Work Plan

Remedial Investigation/Feasibility Study
Port of Seattle North Terminal 115

for
Washington State Department of Ecology on Behalf of Port of Seattle

May 9, 2013

GeoEngineers
Earth Science + Technology

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Plaza 600 Building
600 Stewart Street, Suite 1700
Seattle, Washington 98101
206.728.2674

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File No. 0303-112-00

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Prepared for:

Port of Seattle
P.O. Box 1209
Seattle, Washington 98111

Attention: Brick Spangler

Prepared by:

GeoEngineers, Inc.
Plaza 600 Building
600 Stewart Street, Suite 1700
Seattle, Washington 98101
206.728.2674

Garrett R. Leque, LG
Geologist

Iain H. Wingard
Associate, Environmental Scientist

John M. Herzog, PhD
Principal

GRL:IHW:JMH:cn

GeoEngineers

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1.0 INTRODUCTION

This document presents a Work Plan for the Remedial Investigation/Feasibility Study (RI/FS) at Port of Seattle North Terminal 115 (the Site) located at 6000 West Marginal Way SW in Seattle, Washington (Figure 1). The Port of Seattle (Port) is performing the RI/FS in accordance with Washington State Department of Ecology (Ecology) Agreed Order DE-8099 (the Agreed Order, Ecology 2011). The Site, as is currently defined in the Agreed Order, is generally located in the northwestern portion of the Port's Terminal 115 facility on the western bank of the Lower Duwamish Waterway (LDW) and is listed in the Ecology Database as Facility Site ID 2177.

Historical activities at the Site have included filling and industrial operations associated with operation of a tin reclamation facility. Historical tin reclamation facilities located at the Site have included process buildings, settling ponds, above ground and underground storage tanks, and rail lines. Filling and industrial activities have historically occurred on the adjacent properties to the Site. Previous environmental investigations conducted at the Site by the Port and other parties have detected metals, volatile (VOC) and semi-volatile organic compounds (SVOCs) including polycyclic aromatic hydrocarbons (PAHs), and petroleum hydrocarbons, in soil and/or groundwater. Metals and PAHs have also been detected in stormwater solids collected at the Site.

As part of the Scope of Work defined in the Agreed Order, the Port is required to prepare and submit a RI/FS Work Plan for the Site. The tasks described in this Work Plan will be completed to characterize the nature and extent of soil, groundwater, stormwater, and sediment contamination at the Site and to provide sufficient information to select a cleanup action, if necessary.

The tasks described in this Work Plan include continuous soil sampling and documentation of the physical characteristics of soil horizons as well as chemical analysis of soil samples. Work Plan tasks include documentation of groundwater quality parameters, analysis of groundwater samples, and evaluation of groundwater gradients. The tasks described in this Work Plan also include sampling and analysis of stormwater catch basin solids to evaluate whether contaminants are being transported in stormwater at the Site. An assessment of sediment is also being performed using the results of the sediment investigation being performed for Glacier Northwest. The results of the sediment investigation will be evaluated and incorporated into the RI/FS for the North Terminal 115 Site.

This Work Plan provides details for implementation of the RI/FS including evaluation of existing Site soil, groundwater, and stormwater solids data, identification of potential data gaps for completion of the RI/FS, description of the proposed field investigation, FS, and schedule. This Work Plan was prepared in general accordance with the requirements defined by Model Toxics Control Act (MTCA) Regulation (Washington Administrative Code [WAC] 173-340-350) for submittal to Ecology. Appendices to this Work Plan include the following:

- Appendix A – Terminal 115 Environmental Conditions Report and associated historical aerial photographs (SoundEarth 2011);
- Appendix B – Letter from Onsite Environmental to Port of Seattle;
- Appendix C – Sampling and Analysis Plan;

- Appendix D – Quality Assurance Project Plan;
- Appendix E – Health and Safety Plan;
- Appendix F – Sediment Sampling and Analysis Plan (Glacier Northwest, Inc., December 2011); and
- Appendix G – Public Participation Plan Prepared by Ecology for the Site.

The following sections describe the Site background.

2.0 BACKGROUND INFORMATION

This section presents background information on the Site, including a description of the property's historical, current, and future Site uses; summary of previous environmental investigations, existing data, and identification of contaminants of potential concern (COPCs); and evaluation and identification of data gaps for completion of the RI/FS.

2.1 Property Description

The North Terminal 115 property is located at 6000 West Marginal Way SW in Seattle, Washington, on the west bank of the LDW (Figure 1). The property is approximately 2 acres in size and is located on the northwestern portion of the Port's Terminal 115. The Site is owned by the Port and is currently leased to SeaPac for access to Terminal 115, the Gene Summy Lumber Co., which distributes untreated lumber, and the Commercial Fence Corp., a fence supplier (Figure 1). The Site is bordered to the north by Glacier Northwest and west by West Marginal Way SW. Northland Services Inc. leases the portion of Terminal 115 east and south of the Site. The LDW is located to the east and northeast of the Site. Current and historical features at the property are shown in Figure 2.

The North Terminal 115 property is generally flat. The eastern portion of the property is paved, while the western portion, west of the former processing building, is surfaced with gravel and asphalt and concrete pavement. Stormwater runoff at the Site is collected in catch basins that discharge to the LDW through a 48-inch-diameter storm drain located near the northern property boundary (Figure 2).

A rail line traverses the western boundary of the property adjacent to West Marginal Way. A rail spur also crosses the western portion the property and runs along the southern boundary of the property. A building that was previously used for tin reclamation processes is located in the south central portion of the property. Additionally, an office comprised of modular, mobile structures is located on the western portion of the property.

An asphalt road enters the property from West Marginal Way SW on the northwest corner the Site (Figure 2). Chain link fencing encompasses the property except where the asphalt road enters from West Marginal Way SW. Access to the property is limited to industrial workers and is not allowed for the general public.

2.1.1 Soil Conditions

Based on previous subsurface investigation and review of the Site development history, the stratigraphy of the Site consists of fill material overlying native alluvial floodplain deposits. The soil located on the western portion of the Site is generally characterized by approximately 3 feet of fill material overlying native alluvial floodplain deposits; between approximately 2 to 6 feet of fill is present in the central portion of the Site. Borings advanced on the eastern portion of the Site, east of the historic Duwamish River shoreline (Figure 2), encountered fill material to the total depth of the borings (i.e., between 12 and 15 feet below ground surface [bgs]). Fill material is generally characterized as silty, fine to coarse sand, sandy silt or fine to coarse gravel with sand and/or silt. Fill material color is characterized as brown, black, green or gray. Thin layers (i.e., approximately 6 inches in thickness) of wood debris (i.e., "2 x 4 planks" or "untreated wood debris") and concrete were identified at two locations (i.e., MW-3 and DP-1) during previous investigation of the Site (Figure 2). No other debris or waste materials were identified in fill during previous investigation of the Site.

A native silt/clay aquitard ranging from 5.5 to 6.5 feet thick was identified to be present at between 8.5 and 15.5 feet bgs in soil borings collected north of, and adjacent to, the Site. The aquitard was characterized to consist of slightly clayey silt, low to medium plasticity, containing some organic material and ranging from dry to moist. Soil with similar characteristics was identified to be present at depths ranging from approximately 11 to 13 feet bgs in the western and central portions of this Site (Landau, 2009).

2.1.2 Groundwater Conditions

Groundwater depths were measured in 13 wells located at or adjacent to the Site in November and December 2009. Depth to groundwater was found to be approximately 5 to 10 feet bgs. Groundwater flow was inferred to be generally to the north and northeast based on the water level measurements in the wells. Groundwater levels and flow direction may vary in the northeastern portion of the Site as a result of the presence of a 48-inch-diameter City of Seattle storm drain that is located on the northern portion of the property and changes in the river level as a result of tidal fluctuations and river flow.

Groundwater at the Site is not currently being used as a source of potable water.

2.2 Site Development and Use History

2.2.1 Site Development

The general Site development and use history is based on the findings provided in the Lower Duwamish Glacier Bay Source Control (SAIC, 2007) and Terminal 115 Environmental Conditions (SoundEarth 2011) reports. The Site was originally part of the Duwamish River estuary system. In the late 1800s and early 1900s, dredging and filling of the meandering Duwamish River and adjoining tidelands and estuary were conducted to create the straightened channel that is now known as the LDW.

A review of aerial photographs from between 1922 and 1990 was performed as part of the Terminal 115 Environmental Conditions Report to evaluate the development history for the entire

Terminal 115 property (SoundEarth 2011). The following summarizes the results of the aerial photograph review for the Site.

- An oblique aerial photograph taken in 1922 indicates that the elevation of the Site was above the level of surface water in the adjacent Duwamish Waterway. However, the property to the north appears to be partially inundated (Photo A-1, Insert C in Appendix A). A berm appears to be present along the eastern boundary of the property that would become the North Terminal 115 Site and the property appears to be vegetated.
- Changes in Site features are not apparent in aerial photographs taken in the 1936, 1946 and 1956 (Photos A-2 through A-4 in Appendix A). However, the property to the north appears to have been filled. An Army Corps of Engineers (USACE) drawing indicates that dredged material from the Duwamish River was placed on portions of property north of North Terminal 115 in 1935 (USACE, 1935). Log rafts are present along the shoreline of the Site in the aerial photographs from this time period.
- The shoreline at the Site was extended between 1961 and 1965 to the current easternmost extent of North Terminal 115 (Photos A-5 and A-6 in Appendix A). The source of the fill material used at the Site is not known. A 1987 letter (with aerial photographs attached) from the Port of Seattle to Robert Duffner (POS, 1987) describes a 1963 aerial photograph in which the area just south of North Terminal 115 is being filled with sediments from the Duwamish channel. The letter and associated photographs indicate that cement kiln dust is being placed further to the south of the sediment placement area. A large building, aboveground tanks, three ponds and rail lines that comprise the tin reclamation facility are visible in a 1965 aerial photograph (Photo A-6 in Appendix A). No filling is observed to be occurring adjacent to North Terminal 115.
- Substantial filling is observed to have occurred on the adjacent property to the south in a 1970 aerial photograph (Photo A-7 in Appendix A). Additionally, two ponds are present on the North Terminal 115 property. It appears that two of the three ponds, the two western-most ponds, have been combined into one pond.
- The ponds are not observed at the North Terminal 115 Site in a 1978 and 1990 aerial photographs (Photos A-8 and A-9 in Appendix A). The location of the former ponds appears to have been filled (Photo A-8 in Appendix A). The building, aboveground tanks and rail lines are still apparent in the photograph. Additionally, the remainder of Terminal 115 is filled and operating.

2.2.2 Site Use History

Use of the Site began in 1963 with the construction of the tin reclamation facility.

The tin reclamation facility was operated by several businesses between 1963 and 1998. M & T Chemicals operated the facility from 1963 to 1978. From 1978 to 1991, Metals Recycling, Inc. (MRI), and from 1991 to 1997, MRI Division of Proler Corporation, used the facility for tin reclamation. In 1997 and 1998 Schnitzer Steel Industries closed the tin reclamation operations at the Site. The Site is currently owned by the Port which purchased the North Terminal 115 property in 1969. The Port purchased the property from John and Dorothy Farrell, who were leasing the property to M & T Chemicals. North Terminal 115 is currently leased to SeaPac for access to Terminal 115, the Gene Summy Lumber Co. which distributes untreated lumber and the

Commercial Fence Corp., a fence supplier. Figure 1 presents a plan view of the Site that shows the current property use and Site features. Figure 2 depicts "as built" conditions (current and historic) and shows above and below ground features. No engineering "as builts" are known to exist that are available for review. COPCs related to current operations are discussed in Section 2.7.

The tin reclamation plant recycled metals by dissolving the waste metal in solution with caustic lye and separating it from solution via electrowinning. The document that appears to contain the most complete description of this process is a 1987 TSCA inspection report that states the following:

> "The company buys tinned plate scrap such as tin cans from recyclers for steel recovery. Sodium hydroxide and sodium nitrate are used to convert the tin and other metals on the cans to salts including sodium stannate. The steel is then removed from the caustic bath for washing and bailing. Electricity is next used to reduce the tin salt in the caustic bath back to tin metal. The metal is subsequently cast into ingots."

Approximately 2,200 tons of de-tinned steel ingots were reportedly produced each month at the property (SAIC, 2007).

The tin reclamation facility included a large building with concrete floors where tin reclamation processes occurred. Features of the historical facility are identified on Figure 2. The processing building was equipped with two 16-ton cranes, a plating room, a boiler room, and an area where the caustic lye and metals materials were mixed. The plant also included three settling ponds estimated to be approximately 6-feet deep that were intended to capture waste sludge for further extraction of metals. These settling ponds were reported to be unlined and included dikes to prevent loss of material. Storage and processing tanks were located outdoors on the northern side of the building within a tank farm. The storage and processing tanks are visible in a 1965 aerial photograph, and were therefore likely installed sometime between facility startup in 1963 and 1965. Based on historical aerial photographs and a 1987 TSCA inspection report, the number of storage and processing tanks appears to have varied through time between about 13 to 16 tanks. The storage and process tanks contained acids and bases such as sodium hydroxide and sulfuric acid, and ranged in size from 180 gallons to 15,000 gallons, Secondary containment for the tank farm consisted of a bermed concrete pad (Ecology, 1987). The secondary containment system was installed no later than 1970, based on a document titled "Description of Waste Water System – Seattle", stamped "received by Ecology" on October 13, 1970. It is likely that the secondary containment system would have been constructed before setting the storage and process tanks in place. Stormwater falling on the containment pad was collected in a sump and pumped to the sanitary sewer, according to a 1991 document (AET, 1991). The facility contained a paved area where piles of recycled cans and compressed de-tinned steel bales were stored. Stormwater runoff from the paved areas was collected in a sump and also pumped to the sanitary sewer (AET, 1991).

No records are known to exist that make reference to waste stream generation or disposal at the Site until the early 1970s. The following discussion of waste streams is largely based on the document titled "Description of Waste Water System – Seattle", stamped "received by Ecology" on October 13, 1970. Waste streams generated from the tin reclamation process included spent plating solution, black mud, and black mud filtrate. The spent plating solution and black mud filtrate were reported to have been disposed of in the sanitary sewer. The black mud was captured in the settling ponds constructed at the Site. Three settling ponds located in the eastern portion of the Site are identifiable in aerial photographs from 1965 to 1967. A 1970 aerial photograph shows that only two settling ponds were present. In about 1972, a filter press was installed and the black mud was dewatered to a semi-dry cake and stockpiled on the eastern end of the property. About that time, the remaining black mud was reported to have been removed from the ponds and sold for further tin reclamation. In about 1978, the settling ponds were filled with gravel (E&E, 1988) and have since been paved over. From 1972 to 1988, the stockpiled black mud was sold to off-site sources including Tex Tin in Texas, U.S.A, and unknown location(s) in England (AET, 1991). After 1988, the black mud was no longer sold and was instead stockpiled on Site until 1991. In 1991, the stockpiles of mud were removed and disposed of at an off-site landfill. The COPCs from Site activities are discussed in Section 2.7.

The results of samples collected of spent plating solution and black mud filtrate between 1972 and 1983 indicate that the pH ranged from 7.2 to greater than 14 and that the metals (cadmium, chromium, copper, nickel lead and zinc) concentrations ranged between 0.027 and 3.6 mg/L. The pH and metals concentrations from the sample analyses are generally elevated compared to current groundwater and surface water criteria.

The tin reclamation facility ceased operations in 1997 or 1998. The primary processing building remains on the property but the equipment has been removed and settling ponds used for tin reclamation have been filled.

2.3 Future Site Use

The Site is located in an industrialized corridor surrounding the LDW in South Seattle. The Site and adjacent properties are zoned Industrial General 1, Unlimited 85 (i.e., IG1 U85). The surrounding area is characterized by manufacturing, shipping terminals, warehouses, railways, water transportation and other industrial uses.

The current and anticipated future use of the Site is generally characterized as industrial lease area for the Port. Specific future uses at the Site will depend on the industrial operations of the Port's lessees.

2.4 Previous Investigations and Summary of Existing Data

Four investigations have been performed at the Site. The results from the previous investigations are discussed in the following sections. Soil, stormwater solids and groundwater analytical results from the previous studies are presented in Tables 1 and 2, respectively. Previous soil, stormwater solids, groundwater sampling locations and the analyses performed at each location are presented on Figures 3 and 4.

2.4.1 TSCA Site Inspection - 1987, Washington State Department of Ecology

A Toxic Substances Control Act (TSCA) inspection was conducted at the Site by Ecology in 1987. The inspection was performed to evaluate the possibility that PCBs were used at the property. No use of PCBs was identified and no PCB-containing transformers were found at the Site (Ecology, 1987).

2.4.2 1991 Waste Characterization - 1991, ENSR

A waste characterization study was conducted in 1991 by ENSR Consulting and Engineering for the MRI Corporation. The waste characterization study consisted of collecting 36 samples of black mud from two materials stockpiles. The samples were composited into six samples that were submitted for laboratory analysis. The samples were tested for Resource Conservation and Recovery Act (RCRA) metals (i.e., arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver), tin and zinc using the toxicity characteristic leaching procedure (TCLP). Additionally, the samples were analyzed for corrosivity, reactivity, ignitability and pH. Metals including arsenic, barium, cadmium, chromium, lead and zinc were detected in one or more of the TCLP analyses. The detected metals concentrations were generally one to three orders of magnitude below the Dangerous Waste criteria. The pH of the black mud in aqueous solution ranged from 7.43 to 7.75. Based on the sample results, the black mud was not designated as a dangerous waste (ENSR, 1991).

2.4.3 Site Hazard Assessment - 1998, Seattle-King County Department of Public Health

A Site Hazard Assessment (SHA) was performed in 1998 by the SKCDPH. The SHA consisted of collecting three soil samples from the unpaved railroad spur area located on the western portion of the Site. A sketch of the sample locations was included in the SHA report and the estimated sample locations are provided on Figure 3. The samples were collected at depths of 5, 6 and 16 inches bgs and analyzed for RCRA metals, tin and zinc. Barium, cadmium, chromium, lead, tin and zinc were detected in one or more of the samples. The SHA states that the detected concentrations were less than MTCA Method A and B criteria for all metals except lead. The detected concentration of lead in one sample (i.e., 470 milligrams per kilogram [mg/kg]) located adjacent to the Process Building (i.e., MST-1) was identified to be greater than the Method A criteria for residential soil (i.e., 250 mg/kg) but less than the Method A criteria for industrial soil (i.e., 1,000 mg/kg). The actual hazard assessment was based on past practices (i.e., use of settling ponds, etc.) and not the results of soil samples, as the soil samples did not exceed screening levels used as part of the SHA.

The SHA was based on the groundwater exposure pathway and evaluation of tin and zinc. The Site was ranked a 5, where 1 represents the highest relative risk and 5 is representative of the lowest level of relative risk. The SHA stated that because the groundwater in the area is not usable for drinking or for irrigation purposes, the Site was not considered a significant threat to public health (SKCDPH, 1998). Analytical results from the 1997 SHA soil samples are presented in Table 1.

2.4.4 Environmental Investigation Report - 2009, Landau Associates

Landau Associates performed an investigation of the Site in October and November 2009. The investigation included advancement of cores and installation of ten, 1-inch-diameter monitoring wells at the Site. An eleventh location was investigated by direct-push coring only (i.e., no permanent monitoring well was installed). Borings were advanced in the following locations:

- DP-1, MW-1 and MW-2 were installed in the western portion of the Site where samples were previously collected in the rail line area.
- MW-3 was installed downgradient of the former aboveground storage (AST) tank area.

- MW-4 was installed in the north-central portion of the Site.
- MW-5 was installed in the former location of the settling ponds.
- MW-6 and MW-10 were installed near the property boundary on the eastern portion of the Site.
- MW-7 through MW-9 were installed east of the North Terminal 115 Site.

Sampling locations from this investigation are shown on Figure 2.

Soil samples were collected from boring locations DP-1, MW-1, MW-3 and MW-5. The soil samples collected were analyzed for a combination of chemicals of potential concern (COPCs) identified for the adjacent Glacier Northwest site including metals, semi-volatile organic compounds (SVOCs) and polychlorinated biphenyls (PCBs). Analysis for priority pollutant metals and tin was performed on soil samples at the request of Ecology. In addition, soil samples collected from boring MW-1 were analyzed for petroleum hydrocarbons (i.e., gasoline-, diesel- and oil-range petroleum hydrocarbons) because sheen was observed in the soil sample collected from just above the water table. Soil samples from all other locations (i.e., other than DP-1, MW-1, MW-3 and MW-5) were not analyzed because indications of contamination were not identified based on field screening (i.e., visual observations, monitoring of organic vapors and odor). Analytical results for the 12 soil samples collected by Landau Associates are summarized in Table 1.

Ecology collected split soil samples from most of the borings advanced at the Site by Landau Associates. Ecology performed analysis for metals (i.e., antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium and silver) on two samples collected from boring location MW-10 (Table 1).

Multiple metals including arsenic, cadmium, chromium, copper, lead, mercury, nickel, tin and zinc were detected in one or more soil samples collected from DP-1, MW-1, MW-3 and MW-5. SVOCs including polycyclic aromatic hydrocarbons (PAHs), methyphenol, hexachlorocyclopentadiene, dibenzofuran and carbazole were detected at least once in nine soil samples. Additionally, oil-range petroleum hydrocarbons were detected in one of three samples collected from MW-1. PCBs were not detected in the 12 soil samples collected from the Site. Additionally, metals were detected in the sample that was collected from MW-10 analyzed by Ecology (Figure 3).

The analytical results were compared to MTCA Method A, B and/or C values for screening purposes. The report noted that soil concentrations were greater than the MTCA screening levels for metals including arsenic, cadmium, chromium, copper, lead mercury, nickel, and zinc in ten samples. The report also noted that total cPAH concentrations in soil were greater than screening levels as well as the concentrations for several individual semi-volatiles in two samples. Additionally, the report noted that metals concentrations were greater than the screening levels in groundwater samples collected from 14 monitoring wells. The concentrations of volatile organic compounds in groundwater in one well and semi-volatile organic compounds in five wells were also greater than the screening levels. Note that the exceedances were based on screening levels used in the Environmental Investigation Report and that Site screening levels will ultimately be determined as part of the RI/FS process.

Groundwater samples were collected from locations MW-1 through MW-10 and DP-1 which were installed as part of the investigation. Additionally, samples were collected from MW-25 through MW-27 which were previously installed along the property boundary between North Terminal 115 and the Glacier Northwest Site as part of the investigation of the Glacier Northwest Site. For the purposes of the North Terminal 115 investigation, the letter "G" has been added to the monitoring well designation (i.e., GMW-25, GMW-26 and GMW-27) for the wells originally installed to investigate the Glacier Northwest Site (Figure 2). Groundwater samples were analyzed for a combination of chemicals of potential concern identified for the Glacier Northwest site including metals (total and dissolved) and SVOCs. Analysis for priority pollutant metals and tin was performed on groundwater samples at the request of Ecology. Both total and hexavalent chromium analyses were performed on groundwater samples. Volatile organic compound (VOC) analysis was also performed on groundwater samples as VOCs were identified as contaminants of potential concern for the site. In addition, the groundwater samples from MW-1 and DP-1 were analyzed for petroleum hydrocarbons (i.e., gasoline-, diesel- and oil-range petroleum hydrocarbons) because sheen was observed in soil collected from just above the water table at MW-1. Analytical results for groundwater samples collected at the site are presented in Table 2.

Metals including antimony, arsenic, cadmium, chromium (i.e., total chromium), copper, lead, mercury, nickel, tin and zinc were detected in one or more groundwater samples collected from MW-1 through MW-10, DP-1, and GMW-25 through GMW-27. Multiple VOCs were detected at least once in groundwater collected from DP-1 and MW-1 through MW-8. Acetone was the most frequently detected VOC and was detected in eight of 15 samples. SVOCs including PAHs were detected in groundwater collected from DP-1 and MW-1 through MW-7. Oil-range petroleum hydrocarbons were detected in groundwater collected from DP-1 but not MW-1 (Figure 4). Additionally, total hexavalent chromium was not detected in any groundwater samples.

Stormwater solids were collected and analyzed at one catch basin location (CB-1). The solids were collected in Teflon containers placed just below the stormwater grate. The containers captured stormwater and associated solids that were entering through the grate. The solids that settled out of the stormwater were submitted for analysis. The stormwater solids sample was analyzed for a combination of COPCs identified for the Glacier Northwest site including metals (antimony, arsenic, copper, lead, mercury, tin and zinc), SVOCs and PCBs. The sample was also analyzed for chromium. Analytical results for stormwater solids samples collected at the site are presented in Table 1.

Multiple metals including chromium, copper, lead, tin and zinc were detected in the one stormwater solids sample collected at catch basin CB-1. PAHs were also detected in the stormwater solids sample. PCBs were not detected in the sample (Figure 3).

Landau concluded in their report on the investigation that potential migratory pathways from the Site to Glacier Bay (located to the north of the Site and within the LDW) include groundwater and the existing storm drain system. Soil was not considered a potential pathway based on the Site conditions and analytical results. However, leaching of contaminants from soil to groundwater was noted as an indirect pathway for contaminants to enter Glacier Bay.

2.4.5 Terminal 115 Environmental Conditions Report – 2011, SoundEarth Strategies

An Environmental Conditions Report was prepared for Terminal 115 including North Terminal 115 in 2011. The report presents a review and evaluation of information concerning land development activities, current and historical activities and operations, current and historical spills and releases on and immediately adjacent to Terminal 115 to identify issues of environmental concern that could affect the environmental condition of soil, groundwater, surface water, and sediment at and adjoining Terminal 115. Additionally, the report evaluates pathways the may allow migration of potential contaminant to the LDW. The report includes information concerning development, past industrial activities, and releases at the North Terminal 115 Site and adjacent sites. The report and aerial photographs provided with the report are provided in Appendix A.

2.5 Preliminary Conceptual Site Model, Exposure Pathways and Receptors

A preliminary conceptual site model (CSM) was developed based on the physical conditions at the Site, potential sources of contamination to Site media, the findings from previous investigations, and evaluation of the potential contaminant transport and exposure pathways. The CSM is a tool prepared to assist in identifying data gaps, develop an investigation approach to fill the data gaps, and for evaluating and identifying remedial actions for the Site. The preliminary CSM is presented in Figure 5 and is discussed below.

Fill is present from the surface to depths ranging from approximately 1 to 6 feet bgs on the western and central portions of the Site and to depths greater than approximately 15 feet bgs on the eastern portion of the Site. The source of fill is not known. Underlying the fill are native alluvial floodplain deposits. Soils identified as an aquitard comprised of an organic silt is present at depths ranging from approximately 11 to 13 feet bgs in the western and central portions of the Site (Landau, 2009).

Depth to groundwater is approximately 5 to 10 feet bgs. Groundwater flow is to the north and northeast. Groundwater levels and flow direction may vary in the northeastern portion of the Site as a result of the presence of a 48-inch-diameter City of Seattle storm drain that is located on the northern portion of the property and changes in the river level as a result of tidal fluctuations and river flow.

Stormwater infiltrates into the soil on the western portion of the Site and flows into catch basins off of asphalt and concrete surfaces on the remaining portions of the Site. The catch basins are connected to stormwater pipes which drain into the City of Seattle's 48-inch stormwater pipe that discharges to the Lower Duwamish Waterway. Therefore, the stormwater to sediment pathway is complete.

Fill materials placed on the Site could potentially contain contaminants or releases may have occurred to soil and groundwater at the Site. Past industrial activities at the Site that may have resulted in releases to soil include process discharges to the settling ponds, aboveground storage of process liquids and wastes, tin reclamation processing, rail activities and underground storage of fuel. Contaminants in fill or released to soil may have migrated to groundwater. Groundwater at the Site ultimately discharges to surface water in the LDW. Surface water in the LDW is comprised of marine, brackish and fresh water.

Potential receptors based on current and future Site use and transport pathways include the following:

- Workers, and wildlife at the Site,
- Aquatic organisms in Glacier Bay and LDW,
- Humans and wildlife using Glacier Bay and LDW.

Groundwater at the Site or potentially affected by the Site is not currently being used for drinking water Drinking water utilized at the Site is supplied by the City of Seattle. Groundwater at the Site is not likely considered a potential future source of potable or drinking water due to its proximity to the LDW, which is a mixture of marine and fresh water. Extended periods of groundwater extraction at the Site would likely cause the groundwater to have high salinity content, which would make it unsuitable as potable or drinking water. Additionally, the groundwater beneath the property is also likely to be brackish as a result of mixing with adjacent marine surface water.

As stated above, groundwater from the Site discharges to surface water within the LDW. Surface water in the LDW is comprised of both marine and fresh water is not used for drinking water. Future groundwater potability or non-potability will be evaluated and discussed further in the RI.

A preliminary Simplified Terrestrial Ecological Evaluation (TEE) concluded that the nature of contamination identified at the Site and land use at the Site and surrounding area do not make substantial wildlife exposure likely. The Site does not provide suitable habitat for potential terrestrial ecological receptors as the ground surface is predominantly covered by concrete and asphalt pavement, buildings and stored materials. The areas of the Site that are not covered are within areas of active industrial operations and include gravel roadways and operational surfaces. However, an evaluation of terrestrial ecological receptors will be performed as part of the RI/FS.

2.6 Data Gap Assessment

The purpose of the RI/FS is to characterize the nature and extent of contamination at the Site and to provide adequate information to evaluate and identify remedial actions, if warranted. Additional environmental information is required to fill existing data gaps that have been identified based on review of past use and filling activities at the Site, review of the existing sampling and analysis results for the Site, and preliminary discussions between the Port and Ecology on the scope of the RI/FS. The following is a summary of the currently identified data gaps and description of the sampling and analysis to fill the identified data gaps.

- Additional Characterization of Fill – Fill is known to be present from the surface to depths ranging from approximately 3 to 6 feet bgs on the western and central portion of the Site and to depths greater than approximately 15 feet bgs on the eastern portion of the Site. The source of the fill material is not known. Soil and groundwater sampling have previously been performed that have provided initial characterization of fill material. However, additional characterization of fill material has been requested by Ecology. Soil, groundwater and stormwater catch basin solids sampling and analysis will be performed at each of the proposed investigation locations to further characterize fill material present at the Site.

- **Additional Characterization of the Former Settling Ponds** – Multiple settling ponds that were historically located on the eastern portion of the Site (Figure 2) were previously used to capture waste sludge from the tin reclamation facility. Soil and groundwater sampling and analysis have previously been performed at the location in the vicinity of one of the former settling ponds. Additional soil and groundwater sampling and analysis will be performed within and adjacent to the approximate location of each of the known former settling pond locations to further characterize potential contamination related to former discharges to the settling ponds. The nature and extent of contamination present in the former settling ponds will investigated including below the original ponds and groundwater contamination will be characterized out to where it has come to be located.
- **Characterization of Former Aboveground Storage Tank (AST) Area** – ASTs that were used to store process solutions and wastes were previously located in a containment area in the central portion of the Site (Figure 2). Stormwater falling on the containment area was collected in a sump and pumped to the sanitary sewer under a Metro Permit. Releases may have occurred from the ASTs as part of past tin reclamation activities. Soil and groundwater sampling and analysis have previously been performed at one location in the former AST area. Additional soil and groundwater sampling and analysis will be performed within and adjacent to the AST area to further characterize potential contamination related to past releases.
- **Characterization of Process Building Area** – The Process Building previously used for tin reclamation is located in the central portion of the Site (Figure 2). Releases may have occurred from tin reclamation activities in or adjacent to the Process Building. Soil and groundwater sampling have not previously been performed to specifically evaluate past activities at the Process Building. Additional soil and groundwater sampling and analysis will be performed within and adjacent to the Process Building to further characterize contamination related to potential past releases.
- **Investigation of Rail Line Area** – Two rail lines are located on the western portion of the Site (Figure 2). Contaminant releases may have occurred from past rail activities. Soil and groundwater sampling and analysis have previously been performed at multiple locations in one of the former rail line areas. Additional soil and groundwater sampling and analysis will be performed within and adjacent to the rail lines to further characterize contamination related to potential past releases.
- **Evaluation of a Former Underground Storage Tank (UST)** – A heating oil UST was previously located on the west side of the processing building (Figure 2). The UST was removed in February 1992, and the area was backfilled. Visual inspection of the removed UST indicated no pitting or penetration of the tank. No soil staining or visible evidence of a release was observed during UST removal; however, hydrocarbon odors were noted in soil removed from the excavation. Four soil borings around the UST were later completed to investigate a potential release (B-1 through B-4). Five soil samples (four samples plus a field duplicate) were submitted for diesel petroleum hydrocarbons by Method WTPH-D. Diesel was not detected in four of the five soil samples at detection limits between 25 to 36 mg/kg. A sample from boring B-2 contained diesel at a concentration of 66 mg/kg. The diesel was confirmed to be #2 diesel (i.e., heating oil) based on the chromatogram from the analysis. Soil and groundwater sampling and analysis performed in 2009 at locations adjacent to the former UST location (i.e., MW-1 on Figure 3 and DP-1 on Figure 4) indicate the potential presence of

petroleum hydrocarbons. Additional soil and groundwater sampling and analysis will be performed adjacent to the former UST location to further characterize the nature and extent of potential contamination related to past releases.

- **Characterization of Arsenic in Soil and Groundwater** – Arsenic was detected in soil and groundwater on the northern portion of the Site and southern portion of the adjacent Glacier Northwest site. Additional soil and groundwater sampling and analysis will be performed on the northern portion of the Site to further characterize arsenic contamination.
- **Stormwater Catch Basin Solids** – Stormwater catch basin solids samples have not been collected and analyzed as part of previous environmental investigations of the Site. Stormwater catch basin solids samples will be collected from catch basins located on the Site to evaluate whether contaminants are being transported by stormwater present at the Site.
- **Groundwater Gradients and Flow** – Measurement of groundwater elevations at the Site was previously performed during two separate events in November and December of 2009. Additional information is necessary to evaluate hydraulic conductivity and groundwater gradients including potential influences as a result of the presence of a 48-inch-diameter storm drain located on the northern portion of the property and changes in the river level as a result of tidal fluctuations and river flow. A tidal study is proposed at the property utilizing the new groundwater monitoring wells and selected existing wells. The groundwater gradient data will be used to evaluate the potential groundwater transport pathway from the property to Glacier Bay and from the Glacier Northwest property to Terminal 115 North. Cross-sections illustrating both north-south and east-west soil stratigraphy and groundwater horizon will be prepared to further identify areas of native soil, fill placement and the extent of the ponds. Selected monitoring wells will be installed generally deeper than previous wells installed at the site to further assess the vertical extent of potential groundwater contamination. Specifically, four wells will be installed with well screen intervals that target a potential aquifer that is beneath the silt aquitard at the site.
- **Sediment** – Groundwater from the North T115 Site likely flows toward and discharges to Glacier Bay and the LDW. Stormwater from the North T115 Site also flows to the LDW. Sediment in Glacier Bay and the LDW are being sampled and analyzed as part of the investigation of Glacier Northwest. Surface and subsurface sediment samples are being collected in more than two dozen locations including near the outfall that receives stormwater from the North T115 Site. The results of the sediment sampling and analysis to be performed to investigate the Glacier Northwest Site will be used in the RI/FS for the North T115 Site.

