USEPA 8021B: Toluene	BTEX by USEPA 8021B: Xylene (total)	TPH by NWTPH-Gx/Dx: Gasoline-Range Organics	TPH by NWTPH-Gx/Dx: Diesel-Range Organics	TPH by NWTPH-Gx/Dx: Oil-Range Organics
		Unit	µg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Excavation Area	**Location**	**Depth (feet bgs)**								--
Concrete Pad Area (Excavation Area 5)	K-301[2]	13.5–15	15.6	***74***	**130**	**86**	**480**	***8,500***	--	--
	K-301[2]	16–17	--	0.27	0.084	0.084	0.32	19	--	--
	K-301[2]	17–18	--	**0.35**	0.02 U	0.02 U	0.06 U	2.8	--	--
	K-301[2]	18–19	--	0.21	0.02 U	0.02 U	0.06 U	2 U	--	--
	K-301[2]	19–20	--	0.057	0.02 U	0.02 U	0.06 U	2 U	--	--
	K-302	4–5	--	0.02 U	0.02 U	0.02 U	0.06 U	2 U	--	--
	K-302	10–12	1.47	***18***	**83**	**67**	**370**	***6,500***	--	--
	K-302	13–14	--	**5.9**	**27**	**20**	**140**	**2,300**	--	--
	K-302	14–15	--	**0.42**	0.28	0.23	1.4	**39**	--	--
	K-302	15–16	--	0.025	0.02 U	0.02 U	0.06 U	2 U	--	--
Bulkhead Area (Excavation Area 6)	K-303	12–13	--	0.02 U	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	K-303	13–14	--	0.2	0.02 U	0.26	0.89	23	**7,300** JM	**33,000**
	K-303	14–15	--	0.02 U	0.02 U	0.02 U	0.06 U	2 U	250 JM	1,100
	K-303	15–16	--	0.038	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	K-304	12–13	--	0.02 U	0.12	0.18	0.17	**34**	50 U	250 U
	K-304	13–14	--	0.12	0.02 U	0.057	0.06 U	10	50 U	250 U
	K-304	14–15	--	0.041	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	K-304	15–16	--	0.02 U	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	K-305	12–13	--	0.02 U	0.36	0.5	0.76	**110**	50 U	250 U
	K-305	13–14	--	0.02 U	0.025	0.061	0.06 U	10	50 U	250 U
	K-305	14–15	--	0.02 U	0.02 U	0.046	0.06 U	4.9	50 U	250 U
	K-305	15–16	--	0.031	0.02 U	0.1	0.086	8.2	50 U	250 U
	K-307	12–13	--	0.15	2.3	2	0.3 U	**450**	230 JM	320
	K-307	13–14	--	0.037	0.43	0.38	0.34	**88**	50 U	250 U
	K-307	14–15	--	0.02 U	0.02 U	0.034	0.06 U	5.2	50 U	250 U
	K-307	15–16	--	0.02 U	0.02 U	0.032	0.06 U	5.3	50 U	250 U
	K-308	14–15	--	0.02 U	0.02 U	0.059	0.071	4.5	--	--
	K-308	15–16	--	0.02 U	0.02 U	0.027	0.06 U	3.2	--	--
	K-308	16–17	--	0.02 U	0.02 U	0.02 U	0.06 U	2 U	--	--
	K-308	17–18	--	0.02 U	0.02 U	0.02 U	0.06 U	2 U	--	--

Notes:

(shading) Shading indicates soil to be left in place below the design base of excavation elevation.
-- Not analyzed.
bold Concentration exceeds applicable site cleanup level (refer to Table 2.1 of the EDR).
bold italic Concentration exceeds applicable site remediation level (refer to Table 2.1 of the EDR).
1 The RCRA regulatory level for hazardous waste designation is a TCLP-benzene result greater than 500 µg/L.
2 Sample location K-301 was located on the loading dock concrete pad, which is approximately 5 feet above the surrounding ground surface.

Abbreviations:

bgs Below ground surface
BTEX Benzene, toluene, ethylbenzene, and xylenes
EDR Engineering Design Report
µg/L Micrograms per liter
mg/kg Milligrams per kilogram
RCRA Resource Conservation and Recovery Act
TCLP Toxicity characteristic leaching procedure
TPH Total petroleum hydrocarbon

Qualifiers:

JM Analyte was detected, result is considered an estimate due to poor chromatographic match to standard.
U Analyte was not detected at the given reporting limit.

Table D.3
Excavation Confirmational Sampling Results—June 2015

			BTEX by USEPA 8021B				TPH by NWTPH-Gx/Dx		
		Analyte	Benzene	Ethylbenzene	Toluene	Xylene (total)	Gasoline-Range Organics	Diesel-Range Organics	Oil-Range Organics
		Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Excavation Area	**Sample Location**	**Depth (ft bgs)**							
Hog Fuel Area (Excavation Areas 2 and	EA2	11.2–12.2	0.02 U	0.02 U	0.02 U	0.06 U	2 U	--	--
	EA2	12.2–13.2	0.02 U	0.043	0.023	0.06 U	7.1	--	--
	EA3	4.4–5.4	--	--	--	--	--	170 JM	**1,400**
	EA3	5.4–6.4	--	--	--	--	--	50 U	250 U
Concrete Pad Area (Excavation Area 5)	B13[1]	14.9–15.9	**0.44**	0.038	0.044	0.06 U	9.9	--	--
	B13[1]	15.9–16.9	0.3	0.087	0.093	0.15	18	--	--
	B14[1]	15.8–16.8	**0.71**	0.31	0.22	1.7	**35**	--	--
	B14[1]	16.8–17.8	**1.7**	1.3	0.74	7.6	**110**	--	--
	B15[1]	15.9–16.9	**4.8**	2.6	0.034	0.5	25	--	--
	B15[1]	16.9–17.9	**0.6**	0.29	0.02 U	0.06 U	9.7	--	--
	C13[1]	16.0–17.0	**0.6**	0.055	0.02 U	0.06 U	5.1	--	--
	C13[1]	17.0–18.0	**1.4**	0.84	0.5	1.3	**76**	--	--
	C14[1]	15.9–16.9	**2.6**	2	0.087	0.17	21	--	--
	C14[1]	16.9–17.9	**0.33**	0.05	0.02 U	0.06 U	2 U	--	--
	C15[1]	15.9–16.9	0.18	0.19	0.02 U	0.06 U	2 U	--	--
	C15[1]	16.9–17.9	0.041 J	0.26 J	0.02 U	0.14 J	**45** J	--	--
	D11	10–10.9	**1.1**	**11**	**7.6**	**72**	**1,200**	--	--
	D11	10.9–11.9	**0.4**	3.9	2.3	**21**	**410**	--	--
	D11	11.9–12.9	**0.34**	0.02 U	0.02 U	0.06 U	2 U	--	--
	D11	12.9–13.9	0.05	0.02 U	0.02 U	0.06 U	2 U	--	--
	D12	10.3–11.3	**1.6**	0.98	0.37	3.1	**66**	--	--
	D12	11.3–12.3	**1.4**	0.47	0.19	1.4	**30**	--	--
	D13[1]	16.1–17.1	**1.2**	0.37	0.63	1.7	**41**	--	--
	D13[1]	17.7–18.1	**1.8**	0.6	0.68	1.7	**59**	--	--
	D13[1]	18.1–19.1	**0.36**	0.25	0.33	1.1	**45**	--	--
	D13[1]	19.1–20.1	**0.88**	0.26	0.26	0.67	**34**	--	--
	D13[1]	20.1–22.1	0.12	0.058	0.047	0.12	7.5	--	--
	D13[1]	22.1–24.1	0.02 U	0.02 U	0.02 U	0.06 U	2 U	--	--
	D14[1]	15.9–16.9	**1**	2.3	0.77	6.5	**260**	--	--
	D14[1]	16.9–17.9	0.073	0.19	0.063	0.7	**48**	--	--
	D15[1]	15.9–16.9	**0.41**	0.71	0.043	0.06 U	19	--	--
	D15[1]	16.9–17.9	0.02 U	**18**	5.7	**28**	**1,700**	--	--
	D15[1]	17.9–18.9	0.28	1.7	0.41	1.2	**150**	--	--
	D15[1]	18.9–19.9	0.02 U	0.02 U	0.02 U	0.06 U	2 U	--	--
	E8	10.3–11.3	0.044	0.2	0.064	0.06 U	7.7	--	--
	E8	11.3–12.3	0.02 U	0.082	0.029	0.06 U	3.8	--	--
	E9	9.7–10.7	0.084	0.2	0.02 U	0.06 U	2 U	--	--
	E9	10.7–11.7	0.25	0.3	0.037	0.06 U	4.7	--	--
	E11	10.2–11.2	0.02 U	0.081	0.036	0.088	17	--	--
	E11	11.2–12.2	0.02 U	0.15	0.061	0.2	11	--	--
	E12	9.9–10.9	0.068	0.02 U	0.02 U	0.06 U	2 U	--	--
	E12	10.9–11.9	**2.4**	0.046	0.047	0.06 U	11	--	--
	F8	9.5–10.5	0.038	3	0.54	6.7	**360**	--	--
	F8	10.5–11.5	0.14	1.4	0.44	1.1	**75**	--	--
	F9	10.4–11.4	0.18	0.23	1.7	9	**210**	--	--
	F9	11.4–12.4	0.062	0.28	0.071	0.1	11	--	--
	F9	12.1–13.4	0.08	0.02 U	0.02 U	0.06 U	2.7	--	--
	F9	13.4–14.4	0.02 U	0.02 U	0.02 U	0.06 U	2 U	--	--
	F9	14.4–16.4	0.02 U	0.27	0.13	0.32	23	--	--
	F9	16.4–18.4	0.03	0.076	0.029	0.11	5.8	--	--
	F10	10.2–11.2	0.02 U	0.02 U	0.02 U	0.06 U	3.1	--	--
	F10	11.2–12.2	0.02 U	0.02 U	0.02 U	0.06 U	2 U	--	--
	F11	10.2–11.2	**0.62**	0.3	0.02 U	0.089	5.8	--	--
	F11	11.2–12.2	0.18	0.19	0.02 U	0.06 U	5.5	--	--
	F12	10.1–11.1	0.13	0.17	0.02 U	0.14	6.8	--	--
	F12	11.1–12.1	**0.32**	0.23	0.043	0.12	7.4	--	--
	F13[1]	16.2–17.2	0.27	0.73	0.02 U	0.92	**75**	--	--
	F13[1]	17.2–18.2	**0.69**	3.1	1	1.6	**290**	--	--
	F14[1]	16.2–17.2	**6.2**	**14**	2.8	5	**790**	--	--
	F14[1]	17.2–18.2	**2.4**	1.6	0.33	0.78	**69**	--	--

Table D.3
Excavation Confirmational Sampling Results—June 2015

			BTEX by USEPA 8021B				TPH by NWTPH-Gx/Dx		
		Analyte	Benzene	Ethylbenzene	Toluene	Xylene (total)	Gasoline-Range Organics	Diesel-Range Organics	Oil-Range Organics
		Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Excavation Area	Sample Location	Depth (ft bgs)							
Bulkhead Area (Excavation Area 6)	B5	11.5–12.5	0.02 U	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	B5	12.5–13.5	0.059	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	C4	11.8–12.8	0.14	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	C4	12.8–13.8	0.2	0.02 U	0.02 U	0.06 U	3.1	50 U	250 U
	C5	12–13	0.15	0.02 U	0.025	0.06 U	3	50 U	360
	C5	13–14	0.13	0.02 U	0.035	0.06 U	4.6	50 U	250 U
	C5	14–15	0.098	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	C5	15–16	0.095	0.02 U	0.02 U	0.06 U	3.1	50 U	250 U
	C5	16–18	0.073	0.02 U	0.02 U	0.06 U	2.8	50 U	250 U
	C5	18–20	0.02 U	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	C6	11.2–12.2	**0.32**	0.02 U	0.12	0.12	6.5	**5,300** JM	**33,000**
	C6	12.2–13.2	**0.93**	0.02 U	0.44	1	23	1,800 JM	**10,000**
	C6	13.2–14.2	0.18	0.02 U	0.02 U	0.06 U	3.1	**2,500** JM	**14,000**
	C6	14.2–15.2	0.076	0.02 U	0.02 U	0.06 U	3.7	50 U	250 U
	D4	11.8–12.8	0.02 U	0.02 U	0.035	0.14	24	50 U	250 U
	D4	12.8–13.8	0.043	0.02 U	0.02 U	0.06 U	2.3	50 U	250 U
	D5	11.6–12.6	**0.37**	0.1 U	1.4	0.94	**150**	**2,800** JM	**16,000**
	D5	12.6–13.6	**0.36**	0.1 U	0.42	0.49	**46**	**2,600** JM	**15,000**
	D5	13.6–14.6	0.073	0.02 U	0.02 U	0.06 U	3.5	50 U	250 U
	D5	14.6–15.6	0.12	0.027	0.17	0.17	17	50 U	250 U
	D6	11.4–12.4	**1.5**	0.09	0.39	0.23	17	**4,900** JM	**39,000**
	D6	12.4–13.4	0.19	0.036	0.063	0.25	21	110 JM	800
	D7	10.6–11.6	**0.39**	0.036	0.48	0.12	18	**8,400** JM	**74,000**
	D7	11.6–12.6	**0.78**	0.082	0.047	0.26	7.5	**3,400** JM	**31,000**
	D7	12.6–13.6	**0.32**	0.036	0.21	0.19	6.1	1,100 JM	**9,700**
	D7	13.6–14.6	0.18	0.052	0.085	0.18	9.3	95 JM	800
	E2	12.6–13.6	0.02 U	0.02 U	0.029	0.06 U	4.4	50 U	250 U
	E2	13.6–14.6	0.028	0.11	0.15	0.1	20	50 U	250 U
	E3	12.2–13.2	0.02 U	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	E3	13.2–14.2	0.02 U	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	E5	11.75–12.75	0.02 U	0.055	0.065	0.06 U	11	50 U	250 U
	E5	12.75–13.75	0.069	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	E7	11.6–12.6	0.03	0.11	0.025	0.06 U	3	**2,100** JM	**23,000**
	E7	12.6–13.6	0.081	0.25	0.046	0.06 U	4.5	50 U	950
	F1	13.5–14	0.02 U	0.02 U	0.02 U	0.06 U	2 U	--	--
	F1	14–15	0.02 U	0.02 U	0.02 U	0.06 U	2 U	--	--
	F2	12.3–13.3	0.02 U	0.02 U	0.02 U	0.06 U	2 U	--	--
	F2	13.3–14.3	0.02 U	0.02 U	0.02 U	0.06 U	2 U	--	--
	F4	11.2–12.2	0.02 U	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	F4	12.2–13.2	0.02 U	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	F5	11.5–12.5	0.034	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	F5	12.5–13.5	0.024	0.02 U	0.02 U	0.06 U	2 U	50 U	250 U
	F6	11.3–12.3	0.02 U	0.11	0.3	0.06 U	**47**	50 U	250 U
	F6	12.2–13.3	0.02 U	2.2	5.2	**10**	**900**	69 JM	250 U
	F6	13.3–14.3	0.06	0.41	0.69	1.6	**130**	--	--
	F6	14.3–15.3	0.032	0.02 U	0.02 U	0.06 U	4	--	--
	F7	10.7–11.7	0.033	0.12	0.082	0.23	17	--	--
	F7	11.7–12.7	0.12	0.24	0.13	0.42	22	--	--
	G5	11.7–12.7	0.02 U	0.02 U	0.02 U	0.06 U	2 U	--	--
	G5	12.7–13.7	0.02 U	0.025	0.02 U	0.067	3.6	--	--
	G6	11.7–12.7	0.02 U	0.02 U	0.025	0.06 U	4.9	--	--
	G6	12.7–13.7	0.02 U	0.02 U	0.02 U	0.06 U	2 U	--	--

Notes:

Shading indicates soil to be left in place below the design base of excavation elevation.

-- Not analyzed.

bold Concentration exceeds applicable site cleanup level (refer to Table 2.1 of the EDR).

1 Sample location was located on the loading dock concrete pad, which is approximately 5 feet above the surrounding ground surface.

Abbreviations:

bgs Below ground surface
BTEX Benzene, toluene, ethylbenzene, and xylenes
EDR Engineering Design Report
µg/L Micrograms per liter
mg/kg Milligrams per kilogram
TPH Total petroleum hydrocarbon

Qualifiers:

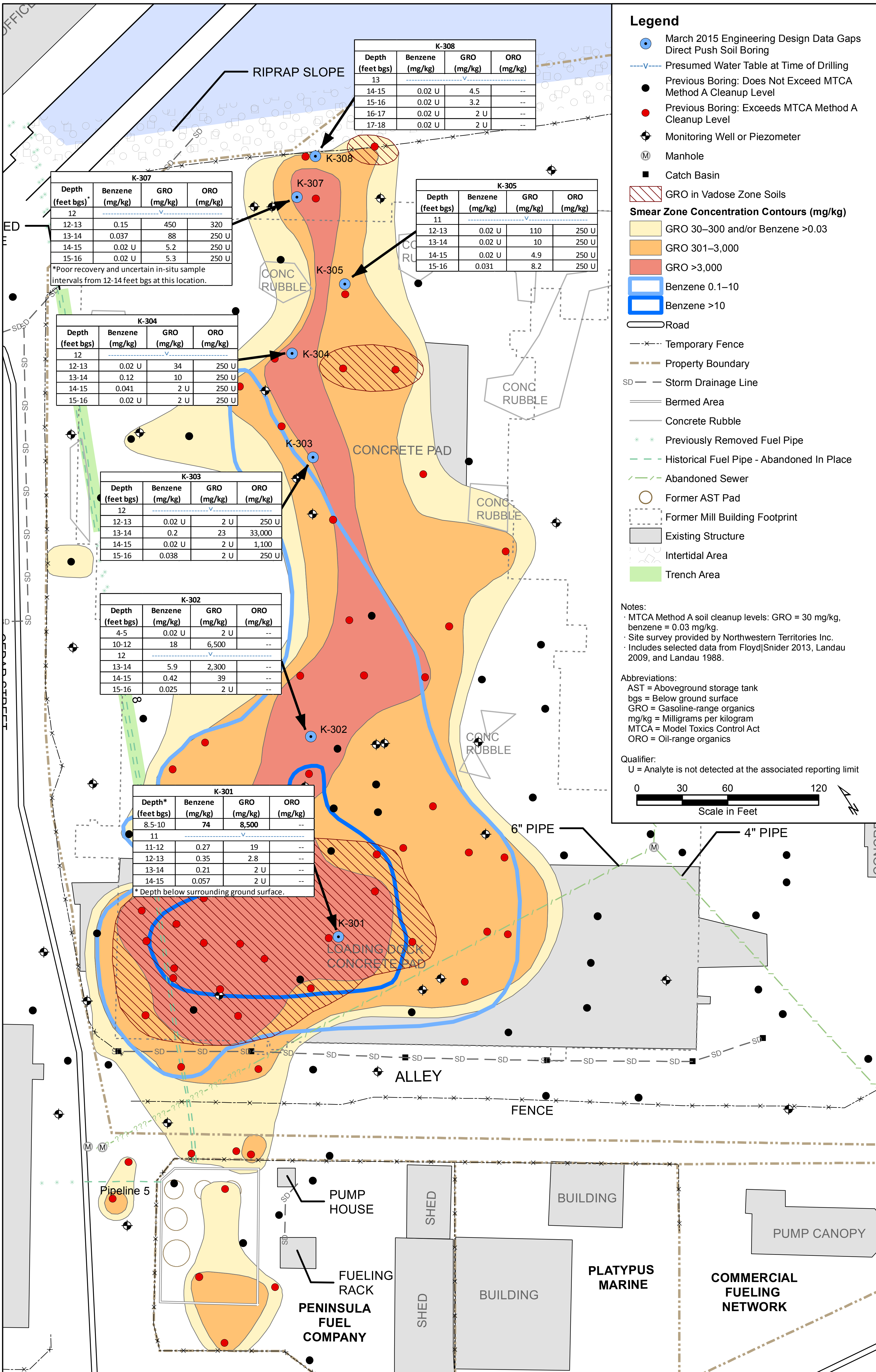
JM Analyte was detected, result is considered an estimate due to poor chromatographic match to standard.
U Analyte was not detected at the given reporting limit.

K Ply Site

Engineering Design Report

Appendix D
Remedial Design Data Collection Report

Figures



K-308

Depth (feet bgs)	Benzene (mg/kg)	GRO (mg/kg)	ORO (mg/kg)
13			
14-15	0.02 U	4.5	--
15-16	0.02 U	3.2	--
16-17	0.02 U	2 U	--
17-18	0.02 U	2 U	--

K-307

Depth (feet bgs)*	Benzene (mg/kg)	GRO (mg/kg)	ORO (mg/kg)
12			
12-13	0.15	450	320
13-14	0.037	88	250 U
14-15	0.02 U	5.2	250 U
15-16	0.02 U	5.3	250 U

*Poor recovery and uncertain in-situ sample intervals from 12-14 feet bgs at this location.

K-305

Depth (feet bgs)	Benzene (mg/kg)	GRO (mg/kg)	ORO (mg/kg)
11			
12-13	0.02 U	110	250 U
13-14	0.02 U	10	250 U
14-15	0.02 U	4.9	250 U
15-16	0.031	8.2	250 U

K-304

Depth (feet bgs)	Benzene (mg/kg)	GRO (mg/kg)	ORO (mg/kg)
12			
12-13	0.02 U	34	250 U
13-14	0.12	10	250 U
14-15	0.041	2 U	250 U
15-16	0.02 U	2 U	250 U

K-303

Depth (feet bgs)	Benzene (mg/kg)	GRO (mg/kg)	ORO (mg/kg)
12			
12-13	0.02 U	2 U	250 U
13-14	0.2	23	33,000
14-15	0.02 U	2 U	1,100
15-16	0.038	2 U	250 U

K-302

Depth (feet bgs)	Benzene (mg/kg)	GRO (mg/kg)	ORO (mg/kg)
4-5	0.02 U	2 U	--
10-12	18	6,500	--
12			
13-14	5.9	2,300	--
14-15	0.42	39	--
15-16	0.025	2 U	--

K-301

Depth* (feet bgs)	Benzene (mg/kg)	GRO (mg/kg)	ORO (mg/kg)
8.5-10	**74**	**8,500**	--
11			
11-12	0.27	19	--
12-13	0.35	2.8	--
13-14	0.21	2 U	--
14-15	0.057	2 U	--

* Depth below surrounding ground surface.

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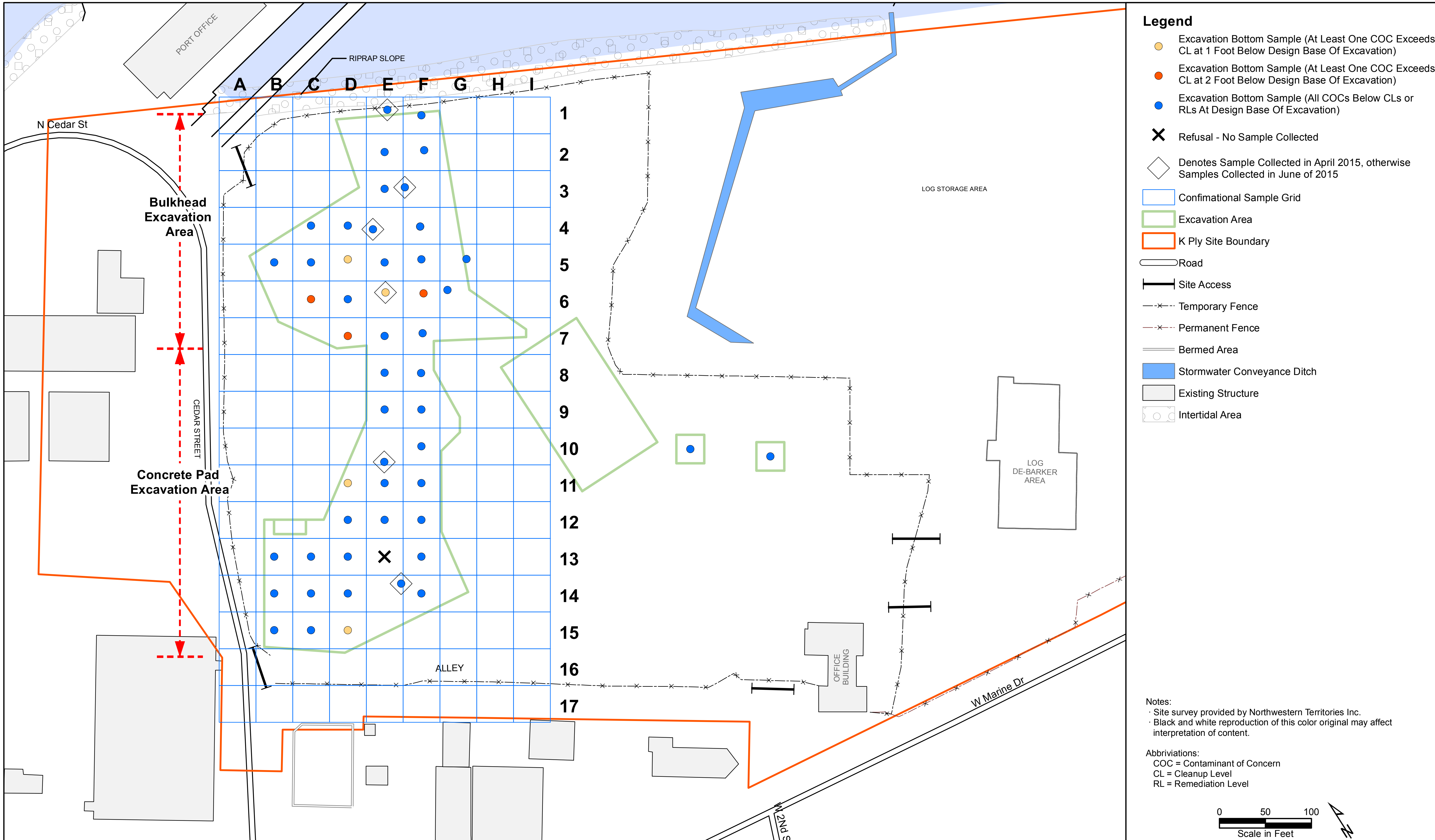
Port Angeles, Washington

Figure D.1
Remedial Design
April 2015 Soil Sampling Results

I:\GIS\Projects\PPA_KPLY\MXD\DataGapsSampling\Figure D.1 - Remedial Design Concrete Sampling Results.mxd
7/15/2015



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K Ply Site
Port Angeles, Washington

Figure D.2
Excavation Confirmational Bottom Sampling Locations

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7/17/2015

K Ply Site

Engineering Design Report

Appendix E
Sewer Discharge Permit/Engineering Report

Industrial Wastewater Discharge Permit

Permit Number: 2015-04
Effective Date of Permit: 08/17/2015
Expiration Date of Permit: 12/31/2015

In accordance with the provisions of the City of Port Angeles Sewer Use Ordinance, Industry Name: **Port of Port Angeles** (Herein known as Permittee), located at: **K-Ply Remediation Project, 439 Marine Drive,** discharging to the City of Port Angeles, is hereby authorized to discharge wastewater from the above identified facility, and through the discharge points identified in Section 1.A., into the public sanitary sewer system in accordance with the conditions set forth in this permit. The Permittee is identified as a **Minor Industrial User** with **restrictions as described in Section 1. B**, and is responsible to comply with the conditions identified in the City's most recently approved Sewer Use Ordinance.

This permit is **effective on 08/17/2015**, and will **expire on 12/31/2015**. This permit is issued based upon the information provided in the "Industrial Waste Discharge Permit Application" and the "K Ply Site Wastewater Treatment Engineering Report (Floyd Snyder August 4, 2015)"**.** Discharges not identified in the Application may be cause for enforcement as identified in the following paragraph.

Compliance with this permit does not relieve the Permittee of its obligation to comply with any or all applicable pretreatment regulations, standards or requirements under local, State, and Federal laws, including any such regulations, standards, requirements, or laws that may become effective during the term of this permit. Noncompliance with any term or condition of this permit, or any compliance schedule, shall constitute a violation of the City of Port Angeles Sewer Use Ordinance, and may be grounds for administrative action or enforcement proceedings including civil or criminal penalties (of up to $10,000 per day per violation), injunctive relief, and summary abatement, as identified in the City of Port Angeles Sewer Use Ordinance. This permit grants the **Port of Port Angeles** the right to discharge the waste streams and pollutants identified in the permit application subject to the pretreatment standards and requirements of the permit.

Industrial Waste Discharge Permits are issued to a specific user for a specific operation. A wastewater discharge permit shall not be reassigned or transferred or sold to a new owner, new user, different premises, or a new or changed operation without the approval of the Director and provision of a copy of the existing permit to the new owner/user. If no changes are made to the operation by the new owner, the approval shall be completed in at least thirty (30) days. Certification by the new owner or new user that no significant changes in operation have occurred may be required. If modifications are made in the operation, or if a new use of the premises is planned by the new user, a permit modification or issuance of a new permit shall be required.

The Permittee shall re-apply for an Industrial Wastewater Discharge Permit at least 90 days prior to the expiration date, in accordance with the requirements of the City of Port Angeles Sewer Use Ordinance.

By: ____ Issued this ____ day of _________, **2015**
Craig Fulton, Director of Public Works & Utilities

____ Date: ___________________, **2015**
Chris Hartman, Director of Engineering
Acknowledge Receipt of Permit

SECTION 1
MONITORING REQUIREMENTS/EFFLUENT LIMITATIONS

1.A. During the effective period of this permit, the Permittee is authorized to discharge those **approved** process wastewaters listed in the Application and Engineering Report, from the following outfall(s):

Outfall 001: Sampling port located between lead and lag granulated activated carbon (GAC) media units. Permit limits for organics do not apply to discharge from outfall 001. Monitoring is to watch for “breakthrough” only. Reporting still required.

Outfall 002: Sampling port located between lag GAC unit and discharge into City sanitary sewer manhole #1627.

1.B. Applicable Regulation(s): Section 13.06 City of Port Angeles Municipal Code, Sewer Use Ordinance, Industrial Wastewater Pretreatment. The Final Local Limits Report (October 2009). City of Port Angeles 2009 Local Limits spreadsheet. EPA National Recommended Water Quality Criteria.

The discharge from the above-identified outfalls shall not exceed the following effluent limitations. The Permittee shall monitor and report the information from the above-identified outfalls for the following parameters, at the indicated frequencies, using the City’s provided Discharge Monitoring Report template. Any time the Permittee becomes aware its discharge violates any of the following limits, the Permittee shall immediately cease discharge and notify the Source Control Specialist. Permittee shall not resume discharge until authorized in writing by the City’s Source Control Specialist or Wastewater Superintendent.

INDUSTRIAL WASTEWATER DISCHARGE LIMITS & MONITORING REQUIREMENTS							
Parameter	Units	Outfall #	Daily Min.	Daily Average	Daily Maximum	Monitoring Frequency	Sample Type
Flow	Gpd	2		<25,000†	121,000‡	Daily	Meter
pH	SU	2	5.0		10.0	1st week & monthly$^{\alpha}$	Grab
BOD_5	mg/L	2			400	1st week & monthly$^{\alpha}$	Grab
TSS	mg/L	2			400	weekly	Grab
Arsenic	mg/L	2			0.21	1st week & monthly$^{\alpha}$	Grab
Cadmium	mg/L	2			0.14	1st week & monthly$^{\alpha}$	Grab
Chromium	mg/L	2			42.2	1st week & monthly$^{\alpha}$	Grab
Copper	mg/L	2			2.43	1st week & monthly$^{\alpha}$	Grab
Cyanide	mg/L	2			0.50	1st week & monthly$^{\alpha}$	Grab
Lead	mg/L	2			1.09	1st week & monthly$^{\alpha}$	Grab
Mercury	mg/L	2			0.09	1st week & monthly$^{\alpha}$	Grab
Molybdenum	mg/L	2			0.17	1st week & monthly$^{\alpha}$	Grab
Nickel	mg/L	2			1.38	1st week & monthly$^{\alpha}$	Grab
Selenium	mg/L	2			0.86	1st week & monthly$^{\alpha}$	Grab
Silver	mg/L	2			0.85	1st week & monthly$^{\alpha}$	Grab
Zinc	mg/L	2			2.38	1st week & monthly$^{\alpha}$	Grab
Benzene	mg/L	1 & 2			0.13	1st week & monthly$^{\alpha}$	Grab
Ethylbenzene	mg/L	1 & 2			1.59	1st week & monthly$^{\alpha}$	Grab
H2S	ug/L	1 & 2			34.1	1st week & monthly$^{\alpha}$	Grab
PCP	ug/L	1 & 2			3.0	1st week & monthly$^{\alpha}$	Grab
Toluene	mg/L	1 & 2			1.36	1st week & monthly$^{\alpha}$	Grab
Xylenes	mg/L	1 & 2			2.34	1st week & monthly$^{\alpha}$	Grab
TPH-G	mg/L	1 & 2			1	1st week & monthly$^{\alpha}$	Grab
TPH-D	mg/L	1 & 2			5	1st week & monthly$^{\alpha}$	Grab

SEE IMPORTANT FOOTNOTES ON FOLLOWING PAGE!

† Daily average flow shall be calculated by dividing the total flow for each calendar month by the number of days in that month.

‡ Daily maximum flow shall be the highest single daily flow during each calendar month. Surcharging City manholes or cleanouts or causing sewer backups in properties near the K-Ply remediation site is strictly prohibited. The City reserves the right to temporarily suspend discharge from this project without prior notice if combined sewer overflows (CSOs) or local surcharging or backups occur.

α Outfalls 001 & 002 shall be sampled and monitored within first seven calendar days of operation to prove effectiveness of system. Lab turnaround time shall be fastest possible. Assuming system is working properly, monitoring will be required monthly thereafter, except for flow (daily) and TSS (weekly).

Monitoring Waiver Granted? Yes:___. NO: **X** Date:

1.C. Additional Permit Conditions:

i. The Permittee shall be responsible to provide protective barriers around the City's manhole #1627, for the protection of the public, equipment, and contractors. The Permittee shall be responsible for any permit modification costs or damage caused by non-compliant or unapproved discharges to the sewer system or wastewater treatment plant.

ii. The Permittee or its contractors shall provide an employee or employees sufficiently trained to monitor and maintain the wastewater treatment system according to Section 4 and Section 5 of the "K Ply Site Wastewater Treatment Engineering Report" prepared by Floyd/Snider on August 4, 2015, or as amended. That employee shall be on the project site any time work is being conducted on the project site and wastewater is being discharged, and shall be reasonably available to meet with City or Port staff regarding the treatment system between 7:00 a.m. and 3:30 p.m., Monday through Friday.

1.D. All collection, preservation, handling and laboratory analyses of samples for compliance monitoring shall be performed in accordance with 40 CFR Part 136, and amendments thereto, unless specified otherwise in this permit. All laboratories must be registered or accredited laboratories per (WAC 173-50, WAC 173-216-125). State regulations require that limitations set forth in a waste discharge permit must be based on the technology available to treat the pollutants (technology-based) or be based on the effects of the pollutants to the POTW (local limits). Waste water must be treated using all known available and reasonable methods of prevention, control, and treatment (AKART) and not interfere with the operation of the POTW.

If a commercial laboratory performs sampling and/or analysis on behalf of the Permittee, it is the Permittee's responsibility to ensure that all sampling & analyses are performed in accordance with 40 CFR Part 136, or as otherwise specified. All samples must be collected using a 24-hour flow-proportional sampler unless other sample methods are specifically approved by the City and also in compliance with Section 1.E. of this permit and 40 CFR 403.12(g).

1.E. All daily discharge log sheets shall be retained for three years after the expiration date of this permit, and shall be made readily available to the City of Port Angeles Source Control Specialist for inspection or copying upon request.

1.F. Federal and Local General Discharge Prohibitions:

Except as hereinafter provided, no person shall discharge any wastewater containing pollutants in sufficient quantity (flow or concentration), either singly or by interaction with other pollutants, to pass through or interfere with the wastewater system, to injure or interfere with any wastewater treatment process; to interfere with the use of or disposal of treatment plant sludge; to constitute a hazard to humans or animals; to create a toxic effect in the receiving waters of the sewer system; to exceed the limitation set forth in a National Pretreatment Standard; or to exceed a local limit established by the Source Control Specialist. Discharge of any waste stream not identified in this permit, including one-time discharges and wastes from periodic maintenance, without prior written approval is prohibited. Dilution as a substitute for treatment is prohibited. Bypassing any treatment component is prohibited. The permittee may not discharge any substance or cause any conditions prohibited under the Port Angeles Municipal Code (Section 13.06.030 Discharge Prohibitions) Sewer use Ordinance, see Attachment A.

SECTION 2
REPORTING REQUIREMENTS

2.A. Each industrial user is required to notify the Director of any planned significant changes to the industrial user's operations or pretreatment systems that might alter the nature, quality, or volume of its wastewater.

1. The Director may require the industrial user to submit such information as may be deemed necessary to evaluate the changed condition.

2. The Director may modify an existing wastewater permit to accommodate the change.

3. No industrial user shall implement the planned changed condition(s) until the Director has responded to the industrial user's notice.

4. For purposes of this requirement, flow increases of fifteen percent (15%) or greater, and the discharge of any previously unreported pollutant shall be deemed significant.

2.B. Any user which experiences an upset in operation which places the user in a temporary state of noncompliance with this Industrial Wastewater Discharge Permit shall inform the Director of the upset immediately of the first awareness of it. The user shall also submit, within 5 days of becoming aware of the upset, a description of the discharge and its causes, the period of noncompliance (if not corrected, the time noncompliance is anticipated to end), and the steps being taken to reduce, eliminate and prevent recurrence of the noncompliance. Noncompliance caused by operational error, improperly designed pretreatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation does not constitute an upset.

2.C. Bypass: The intentional diversion of one or more waste streams or processes from any portion of the Permittee’s facility is prohibited; unless the Permittee has followed P.A.M.C. Section 13.06.182, specifically sub sections (B), (C) and (D).

2.D. The Permittee must submit a signed monthly Discharge Monitoring Report for each month of the project, due by the 15th day of the month following sampling, per 40 CFR Parts 403.12(e) and (h). The reports shall indicate the volume, nature and concentration of all pollutants in the effluent for which monitoring, sampling, and analyses were performed. These reports must be based on sampling and analysis performed in the period covered by the report, and in accordance with the techniques described in 40 CFR Part 136. In cases where a permitted discharge requires compliance with a Best Management Practice (or pollution prevention alternative), the User shall submit documentation required by the City necessary to determine the compliance status.

2.E. If the Permittee subject to reporting requirements in 40 CFR 403.12(e) (Periodic Compliance Reports) monitors any regulated pollutant more frequently than required by the City, using the procedures specified in 40 CFR Part 136, and from the location identified on the last page of this permit, the results of this monitoring shall be included in the compliance report.

2.F. If sampling performed by the Permittee indicates a permit violation, the Permittee shall notify the City within 24 hours once aware of the violation. The Permittee shall also repeat the sampling and analysis and submit the results of the repeat analysis to the City within 30 days after becoming aware of the violation per 40 CFR Part 403.12(g). If the violation is confirmed, the Permittee must continue the notification and re-sampling requirement until compliance is achieved consistently. If the City performs sampling and a violation is noted, the Permittee may also be required to perform repeat sampling until the Permittee indicates they are consistently in compliance.

SECTION 3
NOTIFICATION AND RECORD KEEPING REQUIREMENTS

3.A Each time a sample is taken because it is required by this permit (even if taken by a second party), you must record the following data (seven bulleted items). When you report the results of the sampling, include this information so that we know it was done correctly, and keep a copy of the report you send to the City as well.

- The date, exact place, time, and methods of sampling or measurements, and sampling preservation techniques;
- Who performed the sampling or measurements;
- The date(s) the analyses were performed;
- Who performed the analyses;
- The analytical techniques or methods used;
- The results of such analyses; and
- Any BMP requirements and records/logs related to BMP requirements.

3.B. The Permittee shall retain for a minimum of three years all such records defined in Section 3.A. above, and shall make such records available for inspection and copying by the City, the DOE Director and the EPA Regional Administrator. This period may be extended by the request of the City, the DOE Director or the EPA at any time. All records that pertain to matters which are the subject of special orders or any other enforcement or litigation activities brought by the City shall be retained and preserved by the permittee until all enforcement activities have concluded and all periods of limitation with respect to any and all appeals have expired.

3.C. For any information faxed or e-mailed to the City, the original shall be retained on the Permittee's premises for a minimum of three (3) years; or the original may be mailed to the City as a follow-up to the fax, with copies being retained on the Permittee's premises. This section does not supersede Section 3.B. above.

3.D. Representative Sampling: Samples and measurements taken as required by this permit shall be representative of the volume and nature of the monitored discharge. All samples shall be taken at the monitoring points specified in this permit, and unless otherwise specified, before the permitted discharge joins or is diluted by any other wastestreams, body of water or substance. Samples must also be taken in accordance with 40 CFR Part 136 methodologies.

All equipment used for sampling and analyses must be routinely calibrated, inspected and maintained to ensure its accuracy. Monitoring points shall not be changed without notification to, and prior City approval.

SECTION 4
STANDARD CONDITIONS

4.A. Permit Modification: This Industrial Wastewater Discharge Permit may be modified for good and valid cause at the written request of the Permittee or at the discretion of the Source Control Specialist. Copies of all permit modifications shall be sent to the Source Control Specialist. Examples of when a permit may be modified may be including, but not limited to the following reasons:

- To incorporate any new or revised Federal, State or local Pretreatment Standards or requirements;
- To address significant alterations or additions to the User's operation, processes, or wastewater volume or character since the time of the individual wastewater discharge permit issuance;
- A change in the POTW that requires either a temporary or permanent reduction or elimination of the authorized discharge;
- Information indicating that the permitted discharge poses a threat to the City's POTW, City personnel, or receiving waters;
- Violation of any terms or conditions of the individual wastewater discharge permit;
- Misrepresentations or failure to fully disclose all relevant facts in the wastewater discharge permit application or in any required reporting;
- To correct typographical or other errors in the individual wastewater discharge permit;
- To reflect transfer of the facility ownership or operation to a new owner or operator;
- Permittee modification requests shall be submitted to the Director and shall contain a detailed description of all proposed changes in the discharge. The Director may deny a request for modification if the change will result in violations of Federal, State, or local laws or regulations; will overload or cause damage to any portion of the sewer system; or will create an imminent or potential hazard to personnel.

4.B. Dilution Prohibition: No user shall intentionally increase the use of process water or, in any way, attempt to dilute a discharge as a partial or complete substitute for adequate treatment to achieve compliance with the limitations contained in the National Pretreatment Standards, or in any other pollutant limitation developed by this Ordinance or the State. It is understood that an industry may vary water usage in the ordinary course of processing. This section is not intended to interfere with this flexibility The City may impose mass limitations on dischargers, which in its judgment appear to be using dilution to meet applicable pretreatment standards or requirements of this section or in cases where the imposition of mass limitations is otherwise deemed appropriate by the City.

4.C. Inspection and Entry: The Source Control Specialist shall have the right to enter the premises of any User to determine whether the User is complying with all requirements of this ordinance and any individual wastewater discharge permit or order issued hereunder.

Users shall allow the Director ready access to all parts of the premises for the purposes of inspection, sampling, records examination and copying, and the performance of any additional duties. The Director shall have the right to set up on the User's property, or require installation of, such devices as are necessary to conduct sampling and/or metering of the User's operations. Unreasonable delays in allowing the Director access to the User's premises shall be a violation of this permit.

4.D. Signatory Requirements/Certification Statement: All reports submitted by Industrial Users shall be signed per the signatory requirements in 40 CFR Part 403.12(l). The signed certification statement defined in 40 CFR Part 403.6(a)(2)(ii), stating:

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

shall accompany all reports and testing results submitted by any Permittee.

4.E. The Permittee shall notify the City, EPA Regional Waste Management Division Director, and Washington DOE Hazardous Waste Division in writing of any discharge into the POTW of a substance, which, if otherwise disposed of, would be a hazardous waste under 40 CFR part 261, in accordance with 40 CFR 403.12(p).

SECTION 5
AMINISTRATIVE REQUIREMENTS

5.A. The Permittee must apply for renewal of this permit at least three months prior to its expiration.

5.B. This permit may be transferred to a new owner on the condition that said person(s) comply with all the provisions contained herein.

5.C. At any time during the duration of this permit, permittee may appeal a term or condition of this permit. Any such appeals will be made to the Source Control Specialist.