2.7 Site Contaminants of Potential Concern

COPCs for Site soil, groundwater, stormwater, and sediment include contaminants previously detected at the Site and contaminants potentially associated with past industrial operations and fill material. COPCs for the Site include the following constituents:

- Metals – Multiple metals have previously been detected in Site soil, groundwater and stormwater solids and may be associated with past industrial operations, material used as fill at the Site, as well as adjacent Site activities. Additional soil, groundwater, and stormwater catch basin solids samples will be collected and analyzed to define the nature and extent of metals contamination. Sediment sample results from the investigation of the Glacier

Northwest Site will be used to define the nature and extent of metals contamination in sediment.

- SVOCs including PAHs – SVOCs including PAHs have previously been detected in Site soil, groundwater and stormwater solids and may be associated with material used to fill the Site and past industrial activities. Additional soil, groundwater, and catch basin solids will be analyzed to define the nature and extent of SVOC contamination. Sediment sample results from the investigation of the Glacier Northwest Site will be used to define the nature and extent of SVOC contamination in sediment.
- VOCs – VOCs were previously detected in groundwater and may be associated with past industrial activities. As VOCs were previously detected in groundwater at levels greater than MTCA criteria, soil and groundwater will be investigated to define nature and extent of VOC contamination.
- Petroleum hydrocarbons – Petroleum hydrocarbons were previously detected in soil and groundwater adjacent to the former location of a UST and may be associated with a release from the tank. Additional soil, groundwater, and stormwater catch basin solids will be investigated to determine the nature and extent of petroleum hydrocarbon contamination. Sediment sample results from the investigation of the Glacier Northwest Site will be used to define the nature and extent of petroleum hydrocarbon contamination in sediment.
- PCBs – PCBs were not identified to be present during a 1987 TSCA Site Inspection, nor were PCBs detected in soil and stormwater solids samples previously collected from the Site. However, PCBs have been identified as a COPC by Ecology. Additional soil and stormwater catch basin sampling and analysis will be performed to further evaluate the presence of PCBs at the Site and nature and extent of PCB contamination, if present. Sediment sample results from the investigation of the Glacier Northwest Site will be used to define the nature and extent of PCB contamination in sediment.
- Dioxins and furans – Dioxins and furans have not been identified to be associated with past Site activities. However, dioxins and furans in the LDW have been identified as a COPC by Ecology. Additional soil samples will be analyzed for dioxins and furans to evaluate the presence of dioxins and furans at the Site. Sediment sample results from the investigation of the Glacier Northwest Site will be used to evaluate the nature and extent of dioxin/furan contamination in sediment.
- pH – pH analyses will also be performed on soil samples and measured in the field on groundwater samples as former operations at the Site were known to have used alkaline chemicals for tin processing.

3.0 REMEDIAL INVESTIGATION

The RI will evaluate existing and/or new soil, groundwater, stormwater catch basin solids and sediment data to delineate the nature and extent of contamination. New data will be obtained to fill the currently identified data gaps and complete the characterization of the Site for the purpose of developing and evaluating cleanup action alternatives and selecting a cleanup action. The scope of the RI will include a soil investigation, groundwater investigation, and stormwater catch basin solids sampling and analysis. Sediment data collected as part of the investigation of the Glacier Northwest Site will also be evaluated as part of the RI.

3.1 Screening levels, Analytical Methods and PQLs

A preliminary evaluation of potential screening levels was performed to identify analytical methods and associated detection limits to be used for the North Terminal 115 RI sampling and analysis. The evaluation of screening levels included consideration of Site use, contaminant transport pathways, and potential receptors. Ecology provided preliminary screening levels that have been developed and/or used for cleanup sites in the vicinity of the LDW. These were reviewed to assess analytical methods and associated detection limits for soil, groundwater, and stormwater catch basin solids to be used as part of the RI.

Soil, groundwater, and stormwater catch basin solids will be analyzed by Onsite Environmental, Inc. an Ecology-accredited commercial laboratory using analytical methods that provide the lowest commonly available and technically reliable Practical Quantitation Limits (PQLs). Appendix B includes a letter from Onsite Environmental to the Port of Seattle indicating that the PQLs are the lowest commonly available and technically reliable PQLs achievable. Note that the PQLs provided in this Work Plan are goals as the actual PQLs achieved by the laboratory are influenced by sample characteristics (e.g., moisture content for soil, matrix interferences, etc.) and/or the presence of contamination in Site samples.

The analytical results for Site samples will be compared to screening levels developed as part of the RI. Cleanup levels will ultimately be developed for the Site as part of the RI/FS in consideration of the cleanup criteria specified in MTCA. The lowest commonly available and technically reliable PQLs are being used in this Work Plan to ensure that the PQL is appropriately conservative if determined to be the cleanup level because risk based cleanup levels are below the PQL.

3.2 Soil Investigation

Per WAC 173-340-350, the purpose of the RI is to collect, develop, and evaluate sufficient information regarding a site to select a cleanup action under WAC 173-340-360 through WAC 173-340-390.

The objective of the soil investigation is to define the nature and extent of contamination in soil, where contamination comes to be located (Site). Soil sampling will be performed at 33 locations to collect samples representative of fill and native soil that may have been impacted by past Site activities. The proposed soil sample locations were positioned to collect soil samples to address identified data gaps and to provide comprehensive coverage of the Site. Information obtained from previous Site investigations was used to support selection of the proposed soil sample locations. The soil sampling locations are presented in Figures 6 and 7.

Soil sampling will be completed using a combination of methodologies including: direct-push sampling at sampling locations B-1 through B-17, hollow-stem auger borings at 14 sampling locations (MW-2D, MW-4D, MW-10D, MW-19D and MW-11 through MW-20), and test pit explorations at sampling locations TP-1 through TP-3. The soil explorations will be advanced to depths ranging from approximately 4 to 20 feet bgs. A minimum of three soil samples will be collected from each exploration, and a minimum of three to six samples from each location will be submitted for chemical analysis. Samples will be collected from the fill horizon(s) as well as the water table and native soil horizons at locations where the exploration depth is sufficient to encounter all three horizons. All three horizons may not be encountered at each investigation location as a result of changes in Site stratigraphy and/or investigation depth. Table 3 and Figures 7A through 7C present the soil sampling locations, investigation location purpose, depth, and anticipated horizons to be sampled.

Soil will be screened in the field for the presence of contamination. Field screening will consist of visual observation for the presence of contamination (i.e., staining, etc.), water sheen testing and organic vapor monitoring. The procedures for field screening are presented in the SAP in Appendix C. Soil samples submitted for analysis will be obtained from discrete stratigraphic zones or the smallest interval necessary and will include no more than an interval of approximately 1 foot thick of homogeneous material. In general, soil with the greatest evidence of contamination based on the field screening will initially be submitted for chemical analysis from each location. Additional samples with no evidence or lesser evidence of contamination may be collected and archived for potential follow-up analysis based on the analytical results from the initial samples. Analysis will be performed on additional samples from a given investigation location when supplemental data is needed to characterize or delineate contamination present in the initial sample(s) that were analyzed.

Soil samples from each investigation location will be submitted for analysis for priority pollutants and COPCs based on previous sample results, presence of fill, and proximity to specific past Site activities (i.e., former settling ponds, former ASTs, former UST, process building, rail lines, and arsenic contamination identified in soil and groundwater, etc.). Soil samples will be submitted for a combination of the following analyses:

- Priority pollutant metals (antimony, arsenic, beryllium, cadmium, chromium, copper, mercury, nickel, lead, selenium, silver, thallium and zinc) and barium and tin by EPA Method 6020A and 7471B.
- SVOCs by EPA Method 8270D/SIM.
- VOCs by EPA Method 8260C.
- PCBs by EPA Method 8082A.
- Gasoline-range petroleum hydrocarbons by Ecology Method NWTPH-Gx.
- Diesel- and heavy oil-range petroleum hydrocarbons by Ecology Method NWTPH-Dx.
- Soil pH by SW 846-9045C.
- Dioxins and furans by EPA Method 1613/8290.

Table 3 presents the proposed soil analyses to be performed at each location. Samples will be submitted to an Ecology-certified laboratory (Onsite Environmental, Inc.) for analysis.

The SAP discusses procedures for completing the borings and test pit excavations and soil sample collection (Appendix C). The Quality Assurance Project Plan (QAPP) includes QA procedures for soil sampling and analysis (Appendix D). The Health and Safety Plan (HASP) includes health and safety procedures for the RI fieldwork (Appendix E).

3.3 Groundwater Investigation

The objective of the groundwater investigation is to define the nature and extent of contamination in groundwater, where present. Groundwater sampling will be performed at approximately 24 to 27 locations, depending on access agreements, to collect samples representative of groundwater conditions at the Site. Information obtained from previous Site investigations and historical information was used to support selection of the proposed groundwater sample locations. The groundwater sampling locations are presented in Figures 6 and 8.

Samples will be collected and submitted for chemical analysis from existing Site monitoring wells MW-1 through MW-10 and proposed monitoring wells MW-2D, MW-4D, MW-10D, MW-19D and MW-11 through MW-20. Samples will potentially be collected and submitted for chemical analysis from existing monitoring wells GMW-25 through GMW-27 (based on access agreements). Procedures for monitoring well installation, well development, water level monitoring and groundwater sample collection are described in the SAP presented in Appendix C.

Four rounds of groundwater samples will be obtained using low flow techniques from the new and existing monitoring wells for chemical analysis during four quarterly sampling events, which will be conducted during low tides, where appropriate. Groundwater samples will be collected at least two weeks after well development and completion of a tidal study that is to be performed to evaluate groundwater flow characteristics including elevation changes in Site groundwater in response to water level changes in the LDW (see Section 3.4.1). Groundwater samples will be submitted for chemical analysis of priority pollutants and COPCs selected based previous sample results, presence of fill, investigation and proximity to specific past Site activities (i.e., former settling ponds, former ASTs, former UST, process building, rail lines, and arsenic contamination identified in soil and groundwater, etc.). Groundwater samples will be submitted for a combination of the following analyses:

- Total priority pollutant metals (antimony, arsenic, beryllium, cadmium, chromium, copper, mercury, nickel, lead, selenium, silver, thallium and zinc) and barium and tin by EPA Method 200.8 and 7470A.
- SVOCs by EPA Method 8270D/SIM.
- VOCs by EPA Method 8260C.
- Gasoline-range petroleum hydrocarbons by Ecology Method NWTPH-Gx.
- Diesel- and heavy oil-range petroleum hydrocarbons by Ecology Method NWTPH-Dx.

Table 4 presents the proposed groundwater analyses to be performed at each location. Samples will be submitted to an Ecology-certified laboratory for analysis.

The SAP includes procedures for well installation, well development, water level monitoring, and groundwater sample collection (Appendix C). The Quality Assurance Project Plan (QAPP) includes QA procedures for groundwater sampling and analysis (Appendix D). The Health and Safety Plan (HASP) includes health and safety procedures for RI fieldwork (Appendix E).

3.3.1 Hydraulic Conductivity Testing and 72-Hour Tidal Study

Hydraulic conductivity testing and a 72-hour tidal study will be performed to characterize groundwater flow characteristics and gradients at the Site. The aquifer hydraulic conductivity will be estimated by conducting slug tests in monitoring wells MW-11 through MW-17 at the Site. A 72-hour tidal study will be conducted to evaluate elevation changes in Site groundwater in response to water level changes in the LDW. Water level elevation data will be collected every 15 minutes in monitoring wells MW-1, MW-7, MW-9, MW-10, MW-12 through MW-16, MW-18, MW-19 as well as GMW-26 and GMW-27, depending on access agreements, at the Site and adjacent to the 48-inch storm drain line located on the northern portion of the Site using electronic data loggers and well transducers. Electronic data measurements will be confirmed by periodically obtaining manual water level measurements during the study. Groundwater flow directions determined from the tidal study will be used in conjunction with groundwater monitoring analytical results to better define the nature and extent of groundwater contamination at the Site. Procedures for performing slug tests and the tidal study are presented in the SAP (Appendix C).

3.4 Stormwater Catch Basin Solids Investigation

The objective of the catch basin investigation is to characterize the nature and extent of contaminants in the stormwater conveyance system. North Terminal 115 currently operates under the Port's Phase I National Pollutant Discharge Elimination System (NPDES) General Permit for Municipal Stormwater. The Port requires tenants to develop and maintain Stormwater Pollution Prevention Plans (SWPPPs) and implement measures to prevent and control the discharge of contaminated stormwater to surface water or groundwater within their operational footprint (SoundEarth, 2011).

Catch basin sampling will be performed at all catch basin locations at the Site to collect samples representative of material captured by the stormwater catch basin system. Samples collected from the most downgradient catch basins at the Site based on stormwater flow direction within the stormwater conveyance system (i.e., CB-313, CB-322, CB-323, CB-324, and CB-328) will initially be analyzed. Samples from upgradient catch basins will potentially be analyzed based on the results of the initial downgradient samples. The catch basin locations and stormwater flow direction are presented in Figure 6 and 9.

The investigation and sampling of Site stormwater catch basin solids will be performed by obtaining samples using a stainless steel spoon or, where necessary, will be obtained using a sampler attached to an extension arm to reach into deeper catch basins. One sample will be collected from each catch basin for potential chemical analysis.

Stormwater catch basin samples will be screened in the field for the presence of contamination. Field screening will consist of visual observation for the presence of contamination (i.e., staining, etc.), water sheen testing and organic vapor monitoring. The procedures for field screening are presented in the SAP in Appendix C. Catch basin samples from each investigation location will be submitted for analysis for COPCs, including all SMS chemicals. Catch basin samples will be submitted for a combination of the following analyses including:

- Priority pollutant metals (antimony, arsenic, beryllium, cadmium, chromium, copper, mercury, nickel, lead, selenium, silver thallium and zinc) and barium and tin by EPA Method 6020A/7471B.
- SVOCs by EPA Method 8270D/SIM.
- PCBs by EPA Method 8082A.
- Gasoline-range petroleum hydrocarbons by Ecology Method NWTPH-Gx.
- Diesel- and heavy oil-range petroleum hydrocarbons by Ecology Method NWTPH-Dx.
- Dioxins and furans by EPA Method 1613/8290.

Table 5 presents the proposed analyses to be performed at each stormwater catch basin location. Samples will be submitted to an Ecology-certified laboratory for analysis.

The SAP discusses procedures for sample collection (Appendix C). The Quality Assurance Project Plan (QAPP) includes QA procedures for catch basin sampling and analysis (Appendix D). The Health and Safety Plan (HASP) includes health and safety procedures for the RI fieldwork (Appendix E).

3.5 Sediment Investigation

Comprehensive sediment sampling and analysis has been proposed by Glacier Northwest as part of the investigation of the Glacier Northwest Site. Sediment samples are proposed to be collected along the shoreline, near outfall locations, and farther offshore of the North T115 Site. Based on POS review of the Glacier Northwest sampling plan, the data generated will be sufficient to evaluate potential sediment impacts from historical uses of the North T115 Site. The results of the sediment investigation performed as part of the Glacier Northwest Site will be evaluated as part of the RI for the North T115 Site. The sampling and analysis plan for the sediment investigation proposed by Glacier Northwest is provided in Appendix F.

4.0 FEASIBILITY STUDY

The Draft Remedial Investigation Report will be submitted to Ecology as required in the Agreed Order, Exhibit C- Schedule of Deliverables. The RI/FS will develop cleanup levels for the Site and evaluate hazardous substances in soil, groundwater, stormwater catch basin solids, and sediment by comparing analytical results from the analyses to appropriate cleanup levels. Soil, groundwater, stormwater catch basin solids, and sediment cleanup criteria will be developed and used in accordance with MTCA. If the RI data do not exceed cleanup levels, the FS will be limited to establishment of cleanup levels and points of compliance. If the RI soil, groundwater, catch basin solids, and/or sediment data do exceed cleanup levels, then the FS will develop and evaluate cleanup action alternatives for contaminated media so that cleanup actions may be selected. The FS will:

- Develop cleanup levels and points of compliance and, as necessary, establish remediation levels;
- Delineate affected media where evaluation of remedial action as appropriate;

- Develop remedial action objectives; and
- Screen and evaluate specific cleanup alternatives and recommend a preferred alternative.

The following sections provide the details of the FS process that will be completed, if necessary, for the Site.

4.1 Establishment of Cleanup Levels, Points of Compliance and Remediation Levels

Cleanup standards, including cleanup levels and points of compliance, will be developed for soil, groundwater, stormwater catch basin solids, and sediment in accordance with MTCA requirements. Exposure pathways and receptors will be identified as part of cleanup level development. As needed, remediation levels may also be established for specific cleanup alternatives.

Cleanup levels for soil will be protective of human health and the environment including terrestrial ecological receptors and aquatic species, groundwater, and sediment based on current and future uses of the property. The point of compliance for soil will also be established.

Cleanup levels for groundwater will be based on protection of human health, surface water and sediment in the LDW. Groundwater at or potentially affected by the Site is not a current or reasonable future source of drinking water. It is expected that information developed during the RI will be used to demonstrate that groundwater at the property meets the requirements of WAC 173-340-720 for non-potable groundwater. A groundwater point of compliance will be developed. The point of compliance may be conditional, located at or near the groundwater/surface water interface.

Cleanup levels for stormwater catch basin solids will be based on protection of surface water and sediment in the LDW. Cleanup levels for sediment will be based on protection of human health and benthic and aquatic species in accordance with the Sediment Management Standards.

4.2 Delineation of Media Requiring Remedial Action

The RI process will determine if soil, groundwater, stormwater catch basin solids, and sediment sample results exceed cleanup levels and, if so, identify the locations of the exceedances. Based on any exceedances and the established points of compliance, the FS will identify the extent or volume of soil, groundwater, stormwater catch basin solids, or sediment that requires remedial action.

4.3 Development of Remedial Action Objectives

Remedial action objectives (RAOs) that define the goals of the cleanup that must be achieved to adequately protect human health and the environment will be developed for each medium and area identified as requiring remedial action. These RAOs will be action-specific and/or media-specific. Action-specific RAOs are based on actions required for environmental protection that are not intended to achieve a specific chemical criterion. Media-specific RAOs are based on developed cleanup levels. The RAOs will specify the COCs, the potential exposure pathways and receptors, and acceptable contaminant levels or range of levels for each exposure pathway, as appropriate.

4.4 Applicable or Relevant and Appropriate Requirements

In addition to the cleanup standards developed through the MTCA process, other regulatory requirements must be considered in the selection and implementation of the cleanup action. MTCA requires the cleanup standards to be "at least as stringent as all applicable state and federal laws" [WAC 173-340-700(6)(a)]. Besides establishing minimum requirements for cleanup standards, applicable state and federal laws may also impose certain technical and procedural requirements for performing cleanup actions. These requirements are described in WAC 173-340-710.

MTCA defines applicable state and federal laws to include legally applicable requirements and those requirements that are relevant and appropriate (ARARs). The primary ARARs will be the MTCA cleanup levels and regulations that address implementation of a cleanup under MTCA. Other potential ARARs may include the following:

- Washington Pollution Control Act and the implementing regulations: Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201A WAC).
- Washington Hazardous Waste Management Act and the implementing regulations: Dangerous Waste Regulations (Chapter 173-303 WAC), to the extent that any dangerous wastes are discovered or generated during the cleanup action.
- Washington's Shoreline Management Act with respect to construction cleanup activities conducted within 200 feet of the shoreline.
- Archeological and Historical Preservation – The Archeological and Historical Preservation Act (16 USCA 496a-1) would be applicable if any subject materials are discovered during Site grading and excavation activities.
- Health and Safety – Site cleanup-related construction activities would need to be performed in accordance with the requirements of the Washington Industrial Safety and Health Act (RCW 49.17) and the federal Occupational Safety and Health Act (29 CFR 1910, 1926). These applicable regulations include requirements that workers are to be protected from exposure to contaminants and that excavations are to be properly shored.

The FS will identify ARARs that are applicable to the Site cleanup.

4.5 Screening of Cleanup Alternatives

Cleanup alternatives will be developed for each medium of concern. Initially, general remediation technologies will be identified for the purpose of meeting all applicable regulations for each medium. General remediation technologies consist of specific remedial action technologies and process options and will be considered and evaluated based on the media type and the properties of any contaminant(s). These may include institutional controls, containment or other engineering controls, removal, in situ treatment and natural attenuation.

Specific remedial action technologies are the engineering components of a general remediation technology. Several specific technologies may be identified for each general remediation technology and multiple process options may exist within each specific technology. Specific remedial action technologies and representative process options will be selected for evaluation based on documented development or documented successful use for the particular medium and COPCs. Cleanup alternatives will be developed from the general and specific remedial technologies and process options consistent with Ecology expectations identified in WAC 173-340-370 using best professional judgment and guidance documents as appropriate.

During the development of cleanup alternatives, both the current and planned future land use will be considered. For example, where property is already developed, containment alternatives may be given preferential consideration over soil cleanup alternatives that would be more disruptive to Site use/structures.

If the RI identifies localized hot spots of contaminants in soil, active cleanup alternatives such as excavation or in situ treatment alternatives may be appropriate for those limited areas. If there are portions of the property with large volumes of materials with relatively low concentrations of hazardous substances, cleanup alternatives including engineering controls or monitored natural attenuation will be developed. Current and planned future property uses will be considered during development of cleanup alternatives.

4.6 Evaluation of Cleanup Alternatives

MTCA requires that cleanup alternatives be compared to a number of criteria as set forth in WAC 173-340-360 to evaluate the adequacy of each alternative in achieving the intent of the regulations, and as a basis for comparing the relative merits of the developed cleanup alternatives. Consistent with MTCA, the alternatives will be evaluated with respect to compliance with threshold requirements, permanence, and restoration timeframe, and the results of the evaluation will be documented in the RI/FS report. At least one permanent alternative will be evaluated.

5.0 PUBLIC PARTICIPATION

A Public Participation Plan (PPP) was prepared by Ecology for the project that summarizes the RI/FS activities to be conducted at the Site. The PPP is provided in Appendix G. The PPP will be provided to the public to present the opportunity for the public to learn about and provide input on the RI and remedial alternatives as required under MTCA (WAC) 173-340-600.

6.0 SCHEDULE AND REPORTING

The Agreed Order establishes the RI/FS schedule and reporting requirements. The schedule for specific project milestones are provided in the following table. If at any time during the RI/FS/Draft Cleanup Action Plan (DCAP) process unanticipated conditions or changed circumstances are discovered which might result in a schedule delay, the Port shall bring such information to the attention of Ecology. Any requests for a schedule extension will be undertaken as required by the Agreed Order. Any completion times that fall on a holiday or weekend will be extended to the next working day.

The schedule presented below includes 18 months following Ecology's approval of the RI/FS Work Plan to complete RI sampling. The Agreed Order specifies 12 months to complete RI sampling. More than 12 months will be needed to complete the RI sampling to allow for coordination to initiate sampling activities upon approval of the Work Plan and to complete the four quarters of groundwater sampling (i.e., the 4th quarter of sampling would occur in month 12) required by

Ecology. Therefore, the schedule for completion of RI sampling provided below includes additional time to complete the required sampling.

PROJECT MILESTONES	SCHEDULE
Draft Remedial Investigation (RI)/Feasibility Study (FS), Work Plan, Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP)	60 calendar days following the effective date of the Agreed Order. The effective date of the Agreed Order is March 2, 2011.
Final RI/FS Work Plan, SAP, QAPP and Health and Safety Plan (HASP)	45 calendar days following Ecology's review comments on the revised draft RI/FS Work Plan, SAP, QAPP and Health and Safety Plan (HASP).
Remedial Investigation Sampling Completed	18 months following Ecology's approval of the Final RI/FS Work Plan.
Submitted Validated Data to Ecology	Within 90 days following analysis.
Draft RI Report	90 days following receipt of all validated data from RI sampling.
Final RI Report	45 calendar days following Ecology's review comments on the draft RI Report.
Draft FS Report	90 days following completion of the Final RI Report.
Draft Final FS Report	45 calendar days following Ecology's review comments.
2nd Draft Final FS Report	60 calendar days following completion of the public comment period.
Draft Responsiveness Summary and Final Feasibility Study	45 calendar days following Public Comment Period.
Final Responsiveness Summary	30 calendar days following receipt of Ecology's review comments
Draft Cleanup Action Plan (DCAP)	90 calendar days following completion of the Final FS report.
Progress Reports	The 15th of every month beginning after the completion of the first full month after the effective date of the Agreed Order.

7.0 REFERENCES

Agreed Order – Washington State Department of Ecology to the Port of Seattle. 2011.

AET, 1991. Advanced Environmental Technologies, 1991. Exhibit 1 from AET, stamped received by Ecology. July 29, 1991.

Glacier, 2011. Glacier Environmental NW. Sediment Sampling and Analysis Plan. December 2011.

Ecology, 1987. Washington State Department of Ecology, TSCA Inspection Report. February 26, 1987.

E&E, 1988. Ecology and Environment, 1998. Site Inspection Memorandum to John Osborn, USEPA," from William Richards, E&E. February 24, 1988.

ENSR, 1991. ENSR Consulting and Engineering. MRI Corporation, Waste Characterization Program, Document Number 4506-001-781. March 1991.

Landau, 2009. Landau Associates Environmental Investigation Report, Port of Seattle Terminal 115 North, Seattle, Washington. December 31, 2009.

Port of Seattle, 1987. Letter from George Blomberg to Robert Duffner: Terminal 115 Site Inspection, Preliminary Assessment Screening – Follow-up Inspection. November 3, 1987.

SKCHD, 1998. Seattle-King County Health Department. Letter from Peter Isaksen, SKCHD, to Port of Seattle regarding Site Hazard Assessment. February 17, 1998.

SoundEarth, 2011. Terminal 115 Environmental Conditions. April 6, 2011.

SAIC, 2007. Lower Duwamish Waterway, Glacier Bay Source Control Area, Summary of Existing Information, and Identification of Data Gaps, prepared for the Washington State Department of Ecology. June 2007.

8.0 LIMITATIONS

We have prepared this Remedial Investigation/Feasibility Study Work Plan for use by the Port of Seattle during the RI/FS at the North Terminal 115 Site. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted environmental science practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

TABLE 1

SUMMARY OF SOIL AND STORMWATER SOLIDS CHEMICAL ANALYTICAL DATA
REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Sample Identification	MST-1	MST-2	MST-3	DP-1 (0.5-1)	DP-1 (6-7)	DP-1 (8.5-9.5)	MW-1 (4-5)	MW-1 (7-8)	MW-1 (11-12)	MW-3 (6.5-7)	MW-3 (10.5-11.5	MW-3 (17-18)	MW-5 (4-5)	MW-5 (10-11)	MW-5 (16-17)	MW-10 3-8	MW-10 10-12	CB-1
Sampled By	King County Health Department	King County Health Department	King County Health Department	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Ecology	Ecology	Landau Associates
Sample Date	11/7/1997	11/7/1997	11/7/1997	10/29/2009	10/29/2009	10/29/2009	10/29/2009	10/29/2009	10/29/2009	10/29/2009	10/29/2009	10/29/2009	10/29/2009	10/29/2009	10/29/2009	10/30/2009	10/30/2009	11/19/2009
Sample Depth	6 inches	5 inches	16 inches	0.5 - 1 foot	6 - 7 feet	8.5 - 9.5 feet	4 - 5 feet	7 - 8 feet	11 - 12 feet	6.5 - 7 feet	10.5 -11.5 feet	17 - 18 feet	4 - 5 feet	10 - 11 feet	16 - 17 feet	3 - 8 feet	10 - 12 feet	n/a
Total Metals by EPA 6000/7000 Series (mg/kg)																		
Antimony	--	--	--	5.4 U	6.8 U	6.7 U	6.2 U	6.3 U	6.6 U	5.7 U	6.9 U	5.8 U	6.1 U	5.7 U	6 U	0.25	0.78	18 U
Arsenic	11 U	11 U	12 U	5.4 U	6.8 U	6.7 U	6.2 U	6.3 U	6.6 U	5.7 U	11	5.8 U	6.1 U	5.7 U	6 U	7.62	11.6	18 U
Barium	120	32	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium	--	--	--	0.54 U	0.68 U	0.67 U	0.62 U	0.63 U	0.66 U	0.57 U	0.69 U	0.58 U	0.61 U	0.57 U	0.6 U	0.21	0.19	--
Cadmium	0.98	0.69	0.59 U	1.2	0.68 U	0.67 U	0.62 U	0.63 U	0.66 U	0.57 U	0.69 U	0.58 U	0.61 U	0.57 U	0.6 U	0.16	0.1 U	--
Chromium (Total)	22	33	8.4	72	46	54	39	41	55	38	55	42	55	34	34	31.0	28.1	34
Copper	--	--	--	110	29	31	22	28	33	19	33	38	31	19	20	34.7	20.5	150
Lead	470	110	36	220	5.5	6	19	44	5.5	9.8	46	17	7.8	13	27	141	16.2	59
Mercury	0.29 U	0.27 U	0.29 U	0.11	0.068 U	0.067 U	0.062 U	0.063 U	0.066 U	0.057 U	0.086	0.058 U	0.061 U	0.057 U	0.06 U	0.0313	0.0217	0.18 U
Nickel	--	--	--	35	63	58	44	51	60	37	72	40	65	38	35	33.0	35.3	--
Selenium	11 U	11 U	12U	11 U	14 U	13 U	12 U	13 U	13 U	11 U	14 U	12 U	12 U	11 U	12 U	0.5 U	0.5 U	--
Silver	0.57 U	0.54 U	0.59 U	0.54 U	0.68 U	0.67 U	0.62 U	0.63 U	0.66 U	0.57 U	0.69 U	0.58 U	0.61 U	0.57 U	0.6 U	0.1 U	0.1 U	--
Thallium	--	--	--	5.4 U	6.8 U	6.7 U	6.2 U	6.3 U	6.6 U	5.7 U	6.9 U	5.8 U	6.1 U	5.7 U	6 U	--	--	--
Tin	550	880	170	780	3	1.3U	48	96	1.3U	1.1U	12	77	7.7	28	170	--	--	640
Zinc	310	330	76	1400	57	66	52	77	62	34	83	52	59	42	50	--	--	580
Semivolatile Organic Compounds (SVOCs) by 8270D/SIM (mg/kg)																		
1,2,4-Trichlorobenzene	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
1,2-Dichlorobenzene	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
1,2-Diphenylhydrazine	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
1,3-Dichlorobenzene	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
1,3-Dinitrobenzene	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
1,4-Dichlorobenzene	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
1-Methylnaphthalene	--	--	--	0.078	0.009 U	0.009 U	0.0082 U	0.042	0.0089 U	0.11	0.0093 U	0.094	0.0082 U	0.038 U	0.008 U	--	--	0.024 U
2,3,4,6-Tetrachlorophenol	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
2,3,5,6-Tetrachlorophenol	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
2,3-Dichloroaniline	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
2,4,5-Trichlorophenol	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
2,4,6-Trichlorophenol	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
2,4-Dichlorophenol	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
2,4-Dimethylphenol	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
2,4-Dinitrophenol	--	--	--	0.91 U	0.23 U	0.23 U	0.21 U	0.21 U	0.22 U	0.19 U	0.23 U	0.97 U	0.21 U	0.19 U	0.2 U	--	--	3 U
2,4-Dinitrotoluene	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
2,6-Dinitrotoluene	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
2-Chloronaphthalene	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
2-Chlorophenol	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
2-Methylnaphthalene	--	--	--	0.13	0.009 U	0.009 U	0.0082 U	0.066	0.0089 U	0.17	0.0093 U	0.2	0.0082 U	0.038 U	0.008 U	--	--	0.024 U
2-Nitroaniline	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
2-Nitrophenol	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
3,3'-Dichlorobenzidine	--	--	--	1.8 U	0.45 U	0.45 U	0.41 U	0.42 U	0.44 U	0.38 U	0.46 U	1.9 U	0.41 U	0.38 U	0.4 U	--	--	6 U

TABLE 1

SUMMARY OF SOIL AND STORMWATER SOLIDS CHEMICAL ANALYTICAL DATA
REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Sample Identification	MST-1	MST-2	MST-3	DP-1 (0.5-1)	DP-1 (6-7)	DP-1 (8.5-9.5)	MW-1 (4-5)	MW-1 (7-8)	MW-1 (11-12)	MW-3 (6.5-7)	MW-3 (10.5-11.5	MW-3 (17-18)	MW-5 (4-5)	MW-5 (10-11)	MW-5 (16-17)	MW-10 3-8	MW-10 10-12	CB-1
Sampled By	**King County Health Department**	**King County Health Department**	**King County Health Department**	**Landau Associates**	**Landau Associates**	**Landau Associates**	**Landau Associates**	**Landau Associates**	**Landau Associates**	**Landau Associates**	**Landau Associates**	**Landau Associates**	**Landau Associates**	**Landau Associates**	**Landau Associates**	**Ecology**	**Ecology**	**Landau Associates**
Sample Date	**11/7/1997**	**11/7/1997**	**11/7/1997**	**10/29/2009**	**10/29/2009**	**10/29/2009**	**10/29/2009**	**10/29/2009**	**10/29/2009**	**10/29/2009**	**10/29/2009**	**10/29/2009**	**10/29/2009**	**10/29/2009**	**10/29/2009**	**10/30/2009**	**10/30/2009**	**11/19/2009**
Sample Depth	**6 inches**	**5 inches**	**16 inches**	**0.5 - 1 foot**	**6 - 7 feet**	**8.5 - 9.5 feet**	**4 - 5 feet**	**7 - 8 feet**	**11 - 12 feet**	**6.5 - 7 feet**	**10.5 -11.5 feet**	**17 - 18 feet**	**4 - 5 feet**	**10 - 11 feet**	**16 - 17 feet**	**3 - 8 feet**	**10 - 12 feet**	**n/a**
Semivolatile Organic Compounds (SVOCs) by 8270D/SIM (mg/kg)																		
4,6-Dinitro-2-Methylphenol	--	--	--	0.91 U	0.23 U	0.23 U	0.21 U	0.21 U	0.22 U	0.19 U	0.23 U	0.97 U	0.21 U	0.19 U	0.2 U	--	--	3 U
4-Bromophenyl phenyl ether	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
4-Chloro-3-Methylphenol	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
4-Chloroaniline	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
4-Chlorophenyl-Phenylether	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
4-Nitroaniline	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
4-Nitrophenol	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Acenaphthene	--	--	--	0.88	0.009 U	0.009 U	0.015	0.13	0.0089 U	0.18	0.0093 U	0.41	0.0082 U	0.05	0.0099	--	--	0.024 U
Acenaphthylene	--	--	--	0.092	0.009 U	0.009 U	0.0082 U	0.0091	0.0089 U	0.008 U	0.0093 U	0.0082 U	0.0082 U	0.038 U	0.008 U	--	--	0.024 U
Aniline	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Anthracene	--	--	--	0.36	0.009 U	0.009 U	0.0082 U	0.072	0.0089 U	0.008 U	0.0093 U	0.14	0.0082 U	0.13	0.019	--	--	0.024 U
Benz[a]anthracene	--	--	--	0.41	0.009 U	0.009 U	0.0082 U	0.043	0.0089 U	0.008 U	0.0093 U	0.086	0.0082 U	0.17	0.025	--	--	0.03
Benzene, 1,4-Dinitro-	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Benzidine	--	--	--	1.8 U	0.45 U	0.45 U	0.41 U	0.42 U	0.44 U	0.38 U	0.46 U	1.9 U	0.41 U	0.38 U	0.4 U	--	--	6 U
Benzo(a)pyrene	--	--	--	0.35	0.009 U	0.009 U	0.0082 U	0.014	0.0089 U	0.008 U	0.0093 U	0.0082 U	0.0082 U	0.14	0.023	--	--	0.028
Benzo(b)fluoranthene	--	--	--	0.74	0.009 U	0.009 U	0.0082 U	0.023	0.0089 U	0.008 U	0.0093 U	0.0082 U	0.0082 U	0.16	0.028	--	--	0.047
Benzo(ghi)perylene	--	--	--	0.19	0.009 U	0.009 U	0.0082 U	0.014	0.0089 U	0.008 U	0.0093 U	0.0082 U	0.0082 U	0.079	0.015	--	--	0.044
Benzo(k)fluoranthene	--	--	--	0.19	0.009 U	0.009 U	0.0082 U	0.0084 U	0.0089 U	0.008 U	0.0093 U	0.0082 U	0.0082 U	0.06	0.008 U	--	--	0.031
Benzyl Alcohol	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Bis(2-Chloroethoxy)Methane	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Bis(2-Chloroethyl)Ether	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Bis(2-chloroisopropyl) ether	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Bis(2-Ethylhexyl) Phthalate	--	--	--	0.18	0.045 U	0.045 U	0.041 U	0.042	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	2.5
Butyl benzyl phthalate	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Carbazole	--	--	--	0.2	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.069	0.046 U	0.19 U	0.041 U	0.052	0.04 U	--	--	0.6 U
Chrysene	--	--	--	0.69	0.009 U	0.009 U	0.0082 U	0.034	0.0089 U	0.008 U	0.0093 U	0.078	0.0082 U	0.16	0.027	--	--	0.072
Dibenzo(a,h)anthracene	--	--	--	0.055	0.009 U	0.009 U	0.0082 U	0.0084 U	0.0089 U	0.008 U	0.0093 U	0.0082 U	0.0082 U	0.038 U	0.008 U	--	--	0.024 U
Dibenzofuran	--	--	--	0.33	0.045 U	0.045 U	0.041 U	0.087	0.044 U	0.096	0.046 U	0.31	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Dibutyl phthalate	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Diethyl phthalate	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Dimethyl phthalate	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Di-N-Octyl Phthalate	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Fluoranthene	--	--	--	1.9	0.009 U	0.009 U	0.021	0.29	0.0089 U	0.021	0.011	0.93	0.0082 U	0.46	0.087	--	--	0.077
Fluorene	--	--	--	0.55	0.009 U	0.009 U	0.011	0.13	0.0089 U	0.099	0.0093 U	0.47	0.0082 U	0.06	0.011	--	--	0.024 U
Hexachlorobenzene	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Hexachlorobutadiene	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Hexachlorocyclopentadiene	--	--	--	0.4	0.045 U	0.045 U	0.09	0.042 U	0.044 U	0.084	0.1	0.42	0.09	0.038 U	0.088	--	--	0.6 U
Hexachloroethane	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Bis(2-ethylhexyl) adipate	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U

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Sampled By	King County Health Department	King County Health Department	King County Health Department	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Ecology	Ecology	Landau Associates
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Semivolatile Organic Compounds (SVOCs) by 8270D/SIM (mg/kg)																		
Indeno(1,2,3-cd)pyrene	--	--	--	**0.15**	0.009 U	0.009 U	0.0082 U	**0.0085**	0.0089 U	0.008 U	0.0093 U	0.0082 U	0.0082 U	**0.074**	**0.011**	--	--	0.024 U
Isophorone	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
(3+4)-Methylphenol (m,p-Cresol)	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	**0.11**	0.038 U	0.04 U	--	--	0.6 U
m-Nitroaniline	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Naphthalene	--	--	--	**0.077**	0.009 U	0.009 U	0.0082 U	**0.026**	0.0089 U	**0.28**	0.0093 U	**0.081**	0.0082 U	0.038 U	0.008 U	--	--	0.024 U
Nitrobenzene	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
N-Nitrosodimethylamine	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
N-Nitrosodi-n-propylamine	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
N-Nitrosodiphenylamine	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
2-Methylphenol (o-Cresol)	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
O-Dinitobenzene	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Pentachlorophenol	--	--	--	0.91 U	0.23 U	0.23 U	0.21 U	0.21 U	0.22 U	0.19 U	0.23 U	0.97 U	0.21 U	0.19 U	0.2 U	--	--	3 U
Phenanthrene	--	--	--	**1.3**	0.009 U	0.009 U	**0.028**	**0.38**	0.0089 U	**0.098**	**0.01**	**1.5**	0.0082 U	**0.53**	**0.1**	--	--	**0.025**
Phenol	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Pyrene	--	--	--	**2.4**	0.009 U	0.009 U	**0.019**	**0.18**	0.0089 U	**0.013**	0.0093 U	**0.52**	0.0082 U	**0.37**	**0.086**	--	--	**0.072**
Pyridine	--	--	--	0.18 U	0.045 U	0.045 U	0.041 U	0.042 U	0.044 U	0.038 U	0.046 U	0.19 U	0.041 U	0.038 U	0.04 U	--	--	0.6 U
Petroleum Hydrocarbons (mg/kg) by NWPTH-G/NWTPH-Dx (mg/kg)																		
Gasoline-Range	--	--	--	--	--	--	4.4 U	4.7 U	5.7 U	--	--	--	--	--	--	--	--	--
Diesel-Range	--	--	--	--	--	--	31 U	32 U	33 U	--	--	--	--	--	--	--	--	--
Lub Oil-Range	--	--	--	--	--	--	62 U	**83**	66 U	--	--	--	--	--	--	--	--	--
Polychlorinated Biphenyls (PCBs) by EPA 8082 (mg/kg)																		
Aroclor 1016	--	--	--	0.054 U	0.068 U	0.068 U	0.062 U	0.063 U	0.067 U	0.057 U	0.069 U	0.058 U	0.062 U	0.057 U	0.06 U	--	--	0.18 U
Aroclor 1221	--	--	--	0.054 U	0.068 U	0.068 U	0.062 U	0.063 U	0.067 U	0.057 U	0.069 U	0.058 U	0.062 U	0.057 U	0.06 U	--	--	0.18 U
Aroclor 1232	--	--	--	0.054 U	0.068 U	0.068 U	0.062 U	0.063 U	0.067 U	0.057 U	0.069 U	0.058 U	0.062 U	0.057 U	0.06 U	--	--	0.18 U
Aroclor 1242	--	--	--	0.054 U	0.068 U	0.068 U	0.062 U	0.063 U	0.067 U	0.057 U	0.069 U	0.058 U	0.062 U	0.057 U	0.06 U	--	--	0.18 U
Aroclor 1248	--	--	--	0.054 U	0.068 U	0.068 U	0.062 U	0.063 U	0.067 U	0.057 U	0.069 U	0.058 U	0.062 U	0.057 U	0.06 U	--	--	0.18 U
Aroclor 1254	--	--	--	0.054 U	0.068 U	0.068 U	0.062 U	0.063 U	0.067 U	0.057 U	0.069 U	0.058 U	0.062 U	0.057 U	0.06 U	--	--	0.18 U
Aroclor 1260	--	--	--	0.054 U	0.068 U	0.068 U	0.062 U	0.063 U	0.067 U	0.057 U	0.069 U	0.058 U	0.062 U	0.057 U	0.06 U	--	--	0.18 U

Notes:

n/a = not applicable

mg/kg = milligram per kilogram

"--" = not tested

U = Analyte not detected above the reported sample quantization limit

Bold indicates analyte was detected.

TABLE 2

SUMMARY OF GROUNDWATER CHEMICAL ANALYTICAL DATA
REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Sample Identification	DP-1-GW	MW-1	MW-2	MW-3	MW-4	MW-5	MW-55 (Dup of MW-5)	MW-6	MW-7	MW-8	MW-9	MW-10	GMW-25	GMW-26	GMW-27
Sampled By	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates
Sample Date	10/29/2009	11/5/2009	11/5/2009	11/6/2009	11/5/2009	11/5/2009	11/6/2009	11/5/2009	11/4/2009	11/4/2009	11/4/2009	11/4/2009	11/5/2009	11/5/2009	11/4/2009
Total Metals by EPA 6000/7000 Series (µg/L)															
Antimony	1.6	1.4	1 U	1 U	38	12	13	1 U	39	1 U	1 U	1 U	1 U	1 U	1 U
Arsenic	10	19	20	11	1,900	760	790	21	620	11	160	6.9	1,400	370	26
Beryllium	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
Cadmium	4.4 U	4.4 U	4.4 U	11 U	7.3	11 U	11 U	4.4 U	4.4 U	4.4 U	4.4 U	4.4 U	4.4 U	4.4 U	4.4 U
Chromium (Total)	44	11	13	8.2	1,100	410	430	44	100	2.8	2 U	5.4	2 U	2 U	5
Chromium (Hexavalent)	10 U	10 U	10 U	10 U	50 U	50 U	50 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U
Copper	170	22	59	5.7	310	53	55	6.2	40	2.1	1.3	13	1.5	2.8	1 U
Lead	180	68	9.4	5.5	460	32	34	22	220	2.8	1 U	86	1 U	1 U	1.2
Mercury	0.1 U	0.1 U	0.1 U	0.1 U	0.94	0.27	0.31	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	78	22 U	54	26	500	1,000	1,200	41	64	22 U	22 U	22 U	22 U	22 U	22 U
Selenium	5.6 U	5.6 U	5.6 U	10 U	33 U	25 U	25 U	5.6 U	8.9 U	5.6 U	5.6 U	5.6 U	5.6 U	5.6 U	5.6 U
Silver	11 U	11 U	11 U	11 U	11 U	11 U	28 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
Thallium	5.6 U	5.6 U	5.6 U	5.6 U	5.6 U	5.6 U	14 U	5.6 U	5.6 U	5.6 U	5.6 U	5.6 U	5.6 U	5.6 U	5.6 U
Tin	49	160	10 U	32	390	990	1,300	10 U	8.1	10 U	10 U	480	10 U	10 U	10 U
Zinc	480	78	69	40	760	63	75	140	230	32	13	53	19	17	16
Dissolved Metals by EPA 6000/7000 Series (µg/L)															
Antimony	2.6	1.5	1 U	1 U	13	11	6.9	1 U	37	1 U	1 U	1.5	1 U	1 U	1 U
Arsenic	5.1	17	19	15	1400	820	640	18	590	12	180	6	1,200	400	25
Beryllium	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Cadmium	4 U	4 U	4 U	4 U	4.2	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Chromium (Total)	2 U	6.6	2 U	11	520	410	460	13	69	3.2	2.5	2 U	2 U	2 U	8.3
Copper	5.9	4	1 U	1.7	120	49	77	8.9	4.8	1 U	1 U	5.9	1 U	1 U	1 U
Lead	1.1	3	1 U	1 U	470	32	27	4.1	40	1 U	1 U	2.5	1 U	1 U	1 U
Mercury	0.1 U	0.1 U	0.1 U	0.1 U	0.79	0.26	0.19	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	20 U	20 U	20 U	26	410	1,400	970	16	52	20 U	20 U	20 U	20 U	20 U	20 U
Selenium	5 U	5 U	5 U	11 U	20 U	25 U	25 U	5 U	7.2 U	5 U	5 U	5 U	5 U	5 U	8 U
Silver	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Thallium	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tin	10 U	10 U	10 U	10 U	57	640	400	10 U	10 U	10 U	10 U	12	10 U	10 U	10 U
Zinc	12	7.8	7.8	39	460	61	81	26	66	10	5 U	5 U	5 U	5 U	5 U
Semivolatile Organic Compounds (SVOCs) by EPA 8270D/SIM (µg/L)															
1,2,4-Trichlorobenzene	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	0.2 U	--	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-Diphenylhydrazine	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,3-Dinitrobenzene	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1-Methylnaphthalene	0.095 U	0.1 U	0.1 U	10 U	10 U	10 U	10 U	7.4	0.9	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U

TABLE 2

SUMMARY OF GROUNDWATER CHEMICAL ANALYTICAL DATA
REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN
PORT OF SEATTLE NORTH TERMINAL 115
SEATTLE, WASHINGTON

Sample Identification	DP-1-GW	MW-1	MW-2	MW-3	MW-4	MW-5	MW-55 (Dup of MW-5)	MW-6	MW-7	MW-8	MW-9	MW-10	GMW-25	GMW-26	GMW-27
Sampled By	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates
Sample Date	10/29/2009	11/5/2009	11/5/2009	11/6/2009	11/5/2009	11/5/2009	11/6/2009	11/5/2009	11/4/2009	11/4/2009	11/4/2009	11/4/2009	11/5/2009	11/5/2009	11/4/2009
Semivolatile Organic Compounds (SVOCs) by EPA 8270D/SIM (µg/L)															
2,3,4,6-Tetrachlorophenol	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2,3,5,6-Tetrachlorophenol	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2,3-Dichloroaniline	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2,4,5-Trichlorophenol	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2,4,6-Trichlorophenol	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2,4-Dichlorophenol	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2,4-Dimethylphenol	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	**11**	**2.9**	1 U	1 U	1 U	1 U	1 U	1 U
2,4-Dinitrophenol	9.5 U	10 U	10 U	1,000 U	1,000 U	1,000 U	1,000 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrotoluene	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2,6-Dinitrotoluene	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-Chloronaphthalene	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-Chlorophenol	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-Methylnaphthalene	0.095 U	0.1 U	0.1 U	**13**	10 U	10 U	10 U	**1.5**	**1.2**	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
2-Nitroaniline	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-Nitrophenol	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
3,3'-Dichlorobenzidine	9.5 U	10 U	10 U	1,000 U	1,000 U	1,000 U	1,000 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4,6-Dinitro-2-Methylphenol	4.8 U	5 U	5 U	500 U	500 U	500 U	500 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Bromophenyl phenyl ether	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4-Chloro-3-Methylphenol	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4-Chloroaniline	9.5 U	10 U	10 U	1,000 U	1,000 U	1,000 U	1,000 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chlorophenyl-Phenylether	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4-Nitroaniline	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4-Nitrophenol	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Acenaphthene	**0.42**	**2.2**	0.1 U	10 U	10 U	10 U	10 U	**13**	**0.7**	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Acenaphthylene	0.095 U	0.1 U	0.1 U	10 U	10 U	10 U	10 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aniline	4.8 U	5 U	5 U	500 U	500 U	500 U	500 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Anthracene	**0.24**	0.1 U	0.1 U	10 U	10 U	10 U	10 U	0.1 U	**0.12**	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Benz[a]anthracene	**0.14**	**0.012**	0.01 U	**1.3**	1 U	**2**	**1.5**	**0.014**	**0.061**	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Benzene, 1,4-Dinitro-	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Benzidine	9.5 U	10 U	10 U	1,000 U	1,000 U	1,000 U	1,000 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	**0.11**	0.01 U	0.01 U	1 U	1 U	1 U	1 U	0.01 U	**0.037**	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Benzo(b)fluoranthene	**0.24**	0.01 U	0.01 U	**2.1**	1 U	**1.1**	1 U	**0.014**	**0.071**	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Benzo(ghi)perylene	**0.14**	0.01 U	0.01 U	1 U	1 U	1 U	1 U	**0.011**	**0.041**	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Benzo(k)fluoranthene	**0.062**	0.01 U	0.01 U	1 U	1 U	1 U	1 U	0.01 U	**0.017**	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Benzyl Alcohol	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	**1.1**	1 U	1 U	1 U	1 U	1 U	1 U
Bis(2-Chloroethoxy)Methane	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bis(2-Chloroethyl)Ether	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bis(2-chloroisopropyl) ether	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bis(2-Ethylhexyl) Phthalate	**4.2**	1 U	1 U	100 U	100 U	100 U	100 U	**1.3**	**1.6**	1 U	1 U	1 U	1 U	1 U	1 U
Butyl benzyl phthalate	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

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Sample Identification	DP-1-GW	MW-1	MW-2	MW-3	MW-4	MW-5	MW-55 (Dup of MW-5)	MW-6	MW-7	MW-8	MW-9	MW-10	GMW-25	GMW-26	GMW-27
Sampled By	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates
Sample Date	10/29/2009	11/5/2009	11/5/2009	11/6/2009	11/5/2009	11/5/2009	11/6/2009	11/5/2009	11/4/2009	11/4/2009	11/4/2009	11/4/2009	11/5/2009	11/5/2009	11/4/2009
Semivolatile Organic Compounds (SVOCs) by EPA 8270D/SIM (µg/L)															
Carbazole	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	**2.2**	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chrysene	**0.25**	0.01 U	0.01 U	1 U	1 U	**1.8**	**1.3**	**0.014**	**0.061**	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Dibenzo(a,h)anthracene	**0.044**	0.01 U	0.01 U	1 U	1 U	1 U	1 U	0.01 U	**0.012**	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Dibenzofuran	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	**2.5**	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dibutyl phthalate	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Diethyl phthalate	**0.98**	**1.2**	1 U	**190**	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dimethyl phthalate	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Di-N-Octyl Phthalate	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Fluoranthene	**0.67**	**0.16**	0.1 U	10 U	10 U	10 U	10 U	0.1 U	**0.23**	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Fluorene	**0.31**	**0.12**	0.1 U	**11**	10 U	10 U	10 U	**2.5**	**0.29**	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Hexachlorobenzene	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Hexachlorobutadiene	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Hexachlorocyclopentadiene	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Hexachloroethane	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bis(2-ethylhexyl) adipate	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Indeno(1,2,3-cd)pyrene	**0.085**	0.01 U	0.01 U	1 U	1 U	1 U	1 U	0.01 U	**0.024**	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Isophorone	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
(3+4)-Methylphenol (m,p-Cresol)	0.95 U	1 U	1 U	100 U	**1600**	100 U	100 U	**1.9**	**10**	1 U	1 U	1 U	1 U	1 U	1 U
m-Nitroaniline	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Naphthalene	0.095 U	0.1 U	**0.1**	**17**	10 U	10 U	10 U	**3.4**	**12**	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nitrobenzene	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
N-Nitrosodimethylamine	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
N-Nitrosodi-n-propylamine	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
N-Nitrosodiphenylamine	9.5 U	10 U	10 U	1,000 U	1,000 U	1,000 U	1,000 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylphenol (o-Cresol)	0.95 U	1 U	1 U	100 U	**120**	100 U	100 U	**1**	1 U	1 U	1 U	1 U	1 U	1 U	1 U
O-Dinitobenzene	0.95 U	1 U	1 U	100 U	100 U	100 U	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Pentachlorophenol	4.8 U	5 U	5 U	500 U	500 U	500 U	500 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Phenanthrene	**0.63**	0.1 U	0.1 U	10 U	10 U	**18**	**10**	**0.21**	**0.3**	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Phenol	0.95 U	1 U	1 U	100 U	**120**	100 U	100 U	1 U	**51**	1 U	1 U	1 U	1 U	1 U	1 U
Pyrene	**0.56**	0.1 U	0.1 U	10 U	10 U	10 U	10 U	0.1 U	**0.28**	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Pyridine	9.5 U	10 U	10 U	1,000 U	1,000 U	1,000 U	1,000 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Petroleum Hydrocarbons (mg/kg)															
Gasoline-Range by NWTPH-G	100 U	100 U	--	--	--	--	--	--	--	--	--	--	--	--	--
Diesel-Range by NWTPH-DX	0.26 U	0.22 U	--	--	--	--	--	--	--	--	--	--	--	--	--
Lub Oil-Range by NWTPH-Dx	**1.8**	0.35 U	--	--	--	--	--	--	--	--	--	--	--	--	--
Volatile Organic Compounds (VOCs) by EPA 8260B/SIM (µg/L)															
1,1,1,2-Tetrachloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,1-Trichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2,2-Tetrachloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2-Trichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U

TABLE 2

SUMMARY OF GROUNDWATER CHEMICAL ANALYTICAL DATA
REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN
PORT OF SEATTLE NORTH TERMINAL 115
SEATTLE, WASHINGTON

Sample Identification	DP-1-GW	MW-1	MW-2	MW-3	MW-4	MW-5	MW-55 (Dup of MW-5)	MW-6	MW-7	MW-8	MW-9	MW-10	GMW-25	GMW-26	GMW-27
Sampled By	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates
Sample Date	10/29/2009	11/5/2009	11/5/2009	11/6/2009	11/5/2009	11/5/2009	11/6/2009	11/5/2009	11/4/2009	11/4/2009	11/4/2009	11/4/2009	11/5/2009	11/5/2009	11/4/2009
Volatile Organic Compounds (VOCs) by EPA 8260B/SIM (µg/L)															
1,1-Dichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-Dichloroethene	0.02 U	0.02 U	0.02 U	0.02 U	0.04 U	0.1 U	0.1 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
1,1-Dichloropropene	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2,3-Trichlorobenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2,3-Trichloropropane	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2,4-Trichlorobenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2,4-Trimethylbenzene	0.2 U	0.22	0.22	0.2 U	0.74	1 U	1 U	0.54	0.28	0.23	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-Dibromo-3-Chloropropane	1 U	1 U	1 U	1 U	2 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-dibromoethane (EDB)	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-Dichlorobenzene (o-Dichlorobenzene)	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-Dichloroethane (EDC)	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-Dichloropropane	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3,5-Trimethylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.47	1 U	1 U	0.38	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3-Dichlorobenzene (m-Dichlorobenzene)	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3-Dichloropropane	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,4-Dichlorobenzene (p-Dichlorobenzene)	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2,2-Dichloropropane	0.2 U	5 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-Butanone (MEK)	5 U	1 U	5 U	5 U	240	50	51	5 U	11	5 U	5 U	5 U	5 U	5 U	5 U
2-Chloroethyl vinyl ether	1 U	0.2 U	1 U	1 U	2 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-Chlorotoluene	0.2 U	2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-Hexanone	2 U	0.2 U	2 U	2 U	20	11	10	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
4-Chlorotoluene	0.2 U	17	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
4-Methyl-2-Pentanone (Methyl isobutyl ketone)	2 U	0.2 U	2 U	2 U	46	17	17	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Acetone	47	0.2 U	9.8	18	2,400	650	530	5 U	160	8.8	5 U	5 U	5 U	5 U	5 U
Benzene	0.2 U	0.2 U	0.2 U	0.2 U	1.7	1 U	1 U	0.29	0.24	0.22	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Bromobenzene	0.2 U	1 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Bromochloromethane	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Bromodichloromethane	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Bromoform (Tribromomethane)	1 U	0.2 U	1 U	1 U	2 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Carbon Disulfide	0.2 U	0.2 U	0.22	0.2 U	0.4 U	1 U	1	0.2 U	71	5.2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Carbon Tetrachloride	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Chlorobenzene	0.2 U	1 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Chloroethane	1 U	0.2 U	1 U	1 U	2 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	0.2 U	1 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Chloromethane	1 U	0.2 U	1 U	1 U	2 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cis-1,2-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Cis-1,3-Dichloropropene	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Dibromochloromethane	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Dibromomethane	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U

TABLE 2

SUMMARY OF GROUNDWATER CHEMICAL ANALYTICAL DATA
REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Sample Identification	DP-1-GW	MW-1	MW-2	MW-3	MW-4	MW-5	MW-55 (Dup of MW-5)	MW-6	MW-7	MW-8	MW-9	MW-10	GMW-25	GMW-26	GMW-27
Sampled By	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates	Landau Associates
Sample Date	10/29/2009	11/5/2009	11/5/2009	11/6/2009	11/5/2009	11/5/2009	11/6/2009	11/5/2009	11/4/2009	11/4/2009	11/4/2009	11/4/2009	11/5/2009	11/5/2009	11/4/2009
Volatile Organic Compounds (VOCs) by EPA 8260B/SIM (µg/L)															
Dichlorodifluoromethane (CFC-12)	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Ethylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Hexachlorobutadiene	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Isopropylbenzene (Cumene)	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1.3	**1.3**	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Methyl Iodide (Iodomethane)	1 U	1 U	1 U	1 U	2 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methyl t-butyl ether	0.2 U	2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Methylene Chloride	1 U	0.2 U	1 U	1 U	2 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Naphthalene	1 U	1 U	1 U	**1.4**	**2.8**	**5**	**5**	**43**	**37**	1 U	1 U	1 U	1 U	1 U	1 U
n-Butylbenzene	0.2 U	0.4 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
n-Propylbenzene	0.2 U	**3.4**	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
p-Isopropyltoluene	**0.28**	0.2 U	0.2 U	0.2 U	**0.67**	**6.1**	**5.5**	**0.36**	**0.32**	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Sec-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Styrene	0.2 U	**0.26**	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Tert-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Tetrachloroethene	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Toluene	1 U	0.2 U	1 U	1 U	**8**	5 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trans-1,2-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Trans-1,3-Dichloropropene	0.2 U	1 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Trichloroethene (TCE)	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Trichlorofluoromethane (CFC-11)	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Vinyl Acetate	2 U	0.2 U	2 U	2 U	4 U	10 U	10 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Vinyl Chloride	0.02 U	2 U	0.02 U	0.02 U	0.04 U	0.1 U	0.1 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Xylene, m-,p-	0.4 U	0.02 U	0.4 U	0.4 U	0.8 U	2 U	2 U	**0.47**	0.4 U	**0.49**	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Xylene, o-	0.2 U	0.2 U	0.2 U	0.2 U	0.4 U	1 U	1 U	**0.47**	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U

Notes:

n/a = not applicable

µg/L = microgram per liter

"--" = not tested

U = Analyte not detected above the reported sample quantitation limit

Bold indicates analyte was detected.

Chemical analysis performed by OnSite Environmental, Inc. of Redmond, Washington.

TABLE 3

SUMMARY OF SAMPLING APPROACH, OBJECTIVES AND ANALYSES - SOIL

REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Sample Location	Characterization Objectives for Investigation Location							Soil Investigation Total Depth (feet)	Target Soil Sample Horizons					Minimum Number of Samples Collected[3]	Number of Samples Analyzed						
	Fill	Former Ponds	Former ASTs	Process Buildings	Rail Lines	Former UST	Arsenic in Soil		Fill[1]	Water Table[2]	Native Surface	Top of Aquitard	Lower Sand Layer		Metals[4] (EPA 6000/7000)	SVOCs[5] (EPA 8270D/SIM)	VOCs[5] (EPA 8260C)	PCBs[4] (EPA 8082A)	TPH[5] (NWTPH-Gx, Dx)	Soil pH[5] (SW 846 - 9045C)	Dioxins/Furans[4] (EPA 1613/8290)
Direct Push Borings																					
B-1	■				■			4 to 8	■		■			3	2-3	2-3				2-3	
B-2	■				■			4 to 8	■		■			3	2-3	2-3				2-3	
B-3	■				■			4 to 8	■		■			3	2-3	2-3				2-3	
B-4	■				■			~20	■	■	■	■		5	3-5	4-5	4-5	1-5		4-5	
B-5	■			■		■		~20	■	■	■	■		5	3-5	4-5	4-5		4-5	4-5	
B-6	■		■	■		■		~20	■	■	■	■		5	3-5	4-5	4-5	1-5	4-5	4-5	
B-7	■		■	■		■		~20	■	■	■	■		5	3-5	4-5	4-5		4-5	4-5	
B-8	■		■	■		■		~20	■	■	■	■		5	3-5	4-5	4-5		4-5	4-5	
B-9	■		■	■				~20	■	■	■	■		5	3-5	4-5	4-5		4-5	4-5	
B-10	■	■	■					~20	■	■	■	■		5	3-5	4-5				4-5	
B-11	■	■						~20	■	■	■	■		5	3-5	4-5	4-5		4-5	4-5	
B-12	■		■	■				~20	■	■	■	■		5	3-5	4-5	4-5	1-5		4-5	
B-13	■	■						~20	■	■	■	■		5	3-5	4-5	4-5	1-5		4-5	
B-14	■	■		■				~20	■	■	■	■		5	3-5	4-5				4-5	
B-15	■	■					■	~20	■	■	■			4	3-4	4	4			4	
B-16	■	■						~20	■	■	■			4	3-4	4	4		4	4	
B-17	■			■				~20	■	■	■			4	3-4	4	4			4	
Test Pit Excavations																					
TP-1	■				■			~6	■		■			3	2-3	2-3	2-3	1-3		2-3	
TP-2	■				■	■		6 to 10	■	■	■			4	2-4	3-4	3-4		3-4	3-4	
TP-3	■				■	■		6 to 10	■	■	■			4	2-4	3-4	3-4		3-4	3-4	
Hollow Stem Auger																					
MW-2D	■				■	■		30-35	■	■	■	■	■	**6**	3-6	5-6	5-6		5-6	5-6	
MW-4D	■	■	■					30-35	■	■	■	■	■	**6**	3-6	5-6	5-6			5-6	
MW-10D	■	■						30-35	■	■	■	■	■	**5**	3-5	5	5	1-5		5	1-5
MW-19D	■	■						30-35	■	■	■	■	■	**5**	3-5	5	5	1-5		5	1-5
MW-11	■				■		■	~20	■	■	■	■		5	3-5	4-5	4-5			4-5	1-5
MW-12	■						■	~20	■	■	■	■		5	3-5	4-5				4-5	
MW-13	■	■	■	■			■	~20	■	■	■	■		5	3-5	4-5	4-5	1-5		4-5	1-5
MW-14	■						■	~20	■	■	■	■		5	3-5	4-5	4-5			4-5	
MW-15	■	■	■	■				~20	■	■	■	■		5	3-5	4-5				4-5	1-5
MW-16	■	■	■	■				~20	■	■	■	■		5	3-5	4-5	4-5			4-5	
MW-17	■	■						~20	■	■	■			4	3-4	4	4			4	
MW-18	■	■					■	~20	■	■	■			4	3-4	4	4		4	4	
MW-19								~20						0[6]							
MW-20	■				■			~20	■	■	■	■		5	3-5	4-5	4-5		4-5	4-5	

Notes:

[1] The fill to be characterized will include the sampleable portion (i.e. the minus 3/4-inch fraction) of railroad ballast, where encountered.

[2] The water table sample will be sampled across the water table observed at time of drilling.

[3] See Typical Soil Sample Collection Schematics (Figures 7A, 7B and 7C).

[4] The number of samples analyzed from each location for metals, PCBs and dioxins/furans is based on archiving of selected sample intervals for potential future analysis (within hold times). The minimum number of samples indicated will be analyzed, with additional sample intervals analyzed where supplemental data is needed to characterize or delineate contamination present based on the initial sample(s) that were analyzed.

[5] The number of samples analyzed from each location for SVOCs, VOCs, TPH and pH is based on fill thickness at the location. In general, where fill is observed to be greater than approximately several feet thick, an additional fill sample will be analyzed.

[6] Soil samples are to be collected and analyzed from the adjacent well MW-19D.

See Figure 7 for soil sample locations.

TABLE 4

SUMMARY OF SAMPLING APPROACH, OBJECTIVES AND ANALYSES - GROUNDWATER

REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Sample Location	Characterization Objectives for Investigation Location								Anticipated well screen interval (ft bgs)[1]	Groundwater Analyses[2]			
	Fill	Former Ponds	Former ASTs	Process Buildings	Rail Lines	Former UST	Arsenic in Groundwater	Investigate Vertical Extent		Metals (EPA 200.8/7470)	SVOCs (EPA 8270D/SIM)	VOCs (EPA 8260C)	TPH (NWTPH-Gx, Dx)
New Monitoring Wells													
MW-2D								■	25-35	4	4	4	
MW-4D							■	■	25-35	4	4	4	
MW-10D	■						■	■	25-35	4	4	4	
MW-19D	■	■		■				■	25-35	4	4		
MW-11	■				■		■		5-15	4	4		
MW-12	■						■		5-15	4	4		4
MW-13	■	■	■	■			■		5-15	4	4	4	4
MW-14	■						■		5-15	4	4	4	
MW-15	■	■	■	■					10-20	4	4	4	
MW-16	■	■	■	■					5-15	4	4	4	
MW-17	■	■							5-15	4	4	4	4
MW-18	■	■					■		5-15	4	4		4
MW-19	■	■							5-15	4	4		4
MW-20	■				■				5-15	4	4		4
Existing Monitoring Wells													
MW-1	■			■	■	■	■		8-13	4	4	4	4
MW-2	■				■	■	■		10-15	4	4	4	4
MW-3	■	■	■	■		■	■		8-18	4	4	4	4
MW-4	■	■					■		7-12	4	4	4	
MW-5	■	■					■		7-17	4	4	4	4
MW-6	■	■		■			■		7-12	4	4	4	4
MW-7	■	■					■		7-12	4	4	4	4
MW-8	■	■					■		9-14	4	4	4	
MW-9	■	■					■		11-16	4	4		
MW-10	■	■					■		7-12	4	4	4	
GMW-25	■						■		5-15	4	4		
GMW-26	■						■		5-15	4	4		
GMW-27	■						■		5-15	4	4		

Notes:

[1] The anticipated well screen interval is approximate and is based on a limited number of subsurface explorations previously performed at the site; actual well screen intervals will be determined in the field and will be based on the interval best suited to characterize the nature and extent of contamination, and based on the judgement of the field geologist or engineer.

[2] Four rounds of groundwater monitoring will be performed.