SECTION 6
CONTROL AUTHORITY RIGHTS

6.A. At any time during the duration of this permit, the City has the right to:

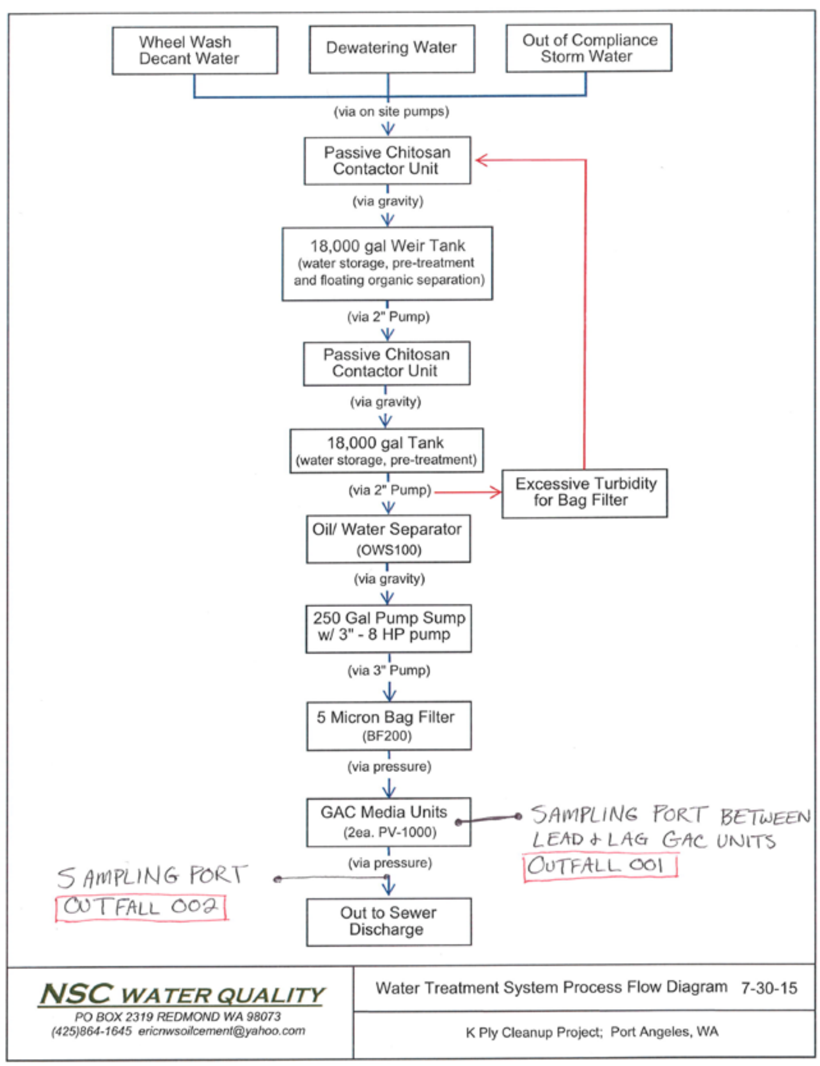
- Reopen this permit in certain situations and cancel it in other specific situations
- Enter the facility without delay
- Sample any waste stream and copy any records pertaining to wastes
- Inspect the facility and take notes and pictures of activities subject to the permit

- Apply injunctive relief to halt any discharge which poses a threat
- Assess civil penalties for violations of permit terms and conditions
- Pursue criminal prosecution for knowing or willful violations
- Determine and annually publish Users in Significant Non-Compliance
- Require the Permittee to provide any information needed to make permit decisions
- Increase the scope and frequency of monitoring in response to changed conditions or non-compliance
- Extend an expired permit

SECTION 7
SAMPLE SITE LOCATIONS

The following outfall sample sites are the official City and Permittee sample collection locations. If required, all samples collected for compliance monitoring must be obtained from these sites.

Outfall 001: Sampling port located between lead and lag granulated activated carbon (GAC) media units.
Outfall 002: Sampling port located between lag GAC unit and discharge into City sanitary sewer manhole #1627.



APPENDIX A

13.06.030 Discharge prohibitions.

A. No user shall introduce or cause to be introduced into the POTW any pollutant or wastewater that causes pass through or interference. These general prohibitions apply to all users of the POTW whether or not they are subject to Categorical Pretreatment Standards or any other National, State, or local pretreatment standards or requirements.

B. No user shall introduce or cause to be introduced into the POTW the following pollutants, substances, or wastewater:

1. Pollutants that either alone or by interaction may create a fire or explosive hazard in the POTW, a public nuisance or hazard to life, or prevent entry into the sewers for their maintenance and repair or are in any way injurious to the operation of the system or operating personnel. This includes waste streams with a closed-cup flashpoint of less than 140 degrees F (60 degrees C) using the test methods specified in 40 CFR 261.21, or its successors.

2. Any soluble waste or wastes having a pH lower than 5.0 or higher than 10.0 or having any other corrosive property that reasonably could be hazardous to structures, equipment, or personnel of the City, such as, but not limited to, battery or plating acids and wastes, copper sulfate, chromium salts and compounds, or salt brine.

3. Solid or viscous substances in amounts that may cause obstruction to the flow in the sewer or other interference with the operation of the system. In no case shall solids greater than one-quarter inch (0.64 cm) in any dimension be discharged.

4. Pollutants, including oxygen-demanding pollutants (BOD, etc.), released in a discharge at a flow rate and/or pollutant concentration that, either singly or by interaction with other pollutants, will cause interference with the POTW.

5. Wastewater having a temperature that will interfere with the biological activity in the system, has detrimental effects on the collection system, or prevents entry into the sewer. In no case shall wastewater be discharged that causes the wastewater temperature at the treatment plant to exceed 104 degrees F (40 C).

6. Petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin, in amounts that will cause pass through or interference.

7. Pollutants that result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems.

8. Trucked or hauled pollutants, except at discharge points designated by the Director in accordance with section 13.06.051 of this chapter.

C. The following classes of discharge are prohibited unless approved by the Director because of extraordinary circumstances, such as lack of direct discharge alternatives due to combined sewer service or need to augment sewage flows due to septic conditions:

1. Noncontact cooling water in significant volumes.

2. Stormwater, or other direct inflow sources.

3. Wastewaters significantly affecting system hydraulic loading that do not require treatment or would not be afforded a significant degree of treatment by the system.

4. New discharges of stormwater, surface water, ground water, artesian well water, roof runoff, subsurface drainage, condensate, deionized water, noncontact cooling water, and unpolluted wastewater, unless specifically authorized by the Director.

5. Sludges, screenings, or other residues from the pretreatment of industrial wastes, unless specifically authorized by the Director.

6. Medical wastes, except as specifically authorized by the Director in a wastewater discharge permit.

D. Noxious or malodorous liquids, gases, solids, or other wastewater that either singly or by interaction with other wastes, are sufficient to create a public nuisance or a hazard to life, or to prevent entry into the sewers for maintenance or repair.

E. Wastewater that imparts color that cannot be removed by the treatment process, such as, but not limited to, dye wastes and vegetable tanning solutions, that consequently imparts color to the treatment plant's effluent, thereby violating the City's NPDES permit.

F. Wastewater containing any radioactive wastes or isotopes except in compliance with applicable State or Federal regulations.

G. Wastewater causing, alone or in conjunction with other sources, the treatment plant's effluent to fail toxicity test.

H. Detergents, surface-active agents, or other substances that may cause excessive foaming in the POTW.

I. Wastewater causing two readings on an explosion hazard meter at the point of discharge into the POTW, or at any point in the POTW, of more than ten percent or any single reading over 20 percent of the lower explosive limit based on an explosivity meter reading.

J. Pollutants, substances, or wastewater prohibited by this section shall not be processed or stored in such a manner that an unintended discharge to the sanitary sewer or the storm sewer could occur.

(Ord. 3397, 4/30/2010)

K Ply Site

Wastewater Treatment Engineering Report

For

Port of Port Angeles – K Ply Remediation Project

Prepared for

The City of Port Angeles
Public Works & Utilities Department
P.O. Box 1150
Port Angeles, WA 98362-0217

Permittee / Owner

Port of Port Angeles
338 West First Street
Port Angeles, WA 98362

Consultant

Port of Port Angeles
Floyd|Snider
601 Union Street, Suite 600
Seattle, WA 98101

Operator / Contractor

Engineering/Remediation Resources Group Inc.
15333 NE 90th Street
Redmond, WA 98052

Engineering Report Preparation Date: August 4, 2015

FLOYD | SNIDER
strategy ▪ science ▪ engineering
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Seattle, Washington 98101 • tel: 206.292.2078

LIMITATIONS

This report has been prepared for the exclusive use of Port of Port Angeles, their authorized agents, and regulatory agencies. It has been prepared following the described methods and information available at the time of the work. No other party should use this report for any purpose other than that originally intended, unless Floyd|Snider agrees in advance to such reliance in writing. The information contained herein should not be utilized for any purpose or project except the one originally intended. Under no circumstances shall this document be altered, updated, or revised without written authorization of Floyd|Snider.

K Ply Site Wastewater Treatment Engineering Report

PROFESSIONAL ENGINEER CERTIFICATION

This document has been prepared for the Port of Port Angeles under the direction of:

Exp. Date: 6/22/2017

Name: **Tucker Stevens, PE**

Date: **August 4, 2015**

Revised August 12, 2015
by Port of Port Angeles

Revision -1: Added note of sampling of PCP & H2S. Added note that Port would consult with City on replacement of GAC units. Added note that Port would sample within the first 7 days of operation. On page 15 of 42.

Revision-2: Added sample point locations to Process Flow Diagram on page 34 of 42

Table of Contents

List of Tables

List of Exhibits

List of Acronyms and Abbreviations

Acronym/Abbreviation	Definition
AO	Agreed Order
BMP	Best Management Practice
BTEX	Benzene, toluene, ethylbenzene, and xylene
City	City of Port Angeles
COC	Contaminant of concern
cPAH	Carcinogenic polycyclic aromatic hydrocarbons
CUL	Cleanup level
DRO	Diesel-range organics
Ecology	Washington State Department of Ecology
ER	Wastewater Treatment Engineering Report
ERRG	Engineering/Remediation Resources Group Inc.
GAC	Granular activated carbon
gpm	Gallons per minute
GRO	Gasoline-range organics
K Ply	K Ply Inc.
LNAPL	Light non-aqueous phase liquid
µg/L	Micrograms per liter
mg/L	Milligrams per liter
MTCA	Model Toxics Control Act
NAPL	Non-aqueous phase liquid
NTU	Nephelometric Units
ORO	Oil-range organics
PCP	Pentachlorophenol
Port	Port of Port Angeles
Project	K Ply Remediation Project
RI/FS	Remedial Investigation/Feasibility Study
Site	K Ply Site
SVOC	Semivolatile organic compound
TEQ	Toxicity equivalent
TESC	Temporary Erosion and Sediment Control
VOC	Volatile organic compound

1.0 Introduction

1.1 PURPOSE AND OBJECTIVES OF THIS REPORT

This Wastewater Treatment Engineering Report (ER) has been prepared by Floyd|Snider on behalf of the Port of Port Angeles (Port) for the K Ply Remediation Project (Project) located at the K Ply Site (Site) at 439 Marine Drive, Port Angeles, Washington, 98363. This ER has been prepared to support the permit application for a minor industrial use discharge authorization from the City of Port Angeles (City) for the discharge of project wastewater to sanitary sewer. Wastewater is defined for the Project as including excavation dewatering water, wheel wash water, decontamination water, and water collected as runoff from contaminated material stockpiles and the paved area of the Site near the contaminated material stockpiles, if any.

This ER was developed using site-specific groundwater and soil quality data presented in the Remedial Investigation/Feasibility Study (RI/FS; Floyd|Snider 2015a) prepared by Floyd|Snider on behalf of the Port in accordance with Agreed Order (AO) No. DE 9546 between Washington State Department of Ecology (Ecology) and the Port (Ecology 2012). The RI/FS and other documents were previously provided to the City, and these documents should be referenced if additional information is required regarding environmental investigations, past operations, or chemical characterization of the Site. This ER was also developed using the preliminary discharge limits provided by the City and the treatment system design information provided by vendors to meet those limits.

1.2 PROJECT DESCRIPTION

The Site is the location of a former plywood mill located in the industrial waterfront part of Port Angeles, Washington. Since the 1920s, the Site has been used to support the wood products industry (i.e., log storage, debarking, lumber, and plywood mills) but was primarily used for plywood manufacture. The mill was built in the 1940s and operated continuously until 2007 under various owners including ITT Rayonier, Inc., K Ply Inc. (K Ply), and Peninsula Plywood Company. Leaks of hydraulic oil from several large presses within the mill contaminated the underlying soil and the leaks reached the groundwater table where a free phase product floating layer upon the groundwater table has formed. In addition, leaks of gasoline from a petroleum pipeline that passed under the mill to an upgradient bulk fuel facility contaminated soil and groundwater under the mill building. Benzene-contaminated groundwater from the site flows into Port Angeles Harbor and presents a risk to the marine life in Port Angeles Harbor, as well as to humans that may eat contaminated seafood.

The mill closed permanently in 2011 and was demolished by the Port in 2013. Mill demolition was done as part of an Interim Cleanup Action funded by Ecology to allow for a more comprehensive environmental investigation, RI/FS, and cleanup action to be completed. The Site is being cleaned up under the authority of the Model Toxics Control Act (MTCA) (Chapter 70.105D of the Revised Code of Washington), administered by Ecology under the MTCA Cleanup

Regulation (Washington Administrative Code 173-340), and under AO No. DE 11302 between Ecology and the Port, effective May 2015.

The Project consists of excavation of all vadose zone gasoline-contaminated soil site-wide that exceeds applicable cleanup levels (CULs) and a large portion of the underlying smear zone soil that is a source of groundwater contamination (refer to Exhibit 1). Excavation of the light non-aqueous phase liquid (LNAPL)-containing soil will also occur. The Project includes approximately 2.4 acres of disturbed area.

The work planned for the Project includes the following:

1. Excavation, hauling, and stockpiling of surface waste, debris, contaminated soil, LNAPL accumulations on the groundwater table, and uncontaminated soil.
2. Potential dewatering for deeper excavation of contaminated soil in up to five 40-foot by 40-foot grids.
3. Off-site transportation and disposal of surface waste, debris, and contaminated soil.
4. Placement of fill to replace excavated soil.
5. Installation of infiltration galleries for future bioremediation.

The remediation work that will be completed is described in greater detail in the Engineering Design Report (Floyd|Snider 2015b). The Port has selected Engineering/Remediation Resources Group Inc. (ERRG) to complete the Project work. The duration of the Project will be approximately 3 months and construction is anticipated to occur between August 3 and November 8, 2015.

2.0 Construction Processes and Activities

There are four construction processes and activities that will generate wastewater during the Project. This wastewater will require treatment prior to discharge to the sanitary sewer. The substances and pollutants that will be present in the wastewater are the same for all four activities, and include: petroleum hydrocarbons, measured as total petroleum hydrocarbon (TPH)-gasoline and TPH-hydraulic oil; benzene, toluene, ethylbenzene, and xylene (BTEX); and turbidity. Metals, pentachlorophenol (PCP), other volatile organic compounds (VOCs), and other potential contaminants of concern (COCs) have been tested for and never detected in site groundwater.

All wastewater will be pre-treated prior to discharge to the sanitary system in a treatment train starting with settling, chitosan treatment, oil/water separation, and 5-micron bag filter, ending with granulated activated carbon (GAC). The construction process and activities that will generate wastewater are presented in Table 1:

Table 1
Wastewater-Generating Construction Processes and Activities

Process Number	Wastewater Generated	Frequency of Discharge	Daily Quantity (gallons per day)	
			Average	Maximum
1	Excavation Dewatering Water	Continuous during a 5- to 7-day period of the project	<50,000	75,000 (50 gpm for 24 hours)
2	Wheel Wash Water	Batch – 2x monthly	<1,000	<5,000
3	Decontamination Water	Occasional	<100	<1,000
4	Contaminated Material Stockpile Water and Paved Area Stormwater	Variable, depends on many factors	<100	40,000 (based on a 6-month design storm)

Abbreviation:
gmp Gallons per minute

The Project includes excavation of soil to a depth of 2 feet below the anticipated groundwater level. This excavation to a depth of 2 feet below groundwater will be conducted using conventional excavation techniques and will not require dewatering. However, there are five 40-foot by 40-foot grid cells within the excavation where the depth of excavation extends to 4 feet below the anticipated groundwater level. Dewatering may be required in these five 40-foot by 40-foot grid cells to allow for the excavation. These grids are all in the location of the former hydraulic oil vaults in the northern portion of the Site. Attempts will be made to excavate these areas at low tide and during dry periods to minimize the volume of water generated by dewatering. The dewatering water from these areas would be pumped to the construction water treatment system for treatment and discharge to sanitary. This phase of the Project is anticipated to last no more than 5 to 7 working days. A very conservative estimate of the total quantity of water to be treated and discharged is 500,000 gallons.

A wheel wash will be used for the duration of the Project to wash the tires of all trucks hauling contaminated material off-site. This Best Management Practice (BMP) is being used to minimize the trackout of contaminated soil onto public streets. The wheel wash will be selected by the contractor, but wheel washes typically use a flocculent water treatment system to treat and reuse the water within the wheel wash. Although water is reused in the units, they do require occasional cleanouts to remove built up sediment and replace the wash water. Sediment removed during these maintenance periods will be disposed of off-site with other contaminated soil. Water will be pumped to the water treatment system for treatment and discharge to the sanitary system.

Decontamination water will be generated as the Project progresses during the regular washing of equipment that comes into contact with contaminated soil. This decontamination water will be minimal and reused to the extent practicable. The decontamination water will be pumped to the construction water treatment system for treatment and discharge to the sanitary system.

All contaminated material and surface debris will be collected and disposed of in a proper manner. Stockpiles containing contaminated material will be covered when not being worked to minimize contact between stormwater and contaminated soil. If water is collected from the contaminated material stockpiles, the water will be pumped to the construction water treatment system for treatment and discharge to the sanitary system. The contaminated material stockpile loading will primarily occur over paved areas and the on-site haul route used to haul contaminated material off-site is paved. Stormwater from these paved areas will be collected via the existing stormwater conveyance system and pumped to the water treatment system for treatment and discharge to the sanitary system. The volume of water from these areas is variable and dependent on the size of the storm event. For a 6-month design storm for Port Angeles, the volume of water requiring treatment and discharge from the contaminated material stockpile and paved area would be approximately 40,000 gallons. Based on the time of year that the project is occurring, storm events generating large volumes of water to be treated and discharged are anticipated to be sporadic. Smaller rain events with small volumes of water generated are expected.

Temporary Erosion and Sediment Control (TESC) measures will be implemented at the Site, meeting the Port's National Pollutant Discharge Elimination System Construction Stormwater General Permit. The TESC measures are shown on the TESC Plans included in Exhibit 1. BMPs that will be used at the Site are also described in the Project Stormwater Pollution Prevention Plan. All BMPs will be implemented where required when determined applicable by the contractor.

3.0 Water Volume and Contamination

Several environmental investigations were completed at the Site between 1988 and 2015. These investigations are summarized in the RI/FS and Cleanup Action Plan (Ecology 2015).

Site-wide groundwater quality was most recently assessed during two monitoring events in October 2013 and January 2014. The description of groundwater quality in the vicinity of the former mill provided below is divided into two sections: the southern portion of the former mill building, and the northern portion of the former mill building including the bulkhead vicinity.

3.1 SOUTHERN PORTION OF THE FORMER MILL BUILDING

In the southern portion of the former mill building, wells PP-15R, PP-26, PZ-04, and PZ-07 were sampled for gasoline-range organics (GRO), diesel-range organics (DRO), heavy oil-range organics (ORO), and BTEX. Additionally, PP-15R was sampled for the petroleum additives specified in MTCA Table 830-1. GRO concentrations in monitoring wells ranged from 2,100 micrograms per liter (µg/L) in samples from PZ-07 to 12,000 µg/L in samples from PP-15R during the October 2013 monitoring event. GRO concentrations measured during the January 2014 event were similarly elevated in this area, ranging from 1,600 to 16,000 µg/L. Detected benzene concentrations were also greatest in samples from PP-15R, with concentrations of 3,700 and 4,400 µg/L during the October and January events, respectively. Benzene concentrations were also the least elevated in samples from PZ-07. GRO and benzene concentrations in groundwater in the southern portion of the former mill building are generally greatest in wells PP-15R and PP-26 to the north and northeast of Pipeline 8 where it runs under the loading dock concrete pad, and decrease farther to the east and southeast in wells PZ-04 and PZ-07.

DRO was detected at 770 and 1,100 µg/L in samples from PZ-04 during the October and January events, respectively, and was detected at concentrations less than 500 µg/L in samples from the remaining wells in the southern portion of the former mill building. Oil-range organics (ORO) were not detected in groundwater samples from the southern portion of the former mill building.

In addition to GRO and BTEX, naphthalene and 1,2-dichloroethane were detected at 13 and 87 µg/L, respectively, in samples collected from PP-15R during October 2013 monitoring. The naphthalene concentration is less than the MTCA Method A groundwater standard of 160 µg/L. The 1,2-dichloroethane detection was not replicated or found elsewhere at the Site, and is considered a localized issue or possible false positive. Lead and the remaining VOCs and semivolatile organic compounds (SVOCs) specified in MTCA Table 830-1 were not detected.

3.2 NORTHERN PORTION OF FORMER MILL BUILDING AND BULKHEAD VICINITY

In the northern portion of the former mill building and the area north along the bulkhead, hydraulic oil product (LNAPL) was measured in wells PP-2, PP-3, PP-11, and PP-12 during both monitoring events, with the thickness of this layer of product ranging from 0.33 feet at PP-3 to 2.23 feet at PP-2 during the October event. Several wells targeted for hydraulic oil product thickness measurement, including PP-1 and PP-10, were not able to be located and were presumed to be destroyed during mill demolition. PP-14 was located but was found to be filled with soil and wood fragments.

Wells in the the northern portion of the former mill building and along the bulkhead that were free of LNAPL, including PP-13, PP-17, PP-18, PP-19, PP-20, PP-21, PP-22, PZ-12, and PZ-13, were sampled for GRO, DRO, ORO, and BTEX. Additionally, wells along the bulkhead were sampled for VOCs and SVOCs and one bulkhead well, PP-18, was sampled for lead and additional VOCs to fulfill the requirements of MTCA Table 830-1. GRO and BTEX were detected in all of these wells except PP-19 and PZ-13, which are located farthest to the northwest of the former K Ply mill building. ORO was not detected in any groundwater samples except for one low-level detection near the reporting limit in PP-13 during the January 2014 monitoring. The greatest GRO and DRO concentrations measured in the northern portion of the Site at 7,500 and 1,300 µg/L, were detected in the samples collected from PP-18 along the bulkhead during the October 2013 monitoring event; GRO and DRO concentrations were similarly elevated in this well during January 2014 monitoring. GRO concentrations greater than 800 µg/L were also detected in samples from PP-13 and PZ-12 during both events. The most elevated benzene concentrations in this area were detected farther to the west in PP-13, which had detected concentrations of 420 µg/L during October 2013 and 320 µg/L during January 2014. PP-17 and PP-18 also had benzene concentrations greater than 100 µg/L during both events.

Non-BTEX VOCs, SVOCs, and lead were generally non-detect, or detected at concentrations less than screening levels, in samples from the northern portion of the former mill building and bulkhead vicinity. However, at PP-18, localized naphthalene detections were noted at 260 and 280 µg/L during the two monitoring events, which are greater than the MTCA Method A cleanup level of 160 µg/L. These detections may be attributed to nearby buried creosote-treated pilings related to the former rail trestle in that area.

In the vicinity of the former caustic soda storage vault, at wells PP-13 and PZ-12, purge water was also field screened for elevated pH during groundwater sampling to determine whether leakage of caustic soda occurred. Values for pH in PP-13 ranged from 7.0 to 7.4 and pH values in PP-12 ranged from 7.0 to 7.3, indicating that caustic soda from the vault has not materially affected groundwater pH and that pH will not be a concern in wastewater generated. These wells were also sampled for formaldehyde to evaluate the potential impacts related to the previous resin release, but formaldehyde was not detected during either event at concentrations greater than a detection limit of 100 µg/L.

3.3 CONTAMINANTS OF CONCERN

Site COCs are summarized in Table 1 below, based on RI results. Additional discussion of COC determination is provided in this section. As described in the RI/FS Work Plan, the RI was designed to provide information suitable for determining site COCs (Floyd|Snider 2013). Based on the historical review of site operations, contaminants of potential concern were identified in the Interim Action Work Plan (IAWP; Floyd|Snider 2012) for further investigation, including PCP, SVOCs, metals, and dioxins/furans. Surface soil sampling conducted as part of the IAWP in specific areas where PCBs and VOCs were stored or used has indicated that these chemicals are not of concern in site soil. Surface soil samples analyzed for metals indicate that metals are not COCs. Site COCs are presented in Table 2 based on exceedances of applicable MTCA Method A criteria. Where COCs are co-located, more prevalent COCs may serve as indicator substances. PCP and dioxins/furans are COCs, but are limited to specific, relatively small areas of the Site.

Table 2
Affected Media and Site Contaminants of Concerns

Constituent	Media	
	Soil	**Groundwater**
GRO	COC	COC
DRO	COC	COC
ORO (hydraulic oil)	COC	COC
BTEX	COC	COC
PCP	COC[1]	Not applicable
Dioxins/furans	COC[1]	Not applicable

Note:
1 Listed as COC because maximum site concentrations exceed MTCA Method B residential criteria but are less than MTCA Method C concentrations.

3.3.1 Other Contaminants of Concern

In addition to the petroleum constituents that make up the primary contamination issues at the Site, there are localized areas of other non-petroleum contaminants.

Dioxins/Furans: This COC is limited in its extent to the area of surface soils near the former mill stack, based on the results from surface soil samples SS-4, SS-5, and SS-6, which contained up to 222 picograms per gram (pg/g) toxicity equivalent (TEQ) dioxin/furan. These concentrations do not exceed the MTCA Method C industrial land use CUL of 590 pg/g TEQ (direct contact and dermal). Dioxins are not water soluble and are not present in groundwater.

Pentachlorophenol: This COC is limited in its extent to the PCP Area, based on a single detection of 230 milligrams per kilogram (mg/kg) of PCP in shallow soil at location AOPC3-10. The MTCA Method C industrial CUL for PCP is 330 mg/kg. PCP is not present in groundwater based on the results of 18 samples.

Carcinogenic Polycyclic Aromatic Hydrocarbons: Carcinogenic polycyclic aromatic hydrocarbons (cPAHs) were not detected at significant concentrations in site groundwater or soil following investigation in locations throughout the Site. A single exceedance of the MTCA Method A CUL of 2 mg/kg was detected in soil at K-89, a soil boring that was advanced immediately adjacent to a buried creosote-treated piling. There were several detections of cPAHs in soil at locations where

DRO, ORO, or PCP were also detected but not at levels of concerns. Therefore, cPAHs are not considered to be a site COC.

Lead: This COC was tested for in groundwater in three wells with significant gasoline contamination and was not detected at concentrations greater than naturally occurring levels. Other metals were tested for in site soil and not found at concentrations greater than naturally-occurring levels. Refer to the RI/FS report for further information.

3.4 SUMMARY OF CONTAMINANT LEVELS EXPECTED IN WASTEWATER

Exhibit 2 presents representative soil and groundwater data for the Site. Pre-treatment raw wastewater concentrations of GRO are expected to reflect that of typical site groundwater and are expected to be between 0.5 and 5 milligrams per liter (mg/L). Concentrations of BTEX are expected to be between 0.2 and 2 mg/L. Concentrations of DRO are expected to be between 0.1 to 10 mg/L. It is possible that, at times, sheen or free petroleum product will be generated in the wastewater as well. Turbidity levels are expected to be highly variable and range from 50 to 5,000 Nephelometric Units (NTU). Assuming the conservative maximum project discharge of 500,000 gallons (2,000,000 liters), the total project loading of organic contaminants to the treatment system is expected to not exceed 20 pounds based on an average TPH influent concentration of 5 mg/L.

3.5 WATER VOLUME

Volume estimates for dewatering were calculated to determine the size of the water treatment system that would be needed for the Project. Those calculations are included in Exhibit 3. In summary, it was determined that a 40-foot by 40-foot grid cell that would need to be excavated 3 feet into the water table would produce approximately 12,500 gallons of water. Taking into account dewatering of the layback areas and groundwater recharge, this volume was increased by 50 percent. Assuming a grid cell would be dewatered over a 12-hour period of time, the approximate flow rate would be between 25 and 30 gpm. Based on these calculations, the decision to add wheel wash water and stormwater to the dewatering water, and vendor experience, it was determined that a system designed to treat 50 gpm would be sufficient for normal operations. However, during peak dewatering activities, the flow rate may increase to rates above 50 gpm; therefore, a system capable of being configured to allow peak discharge of 100-gpm was recommended. Because stormwater collected from the paved areas will be sporadic, the size of the treatment system was designed based on the volume estimates for the dewatering water. Extra volumes of water can be stored on-site in tanks prior to treatment, if needed.

4.0 Wastewater Treatment System

Various options for treatment of wastewater were considered, including sand filtration, chitosan, bag filtration, and GAC. Floyd|Snider requested recommendations and cost estimates from various water treatment vendors based on project-specific information for volume of water, source of water, and expected contaminant concentrations as described in this report. After reviewing the information provided by each vendor, Rain for Rent was chosen as the preferred vendor. Rain for Rent formulated the treatment system described in this section.

The treatment system is designed to be portable and accept water from wheel wash operations, water used for decontamination, water collected from contaminated soil stockpiles, and dewatering water/paved area stormwater. Dewatering water can include water collected from temporary sumps or well points. Incoming water to be treated will flow through a chitosan contactor unit mounted on top of a weir tank. Chitosan acetate is frequently used in systems requiring turbid water pretreatment to enhance flocculation. Water will then flow through 60 feet of 4-inch-diameter mixing line prior to entering the weir tank. The under weir will hold any floating organic contaminants behind for removal and the area after the over weir will be used as a surge cell where a pump will send collected water to an oil/water separator to remove NAPL. The oil/water separator will gravity discharge into a 250-gallon pump sump, where a submersible pump will transfer water through 5-micron bag filters that will remove remaining suspended solids from the water. The water will then flow through two GAC units configured in lead and lag, which will remove the dissolved phase organic COCs. The discharge from the GAC units will go through a totalizing flow meter and then be discharged to the sanitary sewer. Discharge to sanitary sewer would occur at an existing manhole as shown in Exhibit 1.

In the case of very high turbidity (+2,000 NTU), it may be necessary to use an additional settlement tank after the weir tank to increase the time prior to flow through the oil/water separator. The system is designed to treat discharge at 50 gpm; however, the GAC units will include a manifold that allows a 100-gpm flow rate in a parallel configuration.

Flow control valves to balance pump discharge will be included on the weir tank inlet, oil/water transfer pump, and bag filter pump lines. Sample ports will be included on the incoming line, after the oil/water separator, and downstream of both the lead and lag GAC units.

A system schematic is shown in Exhibit 4 that shows the flow process through the entire wastewater treatment system. The Rain for Rent cut sheets for the treatment components are provided in Exhibit 5 and detail the equipment to be used.

5.0 Operations and Maintenance and Sampling

The system is designed to be fully automated, and run via level controls to cycle the pumps. Pumps can be manually started at the control panel in "hand" mode, however. The power will be supplied by on-site power sources; a generator will not be necessary. Final placement of the unit will be at the discretion of the contractor and has not yet been decided. Means and methods for discharge to the sanitary sewer will be contained with the permit issued by the City.

It is expected that the pre-treatment limits in the permit will be easily met by this system, with sampling of the discharge to confirm compliance a minimum of once per month or once every 100,000 gallons, whichever comes first. Sampling will also occur within the first seven weekdays of system operation. Final effluent samples will be collected and analyzed for those parameters associated with the discharge permit.

Assuming a typical carbon efficiency of 20 percent, the 1,000-pound capacity of the primary lead carbon vessel has capacity to treat 200 pounds of influent organics, which is more than sufficient to handle the expected total influent loading of 20 pounds of TPH for the entire project. The lag carbon vessel provides additional security in case of greater than expected loading or premature breakthrough of the lead vessel. Regardless, samples will be collected before and in between the lead and lag vessels to confirm the treatment effectiveness of the carbon and to ensure that no breakthrough of the lead vessel is occurring. These samples will be analyzed for H2S, PCP, GRO, DRO, and BTEX. If signs of breakthrough are observed that are greater than 50 percent of the discharge limits for these compounds, then flow to the lead and lag vessels will be switched. Port and the City shall consult and settle on a mutually agreeable schedule for replacing or refreshing the exhausted GAC.

6.0 References

Floyd|Snider. 2012. *K Ply Mill Site Interim Action Work Plan*. Prepared for the Port of Port Angeles. October.

_____. 2013. *K Ply Site Remedial Investigation/Feasibility Study Work Plan*. Prepared for the Port of Port Angeles. September.

_____. 2015a. *K Ply Site Remedial Investigation/Feasibility Study*. Prepared for the Port of Port Angeles. May.

_____. 2015b. *K Ply Site Draft Engineering Design Report*. Prepared for the Port of Port Angeles. July.

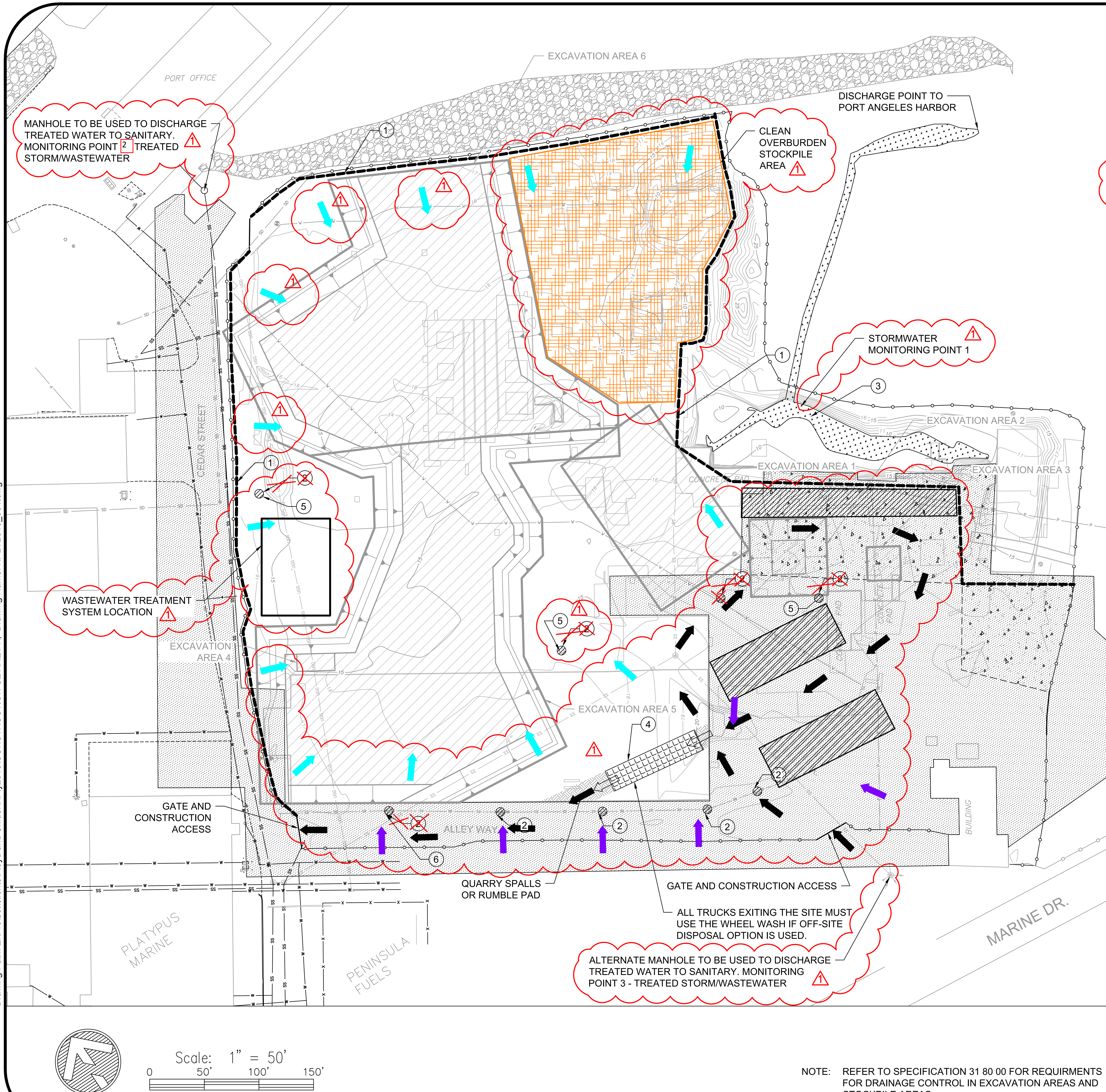
Washington State Department of Ecology (Ecology). 2012. Agreed Order (AO) No. DE 9546 between the Port of Port Angeles and Ecology. 15 October.

_____. 2015. K Ply Site Draft Cleanup Action Plan. 23 March.

K Ply Site

Wastewater Treatment Engineering Report

Exhibit 1
Select Construction Sheets



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TESC NOTES:

1. INSTALL SILT FENCE PER DETAIL 1 ON DWG. C1.1.
2. CATCH BASIN INLET PROTECTION PER DETAIL 2 ON DWG. C1.1.
3. EXISTING STORMWATER DRAINAGE SWALE.
4. INSTALL WHEEL WASH PER DETAIL 4 ON DWG. C1.1. ENTRANCE AND EXIT SHALL BE CONSTRUCTED OF QUARRY SPALLS OR RUMBLE PADS.
5. BLOCK CATCH BASIN.
6. BLOCK EFFLUENT PIPE. PUMP INCOMING WATER TO THE ON-SITE TREATMENT SYSTEM.

TESC LEGEND:

- SILT FENCE
- APPROXIMATE EXTENT OF ASPHALT CONCRETE PAVEMENT
- MIX OF ASPHALT CONCRETE PAVEMENT AND UNPAVED AREA
- CATCH BASIN INLET PROTECTION
- WHEEL WASH
- EXCAVATION AREA
- STORMWATER DRAINAGE SWALE
- CLEAN OVERBURDEN STOCKPILE AREA
- IMPORT BACKFILL STOCKPILE
- ON-SITE HAUL ROUTE
- CONTAMINATED SOIL STOCKPILE
- UNPAVED AREA OVERLAND FLOW
- PAVED AREA OVERLAND FLOW. POTENTIAL FOR CONTACT WITH CONTAMINATED STOCKPILES. WATER TO BE COLLECTED AND TREATED.

NOTE: REFER TO SPECIFICATION 31 80 00 FOR REQUIRMENTS FOR DRAINAGE CONTROL IN EXCAVATION AREAS AND STOCKPILE AREAS.

PORT OF PORT ANGELES WASHINGTON

FOR CONSTRUCTION

KATRINA H. SNIDER, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER
EXPIRES 4/28/2017

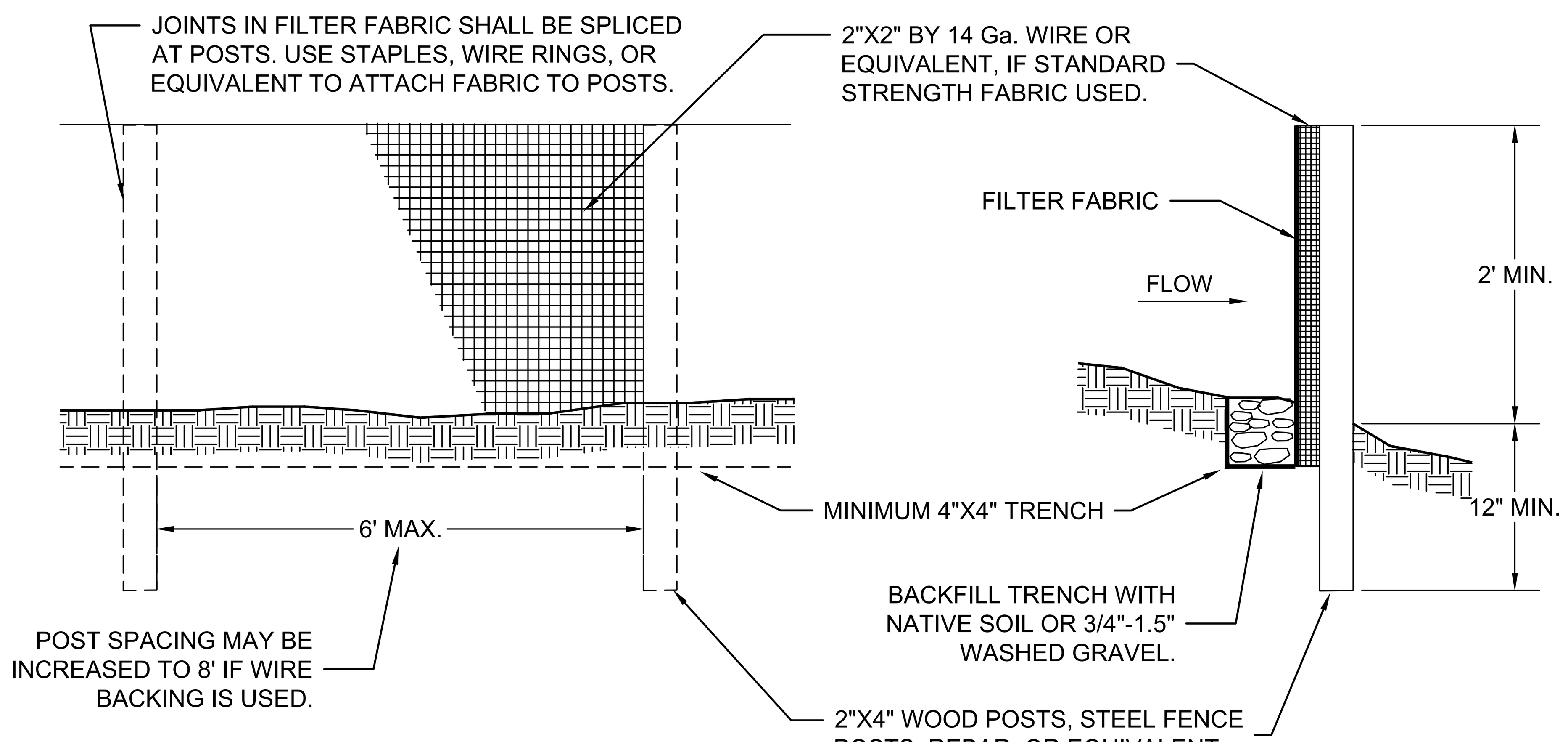
SHEET TITLE: TESC PLAN

PROJECT TITLE AND ADDRESS: K PLY REMEDIATION PROJECT
K PLY MILL SITE
PORT ANGELES, WASHINGTON

NO.	REVISION / ISSUE	DATE
1	TESC UPDATES	7/30

FLOYD | SNIDER
strategy • science • engineering

PROJECT #
DATE 6/8/2015
SCALE (FS) AS SHOWN
SHEET C1.0



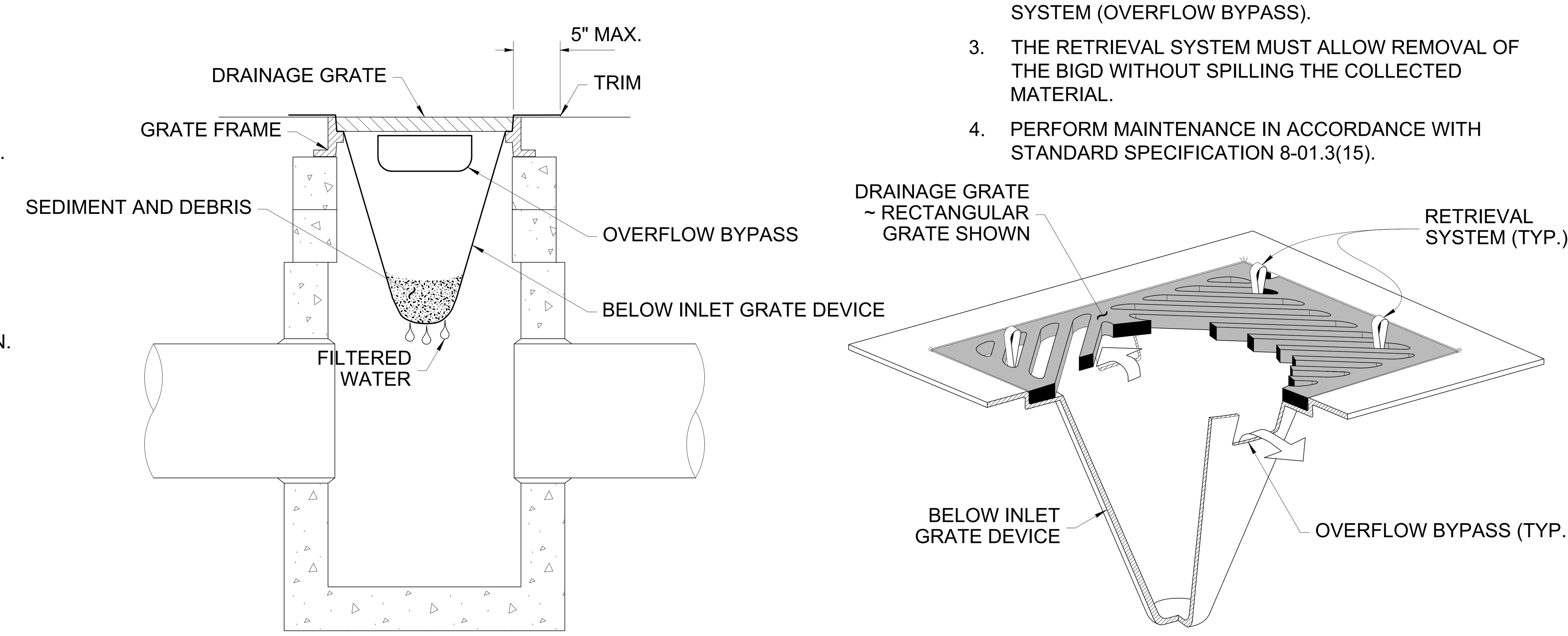
NOTE:

FILTER FABRIC FENCES SHALL BE INSTALLED ALONG CONTOUR WHENEVER POSSIBLE.

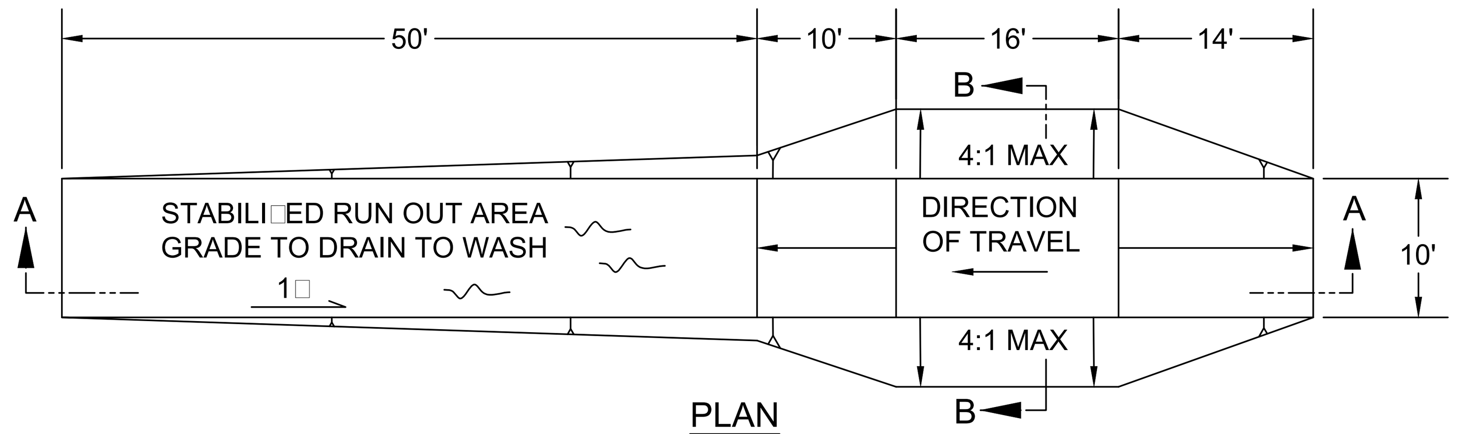
SILT FENCE
NOT TO SCALE
C1.0 | C1.1

NOTES:

1. SI E THE BELOW INLET GRATE DEVICE (BIGD) FOR THE STORMWATER STRUCTURE IT WILL SERVICE.
2. THE BIGD SHALL HAVE A BUILT-IN HIGH-FLOW RELIEF SYSTEM (OVERFLOW BYPASS).
3. THE RETRIEVAL SYSTEM MUST ALLOW REMOVAL OF THE BIGD WITHOUT SPILLING THE COLLECTED MATERIAL.
4. PERFORM MAINTENANCE IN ACCORDANCE WITH STANDARD SPECIFICATION 8-01.3(15).



CATCH BASIN INLET PROTECTION
NOT TO SCALE
C1.0 | C1.1



PLAN
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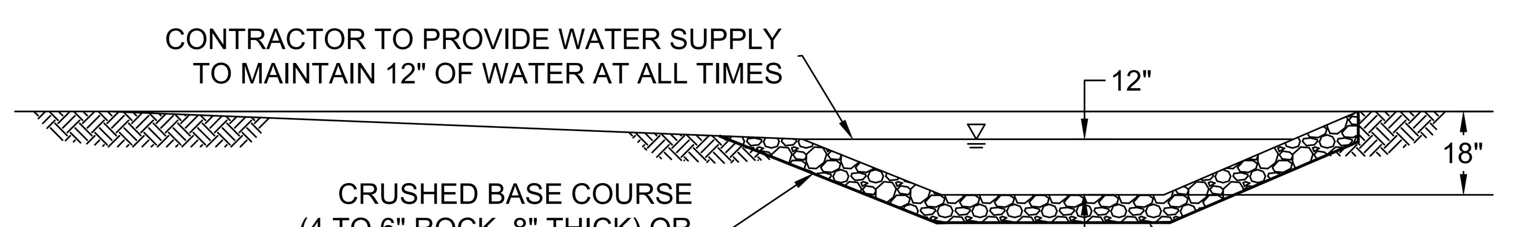
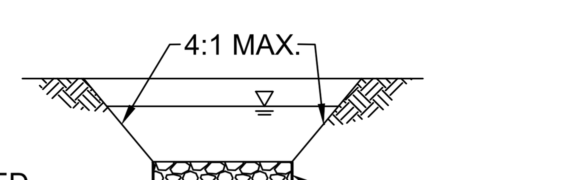


SECTION A-A
NOT TO SCALE
(EXAGGERATED VERTICALLY)



SECTION B-B
NOT TO SCALE
(EXAGGERATED VERTICALLY)

NOTE:
CONTRACTOR TO REMOVE ACCUMULATED SEDIMENT FROM WHEEL WASH MAY BE PIPED TO AN APPROVED SEDIMENT TRAP.

REFERENCE:
USE GEOTEXTILE FABRIC WITH AGGREGATE FOR A TEMPORARY TIRE WASH.

WHEEL WASH
NOT TO SCALE
C1.0 | C1.1

EROSION CONTROL NOTES:

1. ALL EROSION CONTROL MEASURES SHALL BE CONSTRUCTED AND MAINTAINED IN ACCORDANCE WITH THE REQUIREMENTS OF THE STORMWATER MANAGEMENT MANUAL FOR WESTERN WASHINGTON (2012).
2. ALL EROSION CONTROL MEASURES SHALL BE INSPECTED WEEKLY AND AFTER MAJOR STORM EVENTS. ANY DEFICIENCIES SHALL BE REPAIRED IMMEDIATELY.
3. ANY MUD THAT IS CARRIED OFF-SITE BY VEHICLE WHEELS AND DEPOSITED ON PUBLIC ROADWAYS SHALL BE CLEANED UP IMMEDIATELY.
4. ADJACENT PROPERTIES SHALL BE PROTECTED FROM SEDIMENT DEPOSITION BY APPROPRIATE USE OF VEGETATIVE BUFFER STRIPS, SEDIMENT BARRIERS OR FILTERS, DIKES OR MULCHING, OR BY A COMBINATION OF THESE MEASURES.
5. THE SILTATION FENCING SHALL BE MAINTAINED FOR THE DURATION OF THE PROJECT AND LEFT IN PLACE FOLLOWING CLOSEOUT.
6. REFER TO SPECIFICATION 31 80 00 FOR REQUIREMENTS FOR DRAINAGE CONTROL IN EXCAVATION AREAS AND STOCKPILE AREAS.

PORT OF PORT ANGELES WASHINGTON

FOR CONSTRUCTION

SHEET TITLE
TESC DETAILS

PROJECT TITLE AND ADDRESS
K PLY REMEDIATION PROJECT
K PLY MILL SITE
PORT ANGELES, WASHINGTON

NO.	REVISION / ISSUE	DATE

FLOYD | SNIDER
strategy • science • engineering

PROJECT #
DATE 6/8/2015
SCALE (FS) AS SHOWN
SHEET C1.1

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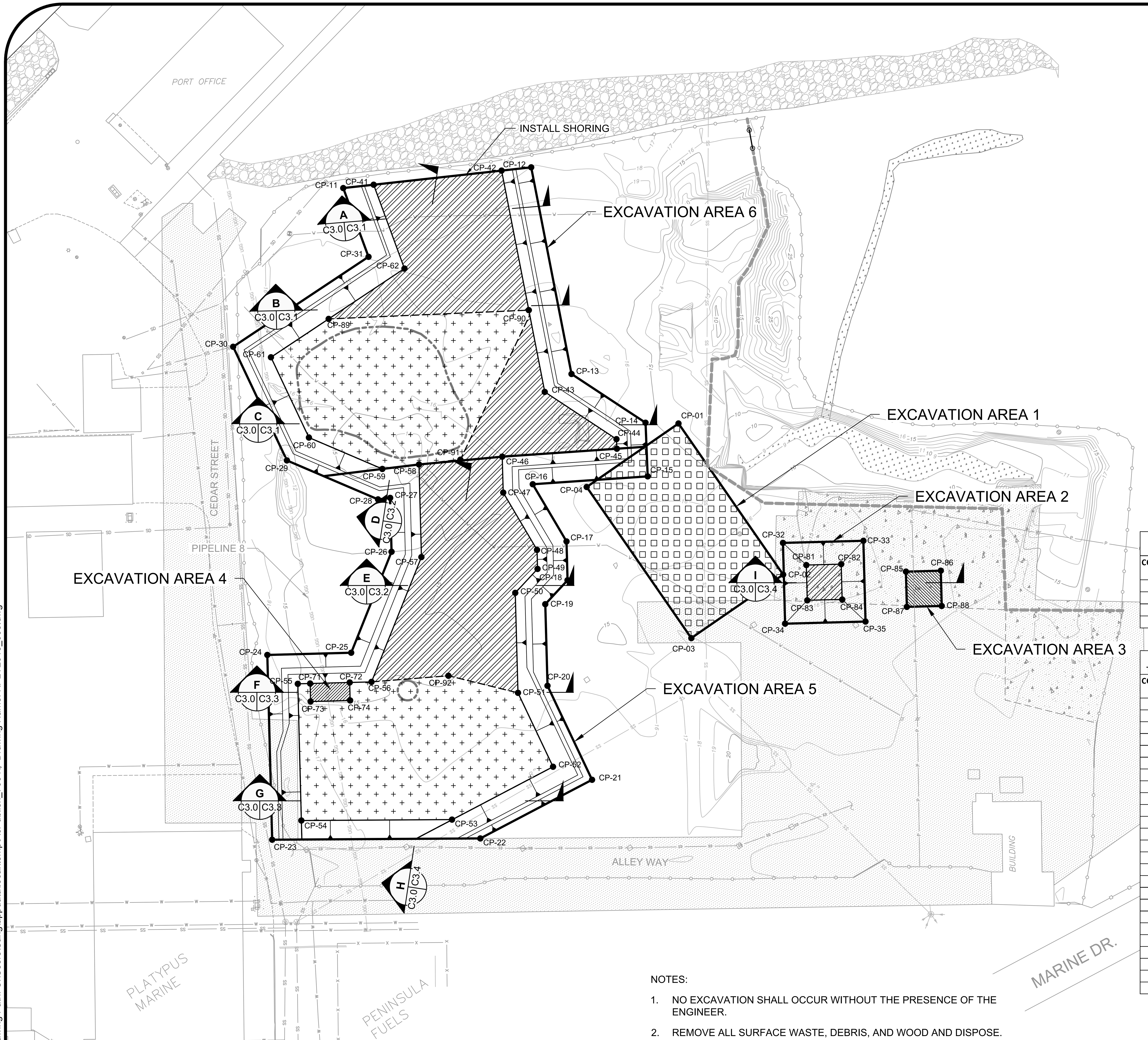

LEGEND:

- CP-51 — CONTROL POINT
- EXCAVATE 6" OF CONTAMINATED SOIL.
- EXCAVATE CONTAMINATED SURFACE SOIL (TO EL. ~11.6) AND SEGREGATE FOR OFF-SITE DISPOSAL. ADDITIONALLY EXCAVATE CONTAMINATED SOIL TO ELEVATION SHOWN ON TABLE 3, FOR DISPOSAL OR TREATMENT.
- EXCAVATE MINIMUM OF 4' OF SOIL CONTAMINATION. SEE TABLE 3 FOR ELEVATIONS.
- EXCAVATE 4' OF OVERBURDEN SOIL. EXCAVATE UNDERLYING CONTAMINATED SOIL. SEE TABLE 3 FOR ELEVATIONS.
- EXCAVATE 8' OF OVERBURDEN SOIL. EXCAVATE UNDERLYING CONTAMINATED SOIL. SEE TABLE 3 FOR ELEVATIONS.
- TRANSITION FROM APPROX. 4' OVERBURDEN TO APPROX. 8' OVERBURDEN
- EXCAVATION AREA EXTENT AT SURFACE
- EXCAVATION AREA EXTENT AT BASE
- LNAPL AREA

TABLE 1: EXCAVATION AREA 1 CONTROL POINTS

CONTROL POINT	NORTHING	EASTING
CP-01	420500.19	1003458.37
CP-02	420339.18	1003460.30
CP-03	420338.01	1003362.55
CP-04	420499.02	1003360.62

TABLE 2: TOP OF SLOPE CONTROL POINTS

CONTROL POINT	NORTHING	EASTING
CP-11	420835.34	1003330.34
CP-12	420758.36	1003476.94
CP-13	420588.53	1003404.96
CP-14	420516.89	1003434.81
CP-15	420476.87	1003410.12
CP-16	420527.44	1003322.81
CP-17	420469.36	1003319.31
CP-18	420440.67	1003301.03
CP-19	420434.19	1003273.14
CP-20	420373.84	1003234.79
CP-21	420283.74	1003221.09
CP-22	420295.86	1003111.23
CP-23	420396.86	1002959.50
CP-24	420533.43	1003046.51
CP-25	420493.95	1003108.47
CP-26	420547.52	1003187.24
CP-27	420587.33	1003212.63
CP-28	420592.20	1003203.07
CP-29	420665.11	1003156.00
CP-30	420774.00	1003172.66
CP-31	420773.05	1003315.00
CP-32	420362.32	1003475.73
CP-33	420324.47	1003535.15
CP-34	420302.61	1003437.69
CP-35	420264.75	1003497.11

TABLE 3: BASE OF EXCAVATION CONTROL POINTS

CONTROL POINT	NORTHING	EASTING	ELEV. AT BASE OF OVERBURDEN	ELEV. AT BASE OF EXCAVATION
CP-41	420822.89	1003354.05	8.55	2.90
CP-42	420770.49	1003453.84	9.48	2.90
CP-43	420588.62	1003376.76	8.33	3.25
CP-44	420519.19	1003405.68	7.63	3.25
CP-45	420512.04	1003401.27	7.28	3.25
CP-46	420562.43	1003314.15	7.90	3.25
CP-47	420535.85	1003297.29	7.51	4.20
CP-48	420477.65	1003293.76	7.74	4.20
CP-49	420463.59	1003284.80	7.83	4.20
CP-50	420457.11	1003256.90	7.72	4.20
CP-51	420383.16	1003209.91	11.61	4.20
CP-52	420312.32	1003199.14	12.34	3.90
CP-53	420323.40	1003099.90	12.33	4.40
CP-54	420396.49	1002990.10	13.56	4.40
CP-55	420497.53	1003054.47	7.06	4.20
CP-56	420462.83	1003108.93	6.82	4.20
CP-57	420529.03	1003206.29	6.85	4.20
CP-58	420597.50	1003249.95	9.75	3.25
CP-59	420612.19	1003221.11	11.10	3.25
CP-60	420670.93	1003183.19	11.50	3.25
CP-61	420747.85	1003194.96	11.60	3.25
CP-62	420746.91	1003335.34	7.96	2.90
CP-71	420491.72	1003063.58	NA	4.20
CP-72	420473.10	1003092.81	NA	4.20
CP-73	420478.43	1003055.12	NA	4.20
CP-74	420459.81	1003084.34	NA	4.20
CP-81	420334.78	1003481.83	7.13	4.20
CP-82	420318.36	1003507.60	7.50	4.20
CP-83	420308.71	1003465.23	7.89	4.20
CP-84	420292.17	1003490.99	8.08	4.20
CP-85	420281.25	1003550.91	NA	12.43
CP-86	420264.83	1003576.68	NA	12.92
CP-87	420255.19	1003534.31	NA	12.61
CP-88	420238.77	1003560.08	NA	12.80
CP-89	420747.44	1003255.63	11.60	3.25
CP-90	420655.80	1003405.23	12.30	3.25
CP-91	420580.72	1003282.30	9.75	3.25
CP-92	420429.63	1003167.79	6.82	4.20

NOTES:

1. NO EXCAVATION SHALL OCCUR WITHOUT THE PRESENCE OF THE ENGINEER.
2. REMOVE ALL SURFACE WASTE, DEBRIS, AND WOOD AND DISPOSE.
3. BASE OF OVERBURDEN ELEVATION WILL BE CONFIRMED BY THE ENGINEER BASED ON FIELD SCREENING.
4. MAINTAIN SIDE SLOPE OF 1.5H:1V IN DRY SOIL AND 3H:1V IN SATURATED SOIL.
5. FOLLOWING ENGINEERS ACCEPTANCE, BACKFILL PER BACKFILL CROSS SECTION SHEET C5.0 AND GRADE SITE TO DRAIN TO THE EAST.
6. EXCAVATION SEQUENCING SHALL BE PERFORMED PER SPECIFICATION 31 23 16 - EXCAVATION.

Scale: 1" = 50'

0 50' 100' 150'

Plot Date: 07/22/15 - 2:12pm, Plotted by: Sang
Drawing Path: C:\Users\Sang\appdata\local\temp\AcPublish_7064\, Drawing Name: KPLY2015_003.dwg

PORT OF PORT ANGELES
WASHINGTON

FOR CONSTRUCTION

KATRINA H. SNIDER, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER
EXPIRES 9/28/2017

SHEET TITLE
EXCAVATION PLAN

PROJECT TITLE AND ADDRESS
K PLY REMEDIATION PROJECT
K PLY MILL SITE
PORT ANGELES, WASHINGTON

NO.	REVISION / ISSUE	DATE

FLOYD | SNIDER
strategy • science • engineering

PROJECT #

DATE 6/8/2015

SCALE (FS) AS SHOWN

SHEET C3.0

K Ply Site

Wastewater Treatment Engineering Report

Exhibit 2
Representative Soil and Groundwater Data

Relevant Groundwater Analytical Data – Southern Portion

		Sample ID	PP-07	PP-07	PP-09	PP-09	PP-15R	PP-15R	PP-23
		Sample Date	10/14/2013	01/27/2014	10/14/2013	01/27/2014	10/14/2013	01/27/2014	10/14/2013
Analyte	Units	MTCA Method A Unrestricted Land Use CUL							
Total Petroleum Hyrocarbons									
Gasoline-Range Organics	μg/L	800	600	590	100 U	100 U	**12,000**	**16,000**	**2,200**
Diesel-Range Organics	μg/L	500	350 JM	370 JM	50 U	50 U	110 JM	340 JM	**810** JM
Motor Oil-Range Organics	μg/L	500	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Volatile Organic Compounds (VOCs)									
Benzene	μg/L	5	1.6	4	1 U	1 U	**3,700**	**4,400**	3.3
Toluene	μg/L	1,000	5.5	4.3	1 U	1 U	100 U	130	11
Ethylbenzene	μg/L	700	1	1 U	1 U	1 U	130	320	6.3
Xylenes[1]	μg/L	1,000	5	1 U	3 U	3 U	300 U	130	8.8
1,2-Dichloroethane (EDC)	μg/L	5					**87**		
1,2-Dibromoethane (EDB)	μg/L								
Methyl tertiary-butyl ether (MTBE)	μg/L								
1,3,5-Trimethylbenzene	μg/L								
Acetone	μg/L								
n-Hexane	μg/L						1 U		
iso-Propylbenzene	μg/L								
Methylene chloride	μg/L	5							
n-Propylbenzene	μg/L								
Cymene	μg/L								
sec-Butylbenzene	μg/L								
Metals									
Lead	μg/L	15					1 U		1 U
Semivolatile Organic Compounds (SVOCs)									
Naphthalene	μg/L	160					13		0.05 U
2-Methylnaphthalene	μg/L								4.5
2,4-Dimethylphenol	μg/L								10 U
3- & 4-Methylphenol	μg/L								20 U
2,4-Dinitrotoluene	μg/L								1
Benzoic acid	μg/L								50 U
Carbazole	μg/L								1 U
Diethylphthalate	μg/L								1 U
Phenol	μg/L								10 U
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)									
Benzo(a)anthracene	μg/L								0.05 U
Benzo(a)pyrene	μg/L	0.1							0.01 U
Benzo(b)fluoranthene	μg/L								0.01 U
Benzo(k)fluoranthene	μg/L								0.01 U
Chrysene	μg/L								0.01 U
Dibenzo(a,h)anthracene	μg/L								0.01 U
Indeno(1,2,3-cd)pyrene	μg/L								0.01 U
Summed cPAH TEQ with One-half of the Reporting Limit[2,3]	μg/L	0.1							0.0096 U
Polycyclic Aromatic Hydrocarbons (PAHs)									
Acenaphthene	μg/L								2.2
Anthracene	μg/L								1 U
Fluorene	μg/L								4.2
Phenanthrene	μg/L								3.2
Pyrene	μg/L								1 U
Polychlorinated Biphenyls (PCBs)									
PCBs (Total, Aroclors)	μg/L	0.1							

Notes:

Blank cells indicate the sample was not analyzed for that analyte.

BOLD Exceeds MTCA Method A Unrestricted Land Use CUL.

1 The reported xylenes concentration is the sum of o-xylene, p-xylene, and m-xylene.

2 Calculation of cPAH TEQ concentrations was performed using the California Environmental Protection Agency 2005 Toxic Equivalency Factors as presented in Table 708-2 of WAC 173-340-900.

3 Calculated using detected cPAH concentrations plus one-half the reporting limit for cPAHs that were not detected.

Abbreviations:

CUL Cleanup level
μg/L Micrograms per liter
MTCA Model Toxics Control Act
TEQ Toxicity equivalent
WAC Washington Administrative Code

Qualifiers:

JM Concentration is estimated due to poor match to standard, acceptable for use with qualification.
U Analyte was not detected, value given is reporting limit.
UJ Analyte is not detected at the associated reporting limit, which is an estimate.

Relevant Groundwater Analytical Data – Southern Portion

		Sample ID	PP-23	PP-24	PP-24	PP-25	PP-25	PP-26	PP-26
		Sample Date	01/27/2014	10/14/2013	01/27/2014	10/15/2013	01/27/2014	10/15/2013	01/27/2014
Analyte	Units	MTCA Method A Unrestricted Land Use CUL							
Total Petroleum Hyrocarbons									
Gasoline-Range Organics	µg/L	800	**1,600**	100 U	100 U	100 U	100 U	**7,000**	**7,900**
Diesel-Range Organics	µg/L	500	**760** JM	50 U	50 U	50 U	50 U	250 JM	400 JM
Motor Oil-Range Organics	µg/L	500	250 U	250 U	250 U	250 U	250 U	280 U	250 U
Volatile Organic Compounds (VOCs)									
Benzene	µg/L	5	1.4	1 U	1 U	1 U	1 U	**1,600**	**1,700**
Toluene	µg/L	1,000	7	1 U	1 U	1 U	1 U	71	61
Ethylbenzene	µg/L	700	3.3	1 U	1 U	1 U	1 U	480	400
Xylenes[1]	µg/L	1,000	4.6	3 U	3 U	3 U	3 U	120 U	74
1,2-Dichloroethane (EDC)	µg/L	5							
1,2-Dibromoethane (EDB)	µg/L								
Methyl tertiary-butyl ether (MTBE)	µg/L								
1,3,5-Trimethylbenzene	µg/L								
Acetone	µg/L								
n-Hexane	µg/L								
iso-Propylbenzene	µg/L								
Methylene chloride	µg/L	5							
n-Propylbenzene	µg/L								
Cymene	µg/L								
sec-Butylbenzene	µg/L								
Metals									
Lead	µg/L	15							
Semivolatile Organic Compounds (SVOCs)									
Naphthalene	µg/L	160							
2-Methylnaphthalene	µg/L								
2,4-Dimethylphenol	µg/L								
3- & 4-Methylphenol	µg/L								
2,4-Dinitrotoluene	µg/L								
Benzoic acid	µg/L								
Carbazole	µg/L								
Diethylphthalate	µg/L								
Phenol	µg/L								
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)									
Benzo(a)anthracene	µg/L								
Benzo(a)pyrene	µg/L	0.1							
Benzo(b)fluoranthene	µg/L								
Benzo(k)fluoranthene	µg/L								
Chrysene	µg/L								
Dibenzo(a,h)anthracene	µg/L								
Indeno(1,2,3-cd)pyrene	µg/L								
Summed cPAH TEQ with One-half of the Reporting Limit[2,3]	µg/L	0.1							
Polycyclic Aromatic Hydrocarbons (PAHs)									
Acenaphthene	µg/L								
Anthracene	µg/L								
Fluorene	µg/L								
Phenanthrene	µg/L								
Pyrene	µg/L								
Polychlorinated Biphenyls (PCBs)									
PCBs (Total, Aroclors)	µg/L	0.1							

Notes:
Blank cells indicate the sample was not analyzed for that analyte.
BOLD Exceeds MTCA Method A Unrestricted Land Use CUL.
1 The reported xylenes concentration is the sum of o-xylene, p-xylene, and m-xylene.
2 Calculation of cPAH TEQ concentrations was performed using the California Environmental Protection Agency 2005 Toxic Equivancy Factors as presented in Table 708-2 of WAC 173-340-900.
3 Calculated using detected cPAH concentrations plus one-half the reporting limit for cPAHs that were not detected.

Abbreviations:
CUL Cleanup level
µg/L Micrograms per liter
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Qualifiers:
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UJ Analyte is not detected at the associated reporting limit, which is an estimate.

Relevant Groundwater Analytical Data – Southern Portion

		Sample ID	PZ-01	PZ-01	PZ-04	PZ-04	PZ-07	PZ-07
		Sample Date	10/14/2013	01/27/2014	10/14/2013	01/27/2014	10/14/2013	01/27/2014
Analyte	Units	MTCA Method A Unrestricted Land Use CUL						
Total Petroleum Hyrocarbons								
Gasoline-Range Organics	µg/L	800	520	490	**9,300**	**7,300**	**2,100**	**1,600**
Diesel-Range Organics	µg/L	500	50 U	60 JM	**770** JM	**1,100** JM	340 JM	120 JM
Motor Oil-Range Organics	µg/L	500	250 U	250 U	250 U	250 U	250 U	250 U
Volatile Organic Compounds (VOCs)								
Benzene	µg/L	5	**8.5**	4.4	**2,300**	**1,400**	**25**	**47**
Toluene	µg/L	1,000	6.7	6.2	40 U	30	17	10 U
Ethylbenzene	µg/L	700	1 U	1 U	40 U	71	110	34
Xylenes[1]	µg/L	1,000	4.4	3 U	120 U	34	30 U	30 U
1,2-Dichloroethane (EDC)	µg/L	5						
1,2-Dibromoethane (EDB)	µg/L							
Methyl tertiary-butyl ether (MTBE)	µg/L							
1,3,5-Trimethylbenzene	µg/L							
Acetone	µg/L							
n-Hexane	µg/L							
iso-Propylbenzene	µg/L							
Methylene chloride	µg/L	5						
n-Propylbenzene	µg/L							
Cymene	µg/L							
sec-Butylbenzene	µg/L							
Metals								
Lead	µg/L	15						
Semivolatile Organic Compounds (SVOCs)								
Naphthalene	µg/L	160						
2-Methylnaphthalene	µg/L							
2,4-Dimethylphenol	µg/L							
3- & 4-Methylphenol	µg/L							
2,4-Dinitrotoluene	µg/L							
Benzoic acid	µg/L							
Carbazole	µg/L							
Diethylphthalate	µg/L							
Phenol	µg/L							
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)								
Benzo(a)anthracene	µg/L							
Benzo(a)pyrene	µg/L	0.1						
Benzo(b)fluoranthene	µg/L							
Benzo(k)fluoranthene	µg/L							
Chrysene	µg/L							
Dibenzo(a,h)anthracene	µg/L							
Indeno(1,2,3-cd)pyrene	µg/L							
Summed cPAH TEQ with One-half of the Reporting Limit[2,3]	µg/L	0.1						
Polycyclic Aromatic Hydrocarbons (PAHs)								
Acenaphthene	µg/L							
Anthracene	µg/L							
Fluorene	µg/L							
Phenanthrene	µg/L							
Pyrene	µg/L							
Polychlorinated Biphenyls (PCBs)								
PCBs (Total, Aroclors)	µg/L	0.1						

Notes:

Blank cells indicate the sample was not analyzed for that analyte.

BOLD Exceeds MTCA Method A Unrestricted Land Use CUL.

1 The reported xylenes concentration is the sum of o-xylene, p-xylene, and m-xylene.

2 Calculation of cPAH TEQ concentrations was performed using the California Environmental Protection Agency 2005 Toxic Equivalency Factors as presented in Table 708-2 of WAC 173-340-900.

3 Calculated using detected cPAH concentrations plus one-half the reporting limit for cPAHs that were not detected.

Abbreviations:

CUL Cleanup level

µg/L Micrograms per liter

MTCA Model Toxics Control Act

TEQ Toxicity equivalent

WAC Washington Administrative Code

Qualifiers:

JM Concentration is estimated due to poor match to standard, acceptable for use with qualification.

U Analyte was not detected, value given is reporting limit.

UJ Analyte is not detected at the associated reporting limit, which is an estimate.

Relevant Groundwater Analytical Data – Northern Portion

		Sample ID	PP-13	PP-13	PP-17	PP-17	PP-18	PP-18	PP-19	PP-19
		Sample Date	10/14/2013	01/28/2014	10/15/2013	01/27/2014	10/15/2013	01/27/2014	10/15/2013	01/27/2014
Analyte	Units	MTCA Method A Unrestricted Land Use CUL								
Total Petroleum Hyrocarbons										
Gasoline-Range Organics	µg/L	800	**1,200**	**1,200**	720	540	**7,500**	**6,500**	100 U	100 U
Diesel-Range Organics	µg/L	500	50 U	64 JM	50 U	95 JM	**1,300** JM	**2,100** JM	50 U	50 U
Motor Oil-Range Organics	µg/L	500	250 U	310	250 U	250 U	250 U	250 U	250 U	250 U
Volatile Organic Compounds (VOCs)										
Benzene	µg/L	5	**420**	**320**	**170**	**120**	**250**	**170**	0.35 U	0.35 U
Toluene	µg/L	1,000	14	10 U	7.8	6.3	8.1	10 U	1 U	1 U
Ethylbenzene	µg/L	700	1.7	10 U	1 U	1 U	430	510	1 U	1 U
Xylenes[1]	µg/L	1,000	20	30 U	8.1	2.6	9.1	20 U	3 U	2 U
1,2-Dichloroethane (EDC)	µg/L	5	4		1 U	1 U	1 U	10 U	1 U	1 U
1,2-Dibromoethane (EDB)	µg/L		1 U		1 U	1 U	1 U	10 U	1 U	1 U
Methyl tertiary-butyl ether (MTBE	µg/L		1 U		1 U	1 U	1 U	10 U	1 U	1 U
1,3,5-Trimethylbenzene	µg/L		1 U		1 U	1 U	2	10 U	1 U	1 U
Acetone	µg/L		10 U		10 U	10 U	10 U	100 U	10 U	10 U
n-Hexane	µg/L									
iso-Propylbenzene	µg/L		3.4		1 U	3.4	67	65	1 U	1 U
Methylene chloride	µg/L	5	5 U		5 U	5 U	5 U	50 U	5 U	5 U
n-Propylbenzene	µg/L		8.1		1 U	7.8	250	250	1 U	1 U
Cymene	µg/L		1 U		1 U	1 U	1 U	10 U	1 U	1 U
sec-Butylbenzene	µg/L		1 U		1 U	1 U	10	10 U	1 U	1 U
Metals										
Lead	µg/L	15					2.44			
Semivolatile Organic Compounds (SVOCs)										
Naphthalene	µg/L	160	0.05 U	0.05 U	0.05 U	0.05 U	**260**	**280**	0.05 U	0.05 U
2-Methylnaphthalene	µg/L		1 U	0.1 U	0.2 U	0.1 U	160	140	0.2 U	0.1 U
2,4-Dimethylphenol	µg/L		10 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U
3- & 4-Methylphenol	µg/L		20 U	2 U	4 U	2 U	4 U	2.1	4 U	2 U
2,4-Dinitrotoluene	µg/L		1 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U
Benzoic acid	µg/L		50 U		10 U		10 U		10 U	
Carbazole	µg/L		1 U	1 U	0.2 U	1 U	0.2 U	1 U	0.2 U	1 U
Diethylphthalate	µg/L		1 U	1 U	0.61	1 U	0.2 U	1 U	0.2 U	1 U
Phenol	µg/L		10 U	1.5	2 U	1 U	2 U	1 U	2 U	1 U
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)										
Benzo(a)anthracene	µg/L		0.05 U	0.01 U	0.05 U	0.01 U	0.05 U	0.01 U	0.05 U	0.01 U
Benzo(a)pyrene	µg/L	0.1	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(b)fluoranthene	µg/L		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	µg/L		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	µg/L		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Dibenzo(a,h)anthracene	µg/L		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	µg/L		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Summed cPAH TEQ with One-half of the Reporting Limit[2,3]	µg/L	0.1	0.0096 U	0.0066 U	0.0096 U	0.0066 U	0.0096 U	0.0066 U	0.0096 U	0.0066 U
Polycyclic Aromatic Hydrocarbons (PAHs)										
Acenaphthene	µg/L		1 U	0.05 U	0.05 U	0.05 UJ	0.39	0.15	0.068	0.05 U
Anthracene	µg/L		1 U	0.05 U	0.073	0.05 U	0.05 U	0.053	0.05 U	0.05 U
Fluorene	µg/L		1 U	0.05 U	0.05 U	0.05 UJ	0.57	0.28	0.05 U	0.05 U
Phenanthrene	µg/L		1 U	0.05 U	0.05 U	0.05 U	0.53	0.36	0.05 U	0.05 U
Pyrene	µg/L		1 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.052	0.05 U
Polychlorinated Biphenyls (PCBs)										
PCBs (Total, Aroclors)	µg/L	0.1					0.1 U			

Notes:

Blank cells indicate the sample was not analyzed for that analyte.

BOLD Exceeds MTCA Method A Unrestricted Land Use CUL.

1 The reported xylenes concentration is the sum of o-xylene, p-xylene, and m-xylene.

2 Calculation of cPAH TEQ concentrations was performed using the California Environmental Protection Agency 2005 Toxic Equivalency Factors as presented in Table 708-2 of WAC 173-340-900.

3 Calculated using detected cPAH concentrations plus one-half the reporting limit for cPAHs that were not detected.

Abbreviations:

CUL Cleanup level

µg/L Micrograms per liter

MTCA Model Toxics Control Act

TEQ Toxicity equivalent

WAC Washington Administrative Code

Qualifiers:

JM Concentration is estimated due to poor match to standard, acceptable for use with qualification.

U Analyte was not detected, value given is reporting limit.

UJ Analyte is not detected at the associated reporting limit, which is an estimate.

Relevant Groundwater Analytical Data – Northern Portion

Analyte	Units	Sample ID / Sample Date / MTCA Method A Unrestricted Land Use CUL	PP-20 10/15/2013	PP-20 01/27/2014	PP-21 10/15/2013	PP-21 01/27/2014	PP-22 10/15/2013	PP-22 01/27/2014	PZ-12 10/14/2013	PZ-12 01/27/2014	PZ-13 10/15/2013
Total Petroleum Hyrocarbons											
Gasoline-Range Organics	µg/L	800	100 U	100 U	100 U	100 U	140	100 U	**910**	**860**	100 U
Diesel-Range Organics	µg/L	500	50 U	50 U	50 U	60 U	80 JM	75 JM	50 U	50 U	50 U
Motor Oil-Range Organics	µg/L	500	250 U	250 U	250 U	300 U	250 U	250 U	250 U	250 U	250 U
Volatile Organic Compounds (VOCs)											
Benzene	µg/L	5	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	**370**	**280**	1 U
Toluene	µg/L	1,000	1 U	1 U	1 U	1 U	1 U	1 U	4.5	3.7	1 U
Ethylbenzene	µg/L	700	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Xylenes[1]	µg/L	1,000	3 U	2 U	3 U	2 U	3 U	2 U	3 U	3 U	3 U
1,2-Dichloroethane (EDC)	µg/L	5	1 U	1 U	1 U	1 U	1 U	1 U			
1,2-Dibromoethane (EDB)	µg/L		1 U	1 U	1 U	1 U	1 U	1 U			
Methyl tertiary-butyl ether (MTBE	µg/L		1 U	1 U	1 U	1 U	1 U	1 U			
1,3,5-Trimethylbenzene	µg/L		1 U	1 U	1 U	1 U	1 U	1 U			
Acetone	µg/L		10 U	10 U	45	10 U	45	10 U			
n-Hexane	µg/L										
iso-Propylbenzene	µg/L		1 U	1 U	1 U	1 U	1 U	1 U			
Methylene chloride	µg/L	5	5 U	5 U	5 U	5 U	5 U	5 U			
n-Propylbenzene	µg/L		1 U	1 U	1 U	1 U	1 U	1 U			
Cymene	µg/L		1 U	1 U	14	1 U	14	3.4			
sec-Butylbenzene	µg/L		1 U	1 U	1 U	1 U	1 U	1 U			
Metals											
Lead	µg/L	15									
Semivolatile Organic Compounds (SVOCs)											
Naphthalene	µg/L	160	0.05 U	0.05 U	0.05 U	0.05 U	20	35	0.05 U	0.05 U	
2-Methylnaphthalene	µg/L		0.2 U	0.1 U	0.2 U	0.1 U	2.4	3.3	1 U	0.1 U	
2,4-Dimethylphenol	µg/L		2 U	1 U	2 U	1 U	8.1	5.5	10 U	1 U	
3- & 4-Methylphenol	µg/L		4 U	2 U	4 U	2 U	100	7.2	20 U	2 U	
2,4-Dinitrotoluene	µg/L		0.2 U	0.5 U	0.2 U	0.5 U	0.2 U	0.5 U	1 U	0.5 U	
Benzoic acid	µg/L		10 U		10 U		230		50 U		
Carbazole	µg/L		0.2 U	1 U	0.2 U	1 U	0.52	1 U	1 U	1 U	
Diethylphthalate	µg/L		0.2 U	1 U	0.2 U	1 U	0.2 U	1 U	1 U	1 U	
Phenol	µg/L		2 U	1 U	2 U	1.9	72	1 U	10 U	1.5	
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)											
Benzo(a)anthracene	µg/L		0.05 U	0.01 U	0.05 U	0.01 U	0.05 U	0.01 U	0.05 U	0.01 U	
Benzo(a)pyrene	µg/L	0.1	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(b)fluoranthene	µg/L		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	µg/L		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	µg/L		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	
Dibenzo(a,h)anthracene	µg/L		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	µg/L		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	
Summed cPAH TEQ with One-half of the Reporting Limit[2,3]	µg/L	0.1	0.0096 U	0.0066 U	0.0096 U	0.0066 U	0.0096 U	0.0066 U	0.0096 U	0.0066 U	
Polycyclic Aromatic Hydrocarbons (PAHs)											
Acenaphthene	µg/L		0.05 U	0.05 U	0.05 U	0.05 U	4.2	5.8	1 U	0.05 U	
Anthracene	µg/L		0.05 U	0.05 U	0.05 U	0.05 U	0.18	0.12	1 U	0.05 U	
Fluorene	µg/L		0.05 U	0.05 U	0.05 U	0.05 U	1.2	1.8	1 U	0.05 U	
Phenanthrene	µg/L		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	1 U	0.05 U	
Pyrene	µg/L		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	1 U	0.05 U	
Polychlorinated Biphenyls (PCBs)											
PCBs (Total, Aroclors)	µg/L	0.1									

Notes:

Blank cells indicate the sample was not analyzed for that analyte.

BOLD Exceeds MTCA Method A Unrestricted Land Use CUL.

1 The reported xylenes concentration is the sum of o-xylene, p-xylene, and m-xylene.

2 Calculation of cPAH TEQ concentrations was performed using the California Environmental Protection Agency 2005 Toxic Equivancy Factors as presented in Table 708-2 of WAC 173-340-900.

3 Calculated using detected cPAH concentrations plus one-half the reporting limit for cPAHs that were not detected.

Abbreviations:

CUL Cleanup level

µg/L Micrograms per liter

MTCA Model Toxics Control Act

TEQ Toxicity equivalent

WAC Washington Administrative Code

Qualifiers:

JM Concentration is estimated due to poor match to standard, acceptable for use with qualification.

U Analyte was not detected, value given is reporting limit.

UJ Analyte is not detected at the associated reporting limit, which is an estimate.

Relevant Soil Analytical Data

		Location	K-00*	K-01*	K-02*	K-06*	K-07*	K-11	K-12	K-18*	K-19	K-20	K-21	K-23*	K-24*	K-25*	K-26*	K-27*	K-28*	K-29	K-33	K-34
		Sample Date	10/16/2013	10/16/2013	10/16/2013	10/16/2013	10/16/2013	9/10/2013	9/11/2013	9/20/2013	9/11/2013	9/11/2013	9/11/2013	9/20/2013	9/20/2013	9/23/2013	9/18/2013	9/18/2013	9/18/2013	9/12/2013	9/11/2013	9/11/2013
		Sample Depth (ft bgs)	14–15	10–11	14–15	15.5–16	11–12	1.5–2.5	1–2	14–15.5	8.5–10	3–4	3.8–5.2	10–10.5	14–15	7–8	9.8–10.3	9.5–11.5	9.5–11.5	8.5–9.5	3–4	3–4
Analytes	**Units**	**MTCA Method A Unrestricted Land Use CUL**																				
Total Petroleum Hydrocarbons																						
Gasoline-Range Organics	mg/kg	30 [1]	**9,300**	**2,200**	**2,400**	**4,200**	**3,400**	**2 U**	**2 U**	**2,000**	**2,400**	**44**	**8,600**	**3,500**	**3,100**	**5**	**2,500**	**4,500**	**6,600**	**3**	**2 U**	**2 U**
Diesel-Range Organics	mg/kg	2,000	**23,000** JM	**13,000 JM**	**14,000**	**2,600**	**7,000**			**690 JM**				**1,700 JM**	**6,200**	**38 JM**	**6,300**	**3,400 JM**	**1,100 JM**	**25 U**		
Oil-Range Organics	mg/kg	2,000	690 JM	**250 U**	**250 U**	**250 U**	**4,600**			**120 U**				**120 U**	**120 U**	**120 U**	**120 U**	**120 U**	**120 U**	**120 U**		
Volatile Organic Compounds (VOCs)																						
Benzene	mg/kg	0.3	**120**	**5**	**11**	**2**	**51**	**0.02 U**	**0.02 U**	**6.6**	**13**	**0.034**	**2.5**	**4.1**	**4.6**	**0.21**	**1.3**	**10**	**7.3**	**0.097**	**0.02 U**	**0.02 U**
Toluene	mg/kg	7	**52**	**10**	**11**	**22**	**180**	**0.02 U**	**0.02 U**	**12**	**21**	**0.16**	**29**	**17**	**15**	**0.02 U**	**7**	**100**	**28**	**0.051**	**0.02 U**	**0.02 U**
Ethylbenzene	mg/kg	6	**170**	**15**	**49**	**78**	**45**	**0.02 U**	**0.02 U**	**35**	**35**	**0.46**	**48**	**36**	**55**	**0.048**	**34**	**50**	**90**	**0.058**	**0.02 U**	**0.02 U**
Xylenes[2]	mg/kg	9	**690**	**92**	**5.9**	**6 U**	**300**	**0.06 U**	**0.098**	**34**	**160**	**0.72**	**290**	**190**	**19**	**0.11**	**24**	**290**	**230**	**0.06 U**	**0.06 U**	**0.06 U**
1,2,4-Trimethylbenzene	mg/kg							**0.05 U**													**0.056**	**0.05 U**
2,6-bis(1,1-Dimethylethyl)-4-Methylphenol	mg/kg																				**1.1**	
2-Methylpentane	mg/kg																					
iso-Pentane	mg/kg																					
n-Hexane	mg/kg																					
n-Pentane	mg/kg																					
Metals																						
Arsenic	mg/kg	20																				
Barium	mg/kg																					
Chromium	mg/kg	2,000																				
Lead	mg/kg	250						**11.6**														
Semivolatile Organic Compounds (SVOCs)																						
bis(2-Ethylhexyl)phthalate	mg/kg																			0.096 U		
Carbazole	mg/kg																			0.006 U		
Diethylphthalate	mg/kg																			0.0081		
Pentachlorophenol	mg/kg																			0.06 U		
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)																						
Benzo(a)anthracene	mg/kg																			0.006 U		
Benzo(a)pyrene	mg/kg																			0.006 U		
Benzo(b)fluoranthene	mg/kg																			0.006 U		
Benzo(k)fluoranthene	mg/kg																			0.006 U		
Chrysene	mg/kg																			0.006 U		
Dibenzo(a,h)anthracene	mg/kg																			0.006 U		
Indeno(1,2,3-cd)pyrene	mg/kg																			0.006 U		
Summed cPAH TEQ with One-half of the Reporting Limit[3,4]	mg/kg	2																		0.0045 U		
Polycyclic Aromatic Hydrocarbons (PAHs)																						
Naphthalene	mg/kg	5						**0.05 U**												0.006 U	0.05 U	0.05 U
Acenaphthylene	mg/kg																			0.006 U		
Acenaphthene	mg/kg																			0.006 U		
Fluorene	mg/kg																			0.006 U		
Phenanthrene	mg/kg																			0.0073		
Anthracene	mg/kg																			0.006 U		
2-Methylnaphthalene	mg/kg																			0.006 U		
Fluoranthene	mg/kg																			0.0093		
Pyrene	mg/kg																			0.0089		
Benzo(g,h,i)perylene	mg/kg																			0.006 U		

Notes:

All data presented within this table are from soil samples collected within the excavation area. This soil will be removed as part of the remediation project. These data are not representative of contaminant concentrations in wastewater, but are provided for reference.

Blank cells indicate the sample was not analyzed for that analyte.

* Indicates a boring that was advanced through the concrete slab, which sits approximately 5 feet above grade.

Bold Indicates a concentration that exceeds the MTCA Method A Unrestricted Land Use CUL.

1 The MTCA Method A Unrestricted CUL for gasoline-range organics in soil is 30 mg/kg if benzene is detected.

2 The reported xylenes concentration is the sum of o-xylene, p-xylene, and m-xylene.

3 Calculation of cPAH TEQ concentrations was performed using the California Environmental Protection Agency 2005 Toxic Equivalency Factors as presented in Table 708-2 of WAC 173-340-900.

4 Calculated using detected cPAH concentrations plus one-half the reporting limit for cPAHs that were not detected.

Abbreviations:

bgs Below ground surface
CUL Cleanup level
ft Feet
mg/kg Milligrams per kilogram
MTCA Model Toxics Control Act
TEQ Toxicity equivalent
WAC Washington Administrative Code

Qualifiers:

J Analyte was detected, result concentration is an estimate.
JM Concentration is estimated due to poor match to standard, acceptable for use with qualification.
U Analyte is not detected at the associated reporting limit.
UJ Analyte is not detected at the associated reporting limit, which is an estimate.