See Figure 8 for groundwater sample locations

TABLE 5

SUMMARY OF SAMPLING APPROACH, OBJECTIVES AND ANALYSES - STORMWATER CATCH BASIN SOLIDS

REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Sample Location	Stormwater Catch Basin Solids Analyses					
	Metals (EPA 6000/7000)	SVOCs (EPA 8270D/SIM)	VOCs (EPA 8260C)	PCBs (EPA 8082A)	TPH (NWTPH-Gx, Dx)	Dioxins/Furans (EPA 1613/8290)
CB-313	1	1	1	1	1	1
CB-322	1	1	1	1	1	1
CB-323	1	1	1	1	1	1
CB-324	1	1	1	1	1	1
CB-328	1	1	1	1	1	1
Other CBs[1]	0-1	0-1	0-1	0-1	0-1	0-1

Notes:

[1] Remaining Site catch basins (i.e., CB-314, 315, 345 and six unnamed catch basins) may be analyzed based on the results from CB-313, 322, 323, 324 and 328.

See Figure 9 for catch basin solids samples locations.

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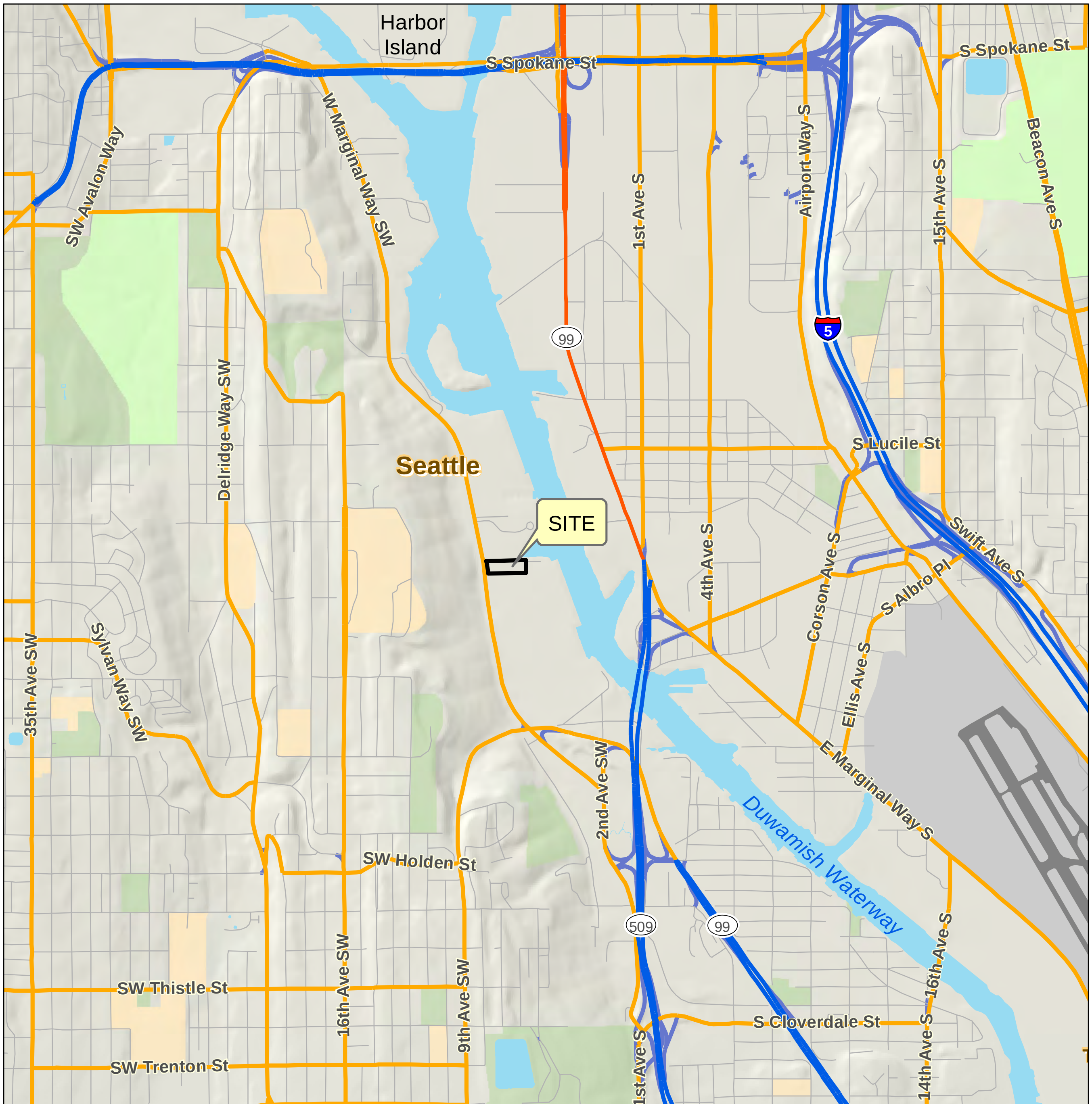

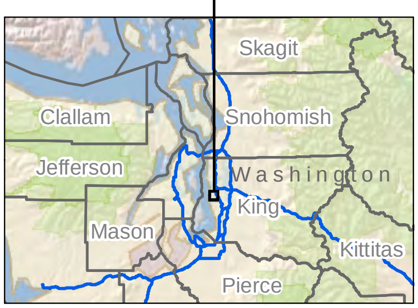

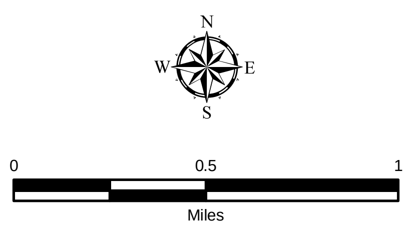

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
Data Sources: ESRI Data & Maps, Street Maps 2008. King County parcels 2008. Projection: NAD 1983, UTM Zone 10 N

Vicinity Map

Port of Seattle - North Terminal 115
Seattle, Washington

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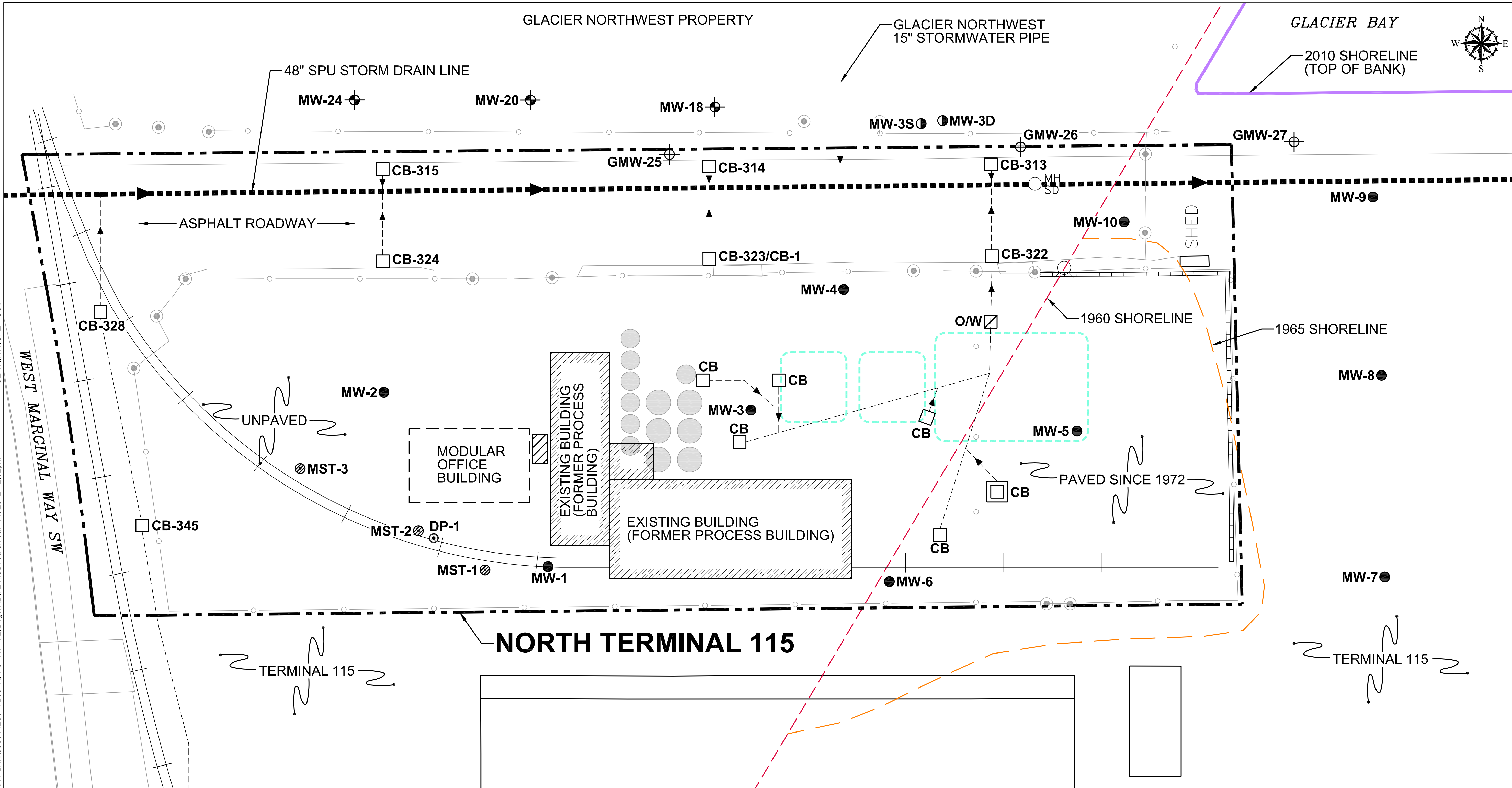
Figure 1

Office: SEA Path: \\Seal\projects\0\0303112\GIS\030311200_T200_RI-FS_WP_F1_VM.mxd Map Revised: 04/08/2011 SCY



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Reference: Base CAD drawing provided by Port of Seattle. Locations of historic features from SAIC 2007, Landau 2009, and historic aerial photos (1960 and 1965).

Legend

MW-1 ●	Monitoring well (Landau, 2009)
DP-1 ⊙	Direct push boring (Landau, 2009)
MW-18	Monitoring well (Shaw, 2003)
MW-3S ◑	Monitoring well (Retec, 1996)
MST-1	Estimated location of soil sample (SKCDPH, 1998)
GMW-25	Monitoring well on North Terminal 115 property boundary (Shaw, 2003)
	North Terminal 115 boundary
	48" SPU storm drain line
	2010 Shoreline (top of bank)
	Fence with gate
	Ecology block wall
	Railroad tracks
CB-314	Catch basin, stormwater pipe, and flow direction
O/W	Oil / water separator
CB	Large catch basin

Historical Feature

	1960 Shoreline
	1965 Shoreline
	Approximate location of former evaporation / settling ponds
	Approximate location of former underground fuel storage tank
	Former aboveground storage tank

50 0 50
FEET

Current and Historical Site Features

Port of Seattle - North Terminal 115
Seattle, Washington

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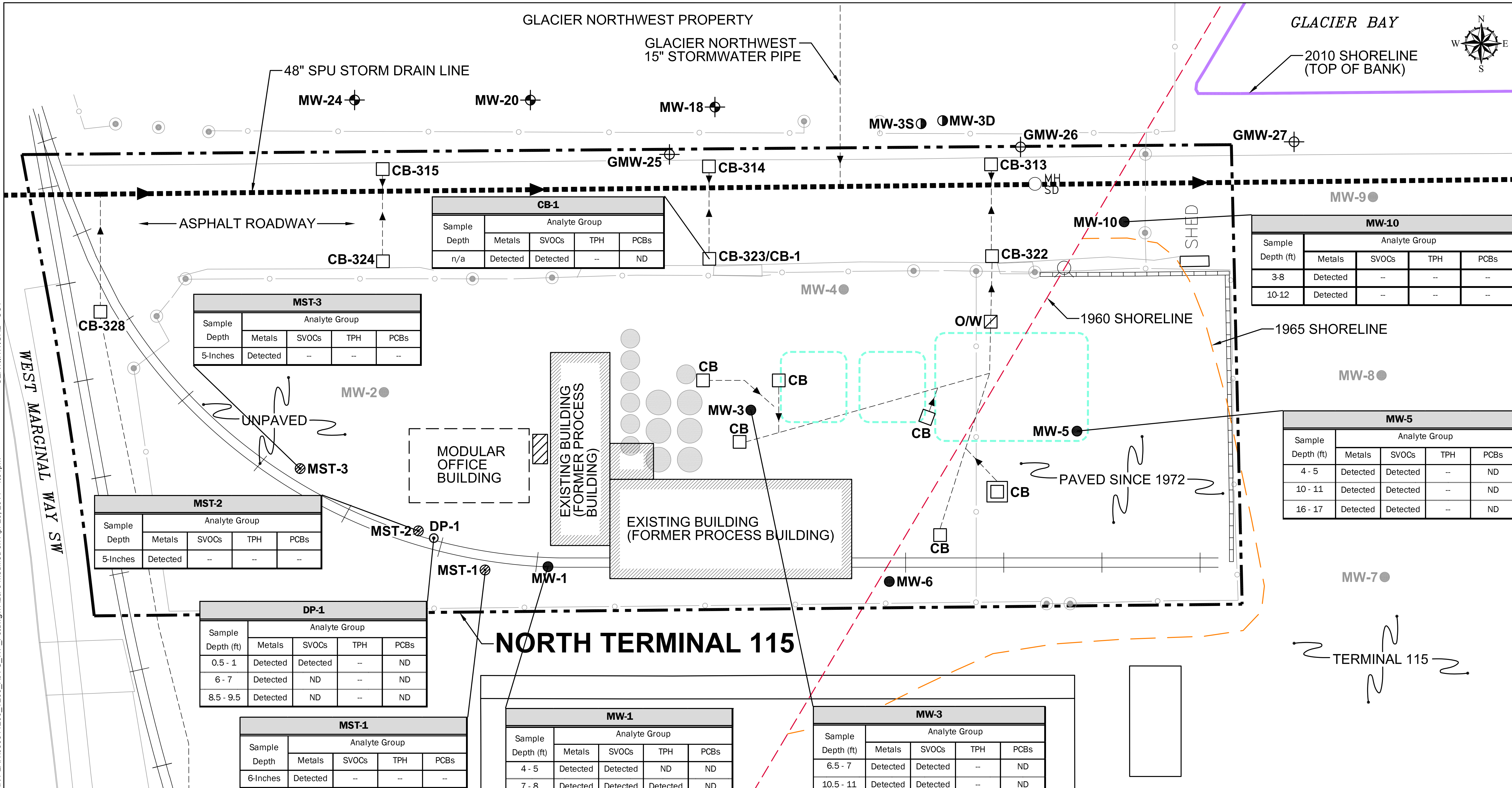
Figure 2



CB-1

Sample Depth	Analyte Group: Metals	SVOCs	TPH	PCBs
n/a	Detected	Detected	--	ND

MST-3

Sample Depth	Analyte Group: Metals	SVOCs	TPH	PCBs
5-Inches	Detected	--	--	--

MST-2

Sample Depth	Analyte Group: Metals	SVOCs	TPH	PCBs
5-Inches	Detected	--	--	--

DP-1

Sample Depth (ft)	Analyte Group: Metals	SVOCs	TPH	PCBs
0.5 - 1	Detected	Detected	--	ND
6 - 7	Detected	ND	--	ND
8.5 - 9.5	Detected	ND	--	ND

MST-1

Sample Depth	Analyte Group: Metals	SVOCs	TPH	PCBs
6-Inches	Detected	--	--	--

MW-1

Sample Depth (ft)	Analyte Group: Metals	SVOCs	TPH	PCBs
4 - 5	Detected	Detected	ND	ND
7 - 8	Detected	Detected	Detected	ND
11 - 12	Detected	ND	ND	ND

MW-3

Sample Depth (ft)	Analyte Group: Metals	SVOCs	TPH	PCBs
6.5 - 7	Detected	Detected	--	ND
10.5 - 11	Detected	Detected	--	ND
17 - 18	Detected	Detected	--	ND

MW-10

Sample Depth (ft)	Analyte Group: Metals	SVOCs	TPH	PCBs
3-8	Detected	--	--	--
10-12	Detected	--	--	--

MW-5

Sample Depth (ft)	Analyte Group: Metals	SVOCs	TPH	PCBs
4 - 5	Detected	Detected	--	ND
10 - 11	Detected	Detected	--	ND
16 - 17	Detected	Detected	--	ND

Notes

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Reference: Base CAD drawing provided by Port of Seattle. Locations of historic features from SAIC 2007, Landau 2009, and historic aerial photos (1960 and 1965).

Legend

- MW-1 ● Monitoring well (Landau, 2009)
- DP-1 ⊙ Direct push boring (Landau, 2009)
- MW-18 ⌖ Monitoring well (Shaw, 2003)
- MW-3S ◑ Monitoring well (Retec, 1996)
- MST-1 ⊘ Estimated location of soil sample (SKCDPH, 1998)
- GMW-25 ⌖ Monitoring well on North Terminal 115 property boundary (Shaw, 2003)
- MW-2 ● Soil sample not collected by Landau

See Figure 2 for additional legend explanations

See Table 1 for analytical results for each sample

SVOCs = Semivolatile Organic Compounds

TPH = Petroleum Hydrocarbons

"--" Not Tested

ND = Analyte not detected greater than the reported sample quantitation limit

PCBs = Polychlorinated Biphenyls

Soil and Stormwater Solids Sampling Locations and Analyses

Port of Seattle - North Terminal 115
Seattle, Washington

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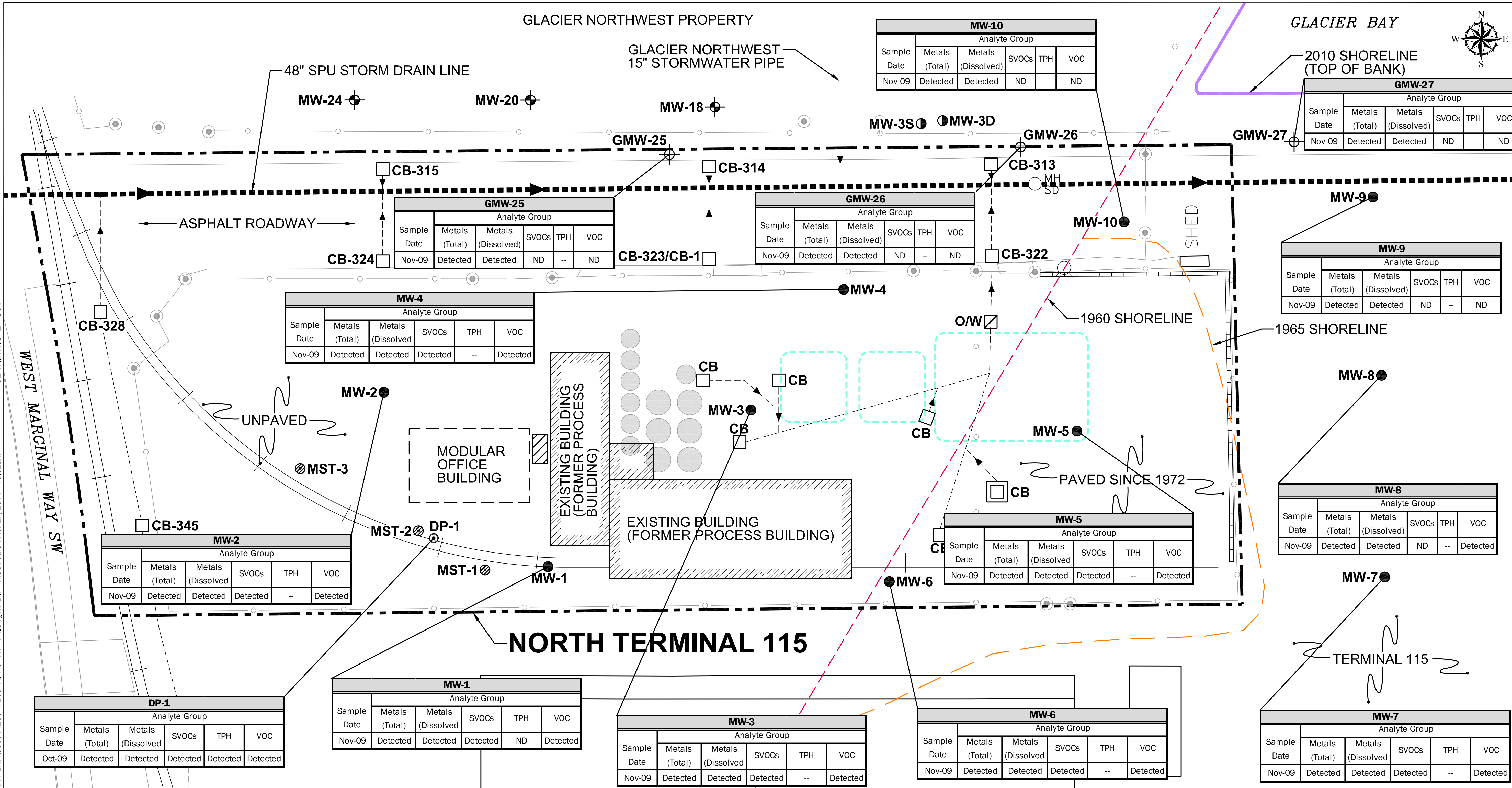
Figure 3



MW-10

Sample Date	Metals (Total)	Metals (Dissolved)	SVOCs	TPH	VOC
Nov-09	Detected	Detected	ND	--	ND

GMW-27

Sample Date	Metals (Total)	Metals (Dissolved)	SVOCs	TPH	VOC
Nov-09	Detected	Detected	ND	--	ND

GMW-25

Sample Date	Metals (Total)	Metals (Dissolved)	SVOCs	TPH	VOC
Nov-09	Detected	Detected	ND	--	ND

GMW-26

Sample Date	Metals (Total)	Metals (Dissolved)	SVOCs	TPH	VOC
Nov-09	Detected	Detected	ND	--	ND

MW-9

Sample Date	Metals (Total)	Metals (Dissolved)	SVOCs	TPH	VOC
Nov-09	Detected	Detected	ND	--	ND

MW-4

Sample Date	Metals (Total)	Metals (Dissolved	SVOCs	TPH	VOC
Nov-09	Detected	Detected	Detected	--	Detected

MW-2

Sample Date	Metals (Total)	Metals (Dissolved	SVOCs	TPH	VOC
Nov-09	Detected	Detected	Detected	--	Detected

MW-8

Sample Date	Metals (Total)	Metals (Dissolved)	SVOCs	TPH	VOC
Nov-09	Detected	Detected	ND	--	Detected

MW-5

Sample Date	Metals (Total)	Metals (Dissolved	SVOCs	TPH	VOC
Nov-09	Detected	Detected	Detected	--	Detected

DP-1

Sample Date	Metals (Total)	Metals (Dissolved	SVOCs	TPH	VOC
Oct-09	Detected	Detected	Detected	Detected	Detected

MW-1

Sample Date	Metals (Total)	Metals (Dissolved	SVOCs	TPH	VOC
Nov-09	Detected	Detected	Detected	ND	Detected

MW-3

Sample Date	Metals (Total)	Metals (Dissolved	SVOCs	TPH	VOC
Nov-09	Detected	Detected	Detected	--	Detected

MW-6

Sample Date	Metals (Total)	Metals (Dissolved	SVOCs	TPH	VOC
Nov-09	Detected	Detected	Detected	--	Detected

MW-7

Sample Date	Metals (Total)	Metals (Dissolved	SVOCs	TPH	VOC
Nov-09	Detected	Detected	Detected	--	Detected

Notes

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Reference: Base CAD drawing provided by Port of Seattle. Locations of historic features from SAIC 2007, Landau 2009, and historic aerial photos (1960 and 1965).

Legend

- MW-1 Monitoring well (Landau, 2009)
- DP-1 Direct push boring (Landau, 2009)
- MW-18 Monitoring well (Shaw, 2003)
- MW-3S Monitoring well (Retec, 1996)
- MST-1 Estimated location of soil sample (SKCDPH, 1998)
- GMW-25 Monitoring well on North Terminal 115 property boundary (Shaw, 2003)

See Figure 2 for additional legend explanations

See Table 1 for analytical results for each sample

SVOCs = Semivolatile Organic Compounds

TPH = Petroleum Hydrocarbons

VOC = Volatile Organic Compounds

"--" Not Tested

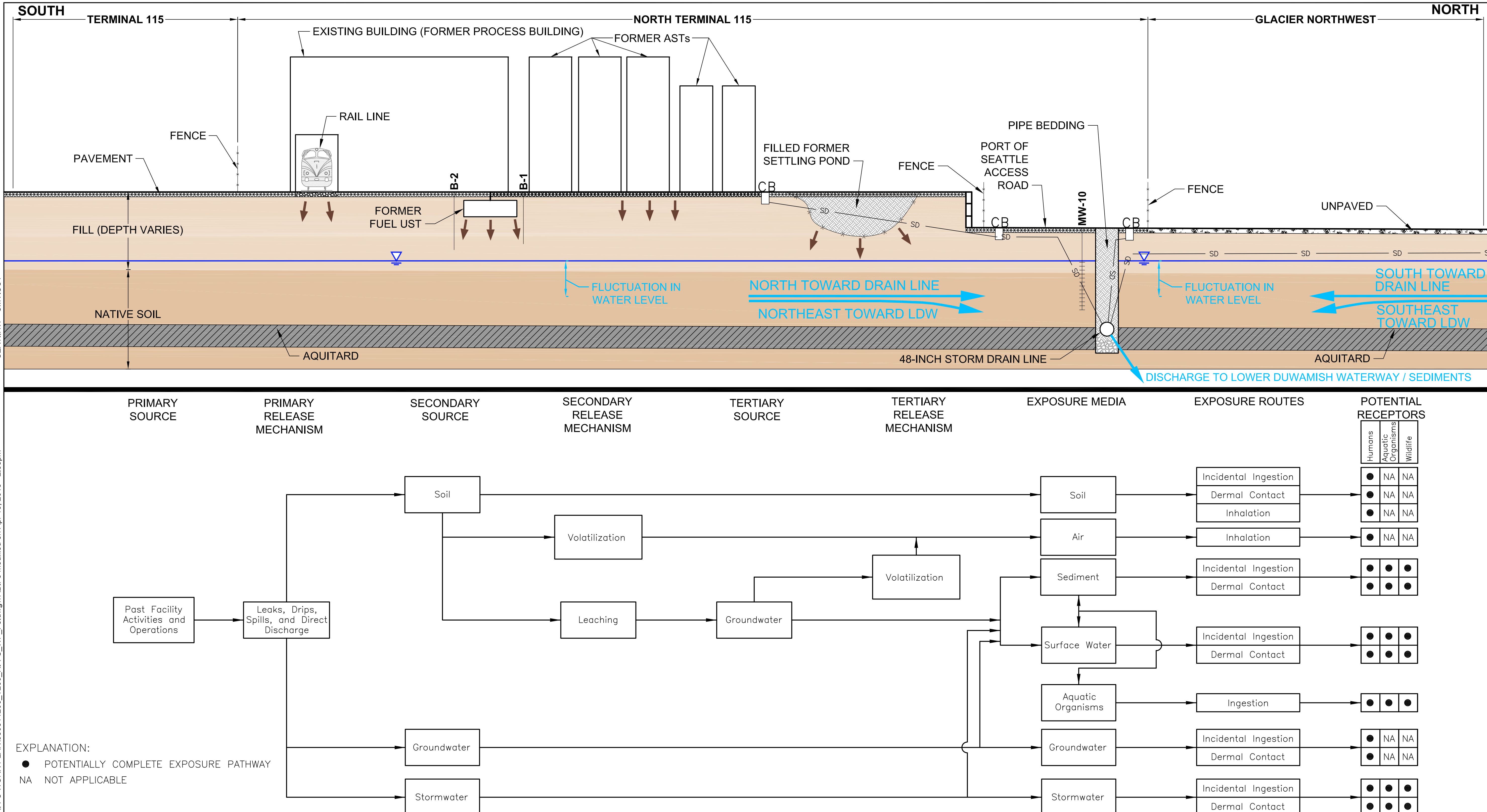
ND = Analyte not detected greater than the reported sample quantitation limit

Groundwater Sampling Locations and Analyses

Port of Seattle - North Terminal 115
Seattle, Washington

GEOENGINEERS

Figure 4



SEAT:IHW : CMV:SCY

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Notes

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Reference: Sketch provided by GeoEngineers staff, March 2011.

Legend

CB SD — Catch basin and Storm Drain Line

Groundwater level

Approximate groundwater flow direction

Potential release

Pavement

Unpaved

MW-10 — Number and approximate location of monitoring well

AST — Aboveground storage tank

UST — Underground storage tank

LDW — Lower Duwamish Waterway

Note: Conceptual Diagram - Not to Scale

Preliminary Conceptual Site Model

Port of Seattle - North Terminal 115
Seattle, Washington

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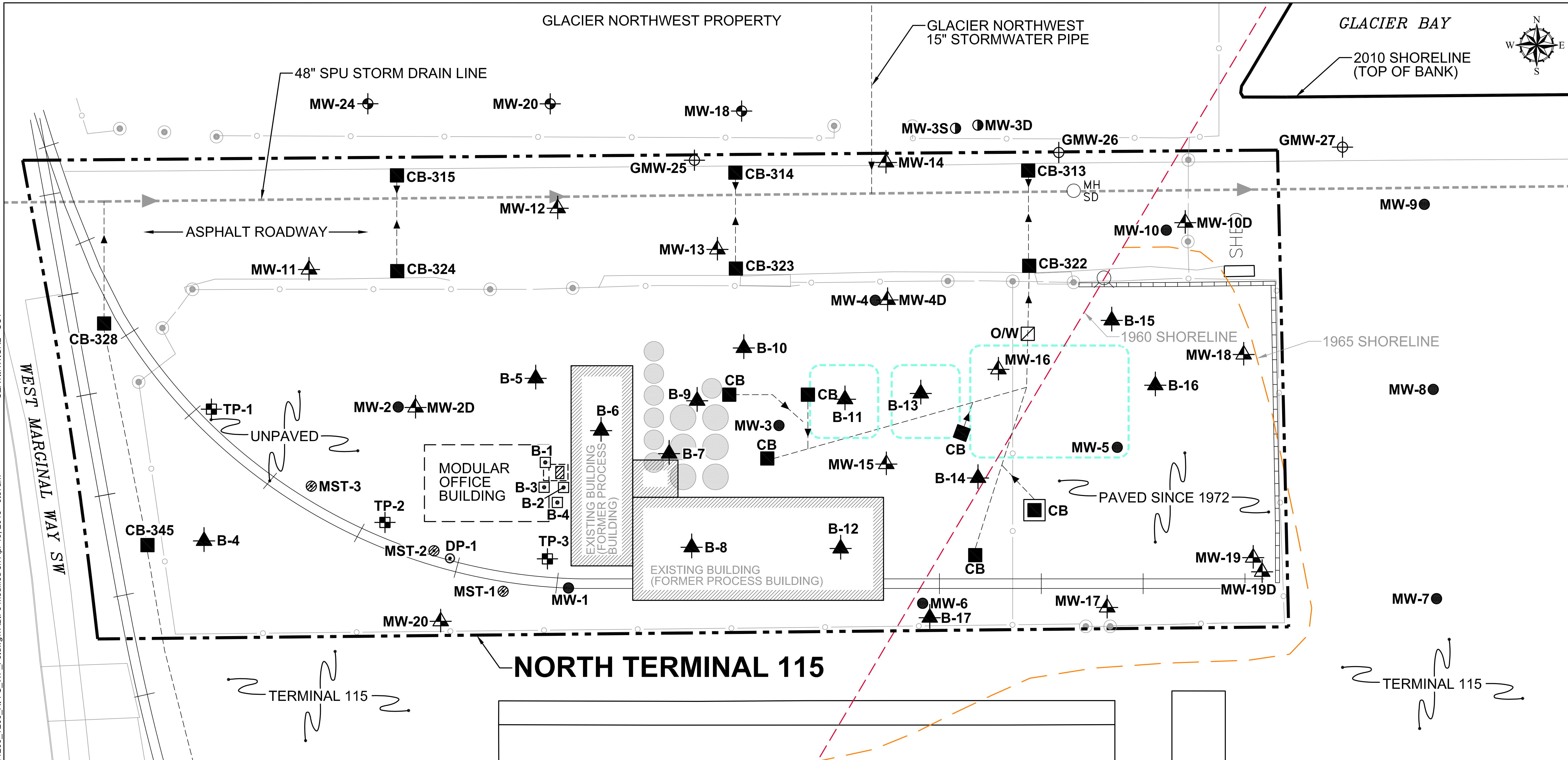
Figure 5



Legend

- B-5 — Proposed new boring
- MW-11 — Proposed new boring completed as monitoring well
- TP-1 — Proposed new test pit
- MW-1 — Monitoring well (Landau, 2009)
- GMW-25 — Monitoring well on North Terminal 115 property boundary (Shaw, 2003)
- DP-1 — Direct push boring (Landau, 2009)
- MW-18 — Monitoring well (Shaw, 2003)
- MW-3S — Monitoring well (Retec, 1996)
- MST-1 — Estimated location of soil sample (SKCDPH, 1998)
- B-1 — Soil boring (ENSR, 1992)
- CB-323 — Proposed catch basin to be sampled
- CB-314 — Catch basin, stormwater pipe, and flow direction
- O/W — Oil / water separator
- CB — Large catch basin
- North Terminal 115 boundary
- 48" SPU storm drain line
- 2010 Shoreline (top of bank)
- Fence with gate
- Ecology block wall
- Railroad tracks

Historical Feature

- 1960 Shoreline
- 1965 Shoreline
- Approximate location of former evaporation / settling ponds
- Approximate location of former underground heating oil storage tank
- Approximate location of excavation zone
- Former aboveground storage tank

50 0 50
FEET

Notes

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Base CAD drawing provided by Port of Seattle. Locations of historic features from SAIC 2007, Landau 2009, and historic aerial photos (1960 and 1965).