Relevant Soil Analytical Data

		Location	K-39	K-40*		K-42*	K-43*	K-45*	K-46*		K-47*	K-48*	K-49*	K-50	K-55	K-56	K-63	K-64	K-65	K-66	
		Sample Date	9/12/2013	9/12/2013		9/20/2013	9/23/2013	9/18/2013	9/19/2013		9/23/2013	9/23/2013	9/23/2013	9/10/2013	9/9/2013	9/9/2013	9/10/2013	9/10/2013	9/10/2013	9/10/2013	
		Sample Depth (ft bgs)	9–10	7–8	10.5–12	11.5–12	10–11	9–11	7–8	10–11	7–8	10–11	10–11	3.5–6	10.5–11	10–10.5	11–12	10.5–11.5	9.5–11.5	11.5–15.5	3.5–5.5
Analytes	Units	MTCA Method A Unrestricted Land Use CUL																			
Total Petroleum Hydrocarbons																					
Gasoline-Range Organics	mg/kg	30 [1]	10	6	14,000	2,800	3,200	2 U	1,300	7,000	7,300	6,000	3,300	860	89	4,600	10	740	3,500	7	160
Diesel-Range Organics	mg/kg	2,000	48 JM			13,000 JM	9,500	25 U	11,000 J	17,000 J	2,100 JM	24,000	6,300	5,200 JM	1,500 JM	990 JM	3,300 JM	3,500 JM	3,300 JM	220 JM	4,200 JM
Oil-Range Organics	mg/kg	2,000	120 U			1,100 JM	8,700	120 U	120 UJ	120 UJ	120 U	230 JM	120 U	5,400	120 U	120 U	32,000	23,000	16,000	310	6,800
Volatile Organic Compounds (VOCs)																					
Benzene	mg/kg	0.3	0.59	0.02 U	46	33	5	0.02 U	3.4	15	5.1	41	21	0.4 U	0.02 U	4.4	0.16	0.47	1 U	0.02 U	0.02 U
Toluene	mg/kg	7	0.069	0.02 U	350	130	23	0.041	4.4	23	58	36	14	12	0.14	23	0.095	5	26	0.032	2.1
Ethylbenzene	mg/kg	6	0.038	0.033	140	42	41	0.02 U	14	51	79	65	40	1.9	0.42	55	0.027	1.4	46	0.02 U	0.35
Xylenes [2]	mg/kg	9	0.12	0.29	800	260	150	0.06 U	36	200	490	320	62	5.5	1.3	240	0.17	4.9	20	0.067	0.98
1,2,4-Trimethylbenzene	mg/kg																0.05 U				
2,6-bis(1,1-Dimethylethyl)-4-Methylphenol	mg/kg																				
2-Methylpentane	mg/kg																0.55				
iso-Pentane	mg/kg																1.4				
n-Hexane	mg/kg				70					12				0.31							
n-Pentane	mg/kg																0.32				
Metals																					
Arsenic	mg/kg	20																			
Barium	mg/kg																				
Chromium	mg/kg	2,000																			
Lead	mg/kg	250			19					12.8				58.4				3.68			11.1
Semivolatile Organic Compounds (SVOCs)																					
bis(2-Ethylhexyl)phthalate	mg/kg		0.096 U																		
Carbazole	mg/kg		0.006 U																		
Diethylphthalate	mg/kg		0.0061																		
Pentachlorophenol	mg/kg		0.06 U																		
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)																					
Benzo(a)anthracene	mg/kg		0.006 U							0.1 U							0.1 U	0.56			
Benzo(a)pyrene	mg/kg		0.006 U							0.1 U							0.1 U	0.1 U			
Benzo(b)fluoranthene	mg/kg		0.006 U							0.1 U							0.1 U	0.1 U			
Benzo(k)fluoranthene	mg/kg		0.006 U							0.1 U							0.1 U	0.1 U			
Chrysene	mg/kg		0.006 U							0.11							0.18	0.29			
Dibenzo(a,h)anthracene	mg/kg		0.006 U							0.1 U							0.1 U	0.1 U			
Indeno(1,2,3-cd)pyrene	mg/kg		0.006 U							0.1 U							0.1 U	0.1 U			
Summed cPAH TEQ with One-half of the Reporting Limit [3,4]	mg/kg	2	0.0045 U							0.076							0.077	0.13			
Polycyclic Aromatic Hydrocarbons (PAHs)																					
Naphthalene	mg/kg	5	0.18							38							0.05 U	0.1 U			
Acenaphthylene	mg/kg		0.006 U														0.1 U	0.1 U			
Acenaphthene	mg/kg		0.006 U														0.28	0.1 U			
Fluorene	mg/kg		0.006 U														0.1 U	0.1 U			
Phenanthrene	mg/kg		0.0061														0.1 U	0.23			
Anthracene	mg/kg		0.006 U														0.1 U	0.1 U			
2-Methylnaphthalene	mg/kg		0.096																		
Fluoranthene	mg/kg		0.006 U														0.1 U	0.1 U			
Pyrene	mg/kg		0.006 U														0.1 U	0.16			
Benzo(g,h,i)perylene	mg/kg		0.006 U														0.1 U	0.1 U			

Notes:

All data presented within this table are from soil samples collected within the excavation area. This soil will be removed as part of the remediation project. These data are not representative of contaminant concentrations in wastewater, but are provided for reference.

Blank cells indicate the sample was not analyzed for that analyte.

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Bold Indicates a concentration that exceeds the MTCA Method A Unrestricted Land Use CUL.

1 The MTCA Method A Unrestricted CUL for gasoline-range organics in soil is 30 mg/kg if benzene is detected.

2 The reported xylenes concentration is the sum of o-xylene, p-xylene, and m-xylene.

3 Calculation of cPAH TEQ concentrations was performed using the California Environmental Protection Agency 2005 Toxic Equivalency Factors as presented in Table 708-2 of WAC 173-340-900.

4 Calculated using detected cPAH concentrations plus one-half the reporting limit for cPAHs that were not detected.

Abbreviations:

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CUL Cleanup level
ft Feet
mg/kg Milligrams per kilogram
MTCA Model Toxics Control Act
TEQ Toxicity equivalent
WAC Washington Administrative Code

Qualifiers:

J Analyte was detected, result concentration is an estimate.
JM Concentration is estimated due to poor match to standard, acceptable for use with qualification.
U Analyte is not detected at the associated reporting limit.
UJ Analyte is not detected at the associated reporting limit, which is an estimate.

Relevant Soil Analytical Data

		Location	K-67	K-68	K-69	K-70	K-71	K-73	K-79	K-80	K-81	K-92	K-103	KT-10	KT-11	KT-12		KT-21	PZ-06A
		Sample Date	10/14/2012	10/14/2013	10/14/2013	10/14/2013	10/14/2013	10/14/2013	10/14/2013	10/14/2013	10/15/2013	9/20/2013	10/16/2013	9/10/2013	9/11/2013	9/10/2013		9/12/2013	9/10/2013
		Sample Depth (ft bgs)	11–12	10.5–11.5	11–12	11–12	11–12	11–12	6–7	6.5–7.5	7.5–9.5	7.5–8	13–14	2–3	1–1.5	3–3.5	8.5–9	0.5–1.5	3–4
Analytes	Units	MTCA Method A Unrestricted Land Use CUL																	
Total Petroleum Hydrocarbons																			
Gasoline-Range Organics	mg/kg	30 [1]	2 U	2 U	49	1,000	2 U	3	3,300	3,300	3,000	1,500	5,600	4	2 U			2	1,300
Diesel-Range Organics	mg/kg	2,000	2,000 JM	20 U	30 JM	940 JM	20 U	2,500 JM	670 JM	1,500 JM	580 JM	79 JM	2,300 JM	25 U	200 JM	25 U	34 JM		140 JM
Oil-Range Organics	mg/kg	2,000	24,000	100 U	180	3,100	100 U	25,000	100 U	100 U	100 U	120 U	2,400	120 U	2,600	120 U	120 U		120 U
Volatile Organic Compounds (VOCs)																			
Benzene	mg/kg	0.3	0.02 U	0.02 U	0.1 U	0.23	0.02 U	0.17	5.6	2.5	0.4 U	0.02 U	2 U	0.02 U	0.02 U			0.02 U	0.2 U
Toluene	mg/kg	7	0.02 U	0.02 U	0.28	4.1	0.02 U	0.061	19	41	14	9.1	31	0.02 U	0.02 U			0.02 U	0.2 U
Ethylbenzene	mg/kg	6	0.02 U	0.02 U	0.14	3.8	0.02 U	0.02 U	19	31	16	10	87	0.41	0.02 U			0.02 U	1.9
Xylenes [2]	mg/kg	9	0.06 U	0.06 U	0.38	12	0.06 U	0.082	85	210	75	23	15	0.17	0.06 U			0.06 U	14
1,2,4-Trimethylbenzene	mg/kg																		
2,6-bis(1,1-Dimethylethyl)-4-Methylphenol	mg/kg																		4.6
2-Methylpentane	mg/kg																		
iso-Pentane	mg/kg																		
n-Hexane	mg/kg																		0.25 U
n-Pentane	mg/kg																		
Metals																			
Arsenic	mg/kg	20														2.57	1.95		
Barium	mg/kg															15.8	7.33		
Chromium	mg/kg	2,000														13.9	9.59		
Lead	mg/kg	250										3.05		6.84	10.8	3.73	1 U		6.95
Semivolatile Organic Compounds (SVOCs)																			
bis(2-Ethylhexyl)phthalate	mg/kg															120 U	0.48 U		
Carbazole	mg/kg															7.5 U	0.03 U		
Diethylphthalate	mg/kg															7.5 U	0.03 U		
Pentachlorophenol	mg/kg															75 U	0.3 U		
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)																			
Benzo(a)anthracene	mg/kg															2.5 U	0.01 U		
Benzo(a)pyrene	mg/kg															2.5 U	0.01 U		
Benzo(b)fluoranthene	mg/kg															2.5 U	0.01 U		
Benzo(k)fluoranthene	mg/kg															2.5 U	0.01 U		
Chrysene	mg/kg															2.5 U	0.01 U		
Dibenzo(a,h)anthracene	mg/kg															2.5 U	0.01 U		
Indeno(1,2,3-cd)pyrene	mg/kg															2.5 U	0.01 U		
Summed cPAH TEQ with One-half of the Reporting Limit [3,4]	mg/kg	2														1.9 U	0.0076 U		
Polycyclic Aromatic Hydrocarbons (PAHs)																			
Naphthalene	mg/kg	5														7.5 U	0.03 U		
Acenaphthylene	mg/kg															7.5 U	0.03 U		
Acenaphthene	mg/kg															7.5 U	0.03 U		
Fluorene	mg/kg															7.5 U	0.03 U		
Phenanthrene	mg/kg															7.5 U	0.043		
Anthracene	mg/kg															7.5 U	0.03 U		
2-Methylnaphthalene	mg/kg															7.5 U	0.03 U		
Fluoranthene	mg/kg															7.5 U	0.03 U		
Pyrene	mg/kg															7.5 U	0.03 U		
Benzo(g,h,i)perylene	mg/kg															7.5 U	0.03 U		

Notes:

All data presented within this table are from soil samples collected within the excavation area. This soil will be removed as part of the remediation project. These data are not representative of contaminant concentrations in wastewater, but are provided for reference.

Blank cells indicate the sample was not analyzed for that analyte.

* Indicates a boring that was advanced through the concrete slab, which sits approximately 5 feet above grade.

Bold Indicates a concentration that exceeds the MTCA Method A Unrestricted Land Use CUL.

1 The MTCA Method A Unrestricted CUL for gasoline-range organics in soil is 30 mg/kg if benzene is detected.

2 The reported xylenes concentration is the sum of o-xylene, p-xylene, and m-xylene.

3 Calculation of cPAH TEQ concentrations was performed using the California Environmental Protection Agency 2005 Toxic Equivalency Factors as presented in Table 708-2 of WAC 173-340-900.

4 Calculated using detected cPAH concentrations plus one-half the reporting limit for cPAHs that were not detected.

Abbreviations:

- bgs Below ground surface
- CUL Cleanup level
- ft Feet
- mg/kg Milligrams per kilogram
- MTCA Model Toxics Control Act
- TEQ Toxicity equivalent
- WAC Washington Administrative Code

Qualifiers:

- J Analyte was detected, result concentration is an estimate.
- JM Concentration is estimated due to poor match to standard, acceptable for use with qualification.
- U Analyte is not detected at the associated reporting limit.
- UJ Analyte is not detected at the associated reporting limit, which is an estimate.

K Ply Site

Wastewater Treatment Engineering Report

Exhibit 3
Dewatering Water Volume Calculations

FLOYD | SNIDER
strategy ▪ science ▪ engineering

Two Union Square
601 Union Street, Suite 600
Seattle, WA 98101
tel: 206.292.2078
fax: 206.682.7867

[X] Calculation
[ ] Meeting Notes
[ ] Phone Call Notes
[ ] Memorandum

Date: 7/22/15
Project No.: PoPA-KPly

Created by: J. Pracht
Reviewed by: T. Stevens
Subject: Dewatering Calculations

Question: What is the approximate GPM the treatment system will need to handle?

40'x40' grid cells
Approximately 3' into the water table
Porosity = 0.35

Volume of soil = (40ft)(40ft)(3 feet) = 4800 ft^3
Volume of water = ($4800 ft^3$)(0.35) = 1680 ft^3

1 ft^3 = 7.48 gallons

$1680 ft^3 \cdot \frac{7.48 \text{ gallons}}{1 ft^3}$ = 12566 gallons of water per grid

Increase by 50% to account for layback areas and groundwater recharge
(12566 gallons)(1.5) ≅ 18850 gallons

What is the gpm if a grid cell is dewatered over a 12-hr period?

$\frac{18850 \text{ gallons}}{12 \text{ hr}} = 1570 \frac{\text{gal}}{\text{hr}} \cdot \frac{1 \text{hr}}{60 \text{min}} \cong 26$ gpm

If water was pumped at 30 gpm 24 hours per day for 7 days, how much water is generated?

$\frac{30 \text{ gallons}}{\text{min}} \cdot \frac{60 \text{ min}}{1 \text{hr}} \cdot \frac{24 \text{ hr}}{1 \text{ day}} \cdot 7 \text{days} \cong 302{,}400$ gallons

K Ply Site

Wastewater Treatment Engineering Report

Exhibit 4
Wastewater Treatment System Schematic

2" Sch 40 PVC From Sumps to Weir Tank

6" Chitosan Contactor Unit

4" Sch 40 PVC Mixing Line and Difuser

Submersible Pump w/ Float Control

2" Transfer Line From the Weir to Storage Tanks

2" Sch 20 PVC From Storage Tank to Oil/ Water Separator

2" Recycle Line Incase of Elevated Tank Turbitity

100 GPM Oil / Water Seperator

2" Sch 40 PVC From Pump, Through Bag Filter and Into Carbon

100 GPM Bag Filter

PV1000 GAC Unit (50 GPM each)

2" Sch 40 PVC Discharge From Carbon to Sewer

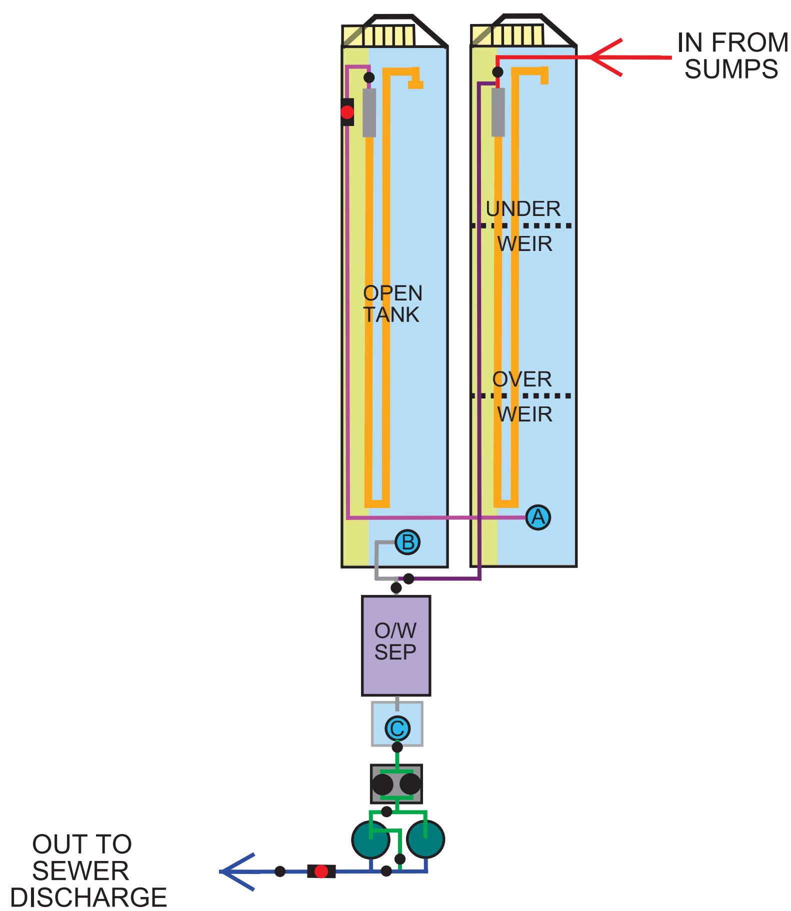
2" Flow Meter

2" Flow Control Gate Valve

This passive treatment system is designed to accept water from temporary sumps or well points that will be used to de-water work areas on a 24/7 basis as well as wheel wash decant and out of compliance storm water. Each sump could be plumbed to a common 2" discharge line with check valves to prevent back flow or recirculation. The system can treat flows up to 100 GPM but the open tank behind the weir tank will store on-site surge flows of up to 18,000 gallons.

Two 18,000 tanks will be used as a pre-treatment system. Incoming water will flow through a chitosan contactor unit mounted on top of the weir tank and then through 60' of 4" mixing line prior to entering the weir tank. The under weir will hold any floating organic contaminates behind it for removal and the area past the over weir will be used as a pump cell. A 2"-120 volt pump sends collected water from the over weir cell through an additional chitosan contactor unit and 60' of 4" mixing line prior to entering the second pre-treatment/ storage tank via a flow diffuser. A 2"-120 volt pump sends collected water from the storage tank to the OWS100 oil/ water separator, which then gravity discharges into a 250 gal. pump sump. A 3"- 480 volt submersible pump transfers water from the sump through a BF200 bag filter with 5 micron bags. Line pressure conveys water from the bag filter through two PV1000 GAC units configured in lead and lag (as an alternative, a manifold will allow a 100 GPM flow rate in a parallel configuration). The discharge from the GAC units will go through a totalizing flow meter and flow control valve prior to directly discharging to sewer.

Flow control valves to balance pump discharge are included on the weir tank inlet, tank transfer pump, oil/ water transfer pump and bag filter pump lines. Sample ports will be added on the incoming line, after the oil/ water separator, and down stream of both the lead and lag GAC units. As stated above, the GAC units shown include a manifold that allows for a lead and lag configuration for a 50 GPM flow rate as well as a parallel configuration for a 100 GPM flow rate.

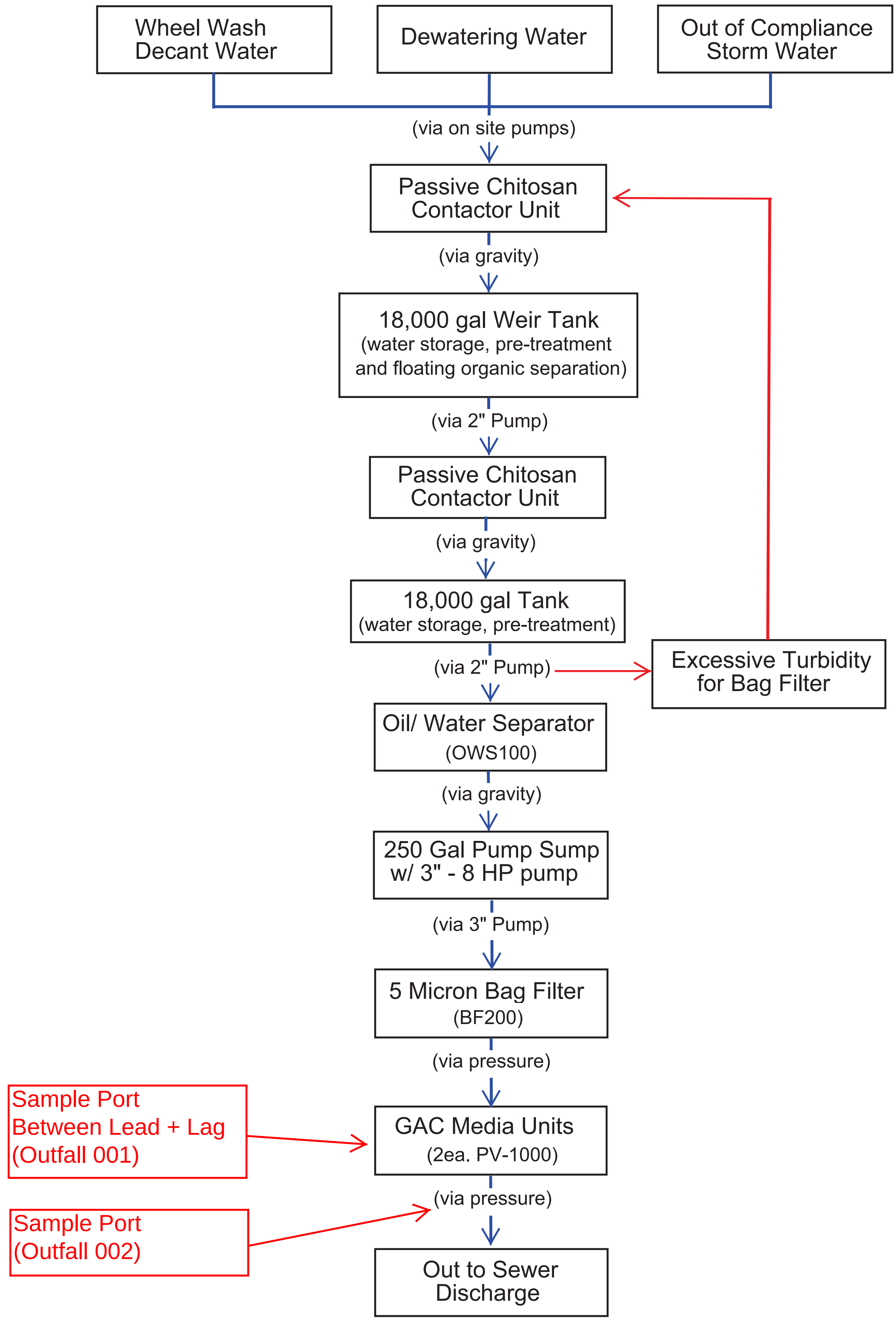


SCALE 1"=
15.00 ft

NSC WATER QUALITY
PO BOX 2319 REDMOND WA 98073
(425)864-1645 ericnwsoilcement@yahoo.com

50-100 GPM Water Treatment System Schematic 7-30-15

K-Ply Site ; Port Angeles, WA



NSC WATER QUALITY PO BOX 2319 REDMOND WA 98073 (425)864-1645 ericnwsoilcement@yahoo.com	Water Treatment System Process Flow Diagram 7-30-15
	K Ply Cleanup Project; Port Angeles, WA

Wastewater Treatment Engineering Report

Exhibit 5
Rain for Rent Cut Sheets

Sound Environmental Concepts, LLC

Passive Treatment Socks Specification Sheet

Purpose: This specification sheet communicates the necessary characteristics for the SEC Chitosan Lactate product. It has taken many years to develop the passive delivery systems, the regulatory background testing, the operation and training manuals, and performance results that accomplish the necessary end objectives of water treatment.

Chitosan lactate flake (100%) Specification:

Viscosity range: ≥ 150 cps (1% solution @ standard temperature and pressure after 2 hours of mixing)
pH (1% solution): 3.5 to 4.0
Solids content: ≤ 1.5%
Turbidity: 10 NTU or less
Solubility: > 99%

Ingredients:
Chitosan lactate is a water treatment grade of chitosan and lactic acid. There are no additional additives.

Shelf-Life:
The dry product has indefinite shelf-life

Manufactured by: Sound Environmental Concepts, LLC

~~Passive Treatment Sock 1-lb. Specifications:~~

~~Length~~	~~36 Inches~~
~~Width:~~	~~5 in. diameter~~
~~Fabric:~~	~~Woven polypropylene~~
~~Chitosan:~~	~~1.0 lb (dry weight)~~
~~Treatment:~~	~~100,000 gal. @ 1 mg/L~~

Passive Treatment Sock 2-lb. Specifications:

Length	72 Inches
Width:	5 in. diameter
Fabric:	Woven polypropylene
Chitosan:	2.0 lb (dry weight)
Treatment:	200,000 gal. @ 1 mg/L

Applications:
Turbid water pretreatment (gravity settling)
Sand filtration
Biofiltration
Bag Filtration

Steel Tank

Flip Top Weir

Overview:

18,100 gallon flip top weir tanks from Rain for Rent have a standard “V” shaped floor for ease of draining all stored liquids completely through a 4” butterfly valve with Buna seals standard.

Features:

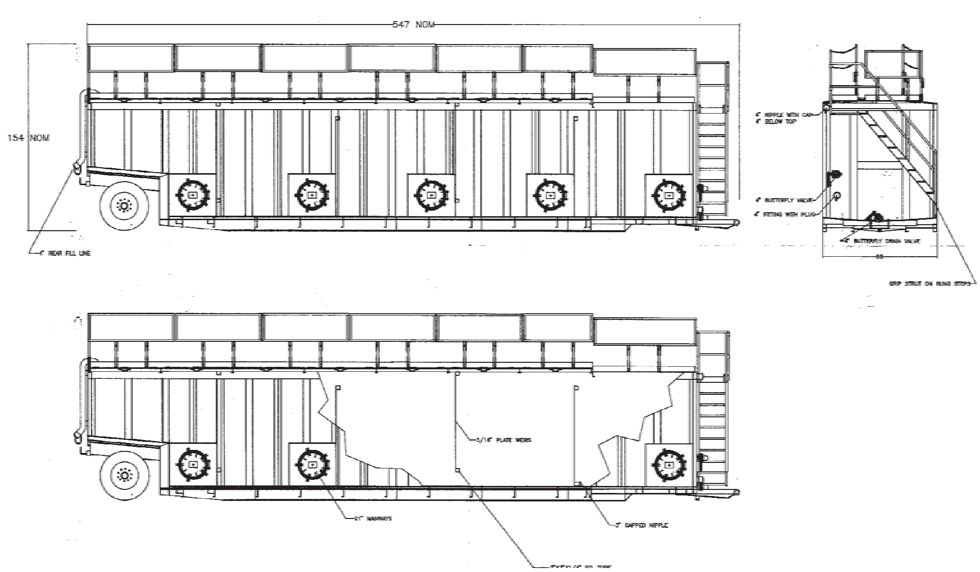
Store liquids with confidence with Rain for Rent’s 18,100 gallon flip top weir tank. Permanently attached axels for maximum maneuverability allow this 18,100 gallon tank to be moved with ease on the jobsite and a safety staircase ensures proper protection for workers on site. Internal weirs allow for extra filtration and settling of materials.

Specs:

Manways	Four 22” hatches
Material	Steel
Capacity	18,100 gallons
Dry weight	27,000 lbs.
Footprint:	516” x 96” x 126”

Accessories:

- Spillguard
- Suction and Discharge Hoses
- Level gauges



Liquid ingenuity.™

800-742-7246
rainforrent.com

Oil Water Separator OWS100

Overview:

The OWS100 is a parallel corrugated plate gravity displacement type separator designed in accordance with API 421 to remove free and dispersed non emulsified oil and settleable solids. It is skid mounted with leveling jacks. It requires no power and features no moving parts for ease and reliability.

Features:

The OWS 100 removes free and dispersed non-emulsified oil, settleable solids and additionally functions as a gravity flow oil-skimmer for flows up to 150 GPM with a 0.7 specific gravity.

- 3 cubic feet sludge capacity
- 0.5 inch coalescing pack or oil attracting media
- One tank requiring six coalescing packs

(for the K Ply site, in-line valves will be used
to keep the flow rate between 50 to 100 GPM)

Specs:

Max Flow	150 GPM
Material	Stainless Steel
Dry weight	1400 lbs.
Footprint:	96” x 66”
Inlet x outlet	4” x 4” Flange

Accessories:

- Spillguard
- Suction and Discharge Hoses

Bag Filter

BF200

Overview:

The BF200 bag filter unit features two bag filter tanks and utilizes 7” x 30” bag filters for superior filtration from 100 to 1 micron for flows up to 200 GPM.

(for the K Ply site, in-line valves will be used to keep the flow rate between 50 to 100 GPM and the duplex bags will be operated in parallel to reduce the pressure loss and increase life)

Features:

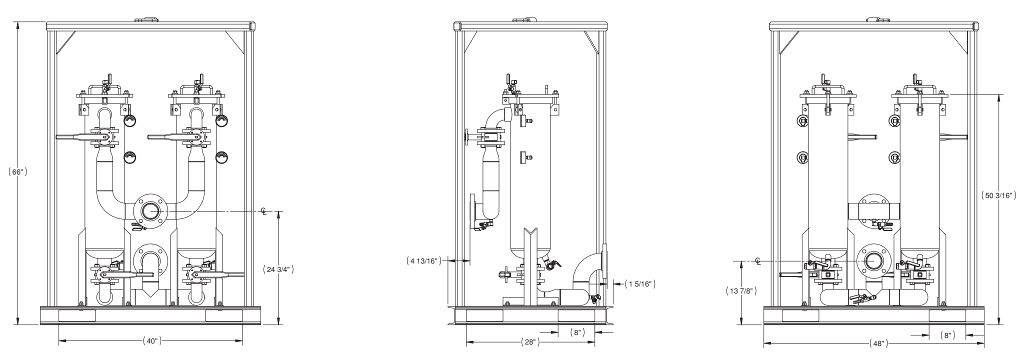
- No moving parts
- Skid mounted
- Fitted with bleed valves and pressure gauges
- Chambers constructed of 304 Stainless Steel
- Piping constructed of 304 stainless steel
- Stainless Steel inlet and outlet manifolds

Specs:

Max Flow	200 GPM
Material	Stainless Steel
Max PSI	125 PSI
Dry weight	800 lbs.
Footprint:	48” x 36”
Inlet x outlet	3” x 3” Flange

Accessories:

- Spillguard
- Suction and Discharge Hoses



Liquid ingenuity.™
800-742-7246
rainforrent.com

EVOQUA
WATER TECHNOLOGIES

PV® SERIES LIQUID PHASE ADSORBERS

~~PV-500~~, PV-1000, ~~PV-2000~~

Applications

The PV® Series adsorbers are designed for use in a wide range of low/high flow and pressure applications.

- Groundwater remediation
- Wastewater filtration
- Tank rinse water treatment
- Pilot testing
- Underground storage tank clean up
- Leachate treatment
- Dechlorination
- Spill cleanup
- Hydrotesting
- Drinking Water

Installation, Startup and Operation

Evoqua can provide a total service package that includes utilizing OSHA trained personnel providing on-site carbon changeouts, packaging and transportation of spent carbon for recycling at our reactivation facilities.

At the time of purchase or rental of the adsorbers, arrangements should be made for the reactivation of the spent carbon. Evoqua will provide instructions and assistance on how to obtain acceptance of the spent carbon at our reactivation facilities. Spent carbon cannot be accepted for reactivation until the acceptance process is completed.

BENEFITS & DESIGN FEATURES

- Durable, carbon steel construction includes internally/externally welded seams
- SSPC-SP5 sandblasted, NSF-approved baked epoxy interior coating; urethane exterior finish
- Approved for the transport of hazardous spent carbon
- Top and side manways permit easy access and inspection of vessels internals and linings
- Skid-mounted for easy handling and installation
- Optimized underdrain system for low pressure drop operation

Piping Manifold (Optional)

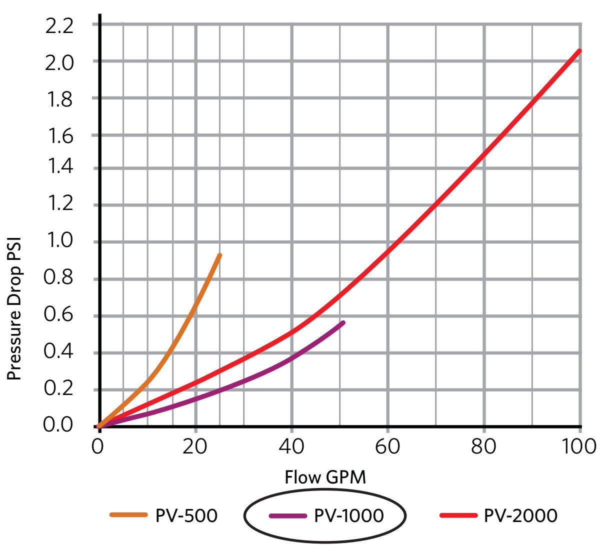
- 2"/3" sch 80 PVC piping and valves that allow either adsorber to be used in the lead or lag position (optional carbon steel and stainless steel piping)
- Series or parallel operation
- Clean utility water connection for manual backflush
- Sampling ports and pressure gauges
- Flexible hoses with Kamlock fittings allow easy installation and removal during service exchange operations
- Available for purchase or rental

SPECIFICATION/TYPICAL PROPERTIES

	PV®-500	PV®-1000	PV®-2000
Dimensions (Dia. x Overall Height – Approx.)	30″ x 5′7″	48″ x 5′7″	48" x 8′8"
Inlet Connection (Top)	2"	3" NPT (Female)	3" NPT (Female)
Outlet Connection (Bottom)	2"	3" NPT (Male)	3" NPT (Male)
Manway, Top & Lower Side	11″ X 15″ (top only)	11″ X 15″	11″ X 15″
Internal Piping	PVC	PVC	PVC
Interior Coating (All Units)	Epoxy	Epoxy	Epoxy
Exterior Coating (All Units)	Epoxy/Urethane	Epoxy/Urethane	Epoxy/Urethane
Carbon Fill Volume (Cu.ft.)	18.5	34	68
Vessel Weight (lbs.):			
Shipping (With Carbon)	1050	1910	3200
Operating (Approx.)	1750	4300	7500
Flow, CFM (Nominal)	25	50	100
Pressure, PSIG (Maximum)[1]	75	75	75
Temperature, °F (Maximum)	140	140	140
Pounds Of Activated Carbon	500	1000	2000
Contact Time @ Max Flow/Min	5	5	5
Backflush rate (GPM) @ 55°F	15-20	40-50	40-50

[1]The PV® Series adsorbers are not ASME code stamped. Pressure rating applies to liquid only.
For detailed dimensional information or drawings, contact your local Evoqua sales representative.
For information on the HP® Series ASME code stamped adsorbers, contact your local Evoqua representative

PV® Series Pressure Drop (8x30 Mesh Gac)

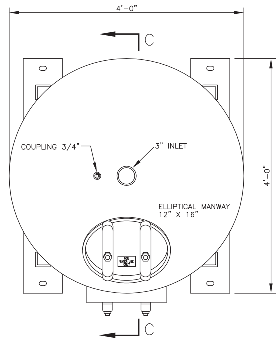


Safety Note: Wet activated carbon readily adsorbs atmospheric oxygen. Dangerously low oxygen levels may exist in closed vessels or poorly ventilated storage areas. Workers should follow all applicable state and federal safety guidelines for entering oxygen depleted areas.

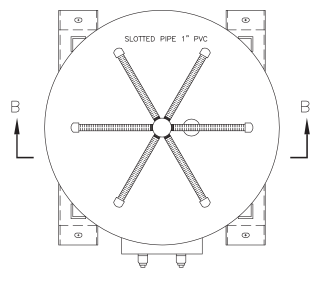
All information presented herein is believed reliable and in accordance with accepted engineering practices. Evoqua makes no warranties as to completeness of information. Users are responsible for evaluating individual product suitability for specific applications. Evoqua assumes no liability whatsoever for any special, indirect or consequential damages arising from the sale, resale or misuse of its products.

evoqua WATER TECHNOLOGIES

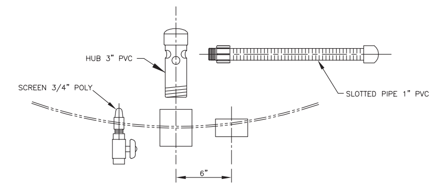
4800 North Point Parkway, Suite 250, Alpharetta, GA 30022
+1 (866) 926-8420 (toll-free) **+1 (978) 614-7233** (toll) **www.evoqua.com**



PLAN VIEW



SECTION "A–A"



ENLARGED SECTION VIEW B–B
UNDERDRAIN ASSEMBLY–(SEPARATED)

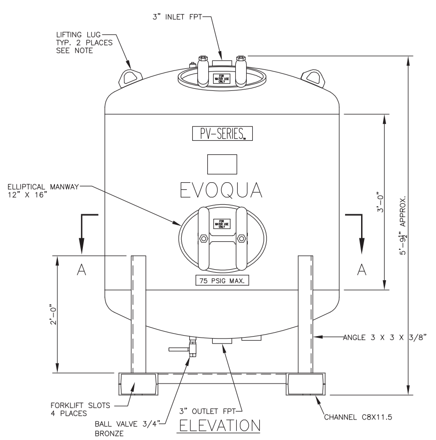
NOTES:

1. DESIGN DATA:
   48" DIAMETER PRESSURE VESSEL–75 PSIG(MAX)
   @ 150°F–NOT ASME CODE STAMPED
   FOR WATER USE ONLY
   MAXIMUM FLOW RATE: 50 GPM
   MAXIMUM CARBON CAPACITY: 1000 LBS. ACTIVATED CARBON

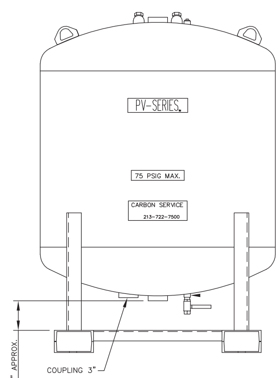
2. MATERIAL:
   HEADS: STD. F & D NON CODE 3/16" THICKNESS C.S.
   SHELL: 3/16" THK. 48" OD x 36" LONG C.S.
   SKID: SA 36–HR

3. SURFACE PREPARATION:
   INTERIOR:
   SANDBLAST: SSPC–SP–5 WHITE METAL
   ABRASIVE: GARNET OR GRIT – PROFILE: 1.5–2 MILS
   COATING: 3M BRAND SCOTCHKOTE 134
   THICKNESS: 10–15 DFMT – COLOR: GREEN
   EXTERIOR:
   SANDBLAST: SSPC–SP–10 NEAR WHITE METAL
   ABRASIVE: GARNET OR GRIT – PROFILE: 1.5–2 MILS
   PRIMER COAT: RUST PREVENTATIVE EPOXY PRIMER
   THICKNESS: 4–6 DFMT – COLOR: RED
   FINISH COAT: HIGH BUILD POLYURETHANE
   THICKNESS: 3–4 DFMT – COLOR: BLUE (FED. I.D.#15052)

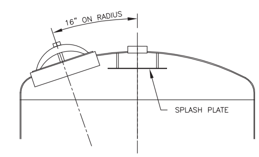
4. LIFTING REQUIREMENTS:
   3,700 LBS. MINIMUM RATING.
   EST. WEIGHTS:
   910 LBS. – EMPTY VESSEL
   1910 LBS. – WITH CARBON
   4300 LBS. – OPERATING



ELEVATION



REAR ELEVATION



HEAD SECTION C–C

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN

DESIGNER	DATE
AJA	9–19–14
CHECKER	DATE
ENGINEER	DATE
MANAGER	DATE
FILE:	
SCALE: 1:12	

TITLE PV1000 ST SALES DRAWING

CLIENT

EVOQUA WATER TECHNOLOGIES
WATER TECHNOLOGIES
RED BLUFF, CA
530–527–2664

PROJECT	CODE	DRAWING	SHEET	REV
	SALES	PV1000–ST	1 OF 1	0

STD: BORDER–0106–24X36D1 | INTL REF: | BAR = 1" AT PLOT SCALE

K Ply Site

Engineering Design Report

Appendix F
Biological Amendment Design

Table of Contents

List of Attachments

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
CPOC	Conditional point of compliance
CUL	Cleanup levels
Ecology	Washington State Department of Ecology
GRO	Gasoline-range organics
µg/L	Micrograms per meter
mg/kg	Milligrams per kilogram
ORC-A	Oxy-hydroxide-based oxygen-releasing compound Advanced Pellets
ppb	Parts per billion
PVC	Polyvinyl chloride
Site	K Ply Site

1.0 Introduction

Groundwater at the K Ply Site (Site) is expected to be contaminated following excavation. In part, this is due to existing conditions, and could potentially be exacerbated by excavation activities, which disturb contaminated soil in contact with groundwater. Post-excavation groundwater will be treated using bioremediation amendments provided by REGENESIS, a national vendor of in situ chemicals used to treat contaminated soil and groundwater. REGENESIS provided technical assistance with design of the excavation treatment systems using site-specific analytical data, soil lithology, and hydrogeology provided by Floyd|Snider. REGENESIS' proposal and design documentation is included as Attachment F.1 and addresses the first and second application methodologies discussed below.

Bioremediation amendments will be applied to groundwater using three different methods:

1. Direct placement in the excavation areas (to treat the expected spike in groundwater concentrations due to excavation disturbance)
2. Geoprobe injections of a bioremediation amendment under S. Cedar Street (to treat the dissolved phase benzene plume)
3. Future injections of a bioremediation amendment via infiltration galleries

The contractor will be responsible for the purchase, shipping, and application of bioremediation materials for the direct placement in the excavation areas. Floyd|Snider will be responsible for the purchase, shipping, and application of bioremediation materials for the Geoprobe injections under S. Cedar Street. Injections by Geoprobe will be done by a licensed driller under supervision by Floyd|Snider.

2.0 Direct Placement

The bioremediation amendment that has been selected for direct placement in the excavation areas (Excavation Areas 5 and 6) is the calcium oxy-hydroxide-based oxygen-releasing compound Advanced Pellets (ORC-A) manufactured by REGENESIS. ORC-A have been optimized by REGENESIS for in situ treatment in excavations and trenches. They are designed for ease-of-application and material handling and have been used for long-term, controlled-release of oxygen in similar projects with proven success.

ORC-A is a product designed to produce a controlled-release of molecular oxygen (up to 17 percent by weight) for up to 1 year. Current dissolved oxygen concentrations on-site are in the range of 1 to 3 milligrams per liter. The readily available oxygen produced by the ORC-A will accelerate aerobic biodegradation processes up to 100 times faster than their naturally occurring rates. In addition to oxygen, the pellets contain nutrients (nitrogen, phosphorous, and potassium), which are beneficial to the growth of aerobic bacteria.

ORC-A will be used in the Concrete Pad and Bulkhead Excavation Areas (Excavation Areas 5 and 6) to stimulate the aerobic biodegradation of residual petroleum contamination during excavation activities. This action will ensure that cleanup levels (CULs) in groundwater are met within a reasonable timeframe at the conditional point of compliance (CPOC).

ORC-A will be applied to backfill going into saturated soils only, and only within the footprint of the excavation areas. The ORC-A will be mixed into the 2 feet of clean backfill (from approximately 10 to 12 feet below ground surface) that is placed in the saturated zone. The method of application will be directed by the contractor, but the ORC-A will be mixed evenly through the backfill at a rate of 3 pounds per cubic yard of backfill in accordance with the manufacturer's instructions (Attachment F.1). Based on a 2-foot backfill thickness in the saturated zone, 16,750 pounds of ORC-A will be mixed with 2 feet of clean backfill throughout the entire 74,000-square-foot excavation footprint. For the purposes of determining a conservatively safe amount of ORC-A to add to the excavation, it is assumed that groundwater concentrations post-excavation (within the excavation area) will range from 500 to 5,000 parts per billion (ppb) of gasoline-range organics (GRO) and 200 to 2,000 ppb benzene. Outside of the excavation areas (laterally, in the plume area [beneath S. Cedar Street and extending toward Terminal 1]), concentrations of up to 10,000 ppb GRO and 200 ppb benzene may be present. Calculations to determine the mass of GRO present in residual concentrations of this magnitude are in the calculation sheets in Attachment F.2. The calculation sheets in Attachment F.2 demonstrate that the amount of oxygen to be added via the ORC-A is approximately 20 times the amount needed to biologically degrade (oxidize) an estimated residual GRO concentration of 5,000 micrograms per liter (µg/L), given ideal conditions.

2.1 CONTINGENCY ACTIONS

The majority of the soil that exceeds CULs will be excavated during remedial construction. Soil concentrations remaining within the footprint of the excavation are expected in general to be less than 30 milligrams per kilogram (mg/kg) for GRO and 0.3 mg/kg for benzene, the site CULs. However, it is anticipated that there will be select, but limited, exceedances of the CULs in small pockets within the excavation footprint beneath the bottom of the excavation that are not reasonable to further excavate. Contingency actions are necessary if soil CULs are not met by the 2-foot excavation into the water table.

To determine the range of soil concentrations that could be treated by ORC-A as a contingency action, it is assumed that there will be select, but limited exceedances of the soil GRO CUL (30 mg/kg) in certain grids. Attachment F.2 provides calculations that show the oxygen requirements to degrade a range of residual soil concentrations. These calculations were used to determine the following contingency actions for a range of residual soil concentrations within the excavation footprint. Based on these calculations and vendor experience, ORC-A loses effectiveness in treating groundwater with residual soil concentrations above 300 mg/kg. The contingency actions include no action, additional ORC-A application, additional excavation, and, as a final backup in case additional excavation is not practical, chemical oxidation to address the unexpected condition where very high levels of GRO remain. All contingency actions will be discussed with the Washington State Department of Ecology (Ecology).

The table below presents possible contingency actions for a range of residual soil concentrations.

GRO Concentration Range (mg/kg)	Contingency Action
0–30	No action as CULs are met. ORC-A in clean backfill provides a sufficient amount of oxygen to degrade residual concentrations in groundwater. No further source of hydrocarbons is assumed to be present to recontaminate groundwater to concentrations greater than CULs.
30–300	No action in the upgradient Concrete Pad Excavation Area as these concentrations are less than the remediation level in this area. ORC-A in clean backfill provides a sufficient amount of oxygen to degrade residual concentrations in soil. Contingency actions in the Bulkhead Excavation Area will be determined based on the actual concentration in each 40- by 40-foot grid cell, frequency of exceedance, and proximity to the bulkhead. Additional soil will be excavated where feasible. In areas where excavation is not feasible, mixing in ORC-A below the excavation base will be performed to degrade residual concentrations.
300–3,000	Contingency measures will be applied to the Bulkhead Excavation Area only, as this GRO concentration range is less than the Site remediation level. Soil will be excavated where feasible. In areas where excavation is not feasible, chemical oxidation will be performed to degrade remaining concentrations.
>3,000	Soil concentrations of this magnitude following excavation are highly unlikely. Contingency measures will be applied to both the Bulkhead Excavation Area and the Concrete Pad Excavation Area. Soil will be excavated where feasible. In areas where excavation is not feasible, chemical oxidation will be performed to degrade remaining concentrations.

3.0 S. Cedar Street Benzene Plume Bioremediation Injections

The S. Cedar Street benzene plume will be treated with bioremediation through a series of Geoprobe injections. The first set of injections will be concurrent with excavation activities.

A direct-push Geoprobe will be used to directly inject a slurry mixture of ORC-A into Geoprobe boreholes throughout a plume area of approximately 1 acre (roughly corresponding to benzene concentrations greater than 500 µg/L). The slurry mixture will be formed by mixing the ORC-A powder with water according to REGENESIS' instructions (Attachment F.1). The slurry mixture will be injected by connecting a slurry pump and hose system to a direct-push Geoprobe and injecting a pre-determined amount of slurry into the aquifer.

An estimated 2,250 pounds of ORC-A (25 pounds per borehole) will be injected into the upper 5 feet of the aquifer (where the plume lies) across six rows lying 50 feet apart and oriented transverse to the plume axis. The spacing between injection points along each row will be 10 feet; therefore, a total of 90 injection points will be laid out in a 10-foot by 50-foot array. Due to utilities under S. Cedar Street, not all 90 injection points will be able to be on an equal grid spacing, some offset may be necessary to avoid utilities.

4.0 Bioremediation Amendment Gallery

Five infiltration galleries will be installed in the Concrete Pad and Bulkhead Excavation Areas prior to backfilling. These infiltration galleries will allow for future application of an oxygen-supplying amendment (i.e., hydrogen peroxide) if future groundwater monitoring indicates that the groundwater CULs are not being attained at the CPOC. The infiltration galleries may also be used, following Ecology approval, to allow for a limited amount of infiltration of clean site stormwater, such as from roof runoff as this would introduce highly oxygenated water, which would stimulate bioremediation.

Design criteria for bioremediation include the following:

- Install five infiltration galleries approximately 100 to 200 feet apart throughout the excavation areas.
- The length of the infiltration galleries will vary from 130 to 260 feet in order to maximize the area with GRO contamination that will be treated.
- Infiltration galleries will be installed at depths approximately 1 foot above the seasonal high groundwater table. This will allow the aqueous liquid to drain through crushed concrete backfill below the gallery and mix into the water table below.
- The infiltration gallery pipes will be installed via utility trenching.
- Each pipe will be a 6-inch-diameter schedule 40 polyvinyl chloride (PVC) pipe. Attachment F.3 includes calculations that show that a 6-inch-diameter pipe has a sufficient capacity to allow for the addition of enough hydrogen peroxide to degrade a range of future GRO concentrations.
- Perforated holes will be drilled in the bottom of the PVC piping. Perforations will be 1 inch in diameter and spaced 6 inches apart to allow for the infiltration to the water table of an aqueous solution of bioamendments. Preliminary calculations to determine perforation size and spacing are provided in Attachment F.3; however, a field test will be performed to ensure that the diameter and spacing of the perforations is adequate to allow for relatively equal distribution of the aqueous solution.

- The pipe will be wrapped in a non-woven filter fabric to prevent soil clogging.
- The pipe will be embedded in pea gravel, which will serve to protect the pipe and allow for flow into the groundwater. A minimum of 6-inches of pea gravel will be placed on all sides of the pipe.
- The pipes will be gently sloped (approximately 0.5 percent) at each end to a low central point to ensure that the aqueous solution that is injected reaches the entire length of the gallery, distributes evenly, and does not pond at the central low point.
- There will be PVC risers on both sides of the infiltration gallery that will be used to inject the bioremediation amendment. These risers will be temporarily capped until site redevelopment. In the future, when the grade at the Site is finished, utility structures may be placed around the infiltration gallery risers for protection.

The type and volume of oxygen-supplying amendment to be injected will be determined in the future as post-remediation groundwater conditions are established. The specific application instructions and application rates will be determined upon selection of an oxygen-supplying amendment.

5.0 Future Bioremediation to Treat Groundwater

Prior to injection activities and following the completion of the excavation and the initial injection of bioremediation amendments under S. Cedar Street, an assessment of groundwater conditions site-wide will be performed to monitor treatment effectiveness and determine the need for additional in situ biotreatment of groundwater. Given that the ORC-A has an expected lifetime of up to 1 year, the need for additional treatment will be based upon 1 year of post-injection monitoring.

During these monitoring events, the following groundwater parameters will be collected: pH, temperature, dissolved oxygen, oxidation-reduction potential, specific conductance, turbidity, chemical oxygen demand, and biological oxygen demand. The samples will be also be analyzed for GRO, diesel-range organics, oil-range organics, benzene, toluene, ethylbenzene, and xylenes (BTEX), total and dissolved iron and manganese, and methane to help assess redox conditions.

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K Ply Site

Engineering Design Report

Appendix F
Biological Amendment Design

Attachment F.1
REGENESIS Proposal
and Design Documentation

RegenOx™
Example Specification

In situ Chemical Oxidation
Specification for Chemical Technology Amendment:

Chemical Technology

Vendor shall supply ________________lbs of a chemical oxidant system. The chemical oxidant system shall have a proven track record for stimulating *in situ* chemical oxidation of contaminants and be acceptable for use in environmental restoration projects.

The chemical oxidant system shall offer the ability to oxidize the contaminants of concern through multiple chemical pathways including direct chemical oxidation and free radical oxidation via perhydroxyl radical, hydroxyl radical and superoxide radical pathways.

Safety is a priority concern, therefore the chemical oxidant system shall not produce excess heat or reactivity during mixing or application. The use of concentrated liquid oxidizers or concentrated liquid acids or base solutions will be prohibited.

Compatibility with infrastructure at the site is also a concern. Therefore, oxidizer systems known to impact steel and concrete are not acceptable.

An acceptable chemical oxidant system would be RegenOx™ or an equivalent catalyzed sodium percarbonate system.

Application Services

Vendor shall supply all necessary services to properly apply the chemical oxidant system into the subsurface. Application will require direct injection of the chemical oxidation to the locations and depths as specified by the design.

REGENESIS

May 12, 2015 Proposal No. BRG49088 – Revision I

Tom Colligan
Floyd Snider
601 Union Street Suite 600
Seattle, WA 98101-2390

RE: Proposal for Remediation using ORC Advanced/ORC-Advanced Pellets and potentially RegenOx at the K-Ply Site

Dear Mr. Colligan:

Thank you for the opportunity to technically evaluate this project. Below we have provided information related to the design and application of RegenOx™, ORC Advanced® and ORC-Advanced Pellets® to treat sorbed- and dissolved-phase residual petroleum hydrocarbons in three separate areas outlined on the attached site map.

Product Description

Detailed descriptions of RegenOx and ORC Advanced products can be found at the following website links: RegenOx and ORC Advanced.

Product Quantities and Cost

ORC Advanced Pellets

16,750 lbs (55.1 lb bags)
ORC Advanced Product Cost - $131,487.50 ($7.85/lb)

ORC Advanced Powder

2,280 lbs (40 lb bags)
ORC Advanced Powder Cost - $17,898 ($7.85/lb)

Total Product Cost (w/o) Contingencies = $149,385.50

Contingency

RegenOx (Four 40 x 40 x 2 foot cells – Part A per cell 2,400 lbs Part B per cell 1,200 lbs)

14,400 lbs (Part A = 9,600 lbs Part B = 4,800 lbs)
RegenOx Cost - $30,960

ORC-Advanced Pellets – (Four 40 x 40 x 1 foot cells)

1,324 lbs (331 lbs per cell)
ORC-Advanced Pellet Cost - $10,393.40

Total Product Cost with Contingencies - $190,738.90*

*The above cost does not include freight or applicable taxes. Please contact Regenesis customer service at 949.366.8000 or customerservice@regenesis.com, or me at 916.740.3411 for a shipping quote.

Proposed Application Design

Bulkhead Excavation Area – 40,000 square feet

In the 40,000 square foot excavation we recommend that 9,036 lbs of ORC-Advanced Pellets be uniformly distributed from 10 to 12 feet bgs.

Concrete Pad Excavation Area – 34,000 square feet

In the 34,000 square foot excavation we recommend that 7,714 lbs of ORC-Advanced Pellets be uniformly distributed from 10 to 12 feet bgs.

Four Potential 40 x 40 x 1 foot Cells - Bioremediation

Per our conversation additional ORC-Advanced Pellets is recommended as a contingency in case some of the soil contamination left at the base of the excavation is between 30 and 300 mg/kg. The amount of product recommended for each 40 x 40 x 1 foot cell is 331 lbs. In these cells the ORC-Advanced Pellets should be mixed from 12 to 13 ft bgs.

Four Potentail 40 x 40 x 2 foot Cells - ISCO

Per our conversation the RegenOx has been recommended as a contingency in case some soil contamination above 300 mg/kg is left at the base of the excavation. The amount of product recommended for each 40 x 40 x 2 foot cell is 2,400 lbs of RegenOx Part A and 1,200 lbs of RegenOx Part B. The RegeneOx should be thoroughly mixed with the contaminated soil. This amount of product, if properly mixed, should treat up to 5,000 mg/kg of total hydrocarbon.

Cedar Street Benzene Plume – 45,000 sq ft plume with a 5 ft treatment interval

In the 45,000 square foot plume we recommend that 2,280 lbs of ORC-Advanced be mixed with water to form a slurry and injected into 90 points spaced 10 feet on center within rows and 50 feet on center between rows. The injection should occur throughout the top 5 feet of the aquifer (assumed to be 10 to 15 ft bgs).

Regenesis agrees with Floyd Snider that post excavation related plume/mass re-equilibrium would be a prudent step prior to application of ORC-A in this area. However, in the case where this is not possible, we have attempted to provide Floyd-Snider with a viable yet optimized program. This program is based on the notion of maximizing the dose response and likelihood of success with lower level of effort/expense.

In this area we suggest that Floyd Snider selectively decrease the average point spacing from the previous recommendations of 10 ft x 50 ft center spacing. We suggest a more closely spaced array be used along the center line of the plume/plumes as well as the western half of this plume (property boundary and off-site areas). We think that reallocation of ORC-A via the recommended 90 point array can be best accomplished by focusing the application on the plumes center line and western half. In these sections of the plume the injection point center spacing should by decreased and increase center spacing outside these areas. In particular the eastern section of the plume (adjacent to the excavation + amendment application areas). Although it is unclear how or if excavation + amendment addition will affect the eastern section of the Cedar Street Plume we believe emphasizing the center line + western/off-site plume sections will improve the chances of success. To this end we propose decreasing the center spacing of injection points along the center line of the plume and in the area of the performance monitoring wells from 10 to 8 feet (within rows). Ideally at least one injection points should be placed 5 to 8 feet directly upgradient of any key monitoring well.

Groundwater Monitoring

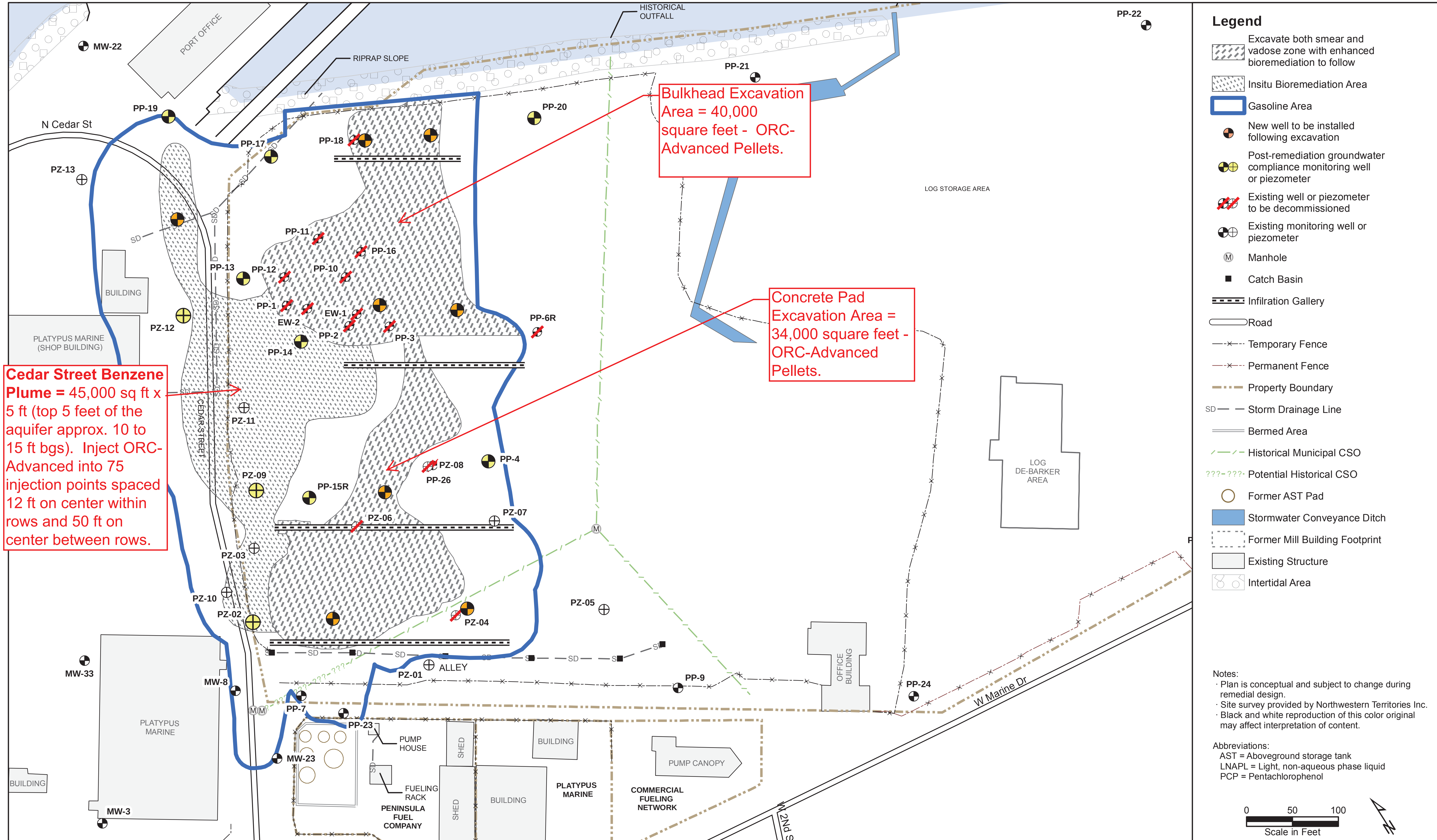
We recommend collecting the following groundwater parameters prior to and during quarterly performance monitoring following completion of the injection activities: chemicals of concern, pH, dissolved oxygen, oxidation-reduction potential, specific conductance, chemical oxygen demand, biological oxygen demand, total and dissolved iron, and methane.

Regenesis appreciates the opportunity to present you with this proposal. If you need any additional information please feel free to contact Ashley Cedzo at 425.419.8266 (acedzo@regenesis.com) or me at 916.740.3411 (bgriffiths@regenesis.com).

REGENESIS

J. Brittain Griffiths, Jr.

J. Brittain Griffiths
Technical Manager – Western Region



Cleanup Action Plan
K Ply Site
Port Angeles, Washington

Figure 5.2
Groundwater Compliance Monitoring Well Network and Infiltration Gallery Layout

REGENESIS

ORC ADVANCED OXYGEN RELEASE COMPOUND

Design Summary Output

Regenesis Technical Support: USA (949) 366-8000
www.regenesis.com

Date:	5/12/2015
Site Name:	K Ply
Location:	Cedar Street Benzene Plume
Consultant (Firm/Name):	Floyd Snider

ORC Advanced Grid Design Specifications
K Ply
Cedar Street Benzene Plume

Design Specifications	Quantity	Units
Treatment Area Size	45,000	ft^2
Depth to Top Treatment Interval	10	ft
Depth to Bottom Treatment Interval	15	ft
Vertical Treatment Thickness	5	ft
Number of Injection Points	90	---
Injection Point Spacing (within rows)	10	ft on center
Injection Point Spacing (between rows)	50	ft on center
Total Linear Drilling	1,350	ft
Product Quantities	**Quantity**	**Units**
ORC Advanced per Foot	5	lbs
ORC Advanced per Point	25	lbs
Total ORC Advanced	2,280	lbs
Field Mixing/Injection Ratios		**Units**
ORC Advanced Slurry %	30%	%
Mixing Water per Foot	1.4	gallons
Mixing Water per Point	7	gallons
Total Water for Mixing	638	gallons
Injection Slurry (Water + ORC-A) per Foot	1.6	gallons
Injection Slurry (Water + ORC-A) per Point	8	gallons
Total Injection Slurry (all Points)	740	gallons

K-Ply Site RegenOx Part A/Part B + ORC-A Pellets

Bulkhead Excavation: 40,000 ft2 of excavation area with a single excavation unit cell size of 40 x 40 x 4 ft ≈ 25 cells

Total Excavation Depth 12 ft. Target treatment zone 10 to 12 feet bgs.

Application: 9,036 lbs. ORC-A pellets evenly mixed from 10 to 12 feet bgs. This equates to approximately 361 lbs of ORC-Advanced Pellets per 40 x 40 x 2 foot cell.

Concrete Pad Excavation: 34,000 ft2 excavation with a single excavation unit cell size of 40 x 40 x 4 ft ≈ 21.25 cells

Total Excavation Depth 12 ft; Target treatment zone 10 to 12 feet bgs.

Application: 7,714 lbs. ORC-A pellets evenly mixed from 10 to 12 feet bgs. This equates to approximately 359 lbs of ORC-Advanced Pellets per 40 x 40 x 2 foot cell.

RegenOx Contingency Applicaiton

Application Related Instructions are based on an assumed DTGW of 10 feet BGS

Apply RegenOx Part A (dry) into the base of each 40 x 40 x 2 ft excavation cell using a front end loader bucket. Mix the RegenOx Part A into the floor of each excavation cell using the excavator bucket. It is necessary to mix these materials as thoroughly as is practicable into the saturated soil section prior to addition of RegenOx Part B + water solution.

Technical Note: the dose response of RegenOx or any oxidant is directly proportional to the level of contact between the oxidant and the contaminant. On excavation sites where RegenOx is mixed into the contaminated soil section it is a best practice to thoroughly mix dry Part A into the saturated native soil section and follow up with application of Part B (activator) as 9-10% solution with water. Upon spray application of the Part B solution onto the excavation floor the solution is physically mixed into the target treatment zone (native soil + RegenOx Part A) using the backhoe bucket. This two-step soil mix process ensures the greatest contact between the Part A oxidant, Part B activator solution and the contaminants.

Part B + Water solution mixing can be easily accomplished using an appropriately sized conical bottom tank. We suggest that the Part B and water solution be mixed in an appropriately sized tank. The best practice is to use mechanical means of mixing the Part B and water into a slurry. Part B is not soluble in water, as such it must be physically agitated to ensure formation of an even diluted solution.

Delivery of the Part B activator will be in 400 lb./50 gallon drums. Prior to transfer we recommend that each drum be homogenized using an electric drill equipped with a paddle mixer. Upon homogenization of the drum contents use a standard electric drum pump to transfer the 2.5 - 50 gallon drums of Part B into 1,100 gallons of water. Mix thoroughly for 5-8 minutes (minimum of 2 turnover volumes) using a centrifugal pump rated at 150-200 gallons per minute.

Spray apply the entire Part B solution into the excavation bottom using the centrifugal pump + an appropriate hose and nozzle set while thoroughly mixing the Part B activator into the TTZ using the back hoe bucket.

Technical Note: it is very common to observe foaming and bubbling of the RegenOx mixture. This is a common reaction and is directly associated with contaminant destruction.

ORC-A Pellet Only Application

Application of ORC-A pellets into each 40 x 40 ft excavation unit is best accomplished by emptying a predetermined number of 40 lb plastic lined bags of ORC-A pellets into the excavator's back hoe bucket (along with RegenOx Part A as applicable). Lower the bucket into the excavation and mix thoroughly with a predetermined unit of soil (see above for ORC-A rates of application per unit of soil).

REGENESIS ORC ADVANCED® PELLETS

Dust Minimizing Formulation for Excavations, Tank Pits and Trenches

PRODUCT APPLICATION INSTRUCTIONS

Introduction

The features and benefits of controlled-release, ORC Advanced are posted in other areas (product brochure, www.regenesis.com, and MSDS). From the field application standpoint, the benefits of ORC Advanced® Pellets (ORC-A Pellets) are in ease of handling and Health & Safety. Pelletized ORC Advanced is much easier to use because it eliminates the need for water and equipment associated with spray application and Health & Safety are dramatically improved by elimination of ORC Advanced dust and associated respiration issues. The later feature makes the material much easier to handle in open-air application approaches such as excavations and trenches.

Design Considerations

The new configuration of this material does not change the quantity estimated in the design process. The materials' available oxygen is up to 17% by weight and its physical attributes are designed to be easier to handle through the use of a pelletized version of the product and the elimination of the dust associated with dry application of ORC Advanced powder.

Application Methods

The pelletized form allows the user to simply and easily apply the ORC Advanced in a dry format using existing on-site operations or by manual methods. Some typical methods include:

- Application via the excavator bucket:
  - Simply insert a pre-determined quantity (unit - bucket or bag) of ORC-A Pellets into an excavator bucket and use the excavator to mix and distribute the ORC-A Pellets into previously backfilled soil
- Application via manual or mechanical broadcasting/spreaders:
  - Manually or mechanically broadcast/spread pelletized ORC-A Pellets into the excavation at a pre-determined rate per unit of backfill material or per soil lift (as the soil is being backfilled)
  - Follow the manual broadcast step with mechanically mixing the ORC-A Pellets directly into the backfill using the excavator equipment

Example Estimates:

Using an example unit weight of ORC-A Pellets (40 lb. bag)

For a 0.1% weight of ORC-Advanced to backfill:

- Each 100,000 lbs. of soil
- Apply 100 lbs. (4 buckets) ORC-A Pellets

PRODUCT APPLICATION INSTRUCTIONS

For a 0.2% weight of ORC-Advanced to backfill:
- Each 100,000 lbs. of soil
- Apply 200 lbs. (approx. 5 bags) ORC-A Pellets

Example Estimates (SI Units):

Using an example unit weight of ORC-A Pellets (18.1 kg bag)

For a 0.1% weight of ORC-A Pellets to backfill:
- Each 45 metric tons of soil
- Apply 45 kg (approx. 3 bags) ORC-A Pellets

For a 0.2% weight of ORC-A Pellets to backfill:
- Each 90 metric tons of soil
- Apply 90 kg (approx. 5 bags) ORC-A Pellets

REGENESIS

Oxygen Release Compound (ORC®)
&
Advanced Formula Oxygen Release Compound (ORC Advanced™)

INSTALLATION INSTRUCTIONS

SAFETY

Pure ORC and ORC Advanced are shipped as fine white and pale yellow powders, respectively. ORC is considered to be a mild oxidizer while ORC Advanced is considered an oxidizer therefore both products should be handled with care while in the field. Field personnel should take precautions while installing either the ORC or ORC Advanced product. Typically, the operator should work upwind of the products as well as use the appropriate personal protection equipment (PPE) which includes eye, respiratory protection, and gloves as deemed appropriate by exposure duration and field conditions. In addition, personnel operating the field equipment utilized during installation activities should have appropriate training, supervision and experience.

GENERAL GUIDELINES

ORC/ORC Advanced can be installed in the contaminated saturated zone in the ground utilizing hand-augured holes, direct-push, hollow stem augers or air/mud-rotary drilling techniques. For optimum results, the ORC/ORC Advanced slurry should be installed across the entire vertical contaminated saturated thickness, including the capillary fringe and "smear zone."

Two general approaches are available for installation of these products. The first is to inject the ORC/ORC Advanced slurry through direct-push drive rods across the contaminated saturated zone and the second is to backfill the application points with the ORC/ORC Advanced slurry. Using the injection method should increase oxygen dispersion in the zone of interest over the life of the project because the ORC/ORC Advanced slurry affects a larger zone right from the start. If the backfill method is used more time may be required for the completion of the remediation process because oxygen distribution will be most likely be less.

It is important that the installation method and specific ORC/ORC Advanced slurry point location be established prior to field installation. It is also important that the ORC/ORC Advanced slurry volume and solids content for each drive point be pre-determined. The Regenesis Technical Services Group is available to discuss these issues. The Helpful Hints at the end of these instructions offers relevant information. Further information regarding ORC/ORC Advanced is available on the Regenesis website at www.regenesis.com.

SPECIFIC INSTALLATION PROCEDURES

1. Identify the location of all underground structures, including utilities, tanks, and distribution piping, sewers, drains, and landscape irrigation systems.

2. Identify surface and aerial impediments.

3. Adjust planned installation locations for all impediments and obstacles.

4. Pre-mark the installation grid/barrier point locations, noting any that have special depth requirements.

5. Set up the unit over each specific point, following manufacturer recommended standard operating procedures (SOP).

The section below contains instructions for augured-hole (hollow stem or air/mud rotary) applications. For direct-push applications, go to the following section.

<u>**Instructions for Augured Whole Applications**</u>

6. Hand augering and solid stem auger applications will generally require the soil matrix to stay open during auger removal. If this is the method being used, the ORC/ORC Advanced slurry should be installed immediately upon tool removal from the borehole.

7. Mix the appropriate quantity of ORC/ORC Advanced slurry for the current application point. Do not mix more slurry than will be used within a 30-minute period because the slurry could solidify and become useless.

8. Where soil conditions are unstable in the saturated zone, we recommend using a thicker ORC/ORC Advanced slurry. A solids content of 65-67% (consistency of toothpaste) is appropriate in these situations, since it comes relatively close to mimicking the density of soil.

9. <u>**Tremie pipe option #1**</u>: The slurry may be pumped through standard geotechnical slurry pumps and a tremie hose/pipe. We strongly recommend following the equipment manufacturer's standard operating instructions. Regenesis recommends that the tremie application be performed from the bottom of the hole up to the top of the capillary fringe. This is especially important if there is groundwater in the bottom of the installation hole, since it serves to maintain the densest portion of the ORC/ORC Advanced slurry mix.

10. <u>**Tremie pipe option #2**</u>: In relatively shallow situations, a tremie pipe may be used. Depending on the open hole diameter, a PVC tremie pipe with a one- to two-inch diameter may be used. The hole should be filled from the bottom of the hole to the top of the capillary fringe. It is normally a good idea, and may sometimes be a necessity, to use a "plunger" inside the tremie pipe to push the slurry through as the pipe is withdrawn. A funnel to pour slurry into the tremie pipe is advised.

11. **Hollow-stem auger option #1**: If the borehole being drilled would collapse during tool removal, augering applications require a hollow stem. By drilling with a plug in place, an open temporary source hole is created. The slurry may be installed with a tremie pipe or a tremie pump, following the pump manufacturer's operating instructions. Depending on the saturated zone soil conditions, it may be necessary to carefully coordinate the rate of auger withdrawal with the rate of slurry addition to preserve the hole void space for acceptance of the slurry.

12. **Hollow stem auger option #2 (auger as "tremie pipe")**: When soil conditions in the saturated zone are unstable and borehole collapse is likely, the hollow stem auger may be used as a tremie pipe. Prior to dropping the auger plug at the bottom of the hole, the ORC/ORC Advanced slurry is poured directly into the hollow stem, in a volume equal to the expected requirement for the hole. A plunger inside the auger is used to push the slurry down in the hole to keep it there as the auger is removed.

Skip the next section and proceed to Step 13.

For Direct-Push Applications

6. Push the drive rods (A 1.5-inch pre-probe can be used but is not recommended) with the detachable tip to the maximum desired depth. Standard drive rods (typically 1.25-inch O.D.) should be used. Pre-counted drive rods should be positioned prior to the installation driving procedure to assure the desired depth is reached.

7. Disconnect the drive rods from the implantable tip, following standard equipment procedures.

8. Mix the appropriate quantity of ORC/ORC Advanced slurry for the current injection point. Do not mix more slurry than will be used within a 30-minute period.

9. Set up and operate an appropriate slurry pump according to manufacturer's directions. Connect the pump to the probe puller/injector connector via a standard delivery hose. The hose is then attached to the drive rod with its quick disconnect fitting. Upon confirmation of all connections, add the ORC/ORC Advanced slurry to the pump hopper/tank.

10a. **Injection Application (if this is a backfill application, go to step 10b)**: While slowly withdrawing the drive rods, pump the pre-determined amount of ORC/ORC Advanced slurry into the aquifer. Typically, ORC/ORC Advanced injection rates are based on pounds of material installed per foot of vertical treatment. Observe pump pressure levels for indications of slurry dispersion and/or slurry refusal into aquifer (increasing pressure indicates reduced acceptance of material by the aquifer). As an optional pre-treatment step, pump one to two gallons of tap water into the aquifer to enhance dispersion pathways from the probe hole.

10b. **Backfill Application**: Pump the pre-determined quantity of ORC/ORC Advanced slurry into the borehole being treated. Observe pump pressure levels for indications of slurry dispersion and/or slurry refusal into aquifer (increasing pressure indicates reduced acceptance of material by the aquifer).

11. Remove one four-foot section of the drive rod. If the drive rod contains slurry, return it to the ORC/ORC Advanced bucket/pump hopper for reuse.

12. Repeat steps 10 and 11 until treatment of the entire targeted thickness has been achieved. It is generally recommended that the procedure extend to the top of the capillary fringe/smear zone.

13. Place an appropriate seal, such as bentonite, above the ORC/ORC Advanced slurry through the entire vadose zone. This helps ensure that the slurry stays in place and prevents contaminants from migrating go the surface. Depending on soil conditions and local regulations, a bentonite seal can be pumped through the grout pump or added via chips or pellets after the drive rods have been removed.

14. Remove and decontaminate the drive rods and pre-probe (optional).

15. Finish the probe hole at surface as appropriate (concrete or asphalt cap, if necessary).

16. Move to the next injection point, repeating steps 5 through 15.

HELPFUL HINTS

1) Physical characteristics

The ORC/ORC Advanced slurry is made using the dry ORC/ORC Advanced powder makes a smooth slurry, the consistency of which depends on the amount of water used.

A 65-67% solids content ORC/ORC Advanced slurry (consistency of toothpaste) is thick but can still be pumped easily. This solids content slurry is normally used for back filling a borehole or probe hole. It is especially useful in situations where maximum density is desired, such as when ground water is present in the hole or when there are heaving sands.

As a rule, it is best to mix the first batch of slurry at the maximum solids content one would expect to use. The slurry can then be thinned by adding water in small increments. By monitoring this process, the appropriate quantities of water for subsequent batches can be determined.

The slurry should be mixed at about the time it is expected to be used. It is best not to hold it for longer than 30 minutes. Thinner slurries can experience separation if they stand too long. All solids content ORC/ORC Advanced slurries have a tendency to form a weak cement when left standing for extended periods or time. If a slurry begins to thicken too much, it should be mixed again and additional water should be added.

The ORC/ORC Advanced slurry should not be left sitting inside a grout pump or hose for extended periods because it will begin to set-up and harden. This problem can generally be avoided by re-circulating the slurry through the pump and hose back into the pump's hopper or mixing tank.

2) *Pump Equipment Cleaning and Maintenance*

Pumping equipment and drive rods can be lightly cleaned by circulating clear water through them. If necessary, further cleaning and decontamination should be performed according to the equipment supplier's standard procedures and local regulatory requirements.

3) *General Operating Procedures for Backfill Applications*

When performing a backfill installation, it is important to fill the appropriate portion of the hole with a thick (65-67% solids content) slurry that will solidify in place. Moderate amounts of pressure should be used to avoid fracturing the soil matrix or pumping slurry into the soil.

The operator should use care and monitor pumping pressures and quantities to ensure that the hole is being filled without pushing excess material into the soil matrix. Ideally, the rate of slurry pumping will be coordinated with the rate of drive rod withdrawal. It is usually important to install the slurry material to the top of the capillary fringe.

In addition, it is important that the entire contaminated saturated zone is treated (including the capillary fringe), as this is often the location of highest contaminant concentrations. Failure to properly treat this area can undermine an otherwise successful remediation effort.

REGENESIS

DIRECTIONS FOR ORC Advanced® SLURRY MIXING

1. Open the 5-gallon bucket and remove the pre-measured bag of ORC Advanced (each bag contains 25 lbs of ORC Advanced).

2. Measure and pour water into the 5-gallon bucket according to the desired slurry consistency (a slurry calculation table is available on the Regenesis software in the Appendix tab):

% Solids	Quantity of ORC Advanced (lbs)	Quantity of Water (gal)
65	25	1.6
60	25	2.0
55	25	2.5
50	25	3.0
45	25	3.7
40	25	4.5
35	25	5.6
30	25	7.0
25	25	9.0
20	25	12.0

3. Add the corresponding quantity of water to the pre-measured quantity of ORC Advanced.

4. Use an appropriate mixing device to thoroughly mix the ORC Advanced and water together. A hand-held drill with a "jiffy mixer" or a stucco mixer on it may be used in conjunction with a small paddle to scrape the bottom and sides of the container. Standard environmental slurry mixers may also be used, following the equipment instructions for operation. For small quantities, the slurry can be mixed by hand if care is taken to blend all lumps into the mixture thoroughly.

CAUTION: **ORC Advanced may settle out of slurry if left standing.** ORC Advanced eventually hardens into a cement-like compound and cannot be re-mixed after that has occurred. Therefore, mix immediately before using to ensure that the mixture has not settled out. **Do not let stand more than 30 minutes.** If a mechanical slurry mixer attached to a pump is being used, the material may be cycled back through the mixer to maintain slurry suspension and consistency.

ORC Advanced™
Example Specification

Enhanced Aerobic Bioremediation Amendment
Specification for Slow Release Oxygen Source:

Slow Release Oxygen Source

Vendor shall supply ________________lbs of an oxygen releasing amendment. The oxygen releasing amendment shall have a proven track record for stimulating *in situ* aerobic bioremediation of contaminants and be acceptable for use in environmental restoration projects.

The oxygen releasing amendment shall offer at least 17% wt/wt active oxygen release when taking into consideration the total weight of all material constituents. The oxygen releasing amendment shall offer a controlled release technology with a documented track record for releasing oxygen into groundwater for periods of time exceeding 12 months in environmental settings similar to the subject site.

An acceptable oxygen releasing amendment would be ORC-Advanced® or an equivalent solid oxygen releasing compound incorporating a documented phosphate intercalation slow release technology so as to achieve the required 12 month oxygen release profile.

Application Services

Vendor shall supply all necessary services to properly apply the oxygen releasing amendment into the subsurface. Application will require direct injection of the oxygen releasing amendment to the locations and depths as specified by the design.

ORC-Advanced™ Pellets
Example Specification

Enhanced Aerobic Bioremediation Amendment Specification for Slow Release Oxygen Source:

Slow Release Oxygen Source

Vendor shall supply ________________ lbs of a pelletized oxygen releasing amendment. The oxygen releasing amendment shall have a proven track record for stimulating *in situ* aerobic bioremediation of contaminants and be acceptable for use in environmental restoration projects.

The oxygen releasing amendment shall offer up to 17% wt/wt active oxygen release when taking into consideration the total weight of all material constituents. The oxygen releasing amendment shall offer a controlled release technology with a documented track record for releasing oxygen into groundwater for periods of time exceeding 12 months in environmental settings similar to the subject site.

An acceptable oxygen releasing amendment would be ORC-Advanced Pellets® or an equivalent solid oxygen releasing pelletized compound incorporating a documented phosphate intercalation slow release technology so as to achieve the required 12 month oxygen release profile.

Application Services

Vendor shall supply all necessary services to properly apply the pelletized oxygen releasing amendment into the subsurface. Application will require direct mixing of the oxygen releasing amendment with the backfill at the locations and depths specified by the design.

K Ply Site

Engineering Design Report

Appendix F
Biological Amendment Design

Attachment F.2
Mass Calculation Sheets

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X Calculation
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☐ Memorandum

Date: 5/11/15

Project No.: POPA - KPly

Created by: J. Pracht

Reviewed by: Tom Colligan 5/12/15

Subject: K-PLY MASS CALCULATIONS — GROUNDWATER REMOVAL

GOAL: DETERMINE HOW MUCH OXYGEN IS REQUIRED TO DEGRADE RESIDUAL GRO CONTAMINATION IN GROUNDWATER AND SOIL

ASSUMING HEXANE:

$$2C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O$$

$mW_{C_6H_{14}} = 86$
$mW_{O_2} = 32$

lbs of O_2 to degrade 1 lb Hexane $= \frac{19(32)}{2(86)} = \frac{608}{172} = \boxed{3.5 \text{ lbs}}$

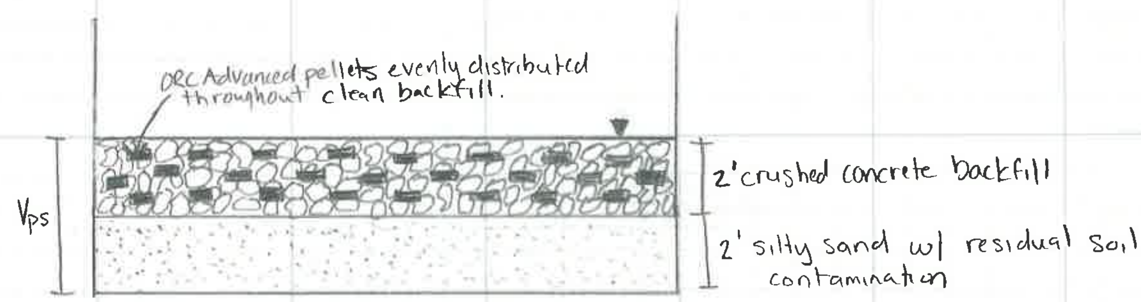
ASSUMING OCTANE:

$$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$$

$mW_{C_8H_{18}} = 114$
$mW_{O_2} = 32$

lbs of O_2 to degrade 1 lb Octane $= \frac{25(32)}{2(114)} = \frac{800}{228} = \boxed{3.5 \text{ lbs}}$

Area of Excavation $= 74{,}000 \text{ ft}^2$
Groundwater Treatment Thickness $= 4 \text{ ft}$
Porosity $= 0.4$ (conservative estimate for crushed concrete)
ORC Oxygen Content $= 17\%$



Vps = Volume of pore space (water) to be treated

$$V_{ps} = 74{,}000 \text{ ft}^2 \cdot 4 \text{ ft} \cdot 0.4 \cdot \frac{28.3 \text{ L}}{\text{ft}^3} = 3{,}350{,}720 \text{ L of water}$$

Residual TPHg concentration in groundwater = 5000 ppb

$$5000 \text{ ppb} \cdot \frac{1 \text{ mg/L}}{1000 \text{ ppb}} \cdot \frac{1 \text{ g}}{1000 \text{ mg}} \cdot 3{,}350{,}720 \text{ L} \cdot \frac{0.0022 \text{ lbs}}{\text{g}} = \boxed{37 \text{ lbs TPH}_g}$$

Oxygen Required $= (37)(3.5) \cong \boxed{130 \text{ lbs } O_2}$ ORC Required $= \frac{130}{0.17} = \boxed{764 \text{ lbs ORC}}$

✓

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Date: 5/11/15
Project No.: POPA-KPly

Created by: J. Pracht
Reviewed by: Tom Colligan 5/12/15

Subject: K-PLY MASS CALCULATIONS - SOIL RESIDUAL

Soil 40x40 Treatment Cells

Area = 40 ft x 40 ft = 1600 ft^2

Number of Treatment Cells = $\frac{74{,}000\ ft^2}{1600\ ft^2}$ = 46.25

Two Options for Treatment Cell Thickness: 1 ft, 2 ft

(v) Volume (option 1) = 1600 $ft^2 \cdot$ 1 ft = 1600 ft^3

(v) Volume (option 2) = 1600 $ft^2 \cdot$ 2 ft = 3200 ft^3

TPHg residual soil concentration (C_{TPHg})

30 mg/kg (CUL) ✓

100 mg/kg ✓

500 mg/kg ✓

ρ_{soil} = 110 lbs/ft^3 (Density) ✓

Equation:

$$Mass_{TPHg}(g) = C_{TPH}\left(\frac{mg}{kg}\right) \cdot \frac{1\ kg}{2.2\ lbs} \cdot \frac{1\ g}{1000\ mg} \cdot \rho_{soil}\left(\frac{lbs}{ft^3}\right) \cdot V(ft^3)$$

$$Mass_{TPHg}(lbs) = Mass_{TPHg}(g) \cdot \frac{0.0022\ lbs}{g}$$

$$O_2\ Required = Mass_{TPHg}(lbs) \cdot 3.5$$

TPHg Conc	grams TPHg	lbs TPHg	lbs O_2 Required	
30 mg/kg	2400	5.3 ✓	19	Option 1 — 1 ft thickness
100 mg/kg	8000	18 ✓	62 ✓	
500 mg/kg	40,000	88 ✓	309 ✓	
30 mg/kg	4800	11	37	Option 2 — 2 ft thickness
100 mg/kg	16,000	35	124 ✓	
500 mg/kg	80,000	176	618 ✓	

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Date: 5/11/15

Project No.:

Created by: J. Pracht

Reviewed by:

Subject: K-PLY MASS CALCULATIONS

$$\text{ORC Required} = \frac{\text{lbs of } O_2}{0.17}$$

ORC Required per 40x40 Cell

	Option 1	Option 2
30 mg/kg	109 lb	218 lb
100 mg/kg	363 lb	727 lb
500 mg/kg	1816 lb	3633 lb

K Ply Site

Engineering Design Report

Appendix F
Biological Amendment Design

Attachment F.3
Infiltration Gallery Calculation Sheets

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Date: 5/14/15
Project No.: POPA-KP1y

Created by: J. Pracht
Reviewed by: T. Stevens

Subject: Hydrogen peroxide Mass Calcs

Goal: How much H_2O_2 (@ 3% and 6%) would be required to degrade residual groundwater concentrations?

Assuming Octane

$$2C_8H_{18} + 25O_2 \longrightarrow 16CO_2 + 18H_2O$$

lbs of O_2 to degrade lbs Octane: $\frac{25(32)}{2(114)} = \frac{800}{228} \approx 3.5$ lbs

Area of groundwater contamination treated by infiltration galleries $\approx 127{,}500\ ft^2$
Groundwater Treatment Thickness = 4 ft
Porosity - 0.3 (conservative estimate for crushed concrete & silty sand)
Molecular weight H_2O_2 = 34
Molecular weight O_2 = 32

% O_2 by weight = 32/34 = 94%

Volume of pore space (water) to be treated

$V_{ps} = 127{,}500\ ft^2 \cdot 4\ ft \cdot 0.3 \cdot \frac{28.3\ L}{ft^3} = 4{,}329{,}900$ L of water

Residual TPH_g = 5000 ppb

$5000\ ppb \cdot \frac{1\ mg/L}{1000\ ppb} \cdot \frac{1\ g}{1000\ mg} \cdot 4329900\ L \cdot \frac{0.0022\ lbs}{g} = 47$ lbs TPH_g

Residual TPH_g = 500 ppb

$500\ ppb \cdot \frac{1\ mg/L}{1000\ ppb} \cdot \frac{1\ g}{1000\ mg} \cdot 4329900\ L \cdot \frac{0.0022\ lbs}{g} = 4.7$ lbs TPH_g

5000 ppb - Oxygen required = (47)(3.5) = 164.5 lbs O_2
3% H_2O_2 solution required = $\frac{164.5\ lbs\ O_2}{(0.94)(0.03)}$ = 5833 lbs 3% H_2O_2 $\cdot \frac{1\ gal}{8.33\ lb}$ = 700 gal
6% H_2O_2 solution required = $\frac{164.5\ lbs\ O_2}{(0.94)(0.06)}$ = 2917 lbs 6% H_2O_2 $\cdot \frac{1\ gal}{8.33\ lb}$ = 350 gal

500 ppb - Oxygen required = (4.7 lbs)(3.5) = 16.45 lbs O_2
3% H_2O_2 required = 16.45 lbs O_2/(0.94)(0.03) = 583.3 lbs 3% H_2O_2 · 1 gal/8.33 lb = 70 gal
6% H_2O_2 required = 16.45 lbs O_2/(0.94)(0.06) = 291.7 lbs 6% H_2O_2 · 1 gal/8.33 lb = 35 gal

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Date: 5/13/15
Project No.: POPA-KPly

Created by: J. Pracht
Reviewed by: T. Stevens

Subject: Infiltration Gallery Piping Design

Goal: Determine flow rate and capacity of a 6" pipe with slope = 0.5%.