RI/FS Sample Locations

Port of Seattle - North Terminal 115
Seattle, Washington

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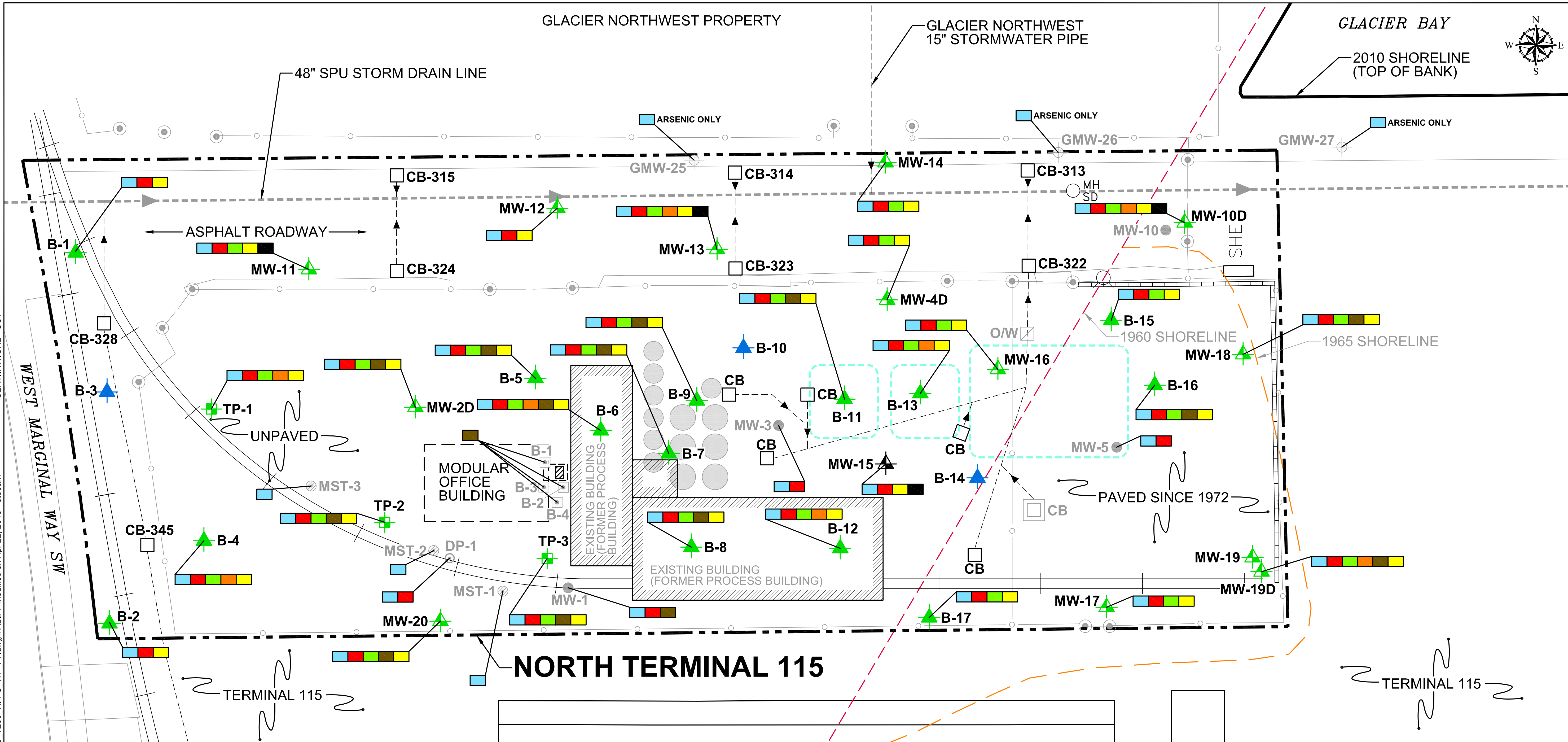
Figure 6



Notes

1. The locations of all features shown are approximate.
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Reference: Base CAD drawing provided by Port of Seattle. Locations of historic features from SAIC 2007, Landau 2009, and historic aerial photos (1960 and 1965).

Legend

- B-5 Proposed new boring to be sampled and analyzed
- MW-11 Proposed new monitoring well to be sampled and analyzed
- TP-1 Proposed new test pit to be sampled and analyzed
- B-3 Proposed new boring to be sampled and archived
- MW-1 Previous boring/monitoring well with soil sampling and analysis
- DP-1 Previous direct push boring with soil sampling and analysis
- MST-1 Previous soil sample with soil sampling and analysis
- GMW-25 Previous boring/monitoring well with soil sampling and analysis
- B-1 Previous soil boring with soil sampling and analysis
- CB-314 Catch basin, stormwater pipe, and flow direction
- O/W Oil / water separator
- CB Large catch basin
- North Terminal 115 boundary
- 48" SPU storm drain line
- 2010 Shoreline (top of bank)
- Fence with gate
- Ecology block wall
- Railroad tracks

Soil Analyses

PCBs, VOCs, TPH, PP Metals, barium, and tin, SVOCs, Dioxins/Furans, Soil pH

Note: Color indicates analysis to be performed at proposed sample location and analysis that was performed at previous sample location.

Historical Feature

- 1960 Shoreline
- 1965 Shoreline
- Approximate location of former evaporation / settling ponds
- Approximate location of former underground heating oil storage tank
- Approximate location of excavation zone
- Former aboveground storage tank

50 0 50
FEET

Soil Sample Locations

Port of Seattle - North Terminal 115
Seattle, Washington

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Figure 7

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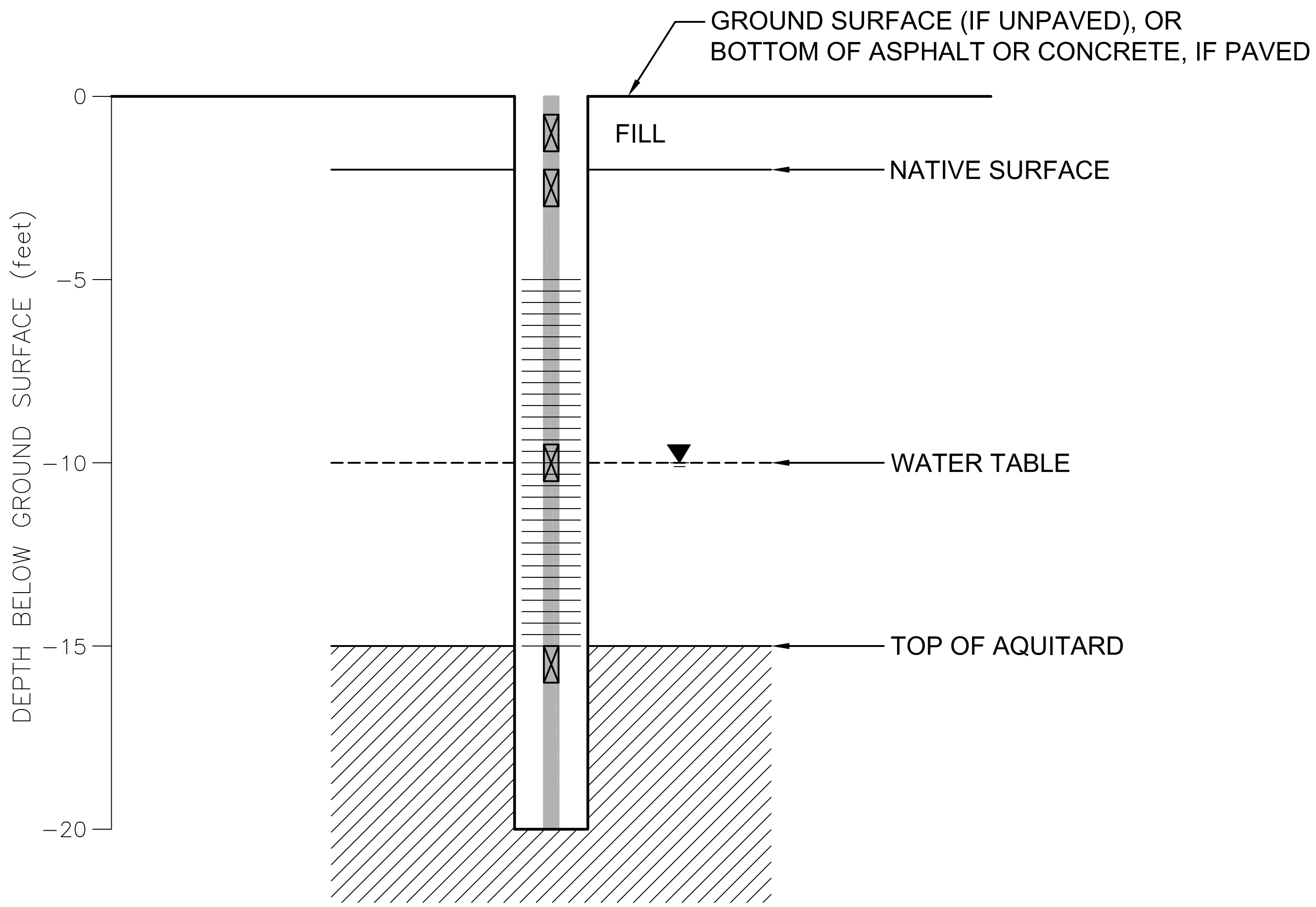
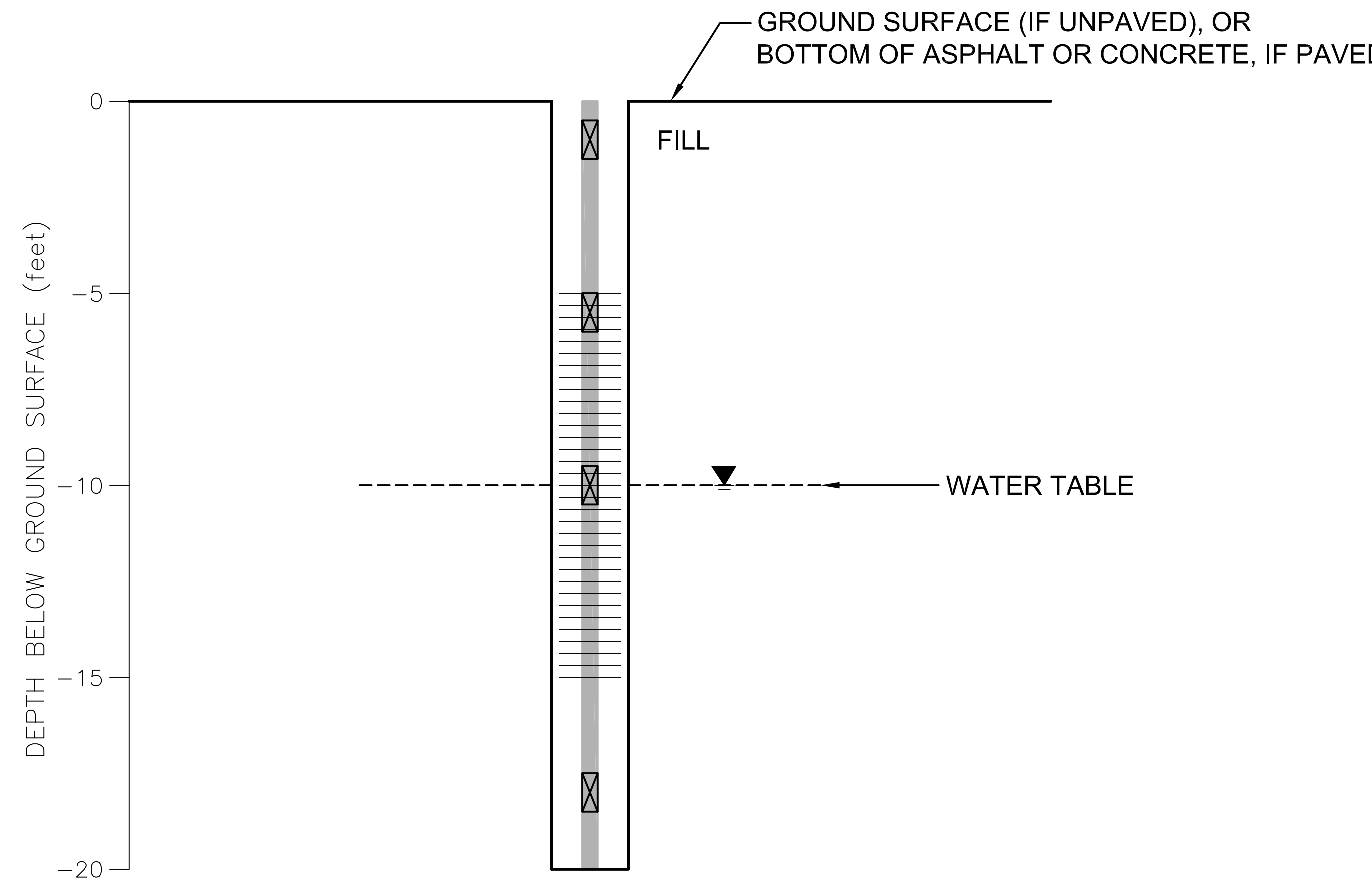
SEAT:IHW:GRL : SCY

"WESTERN" WELL INSTALLATION



"EASTERN" WELL INSTALLATION



LEGEND

- DEFAULT SAMPLE INTERVAL TO BE COLLECTED: UP TO 1-FOOT LONG SOIL SAMPLE INTERVAL (SHORTER IF THINNER LAYERS OBSERVED)
- SUPPLEMENTAL DISCRETE SAMPLES THAT MAY BE COLLECTED BASED ON FIELD SCREENING OR OBSERVED LITHOLOGY
- APPROXIMATE 10' WELL SCREEN SCREENED ACROSS THE WATER TABLE OBSERVED AT TIME OF DRILLING

HORIZONTAL SCALE: NO SCALE
VERTICAL SCALE: 1" = 5'

Note:
1. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Drawing created from sketch provided by GeoEngineers' personnel.

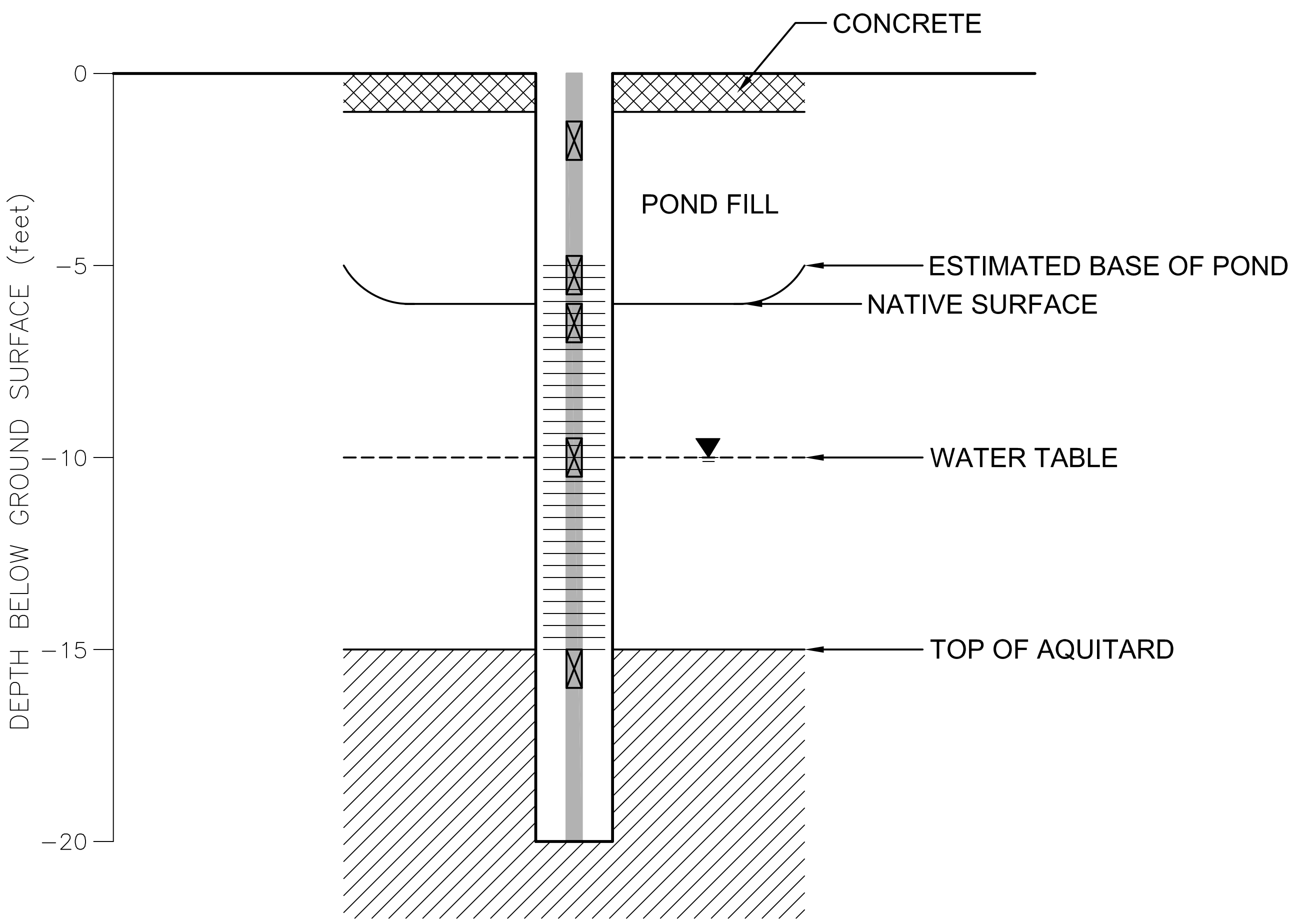
Typical Soil Sample Collection Schematic

Port of Seattle - North Terminal 115
Seattle, Washington

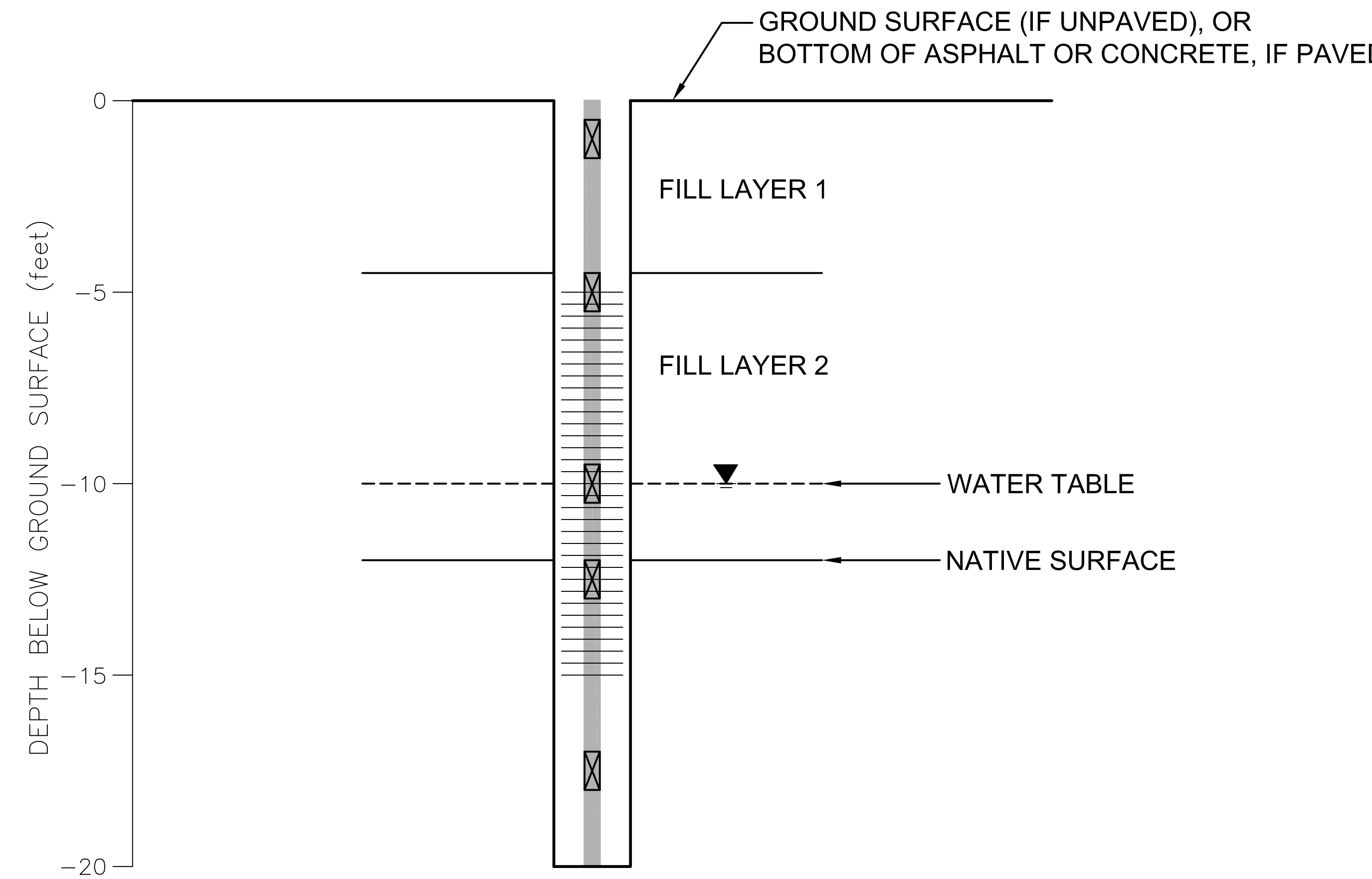
GEOENGINEERS

Figure 7A

"POND" WELL INSTALLATION



"THICK FILL" WELL INSTALLATION



LEGEND

DEFAULT SAMPLE INTERVAL TO BE COLLECTED: UP TO 1-FOOT LONG SOIL SAMPLE INTERVAL (SHORTER IF THINNER LAYERS OBSERVED)

SUPPLEMENTAL DISCRETE SAMPLES THAT MAY BE COLLECTED BASED ON FIELD SCREENING OR OBSERVED LITHOLOGY

APPROXIMATE 10' WELL SCREEN SCREENED ACROSS THE WATER TABLE OBSERVED AT TIME OF DRILLING

HORIZONTAL SCALE: NO SCALE
VERTICAL SCALE: 1" = 5'

Note:
1. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Drawing created from sketch provided by GeoEngineers' personnel.

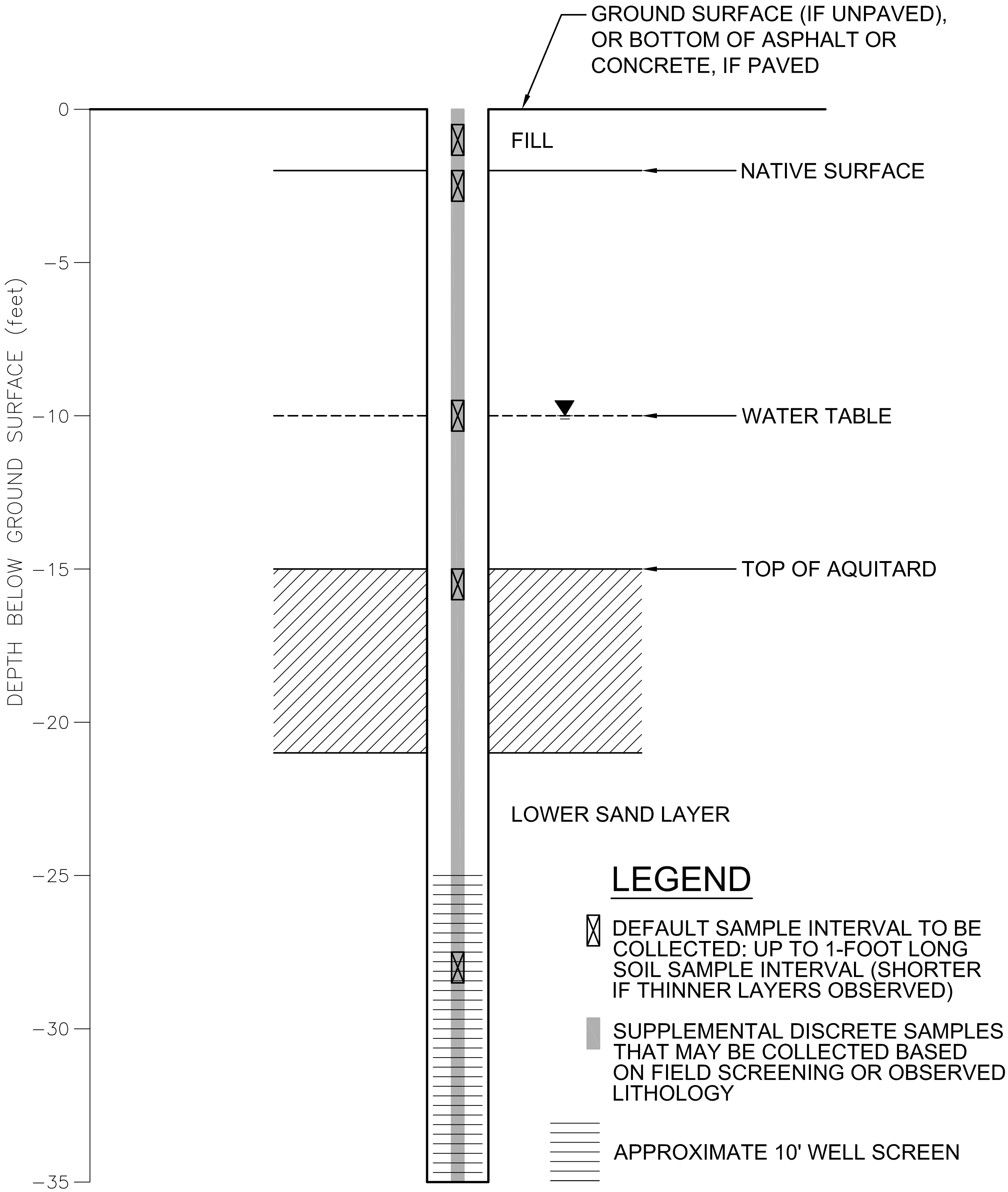
Typical Soil Sample Collection Schematic

Port of Seattle - North Terminal 115
Seattle, Washington

GEOENGINEERS

Figure 7B

"DEEP" WELL INSTALLATION



HORIZONTAL SCALE: NO SCALE
VERTICAL SCALE: 1" = 5'

Note:

1. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

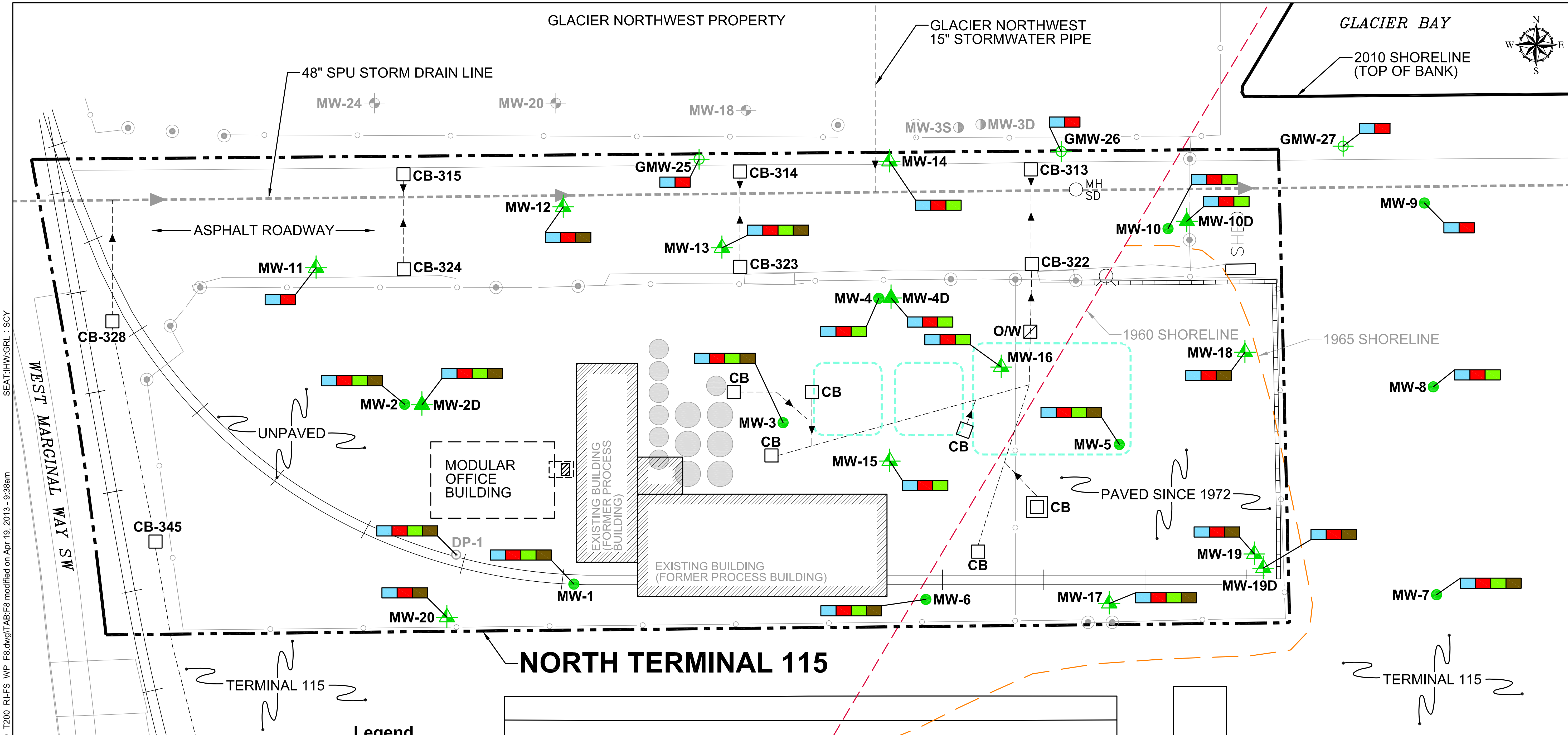
Reference: Drawing created from sketch provided by GeoEngineers' personnel.

Typical Soil Sample Collection Schematic

Port of Seattle - North Terminal 115
Seattle, Washington

GEOENGINEERS

Figure 7C



Legend

MW-11 Proposed new monitoring well to be sampled and analyzed
MW-2D Proposed new deep monitoring well to be sampled and analyzed
MW-1 Existing monitoring well to be sampled and analyzed
GMW-25 Existing monitoring well to be sampled and analyzed
DP-1 Previous direct push boring with groundwater sampling and analysis
MW-18 Monitoring well (Shaw, 2003)
MW-3S Monitoring well (Retec, 1996)

Groundwater Analyses

VOCs — TPH

PP Metals, barium, and tin — SVOCs

Note: Color indicates analysis to be performed at proposed sample location and analysis that was performed at previous sample location.

CB-314 Catch basin, stormwater pipe, and flow direction
O/W Oil / water separator
CB Large catch basin
North Terminal 115 boundary
48" SPU storm drain line
2010 Shoreline (top of bank)
Fence with gate
Ecology block wall
Railroad tracks

Historical Feature

1960 Shoreline
1965 Shoreline
Approximate location of former evaporation / settling ponds
Approximate location of former underground heating oil storage tank
Approximate location of excavation zone
Former aboveground storage tank

Notes

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Base CAD drawing provided by Port of Seattle. Locations of historic features from SAIC 2007, Landau 2009, and historic aerial photos (1960 and 1965).

50 0 50

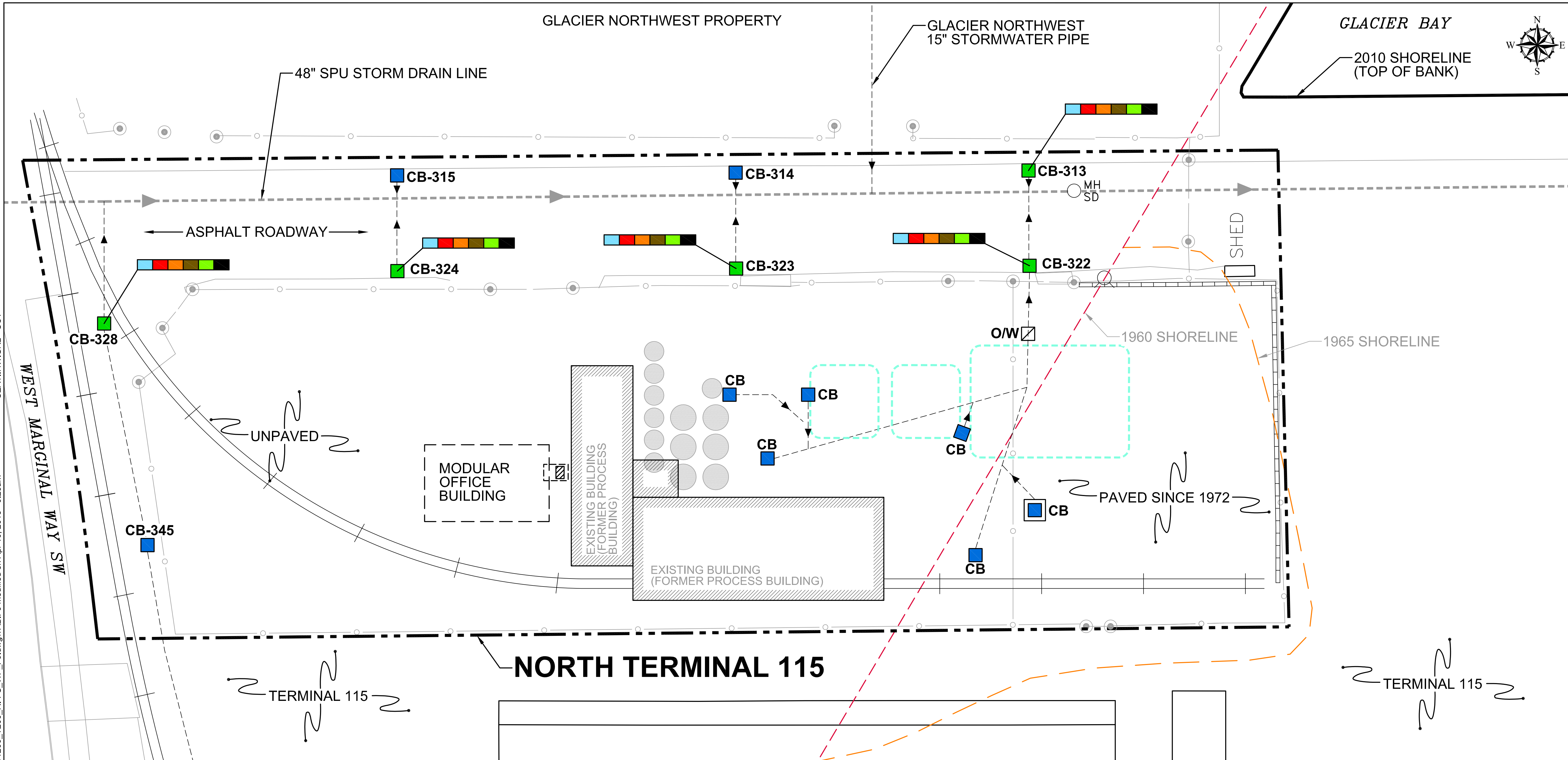
FEET

Groundwater Sample Locations

Port of Seattle - North Terminal 115
Seattle, Washington

GEOENGINEERS

Figure 8



Notes

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Base CAD drawing provided by Port of Seattle. Locations of historic features from SAIC 2007, Landau 2009, and historic aerial photos (1960 and 1965).