For 6-inch pipe flowing full: Manning Equation

$$Q_p = \frac{1.49}{n}\left(\pi \frac{D^2}{4}\right)\left(\frac{D}{4}\right)^{2/3} S^{1/2}$$

Q_p = flow through pipe, cfs
n = roughness coefficient = 0.01 for PVC
D = Pipe diameter = 6" = 0.5 ft
S = Slope = 0.5% = 0.005

$$Q_p = \frac{1.49}{0.01}\left(\pi \frac{(0.5\,ft)^2}{4}\right)\left(\frac{0.5\,ft}{4}\right)^{2/3}(0.005)^{1/2}$$

$$Q_p = 0.517\,cfs \cdot \frac{449\,gpm}{1\,cfs} = \underline{\underline{232\,gpm}}$$

Total Capacity of 1070 feet of 6" pipe

Area $= \pi\left(\frac{0.5}{2}\right)^2 = 0.196\,ft^2$
Volume $= (1070\,ft)(0.196\,ft^2) = 210\,ft^3$

$1\,ft^3 = 7.48$ gallons

$$210\,ft^3 \cdot \frac{7.48\,gallons}{1\,ft^3} = \underline{\underline{1572\,gallons}}$$

$$\text{Capacity per foot} = \frac{1572\,gallons}{1070\,ft} \approx \underline{\underline{1.47\,gallons/ft}}$$

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Date: 5/13/15
Project No.: POPA-KPly
Created by: J. Pracht
Reviewed by: T. Stevens
Subject: Infiltration Gallery Piping Design

Goal: Determine flow through 0.5" and 1" orifice and number of perforations desired per length of pipe

Length of each infiltration gallery segment
① 130 ft
② 220 ft
③ 200 ft
④ 260 ft
⑤ 260 ft

Orifice Equation (Assume free flow - not limited by soil capacity)

$Q_0 = C_d A \sqrt{2gh}$

Q_0 = flow through an orifice, cfs
C_d = coefficient of discharge
A = Area of the orifice, ft^2
g = Acceleration due to gravity, 32.2 ft/s^2
h = height of water surface above perforation

For ½" perforation (assume pipe full flow)

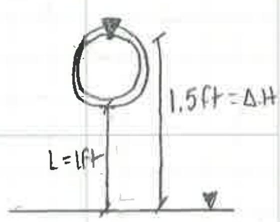
$$Q_0 = 0.6 \cdot \pi \left(\frac{0.5\,in \cdot \frac{1\,ft}{12\,in}}{2} \right)^2 \cdot \sqrt{2 \cdot 32.2\,ft/s^2 \cdot 0.5\,ft}$$

$$Q_0 = 0.00464\,cfs \cdot \frac{449\,gpm}{1\,cfs} \approx \underline{\underline{2.1\,gpm}}$$

For 1" perforation (assume pipe full flow)

$$Q_0 = 0.6 \cdot \pi \left(\frac{1\,in \cdot \frac{1\,ft}{12\,in}}{2} \right)^2 \cdot \sqrt{2 \cdot 32.2\,ft/s^2 \cdot 0.5\,ft}$$

$$Q_0 = 0.01857 \cdot \frac{449\,gpm}{1\,cfs} = \underline{\underline{8.3\,gpm}}$$



Flow through soil will be the limiting factor
Hydraulic conductivity varies from 10^{-5} cm/s to $\underline{10^{-2}}$ cm/s

Flow through soil per perforation (½" & 1")

$Q = KiA$ Q = flow through soil i = hydraulic gradient = $\frac{\Delta H}{L}$ A = Area of one perforation

$$Q_{1/2} = 10^{-5} \frac{cm}{s} \cdot \frac{0.0328\,ft}{1\,cm} \cdot \frac{1.5\,ft}{1\,ft} \cdot \pi \left(\frac{0.5/12\,ft}{2} \right)^2 \cdot \frac{449\,gpm}{1\,cfs} = 3.0 \times 10^{-7}\,gpm$$

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Date: 5/13/15
Project No.: POPA-KPly
Created by: J. Pracht
Reviewed by: T. Stevens
Subject: Infiltration Gallery Piping Design

$$Q_{1/2} = 10^{-2}\frac{cm}{s} \cdot \frac{0.0328\ ft}{1\ cm} \cdot \frac{1.5\ ft}{1\ ft} \cdot \pi\left(\frac{0.5/12}{2}\right)^2 \cdot \frac{449\ gpm}{1\ cfs} = 3.0\times10^{-4}\ gpm$$

1-inch perforation

$$Q_1 = 10^{-5}\frac{cm}{s} \cdot \frac{0.0328\ ft}{s} \cdot \frac{1.5\ ft}{1\ ft} \cdot \pi\left(\frac{1/12}{2}\right)^2 \cdot \frac{449\ gpm}{1\ cfs} = 1.2\times10^{-6}\ gpm$$

$$Q_1 = 10^{-2}\frac{cm}{s} \cdot \frac{0.0328\ ft}{s} \cdot \frac{1.5\ ft}{1\ ft} \cdot \pi\left(\frac{1/12}{2}\right)^2 \cdot \frac{449\ gpm}{1\ cfs} = 1.2\times10^{-3}\ gpm$$

Flow through 1/2" perforation: 3.0×10^{-7} to 3.0×10^{-4} gpm
(soil limiting)

Flow through 1" perforation: 1.2×10^{-6} to 1.2×10^{-3} gpm
(soil limiting)

How long to drain 700 gal H_2O_2 with 1" holes every 6"?

Length of pipe 1070, so 2138 holes

Assume 1.2×10^{-4} gpm per hole (mid range from above analysis)

2138 holes $\cdot\ 1.2\times10^{-4}$ gpm = 0.257 gpm (total)

$$700\ \text{gallons} \cdot \frac{min}{0.257\ gal} \cdot \frac{1\ hr}{60\ min} \cdot \frac{1\ day}{24\ hr} = 1.9\ \text{days}$$

K Ply Site

Engineering Design Report

Appendix G
Sampling and Analysis Plan/
Quality Assurance Project Plan

Table of Contents

List of Tables

List of Figures

List of Abbreviations and Acronyms

Acronym/ Abbreviation	Definition
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylenes
COC	Contaminant of concern
DO	Dissolved oxygen
DRO	Diesel-range organics
Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
GRO	Gasoline-range organics
HCID	Hydrocarbon identification
NAPL	Non-aqueous phase liquid
ORO	Oil-range organics
PID	Photoionization detector
Port	Port of Port Angeles
QA/QC	Quality assurance/quality control
RI/FS	Remedial Investigation/Feasibility Study
SAP/QAPP	Sampling and Analysis Plan/Quality Assurance Project Plan
Site	K Ply Site

1.0 Project Description

This Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) presents the specific field protocols and field and laboratory quality assurance/quality control (QA/QC) procedures associated with the cleanup action to be conducted at the K Ply Site (Site) located in Port Angeles, Washington. It is presented as an appendix to the Engineering Design Report (EDR).

1.1 INTRODUCTION

The Cleanup Action Plan describes field sampling activities to be performed as part of the cleanup action, including sampling that will be conducted as part of soil excavation activities and sampling that will be conducted as part of post excavation monitoring activities, including:

Soil excavation performance monitoring:

- Excavation confirmational sampling: includes collection of performance monitoring soil samples from post-excavation sidewalls and bottom to confirm that excavation has met site cleanup and/or remediation levels.
- Soil stockpile screening and sampling: includes field screening and sampling of excavated soil or imported soil to assess its appropriateness for use as excavation backfill.
- Long-term soil monitoring: includes initial collection of samples outside of the excavation areas to better define the extent of remaining contamination exceeding site cleanup levels. Additional confirmational monitoring soil samples will be collected every 5 years to assess the rate of natural degradation of petroleum hydrocarbons and determine whether additional soil treatment is necessary to achieve site soil cleanup levels.
- Long-term Groundwater Monitoring: includes collection of groundwater samples to define post-excavation site conditions and collection of groundwater samples in new and existing wells to assess the effectiveness of the remedial action. Compliance monitoring groundwater samples will also be collected to assess whether site cleanup levels are being met at the point of compliance.

Stormwater sampling:

- Stormwater sampling to verify that site contaminants are not being discharged to surface waters via the remedial action.

The project sampling and data management responsibilities are outlined in Section 2.0, and data quality objectives are summarized in Section 3.0. Sampling plans for performance monitoring, long-term soil monitoring, and long-term groundwater monitoring are presented in Sections 4.0 through 6.0. Field sample collection protocols for all sampling activities are presented in Section 7.0.

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2.0 Project Organization and Responsibility

The various QA field, laboratory, and management responsibilities of key project personnel are defined below.

2.1 MANAGEMENT RESPONSIBILITIES

Jesse Waknitz—Port of Port Angeles

Jesse Waknitz is the Port of Port Angeles' (Port's) primary point of contact. He will perform the following:

- Authorize and coordinate access for field activities.
- Assist with field activities.
- Review and approve all reports (deliverables) before their submission to Washington State Department of Ecology (Ecology).
- Manage the disposal of any investigation-derived waste.

Tom Colligan—Floyd|Snider Project Manager

Tom Colligan, Project Manager, will have overall responsibility for project implementation. As Project Manager he will be responsible for maintaining QA on this project and ensuring that the Remedial Investigation/Feasibility Study (RI/FS) Work Plan (Floyd|Snider 2013) objectives are met. The Project Manager will perform the following:

- Approve the SAP/QAPP.
- Monitor project activity and quality.
- Provide overview of field activities to the Port and Ecology.
- Provide technical representation of project activities at meetings.

Tucker Stevens—Floyd|Snider Project Engineer

Tucker Stevens, Project Engineer, will have overall responsibility for implementation of the cleanup action. As Project Engineer, he will be responsible for ensuring that the remedial objectives are met. The Project Engineer will perform the following:

- Approve contractor plans.procedures for contaminated media handling and disposal to ensure consistency with the Cleanup Action Plan and EDR.
- Provide overview of field activities to the Port and Ecology.
- Prepare and review the draft completion reports.
- Provide technical representation of project activities at meetings.
- Oversee completion of the Construction Completion Report.

2.2 QUALITY ASSURANCE RESPONSIBILITIES

Chell Black—Floyd|Snider Data Manager

The Data Manager will be responsible for the data validation of all sample results from the analytical laboratories and entering the data into a database. Additional responsibilities include the following:

- Review of laboratory reports.
- Loading analytical data to Ecology's Environmental Information Management (EIM) database.
- Advising on data corrective action procedures.
- QA/QC on analytical data reports.
- Database management and queries.

2.3 LABORATORY RESPONSIBILITIES

An Ecology-accredited laboratory will perform all analytical services in support of the cleanup action activities.

Laboratory Project Manager

The Laboratory Project Manager will be responsible for the following:

- Coordinating laboratory analyses with Floyd|Snider.
- Reviewing and approving final analytical reports.
- Scheduling sample analyses.
- Overseeing data review.

2.4 FIELD RESPONSIBILITIES

Ken Preston—Floyd|Snider Field Supervisor

The Field Supervisor will be responsible for managing day-to-day work activities in the field. The Field Supervisor will report directly to the Floyd|Snider Project Engineer. Specific responsibilities include the following:

- Ensuring that the contractor is performing according to the plans and specifications.
- Preparing daily reports.
- Tracking project activities and schedule.
- Tracking quantities of materials used.
- Coordinating with the Project Engineer.
- Coordinating and managing work activity.
- Monitoring soil excavation and handling.

Lisa Meoli/Jenny Pracht—Floyd|Snider Field Sampling Leads

The Field Sampling Leads will be responsible for leading and coordinating sampling activities in the field. The Field Sampling Leads will report directly to the Floyd|Snider Project Engineer. Specific responsibilities include the following:

- Coordinating with the Project Engineer and Field Supervisor.
- Managing collection of excavation confirmational samples.
- Coordinating and managing field sampling staff including drillers.
- Reviewing field data including field logs and field measurement data.
- Coordinating with the laboratory.

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3.0 Sample Data Quality Objectives

The sample data quality objectives will be consistent with the sample data quality objectives presented in the RI/FS SAP. These include: laboratory QA objectives; sample handling and custody documentation; data reduction, validation, and reporting; and corrective actions.

Laboratory data QA criteria for the required soil and groundwater analyses to be performed during the cleanup action and subsequent long-term monitoring are summarized in Table G.1. The analytical methods, preservation, bottle type, and required holding times for these analyses are presented in Table G.2. The required quantitation limits for sample analyses are presented in Table G.3.

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4.0 Soil Confirmational Sampling

Confirmational sampling will be performed to ensure that the remediation goals of soil excavation are met. Such sampling includes excavation confirmational sampling and stockpile and imported fill sampling. Laboratory analytical requirements for performance monitoring sampling are presented in Table G.4.

4.1 EXCAVATION CONFIRMATIONAL SAMPLING PLAN

In order to assess whether the initial excavation depths are adequate to achieve project objectives, confirmational samples will be collected prior to excavation in the Hog Fuel Storage Area (Excavation Areas 2 and 3), Concrete Pad Area (Excavation Area 4), and Bulkhead Area (Excavation Area 6) via hollow-stem auger borings. During cleanup action excavation, confirmational samples will be collected from the excavation sidewalls via excavator or hand sampling to determine whether the excavation has also removed the lateral extents of contamination.

Bottom samples will be located on a grid with 40-foot centers, as shown on Figure G.1. At each location, samples will be collected at sequential 1-foot intervals starting at the planned elevation of the excavation bottom typically set at 2 feet below the water table. Sample collection procedures are presented in Section 7.1.1. Existing samples, previously collected during the engineering design data gaps investigation (Appendix D of the EDR), will serve as the excavation bottom confirmational samples those grid locations.

Sidewall samples from subsurface soil excavation areas will be collected at 40-lineal-foot intervals along the entire initial excavation perimeter in all excavation areas, as shown on Figure G.1. Samples will be collected from the sidewall profile with the strongest field indications of contamination, according to the procedures presented in Section 7.1.2. Sidewall samples may be collected via excavator or hand sampling after the planned horizontal limits of excavation have been reached.

4.2 SOIL FIELD SCREENING AND STOCKPILE SAMPLING PLAN

In addition to compliance monitoring soil sampling, field screening of excavated soils and sampling of stockpiled soils will also be performed during the cleanup action.

During subsurface soil excavation, all soils including presumed clean overburden will be field screened for indications of contamination. Field screening will be performed by the Project Engineer, Field Supervisor, or Field Sampling Leads. Soils determined to be potentially contaminated during field screening will be segregated for treatment or disposal. Soils determined to be potentially clean and suitable for use as backfill will be stockpiled on-site, and sampled at the frequency of one sample for every 500 cubic yards to ensure their chemical suitability for use as excavation backfill.

The stockpiles of presumed clean excavated material will be laboratory-screened using the hydrocarbon identification (HCID) method. If HCID analysis does not detect gasoline-range organics (GRO) or diesel-range organics (DRO), the soil will be confirmed clean. If HCID screening detects DRO, the sample will be analyzed to obtain a DRO and ORO concentration to compare to the Site cleanup level. If HCID screening detects GRO, the sample will be analyzed to obtain GRO and benzene, toluene, ethylbenzene, and xylenes (BTEX) to compare to the Site cleanup levels. Laboratory analytical data will be reported on a rush turnaround time of 48 to 72 hours after sample receipt, and the contractor may combine stockpiles only after they are confirmed to be clean based on non-detect HCID screening results or site contaminant of concern (COC) concentrations less than their cleanup levels.

If imported backfill material does not already have chemical analytical data provided by the source of the material, it will be sampled for site COCs as well as the Resource Conservation and Recovery Act (RCRA) 8 metals. Stockpile sample analyses are presented in Table G.4.

Soil field screening procedures are described in Section 7.2 and stockpile sampling protocols are described in Section 7.3.

5.0 Long-Term Soil Monitoring Plan

Because the planned cleanup action excavation will leave some residual GRO and BTEX contamination in place at concentrations greater than cleanup levels in some grids within, as well as outside, the Concrete Pad Area, and possibly grids in other areas, long-term soil confirmational monitoring will be conducted subsequent to completion of the excavation and at 5-year intervals thereafter. These samples will define the full limits of soil exceeding cleanup levels and also establish baseline COC concentrations within the areas, which are expected to diminish over time, to be confirmed with further testing.

To establish the full extent of soil contamination greater than cleanup levels lying outside of the final limits of excavation, soil samples will be collected at 40-foot intervals extending laterally from the limits of the excavation in areas where residual contamination was established during the RI/FS, using an extension of the same sampling grid established for excavation confirmational sampling. Samples will be analyzed for GRO and BTEX, as presented in Table G.4. Tentative long-term soil monitoring grid locations are shown on Figure G.2.

Long-term soil monitoring sampling protocols within the grids showing cleanup level exceedances will be conducted every 5 years, as described in Section 7.1.3.

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6.0 Long-Term Groundwater Monitoring Plan

Following soil excavation and in situ treatment, several new groundwater monitoring wells be installed for compliance and performance monitoring. These new wells and a subset of existing site wells will comprise the long-term monitoring well network detailed on Table G.3. The data collected from this network will be used to assess the effectiveness of in situ bioremediation and inform the need for potential future bioremediation injections according to the criteria presented in Table 3.2 of the EDR. Five new and existing wells located adjacent to the riprap slope will be sampled to determine whether site groundwater cleanup levels are being met at the conditional point of compliance.

Quarterly confirmational monitoring will be conducted for a minimum of 2 years after remedy implementation to confirm long-term remedy effectiveness. Samples will be analyzed for site COCs including GRO, BTEX, DRO, and oil-range organics (ORO), as well as parameters to monitor the conditions necessary for bioremediation, as presented in Table G.4. Groundwater confirmational monitoring will be required as long as soil COC contamination at concentrations greater than cleanup levels remains. A reduction in sampling frequency to semi-annually may occur after this initial 2-year period if results are stable or decreasing. Confirmational monitoring will be conducted until groundwater meets cleanup levels at the conditional point of compliance over four consecutive monitoring events, following which sampling will occur at a minimum frequency of once every 18 months to confirm groundwater is still in compliance. The locations of the proposed new and existing monitoring wells for performance and compliance monitoring are shown on Figure G.3. Well construction details are provided in Table G.5. The long-term groundwater monitoring plan may be modified in the future based on sampling results, in coordination with Ecology.

The new monitoring wells will be installed and developed consistent with the protocols outlined in the RI/FS SAP and K Ply Site Interim Action Work Plan (Floyd|Snider 2012). Groundwater sampling protocols are described in Section 7.4.

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7.0 Field Procedures

The following sections describe the specific protocols that will be used to collect soil samples for excavation confirmational and long-term monitoring, screen excavated soils for on-site treatment, disposal, or reuse; collect samples of stockpiled materials intended for use as excavation backfill; and collect groundwater samples.

7.1 SOIL SAMPLING PROTOCOLS

Soil sampling will include collection of excavation bottom samples via hollow-stem auger, excavation of sidewall samples via excavator or hand grabs, and long-term soil confirmational samples via direct-push borings.

7.1.1 Excavation Bottom Soil Sample Collection

Excavation bottom samples will be collected via hollow-stem auger prior to excavation activities. The soils below the observed water table will be sampled via split spoons driven 18 inches deep instead of by Geoprobes (which are driven 48 inches deep) to ensure good sample recovery, in order to accurately determine the depth of contamination at each location. Because the soils above the bottom design depth of the excavation have been investigated thoroughly during the RI, these soils will not be logged or sampled during pre-excavation sampling. During bottom sample collection, depth to groundwater in soil borings and monitoring wells and in monitoring wells near the bulkhead during a low tide cycle will also be measured to gather information about likely groundwater conditions during excavation. Samples will be collected according to the following protocols:

- Prior to drilling, measure and record depth to water below ground surface (bgs) in representative site monitoring wells. Record depth to water hourly over one low tide cycle at the five monitoring wells near the riprap slope.
- Drive 5 to 6 test borings adjacent to existing wells and compare the water table elevation as measured in the boring at the time of drilling to that in the adjacent well (for calibration purposes); temporary well screens may be placed in these calibration borings to measure the water level over time if the observed depth to water in the boring is significantly different (i.e., greater than 0.5 feet) than the depth to water observed in the well.
- In each accessible grid, advance the hollow-stem auger boring to 1 foot above the bottom design depth of the excavation (typically 11 to 12 feet bgs).
- Beginning at this depth, drive three 18-inch split spoon samples (i.e., 4.5 feet total) continuously using a 140-pound hammer.
- Open the sampler and record the length of soil recovered as a percentage of the drive length. Assign in situ depths to the recovered soil by uniformly decompressing the recovered interval (i.e., if recovery was 75 percent, each 0.75 feet of recovered soil is assigned a depth interval of 1 foot), unless obvious sample loss has occurred.

- Record the number of hammer blows required to drive the sampler, soil type, water table at time of drilling, and field indications of contamination, if present (i.e., sheen, odor, elevated photoionization detector [PID] readings or presence of non-aqueous phase liquid [NAPL]; refer to Section 7.2 for detailed soil screening protocols).
- Collect soil samples for laboratory analysis from three or four (depending on recovery) continuous 1-foot intervals beginning at or just above the initial elevation of the excavation bottom, consistent with the soil sample collection and handling procedures in the RI/FS SAP. All samples will be analyzed for BTEX and GRO. Samples collected within the Hydraulic Oil Area will also be analyzed for DRO.
- At three equally distributed locations, collect deeper soil samples by driving two additional cores to approximately 18 feet bgs to confirm that deeper intervals below the water table are not contaminated.
- The sample collected from soil lying in the first foot below the base of excavation will be analyzed for the relevant site COCs, with the remaining samples archived for future analysis as necessary, with the exception of the deeper samples, which will be analyzed across 2-foot intervals beginning at 12 feet bgs.

The Field Sampling Leads will maintain a field notebook or field boring logs recording the soil screening observations and sample collection information. Excavation bottom sample locations are shown on Figure G.1.

7.1.2 Excavation Sidewall Soil Sample Collection

The method of sidewall sample collection will be determined in coordination with the contractor, and will be dependent on safe conditions for entry into the excavation by field sampling personnel. Prior to sidewall sample collection, the excavation depth bgs will be verified by a field technician. Sidewalls will be field screened for the presence of contamination (i.e., sheen, odor, elevated PID readings, or presence of NAPL; refer to Section 7.2 for detailed soil screening protocols) after exposing a fresh soil surface if screening is not performed immediately after excavation. Samples will be collected from the depth interval with the strongest field indications of contamination.

The Field Sampling Leads will maintain a field notebook with soil screening observations including the location and depth of the soil and the screening criteria. Sidewall sample locations are shown on Figure G.1.

7.1.3 Long-Term Monitoring Soil Sample Collection

Long-term soil monitoring samples will be collected via direct push borings according to the procedures in the RI/FS SAP and Ecology-approved SAP Addendum (Floyd|Snider 2015). Samples will be collected from the depth interval with the strongest field indications of contamination (i.e., sheen, odor, elevated PID readings, or presence of NAPL; refer to Section 7.2 for detailed soil screening protocols). If field indications of contamination are not observed, a soil sample will be collected from within the 8 to 12 feet bgs smear zone where contamination was consistently encountered during the RI.

7.2 SOIL SCREENING PROTOCOLS

In the shallow Hog Fuel Storage Area excavation and PCP Area (Excavation Areas 3 and 4), the top 4 feet of soil will be presumed to be contaminated.

In the deep Hog Fuel Storage Area excavation and Concrete Pad Area excavation (Excavation Areas 2 and 5), where GRO, DRO, and/or BETX contamination are present, field screening for potential contamination will include qualitative monitoring for gasoline odors, sheen testing, and measuring volatile organic compound concentrations by PID either at a freshly exposed soil surface or in the headspace of a sealed container with a small amount of soil placed inside. The presence of gasoline odors, rainbow sheens, and/or elevated PID readings (i.e., greater than ~10 parts per million by volume [ppmv] over background) will indicate potentially contaminated soil.

In the Bulkhead Area excavation (Excavation Area 6), where GRO, BETX, and/or ORO contamination are present, field screening will include the criteria above, along with qualitative observations of ORO including the presence of hydraulic oil odor and/or NAPL. Indications of NAPL include visually oily soil, oily spots or residue when blotting the soil with a clean paper towel, an oil film that develops when soils are sheen tested, and fluorescence when soil is placed under ultraviolet light.

7.3 STOCKPILE SAMPLING PROTOCOLS

Stockpiles will be sampled at a frequency of one sample per 500 cubic yards excavated. The sample locations will be biased toward any area that may indicate residual soil contamination, if field indications are noted. Each discrete sample will be collected with a decontaminated stainless steel spoon or hand auger from depths between approximately 0.5 and 1 foot below the stockpile surface. Stockpile sample locations will be recorded for future segregation and/or additional characterization, if appropriate.

For imported backfill material, if an existing sample analysis is not available, three discrete samples per source will be collected from the first 500 yards of soil imported and composited to create a representative sample for analysis.

Samples will be placed in a decontaminated stainless steel bowl directly from the stainless steel spoon or hand-auger, homogenized, and placed in labeled, laboratory-supplied jars.

7.4 GROUNDWATER SAMPLING PROTOCOLS

Groundwater samples will be collected using low-flow techniques, following the procedures described in the RI/FS SAP.

During purging, field water quality parameters including temperature, pH, conductivity, oxidation-reduction potential (ORP) salinity, and turbidity will be measured in the purge water using a multi-parameter water quality instrument. Dissolved oxygen (DO) will be measured in the screened interval of the well using a down-well optical DO sensor. Field measurements will be recorded on a groundwater sample collection form. The last set of field parameters measured during purging will represent field parameters for the groundwater sample.

7.5 STORMWATER SAMPLING PROTOCOLS

Stormwater leaving the Site via the central drainage swale will be sampled monthly to ascertain whether site contaminants are being discharged to surface water. Sampling will occur during the first monthly rain event where and when a distinct discharge from the Site into the drainage swale is visible. Samples will be collected by dipping sample vials into the discharge until free of headspace. Samples will be analyzed for DRO, ORO, GRO and BTEX using the methodologies in Table G.2.

7.6 SAMPLE NOMENCLATURE, HANDLING, AND ANALYSIS

The sample number format for stockpile samples will be based on the scheme designated by the Project Engineer, Field Supervisor, or Field Sampling Leads, and the discrete sample number, separated by a dash. For example, the second discrete sample collected from the stockpile designated Stockpile 3 would be named “Stockpile-03-01.”

The sample number format for excavation confirmational and long-term monitoring samples will be based on the grid system, consisting of 40-foot rows oriented north-south and east-west as shown on Figures G.1 and G.2. Samples will be named according to their grid location. Excavation confirmational samples will also include a designation of “S” for sidewall sample or “B” for bottom sample, and all soil sample numbers will include a depth or depth interval, separated by dashes. For example, the long-term soil monitoring sample collected from 11 to 12 feet bgs at grid location H12 would be named “H12-11-12” and the sidewall sample collected from grid location C4 at 11 feet bgs would be named “C4-S-11.” If two or more sidewall samples are located within the same grid location, they will be designated “S1,” “S2,” and so on, so that each sidewall sample location has a unique identifier. If additional lateral excavation is necessary to remove remaining soil contamination, sidewall samples will be collected from the same location and depth along the excavation perimeter as the original sidewall samples. Sidewall samples collected after additional excavation will be appended with “A,” “B,” and so on. For the example above, the sample collected after initial excavation would be named “C4-S-11-A.”

The sample number format for groundwater samples will be the well ID. For example, a sample collected from well PP-19 would be labeled “PP-19.”

The sample collection date will be known from the sample bottle and chain-of-custody form. Sample labels will include the time of collection and initials of sampler on the bottle label.

The samples will be shipped overnight or delivered to the laboratory on the day following collection or as soon as possible following collection to ensure that analytical holding times specified in Table G.2 are met.

7.6 EQUIPMENT DECONTAMINATION

Field sampling equipment, such as the split spoon samplers, stainless steel bowls and spoons, and water level indicator will be cleaned between each use according to the following procedure:

1. Water will be sprayed over equipment to dislodge and remove any particles.
2. Surfaces of equipment contacting sample material will be scrubbed with brushes using an Alconox solution.
3. Scrubbed equipment will be rinsed and scrubbed with clean water.
4. Equipment will undergo a final spray rinse of deionized water.

7.7 SURVEYING

Soil sampling locations will be marked after collection and surveyed. All newly installed wells will be professionally surveyed after installation. Site mapping will be conducted using the Washington State Plane North Coordinate System and elevations given relative to Mean Sea Level.

7.8 INVESTIGATION-DERIVED WASTE MANAGEMENT

Waste soils from confirmational sampling during excavation will be combined with presumed contaminated soils for treatment or disposal. Waste soils from pre-excavation bottom sampling will be stored on-site temporarily in drums or covered stockpiles until the cleanup action is underway. Waste soils from long-term soil monitoring will be drummed on-site and properly labeled.

Investigation-derived waste liquids, such as well development waters and decontamination fluids will be drummed on-site and appropriately labeled. Profiling and disposal of long-term soil monitoring waste soils and contaminated waste waters will be coordinated by the Port.

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8.0 References

Floyd|Snider. 2015. *Memorandum Re: SAP Addendum for Design Data Gaps Sampling.* Prepared for Washington State Department of Ecology. 24 March.

_____. 2013. *K Ply Site Remedial Investigation/Feasibility Study Work Plan*. Prepared for Port of Port Angeles, Port Angeles, Washington. September.

_____. 2012. *K Ply Mill Site Exhibit B, Interim Action Work Plan.* Prepared for Port of Port Angeles, Port Angeles, Washington. October.

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Appendix G
Sampling and Analysis Plan/
Quality Assurance Project Plan

Tables

Table G.1
Data Quality Assurance Criteria

Parameter	Reference	Precision (Relative Percent Difference)	Accuracy (Percent Difference from Standard)	Completeness (Percentage of Data Validated)
Soil				
Pentachlorophenol	USEPA Method 8270D	± 20%	± 60%	95%
DRO	NWTPH-Dx	± 20%	± 50%	95%
GRO	NWTPH-Gx	± 20%	± 50%	95%
BTEX Compounds Benzene Toluene Ethylbenzene Xylenes	USEPA Method 8021B or 8260C	± 20%	± 50%	95%
RCRA 8 Metals Arsenic Barium Cadmium Chromium Lead Silver Selenium	USEPA Method 6020	± 20%	± 50%	95%
Mercury	USEPA Method 1631			
Water				
DRO	NWTPH-Dx	± 20%	± 60%	95%
GRO	NWTPH-Gx	± 20%	± 60%	95%
BTEX Compounds Benzene Toluene Ethylbenzene Xylenes	USEPA Method 8021B or 8260C	± 20%	± 50%	95%
Total Iron	USEPA Method 200.8/6020A	± 20%	± 50%	95%
Dissolved Iron	USEPA Method 200.8/6020A	± 20%	± 50%	95%
Chemical Oxygen Demand	USEPA Method 410.4	± 20%	± 10%	95%
Biochemical Oxygen Demand	SM 5210B	± 20%	± 30%	95%
Methane	RSK-175	± 20%	± 50%	95%

Abbreviations:
BTEX Benzene, toluene, ethylbenzene, xylenes
DRO Diesel-range organics
GRO Gasoline-range organics
RCRA Resource Conservation and Recovery Act
USEPA U.S. Environmental Protection Agency

Table G.2
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Parameter	Reference	Bottle Type	Preservative	Holding Time
Soil				
DRO	NWTPH-Dx	(1) 4-oz WMG	None, cool to ≤6 °C	14 days to extract, then 40 days to analyze
GRO	NWTPH-Gx	(3) Tared Glass VOA vials with PTFE Septum	Methanol and cool to ≤6 °C, or none and cool to ≤6 °C	14 days to analyze with MeOH preservation or if none, 2 days at ≤6 °C, 14 days at ≤-7 °C
BTEX Compounds	USEPA Method 8021B or 8260C			
Benzene				
Toluene				
Ethylbenzene				
Xylenes				
RCRA Metals	USEPA Method 6020	(1) 4-oz WMG	None, cool to ≤6 °C	6 months (or freeze for 1 year) (28 days for mercury)
Arsenic				
Barium				
Cadmium				
Chromium				
Lead				
Silver				
Selenium				
Mercury	USEPA Method 1631			
Water				
DRO	NWTPH-Dx	(2) 500-mL amber glass	None, cool to ≤6 °C	7 days to extract, then 40 days to analyze
GRO	NWTPH-Gx	(4) 40-mL VOA vials with PTFE Septum	HCl to pH ≤2.0, cool to ≤6 °C	14 days to analyze
BTEX Compounds	USEPA Method 8021B or 8260C			
Benzene				
Toluene				
Ethylbenzene				
Xylenes				
Total Iron	USEPA Method 6020A/200.8	(1) 500-mL HDPE	Nitric acid	6 months
Dissolved Iron	USEPA Method 6020A/200.8	(1) 500-mL HDPE	Field filtered and nitric acid	6 months
Chemical Oxygen Demand	USEPA Method 410.4	(1) 500-mL amber glass	H_2SO_4 to pH<2, cool to ≤6 °C	28 days
Biochemical Oxygen Demand	USEPA Method 5210B	(1) 500-mL HDPE	None, cool to ≤6°C	48 hours
Methane	RSK-175	(3) 40-mL VOA vials with PTFE Septum	Add 1:1 HCL prior to collection, cool to ≤6 °C	14 days to analyze

Abbreviations:
BTEX Benzene, toluene, ethylbenzene, xylenes
°C Degrees Celsius
DRO Diesel-range organics
GRO Gasoline-range organics
H_2SO_4 Sulfuric acid
HCl Hydrochloric acid
HDPE High-density polyethylene
MeOH Methanol
mL Milliliter
oz Ounce
PTFE Polytetrafluoroethylene (Teflon)
RCRA Resource Conservation and Recovery Act
USEPA U.S. Environmental Protection Agency
VOA Volatile organic analysis
WMG Wide-mouth glass jar

Table G.3
Analytical Methods, Detection Limits, and Reporting Limits

Parameter	Reference	Units	Detection Limit	Reporting Limit/PQL
Soil				
DRO	NWTPH-Dx	mg/kg	5.8	25–50
GRO	NWTPH-Gx	mg/kg	0.3	2
BTEX Compounds				
Benzene	USEPA Method 8021B	µg/kg	6	20
Toluene	USEPA Method 8021B	µg/kg	2	20
Ethylbenzene	USEPA Method 8021B	µg/kg	2	20
Xylenes	USEPA Method 8021B	µg/kg	6	60
RCRA Metals				
Arsenic	USEPA Method 6020	mg/kg	0.05	1
Barium	USEPA Method 6020	mg/kg	0.009	1
Cadmium	USEPA Method 6020	mg/kg	0.02	1
Chromium	USEPA Method 6020	mg/kg	0.03	1
Lead	USEPA Method 6020	mg/kg	0.02	1
Silver	USEPA Method 6020	mg/kg	0.02	1
Selenium	USEPA Method 6020	mg/kg	0.2	1
Mercury	USEPA Method 1631	mg/kg	0.001	0.2
Water				
DRO	NWTPH-Dx	mg/L	0.009	0.05
GRO	NWTPH-Gx	mg/L	0.006	0.1
BTEX Compounds				
Benzene	USEPA Method 8021B	µg/L	0.02	1
Toluene	USEPA Method 8021B	µg/L	0.03	1
Ethylbenzene	USEPA Method 8021B	µg/L	0.03	1
Xylenes	USEPA Method 8021B	µg/L	0.09	3
Total Iron	USEPA Method 200.8/6020A	µg/L	16.9	50
Dissolved Iron	USEPA Method 200.8/6020A	µg/L	16.9	50
Chemical Oxygen Demand	USEPA Method 410.4	mg/L	2	10
Biochemical Oxygen Demand	SM5210B	mg/L	NA	2
Methane	USEPA Method 3810	µg/L	2.33	5

Abbreviations:
BTEX Benzene, toluene, ethylbenzene, xylenes
DRO Diesel-range organics
GRO Gasoline-range organics
µg/L Micrograms per liter
µg/kg Micrograms per kilogram
mg/L Milligrams per liter
mg/kg Milligrams per kilogram
NA Not applicable
PQL Practical quantitation limit
RCRA Resource Conservation and Recovery Act
USEPA U.S. Environmental Protection Agency

Table G.4
Confirmational Monitoring Sample Analyses

Area	Analysis	Method
Soil Excavation Confirmation Samples		
Hog Fuel Storage Area (Excavation Area 2)	GRO	NWTPH-Gx
	BTEX Compounds	USEPA Method 8021B
Hog Fuel Storage Area (Excavation Area 3)	DRO and ORO	NWTPH-Dx
Concrete Pad Area (Excavation Area 5)	GRO	NWTPH-Gx
	BTEX Compounds	USEPA Method 8021B
	DRO[1]	NWTPH-Dx
Bulkhead Area (Excavation Area 6)	GRO	NWTPH-Gx
	BTEX Compounds	USEPA Method 8021B
	DRO[1] and ORO[2]	NWTPH-Dx
Stockpile Samples		
Site-Wide Excavated Soil	DRO	HCID
	GRO	
Site-Wide Excavated Soil *(if HCID detects DRO or GRO)*	DRO and ORO	NWTPH-Dx
	GRO	NWTPH-Gx
	BTEX Compounds	USEPA Method 8021B
Site-Wide Imported Backfill Material	DRO and ORO	NWTPH-Dx
	GRO	NWTPH-Gx
	BTEX Compounds	USEPA Method 8021B
	RCRA 8 Metals	USEPA Method 6020 (USEPA Method 1631 for Mercury)
Long-Term Soil Monitoring Samples		
Site-Wide Areas of Residual Soil Contamination	DRO and ORO	NWTPH-Dx
	GRO	NWTPH-Gx
	BTEX Compounds	USEPA Method 8021B
Long-Term Groundwater Monitoring Samples		
Site-Wide Groundwater Confirmation	DRO	NWTPH-Dx
	ORO	NWTPH-Dx
	GRO	NWTPH-Gx
	BTEX Compounds	USEPA Method 8021B
	Total Iron	USEPA Method 200.8/6020A
	Dissolved Iron	USEPA Method 200.8/6020A
	Chemical Oxygen Demand	USEPA Method 410.4
	Biochemical Oxygen Demand	SM5210B
	Methane	USEPA Method 3810
Point of Compliance	DRO	NWTPH-Dx
	ORO	NWTPH-Dx
	GRO	NWTPH-Gx
	BTEX Compounds	USEPA Method 8021B

Notes:

1 Samples will be analyzed for DRO based on field screening indications of potential DRO contamination.

2 Samples will be analyzed for DRO and ORO if the sample is collected within the Hydraulic Oil Area or if field screening indicates potential DRO or ORO contamination.

Abbreviations:

BTEX Benzene, toluene, ethylbenzene, xylenes
DRO Diesel-range organics
GRO Gasoline-range organics
HCID Hydrocarbon identification
ORO Oil-range organics
RCRA Resource Conservation and Recovery Act

Table G.5
Long-Term Groundwater Monitoring Well Network

Well ID	Type	Purpose	Screened Interval (feet bgs)
Existing Wells			
PP-4R	Monitoring well, aboveground completion	Performance monitoring	8–18
PP-13	Monitoring well, flush mount	Performance monitoring	10-15
PP-17	Monitoring well, flush mount	Compliance monitoring	5-15
PP-19	Monitoring well, flush mount	Compliance monitoring	5-15
PP-20	Monitoring well, aboveground completion	Compliance monitoring	8-18
PZ-02	Piezometer, flush mount	Performance monitoring	5-15
PZ-09	Piezometer, flush mount	Performance monitoring	5-15
PZ-12	Piezometer, flush mount	Performance monitoring	5-15
New (to be installed) Wells			
PP-14R	Monitoring well, flush mount	Performance monitoring	8–18
PP-18R	Monitoring well, flush mount	Performance and compliance monitoring	8–18
PP-27	Monitoring well, flush mount	Performance monitoring	8–18
PP-28	Monitoring well, flush mount	Performance monitoring	8–18
PP-29	Monitoring well, flush mount	Performance monitoring	8–18
PP-30	Monitoring well, flush mount	Performance monitoring	8–18
PP-31	Monitoring well, flush mount	Performance monitoring	8–18
PP-32	Monitoring well, flush mount	Performance monitoring	8–18
PP-33	Monitoring well, flush mount	Performance monitoring	8–18
PP-34	Monitoring well, flush mount	Performance and compliance monitoring	8–18

Abbreviation:
bgs Below ground surface

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Sampling and Analysis Plan/
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Figures

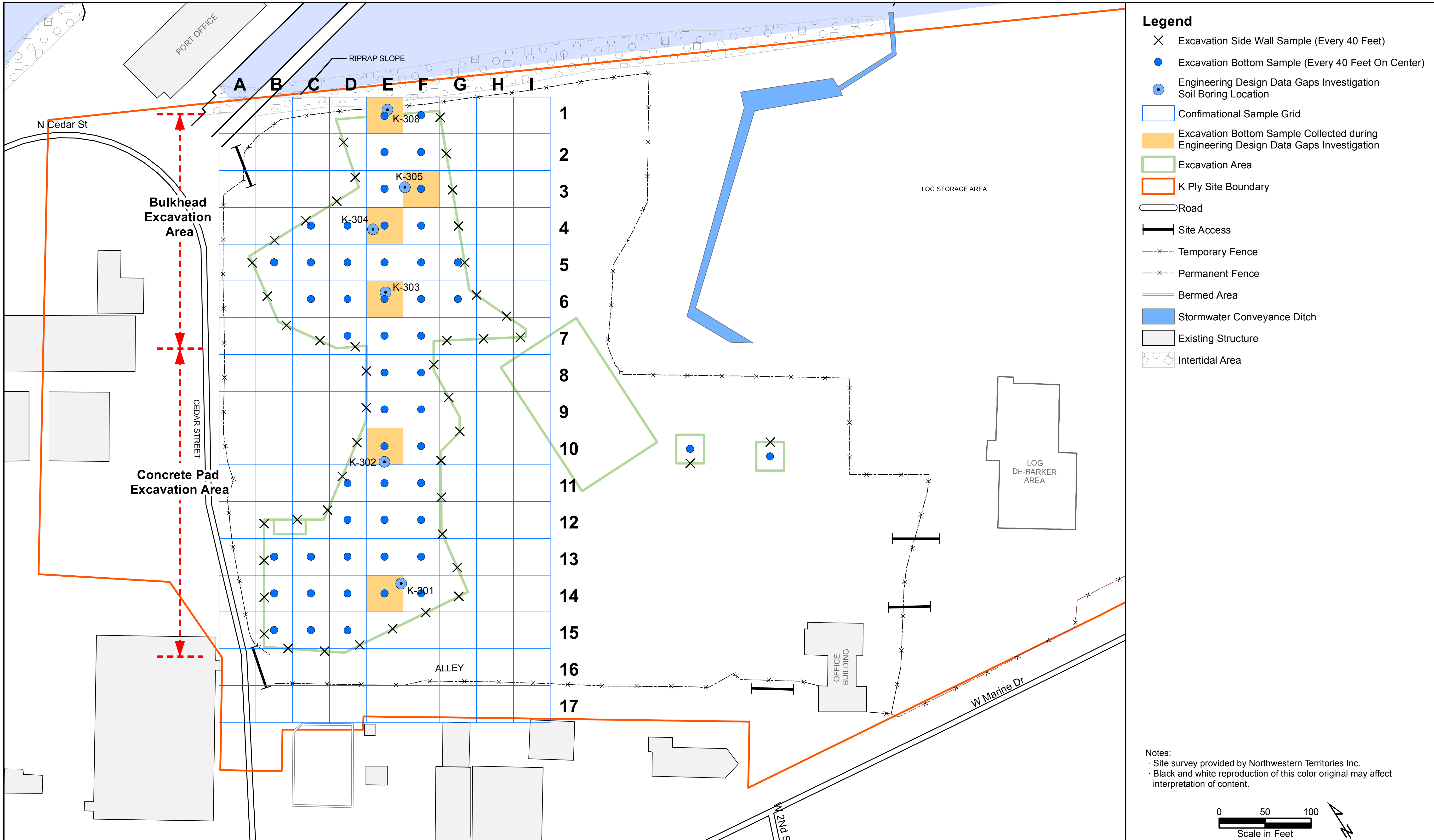

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Figure G.1
Excavation Confirmational Sampling Locations

I:\GIS\Projects\PPA_KPLY\MXD\SampleAnalysisPlan\Figure G.1 - Excavation Confirmational Sampling Locations With Grid.mxd
5/28/2015

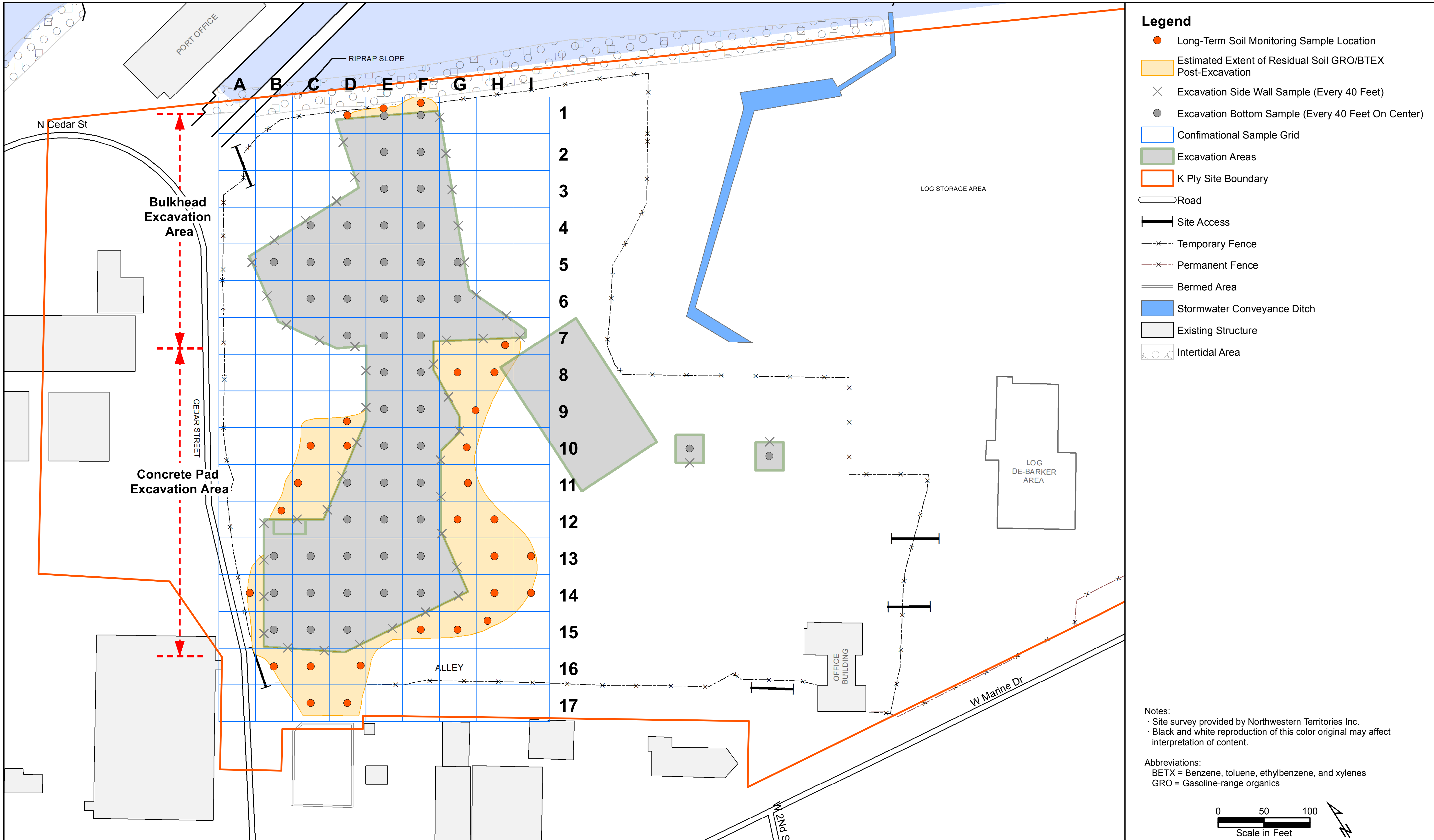

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Figure G.2
Long-Term Soil Monitoring Sample Locations

I:\GIS\Projects\PPA_KPLY\MXD\SampleAnalysisPlan\Figure G.2 - Long-Term Soil Monitoring Sample Locations.mxd
5/28/2015

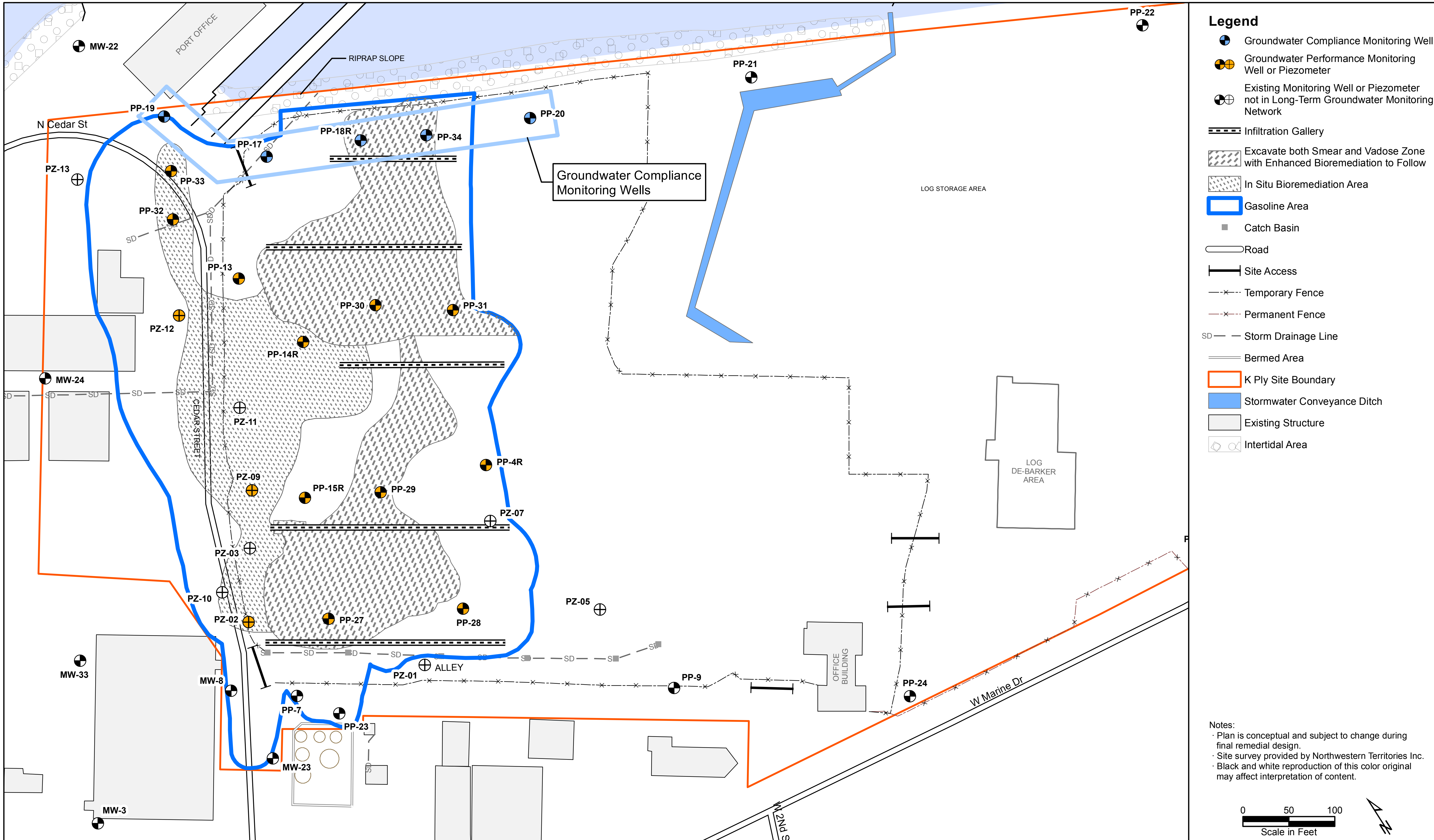

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Figure G.3
Long-Term Groundwater Monitoring Well Network

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5/28/2015

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Appendix H
Monitoring and Inadvertent Discovery Plan

REDACTED Archaeological Monitoring and Inadvertent Discovery Plan for the K Ply Site Remedial Investigation, City of Port Angeles, Washington

Prepared for:
Floyd|Snider
Seattle, Washington

Submitted by:
Historical Research Associates, Inc.
Jordan Pickrell, PhD
Jennifer Gilpin, MA

Seattle, Washington
May 2015

Historical Research Associates, Inc.

This archaeological monitoring and inadvertent discovery plan was prepared by HRA archaeologists Jordan Pickrell, PhD, and Jennifer Gilpin, MA, who meet the Secretary of the Interior's professional qualifications standards for archaeology. This plan is intended for the exclusive use of the Client and its representatives. It contains the procedures to follow for archaeological monitoring during ground disturbing activities, as well as procedures to follow regarding inadvertent discovery of cultural resources and human remains. It should not be considered to constitute project clearance with regard to the treatment of cultural resources or permission to proceed with the project described in lieu of review by the appropriate reviewing or permitting agency. This plan should be submitted to the appropriate state and local review agencies for their comments prior to the commencement of the project.

Table of Contents

List of Figures

1. Introduction

Floyd|Snider is assisting the Port of Port Angeles (Port) with investigation and cleanup of environmental contamination at the K Ply Site (Project) under Agreed Order No. DE 9546 (Agreed Order [1]) with the Washington State Department of Ecology (DOE). The K Ply Site is located along the Port Angeles Harbor shoreline at 439 Marine Drive, Port Angeles, Washington. It is situated in the west half of Section 3, Township 30 North, Range 6 West, Willamette Meridian (Port Angeles, Washington Quadrangle; Figure 1-1).

1.1 Project Description

The current phase of the Project consists of excavation of all vadose zone gasoline-contaminated soil that exceeds applicable cleanup levels (CUL) and a large portion of the underlying smear zone soil that is a source of groundwater contamination. Excavation will also occur in the areas where light non-aqueous phase liquid (LNAPL) containing soil exists. Soil within other designated cleanup areas will also be excavated and either disposed of or relocated on site. In addition to the excavations, soil sampling will be conducted in the Log Pond Fill Area in order to delineate the boundary of the contamination in this portion of the project area. The total excavation volume is expected to be approximately 34,900 cubic yards (CY). Additionally, the Project includes replacement of select monitoring wells that were abandoned prior to project construction.

1.2 Regulatory Context

Due to the involvement of the DOE, the project will comply with State of Washington regulations regarding the consideration of cultural resources, including those outlined in the State Environmental Policy Act (SEPA), and Regulatory Code of Washington (RCW) Chapter 27.53 (Archaeological Sites and Resources) and Chapter 27.44 (Indian Graves and Records).

In addition, the Port, the City of Port Angeles (City), and the Lower Elwha Klallam Tribe (LEKT) have a Settlement Agreement that all ground disturbing activities along the City's waterfront (between the bluff to the south and the shoreline) be monitored, with oversight by the City and/or LEKT representatives.

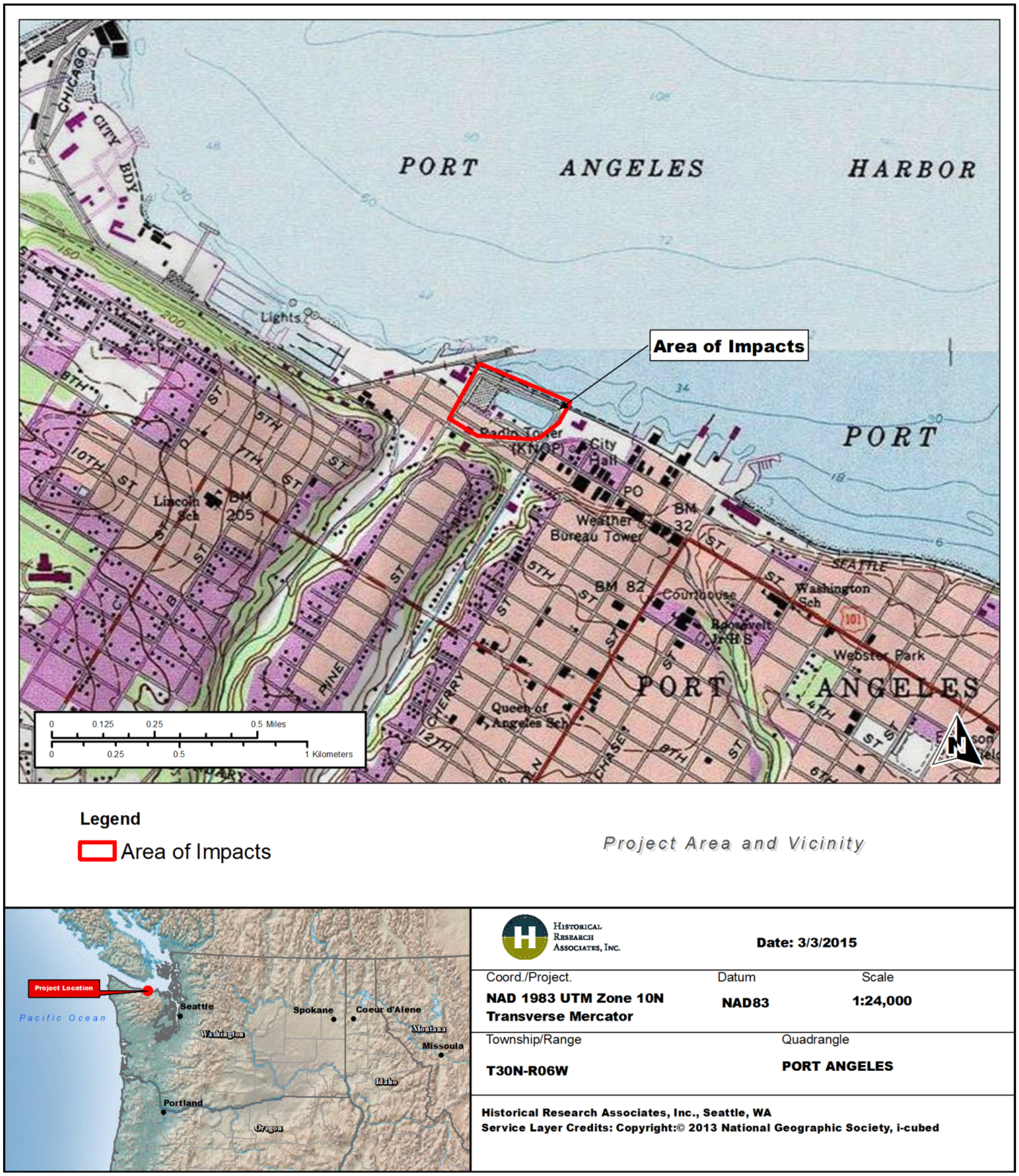

Figure 1-1. Project area and vicinity.

1.3 Area of Impacts

The Area of Impacts (AI) is defined as the portions of the project area wherein ground-disturbing activities could impact human remains or archaeological deposits that are eligible or potentially eligible for listing in national, state, or local registers. The Project AI includes locations of proposed environmental sampling and remedial excavation. This area measures approximately 21.5 acres (Figure 1-2).

Figure 1-2. Project Area of Impacts location Map.

2. Background Research

The reader is asked to refer to the previous archaeological monitoring reports (Meoli 2008; Raff-Tierney and Gilpin 2014; Tingwall and Rust 2009) for detailed archival and background research associated with the Project. The following sections provide a summary of the environmental and cultural contexts for the AI, for reference by the monitoring archaeologist during environmental sampling and remediation activities.

2.1 Environmental Context

The AI is located adjacent to Port Angeles Harbor on flat land at 15 feet (ft) above mean sea level, flanked on either side by Tumwater and Valley Creeks (Tingwall and Rust 2009). Fill deposits dredged from the harbor, and possibly derived from the 1914 sluicing project (see Martin 1983:106, 109–119), overlie native beach deposits and measure 8 to 16 ft thick. Native beach deposits developed and deposited during the Holocene are about 30 ft thick and overlie approximately 300-ft-thick glacial deposits and bedrock. Bedrock in the vicinity of the AI is from the Twin River Formation, which consists of olive to greenish gray claystone, mudstone, and siltstone and dates to the late Eocene to early Miocene (Floyd|Snider 2013).

Examination of the United States Surveyor General's (USSG) 1879 General Land Office (GLO) map (Figure 2-1) and the historic-period maps prepared by the Wengler Surveying & Mapping Co. (2007) show that the historic-period shoreline was located within the southern portion of the AI. As archaeologist Dr. Gary Wessen points out, a sea level curve taken by Gowan (2007) indicates that the sea level had risen to “within a few meters of the modern level by ca. 5,000 years B.P.,” meaning that during the Late Pleistocene and early Holocene, the harbor shoreline was somewhat farther north, and that the AI would have largely been a terrestrial environment. These deposits, if extant (and not eroded away), would likely be deeply buried (Wessen 2010:5).

The protected harbor provided by Ediz Hook provided an ecosystem bountiful in flora and fauna available to the region’s inhabitants. Larger land mammals, including Roosevelt elk, black-tailed deer, black bear, and wolf, were historically available in the vicinity of the AI, as were marine mammals such as orcas and harbor seals. Smaller mammals, including waterfowl, raccoon, rabbit, and squirrel, would also have utilized the vicinity of the AI. Salmon were present in the larger creeks along the coastline, and they were certainly readily available to inhabitants of the AI vicinity. Marine invertebrates available along the coastline, within or close to the AI, included butter and horse

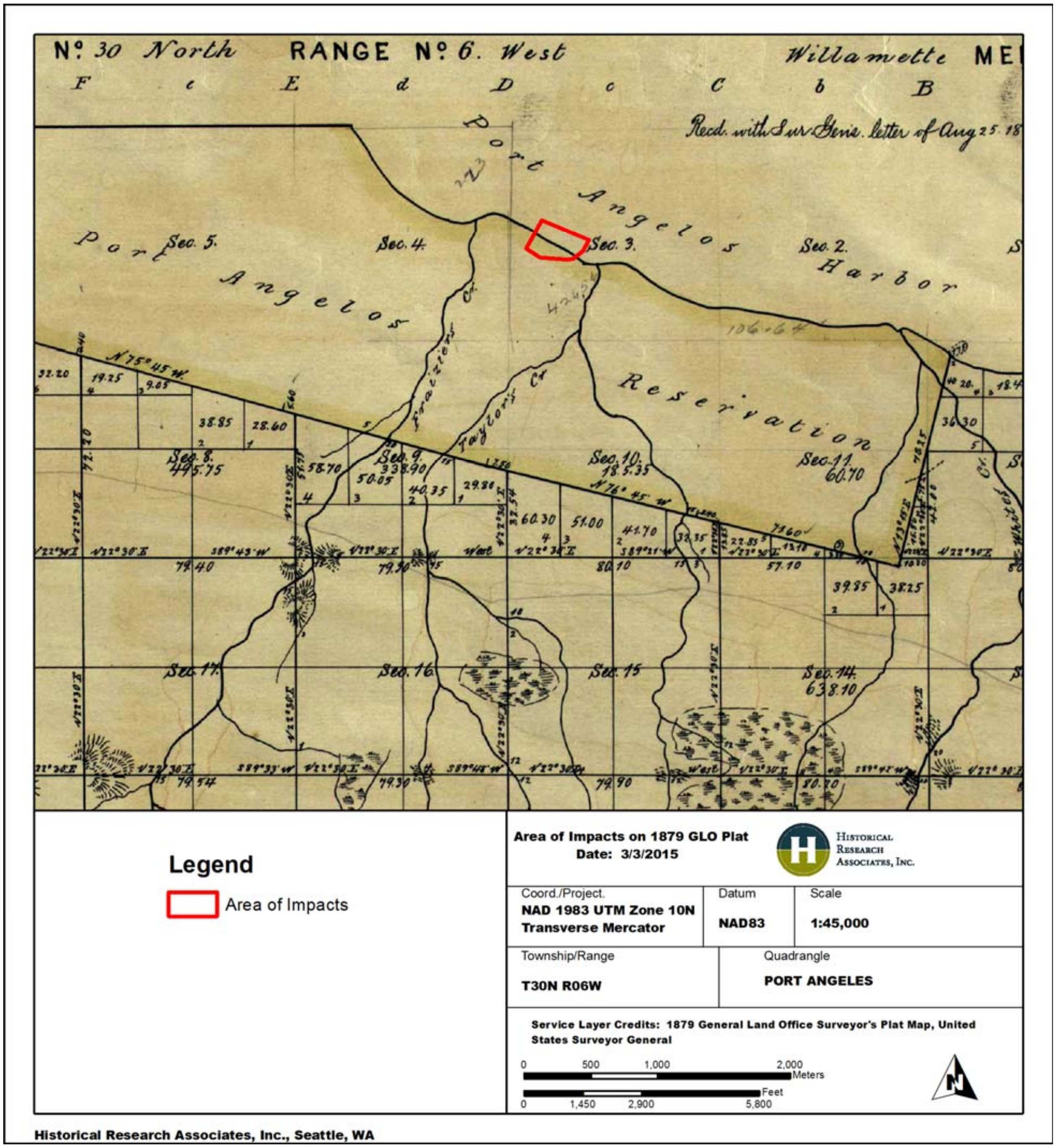

Figure 2-1. GLO plat from 1879, showing the location of the AI on the historic shoreline of Port Angeles Harbor (USSG 1879).

clams, sea and bay mussels, scallop, native oysters, cockles, limpets, barnacles, and sea urchins (Schalk 1988; Suttles 1990).

2.2 Cultural Context

Human occupation of the Port Angeles area began soon after the last glacial retreat, approximately 11,500 years ago. Ediz Hook formed between 9,000 and 5,000 years ago, creating a protected harbor with broad beaches and lagoons. Such ecosystems nurtured a local abundance of plant and animal life which would have encouraged human occupation in the vicinity of the AI (Tingwall and Rust 2009:3). The overall climatic regime did not settle into a modern pattern until circa 5,000 years ago, coinciding with the establishment of more permanent settled village occupations (Kovanen and Easterbrook 2001).

High acid content in soils in the Puget Sound region tends to decompose bone, shell, wood and textiles, while allowing for the preservation of lithic artifacts (Nelson 1990:481). Due to preservation and macro-level changes to the topography, prehistoric archaeological remains in the AI are most likely to be related to the Late Pacific period and Ethnohistoric period (after 1775 A.D.) (Ames and Maschner 1999). In 2011, former City archaeologist Derek Beery recorded a precontact isolated find (Smithsonian Number 45CA689), close to the AI. It is a small andesitic flake tool, identified as such by its resharpening scars and slightly crushed platform. It was observed in redeposited midden sediments (Beery 2011).

The area is the traditional home of the Klallam people, who relied on the project area vicinity for hunting, fishing, and gathering (Eells 1889; Gunther 1927). The AI is near three Klallam villages that have been reported in historic and ethnographic documents. The *Tse-whit-zen* village was located west near the Ediz Hook lagoon, and *I'e'nis* village was located east of the AI near Ennis Creek. A third, unnamed village was historically noted as being located close to the AI (Tingwall and Rust 2009:4). This village was depicted on the 1853 Coast and Geodetic Survey map of Port Angeles Harbor; although no evidence of the village has been found, oral histories provided by LEKT elders support the idea of its existence (Beery 2010a:35–36).

Port Angeles Harbor was first sighted by Europeans in 1791 and named by Don Francisco de Eliza. Anglo-American settlement of the area began in the 1860s. Within 20 years, lumber mills and railroads were expanding in the area. Port Angeles soon became one of the largest suppliers of lumber products on the West Coast (Tingwall and Rust 2009:2–4)

The Chicago, Milwaukee, St. Paul & Pacific Railroad (later known as the Milwaukee Road) was constructed by 1916, on the north side of the AI (Beery 2010b). At this time, much of the AI was still intertidal shoreline. A rail spur from the main line was extended into the AI, to the south side of what would eventually be the K Ply Mill. Wood products from the mill were loaded and transported to Port Townsend. Timbers associated with the railroad trestle, and the eventual bulkhead, were largely creosote treated (Floyd|Snider 2013:2-3).

The AI was first partially filled in 1926 with sediment dredged from Port Angeles Harbor. The current, northern bulkhead wall was built at this time, following the line of the Milwaukee Road trestle, and a second bulkhead was built further inland, on the south side of the future mill building (Floyd|Snider 2013:2-1). The M. R. Alleman mill, a small lumber mill about which little is known, was constructed just behind this second bulkhead and south of what would eventually be the K-Ply mill building. Sometime before 1941, this mill closed and the entire area south of the outer bulkhead except the log pond was filled (Floyd|Snider 2013:2-3).

In 1941, the Peninsula Plywood Corporation constructed the Pen Ply Mill at this site. Plywood constructed at the mill was utilized for the war effort in World War II and during the post-war boom. The mill operated under various owners, including ITT Rayonier, Klukwan, Inc. (who renamed the mill "K Ply"), and Peninsula Plywood Company, until it was closed permanently in 2011 (Floyd|Snider 2013:2-3–2-4; Martin 1983:140; Tingwall and Rust 2009:4–5). Operations through these years included log storage, hog fuel burning, and log debarking and peeling. Log storage occurred in the yard and log pond, which was excavated in 1941 and periodically filled from 1946 until it was completely filled in 1997 (Floyd|Snider 2013:2-3, 2-6).

The Milwaukee Road has been recorded in segments throughout Clallam County as archaeological site 45CA458 (Beery 2010b; Ferland 2010; Speulda et al. 1994). The closest recorded railroad segment to the AI is located approximately 0.2 mi to the east. The road (and former railroad grade) has not been formally evaluated for listing in the National Register of Historic Places (NRHP). The road, originally conceived as a logging railroad in the early 1900s by Michael Earles, was extended to Port Angeles with the help of investors. The right-of-way for the railroad through Port Angeles was secured by 1914 and it was constructed by 1916 under the name Seattle, Port Angeles, and Western Railroad Company. In December 1918/January 1919, the project was transferred to the Chicago, Milwaukee, St. Paul & Pacific Railroad. During World War I, the railroad was utilized as part of the Spruce Railroad, intended to ship the strong, light wood for use in aircraft. During the 1920s and 1930s, the railroad was utilized by commercial logging companies, although the line was also used for passenger service in these decades (under the name Seattle, Port Angeles, and Lake Crescent Railway). The railroad was sold to the Seattle and North Coast Railroad in 1980, and it was abandoned by 1985 (Beery 2010b; Ferland 2010; Secrest 1997; Wiersema n.d.).

3. Potential for Encountering Archaeological Resources

Historical Research Associates, Inc. (HRA), used a combination of background archival research and the results of previous archaeological monitoring to form predictions regarding the presence of cultural resources within the AI. The Washington Department of Archaeology and Historic Preservation (DAHP) predictive model map for the AI, examined during archival research, shows that the AI is located on land considered to have a very high potential for archaeological resources. While monitoring ground disturbing activities within the AI in 2013, HRA observed two historic-period archaeological features: 1940s-era fuel pipes; and a 100-ft segment of railroad spur.

The fuel pipes are associated with the Peninsula Fuel Company, which began operations in the late 1930s under the General Petroleum Corporation (Floyd|Snider 2013). Pen Ply began development of a plywood lumber mill within the AI in 1941. After Klukwan, Inc., acquired the business in 1989, the mill became known as the K Ply building. In 2012, DAHP issued a determination of non-significance for the K-Ply complex while the mill was still standing (Kaehler 2012). The standing structure was torn down in advance of the current phase of the Project (Floyd|Snider 2013). HRA anticipates that under Washington State law, the K Ply mill complex will be recorded and evaluated, and its eligibility for listing in the NRHP determined by DAHP, as the proposed remediation work will remove most if not all of the remaining structural features.

HRA also observed 100-ft segment of railroad associated with a previously recorded archaeological site, the Chicago, Milwaukee, St. Paul & Pacific Railroad (45CA458). Features recorded within the AI in 2013 include a railroad spur, two cart bases on the railroad tracks, and mid-twentieth century smoking related artifacts on and close to the rail grade (Raff-Tierney and Gilpin 2014). HRA expects that remediation activities within the AI will expose additional features associated with archaeological site 45CA458, including additional grade, rails, and a bulkhead. At this time, the site's eligibility for the NRHP has not been evaluated. HRA anticipates that the railroad spur will be evaluated for NRHP eligibility prior to the current monitoring phase of the Project because the proposed remediation work will remove most, if not all, of the associated features within the AI.

HRA expects to encounter and exposures of historic-period features related to finds noted during previous monitoring: wooden piles; portions of known bulkheads; additional fuel and utility lines; and concrete foundations and structural remains (Raff-Tierney and Gilpin 2014). HRA anticipates that additional isolated historic-period archaeological materials will be observed in the historic-period fill. These materials—which will likely include fragments of brick, glass, metal (i.e., cans, machinery, and/or assorted tools), and slag—may have been intentionally deposited during the filling episodes, or were already present in the graded and/or dredged fill soils and redeposited during later fill episodes. Any historic-period archaeological features or artifacts found *in situ* will be treated as inadvertent discoveries (See Section 4.3).

The AI is located near Tumwater Creek and is in close proximity to one of the three documented Klallam villages in the Port Angeles Harbor area: the unnamed village at Tumwater Creek. Nearby precontact archaeological sites, including the *Tse-Whit-Zen* village site (45CA523), which as of June, 2014, is listed on the NRHP, have been recorded in areas that have seen large amounts of historic-period and modern development (Hartmann 2003; Raff-Tierney and Gilpin 2014). This belies the notion that the historic-period development has obliterated potentially significant pre-contact archaeological materials around the shoreline of Port Angeles Harbor.

Within the closer vicinity of the AI, former City of Port Angeles archaeologist Derek Beery recorded an andesitic flake tool within redeposited shell midden (Beery 2011). It is feasible that shell midden deposits—either intact or redeposited (i.e., dredged)—are located within the AI. Such deposits could be located beneath or within fill layers and may contain faunal materials and bone or stone tools. Additional precontact through historic-period archaeological materials may include the remnants of fish weirs, fishing or collecting implements (i.e., bone spears, basketry). Such archaeological resources will be treated as inadvertent discoveries (See Section 4.3).

4. Procedures for Archaeological Monitoring and Inadvertent Discovery Plan (IDP)

4.1 Qualifications and Certificates

The Port or their representative will arrange for a Professional Archaeologist who meets the Secretary of the Interior's (SOI) qualifications (36 CFR Part 61; required by the State of Washington in RCW 27.53.030.8) to provide oversight for all cultural resources related activities for the Project. This oversight will include communication with environmental staff at Floyd|Snider and/or the Port Representative regarding upcoming remediation activities and archaeological monitoring. Per the Settlement Agreement, an archaeological monitor will be present for all of the Project's ground disturbing activities.

For archaeological monitoring activities, if a Professional Archaeologist meeting the SOI qualifications is not available then an experienced archaeologist (e.g., one who has worked in a variety of archaeological field situations) will be allowed to do so given that a "Supervisory Plan for Archaeological Monitoring" has been filed with DAHP by the consultant prior to their work at the site. An example of this form is located in Appendix A. Appendix B contains a Project Contacts list that includes the names of the supervising archaeologists at HRA, namely Jennifer Gilpin, MA; Brent Hicks, MA, RPA; and Lynn Compas, MA, RPA. This contacts list will be updated as needed during the course of the project.

Per project requirements, any Professional or monitoring archaeologists on site will be trained in Hazardous Waste Operations and Emergency Response (HAZWOPER) at the 40-hour level. The archaeological consultant will prepare a project-specific Health and Safety Plan (HASP), prior to archaeological monitoring, for use by the monitoring archaeologist and Professional archaeologist.

4.2 Monitoring Procedures

The following sections outline the procedures for archaeological monitoring at the AI, organized primarily by activity (environmental sampling or boring versus broader-scale remedial excavation) and by anticipated materials.

For all monitoring activities within the APE:

1. Prior to the commencement of construction activities, the monitoring archaeologist will brief Floyd|Snider staff, the Port Representative, and the contracted construction operators (e.g., drillers, excavator operators) about potential cultural resource issues. This will include an explanation of the purpose of the work, how it will be conducted, and types of cultural resources that crew members may encounter during the Project.

2. Prior to archaeological monitoring, the Port will invite interested Native American Tribes to observe the monitoring, provided that all safety requirements are met, including 24- or 40-hour HAZWOPER training.

3. The monitoring archaeologist will record the work as follows: daily activities will be recorded on a Daily Record Form (Appendix C) and in a field notebook. Overview photographs of the AI, monitored locations, example work activities, and any cultural materials will be taken as feasible. The monitoring archaeologist will record this information in a photograph log. In addition, the monitoring archaeologist will prepare sketches/drawings of particular areas, artifacts, features, and (as feasible) soil profiles. The locations of archaeological monitoring will be noted on a field map for the project.

4. The Daily Record form will be submitted nightly, when feasible, to the professional archaeologist so that it is available for review by consulting parties. The Daily Record Forms will also be used to compile a brief Weekly Status Report that will be submitted in electronic form to the consulting parties.

5. The monitoring archaeologist will follow instructions provided in the project specific HASP, but also from the onsite representative in matters pertaining to safety and all environmental exploration and remedial actions.

6. For safety reasons, the monitoring archaeologist will not enter any excavations deeper than 5 ft to inspect a possible find until the excavation has been shored by the contractor, per OSHA standards at 29 CFR 1926.652 (www.osha-slc.gov/).

7. If during soil/sediment excavations the monitoring archaeologist or any member of the remediation project crew believes that they have encountered archaeological materials, the monitoring archaeologist or crew member will direct the Port Representative to stop work—at least temporarily—at that location to protect potential additional resources.

8. The Port Representative, in communication with the monitoring archaeologist, will establish a buffer zone appropriate in size to the location and nature of the cultural material to protect the location and the monitoring archaeologist during this inspection.

9. The Port Representative will inform the geotechnical/construction contractor(s) about the archaeologist's monitoring work and make provisions, within its agreement with the contractor(s), for work stoppage, relocation of activity, and for temporary shoring of the trench, when applicable, for inspection of possible finds.
10. If an archaeological monitor is ***not*** present, the Port Representative will temporarily halt the work in that location and contact the professional archaeologist and will describe the find to ascertain the necessary next steps. The Port Representative will establish a buffer zone of at least 50 ft around the find to protect the location during this time.
11. As listed in Section 3, precontact and ethnohistoric archaeological deposits may include, but are not limited to:
    a. Intact and redeposited shell midden sediments;
    b. Clusters of fire-modified rock (FMR), charcoal, or other evidence of fire-related activities; and
    c. Faunal remains in association with stone chips or tools.
12. Historic-period archaeological materials may include:
    a. Features such as utility lines, piles and bulkheads, footings, and foundations,
    b. Additional intact and disturbed railroad grade; and
    c. Isolated artifacts within the fill or in intertidal sediments.
13. According to DAHP guidelines, archaeological resources are defined as follows:

    Isolate: One distinct artifact or a few fragments of the same artifact that are too far away (typically more than 30 m) from other cultural materials (over 50 years old) to be considered part of a site. If diagnostic, the find should be recorded on an Isolate Form and photographs taken.

    Intact Artifact Deposit or Feature: Two or more distinct artifacts or one feature (immovable object such as a concrete foundation) within a 50 meter (m) area. Such deposits would be considered an archaeological site and depending on size and nature, take longer than an isolated find to record on an Archaeological Site Inventory Form. Additionally, steps in Section 4.5 below should be implemented.

    Disturbed Artifact Deposits: Artifacts identified in disturbed soils (such as historic fill) should be documented in monitoring notes and photographed. Depending on the volume of artifacts and the level of disturbance, the site may or may not need to be recorded on a Site

Form. Limited investigation around the artifacts may be necessary to determine if additional materials are present and the site boundaries extend, following the protocol steps below as necessary.

Other: Abandoned/remnant utilities and materials less than 50 years old are not considered significant. These items should be documented in monitoring notes, but would not be recorded on Isolate or Site Forms. No further action is necessary.

14. The monitoring archaeologist will identify whether any observed cultural materials should be classified an isolate, an intact archaeological deposit, disturbed artifact deposits, or other materials, and to allow for discussion between the Port Representative, DAHP, DOE, and the on-call professional archaeologist.

15. If monitoring reveals human remains, the procedures listed in **Section 5** will be followed.

16. When monitoring work has been completed, the professional archaeologist will prepare a report discussing the methods and results of the work. The draft report will be provided to Floyd|Snider and/or the Port Representative. After a short review period, Floyd|Snider and/or the Port Representative will direct the professional archaeologist to make revisions that take into account review comments. The professional archaeologist will provide a final copy to Floyd|Snider and/or the Port Representative for distribution to the Port, DOE, affected Tribes, and DAHP. The professional archaeologist will incorporate revisions from these agencies after the review period.

4.3 Procedures for Archaeological Monitoring of Soil Sampling and Replacement Ground Well Installation

1. During drilling of borings for soil/sediment samples and replacement of monitoring wells, the archaeological monitor will examine soils/sediments if it is determined that it is safe to do so, including those from borings and in soil cuttings.

2. Excavation at each testing location will not continue until the archaeological monitor has had an opportunity to inspect the soils/sediments.

3. The monitoring archaeologist will work with the Port Representative to obtain accurate soil/sediment descriptions for use in the monitoring report.

4. The Port Representative will authorize the archaeologist to stop the boring periodically, as needed, for a closer examination of exposed soils.

5. It is not anticipated that the archaeologist will halt work activities at a boring location if archaeological materials are observed in the soil/sediment sample cores (unless there is

suspicion that those materials contain human remains; see Section 5). The archaeologist will instead treat the boring as methodologically equivalent to a Phase I archaeological shovel probe and may need to continue examination of soils/sediments to accurately characterize the observed materials.

   a. For example, if there is suspicion that the artifacts may be disturbed or in a fill layer, the archaeologist or archaeological monitor may request that drilling and sampling continue to assess the nature of soils/sediments below the observed materials. A description of the cultural materials, their sedimentary context, and depth will help the archaeologist to compare deposits across the wider site, if additional materials are observed, and to ascertain the depositional context.

6. If drilling is allowed to continue, the monitoring archaeologist will take notes on the find along with overview photographs to enable the Professional Archaeologist to form a basic description of the characteristics and location of the cultural materials for further investigation during future phases of construction work, to allow for minimal delays in work activities.

7. Following the observation of cultural resources (*not* including human remains) in an environmental core, the professional archaeologist will contact the consulting parties within 24 hours. This communication is assumed to take the form of a brief email, describing the characteristics of the find and outlining a proposed plan of action in the instance that additional nearby cores contain similar materials.

4.4 Procedures for Archaeological Monitoring of Remedial Excavations

1. During remedial excavations, the archaeological monitor will examine exposed soils/sediments as feasible and safe, including those in the excavation trenches and in back-dirt piles. It is anticipated that the monitoring archaeologist will be able to differentiate between historic-period fill and native sediments more easily than in the environmental bores, given the broader exposures provided.

2. The archaeologist will watch for precontact or historic-period artifacts or layers/lenses of organic material or shell, and organically enriched midden soils that might indicate past human use. The archaeologist will also watch for features associated with previously evaluated sites (the railroad spur and the K-Ply mill), and anticipated historic-period features (e.g. wooden pile and bulkhead features, the pre-1941 lumber mill).

3. It is anticipated that archaeological site 45CA458 will be evaluated prior to the current phase of the Project. As features associated with 45CA458 are observed, the recommendations outlined in the site's treatment plan or NRHP evaluation memorandum will be followed. Such recommendations may include additional documentation of the site, at minimum.

4. It is anticipated that the historic-period Pen Ply/K Ply mill complex will be evaluated prior to the current phase of the Project. As additional features associated with the complex are observed, the recommendations outlined in the site's treatment plan or NRHP evaluation memorandum will be followed. Such recommendations may include additional documentation of the site, at minimum.

5. If cultural materials *not associated* with either the Pen Ply/K Ply mill complex or archaeological site 45CA458 are observed, procedures for the inadvertent discovery of archaeological materials will be followed (refer to Section 4.5). Such cultural resources include all precontact cultural resources (whether redeposited or *in situ*) as well as any unevaluated historic-period resources (including but not limited to features associated with the bulkheads and the pre-1941 lumber mill).

4.5 Inadvertent Discovery of Archaeological Materials

1. If during ground disturbing activities during project remediation, the archaeological monitor or any member of the remediation project crew believes that they have encountered precontact (including, but not limited to, intact deposits of midden; clusters of FMR, charcoal, or other evidence of fire-related activities; stone chips or tools; and faunal remains in association with stone chips or tools) or historic-period archaeological materials *different from the materials associated with the K-Ply mill or archaeological site 45CA458,* the archaeologist or crew member will direct the Port Representative to stop work—at least temporarily—at that location to protect potential additional resources.

2. If there is suspicion that the artifacts may be disturbed or in a fill layer, the monitoring archaeologist may request that mechanical excavation continue to assess the extent of the deposit and the nature of soils/sediments below the observed materials. The monitoring archaeologist will coordinate with the Port Representative to direct the contractor in such circumstances. If excavation is allowed to continue, the monitoring archaeologist will take notes on the find along with overview photographs to enable the professional archaeologist to form a basic description of the characteristics and location of the cultural materials for further investigation during future phases of construction work, to allow for minimal delays.

3. If the monitoring archaeologist believes that the find is a prehistoric or historic-period archaeological resource requiring further evaluation, the Port Representative will take

appropriate steps to protect the discovery site by installing a physical barrier (i.e., exclusionary fencing) and prohibiting all machinery, other vehicles, and unauthorized individuals from crossing the barrier.

4. Within 12 hours of the initial discovery, and once the site has been preliminarily characterized, the professional archaeologist will inform the Port Representative, who will contact the Port. The Port will in turn contact DOE, who will contact DAHP and the cultural resources representatives for the affected Tribes (see Appendix B, Contact List). Under RCW 27.53, all prehistoric archaeological sites are protected regardless of significance or eligibility for national, state, and/or local historic registers. A determination of eligibility for listing in the NRHP by DAHP must be obtained for archaeological sites. It is presumed that archaeological sites are eligible for listing in the NRHP until and unless DAHP makes a determination that they are not.

5. The Professional archaeologist will perform an NRHP evaluation of the resource, as feasible, within the initial week after discovery (and ideally within 36 hours). Evaluation activities will include mapping, photography, subsurface testing, sample collection, and/or other activities, as determined appropriate by DAHP in coordination with the other consulting parties (e.g., the Port, DOE, and Tribal representatives).

6. Once the NRHP evaluation has been performed, DOE, as the lead agency, will contact the appropriate parties (the Port, DAHP, and Tribes), as soon as practical (i.e., within 24 hours), to seek consultation regarding the National Register-eligibility of the discovery. If DAHP determines that the discovery is an eligible resource, they will consult with appropriate parties on an appropriate form of treatment. Treatment measures may include mapping, photography, limited probing, and sample collection, or other activities.

7. The Port will arrange for the implementation of the treatment measures agreed upon by the consulting parties. If treatment measures determined by the consulting parties include sample collection, the archaeological resources will be examined by the archaeologist and possibly analyzed by specialists, as needed and appropriate.

8. When evaluation of the archaeological site has been completed, the professional archaeologist will prepare a memorandum discussing the methods and results of the evaluation. The draft memorandum will be provided to Floyd|Snider and/or the Port Representative. After a review period, Floyd|Snider and/or the Port Representative will direct the archaeologist to make revisions that take into account review comments. The professional archaeologist will provide a final draft copy to Floyd|Snider and/or the Port Representative for distribution to the consulting parties. After a review period, the

professional archaeologist will make revisions that take into account any review comments by consulting agencies.

5. Inadvertent Discovery of Human Remains

Any human remains that are discovered during project-related excavation will be treated with dignity and respect.

In the event that human remains are discovered, the following procedures are to be followed to ensure compliance with RCW 68.50 *Human Remains*, RCW 68.60: *Abandoned and Historic Cemeteries and Historic Graves*, and RCW 27.44: *Indian Graves and Records*.

If ground disturbing activities encounter human skeletal remains during activities associated with the Project, then all activity **must** cease that may cause further disturbance to those remains and the area of the find must be secured and protected from further disturbance. The following steps should be taken:

1. Per RCW 68.50.645, 27.44.055, and 68.60.055 (1) Any person who discovers skeletal human remains must notify the county coroner and local law enforcement in the most expeditious manner possible (Appendix B). Any person knowing of the existence of human remains and not having good reason to believe that the coroner and local law enforcement has notice thereof and who fails to give notice thereof is guilty of a misdemeanor.
    1. However, to establish if a bone is human, Dr. Guy Tasa is available to review pictures of a bone. His information is in the contact list in Appendix B. The Port representative will immediately notify DOE who will then contact Dr. Tasa, or give permission for the professional archaeologist to contact Dr. Tasa.
        a. If Dr. Tasa establishes that the bone **is not human**, then there is no need to contact the coroner and procedures outlined in Section 4.5 for the discovery of archaeological materials should be followed.
        b. If Dr. Tasa establishes that the bone **is human**, the Port representative will contact the coroner and local law enforcement discovery.
2. If the bone is human, the remains should not be touched, moved, or further disturbed. The coroner will assume jurisdiction and determine if the remains are forensic or not.

3. If the bones are not forensic, the coroner will report that to DAHP, who will then take jurisdiction over the human remains and report the remains to any appropriate cemeteries and to affected tribes.
4. The state physical anthropologist will make a determination of whether the remains are Native American or not and will report that finding to any appropriate cemeteries, to affected tribes, and to other appropriate consulting parties.
5. DOE will then conduct all consultation with the affected parties as to the future preservation, excavation, and disposition of the remains.

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Appendix A. Example Supervisory Plan

Supervisory Plan for Archaeological Monitoring

Project: **K Ply Remediation Project**
Location: **Port Angeles, Clallam County, Washington**

Monitoring Plan: Attachment A (not included herein)

Name of Archaeological Monitor: TBD

Monitor's Resume Attachment B (not included herein)

Summary of Monitor's Qualifications:

- At least 5 years of archaeological field experience: ☒ Yes ☐ No
- Experience in archaeological excavation: ☒ Yes ☐ No
- Experience with historical and prehistoric archaeological artifacts and deposits that could be found at the monitoring location: ☒ Yes ☐ No
- Experience in archaeological monitoring: (or an HRA onsite supervisor will be present during first monitoring project) ☒ Yes ☐ No

Professional Archaeologist(s) who will serve as Monitoring Supervisor(s):

Name, Degree	Position
Jennifer Gilpin, MA	HRA Project Archaeologist
Lynn Compas, MA	HRA Senior Archaeologist

Supervisory Requirements:

- Monitor will have a cell phone and a digital camera.
- Supervisor will visit the project site at the beginning of the work, if the monitor has not worked at the location previously. Supervisor will visit the project site periodically if the monitoring work continues longer than two full-time weeks. Supervisor will visit the project site if a find is made that needs immediate attention.
- Monitor will record daily notes on HRA's standard monitoring form (Attachment C). Monitor will take at least one photograph daily to record the work progress.
- Monitor will telephone Monitoring Supervisor daily to describe construction work, monitoring methods, and findings, and to discuss any questions.
- Monitor will send electronic photographs of any finds of artifacts or deposits to supervisor for discussion of treatment measures and decisions. The Supervisor will be available to visit site on short notice to view finds that are questionable and/or need immediate attention.
- Monitor will submit written notes weekly for Supervisor's review.
- Supervisor will review written notes at daily monitoring forms at least weekly and during site visits.