Legend

CB-323 Proposed catch basin solids to be sampled and analyzed

CB-315 Proposed catch basin solids to be sampled and archived for potential analysis

Analyses

PP Metals, barium, and tin — PCBs — SVOCs — TPH — VOCs — Dioxins/Furans

Note: Color indicates analysis to be performed at proposed sample location.

CB-314 Catch basin, stormwater pipe, and flow direction

O/W Oil / water separator

CB Large catch basin

North Terminal 115 boundary

48" SPU storm drain line

2010 Shoreline (top of bank)

Fence with gate

Ecology block wall

Railroad tracks

Historical Feature

1960 Shoreline

1965 Shoreline

Approximate location of former evaporation / settling ponds

Approximate location of former underground heating oil storage tank

Approximate location of excavation zone

Former aboveground storage tank

50 0 50
FEET

Stormwater Catch Basin Solids Sample Locations

Port of Seattle - North Terminal 115
Seattle, Washington

GEOENGINEERS

Figure 9

D:\PROJECT\SEATTLE\0303112\00\CAD\RI FS WORK PLAN\0303112-00_T200_RI-FS_WP_F9.dwg\TAB:F9 modified on Apr 10, 2013 - 9:25am

SEAT:IHW:GRL : SCY

APPENDIX A
Environmental Conditions Report and Associated Historical Aerial Photographs (SoundEarth 2011)

SoundEarth Strategies, Inc.
2811 Fairview Avenue East, Suite 2000
Seattle, Washington 98102

TERMINAL 115 ENVIRONMENTAL CONDITIONS REPORT

Property:
Port of Seattle Terminal 115
6000 to 6700 West Marginal Way Southwest
Seattle, Washington

Prepared for:
Port of Seattle
2711 Alaskan Way
Seattle, Washington

Date:
April 6, 2011

Port of Seattle

Prepared for:

Port of Seattle
2711 Alaskan Way
Seattle, Washington 98121

Terminal 115 Environmental Conditions Report
Port of Seattle Terminal 115
6000 to 6700 West Marginal Way Southwest
Seattle, Washington 98106

SoundEarth Project No.: 0675-002-01

Prepared by:

Ryan M. Thompson
Project Scientist

Chris Carter
Senior Scientist

Reviewed by:

John Funderburk, MSPH
Principal

April 6, 2011

SoundEarth Strategies

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FIGURES

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APPENDICES

EXECUTIVE SUMMARY

SoundEarth Strategies, Inc. was commissioned by the Port of Seattle to complete an Environmental Conditions Report of Terminal 115 listed as 6000 to 6700 West Marginal Way Southwest in Seattle, Washington. The primary objective of this Environmental Conditions Report is to perform an independent review and evaluation of current and historical spills and releases, land development activities, and operations on and immediately adjacent to Terminal 115 to identify, to the extent feasible, issues of environmental concern that may have included the use, manufacture, storage, and/or disposal of hazardous or toxic substances that could affect the environmental quality of soil, groundwater, surface water, or sediment at and adjoining Terminal 115. Additionally, the report evaluates the pathways that may allow for the migration of the identified potential and confirmed releases of hazardous or toxic substances to the Lower Duwamish Waterway.

Terminal 115 is located on the western shore of the Lower Duwamish Waterway between river mile 1.6 and river mile 2.1 and has an extensive history of industrial and commercial use that began in 1909. During the course of several investigations conducted along the Lower Duwamish Waterway, Terminal 115 was identified by the Washington State Department of Ecology as a site of potential interest for source control. Terminal 115 North, which is located within the Terminal 115 property boundaries, is currently managed under an Agreed Order between the Port of Seattle and the Washington State Department of Ecology.

Site operations have included dredging and filling, Boeing Plant 1 operations, retail gasoline service stations, vehicle maintenance and salvage, gravel and concrete/cement production, and tin reclamation. Terminal 115 is currently occupied by a number of seafood facilities, cargo storage and transfer operations, vehicle maintenance facilities, and a commercial fleet vehicle refueling station. Upgrades and improvements to infrastructure at Terminal 115 have occurred with each change of operation, and several subsurface investigations and sediment sampling events have been conducted at the property to evaluate the potential for environmental impacts as a result of past and current operations.

This report documents readily available information relevant to potential issues of environmental concern at Terminal 115. This information will be considered in the formulation and implementation of an effective, long-term source control strategy to control potential sources of contaminants to the Lower Duwamish Waterway associated with the Terminal 115 property. Not all of the potential issues of environmental concern translate to a direct or indirect contamination pathway for the waterway. In some cases, an evaluation of contamination pathways impacting the portions of the Lower Duwamish Waterway along Terminal 115 cannot be completed until data gaps associated with potential pathways resulting from current and former operations at Terminal 115 have been assessed and characterized. Source control action items may be identified by the Washington State Department of Ecology to address the data gaps associated with the potential pathways in order to assess the potential for sediment recontamination.

ACRONYMS AND ABBREVIATIONS

μg/L	micrograms per liter
1942 Boeing site plan	a drawing by Boeing titled “Boeing Aircraft Co. - Plant No. 1, Seattle, Wash.” and dated June 2, 1942
1952 Boeing site plan	a drawing by Boeing titled “Plant 1, General Layout Showing Air Distribution System” and dated December 10, 1952
1957 Boeing site plan	a drawing by Leo A. Daly & Associates titled “Sewer Layout: Sewer Facilities Plant I Modernization, Seattle, Washington, Boeing Airplane Company” and dated April 26, 1957
1963 Boeing site plan	a drawing by Boeing titled “Plot Plan: Former Plant I, Terminal 115” and dated 1963
AO	Agreed Order
AST	aboveground storage tank
Baist’s Atlases	Baist’s Real Estate Atlases
bgs	below ground surface
Boeing	The Boeing Company; formerly the Boeing Airplane Company
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CKD	cement kiln dust
cm	centimeter; centimeters
COC	chemical of concern
Columbia	Columbia Environmental Inc.
Crowley	Crowley Marine Services
CSL	Washington State Sediment Cleanup Screening Levels
CSO	combined sewer overflow
CUL	cleanup level
CVOC	chlorinated volatile organic compounds
cy	cubic yards

Data Gaps Report	Summary of Existing Information and Identification of Data Gaps Report
DMMP	Dredged Material Management Program
DRPH	diesel-range petroleum hydrocarbons
Ecology	Washington State Department of Ecology
ECR	Environmental Conditions Report
ENSR	ENSR Consulting and Engineering
EPA	U.S. Environmental Protection Agency
FS	feasibility study
ft/ft	feet per foot
GSM	GeoScience Management, Inc.
Glacier NW	Glacier Northwest, Inc.; formerly Lone Star Northwest, Inc.
GPMS	General Permit for Municipal Stormwater
GRPH	gasoline-range petroleum hydrocarbons
HLA	Harding Lawson Associates
HPAH	high molecular weight polycyclic aromatic hydrocarbon
Icicle	Icicle Seafoods, Inc.
IEC	Issue of Environmental Concern
ISWGP	Industrial Stormwater General Permit
Klinker	Klinker Sand & Gravel Company
Landau	Landau Associates, Inc.
LDW	Lower Duwamish Waterway
MCWPC	Mineralized Cell Wood Preserving Company
MG	million gallons
mg/kg	milligrams per kilogram

MRI	MRI Corporation
MSL	mean sea level
MTCA	Washington State Model Toxics Control Act
N/A	not applicable
Northland	Northland Services, Inc.
NPDES	National Pollutant Discharge Elimination System
ORPH	oil-range petroleum hydrocarbons
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCP	pentachlorophenol
PCS	petroleum-contaminated soil
Phoinix	Phoinix Corporation
POS	Port of Seattle
ppm	parts per million
Proler	Proler International
RCRA	Resource Conservation and Recovery Act
Reichhold	Reichhold, Inc.; formerly Reichhold Chemicals, Inc.
RI	remedial investigation
RM	river mile
ROW	right-of-way
Sanborn Map	Sanborn Fire Insurance Map
SCAP	Source Control Action Plans
Schnitzer	Schnitzer Steel Industries, Inc.
SD	storm drain

Seafreeze	Seafreeze Acquisition, LLC
sf	square feet
SHA	Site Hazard Assessment
Shaw	Shaw Environmental & Infrastructure, Inc.
SKCDPH	Seattle-King County Department of Public Health
SoundEarth	SoundEarth Strategies, Inc.
SPH	separate-phase hydrocarbons
SQS	Sediment Quality Standards
TCLP	Toxicity Characteristic Leaching Procedure
Terminal 115	Port of Seattle Terminal 115 property located at 6000 to 6700 West Marginal Way Southwest in Seattle, Washington
TFH	total fuel hydrocarbons
TPH	total petroleum hydrocarbons
TSCA	Toxic Substances Control Act
USACE	U.S. Army Corps of Engineers
UST	underground storage tank
VOC	volatile organic compounds

1.0 INTRODUCTION

SoundEarth Strategies, Inc. (SoundEarth) was commissioned by the Port of Seattle (POS) to complete an Environmental Conditions Report (ECR) of Terminal 115 listed as 6000 through 6700 West Marginal Way Southwest in Seattle, Washington (Terminal 115; Figure 1). The primary objective of this ECR is to perform an independent review and evaluation of current and historical spills and releases, land development activities, and operations on and around Terminal 115 to identify, to the extent feasible, Issues of Environmental Concern (IECs) that may have included the use, manufacture, storage, and/or disposal of hazardous or toxic substances that could affect the environmental quality of soil, groundwater, surface water, or sediment at and adjoining Terminal 115. Additionally, the ECR evaluates the pathways that may allow for the migration of the identified potential and confirmed releases of hazardous or toxic substances to the Lower Duwamish Waterway (LDW).

1.1 PURPOSE OF STUDY

Terminal 115 is located along the LDW, an approximately 5-mile stretch of the Duwamish River (river mile (RM) 0 to RM 4.9) that was added to the U.S. Environmental Protection Agency's (EPA's) Superfund list in 2001. In December 2000, the EPA and the Washington State Department of Ecology (Ecology) entered into an Agreed Order (AO) with King County, the POS, the City of Seattle, and The Boeing Company (Boeing). The purpose of the order is to perform a Remedial Investigation and Feasibility Study (RI/FS) of the waterway sediment contamination to assess potential risks to human health and the environment and evaluate cleanup alternatives. Ecology published the LDW Source Control Strategy in January 2004 to outline the major source control program elements for the LDW site (Ecology 2004). Preventing recontamination of sediments to levels that exceed the Washington State Sediment Management Standards (according to Chapter 173-204 of the Washington Administrative Code) and the LDW sediment cleanup goals is the primary focus of Ecology's source control strategy. The LDW source control program, under Ecology's lead, is designed to identify and manage sources of contamination to LDW sediments in coordination with sediment remediation activities. This program provides the framework for identifying source control issues and implementing effective remedial controls, potentially including various levels of source removal as remedial action. To support this program effort, Ecology is preparing a Summary of Existing Information and Identification of Data Gaps Report (Data Gaps Report) and Source Control Action Plans (SCAP) to establish current environmental conditions and evaluate historical and ongoing sources of contamination at identified sites along the LDW. Ecology will be producing an independent Lower Duwamish Waterway RM 1.6 to 2.1 West (Terminal 115) Data Gaps Report and SCAP, which includes Terminal 115 and all upland basin areas that may be impact contributors to the LDW.

Terminal 115 is located along the western shore of the LDW between RM 1.55 and RM 2.1, as shown on Figure 1, and has an extensive history of industrial and commercial use that began in 1909. During the course of several investigations along the LDW, Terminal 115 was identified by Ecology as a site of potential interest for source control. Terminal 115 North, which is located within the Terminal 115 property boundaries, is currently managed under an AO between the POS and Ecology. The Terminal 115 property is included in Ecology's Source Control Area RM 1.6 to RM 2.1 (Ecology 2008). Source control strategies specific to the Terminal 115 North site are being developed as part of an RI/FS currently in progress by the POS, under Ecology guidance.

This ECR is part of the comprehensive source control effort for Terminal 115 that the POS is using to establish the basis for developing, implementing, and managing future source control activities for Terminal 115. This document supports the Ecology-generated documents on the larger Source Control Area RM 1.6 to RM 2.1.

1.2 METHODOLOGY/SCOPE OF WORK

This ECR was conducted in accordance with *Scope of Work - RFQ 090053 TERMINAL 115 Baseline Environmental Conditions (and Data Gaps) Report, Port of Seattle Terminal 115*, prepared by SoundEarth and dated September 27, 2010.

The scope of work for this ECR included the following tasks:

- A review of various sources of historical information at governmental agencies, such as the Puget Sound Regional Archives, the King County Assessor's Office, the National Archives Seattle Regional Facility, the City of Seattle Department of Planning and Development, the City of Seattle Engineering Vault, the City of Seattle Municipal Photography Archives, and the Seattle Public Library.
- A review of various sources of historical information at non-profit agencies, such as the Seattle Museum of History and Industry, the Museum of Flight, and HistoryLink.org.
- A review of historical documents, such as Sanborn Fire Insurance Maps (Sanborn Maps), Kroll Maps, Baist's Real Estate Atlases (Baist's Atlases), reverse city directories published by Polk and Cole Co., aerial photographs dating from 1922, historical topographic maps, and historical newspaper articles published by *The Seattle Times* dating from 1921.
- A review of current federal databases including EPA Comprehensive Environmental Response, Compensation, and Liability Information System database; the EPA National Priority List; the EPA Resource Conservation and Recovery Act (RCRA) Notifiers; RCRA Corrective Action Report; Facility Index System; and the Emergency Response Notification System.
- A review of current state databases including the underground storage tank (UST), the leaking UST, and the confirmed and suspected contaminated sites databases.
- A reconnaissance of Terminal 115 and surrounding area to search for visual and/or olfactory evidence of contamination, such as stained soil, unusual odors, distressed vegetation, pipes, drums, oil sheens and/or discolored water, and improper manufacturing or waste disposal practices.
- A reconnaissance of Terminal 115 structures, facilities, equipment, utility services, and operations.
- The preparation of this report.

2.0 SITE DESCRIPTION

The following is a summary of the current configuration and historical land use at Terminal 115, including the location and legal description of the property, a discussion of property topography and shoreline characteristics, a discussion of property and regional geology and hydrogeology, and a discussion of current property use including identification of current structures (both aboveground and subgrade) located at Terminal 115.

2.1 LOCATION AND LEGAL DESCRIPTION

Terminal 115 (which includes Terminal 115 North) is located in the northeast quadrant of Section 30, Township 24 North, Range 4 East in King County, Washington. The street address is 6000 through 6720 West Marginal Way Southwest and 150 through 206 Southwest Michigan Street in Seattle, Washington (Figure 1). Terminal 115 is bounded to the east by the LDW, to the west by West Marginal Way Southwest, and to the north by the Glacier NW property. Terminal 115 is bounded to the south by Southwest Michigan Street, although the office complex located at 200 Southwest Michigan Street (the former Foss Environmental site) is not included within the property boundaries. A vacant lot used for container storage located across Southwest Michigan Street and east of Second Avenue Southwest at 6000 West Marginal Way Southwest is included within the boundaries of Terminal 115.

Terminal 115 consists of two parcels (King County Parcel Nos. 536720-2503 and 536720-2505) covering a total of approximately 99.46 acres (0.155 square mile) of land, located approximately 2 miles south of downtown Seattle, Washington, as shown on Figure 2. Figure 3 depicts the stormwater and sewer infrastructure beneath Terminal 115.

The following is a legal description of Terminal 115.

King County Parcel No. 5367202503: MCLAUGHLINS WATER FRONT ADD PARCEL "F" SEATTLE LOT BOUNDARY ADJUSTMENT NO 2207807 REC NO 20030211900004 WCH IS POR OF JOSEPH R MCLAUGHLINS WATERFRONT ADDITION TO THE CITY OF SEATTLE PLAT IN NE 1/4 STR 30-24-04

King County Parcel No. 5367202505: MCLAUGHLINS WATER FRONT ADD PARCEL "A" SEATTLE LOT BOUNDARY ADJUSTMENT NO 2207807 REC NO 20030211900004 WCH IS POR OF JOSEPH R MCLAUGHLINS WATERFRONT ADDITION TO THE CITY OF SEATTLE PLAT IN NE 1/4 LESS POR CONV TO WASH STATE D.O.T. AS DESC IN Q.C.D. UNDER REC NO 20051129002556 (DESCRIBED AS 'TRACT 1' AND 'TRACT 2') AND LESS POR CONV TO CITY OF SEATTLE AS DESC IN Q.C.D. UNDER REC NO 20051129002557 AND LESS POR CONV TO CITY OF SEATTLE AS DESC IN Q.C.D. UNDER REC NOS 20051129002558 AND 20051129002559 LESS PORS CONV TO STATE OF WASHINGTON AS DESC IN Q.C.D. UNDER REC NO 20051129002573

2.2 TOPOGRAPHY AND SHORELINE CHARACTERISTICS

Terminal 115 has approximately 2,790 feet of shoreline bordering the west side of the LDW between RM 1.5 and RM 2.1. The shoreline includes approximately 1,260 linear feet of concrete and improved riprap bulkhead shoring and 1,510 linear feet of improved riprap, exposed soil, and vegetated slopes. The southern portions of the shoreline also include some dilapidated wood structures adjacent to the former Commercial Fence Corporation that were not investigated for purposes of this investigation because of safety and access limitations. Those portions of Terminal 115 located along the shoreline were constructed either from engineered fill material or former alluvial land that was excavated to create the LDW. The Terminal 115 shoreline is therefore considered an engineered artificial feature.

The Terminal 115 property is topographically flat, with most of the elevation changes occurring within 20 feet of the LDW and in areas abutting West Marginal Way Southwest (Figure 1). A large vegetated greenzone hillside is situated to the west of Terminal 115 with steep grades leading down (east) to the West Marginal Way Southwest right-of-way (ROW). The entirety of the site, not including shoreline areas abutting the LDW, is between 10 and 26 feet above mean sea level (MSL). Most of the terminal facilities reside at elevations of 18 to 25 feet above MSL, as shown on Figure 1. A small unfilled and ungraded section of the southeastern corner of the Terminal 115 site that grades downward to the shoreline of the LSW is situated 10 to 20 feet above MSL. Terminal 115 North contains a terrace that was historically the location of settling basins for former detinning operations, which resulted in a small topographical feature ranging from 26 to 18 feet above MSL.

2.3 GEOLOGY AND HYDROGEOLOGY

The Terminal 115 landscape has an extensive history of erosion and deposition, from glaciofluvial sources to modern stream flow processes, culminating in extensive human modification by placement of fill in the historical Duwamish River channel (Troost and Booth 2008). The following sections provide a summary of the geomorphology and surficial geology, hydrology, and hydrogeology of Terminal 115.

2.3.1 Geology

During the Pleistocene Epoch, the Puget Lobe of the Cordilleran Ice Sheet advanced into the Seattle area. The glacial event, known as the Vashon Stade, resulted in the creation of the Duwamish Trough (Troost and Booth 2008). This significant erosional feature was formed by glacial ice scour from the advancing ice sheet and glaciofluvial processes during melting (Dragovich et al. 1994). The Duwamish Trough subsequently became the outlet for melt waters originating from the western Cascade Range and formed the Duwamish River (Troost and Booth 2008).

Historically, the area of Terminal 115 received alluvial and floodplain deposits of silt, clay, and sand, which are typical deposits from a large river system. The thickness and extent of the materials deposited on the area of Terminal 115 varied as the river meandered.

The majority of the filling activities occurred on the property in the 1950s through 1971. Beginning in November 1969 a program was instituted to reclaim and expand Terminal 115 through extensive filling, dredging, and excavation of the portion of the LDW and Turning Basin No. 1 flowing through the property and nearby river banks (Lane 1971, POS 1972a and 1972b). Figures 4B and 4C and the photographs in Appendix A illustrate progression of the reclamation process, filling the former Turning Basin No. 1 waterway and creating usable land for the expansion of Terminal 115. Based on comparisons between the current elevations of the Terminal 115 apron and the historical soundings of the LDW on the eastern portion of the property mapped in 1956, this reclaimed area contains upwards of approximately 20 feet of fill above the pre-1969 riverbed. Areas including and immediately adjacent to the former Foss Island (Figure 4B) consist of approximately 10 to 20 feet of fill above alluvium. The southern area of Terminal 115 generally has 10 feet or less of fill (Columbia 1997; GSM 1998). Terminal 115 North consists of approximately 0 to 25 feet of fill, with the fill-native interface increasing in depth from the west to east. According to Troost and Booth (2008), fill used to reclaim the historical Duwamish River channel generally consisted of gravel, sand, silt, concrete, bricks, coal, wood, garbage, and other miscellaneous materials. The operational fill history of Terminal 115 is discussed in Section 3.9.

A limited amount of site-specific soil boring data is available for Terminal 115. Soil boring logs from near-surface soil sampling and shallow groundwater monitoring well installations were reviewed to generally identify fill areas and thickness. The reviewed soil boring logs varied in the quality and clarity of lithologic descriptions. However, the following general observations could be gleaned from the available data and are referenced to areas on Terminal 115 (Figure 4):

- Former Boeing Plant 1: up to 10 feet of fill above alluvium (EMCON 1995).
- Schultz Distributing, Inc. (Cardlock Facility): fill to at least 15 feet (Columbia 1997).
- Buildings C1 and C2: fill to at least 15 feet (HLA 1990).
- Terminal 115 North: fill to at least 15 feet in the eastern area to approximately 1 to 5 feet in the western area (Landau 2009).

2.3.2 Hydrogeology

Terminal 115 is located on the west bank of the present day LDW (Figure 1). The Duwamish River was formed in the Pleistocene Epoch and is a meandering river with headwaters originating in the western Cascade Range (Troost and Booth 2008). According to Kroll Maps, Baist's Atlases, and Sanborn Maps, the Duwamish River was channelized in the early 1900s to provide a navigable waterway for commercial maritime traffic. Based on a review of U.S. Army Corps of Engineers (USACE) documents, historical photographs, Sanborn Maps, and Kroll Maps, the majority of the channelization took place between 1914 and the 1920s. Prior to channelization, the Duwamish River flowed in a series of meanders. As previously described, prior to commercial development of the Duwamish River, Turning Basin No. 1 (remnants of an oxbow meander) was located in the central portion of Terminal 115 (Figures 4B and 4C).

Significant data concerning shallow groundwater flow gradient(s) and direction(s) have not been collected for the eastern area of Terminal 115, specifically along the property's boundary with the LDW. Limited data have been collected in the area of Building W-2 in association with a leaking UST, which indicated groundwater flowed to the east (Environmental Science & Engineering, Inc. 1994). Because of this, complete data concerning the local groundwater flow direction and gradient, as well as surface water to groundwater interactions, are not available. However, limited groundwater data are available for other areas of Terminal 115. According to GeoScience Management, Inc. (GSM 1995a), in April 1995 groundwater levels measured in shallow monitoring wells near the southwestern corner of Terminal 115 (Figure 6B) indicated a southwesterly groundwater flow direction (away from the LDW) with a gradient of 0.03 feet per foot (ft/ft). These wells were located approximately 1,500 feet west of the Duwamish River (Figure 6). In 1995 groundwater levels measured in shallow monitoring wells near the southern boundary of Terminal 115 also indicated a southwesterly groundwater flow direction (EMCON 1995).

Numerous studies have been conducted on the hydrology of the Terminal 115 North and Reichhold, Inc. (Reichhold)/Glacier Northwest, Inc. (Glacier NW) sites (ERM 2009). In September 2003, Shaw Environmental & Infrastructure, Inc. (Shaw) measured groundwater levels in shallow monitoring wells on the Reichhold/Glacier NW property, located immediately north of Terminal 115 (Shaw 2003, 2008) and found that the water level data indicated a groundwater flow direction to the southeast at a gradient that ranged from 0.02 to 0.007 ft/ft. A groundwater depression was also noted in the southeast portion of the site (Shaw 2003, 2008). According to reports produced by the POS and Reichhold/Glacier NW, there also appears to be groundwater depression on the central portion of the Terminal 115 North site. Groundwater contours grade towards this point on both sites (Figure 6D).

In general, the flow direction(s) and gradient(s) of shallow groundwater across Terminal 115 are anticipated to be highly variable as a result of (1) the type(s) and extent(s) of fill material, (2) areas of recharge and discharge to the shallow aquifer, and (3) the tidal fluctuations of the LDW. The limited site-specific water level data available for review support this supposition.

2.4 CURRENT PROPERTY USE

Terminal 115 is one of six principal marine cargo facilities and container cargo terminals located within industrial shoreline areas in south Elliott Bay. Terminal 115 includes approximately 99 acres of existing upland marine cargo marshalling area and cargo storage, warehouse, and processing facilities. The existing Terminal 115 upland area and dock structures have been in place since approximately 1970. During the past ten years to the present, principal uses and activities at Terminal 115 have included the following:

- Transshipment of bulk cargo using deep draft vessels.
- Barge cargo operations, including marshalling of cargo for truck, rail, and barge shipment.
- Seafood receiving, processing, and shipping.
- Petroleum storage and distribution.
- Repair and maintenance of cargo shipping containers.
- Cargo warehouse activities, including the storage of goods for trans-shipment.
- Industrial uses, including fabrication of rail sections for use in rail line construction, storage of construction crane equipment, and warehousing and storage of metal and wood construction materials.
- Vessel outfitting, maintenance, and repair.
- General warehouse uses.
- General lumber yard uses.
- Uses as a railroad spur.
- Transshipment and storage of auto vehicles.

The present configuration of Terminal 115 and a discussion of the current tenants are described below and presented on Figure 2. The measurements presented below are approximations that were made using scaled aerial photographs. The measurements are intended to present a general overview of the physical configuration of Terminal 115 and are not intended for planning and/or site assessment purposes.

2.4.1 Surface Structures and Improvements

Terminal 115 has undergone numerous upgrades and improvements throughout the POS's ownership history. Many of the recent improvements have been performed by the tenants to facilitate their operations. The current configuration of Terminal 115 is discussed below.

Entry and Egress. The Terminal 115 areas are served by frontage road and gate facilities located at the north and south margins of Terminal 115 (Figure 2). Northland Services, Inc. (Northland) operates a main entrance for container trucks and other incoming traffic on the southwest corner of the property adjacent to the Schultz Distributing Inc. refueling facility (Cardlock Facility), as well as a primary exit on the northwest corner of the property on the north side of

Terminal 115 North. Northland also operates a smaller gated maintenance and service entrance along West Marginal Way Southwest just south of Terminal 115 North. Northwest Container operates a single entrance and exit located along West Marginal Way on the north end of their leased area. The Seafreeze Acquisition, LLC (Seafreeze) and Icicle Seafoods, Inc. (Icicle) facilities are accessed by a gated entrance at the north end of Second Avenue Southwest. Figure 2 presents the tenant-occupied areas and primary entry and egress locations.

Buildings and Structures. There are 20 permanent structures on Terminal 115. In addition, there are several modular structures utilized for a variety of purposes located across the property.

Surface Conditions. Terminal 115 includes approximately 3,550,000 square feet of paved or concrete surface improvements (including approximately 520,000 square feet of building footprints), approximately 700,000 square feet of gravel/unpaved surface, and minor areas of vegetated surface.

South Berth Area. This area of Terminal 115 includes the two barge berths listed below:

- **Finger Pier berth (Berth 1).** Two creosote pile-supported finger piers (each approximately 70 feet long and 35 feet wide) provide cargo transfer to barges moored in this location.
- **Concrete pier and loading ramp berth (Berth 2).** The southeast corner of the existing concrete piling pier is used in combination with a floating steel transfer span (approximately 80 feet long and 20 feet wide). The transfer span is located parallel to the south edge of the concrete pier and connected to an upland hinge point independent of the concrete pier, which is used to transfer cargo to and from barges.

North Berth Area. The North Berth area (Berths 3 and 4) includes approximately 1,200 linear feet of deep draft vessel moorage at an existing concrete pile-supported pier, with approximately 2.3 acres of pier use area. The North Berth area is operated by Northland.

Other Docks. The area of Terminal 115 currently occupied by Seafreeze subtenant Icicle includes a creosote pile-supported pier used for unloading ships with supplies and live seafood. The southernmost area of Terminal 115 formerly occupied by Commercial Fence Corporation includes a creosote pile-supported pier and floating dock occasionally used for temporary boat moorage.

2.4.2 Subsurface Infrastructure

Five independent stormwater drainage basins convey drainage from the paved and graveled surfaces of the Terminal 115 facilities to eight outfalls that discharge to the LDW. Sewage, some stormwater, and process water are conveyed through multiple drain lines, manholes, and oil/water separators throughout the property to a King County Metro sanitary sewer main located beneath West Marginal Way Southwest. In 2005 and 2006, a resurfacing and stormwater project was conducted by Northland and the POS. Stormwater as-builts were provided to the POS. In August 2006, Phoinix Corporation (Phoinix) performed an inspection of Terminal 115 to locate and verify all drainage structures on the property, including structures related to the separate stormwater systems and the combined sewer system. Phoinix inspected Terminal 115 outfalls to verify their size and location in October 2006 and June 2007. The findings from the inspections performed on Terminal 115 are presented in Phoinix's Stormwater

Inspection Report dated December 5, 2006, and Outfall Verification Report dated September 18, 2007 (Phoinix 2006, 2007). Descriptions of the known and suspected subsurface drain infrastructure and outfalls are provided below, and significant features of the system are depicted on Figure 3.

Stormwater System

According to Phoinix's reports and a review of Seattle Public Utility records, the Terminal 115 stormwater system consists of approximately 366 structures, including 8 outfalls that discharge to the LDW and range in diameter from 12 to 48 inches. Based on POS, Metro King County, and City of Seattle data, POS outfalls 2128, 2127, and 2125 (Figure 3) are connected to City of Seattle storm drain features within the West Marginal Way Southwest ROW. The full extent of the upgradient storm drain infrastructure and contributing discharge sources to the outfalls located at Terminal 115 are discussed in the Ecology Lower Duwamish Waterway RM 1.6 to 2.1 West Data Gaps Report.

Sanitary Sewer System

Sewage is generated from several bathroom facilities on Terminal 115, and process water is generated at the following locations:

- Seafreeze and their subtenants' indoor and outdoor seafood processing areas.
- Northland's food storage container wash-out area.
- Northland's vehicle maintenance and wash facilities.
- Shultz Distributing's oil/water separator

Sewage and process water drain off the property through approximately 37 sewer structures within the Terminal 115 boundary to a 42-inch-diameter King County main line (the West Duwamish Interceptor) located beneath West Marginal Way Southwest. The main line routes wastewater to the West Point Treatment Plant located in Seattle, Washington, except when overflow events occur. Overflow events result in the discharge of combined sewer and storm drain (SD) effluents draining into the LDW from combined sewer overflow (CSO) lines which discharge into the LDW just south of Terminal 115 at the 36-inch-diameter West Michigan Regulator Station discharge pipeline (Discharge Serial Number 042), and on the northern property boundary at the Terminal 115 CSO/SD (Discharge Serial Number 038). The Terminal 115 CSO/SD is connected to the West Duwamish Interceptor through a 24-inch flap gate and discharges to a 48-inch-diameter storm drain on the Terminal 115 site.

2.4.3 Current Tenant Operations

A list of the current property tenants and subtenants, including a description of their operations, the location and approximate amount of space leased, origination of the lease, and stormwater permit information, is provided below. Tenant locations are presented on Figure 2, and stormwater features are presented on Figure 3.

The POS operates under a Phase I National Pollution Discharge Elimination System (NPDES) General Permit for Municipal Stormwater (GPMS), which was issued by Ecology under the Federal Clean Water Act. Three tenants and subtenants on Terminal 115 are required to operate under individual Industrial Stormwater General Permits (ISWGPs) in addition to the GPMS. The

POS requires Terminal 115 tenants to complete and maintain Stormwater Pollution Prevention Plans and implement measures to prevent and control the discharge of contaminated stormwater to surface water or groundwater within their operational footprint. Additionally, tenants and subtenants that operate under an ISWGP are also required to conduct quarterly stormwater sampling and submit discharge monitoring reports to Ecology. Current tenant operations are discussed in detail in Ecology's pending Terminal 115 Data Gaps Report.

Commercial Fence Corporation

Description of Operations: Construction contractor specializing in fences

Location: Terminal 115 North

Space Occupied: 28,152 square feet (sf) of land, and 8,374 sf of warehouse

Port Lease Dates: November 1, 2010 to October 31, 2013

Stormwater Permit: GPMS

Gene Summy Lumber Company

Description of Operations: Lumber yard

Location: Terminal 115 North

Space Occupied: 37,008 sf of land

Port Lease Dates: January 1, 2010 to December 31, 2014

Stormwater Permit: GPMS

Seafreeze Cold Storage

Description of Operations: Seafood processing and cold storage warehouse

Location: South end of Terminal 115

Space Occupied: 12.3 acres (817,429 sf of land and 17,254 sf of submerged land)

Lease Dates: November 1987 to November 21, 2027

Stormwater Permit: GPMS

Icicle Seafoods, Inc. (subtenant to Seafreeze)

Description of Operations: storage subtenant to Seafreeze, involved in seafood processing and cold storage

Location: Southeast corner of Terminal 115

Space Occupied: 5.8 acres

Port Lease Dates: Not applicable (N/A)

Stormwater Permit: ISWGP WAR010720 (formerly SO3010720A)

<u>Shultz Distributing, Inc. (Cardlock Facility)</u>

Description of Operations: Automated commercial vehicle fueling facility

Location: Southwest corner of Terminal 115

Space Occupied: 0.9 acre (40,894 sf of land and 1,560 sf building)

Lease Dates: August 10, 1994 to August 9, 2011

Stormwater Permit: GPMS

<u>Subway Corporation</u> (subtenant to Schultz Distributing)

Description of Operations: A fast food restaurant—a Subway sandwich shop franchise

Location: Southwest corner of Terminal 115

Space Occupied: 0.1 acre

Lease Dates: N/A

Stormwater Permit: N/A

<u>Portside Coffee Company</u> (subtenant to Schultz Distributing)

Description of Operations: A drive-through coffee stand

Location: Southwest corner of Terminal 115

Space Occupied: 0.1 acre

Lease Dates: N/A

Stormwater Permit: N/A

<u>Sea-Pac Transport</u>

Description of Operations: Cargo packaging and shipping

Location: West side of Terminal 115

Space Occupied: 1.26 acres (54,779 sf) land.

Lease Dates: January 1, 2011 to December 13, 2014

Stormwater Permit: GPMS (Formerly ISWGP SO3003983 with Certificate of No Exposure)

<u>Northland Services, Inc.</u>

Description of Operations: A marine shipping business that moves cargo to and from destinations in Alaska and Hawaii

Location: Central portion of Terminal 115

Space Occupied: 57.2 acres

Lease Dates: January 1, 2003 to present

Stormwater Permit: ISWGP WAR000471 (formerly SO3000471D)

Northwest Container Services, Inc. (subtenant to Northland Services, Inc.)

Description of Operations: Container and marine cargo handling

Location: West-central portion of Terminal 115

Space Occupied: 14.7 acres

Lease Dates: N/A

Stormwater Permit: ISWGP WAR003779 (formerly SO3003779C)

3.0 HISTORIC PROPERTY OWNERSHIP AND OPERATIONS

Prior to the 20th century, the Duwamish River valley was used for farming, pasture, logging, and subsistence gathering. After the channelization and dredging of the Duwamish River in the early 20th century, the areas surrounding the river were developed for large-scale industrial use. Seaports, factories, major utilities, and other heavy industrial uses were constructed along the Duwamish River and associated valley. Terminal 115 has been used extensively for commercial and industrial purposes from 1909 until the present. Based on the size and complexity of the site, not all property use and buildings historically present on Terminal 115 are explicitly identified below. Only those significant property uses that are considered Issues of Environmental Concern (IECs) are discussed in detail. An IEC is any current or historical property use that may have resulted in the release of hazardous or potentially hazardous substances to soil, air, groundwater, sediments, or surface water. An IEC is not necessarily considered or defined as potential source for recontamination of the adjacent waterway. The following is a discussion of relevant historical property uses that may be considered IECs, which are summarized in plan view on Figure 4; a timeline denoting significant changes in land use or IEC status is presented on Figure 7. Additional supporting information regarding each of the IECs is provided in Appendix B.

3.1 PRE-INDUSTRIAL HISTORY

The areas of the LDW were densely populated by the Duwamish Tribe, a Coast Salish people that inhabited many areas of King County and metropolitan Seattle prior to settlement in the 1850s by people of European descent. The Duwamish Tribe inhabited villages, practiced limited horticulture and land management, hunted game, and fished along the Duwamish River. Village sites located near the mouth of the Duwamish River and the current location of Terminal 107 (RM 0.5) indicate the former presence of Duwamish village sites consisting of midden piles and multiple longhouses that existed from the 6th century until the 19th century. No documented archeological sites have been recorded for the areas presently occupied by Terminal 115; however, the sources of the village site locations are reported from oral history (Washington State Department of Archeology and Historic Preservation 2010). No archeological evidence has been acquired for Terminal 115.

3.2 PRE-BOEING INDUSTRIAL DEVELOPMENT

As discussed earlier, the Duwamish River was channelized between 1914 and the early 1920s to provide a straight, engineered shipping lane for the industrial development of the Duwamish River Valley. The Terminal 115 property and east-adjoining waterway were channelized between 1915 and 1917. The channelization included the dredging of the bottom of the Duwamish River to an average depth of 20 to

30 feet, the excavating of land to the east and southeast of Terminal 115, and the filling of surrounding areas with dredged sediment (Figures 4B and 4C). Additional dredging operations on the Duwamish River to create desired channel depths continued into the 1920s. The previous oxbow meander of the Duwamish River that was located on Terminal 115 was altered to create Foss Island. In 1917, a rotating metal truss swing bridge, located at the now-vacated West Michigan Street, spanned the LDW (Figure 4).

In 1909, Edward Heath constructed a wood-framed, uninsulated, unheated, two-story boatyard building for the construction of wooden ships on the former Boeing Plant 1 site (Figures 4 and 4A). The boatyard building, referred to during the Boeing operations as building 1-05, now colloquially known as the Boeing Red Barn, was moved to its current location on East Marginal Way and is currently used by the Seattle Museum of Flight. The boatyard was originally built on 200 wooden pilings above the muddy banks of Turning Basin No. 1. Boats were assembled within the barn structure and launched from a quay (Spitzer 1999). Wood processing, treating, and assembly took place at the yard. In 1910, William Boeing Sr., later the founder of Boeing, bought the property and boat building facilities. The land purchased included Lots 7 through 11 of Block 33, McLaughlin's Addition, which is encompassed within the footprint of what would become Boeing Plant 1. The shipyard was utilized as a wooden boat building facility until Boeing occupied the premises in 1917, as discussed in Section 3.4.

3.3 SOUTHERN WATERFRONT BLOCKS—PETROLEUM SITES

The properties located on the southeastern portion of Terminal 115 included the McLaughlin's Waterfront Addition Blocks 18, 19, and 21. The facilities located on these blocks were occupied by private enterprises largely providing services to Boeing employees during the major production periods of Boeing Plant 1. Two historical service stations and a small building described in tax assessor records as a "refinery building" were located on Terminal 115, as shown on Figure 4.

According to archived tax records, a Standard Oil retail gasoline service station (IEC No. 1) was constructed at 171 Tronsen Place in 1923, although the service station was not visible in aerial photographs until 1929. Tronsen Place has been since vacated. The location of the historical service station is shown on Figure 4. Archived tax records indicate that the service station was equipped with three fuel dispensers. Although no additional information regarding the UST system was listed on the tax sheet, judging from the age of the service station and the type of dispensers installed at the facility (hand-operated, direct-feed dispensers), the USTs were likely located directly beneath the dispensers. An automotive repair and lubrication facility operated in conjunction with the retail gasoline service station. Tax records and aerial photographs indicated that the service station was demolished in 1965. According to aerial photographs taken between 1965 and 2008, the portion of the property that was formerly occupied by Standard Oil has remained undeveloped and is currently used as a parking lot and storage area.

Archived tax records indicate that a small building (IEC No. 2; Figure 4) was constructed on Terminal 115 in 1952 at 104 West Michigan Street. In archived tax documents the building is described as a "refinery building," although the type of refining operation was not identified in any of the records reviewed. The tax records suggest that the area was undeveloped by 1966. Aerial photographs from 1953 through 1964 indicate that a small shed structure and numerous automobiles were located on the property. Aerial photographs taken between 1965 and 2008 depict the property used as a parking lot and storage yard.

According to archived tax records, a Richfield-brand retail gasoline service station (IEC No. 3) was constructed at 120 West Michigan Street at an unlisted date. Aerial photographs taken between 1929 and 1936 indicate that the site was undeveloped. The archived tax records indicate that the site was remodeled in 1938; however, this appears to be the date the service station was constructed. Archived tax records indicate that the service station was equipped with three fuel-dispensing pump islands, a service and lubrication garage, and a retail office building. The fuel dispensers were connected to two 500-gallon USTs and one 1,000-gallon UST, and a hydraulic lift was located within a service garage. The current status of these USTs is unknown. The site is listed as a retail gasoline and service station in the 1938 Polk city directory, and aerial photographs between 1946 and 1964 show the service station building located on the site. Aerial orthographic photographs from 1965 through 2008 indicate that the area has remained undeveloped and is currently used as a parking lot and storage lot.

Multiple residences and small commercial facilities existed on the McLaughlin's Waterfront Addition that listed the heating source as "stove," although the later conversion of the heating sources to oil is possible. According to archived tax records, these residences and small businesses, including cafes and small retail stores, were constructed generally between 1920 and 1940, and they were demolished in 1963 and 1965.

3.4 BOEING PLANT 1 (1917–1970)

As mentioned in Section 3.2, the portion of Terminal 115 later known as Boeing Plant 1 (also known as the Oxbow Plant) originally was used for the manufacture of wooden boats (Spitzer 1999). The growing popularity of metal-hulled boats created a lull in sales for the shipyard, and the increase in demand for airplanes, specifically the seaplanes that Boeing was producing, created the incentive for William Boeing Sr. to move his airplane manufacturing company into the former shipyard in 1917. Because the first airplanes were constructed of wood and canvas, the former boat builder Edward Heath was hired, along with many other craftsmen, to construct seaplanes at the plant. According to photographs of the area and archived tax records, the plant expanded considerably in 1925, 1929, 1942, and 1955. The State of Washington Pollution Control Commission conducted a study in 1945 of sources of pollution on the Duwamish-Green River (Foster 1945).It stated in regards to Boeing Plant 1: "This plant has a highly-toxic, chromic acid waste which is discharged into the Turning Basin. This waste comes from two 2,200 gallon tanks which are dumped about every eight months. The daily loss of chromic acid through spillage and drippings amounts to 25 to 50 pounds. Acids are also used in the pickling room but the tanks are never dumped. A very small amount of cutting oil may also get into the river." The total duration of the cited dumping activities is unknown. The Boeing Plant 1 property and associated buildings were sold to the POS in 1970, and the structures located on the premises were demolished between 1970 and 1977. The majority of the Boeing Plant 1 structures were located on the current site of the Seafreeze building. These include buildings 1-02, 1-04, 1-12, 1-13, 1-21, 1-22, 1-25 through 27, 1-29, 1-30, 1-32, 1-35, 1-39, 1-43, 1-50, and the lift station.

The following subsections provide a more detailed review of the activities conducted during the operation of Boeing Plant 1. The composite layout of Boeing Plant 1 and associated operational areas are presented on Figure 4A.

3.4.1 World War I-Era Boeing Plant 1 (1917–1970)

Boeing Plant 1 began operations out of the former Heath Shipyard building (Building 1-05) in 1917, at which time the barn-like structure was outfitted with a second-story drafting and machining room for the manufacture of biplane seaplanes. The construction of components and the assembly of the planes occurred entirely within Building 1-05 until additional buildings were constructed in 1917 and 1918. Considerable expansion of the Boeing airplane factory commenced in 1917 and 1918 for the construction of warplanes used in World War I. According to archived tax assessor records and historical photographs, the assembly building (Building 1-03), plating and paint shop (Building 1-04), boiler house/test warehouse (Building 1-06), and dry kiln (Building 1-10) were constructed in 1917 and 1918. An assembly building, paint shop, storage facility, and crating shop were constructed within a single building in 1918 at Building 1-08. In addition, a small outlying dock was located to the northeast of Building 1-06 and an office was located to the south of Building 1-05. A transformer house (Building 1-07) was constructed as an addition to Building 1-06 in 1928.

According to a Boeing drawing titled “Boeing Aircraft Co. – Plant No. 1, Seattle, Wash.” dated June 2, 1942 (the 1942 Boeing site plan; Boeing 1942), and the 1950 Sanborn Map, Building 1-05 was used as a wood working and planning shop, as well as a storage facility. Building 1-23 appears to be attached to Building 1-05 and was used for paint storage. According to a Boeing drawing titled “Plant 1, General Layout Showing Air Distribution System” dated December 10, 1952 (the 1952 Boeing site plan; Boeing 1952), and a Leo A. Daly & Associates drawing titled “Sewer Layout: Sewer Facilities Plant I Modernization, Seattle, Washington, Boeing Airplane Company” dated April 26, 1957 (the 1957 Boeing site plan; Leo Daly 1957), Building 1-05 was utilized as a maintenance building. Building 1-05 was removed from the property in 1975.

Building 1-03 (IEC No. 4.01) was originally constructed to assemble large seaplanes. In the 1930s, the assembly building became obsolete as the size of the structure could not accommodate the size of modern all-metal aircraft. During the 1930s and 1940s, the building was used to assemble component parts that were later sent to Boeing Plant 2 and the Boeing Renton Factory for final assembly. According to Sanborn Maps and the 1942 Boeing site plan, an oil house was located 30 feet to the west of Building 1-03. Aerial photographs indicate that the assembly building was demolished by 1978.

Archived tax records and Boeing site plans indicate that Buildings 1-06 and 1-10 (IEC No. 4.02), the boiler house and dry kiln, respectively, were located on the waterfront of the World War I-era Boeing Plant 1. These buildings were involved in the drying and treating of wood and the production of heat for the plant. According to the 1942 Boeing site plan, a 4,200-gallon fuel oil UST (Tank No. 16; Figures 4A and 5) was located to the south of Building 1-06. Building 1-07 (IEC No. 4.03) housed a transformer and was built as an addition to the boiler house in 1928. Tax record photographs indicate that the transformer was rated for 26,000 volts. According to aerial photographs, these structures were removed from the site by 1978.

According to historical photographs, Building 1-08 (IEC No. 4.04) was constructed in approximately 1918. Building 1-08, referenced as the old assembly building, was originally used for assembly of parts before crating and delivery. The 1942 Boeing site plan and the 1950 Sanborn Map indicate the use of the building as a welding, paint spraying, crating, materials testing, shipping, and plaster shop. In the 1957 Sanborn Map, Building 1-08 was listed as housing the engineering drafting offices and was equipped with a tank of unknown contents

(Tank No. 15, Figures 4A and 5) located adjacent to the building to the east. The current status of Tank No. 15 is unknown. No other references to the tank were observed in the materials reviewed. The structure was demolished by 1974.

The paint spraying and plating shop (Building 1-04, IEC No. 4.05) was constructed in 1918. The building was located to the south of Building 1-03 and contained facilities for spraying paint and plating airplane parts. The 1942 Boeing site plan and the 1950 Sanborn Map indicate that the westernmost portion of the building was used primarily for paint spraying, and the remainder of the building was used for "anodic treatment," which is synonymous with plating. This technique typically involves treating an aluminum alloy with acid or caustic liquid to improve adhesion of paint and resistance to corrosion. A section diagram included with the archived tax record included a reference to a "Tank - Personal" (Tank No. 14). This was interpreted to represent a storage tank associated with the historical use of the building. No other reference to the "personal" tank was observed in the available records. The current status of Tank No. 14 is unknown. The 1952 and 1957 Boeing site plans and a drawing by Boeing titled "Plot Plan: Former Plant I, Terminal 115" dated 1963 (the 1963 Boeing site plan; Boeing 1963) list Building 1-04 as utilized for finishing and inspection. According to aerial photographs, the building was demolished by 1974.

According to the 1942 Boeing site plan, a parts storage building (Building 1-12, IEC No. 4.06) was constructed at an unknown date south of Building 1-08. Historical photographs suggest that the building was constructed in 1918. Building 1-12, according to the 1957 Boeing site plan, was utilized as a maintenance welding facility. According to aerial photographs, the building was demolished in 1966.

According to aerial photographs taken in the years 1922, 1924, and 1936, several residences unassociated with the Boeing facilities were located on both the eastern and western banks of McAllister's Slough. No building or tax records pertaining to these structures were observed in the available records. Aerial photographs indicate that the structures were removed by 1970 during the infilling of Terminal 115.

3.4.2 Machine Shop/Main Factory Facility—Building 1-02 (1925–1974)

Photographs taken in 1919 suggest that the area occupied by the Boeing Machine Shop (Building 1-02, IEC No. 4.07) was initially developed with a two-story office building. According to aerial photographs, by 1924 the area occupied by Building 1-02 was used as a storage and staging area for materials. According to archived King County tax records, Building 1-02 was constructed in 1925. A Sanborn Map published in 1929 and the 1942 Boeing site plan indicated that Building 1-02 contained brazing and welding facilities, a machine shop, a sheet metal shop, heat treating facilities, an assembly room for airplane components, and metal cutting, burning, and grinding shops. In addition, welding equipment, fuel, and sheet metal was stored in a structure to the west of the building. According to the 1942 Boeing site plan, a fuel dispenser and buried gasoline tank (Tank No. 8; Figures 4A and 5) (IEC No. 4.08) were located to the southwest of Building 1-02. The current status of Tank No. 8 is unknown. Several transformers were located in the vicinity of the building.

In 1951, engine testing facilities were constructed within the southwestern portion of Building 1-02. This area was equipped with 14 cells designed to test airplane engines. A concrete UST and three 5,000-gallon USTs (Tank Nos. 4 through 7; Figures 4A and 5) were installed to the south of

Building 1-02, and the tanks were connected to a system of pumps and fuel piping to connect with the experimental cells. No information regarding the current status of these USTs was available in the records reviewed.

According to the 1942, 1952, and 1957 Boeing site plans, a compressor house (Building 1-39, IEC No. 4.09) was constructed adjacent to the west of Building 1-02 by 1952, and aerial photographs indicate that the compressor house was demolished by 1978. The property is currently occupied by the 1978- and 1994-vintage Seafreeze buildings.

3.4.3 Eastern Test Facilities (1920s–1973)

According to archived tax records, a drop hammer shop and aluminum foundry (Building 1-29, IEC No. 4.10) was constructed to the east of Building 1-02 in 1936. The hammer shop was used to mold structural metal components with a large metal forging hammer. This structure was demolished by 1978 and was located within the footprint of the existing 1978-vintage Seafreeze building.

According to archived tax records, the static test building (Building 1-40, IEC No. 4.11) was constructed in 1942. Static testing refers to the process of strength and integrity testing of structural components of airplanes on the ground. The 1942 Boeing site plan describes buildings to the west of Building 1-40 as used for fuel testing. Photographs of Building 1-40 taken at an unknown date depict several large metal tanks (Tank Nos. 20 and 21; Figures 4A and 5) and storage drums located to the west of the building. According to the 1963 Boeing site plan, Building 1-40 was used as a foundry.

According to aerial photographs and Boeing site plans produced between 1942 and 1963, a brick incinerator operated on the eastern waterfront from at least 1938 until the demolition of Boeing Plant 1 in the 1970s (Building 1-42, IEC No. 4.12). No details regarding the specific materials incinerated at this facility were available.).

According to the 1942 Boeing site plan, three buildings located to the west of Building 1-40 were used for the storage of paint, rivets, and lubrication oil (IEC No. 4.13). A drum storage yard was also listed in the vicinity of the storage buildings. According to aerial photographs, the storage buildings were demolished and replaced by Building 1-41, the fuel-pump testing building, by 1946. According to a POS drawing titled “Longshoremen’s Restroom Sewer Plan” dated September 22, 1971 (POS 1971), two USTs (Tank Nos. 18 and 19; Figures 4A and 5), which were reportedly filled with sand and closed in place, were located to the southwest of the building. The contents of these tanks were not listed in any drawing or diagram. Building 1-41 was demolished by 1978.

According to aerial photographs, the engine testing facility (Building 1-34, IEC No. 4.14) was constructed by 1938. The 1942 Boeing site plan indicated that the engine test facility also included a fuel tank test shed located to the south of the building. According to the 1957 Boeing site plan, Building 1-34 was later converted into a structural test office. Aerial photographs indicated that Building 1-34 was demolished by 1973.

According to the 1942 Boeing site plan, Buildings 1-15, 1-16, and 1-17 were constructed in close proximity to each other, directly north of the drop hammer shop (Building 1-29). These buildings, according to the 1942 Boeing site plan and the 1950 Sanborn Map, were used for parts storage, heat treating, and wing testing. According to aerial photographs and archived tax records, Buildings 1-15, 1-16, and 1-17 were demolished in 1956. Archived tax records indicate that a steam plant and a wastewater lift station were constructed in 1956 and 1957, respectively, in the former location of Buildings 1-15, 1-16, and 1-17. According to tax records and Boeing site plans, the steam plant (Building 1-30, IEC No. 4.15) was equipped with a 20,000-gallon diesel fuel UST (Tank No. 17; Figures 4A and 5) located adjacent to the northwest of the building. The steam plant operated until 1970 and was demolished by 1976. The 20,000-gallon UST was listed in POS drawings as decommissioned and filled in place in 1976. The lift station building (IEC No. 4.16) pumped waste water into a force main prior to discharging the water to outfalls. This structure was abandoned in 1976 and a new lift station that serviced Building 1-01 was installed off the property.

According to the 1952 Boeing site plan, a structure used for sandblasting (Building 1-44, IEC No. 4.17) was constructed on the northern portion of the Plant 1 site. According to aerial photographs and the 1957 and 1963 Boeing site plans, as well as archived tax records, sandblasting took place in this area until 1970. The structures in this area were demolished by 1973.

According to the 1952 Boeing site plan and aerial photographs taken between 1952 and 1970, an acid test building (Building 1-45, IEC No. 4.18) was located to the east of Building 1-40, directly abutting the LDW. The structure was demolished by 1978.

3.4.4 Western Test Facilities/Hazardous Materials Storage (1950s–1974)

According to archived King County tax records, five structures were constructed to the north of Boeing Plant 1 between 1955 and 1964. These structures include a 1955-vintage test revetment building (Building 1-50), a 1955-vintage fuel test laboratory (Building 1-21), a 1955-vintage fuel storage facility (Building 1-22), a 1959-vintage acid storage facility (Building 1-26), and a 1964-vintage flammable materials storage facility (Building 1-27). These facilities were located in close proximity to each other and are presented on Figure 4A.

The 1955-vintage revetment (Building 1-50, IEC No. 4.19) reportedly was used for test purposes. Boeing maintained similar test revetments at the Boeing airfield in the 1950s. Although revetments are often used for aircraft storage, aircraft were neither assembled nor stored at Terminal 115 after 1941. Similarly constructed test revetments utilized by Boeing were used for aircraft munitions testing and engine testing. The test revetment was demolished in 1966.

The 1955-vintage fuel test lab (Building 1-21, IEC No. 4.20) was located within a fenced compound and was constructed of plywood and contained five separated test rooms. The use of Building 1-21 as a fuel test facility is confirmed in the 1957 and 1963 Boeing site plans. According to a Boeing drawing titled “Underground Fuel Tank 3000 Gal Capacity—Move Gasoline Pump,” dated July 28, 1958 (Boeing 1958), a 3,000-gallon UST (Tank No. 13; Figures 4A and 5) containing gasoline was installed between the test lab and the fuel storage building (Building 1-22). A dispenser was installed near the tank. According to aerial photographs, Building 1-21 was demolished by 1973. The current status of Tank No. 13 is unknown.

The 1955-vintage fuel storage facility (Building 1-22, IEC No. 4.21) was located within a fenced compound. The structure was built of reinforced concrete. The site contained multiple unknown drums and a fuel dispenser in a 1960 tax assessment photograph. According to aerial photographs, Building 1-22 was demolished by 1973. The flammable liquids storage shed was built in 1964, and archived records indicate that USTs were located beneath the concrete slab foundation. The structure appears to the north of Building 1-22 in the Boeing 1963 site plan. According to aerial photographs, Building 1-23 was demolished by 1973.

The 1959-vintage acid storage facility (Building 1-26, IEC No. 4.22) was located within a fenced compound and was constructed of concrete blocks. The approximately 15-foot by 100-foot structure contained waste acid and alkali materials produced by Boeing Plant 1 facilities. Waste was containerized in barrels and secured behind fences. According to aerial photographs, Building 1-26 was demolished by 1973.

In addition to the above structures, the 1963 Boeing site plan includes a reference to Building 1-27 (IEC No. 4.23), listed as the hazardous materials storage building. Aerial photographs from 1961 through 1970 confirm the presence of Building 1-27. According to aerial photographs, Building 1-27 appears to have been demolished by 1973. No record of the contents of the structure or the presence of any storage tanks at this location was observed.

According to the 1942 Boeing Site Plan, the 1950 Sanborn Map, and the 1957 Boeing site plan, a paint storage building (Building 1-23; IEC No. 4.24) was located to the west of Building 1-05. The structure appears in aerial photographs taken between 1922 and 1957. The building appears to have been demolished by 1961.

3.4.5 Seafreeze Building (1978 to present)

The Seafreeze building (IEC No. 5) was constructed on the former site of Boeing Plant 1 in 1978. The two-story, concrete, tilt-up-framed, gas-heated structure is occupied by a bulk fish cold storage and processing facility. The facility includes three fish processing rooms and numerous cold storage rooms cooled predominately with an ammonium system. The processing rooms are equipped with numerous floor drains, which are connected to the King County Metro system. The cold storage rooms are used for the storage of fish products, ice cream, and other food items. The coolant system is located on the roof of the structure. No backup electricity generation is located at the facility. According to a 1980 Seafreeze blueprint (Seafreeze 1980), a 4,000-gallon diesel UST (Tank No. 9; Figure 5) was installed in the vicinity of the facility. The tank was located approximately 50 feet to the southwest of the electrical room at the southwest corner of the building. No evidence of any tanks was discovered during the site inspection, and site personnel were unaware of any USTs. A cold storage facility was constructed as an addition to the Seafreeze building in 1994.

3.5 SOUTHWEST TANK FARM AREAS

The boundaries defined as the southwest tank farm areas are presented on Figure 4, which include IEC Nos. 6, 7 and 8. This includes the current service station located at 6020 West Marginal Way Southwest, as well as areas south of the West Front Street ROW and north of the Seafreeze building.

According to archived tax records, a retail gasoline service station was constructed at 460 West Michigan Street in 1930 (IEC No. 6). The service station included two fuel dispensers and a service garage (grease shed) that was equipped with a hydraulic lift. No information regarding the tanks associated with this service station was available. However, judging from the age of installation of the system and the hand-pump dispensers installed at the service station, the storage system likely consisted of USTs installed directly beneath the dispensing pumps. Tax records indicate that in 1949 a new service garage was added adjoining the service station office, at which time the gasoline distributor operating at the service station was Texaco. Historical photographs indicate that the service station was operated by SAV-MOR gasoline in 1956. According to tax records, the original grease shed and repair facility built in 1930 were utilized for auto salvage through at least 1967; the auto salvage yard was visible in the 1950 Sanborn Map. Kroll Maps indicate that an additional building existed to the east of the service station building. No tax records associated with this structure were identified. Reverse directories indicate that the retail gasoline service station was in operation until 1963. After this date, the building was converted to a tavern. Tax records and aerial photographs indicate that the building was demolished in 1970.

In addition, an auto parts store, a tavern, and a single-family residence existed from the 1930s to the 1970s along the central stretch of Southwest Michigan Street. These structures were not associated with Boeing or the above auto service and wrecking companies. Multiple residences, as evidenced by tax records and historical photographs, existed along the western side of McAllister's Slough and the areas surrounding the intersection of West Marginal Way Southwest and Southwest Front Street. Records and historical photographs indicate these residences were present from the 1920s through the late 1960s, when all structures in the vicinity were demolished.

Archived tax records indicate that an aluminum smelter was constructed in 1952 (IEC No. 7). The structure was equipped with an 9,500-gallon UST (Tank No. 26; Figures 4 and 5). According to historical photographs and reverse directories, the aluminum smelter was operated by Materials Reclamation and Maralco Aluminum from 1952 through 1985. In 1985, the building was occupied by a crane services company. A POS site plan titled "Marine Facilities, Terminal 115, Lafarge Temporary Storage Silo MUP: Vicinity Map," Port of Seattle No. 115-9001-C-1, undated (POS 1994), indicates that the building, designated as Building W-4, was utilized as an aluminum warehouse, with an attached maintenance building and office. In 1994, in preparation for the future installation of a retail gasoline station (the existing Cardlock Facility), geotechnical borings were advanced at the property. Separate-phase hydrocarbons (SPH) as diesel-range petroleum hydrocarbons (DRPH) were observed in groundwater, and soil contamination was confirmed (GSM 1995a). In 1995, the UST, which was reported to have a capacity of 9,500 gallons and was confirmed to be a buried tanker rail car that had been altered to serve as a heating oil tank, was removed. Contamination was discovered in soil and groundwater along the floor and sidewalls of the excavation, as well as surrounding the product piping. With the exception of soil underlying the building structural supports, soil was overexcavated and disposed of off the property. Contaminated soil that was left in place was to be removed with the installation of the Cardlock Facility (Columbia 1995). During construction work, a 600-gallon heating oil UST (Tank No. 25) was discovered at the property and was subsequently removed, and contaminated soil was over-excavated (GSM 1996). Property records indicate that the current gasoline- and diesel-dispensing station was installed in 1996 (IEC No. 8). Groundwater monitoring has been conducted at the site from 1995 until 2009, the results of which are discussed further in Section 5.1.2. The site is currently occupied by a restaurant building, a drive-through coffee stand, and a commercial fleet refueling station containing seven fuel-dispensing pump islands and three 10,000-gallon USTs (Tank Nos. 22 through 24; Figure 5).

3.6 KLINKER SAND & GRAVEL COMPANY/READY-MIX GRAYSTONE DIVISION (1922–1970)

According to aerial photographs taken in 1922, what appears to be a gravel mining and mixing plant was in operation along West Marginal Way Southwest near the west-central portion of Terminal 115 (Appendix A: Photo A-1). Archived tax records and a 1930 USACE investigation indicated that Klinker Sand & Gravel Company (Klinker) operated a sand and gravel mining and cement mixing operation in this area (IEC No. 9, Figure 4) (USACE 1930). The company was named "Klinker" in reference to the owner of the company, Jesse Klinker. The USACE indicated in the investigation that water from the nearby slough was used as wash water for sluicing gravel and sand into a sorting box to be used as sanitary fill by the City of Seattle. The operation reportedly produced considerable amounts of fine silt that was discharged into Turning Basin No. 1 (Appendix A: A-1). The USACE did not find that the operation was a threat to the navigable channel. Archived tax records indicated that storage bunkers and a cement mixer were constructed at the facility between 1926 and 1928. Aerial photographs taken between 1946 and 1961 indicate that the areas surrounding the Klinker site became increasingly silted and the shoreline expanded progressively to the east over time (Appendix A: Photo A-2 through A-6), and considerable fill material was introduced to Turning Basin No. 1. According to maps and aerial photographs from 1956, the upland areas surrounding Klinker had expanded considerably since 1922. According to a 1960s Kroll Map and reverse directories, Ready-Mix Concrete's Graystone Division occupied the area formerly occupied by Klinker. Aerial photographs taken in 1961 showed extensive filling in the areas to the east of the former Klinker site, and a large sorting conveyor and barge loading dock had been constructed. Oblique photographs taken by the POS in the early 1960s show the whole of Foss Island connected to the mainland and being filled with a large quantity of white-colored fill material, which was being deposited into large dewatering lagoons constructed on the site (Appendix A: Photo A-6 and A-7). Multiple structures were constructed to accommodate the concrete loading facilities, and large stockpiles of dry cement and concrete material were maintained at the site. The cement loading, mixing, and dock facilities were removed by 1971 after the infilling of Turning Basin No. 1 (Appendix A: Photo A-8).

3.7 CENTRAL TERMINAL 115 FACILITIES (IEC 10, 12 AND 13)

Terminal 115 was initially the oxbow meander of the Duwamish River until 1914, when extensive channelization and dredging activities were completed to create the LDW. During the early periods of the management of the LDW, construction of improvements, landfilling, and waterway use was at times performed in an ad hoc and informal manner. For instance, the original 1909-vintage Heath Shipyard building was completed without USACE permission, and permission to operate the facility was sought retroactively by the proprietors. The management of the LDW and Turning Basin No. 1 primarily focused on maintaining navigable waterways through the elimination and prevention of infill of the shipping channel. Turning Basin No. 1 was used throughout its history as a log boom for the storage of timber and as a point where ships could turn around. The northern areas of the turning basin were reportedly also used as a landfill for unwanted dredge material and cement kiln dust (CKD) (POS 1987, Shannon & Wilson 1991). Subsurface Investigations of soil conditions at Terminal 115 North are not indicative of CKD (Landau 2009), therefore it is not fully understood which areas the reports are referring to. Areas of Terminal 115 bordering West Marginal Way Southwest were gradually filled by the sand and gravel mining and cement operations located on the hillside and central portions of Terminal 115. Silt was commonly sluiced directly into the turning basin from the Klinker operations (USACE 1930). Dredging ships would commonly remove river sediments and deposit the loads onto the northern and southern portions of Terminal 115. As the original upland areas were historically located only a few feet above sea level in the vicinity of former Boeing Plant 1 and Terminal 115 North, infilling was required to build any structures or roadways on the property. Dredging operations within the southern McLaughlin blocks were apparent in photographs taken in 1928, and a 1935 USACE dredge and fill blueprint indicated that the northern-adjoining areas of Terminal 115 also were filled with dredged materials collected from the waterway (USACE 1935). Aerial photographs from 1922 and 1929 indicate that filling of Terminal 115 North occurred prior to 1935. Further filling along the former McAllister's Slough was apparent through the 1930s and 1940s as the formerly inundated portions of Terminal 115 were raised to an elevation suitable for building. In the 1940s, Turning Basin No. 1 east of West Marginal Way Southwest had been incrementally filled with material. In 1953, areas of Foss Island began to be filled with material from a loading site east of the gravel mining and cement operation and from dewatering lagoons used to build up usable land. By 1957, considerable new land had been developed along the mouth of the slough and on Foss Island itself. By 1961, a cement loading dock had been installed at the end of a large filled mass on the southern edge of Foss Island (Appendix A: Photo A-5). The loading area included a cement conveyor, stockpiling areas, multiple truck staging areas, several cranes, several office structures, and other equipment. Light-colored material had been pushed to the east of West Marginal Way Southwest across the entirety of the site, and Foss Island was at this point connected to the hillside. Areas to the east of Foss Island had at this point not been filled and remained as partially dredged waterway. Logs remained stored in booms along the eastern edge of Foss Island and the surrounding shoreline (Appendix A: Photo A-6).

According to reverse directories, a lumber products plant was located at 6336 West Marginal Way Southwest from 1940 until 1951. Aerial photographs indicate that in 1946 a number of small structures were located on the central portion of the property to the east of West Marginal Way Southwest, in the vicinity of a large number of floating log rafts in Turning Basin Number 1. The lumber plant was listed as vacant from 1955, and thereafter no listing was given for any addresses within the 6300 West Marginal Way Southwest block. Aerial photographs indicate that the former lumber plant structures were demolished between 1965 and 1970.

In 1969, work began on the large-scale filling of the footprint of Terminal 115. Initially, sediment unsuitable for use as underlying soil for the facility was removed. General Construction Co. and Morrison-Knudsen Co. initially removed unwanted sludge and debris that had accumulated on the banks of the LDW over the past 50 years. This involved removing 322,000 cubic yards (cy) of material by dredging and excavation in November 1969. In 1970, the area was filled with 740,000 cy of on-property material and 1.1 million cy of fill brought to the property. The material sourced from the property consisted of regrade and dredged material; the source of the off-property material is unknown. However, according to the POS (POS 1987) and aerial photographs taken during this time, the fill likely included CKD. The infilling process involved building a large dike from the Terminal 115 North property east and traversing south to Boeing Plant 1 (Appendix A: Photo A-7). The dike was then backfilled piecemeal with dewatering lagoons that were approximately 5 to 15 acres in area. The dewatering lagoons were filled with imported, reworked, and/or dredged material, and the water in the lagoons was pumped into the LDW. The site improvements were completed between 1971 and 1974. In addition, the POS purchased the former Boeing Plant 1 site from Boeing in 1970 and demolished multiple structures between 1970 and 1974.