Appendix B. Project Contacts List

Project Contacts List

Floyd|Snider
Tucker Stevens – Project Manager
Email: Tucker.Stevens@floydsnider.com

Lisa Meoli
Email: Lisa.Meoli@floydsnider.com

601 Union Street, Suite 600
Seattle, Washington 98101

Telephone: (206) 292-2078

Department of Ecology (DOE)
Connie Groven, Site Project Manager
300 Desmond Drive
Lacey, WA 98516
Telephone: (360) 407-6254

Port of Port Angeles
Jesse Waknitz, Environmental Specialist
338 West First Street
Port Angeles, WA 98362
Telephone: (360) 417-3452

City of Port Angeles
Nathan West, Community Development Director
City of Port Angeles
321 E. 5th Street
Port Angeles, WA 98362
(360) 417-4750

Archaeological Consultant (Current)
Historical Research Associates, Inc. (HRA)
Jennifer Gilpin, MA (Project Archaeologist)
Email: jgilpin@hrassoc.com
Cell Phone: (206) 305-4552

Brent Hicks, MA, RPA
Email: bhicks@hrassoc.com

Lynn Compas, MA, RPA

Email: lcompas@hrassoc.com

Telephone: (206) 343-0226

City of Port Angeles Police Department
Terry Gallagher, Chief of Police
321 E 5th St.
Port Angeles, Washington 98362

Telephone: (360) 452-4545

Clallam County Coroner
Mark Nichols, Coroner
Clallam County Coroner's Office
223 East Fourth Street, Suite 11
Port Angeles, WA 98362

Telephone: (360) 417-2297
Fax: (360) 417-2469
Email: dkelly@co.clallam.wa.us

Native American Tribes
Lower Elwha Klallam Tribe

William White, Tribal Archaeologist
Telephone: (360) 452-8471 ext. 7424
Cell Phone: (360) 460-1617
Fax: (360)452-3428

Frances Charles, Tribal Chair
Telephone: (360) 452-8471 ext. 7411
Cell Phone: (360) 460-2808
Fax: (360)452-3428

Washington State Department of Archaeology and Historic Preservation (DAHP)
State Archaeologist
Gretchen Kaehler, Assistant State Archaeologist, Local Governments
PO Box 48343
Olympia, WA 98501
Telephone: (360) 586-3088 (office)
Cell Phone: (360) 628-2755
Email: Gretchen.Kaehler@dahp.wa.gov

State Physical Anthropologist
Dr. Guy Tasa

PO Box 48343
Olympia, WA 98501
Telephone: (360) 586-3534 (office)
Email: Guy.tasa@dahp.wa.gov

Appendix C. Monitoring Form

Project Name and Number				
Name				
Date	**Total Hours on Site**		**Hours Travel**	
Safety Meeting ☐Yes ☐No	**Issues**			
Weather Conditions				
Site Location				
Site Setting- Ground visibility, materials visible on surface, etc.				
Nature of Construction Activity- Skidding, grubbing, scraping, excavating, demolition, etc.?				
Equipment working in vicinity of Site(s) Types and number of machines				
Workers Present Names and Companies				
Visitors/Other Monitors Names and Companies				
Arch Monitoring Activities Describe in full if equipment was stopped or asked to move **Notes on Discussions** with others- HRA, other contractors, Tribes				
Halt? ☐**Temporary** ☐**Extended**	**Reason?**		**Client/Agency Contacted?** ☐**Yes** ☐**No**	**Contact Name** **Time of Call?** ☐**am**
Instructions- Halt activities, continue to monitor, etc.				
Camera Number **Camera Number**	**Photo Numbers** **Photo Numbers**			

K Ply Site

Engineering Design Report

Appendix I
Health and Safety Plan

Table of Contents

List of Figures

List of Attachments

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
DRO	Diesel-range organics
EZ/CRZ	Exclusion zone/contamination reduction zone
GRO	Gasoline-range organics
HASP	Health and Safety Plan
HSO/SS	Health and Safety Officer/Site Supervisor
mg/kg	Milligrams per kilogram
ORO	Oil-range organics
PID	Photoionization Detector
PM	Project Manager
PPE	Personal protective equipment
ppmv	Parts per million by volume
RI	Remedial Investigation
Site	K Ply Site
SSO	Site Safety Officer
SZ	Support Zone
VOC	Volatile organic compound
WAC	Washington Administrative Code

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1.0 Plan Objectives and Applicability

This Health and Safety Plan (HASP) has been written to comply with the standards prescribed by the Occupational Safety and Health Act (OSHA) and the Washington Industrial Safety and Health Act (WISHA).

The purpose of this HASP is to establish protection standards and mandatory safe practices and procedures for all personnel involved with investigation activities including soil confirmation sample collection during soil excavation at the K Ply Site (Site). This HASP assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may occur during field work activities. This plan consists of site descriptions, a summary of work activities, an identification and evaluation of chemical and physical hazards, monitoring procedures, personnel responsibilities, a description of site zones, decontamination and disposal practices, emergency procedures, and administrative requirements.

The provisions and procedures outlined by this HASP apply to all Floyd|Snider personnel on-site. Contractors, subcontractors, other oversight personnel, and all other persons involved with the field work activities described herein are required to develop and comply with their own HASPs. Subcontractors reporting directly to Floyd|Snider may also submit equipment-specific safety protocols, as needed, to supplement this HASP. All Floyd|Snider staff conducting field activities are required to read this HASP and indicate that they understand its contents by signing the Health and Safety Officer/Site Supervisors' (HSO/SS') copy of this plan.

It should be noted that this HASP is based on information that was available as of the date indicated in the left footer of this document. It is possible that additional hazards that are not specifically addressed by this HASP may exist at the work site, or may be created as a result of on-site activities. It is the firm belief of Floyd|Snider that active participation in health and safety procedures and acute awareness of on-site conditions by all workers is crucial to the health and safety of everyone involved. Should project personnel identify a site condition that is not addressed by this HASP and have any questions or concerns about site conditions, they should immediately notify the HSO/SS and an addendum will be provided to this HASP.

The HSO/SS has field responsibility for ensuring that the provisions outlined herein adequately protect worker health and safety and that the procedures outlined by this HASP are properly implemented. In this capacity, the HSO/SS will conduct regular site inspections to ensure that this HASP remains current with potentially changing site conditions. The HSO/SS has the authority to make health and safety decisions that may not be specifically outlined in this HASP, should site conditions warrant such actions. In the event that the HSO/SS leaves the Site while work is in progress, an alternate Site Safety Officer (SSO) will be designated. Personnel responsibilities are further described in Section 4.0.

This HASP has been reviewed by the Project Manager (PM) and the HSO/SS prior to commencement of work activities. All Floyd|Snider personnel shall review the plan and be familiar with on-site health and safety procedures. A copy of the HASP will be on-site at all times.

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2.0 Background

2.1 SITE BACKGROUND

The Site is located at 439 W. Marine Drive in Port Angeles, Washington and is the site of a former plywood mill. The majority of the mill buildings were demolished in 2012 and 2013, and the Site is currently unoccupied.

A remedial investigation (RI) completed at the Site in 2013-2014 delineated gasoline-range organics (GRO), diesel-range organics (DRO) and oil-range organics (ORO) in site soil and groundwater. The RI also identified minor areas of pentachlorophenol and dioxin/furan contamination in soils.

A Cleanup Action Plan to address the remaining soil contamination at the Site was approved by the Washington State Department of Ecology in 2015. This plan includes excavation of contaminated soil, in situ treatment of residual contamination, and site restoration.

2.2 SCOPE OF WORK

This HASP focuses on field activities associated with the excavation of soils contaminated with chemicals at concentrations considered to be a risk to worker safety, including GRO and associated volatiles, and DRO and ORO. Field activities include collection of excavation bottom pre-characterization soil samples using direct push borings, well decommissioning, excavation oversight, collection of confirmation samples from the excavation sidewalls, well installation, and groundwater monitoring.

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3.0 Emergency Contacts and Information

3.1 DIAL 911

In the event of an emergency, dial 911 to reach fire, police, and first aid.

3.2 HOSPITAL AND POISON CONTROL

Nearest Hospital Location and Telephone: Refer to Figure I.1 below for map and directions to the hospital.	Olympic Medical Center 939 Caroline Street Port Angeles, WA (360) 417-7000
Washington Poison Control Center:	(800) 222-1222

Figure I.1
Hospital Directions

1. Head **southeast** on **MARINE DR/W MARINE DR** going toward **W 2ND ST** - go **0.2** mi
2. Bear Right on **W 1ST ST** - go **0.3** mi
3. Continue on **E 1ST ST** - go **0.8** mi
4. Turn Left on **N RACE ST** - go **0.2** mi
5. Turn Right on **CAROLINE ST/E CAROLINE** ST - go **< 0.1** mi
6. Arrive at **939 CAROLINE ST**, PORT ANGELES

3.3 PROVIDE INFORMATION TO EMERGENCY PERSONNEL

All Floyd|Snider project personnel should be prepared to give the following information:

Information to Give to Emergency Personnel	
Site Location: Refer to Figures I.1 and I.2 and directions above	K Ply Site 439 W. Marine Drive Port Angeles, WA **Site:** The Site is located on the waterfront in Port Angeles and is accessible from W. Marine Drive
Number You are Calling from:	This information can be found on the phone you are calling from.
Type of Accident or Type(s) of Injuries:	Describe accident and/or incident and numbers of personnel needing assistance.

Figure I.2
K Ply Site Location

3.4 EMERGENCY CONTACTS

After contacting emergency response crews as necessary, contact the Floyd|Snider PM, or a Principal to report the emergency. The Floyd|Snider PM may then contact the Site owner, or direct the field staff to do so.

Floyd|Snider Emergency Contacts:

Contact	Office Phone Number	Cell Phone Number
Tom Colligan, PM	(206) 292-2078	(206) 276-8527
Kate Snider, Principal		(206) 375-0762
Teri Floyd, Principal		(206) 713-1329
Allison Geiselbrecht, Principal		(206) 722-2460
Tucker Stevens, HSO/SS		(406) 579-0451

Other Emergency Contacts:

Contact	Company	Cell Phone Number
Jesse Waknitz	Port of Port Angeles	(360) 460-1364
Contractor Safety Officer	TBD	TBD

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4.0 Primary Responsibilities and Requirements

4.1 PROJECT MANAGER

The PM will have overall responsibility for the completion of the project, including the implementation and review of this HASP. The PM will review health and safety issues as needed and as consulted, and will have authority to allocate resources and personnel to safely accomplish the field work.

The PM will direct all Floyd|Snider personnel involved in field work at the Site. If the project scope changes, the PM will notify the HSO/SS so that the appropriate addendum will be included in the HASP. The PM will ensure that all Floyd|Snider personnel on-site have received the required training, are familiar with the HASP, and understand the procedures to follow should an accident and/or incident occur on-site.

4.2 HEALTH AND SAFETY OFFICER AND SITE SUPERVISOR

The HSO/SS will approve this HASP and any amendments thereof, and will ultimately be responsible for full implementation of all elements of the HASP.

The HSO/SS will advise the PM and project personnel on all potential health and safety issues of the field investigation activities to be conducted at the Site. The HSO/SS will specify required exposure monitoring to assess site health and safety conditions, modify the Site HASP based on field assessment of health and safety accidents and/or incidents, and recommend corrective action if needed. The HSO/SS will report all accidents and/or incidents to the PM. If the HSO/SS observes unsafe working conditions by Floyd|Snider personnel or any contractor personnel, the HSO/SS will suspend all work until the hazard has been addressed.

4.3 SITE SAFETY OFFICER

The SSO may be a person dedicated to the task of assisting the HSO/SS during field work activities. The SSO will ensure that all personnel have appropriate personal protective equipment (PPE) on-site and PPE is properly used. The SSO will assist the HSO/SS in field observation of Floyd|Snider personnel safety. If a health or safety hazard is observed, the SSO shall suspend all work activity. The SSO will conduct on-site safety meetings daily before work commences and complete the Daily Tailgate Safety Meeting and Debrief Form (provided as Attachment I.1) after the completion of field work. All health and safety equipment will be calibrated daily and records kept in the daily field logbook. The SSO may perform exposure monitoring if needed and will ensure that equipment is properly maintained.

4.4 FLOYD|SNIDER PROJECT PERSONNEL

All Floyd|Snider project personnel involved in field work activities will take precautions to prevent accidents and/or incidents from occurring to themselves and others in the work areas. Employees will report all accidents and/or incidents or other unsafe working conditions to the HSO/SS or SSO immediately. Employees will inform the HSO/SS or SSO of any physical conditions that could impact their ability to perform field work.

4.5 TRAINING REQUIREMENTS

All Floyd|Snider project personnel must comply with applicable regulations specified in the Washington Administrative Code (WAC) Chapter 296-843, Hazardous Waste Operations, administered by the Washington State Department of Labor and Industries. Project personnel will be 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) trained and maintain their training with an annual 8-hour refresher. Personnel with limited tasks and minimal exposure potential will be required to have 24-hour training and a site hazard briefing and be escorted by a trained employee. Personnel with defined tasks that do not include potential contact with disturbed site soils or waste, groundwater, or exposures to visible dust (e.g., surveying) are not required to have any level of hazardous waste training beyond a site emergency briefing and hazard orientation by the HSO/SS. Floyd|Snider project personnel will fulfill the medical surveillance program requirements.

At least one person on-site during field work will have current cardiopulmonary resuscitation (CPR)/First Aid certification. All field personnel will have a minimum of 3 days of hazardous materials field experience under the direction of a skilled supervisor.

Additional site-specific training that covers on-site hazards, PPE requirements, use and limitations, decontamination procedures, and emergency response information as outlined in this HASP will be given by the HSO/SS before on-site work activities begin.

5.0 Hazard Evaluation and Risk Analysis

In general, there are three broad hazard categories that may be encountered during site work: chemical exposure hazards, fire/explosion hazards, and physical hazards. Sections 5.1 through 5.3 discuss the specific hazards that fall within each of these broad categories. Section 5.4 summarizes the hazard analysis for each specific task.

5.1 CHEMICAL EXPOSURE HAZARDS

This section describes potential chemical hazards associated with soil excavation and sampling. Based on previous site data, the chemicals of concern at the Site are petroleum hydrocarbons, including benzene and GRO, DRO, and ORO. Human health hazards for these compounds are presented below:

Chemical	Greatest Detected Concentration in Site Soil	Routes of Exposure	Potential Toxic Effects
Benzene	120 mg/kg	Inhalation, absorption, ingestion, contact	Eye/skin/respiratory system irritation, nausea, headache, dizziness, lack of coordination, headache, drowsiness
Gasoline-range organics	14,000 mg/kg[1]	Inhalation, absorption, ingestion, contact	Eye/skin/respiratory system irritation, nausea, headache, dizziness, lack of coordination, blurred vision, convulsions,
Diesel-range organics	24,000 mg/kg	Inhalation, absorption, ingestion, contact	Eye and respiratory system irritation, dizziness, headache, nausea
Oil-range organics	32,000 mg/kg[1]	Inhalation, absorption, ingestion, contact	Eye and respiratory system irritation

Note:
1 Greatest concentration observed in site soils; GRO and ORO also present as non-aqueous phase liquid in some site monitoring wells.

Abbreviation:
mg/kg Milligrams per kilogram

This information covers potential toxic effects that might occur if relatively significant acute and/or chronic exposure were to happen. This information does not mean that such effects will occur from the planned site activities. Potential routes of exposure include inhalation, dermal contact, and ingestion. The primary exposure route of concern during site work is ingestion or inhalation of contaminated soil or soil vapor.

Ingestion of volatile organic compounds (VOC)-contaminated soil is highly preventable with the use of appropriate PPE as described in Section 7.1 and pollution prevention and decontamination procedures described in Section 9.0. In order to limit the potential for inhalation of VOCs during site work, ambient air will be monitored with a photoionization detector (PID) during excavation, as described in Section 6.0. Additionally, the contractor will be required to apply odor and VOC suppressant foam to control migration of noxious odors (refer to Attachment I.2 for odor suppressant foam Material Safety Data Sheet). Section 7.2 describes engineering controls that may be enacted to limit the inhalation of VOCs.

5.2 FIRE AND EXPLOSION HAZARDS

Flammable and combustible liquid hazards may occur from fuels and lubricants brought to the property for excavation equipment. When on-site storage is necessary, such material will be stored in containers approved by the Washington State Department of Transportation in a location not exposed to strike hazards and provided with secondary containment. A minimum 2-A:20-B fire extinguisher will be located within 25 feet of the storage location and where refueling occurs. Any subcontractors bringing flammable and combustible liquid hazards to the Site are responsible for providing appropriate material for containment and spill response, and should address these containment and cleanup measures in their respective HASPs. Transferring of flammable liquids (e.g., gasoline) will occur only after making positive metal-to-metal connection between the containers, which may be achieved by using a bonding strap. Storage of ignition and combustible materials will be kept away from fueling operations.

Although there are VOCs present as contamination in site soils, these compounds are typically present in moist to wet soils. Though GRO is not present at concentrations that pose significant fire or explosion hazards, there is a limited risk of flammability in areas where GRO is present as non-aqueous phase liquid. As a precautionary and good housekeeping measure, smoking and open flames will not be permitted inside the excavation area.

5.3 PHYSICAL HAZARDS

When working in or around any hazardous or potentially hazardous substances or situations, including an open excavation and vehicle traffic, all site personnel should plan all activities before starting any task. A tailgate safety meeting, in which personnel identify health and safety hazards involved with the work planned and consult with the HSO/SS as to how the task can be performed in the safest manner, and if personnel have any reasons for concern or uncertainty, shall be conducted prior to the start of work.

All field personnel will adhere to general safety rules including wearing appropriate PPE—hard hats, steel-toed boots, high-visibility vests, safety glasses, gloves, and hearing protection, as appropriate. Eating, drinking, and/or use of tobacco or cosmetics will be restricted in all work areas. Personnel will prevent splashing of liquids containing chemicals and minimize dust emissions.

The following table summarizes a variety of physical hazards that may be encountered on the Site during work activities. For convenience, these hazards have been categorized into several general groupings with recommended preventative measures.

Hazard	Cause	Prevention
Head strike	Falling and/or sharp objects, bumping hazards.	Hard hats will be worn by all personnel at all times when overhead hazards exist, such as during drilling activities.
Fall hazards	Falling into open excavation or other pits on-site.	Existing concrete-lined pits from historical operations will be excluded from the active construction area by fencing. Excavated areas that are not undergoing active work and are not properly sloped for entry by field personnel will be marked by high-visibility tape or temporary fencing and will be backfilled as soon as practical. All personnel will pay attention to fall hazards when walking through the Site.
Foot/ankle twist, crush, slip/trip/fall	Sharp objects, dropped objects, uneven and/or slippery surfaces.	Steel-toed boots must be worn at all times on-site while heavy equipment is present. Pay attention to footing on uneven or wet terrain and do not run. Keep work areas organized and free from unmarked trip hazards. Use caution when entering the excavation area.
Hand cuts, splinters, and chemical contact	Hands or fingers pinched or crushed, chemical hazards. Cut or splinters from handling sharp/rough objects and tools.	Nitrile safety gloves will be worn to protect the hands from dust and chemicals. Leather or cotton outer gloves will be used when handling sharp-edged rough materials or equipment. Refer to preventive measures for mechanical hazards below.
Eye damage from flying materials, or splash hazards	Sharp objects, poor lighting, exposure due to flying debris or splashes.	Safety glasses will be worn at all times on-site. If a pressure washer is used to decontaminate heavy equipment, a face shield will be worn over safety glasses or goggles. Care will be taken during decontamination procedures and groundwater sampling to avoid splashing or dropping equipment into decontamination water.

Hazard	Cause	Prevention
Electrical hazards	Underground utilities, overhead utilities. Electrical cord hazards, such as well development pumps.	No buried electrical lines are present in the excavation areas. Make sure that no damage to extension cords occurs. If an extension cord is used, make sure it is the proper size for the load that is being served and rated SJOW or STOW (an "-A" extension is acceptable for either) and inspected prior to use for defects. The plug connection on each end should be of good integrity. Insulation must be intact and extend to the plugs at either end of the cord. All portable power tools will be inspected for defects before use and must either be a double-insulated design or grounded with a ground-fault circuit interrupter.
Mechanical hazards	Heavy equipment such as drill rigs, excavator, service trucks, etc. Conducting work in road right of ways (on the road shoulder).	Ensure the use of competent operators, backup alarms, regular maintenance, daily mechanical checks, and proper guards. Subcontractors will supply their own HASP. All project personnel will make eye contact with operator and obtain a clear "OK" before approaching or working within swing radius of heavy equipment, staying clear of swing radius.
Traffic hazards	Vehicle traffic and hazards when working near active operations.	When working in or near the right-of-way, orange cones and/or flagging will be placed around the work area. Safety vests will be worn at all times while conducting work off-site. Multiple field staff will work together (buddy system) and spot traffic for each other. Avoid working with your back to traffic whenever possible.
Noise/ damage to hearing	Loud machinery	Wear earplugs or protective ear covers when a conversational level of speech is difficult to hear at a distance of 3 feet; when in doubt, a sound level meter may be used on-site to document noise exposure.

Hazard	Cause	Prevention
Strains from improper lifting	Injury due to improper lifting techniques, over-reaching/ overextending, lifting overly heavy objects.	Use proper lifting techniques and mechanical devices where appropriate. The proper lifting procedure first involves testing the weight of the load by tipping it. If in doubt, ask for help. Do not attempt to lift a heavy load alone. Take a good stance and plant your feet firmly with legs apart, one foot farther back than the other. Turn the forward foot and point it in the direction of the eventual movement. Make sure you stand on a level area with no slick spots or loose gravel. Use as much of your hands as possible, not just your fingers. Keep your back straight, almost vertical. Bend at the hips, holding load close to your body. Keep the weight of your body over your feet for good balance. Use large leg muscles to lift. Push up with one foot positioned in the rear as you start to lift. Avoid quick, jerky movements and twisting motions. Never try to lift more than you are accustomed to lifting.
Cold stress	Cold temperatures and related exposure.	Workers will ensure appropriate clothing, stay dry, and take breaks in a heated environment when working in cold temperatures. **Further detail on cold stress is provided in Section 5.3.1.**
Accidents due to inadequate lighting	Improper illumination.	Work will proceed during daylight hours only, or under sufficient artificial light.

5.3.1 Cold Stress

Field work is expected to be completed in early spring and exposure to cold temperatures may be possible. Exposure to moderate levels of cold can cause the body's internal temperature to drop to a dangerously low level, causing hypothermia. Symptoms of hypothermia include slow, slurred speech, mental confusion, forgetfulness, memory lapses, lack of coordination, and drowsiness.

To prevent hypothermia, site personnel will stay dry and avoid exposure. Site personnel will have access to a warm, dry area, such as a vehicle, to take breaks from the cold weather and warm up. Site personnel will be encouraged to wear sufficient clothing in layers such that outer clothing is wind- and waterproof and inner layers retain warmth (wool or polypropylene), if applicable. Site personnel will keep hands and feet well protected at all times. The signs and symptoms and treatment for hypothermia are summarized below.

Signs and Symptoms

- Mild hypothermia (body temperature of 98–90 °F)
    - Shivering
    - Lack of coordination, stumbling, fumbling hands
    - Slurred speech
    - Memory loss
    - Pale, cold skin
- Moderate hypothermia (body temperature of 90–86 °F)
    - Shivering stops
    - Unable to walk or stand
    - Confused and irrational
- Severe hypothermia (body temperature of 86–78 °F)
    - Severe muscle stiffness
    - Very sleepy or unconscious
    - Ice cold skin
    - Death

Treatment of Hypothermia—Proper Treatment Depends on the Severity of the Hypothermia

- Mild hypothermia
    - Move to warm area.
    - Stay active.
    - Remove wet clothes and replace with dry clothes or blankets and cover the head.
    - Drink warm (not hot) sugary drinks.
- Moderate hypothermia
    - All of the above, plus:
        - Call 911 for an ambulance.
        - Cover all extremities completely.
        - Place very warm objects such as hot packs or water bottles on the victim's head, neck, chest, and groin.
- Severe hypothermia
    - Call 911 for an ambulance.
    - Treat the victim very gently.
    - Do not attempt to re-warm—the victim should receive treatment in a hospital.

Frostbite

Frostbite occurs when the skin actually freezes and loses water. In severe cases, amputation of the frostbitten area may be required. While frostbite usually occurs when the temperatures are 30 °F or lower, wind chill factors can allow frostbite to occur in above-freezing temperatures. Frostbite typically affects the extremities, particularly the feet and hands. Frostbite symptoms include a cold, tingling, stinging, or aching feeling in the frostbitten area followed by numbness and skin discoloration from red to purple, then white or very pale skin. Should any of these symptoms be observed, wrap the area in soft cloth, do not rub the affected area, and seek medical assistance. Call 911 if the condition is severe.

***Protective* Clothing**

Wearing the right clothing is the most important way to avoid 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. The following are recommendations for working in cold environments:

- Wear *at least three layers* of clothing.
  - An outer layer to break the wind and allow some ventilation (like Gortex or nylon).
  - A middle layer of down or wool to absorb sweat and provide insulation even when wet.
  - An inner layer of cotton or synthetic weave to allow ventilation.
- Wear a hat—up to 40 percent of body heat can be lost when the head is left exposed.
- Wear insulated boots or other footwear.
- Keep a change of dry clothing available in case work clothes become wet.
- Do not wear tight clothing—loose clothing allows better ventilation.

Work Practices

- Drinking—Drink plenty of liquids, avoiding caffeine and alcohol. It is easy to become dehydrated in cold weather.
- Work Schedule—If possible, heavy work should be scheduled during the warmer parts of the day. Take breaks out of the cold in heated vehicles.
- Buddy System—Try to work in pairs to keep an eye on each other and watch for signs of cold stress.

5.3.2 Heat Stress

To avoid heat-related illness, current regulations in WAC 296-62-095 through 296-62-09560 will be followed during all outdoor work activities. These regulations apply to any outdoor work environment from May 1 through September 30, annually, when workers are exposed to temperatures greater than 89 °F when wearing breathable clothing, greater than 77 °F when wearing double-layered woven clothing (such as jackets or coveralls), or greater than 52 °F when wearing non-breathing clothing such as chemical resistant suits or Tyvek. The planned work at the Site is expected to be completed prior to the beginning of the time period during which outdoor work is regulated to control heat-related illness.

5.3.3 Biohazards

Bees and other insects may be encountered during the field work tasks. Persons with allergies to bees will make the HSO/SS aware of their allergies and will avoid areas where bees are identified. Controls such as repellents, hoods, nettings, masks, or other personal protection may be used. Report any insect bites or stings to the HSO/SS and seek first aid, if necessary. Site personnel will maintain a safe distance from any urban wildlife encountered, including stray dogs, raccoons, and rodents, to preclude a bite from a sick or injured animal. Personnel will be gloved and will use tools to lift covers from catch basins and monitoring wells.

5.4 HAZARD ANALYSIS BY TASK

The following section identifies potential hazards associated with each task listed in Section 2.2 of this HASP. Tasks have been grouped according to the types of potential hazard associated with them.

Task	Potential Hazard
Soil Boing Installation and Well Decommissioning	Exposure to loud noise; overhead hazards; head, foot, ankle, hand, and eye hazards; electrical and mechanical hazards; lifting hazards; soil vapor and/or dust inhalation hazards; potential dermal or eye exposure to site contaminants in groundwater and soil; traffic hazards; and heat or cold exposure hazards.
Excavation Oversight	Exposure to loud noise; overhead hazards; head, foot, ankle, hand, and eye hazards; electrical and mechanical hazards; lifting hazards; soil vapor and/or dust inhalation hazards; potential dermal or eye exposure to site contaminants in groundwater and soil; fall hazards; traffic hazards; and heat or cold exposure hazards.
Soil Sampling, Field Screening, and Confirmation Soil Sample Collection	Chemical hazards include potential dermal or eye exposure to site contaminants in soil. Physical hazards include slip, trip, or fall hazards; heat and cold exposure hazards; and biological hazards.

6.0 Site Monitoring

This section describes site monitoring techniques and equipment that are to be used during site field activities. The HSO/SS, or a designated alternate, is responsible for site control and monitoring activities.

Soil samples will be screened with a PID to monitor the presence of VOCs. Visual monitoring for dust will be conducted by the HSO/SS to ensure that inhalation of contaminated soil particles does not occur; however, the contaminated Site soils are generally moist to wet and are not expected to generate substantial dust. If visible dust is leaving the work area during contaminated soil excavation, immediate action will be taken to suppress the dust. Water may be used to suppress any dust clouds generated during work activities. The HSO/SS will visually inspect the work site at least daily to identify any new potential hazards. If new potential hazards are identified, immediate measures will be taken to eliminate or reduce the risks associated with these hazards.

Project personnel are expected to perform field work in Level D PPE (i.e., no respiratory protection equipment required with routine air monitoring). A PID will also be used to monitor vapor concentrations in breathing air of total VOCs in parts per million volume (ppmv) throughout excavation activities and a wind sock will be used to assess the prevailing wind direction. VOC concentrations measured during air monitoring will be recorded in a field notebook. The PID will sample the breathing space above the excavation and monitor continuously, and the following institutional controls may be enacted based on the measured VOC concentrations. The action levels for air monitoring for VOCs are as follows:

Monitoring Equipment	VOC Concentration	Action
PID	Less than 0.1 ppmv; less than 0.5 ppmv (ACGIH 8-hour TWA for benzene) for no longer than 15 minutes	Continue operations in Level D PPE. Work upwind of excavation area when possible.
	Greater than 0.1 and less than 0.5 ppmv; intermittent	Leave work area and allow vapor to dissipate; use engineering controls if necessary. Monitor VOC concentration every 5 minutes; resume work once concentrations are less than 0.1 ppmv for 15 minutes.
	Greater than 2.5 ppmv (ACGIH STEL)	Stop operations and evacuate area. Do not resume work until engineering controls able to maintain VOC concentrations less than 0.1 ppmv in breathing space are in place.

Abbreviations:
ACGIH American Conference of Governmental Hygienists
STEL Short term exposure limit
TWA Time-weighted average

Engineering controls that may be undertaken to reduce the risk of airborne VOCs in the work area are discussed in Section 7.2.

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7.0 Hazard Reduction

7.1 PERSONAL PROTECTIVE EQUIPMENT

All work will proceed in Level D PPE, which shall include hard hat, steel-toed boots, hearing protection, eye protection, gloves, and sturdy outer work clothing. Rubber or other waterproof boots must be worn inside the excavation area, as footwear must be thoroughly decontaminated in a boot wash before exiting the excavation area.

All personnel have been trained in the proper use of PPE. The level of protection may be upgraded by the HSO/SS if warranted by conditions present in the work area. As an alternative, work may be temporarily suspended in order to implement appropriate engineering controls. The HSO/SS will periodically inspect equipment such as gloves and hard hats for defects.

For all work involving potential exposure to soil or groundwater, workers will wear nitrile gloves and Level D PPE.

High visibility vests will be worn when working around heavy equipment, and off-site on road shoulders.

7.2 ENGINEERING CONTROLS

The SSO will evaluate the need for engineering controls to reduce exposures to airborne contaminants. Engineering controls should include using a wind sock or other monitoring device to determine the direction of prevailing wind and setting up a work area upwind of the airborne contaminant source. Alternative engineered controls include the use of enhanced ventilation at a work site (e.g., the use of electric fans) to reduce contaminant concentration by dilution, if there is not sufficient circulation of ambient air. If fans are used, they will be directed away from pedestrian pathways and building entrances.

Site perimeter monitoring of the populated areas to the south and west will be conducted daily when wind conditions may cause vapor from the work area to blow off-site, to ensure that airborne contaminants do not affect people in the surrounding area. If noticeable odors or PID readings greater than background concentrations are observed during perimeter monitoring, the contractor will be responsible for applying an odor and VOC suppressant foam to control off-site migration of soil vapor. Shielding may be used in some instances to protect workers from contaminants. Exposures can also be reduced by keeping contaminated soils covered when possible and backfilling the excavation as soon as possible.

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8.0 Site Control and Communication

8.1 SITE CONTROL

Work area controls and decontamination areas will be provided to limit the potential for chemical exposure associated with site activities, and transfer of contaminated media from one area of the Site to another. The support zone (SZ) for the Site includes all areas outside the work area and decontamination areas. An exclusion zone/contamination reduction zone (EZ/CRZ) and SZ will be set up for work being conducted within the limits of the Site. Only authorized personnel shall be permitted access to the EZ/CRZ. Staff will decontaminate all equipment and gear, including work boots, as necessary prior to exiting the CRZ.

The Site is unoccupied and will be fully fenced to prevent members of the public from entering the work area.

8.2 COMMUNICATION

All site work will occur in teams and the primary means of communication on-site and with off-site contacts will be via cell phones. An agreed-upon system of alerting via air horns and/or vehicle horns may be used around heavy equipment to signal an emergency if shouting is ineffective.

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9.0 Decontamination and Waste Disposal

9.1 CONTAMINATION PREVENTION

To avoid personal contact with contaminants, personnel will adhere to the following guidelines:

- Do not walk through areas of known contamination.
- Do not directly handle or touch contaminated materials.
- Make sure all PPE is intact and in good working condition prior to donning.
- Take particular care to protect any skin injuries.
- Stay upwind of airborne contaminants.
- Do not carry cigarettes, gum, or similar items into contaminated areas.

To avoid spreading equipment and sample contamination, personnel will do the following:

- Take care to limit contact with heavy equipment and vehicles.
- If contaminated tools are to be placed on non-contaminated equipment/vehicles for transport to a decontamination area, use plastic to keep the non-contaminated equipment clean.
- Bag sample containers prior to emplacement of sample material.

9.2 DECONTAMINATION

A majority of field activities and sampling are expected to be conducted using Level D PPE. Decontamination procedures for both PPE and field equipment will be strictly followed to prevent off-site spread of contaminated soil or water. The HSO/SS will assess the effectiveness of decontamination procedures by visual inspection. Hands must be thoroughly washed before leaving the Site to eat, drink, or use tobacco.

Equipment and vehicle decontamination generally consists of sweeping (if dry) and/or pressure washing with detergent solution followed by a potable water rinse, requiring construction of a temporary decontamination station. Equipment decontamination will be designed and implemented by the contractor, and the HSO/SS will monitor equipment decontamination to ensure that contaminated media do not leave the Site.

9.3 WASTE DISPOSAL

Floyd|Snider and its subcontractors will employ safe and prudent waste collection and housekeeping practices to minimize the spread of contamination beyond the work zone and the amount of investigation-derived wastes. The Floyd|Snider HSO/SS will work with site personnel to ensure the proper collection, packaging, and identification of waste materials so that waste materials will be properly disposed of.

Waste soils left over from sample processing and decontamination waste water will be disposed of in accordance with the established procedures for the removal and hauling of excavated site soil.

10.0 Emergency Response and Contingency Plan

This section defines the emergency action plan for the Site. It will be rehearsed with all Floyd|Snider field personnel and subcontractors directly overseen by Floyd|Snider, and reviewed whenever the plan is modified or the HSO/SS believes that field personnel are unclear about the appropriate emergency actions.

A muster point of refuge (that is clear of adjacent hazards and not located downwind of site investigation activities) will be identified by the HSO/SS and communicated to the field team each day. In an emergency, all field personnel and visitors will evacuate to the muster point for roll call. It is important that each person on-site understand their role in an emergency, and that they remain calm and act efficiently to ensure everyone's safety.

After each emergency is resolved, the entire project team will meet and debrief on the incident—the purpose is not to fix blame, but to improve the planning and response to future emergencies. The debriefing will review the sequence of events, what was done well, and what can be improved. The debriefing will be documented in a written format and communicated to the PM. Modifications to the emergency plan will be approved by the PM.

Reasonably foreseeable emergency situations include medical emergencies, accidental release of hazardous materials (such as gasoline or diesel) or hazardous waste, and general emergencies such as vehicle accident, fire, thunderstorm, and earthquake. Expected actions for each potential incident are outlined below.

10.1 MEDICAL EMERGENCIES

General emergency procedures that are applicable to almost every activity are presented below.

In the event of a medical emergency, the following procedures should be used:

- Stop any imminent hazard if you can safely do so.
- Remove ill, injured, or exposed person(s) from immediate danger if moving them will clearly not cause them harm and no hazards exist to the rescuers.
- Evacuate other on-site personnel to a safe place in an upwind or cross-wind direction until it is safe for work to resume.

In the event of a chemical exposure, use the following procedures:

- **Skin Contact.** Flush the area with copious quantities of cold water for at least 15 minutes. Do not let contamination spread to other personnel. Seek medical attention. If injuries are severe, summon an ambulance as described below.
- **Eye Contact.** Wash/rinse affected area for at least 15 minutes. An emergency eye wash system will be present on-site. Seek medical attention.

- **Inhalation.** Remove the person from further exposure. Summon an ambulance and contact the hospital as described below, and be prepared to provide respiratory support if the person has difficulty breathing.
- **Ingestion.** Dilute the material with large quantities of water. Summon an ambulance and contact the hospital or poison control center immediately for further instructions.
- If serious injury or a life-threatening condition exists, call **911** for paramedics, fire department, and police. Clearly describe the location, injury, and conditions to the dispatcher. Designate a person to go to the site entrance and direct emergency equipment to the injured person(s). Provide the responders with a copy of this HASP to alert them to chemicals of potential concern.
- Trained personnel may provide cardiopulmonary resuscitation/First Aid if it is necessary and safe to do so. Remove contaminated clothing and PPE only if this can be done without endangering the injured person.
- Call the PM and HSO/SS.
- Immediately implement steps to prevent recurrence of the accident.

Refer to Section 3.2 for a map showing the nearest hospital location (Figure I.1) as well as a hospital phone number and address.

10.2 ACCIDENTAL RELEASE OF CONTAMINATED MATERIALS OR WASTES

The procedures for handling and notification of spills are provided in the Spill Prevention, Control, and Countermeasures Plan (refer to Appendix C of the Engineering Design Report). In the event of a spill, the SSO will evacuate all on-site personnel to a safe place in an upwind direction until the HSO/SS determines that it is safe for work to resume. The SSO will also contact the PM and confirm a response.

10.3 GENERAL EMERGENCIES

In the case of fire, explosion, earthquake, or imminent hazards, work shall be halted and all on-site personnel will be immediately evacuated to a safe place. The local police/fire department shall be notified, by calling 911, if the emergency poses a continuing hazard.

In the event of a thunderstorm, outdoor work will be discontinued until the threat of lightning has abated. During the incipient phase of a fire, the available fire extinguisher(s) may be used by persons trained in putting out fires, if it is safe for them to do so. Contact the fire department as soon as feasible.

10.4 EMERGENCY COMMUNICATIONS

In the case of an emergency, an air horn will be used as needed to signal the emergency. One long (5-second) blast will be given as the emergency/stop work signal. If the air horn is not working, a vehicle horn and/or overhead waving of arms will be used to signal the emergency. In any emergency, all personnel will evacuate to the designated refuge area and await further instruction.

10.5 EMERGENCY EQUIPMENT

The following minimum emergency equipment will be readily available on-site and functional at all times:

- First Aid Kit—contents approved by the HSO/SS, including two blood borne pathogen barriers and an emergency eye wash station
- Spill kit
- Portable fire extinguisher (2-A:10 B/C min)
- A copy of the current HASP

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11.0 Administrative

11.1 MEDICAL SURVEILLANCE

Floyd|Snider personnel involved with field activities must be covered under Floyd|Snider's medical surveillance program that includes biennial physical examinations. These medical monitoring programs must be in compliance with all applicable worker health and safety regulations.

11.2 RECORDKEEPING

The HSO/SS, or a designated alternate, will be responsible for keeping documentation of site activities including: attendance lists of personnel present at site health and safety meetings, accident reports, and signatures of all personnel who have read this HASP.

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12.0 Approvals

Project Manager	Date
Project Health & Safety Officer	Date

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13.0 Signature Page

I have read this Health and Safety Plan and understand its contents. I agree to abide by its provisions and will immediately notify the HSO/SS if site conditions or hazards not specifically designated herein are encountered.

Name (Print)	Signature	Date	Company/Affiliation

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K Ply Site

Engineering Design Report

Appendix I
Health and Safety Plan

Attachment I.1
Daily Tailgate Safety Meeting and Debrief Form

DAILY TAILGATE SAFETY METEETING AND DEBRIEF FORM

Instructions
To be competed by supervisor prior to beginning of work each day, when changes in work procedures occur, or when additional hazards are present. Please maintain a copy of this form with the site-specific HASP for the record.

PROJECT NAME AND ADDRESS:	**WORK COMPLETED/TOOLS USED:**

TOPICS/HAZARDS DISCUSSED:

Chemicals of concern:
Slip, trip, fall:
Heat or cold stress:
Required PPE:
Other Potential Hazards:
• **Environmental:**
• **Physical:**
• **Biological:**
• **Other :**

INFORMAL TRAINING CONDUCTED (Name, topics):

NAMES OF EMPLOYEES:

ADDITIONAL HAZARDS IDENTIFIED AT END OF WORK DAY:

Near Misses/Incidents? If so proceed to Page 2 Near Miss and Incident Reporting Form

Supervisors Signature/Date: ____

NEAR MISS AND INCIDENT REPORTING FORM

INCIDENTS:

INJURIES:

NEAR MISSES:

CORRECTIVE ACTIONS:

Supervisors Signature/Date:

____

K Ply Site

Engineering Design Report

Appendix I
Health and Safety Plan

Attachment I.2
Odor Suppressant Foam
Material Safety Data Sheet

SAFETY DATA SHEET

LONG DURATION FOAM AC-645

Section 1. Identification

GHS product identifier	:	LONG DURATION FOAM AC-645
Chemical name	:	Proprietary Surfactant.
Other means of identification	:	Aqueous anionic surfactant mixture.
Product type	:	Liquid.

Relevant identified uses of the substance or mixture and uses advised against

Product use	:	Aqueous Surfactant. Spray application for VOC and Odor control.
Area of application	:	Industrial applications.

Supplier/Manufacturer	:	Rusmar, Inc. 216 Garfield Avenue West Chester, PA 19380 Phone: 610-436-4314 Fax: 610-436-8436
e-mail address of person responsible for this SDS	:	info@rusmarinc.com Website: www.rusmarinc.com
Emergency telephone number (with hours of operation)	:	888 488 8044 or 212 682 1200 CHEMTREC 800 424 9300

Section 2. Hazards identification

OSHA/HCS status	:	While this material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200), this SDS contains valuable information critical to the safe handling and proper use of the product. This SDS should be retained and available for employees and other users of this product.
Classification of the substance or mixture	:	Not classified.

GHS label elements

Signal word	:	No signal word.
Hazard statements	:	No known significant effects or critical hazards.
Precautionary statements		
Prevention	:	Not applicable.
Response	:	Not applicable.
Storage	:	Not applicable.
Disposal	:	Not applicable.
Hazards not otherwise classified	:	None known.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : Proprietary Surfactant.

Other means of identification : Aqueous anionic surfactant mixture.

CAS number/other identifiers

CAS number : Not available.

Product code : Not available.

Ingredient name	Other names	%	CAS number
Proprietary Surfactant.	-	100	-

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 and hence require reporting in this section.

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. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. Get medical attention if symptoms occur.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. 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. Do not induce vomiting unless directed to do so by medical personnel. Get medical attention if symptoms occur.

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.

Ingestion : No known significant effects or critical hazards.

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.

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 : In a fire or if heated, a pressure increase will occur and the container may burst.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
sulfur oxides

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.

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. 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).

Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. 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.

Section 6. Accidental release measures

Large spill : Stop leak if without risk. Move containers from spill area. 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. 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).

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 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. 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

None.

Appropriate engineering controls : Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

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.
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.
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. [Clear viscous liquid.]
Color	: Translucent. White.
Odor	: Odorless.
Odor threshold	: Not available.
pH	: Not available.
Melting point	: Not available.
Boiling point	: 99°C (210.2°F)
Flash point	: Not applicable.
Evaporation rate	: Not available.
Flammability (solid, gas)	: Not applicable.
Lower and upper explosive (flammable) limits	: Not available.
Vapor pressure	: 3.3 kPa (25 mm Hg) [room temperature]
Vapor density	: Not available.
Relative density	: 1.01 to 1.06
Solubility	: Easily soluble in the following materials: cold water and hot water.
Solubility in water	: Easily soluble.
Partition coefficient: n-octanol/water	: Not available.
Auto-ignition temperature	: Not available.
Decomposition temperature	: Not available.
SADT	: Not available.
Viscosity	: Not available.

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.

Under normal conditions of storage and use, hazardous polymerization will not occur.

Conditions to avoid : Keep away from heat.

Incompatible materials : No specific data.

Hazardous decomposition products : Low levels of sulfur oxides on exposure to high temperatures (concentrate).

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Conclusion/Summary : Not expected.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Conclusion/Summary : Not available.

Carcinogenicity

Conclusion/Summary : Not available.

Reproductive toxicity

Conclusion/Summary : Not available.

Teratogenicity

Conclusion/Summary : Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Section 11. Toxicological information

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	: No known significant effects or critical hazards.

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.

Section 12. Ecological information

Bioaccumulative potential

Not available.

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. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Section 14. Transport information

	DOT Classification	IMDG	IATA
UN number	Not regulated.	Not regulated.	Not regulated.
UN proper shipping name	-	-	-
Transport hazard class(es)	-	-	-
Packing group	-	-	-
Environmental hazards	No.	No.	No.
Additional 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	: **United States inventory (TSCA 8b)**: Not determined.
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 : Not applicable.

Composition/information on ingredients

No products were found.

SARA 313

Not applicable.

State regulations

Massachusetts	: This material is not listed.
New York	: This material is not listed.
New Jersey	: This material is not listed.
Pennsylvania	: This material is not listed.

California Prop. 65

None of the components are listed.

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Inform Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Section 16. Other information

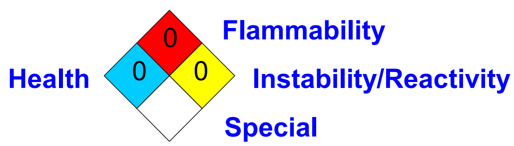
Hazardous Material Information System (U.S.A.)

Health	0
Flammability	0
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.

Procedure used to derive the classification

Classification	Justification
Not classified.	

History

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Date of previous issue : No previous validation

Version : 1

Prepared by : IHS

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

Section 16. Other information

References : HCS (U.S.A.)- Hazard Communication Standard
International transport regulations

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.