A concrete and asphalt apron was constructed across the northern portions of Terminal 115 in 1971 and 1972 (Appendix A: Photo A-8). A concrete pier, 100 feet wide and 1,200 feet long, was installed along the northern portion of Terminal 115. Rail lines were constructed through the central portion of Terminal 115. According to a 1974 POS as-built drawing, eight buildings were completed on the newly constructed apron (POS 1974). The buildings present in 1975 were as follows:

- The Car Wash and Body Shop buildings (Building C-1 and C-2, IEC No. 10) were constructed in 1971. The one-story, steel-framed car wash building (Building C-1) was heated by electric baseboards. The building was equipped with subsurface troughs and reclaiming pits for the catchment of gray water before water was discharged to the sewer system. To the west of the building, a 2,000-gallon AST (Tank No. 27; Figure 5) and a 5,000-gallon kerosene-containing UST (Tank No. 28; Figure 5) were installed at the property in 1971 to fuel a heating device in the car wash and to collect kerosene from a separator system beneath the car wash, respectively. Kerosene was reportedly used as part of the washing process and was recollected. The USTs were removed in 1989. Building C-1, which is currently used as a repair shop and maintenance facility, is connected to on-site storm sewers that lead to the King County Metro sewer system. A 1,000-gallon aboveground storage tank (AST) containing diesel fuel (Tank No. 29; Figure 5) and a connected dispenser are currently located adjacent to the west of the building. The AST is concrete-lined, equipped with secondary containment, and used in refueling equipment by Northland.

- The body shop building (Building C-2) was constructed in 1971. The one-story, structural steel-framed building is located adjacent to the east of Building C-1. The building initially was constructed with a 10,000-gallon UST (Tank No. 30; Figure 5) and fuel-dispensing pump island. The UST and fuel dispenser were removed in 1989. Based on field observations by SoundEarth personnel, the building is currently used as a maintenance facility by Northland.
- The Maintenance building (Building W-2, IEC No. 12) was constructed in 1972. The two-story, structural steel-framed building is currently used for the maintenance of Northland dock equipment. According to the 1975 as-built revisions to a container yard site plan (KPFF 1971a), a 6,000-gallon UST containing diesel (Tank No. 33; Figure 5) connected to a fuel dispenser was located approximately 100 feet to the northeast of Building W-2. The UST was removed in 1993, along with 220 tons of petroleum-contaminated soil (Environmental Science & Engineering, Inc. 1994). Tank No. 33 was replaced with a 6,000-gallon UST, which was installed in 1993 (Tank No. 34) and remains operational, in use by Northland Services. In addition, two ASTs exist in the vicinity of the UST. A 300-gallon, concrete AST containing gasoline and a 400-gallon metal-lined AST containing diesel are connected with fuel dispensers and are equipped with secondary containment (Tank Nos. 31 and 32; Figure 5).
- The Terminal Office building (Building A-5, IEC No. 13) was constructed in 1971. The two-story, wood-framed structure is located to the west of the loading piers on the central portion of Terminal 115. According to 1975 drawings (POS 1975), Building A-5 was equipped with a fueling facility that was located approximately 40 feet to the west of the building. The fuel facility contained two fuel-dispensing pump islands, a 1,000-gallon gasoline UST, and a 2,000-gallon diesel fuel UST (Tank Nos. 36 and 37; Figure 5). According to UST closure documents, the USTs were removed in 1990. A 1,100-gallon UST was installed at the property in 1993 at the same location as the previously removed USTs (Tank No. 35). The fuel dispensers are not currently present, and the 1993-vintage UST has not been used since its installation.

Crowley Marine Services (Crowley), a lighterage company and marine cargo handler which operates tugs and barges to facilitate marine shipping, leased 130,000 square feet of landlocked yard area and rail track at Terminal 115 from 1981 through 1991. Crowley used the land to load rail cars from trucks and trailers for transport to Alaska. It is not clear which area was being leased at this time. Crowley tug, barge, and vessel maintenance and repair operation occupied Terminal 115, as a subtenant of Jones Stevedoring Company, on an unknown area of the Terminal 115 property, from 2001 until 2004.

3.8 TERMINAL 115 NORTH

According to historical maps (POS 1970, 1994, and undated; ABA 1962) and aerial photographs, the west bank of the Duwamish River ran through the center of Terminal 115 North before the dredging operations of the LDW in the 1900s (Figures 4B and 4C). Aerial photographs taken in 1922 indicate that the areas to the north of the site were barely above sea level and appeared flooded. The Terminal 115 North site appears slightly higher than adjoining areas in 1922 aerial photographs. An artificial berm was constructed in an effort to prevent water flow beyond the banks; however, the land behind the berm was frequently inundated. An USACE drawing (USACE 1935) indicates that dredged material from the LDW was placed on portions of Terminal 115 North in 1935. However, judging from aerial photographs taken in 1922 and 1929, it appears the filling operation was restricted to the north-adjoining properties. Aerial photographs from 1922 depict Terminal 115 North at greater elevation than the north-adjoining land. Aerial photographs taken in 1936 and 1938 indicate that areas to the north of Terminal 115 North were no longer inundated by water and appeared to be level with the earthen berm observed in previous photographs.

Reverse directories and aerial photographs indicate that no improvements were located on Terminal 115 North until 1963, when a detinning plant was constructed (IEC No. 14; Figure 4). According to aerial photographs from 1965, a terraced plot of land was added to the eastern portion of this parcel to accommodate two evaporation/settling ponds installed as part of the tin reclamation operations. The shoreline was expanded between 1961 and 1965 to the current easternmost extent of Terminal 115 North to accommodate settling ponds created at the site. In 1970, the Duwamish River shoreline was extended eastward as part of the larger infilling operations at Terminal 115. No information regarding the source of the fill material brought to the site at this time was available.

The M&T detinning plant recycled metals by dissolving the waste metal in solution with caustic lye and separating it from solution via electrowinning. The plant was equipped with two 16-ton cranes, a plating room, a boiler room, and a detinning area where the caustic lye and metals materials were mixed in a chamber. The plant included three settling ponds intended to capture waste sludge for further extraction of metals. These settling ponds were unlined and included dikes to prevent loss of material. According to aerial photographs, and the 1998 Seattle-King County Department of Public Health Site Hazard Assessment (SHA), the evaporation/settling ponds were removed by 1972 (SKCDPH 1998). Waste water was released into the Duwamish River from a waste water system located at the facility. By 1991, the waste water was diverted to the King County Metro system (Advanced Environmental Technology 1991).The detinning plant ceased operations in 1998, and the western portion of the property is currently occupied by Commercial Fence Company, and a lumber yard.

3.9 FILL ACTIVITIES (IEC NO. 11)

The original topography of Terminal 115 and vicinity have been altered significantly during the industrial development of the area. Prior to the channelization of the Duwamish River, the area currently inhabited by Terminal 115 was the site of a river oxbow. The oxbow included a slough (McAllister Slough), which joined the Duwamish River in the vicinity of the present Cardlock Facility. Buildings constructed in the vicinity were built on wood pilings to raise the levels of the floors above the muddy floodplains that dominated the surface of lands surrounding the area. To allow for shipment of goods down the river, a channelization and dredging program of the LDW was initiated by the USACE. Starting in 1913, and continuing through the early 1920s, the Duwamish River was straightened, dredged, and channelized to the condition seen in aerial photographs in the 1920s through approximately 1970. The areas directly surrounding and including the Terminal 115 property were channelized between the years 1915 and 1917. According to historical maps depicting the area before and after the dredging operations (USACE 1935), Foss Island was created out of riverbank material and likely dredge spoils. The LDW areas to the east of the former Boeing Plant 1 site were created from excavated river bank material. The main channel and portions of the river surrounding Foss Island were dredged to accommodate regular ship traffic. McAllister's Slough was not altered during this time frame. Historical photographs taken in 1928 show what appear to be dredge spoils deposited on the former Boeing Plant 1 site from a dredging boat extracting material from the LDW. According to USACE drawings from 1935, portions of Terminal 115 North and the north-adjoining property were filled using dredge spoils from the LDW channel. This material was also used as sanitary fill in areas south of Terminal 115 that would later be occupied by the First Avenue South Bridge.

Aerial photographs taken throughout the 1930s, 1940s, 1950s, and 1960s (Appendix A: Photo A-2 through A-6; Figures 4B and 4C) depict regular infilling activities along the western shores of the Duwamish Waterway Turning Basin No. 1. These activities appear to be associated with the Klinker operations located along West Marginal Way Southwest on the west-central portion of Terminal 115. According to archived tax records and an USACE investigation in 1930, the Klinker operations were involved with the production of sanitary fill for the City of Seattle and the mixing of cement products. According to City of Seattle photographs, McAllister Slough was filled in 1953 with unknown material. Based on review of the photographs, the material appears to consist of miscellaneous debris, including garbage. Aerial photographs from 1953 depict suspected land reclamation dewatering lagoons (dewatering lagoons) located on Foss Island (Appendix A: Photo A-4). Aerial photographs taken in 1956 depict the areas surrounding the Klinker site as extending to the east and connected to Foss Island. Aerial photographs from 1957 depict the entirety of Foss Island as filled with a layer of light-colored material. At that time, Foss Island was connected to the mainland and a berm of material was raised as a bank along the shore bordering the Duwamish River. Aerial photographs from 1961 depict two large dewatering lagoons on Foss Island, and the areas south of Foss Island, formerly occupied by Turning Basin No. 1, as infilled (Appendix A: Photo A-5). The filled land was occupied by a concrete terminal operated by Ready-Mix or Graystone Cement from the 1950s until 1970. The terminal included truck bays, a cement conveyor, several modular and permanent buildings, and a barge-loading pier. McAllister's Slough is depicted as nearly filled; however, a small stream still flowed into the LDW from this location. According to aerial photographs and archived tax records, the eastern portion of Terminal 115 North appears to have been filled sometime between 1963 and 1965 to the current eastern boundary of Terminal 115 North, and to slightly less than the current northern and southern boundaries of the Terminal 115 North property. The shoreline expansion was intended to create land for the construction of evaporation/settling ponds on the property. Aerial photographs taken in 1965 depict the entirety of the Foss Island area occupied by dewatering lagoons, with stockpiled soil in various areas of the cement terminal (Appendix A: Photo A-6). An oblique aerial photograph taken between 1965 and 1968 (Appendix A: Photo A-7) depict two large dewatering lagoons on the former site of Foss Island and an area south of Terminal 115 North. A large stockpile of light-colored fill material is located in the central portion of the Terminal 115 property between the two dewatering lagoons in the photograph. Aerial photographs taken in 1968 depict the Boeing Plant 1 site as surrounded by a raised fill causeway. The cement terminal is present and includes what appear to be large cement stockpiles and large stockpiled areas of light-colored material. The former dewatering lagoons at this point were filled in (Appendix A: Photo A-6 and Photo A-7).

According to a 1971 article in *The Seattle Times* (Lane 1971), construction of the current Terminal 115 configuration began in November of 1969, at which time 322,000 cy of unusable bank material were excavated from the site. Dredging of the site was completed, and the site was filled with 722,000 cy of dredge spoils and 1.1 million cy of off-site fill material. The filling process is detailed in aerial photographs taken around 1970, as shown in Appendix A, Photo A-7. Aerial photographs taken in 1968 and in early 1970 depict what appears to be a retaining dike built across the current shoreline of the site, with dewatering lagoons built behind the retaining dike (Appendix A: Photo A-7). The 1971 article in *The Seattle Times* reported that the dewatering lagoons were installed to prevent siltation of the LDW during infilling activities; to shore the lagoons and dike, 11,495 linear feet of creosoted logs were installed at the site. According to 1970 as-built diagrams produced for the POS, silt was allowed to settle within the dewatering lagoons prior to the water being pumped and discharged into the LDW. Aerial photographs taken in late 1970 show Terminal 115 with its present land area (Appendix A: Photo A-8 through A-10). As a result of the filling activities, the entirety of Turning Basin No. 1 was filled and Glacier Bay to the north was created. Current Terminal 115 improvements, including the apron, docks, and a number of buildings were constructed throughout 1971 and 1972.

CKD is suspected to have been used as fill material at Terminal 115. No evidence exists that CKD was used as fill material on Terminal 115 North. In two reports, CKD is listed as material used as fill on Terminal 115 and vicinity. In a report produced for the City of Seattle (Shannon & Wilson 1991), CKD was mentioned as a fill material deposited in the northern areas of the former Turning Basin No. 1. According to the POS (POS 1987), CKD is listed as fill material imported to the site in 1963 to backfill dewatering lagoons. In addition, cement storage, transport, mixing, truck washing, and the storage of cement slurry occurred on the north-adjoining property.

4.0 OFF-PROPERTY OPERATIONAL HISTORY

The properties adjoining Terminal 115 have been used extensively for industrial and commercial purposes since the early 1900s. While not necessarily associated with Terminal 115 operations, the potential exists for contaminated soil and/or groundwater at off-property facilities to impact Terminal 115 and subsequently the LDW via the stormwater, erosion/leaching, and/or groundwater pathways. The IECs discussed below are presented in plan view on Figure 4.

4.1 SOUTH-ADJOINING PROPERTIES

Prior to industrial development of Terminal 115, the areas to the south of Terminal 115 were used for pastureland and agricultural uses. In 1916, the Michigan Street Bridge was constructed to the south of and on Terminal 115. The areas to the south of Terminal 115 included the Boeing administration building (Building 1-01), several single-family residences, an auto parts store, and a shingle mill. These structures were demolished by 1955 in preparation for the construction of the First Avenue Bridge. In 1956, the First Avenue Bridge was completed, and the Michigan Street Bridge was destroyed. The approaches and transportation infrastructure associated with State Route 99 and the First Avenue Bridge have existed to the south of the Terminal 115 property since that time. The areas to the south of Terminal 115, with the exception of the Boeing Building 1-01, have remained unimproved since 1956.

4.1.1 Boeing Building 1-01

In 1929, Boeing constructed their two-story administrative office building (IEC No. 15.01), which was heated by an oil-burning furnace. King County tax records indicate that the ground floor of

Building 1-01 was utilized as a metallurgical laboratory by Boeing in 1966. Boeing sold the property to the POS in 1970. The property was bought by Foss Redevelopment in 1998 and used as an office and emergency cleanup response center until 2002. The property is currently used as an office building.

According to a POS demolition plan produced in 1991 (Wood/Harbinger 1991), a 4,000-gallon heating oil tank (Tank No. 1; Figure 5) was located to the north of Building 1-01 and removed in 1991. In addition, a 3,000-gallon bunker fuel UST and a 1,000-gallon diesel UST (Tank Nos. 2 and 3; Figure 5) were discovered on the southwestern portion of the property in 1998. These tanks were removed, along with areas of petroleum-contaminated soil (PCS), in 1998 and 2002 (Urban Redevelopment, LLC 2002).

4.1.2 Duwamish Shingle

Tax records indicate that in 1926 a small shingle factory and residence were constructed at 449 West Michigan Street. The mill was located directly across West Michigan Street from the former SAV-MOR service station located at 460 West Michigan Street. The shingle mill appears in photographs in the tax records as a small hut with an attached burner, and the residence is shown with a small AST attached to the building. Reverse city directories indicate that the shingle mill was listed on the property from 1930 until 1940. The site was later filled and leveled before it was incorporated into the ROW for the intersection of Highland Park Way Southwest and West Marginal Way Southwest.

4.2 WEST-ADJOINING PROPERTIES

Prior to the industrial development of the LDW, several single-family residences existed to the west of the Terminal 115 North area. These wood-framed, one- and two-story, stove-heated single-family residences were built between 1890 and 1916. These residences were removed in the 1980s and 1990s. Sand and gravel mining facilities operated in the hillsides overlooking West Marginal Way Southwest from at least the 1920s until an unknown date. Several vacated public ROWs have also been located on the hillside.

4.2.1 Klinker Sand & Gravel Company/Al Bolser Tire Store (IEC No. 9 and 15.02)

According to aerial photographs taken in 1922 and 1924, sand and gravel mining has occurred on the central portions of the west-adjoining property in conjunction with the Klinker operations discussed in Section 3.6. A review of aerial photographs, reverse directories, and archived tax records indicates that a sand and gravel mining and/or cement mixing facility operated at 6515 West Marginal Way Southwest from 1926 until 1960. In the 1960s, the Graystone Company, later purchased and operated by Ready-Mix, Inc., established cement mixing and transport operations on the former Klinker site. In 1986, Al Bolser Tire Stores (IEC No. 15.02) was constructed on the property. The two-story, masonry-framed tire retail and service station was used as a retail floor and a service station for tire and auto repair. According to UST decommissioning records, a gasoline-containing UST and dispenser were located on the property. In 2006, the 5,000-gallon UST was reported removed (Fillco 2006). The building is currently occupied by an equipment rental facility.

4.2.2 Aluminum and Bronze Fabrication (IEC No. 15.03)

According to archived tax records and aerial photographs, the property located at 6301 West Marginal Way Southwest was initially developed with a single-family residence in the 1910s. The wood-framed, one-story residence was heated by a stove. It was demolished in 1964 and replaced by the currently existing 1964-vintage, aluminum and bronze smelting facility (IEC No. 15.03). The smelting facility was originally heated by an oil-burning furnace. The smelter is a single-story, concrete-framed structure, which is located across West Marginal Way Southwest.

4.3 EAST-ADJOINING PROPERTIES

Prior to the dredging and channelization of the Duwamish River, the McLaughlin's Addition plat, located on the southern portions of Terminal 115, included areas now submerged beneath the LDW. According to 1910 tax rolls, a small structure of unknown use occupied this area before its apparent demolition by 1916. The uses of the areas of the former Foss Island were excavated as part of the channelization process for the LDW. Land use prior to 1916 was likely agricultural or pastureland. The areas proximal to the east of Terminal 115 have been a part of the LDW since 1916 (Figure 4C).

4.4 NORTH-ADJOINING PROPERTIES

A single parcel is situated directly-adjoining Terminal 115 to the north of Terminal 115 North (Figure 4). This site is currently used as a cement distribution terminal. Environmental investigations and remediation activities are ongoing as part of an AO between Ecology and the current and previous owners of the property, including Reichhold and Glacier NW.

4.4.1 Reichhold, Inc. (IEC No. 15.04)

The north-adjoining Reichhold/Glacier NW property was historically comprised of three tax parcels, which according to archived tax records and Kroll Maps of Seattle were named Tax Lots 29, 30, and 65. Tax Lot 65, a small parcel adjoining West Marginal Way, was improved by 1938 with a small wooden structure and listed in the 1940 Polk phone directory as occupied by a tool manufacturer. Tax Lot 65 was deeded to the Carlisle Lumber Company in 1941, which deeded the property to the U.S. Government in 1943. According to aerial photographs, archived tax records, and Polk phone directories from 1937 and 1938, the north-adjoining Reichhold/Glacier NW property was initially developed as a wood-preserving plant, which occupied Tax Lot 30. Tax Lot 29 was vacant at this time. Tax Lots 29 and 30 were owned by King County from 1927 to April 1943, when they were deeded to the Carlisle Lumber Company, who deeded both properties to the U.S. government in July 1943. Polk phone directories list the property as occupied by the Mineralized Cell Wood Preserving Company (MCWPC) in 1937 and 1938, at address 5942 West Marginal Way Southwest. The 5942 West Marginal Way Southwest site was listed as vacant in the 1939 Polk reverse phone directory. The tax record for Tax Lot 30 includes a photograph taken in September 20, 1937, of the MCWPC plant. Depicted in the photograph and described in the tax card is a wood-framed 16'x26' shed, inside of which appears to be numerous bags of unspecified products. Adjoining the shed is a small structure with a canopy and smokestack. A wooden A-frame is depicted in the photograph with a single line or hose running from what appears to be a suspended tank or barrel. The tank or barrel appears to be hoisted in the A-frame to approximately 30 feet above the ground. To the west of the shed, upended wooden barrels are observed lying on the exposed surface. In the background of the photograph are numerous logs connected with what appears to be gaskets and hoses, with all the hoses running behind the shed. Runners appear below the logs perpendicular to the length of the logs. The photograph appears to be facing southeast, based on knowledge of the regional geography. The tax card indicates that the shed was constructed in 1927 and was demolished in 1943. The 1937 aerial photograph of Tax Lot 30 depicts two small structures in the central portion of Tax Lot 30. Observed to the south of the two buildings are two parallel light-colored lines running east-west, and a line of darker lines, interpreted to be the logs depicted in the 1937 tax record photograph of Tax Lot 30, running north-south. In 1935, the MCWPC was granted a patent for a method of preserving wood. The technical details of the patent include the following:

- A solution of arsenic, copper, and zinc, as well as trace iron sulfate was to be mixed at elevated temperature (60 degrees Celsius) for use as a wood preserving product.
- Gaskets were to be attached to the ends of newly-felled trees and rubber hoses attached to the gaskets. The wood-treatment solution was to be introduced to the logs under pressure over the course of 96 or more hours.
- The maximum pressure for introduction of the solution into the logs was to not necessitate more than 10 pounds per square inch. The normal operating conditions were stated to be between 5 to 7 pounds per square inch.
- The injected treatment solution was introduced in the end connected to the gasket, and the solution was allowed to exit the treated log on the opposite end.

The MCWPC patent includes diagrams of gaskets and a solution delivery system to be attached to treated logs nearly identical to those observed in the 1937 tax record photograph of the MCWPC plant. A newspaper article from 1937 on the Portland MCWPC plant (Barber 1937) includes a photograph of a plant operation nearly identical to that depicted in the 1937 tax record photograph of the MCWPC plant.

According to environmental reports, tax archive records, and aerial photographs of the area, the north-adjoining Reichhold/Glacier NW property was developed as a lumber yard, which included the production of charcoal from 1941 until 1943. In 1943, the lumber yard/charcoal production facility was converted for use as a factory for wartime production of charcoal filters, specifically a copper-impregnated charcoal product named whetlerite, for use in U.S. Army gas masks. The Crown-Zellerbach Corporation operated the facility from 1943 until 1945. The charcoal was produced at the site in blast furnaces and impregnated with copper to produce the filter cartridges. The facility produced 2.6 million pounds of whetlerite material during its operation from 1943 until 1944 (USACE 1994). According to the *Sources of Pollution in the Duwamish-Green River Drainage Area* study (Foster 1945), the gas mask production process included a copper ammoniate solution wash tank of approximately 750 gallons. The contents of the wash tank were reportedly dumped into the LDW monthly. The Pollution Commission at this time recommended the contents of the wash tank be dumped onto Tax Lot 30 instead, due to concerns over water fouling of the LDW. Tax Lot 30 was reported at this time to be a dump site for discarded charcoal and sawdust.

The charcoal filter factory was leased to Reichhold in 1946 for use as a pilot-scale factory of plywood resins and wood-treating agents. The factory was involved in the production and use of formaldehyde, hydrochloric acid, sodium hydroxide, epoxies, phenols, urea, formic acid, polychlorinated phenolic compounds, and other chemicals (RETEC 1996, Perkins Coie 2008, Shaw 2008). The facility was in operation from 1947 until 1960 and was equipped with thirteen 25,000-gallon chemical ASTs comprising a storage tank farm. In addition, a railway spur that was used to store chemical tank cars was located near the tank farm. According to aerial photographs and archived tax records, the Reichhold plant was located on the central portion of the north-adjoining property. Multiple instances of spills in connection to the chemical production activities at the site were recorded during Reichhold's use of the property. In 1948, drums of ammonia and 8,000 gallons of formalin were reported spilled into the LDW. In 1953, 500 pounds of glue product entered the LDW, and 8,000 gallons of formalin was allowed to enter the LDW through a waste ditch. Phenol, formaldehyde, urea, blood, and resins were reported present in on-site sumps at this time (Perkins Coie 2008). The State of Washington Pollution Control Commission 1955 study *An Investigation of Pollution in the Green-Duwamish River* (SWPCC 1955) indicated that "highly toxic conditions [existed] in the vicinities of the outfall sewers" of the Reichhold plant which "coincided with accidental slug discharges within the industry." Phenol concentrations of LDW water in the vicinity of the outfall were reported to be in excess of 18,000 parts per million (ppm), with a pH of 3.8 at this time (Perkins Coie 2008). Environmental reports (SWPCC 1955, Shaw 2008) indicate that a wastewater impoundment containing hydrochloric acid waste liquids was located on the central portion of the north-adjoining property, approximately 200 feet from the nearest property boundary, and that a pilot-scale pentachlorophenol (PCP) production facility was located on the central portion of the factory grounds. According to aerial photographs and previous reports (Shaw 2003, ERM 2009), waste ditches were located on the central portions of the north-adjoining property and near the southern boundary of the property. After 1958, Reichhold maintained only limited operations at the factory as a laboratory. Reichhold's lease expired in 1961. The factory facilities were demolished between 1964 and 1969.

4.4.2 Glacier NW (IEC No. 15.05)

The POS owned the north-adjoining property from 1964 until 1969. The POS leased the property and granted development rights to Kaiser Gypsum for the construction of buildings associated with cement and concrete production and shipping. A cement distribution terminal was built on the north-adjoining property in 1967. In 1969, the property was sold by the POS to Kaiser Gypsum. In 1987, Kaiser Gypsum sold the property to Lone Star Northwest, Inc., which through business acquisition was renamed Glacier NW. Cement silos, loading bays, processing equipment, and washing racks were installed on the property. The current dock located at the property was installed in 1980. The embayment created by the Terminal 115 apron and the former LDW shoreline located to the north of Terminal 115 has been recently dredged. The property is currently used as a cement distribution terminal. Areas directly north of the property are utilized as a parking lot for cement trucks. A large dock for cement loading is located to the northeast of the Terminal 115 piers.

5.0 ENVIRONMENTAL INVESTIGATION SUMMARIES

Since 1990, several source evaluation investigations have been conducted in five separate areas located on or adjoining Terminal 115, as shown on Figure 6. The investigations on Terminal 115 were primarily conducted in response to petroleum releases from former USTs located on southern portions of Terminal 115, and several investigations were conducted on Terminal 115 North to evaluate the environmental quality of soil and groundwater as a result of the former operations of M & T Chemical and MRI Corporation (MRI), as well as to evaluate catch basin solids, the presence of fill at the property, and any former operations at the property. In addition, sediment quality was evaluated within Berth 1, located on the eastern portion of Terminal 115. These investigations have included sampling and analyses of soil, groundwater, stormwater outfalls and catch basins, and near-shore sediments.

The following sections provide an overview of previous sampling events completed at Terminal 115 and adjacent properties. Copies of selected portions of the investigation reports are included in Appendix C.

5.1 ON-PROPERTY INVESTIGATIONS

The following sections summarize previous subsurface investigations conducted on Terminal 115.

5.1.1 Seafreeze/Boeing USTs (IEC No. 5)

In 1994, EMCON conducted an environmental assessment following the removal of three abandoned 6,000-gallon USTs (Tank Nos. 10 through 12; Figure 5) encountered during construction activities near the southwest corner of the existing Seafreeze facility (Figures 6 and 6A; EMCON 1995). According to EMCON's report, seven soil samples collected at 4 and 8 feet below ground surface (bgs) from the excavation sidewalls contained concentrations of gasoline-range petroleum hydrocarbons (GRPH), DRPH, oil-range petroleum hydrocarbons (ORPH), and/or total xylenes that exceeded the current (2001) Washington State Model Toxics Control Act (MTCA) Method A cleanup levels (CULs) for soil. The sidewall samples were not analyzed for volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), RCRA 8 metals, or polychlorinated biphenyls (PCBs), and no floor samples were collected due to the presence of groundwater at the bottom of the excavation. According to the report, approximately 80 cy of soil were removed from the excavation area, but excavation activities were limited due to the proximity of construction activities.

A composite sample of sludge was collected from within the three USTs and analyzed for GRPH; DRPH; ORPH; benzene, toluene, ethylbenzene, and total xylenes (BTEX); VOCs; semivolatile organic compounds; RCRA 8 metals; and PCBs. The sludge sample contained concentrations of GRPH, DRPH, ORPH, naphthalene, ethylbenzene, and total xylenes that exceeded their respective 2001 MTCA Method A CULs for soil. Composite soil samples collected from the soil stockpiles generated during the removal of the USTs also contained concentrations of GRPH that exceeded the 2001 MTCA Method A CUL. SPH was observed floating on the groundwater within the UST excavation area at 9 feet bgs. Groundwater and SPH were removed from the excavation with a vacuum truck. Groundwater samples were not submitted for laboratory analysis during this investigation.

Additional subsurface investigations were performed at the site from 1994 until 1997. During the course of these investigations, four permanent monitoring wells were installed at the site, to the south, east, west, and within the 1994 UST excavation limits, as well as seven hand-augured temporary wells (EMCON 1995). Groundwater was identified in the course of these investigations to flow to the south. Groundwater samples were collected from the wells from 1994 until 1997. The samples collected from the monitoring wells contained concentrations of lead above the MTCA Method A CUL. In addition, groundwater samples collected from monitoring wells MW08 and MW09 contained concentrations of DRPH above the MTCA Method A CUL. Groundwater samples collected in 1994 from MW08 contained concentrations of vinyl chloride above the MTCA Method A CUL, and MW08 has not been tested for chlorinated volatile organic compounds (CVOCs) since that date. Groundwater samples collected from MW09 contained concentrations of benzene above the current MTCA Method A CUL from 1994 until

1997. No subsurface investigation or groundwater monitoring has been completed at the site since 1997.

5.1.2 Southwest Tank Yard/Cardlock Facility (IEC No. 8)

In July 1995, GeoScience Management, Inc. (GSM) conducted a subsurface investigation and identified the approximate location of an abandoned UST. Historical drawings indicated the presence of an 9,500-gallon heating oil UST (Tank No. 26; Figure 5) used for storing fuel oil to the east of the existing Cardlock Facility on Terminal 115 (Figures 6 and 6B; GSM 1995a). The UST was determined to be a buried tank rail car, with rudimentary fuel delivery systems. The investigation was prompted by the discovery of 2 feet of SPH floating on groundwater in monitoring well MW12. Monitoring well MW12 was installed by AGRA Earth and Environmental Technologies, Inc. on Terminal 115 in 1994 as part of a geotechnical evaluation prior to constructing the Cardlock Facility. The depth to groundwater in MW12 at the time of the initial investigation was approximately 8 feet bgs. At the time of the initial investigation, the current diesel-dispensing Cardlock Facility was not present at Terminal 115.

According to the GSM report, 12 hand-auger borings (HB-1 through HB-12) and seven hollow-stem auger borings (SB-3 and MW-13 through MW-18) were advanced to depths between 3.5 and 14 feet bgs to assess the extent of petroleum contamination in soil and groundwater at the Cardlock Facility site. According to the report, two of four soil samples analyzed contained concentrations of DRPH exceeding the 2001 MTCA Method A CUL for soil. In addition, groundwater samples collected from monitoring wells MW-14 through MW-17 contained concentrations of DRPH that exceeded the 2001 MTCA Method A CUL for groundwater. Groundwater samples were not collected from monitoring wells MW-12 and MW-18 due to the presence of SPH. The depth to groundwater in wells MW-13 through MW-18 ranged from approximately 4 to 8 feet bgs.

In June 1995, GSM conducted recovery of SPH from monitoring wells MW-12 and MW-18. A skimmer originally installed in well MW-12 was moved to MW-18 due to decreased thickness of SPH in MW-12. A total of approximately 7.3 gallons of SPH was removed from monitoring wells MW-12 and MW-18, and monitoring well MW-12 was subsequently abandoned in July 1995 due to “concerns regarding well construction” (GSM 1995b).

In August 1995, GSM collected groundwater samples from monitoring wells MW-13 through MW-17 (GSM 1995a). According to the groundwater monitoring report, the samples contained concentrations of DRPH ranging from 460 micrograms per liter (µg/L) in MW-16 to 180,000 µg/L in MW-14. Samples were not collected from monitoring wells MW-12 or MW-18 due to the presence of SPH (Figure 6B).

In September 1995, the above-mentioned abandoned UST was removed from the Cardlock Facility by Lee Morse General Contractor and the site assessment was conducted by Columbia Environmental Inc. (Columbia 1995). According to the Columbia report, the UST had a capacity of approximately 9,500 gallons and was corroded and generally in poor condition. The report noted that the product lines from the UST were running to the north in the area of previously confirmed petroleum-impacted soil and groundwater. The report concluded that, although only one soil sample collected during the investigation contained a concentration of DRPH exceeding the 2001 MTCA Method A CUL (soil sample S11, collected from the west sidewall at a depth of 9 feet bgs), "significant additional remediation" in the vicinity of the UST excavation may be warranted.

In March 1996, Columbia conducted a subsurface investigation to assess soil conditions prior to and during the construction of the existing Cardlock Facility (Figure 6 and 6B; Columbia 1996a). According to the report, soil samples collected at 4 to 7 feet bgs from three hand-auger borings (HA-1 through HA-3) did not contain concentrations of DRPH, GRPH, or BTEX that exceeded the laboratory reporting limits.

Columbia conducted an additional site assessment in September 1996 (Columbia 1996b). Soil samples were collected prior to the construction of the existing Cardlock Facility from the proposed locations of the new USTs (Tank Nos. 22 through 24), dispenser, catch basin, and oil/water separator. None of the soil samples contained concentrations of DRPH, GRPH, or BTEX in excess of their respective MTCA Method A CULs.

In September 1996, Lee Morse Construction, Inc. removed an abandoned 600-gallon UST (Tank No. 25; Figure 5) used for heating oil storage from the northeast corner of the proposed Cardlock Facility (Figure 6B). GSM conducted the site assessment during the UST removal (GSM 1996). According to the report, the UST was in poor condition with numerous holes observed on the ends and bottom of the tank. Soil samples were analyzed for DRPH and ORPH. Only one soil sample collected from the west excavation sidewall contained a concentration of DRPH that exceeded the 2001 MTCA Method A CUL. According to the report, approximately 25 cy of PCS was stockpiled and the excavation area was backfilled with clean imported fill. Groundwater was not encountered during excavation activities.

In January 1997, Columbia conducted a subsurface investigation to assess the soil and groundwater conditions prior to starting the operation of the Cardlock Facility (Columbia 1997). Four soil borings, completed as monitoring wells MW-19 through MW-22, were advanced to a maximum depth of 17 feet bgs. Soil samples were analyzed for DRPH and ORPH. A discrete soil sample collected from MW-21 at 6 feet bgs contained a concentration of DRPH that exceeded the MTCA Method A CUL. Composite soil samples collected from MW-19, MW-20, and MW-22 contained concentrations of DRPH that were below the MTCA Method A CUL.

Groundwater samples were analyzed for DRPH, ORPH, GRPH, and BTEX, none of which were detected in groundwater collected from wells MW-20 or MW-22. The concentration of DRPH detected in the groundwater sample collected from MW-21 was 908 μg/L, which exceeded the MTCA Method A CUL. Groundwater in monitoring well MW-19 was not sampled.

In April 1997, GSM conducted a groundwater sampling event at the site. Monitoring wells MW13 through MW22 were sampled during this event. The report indicated that concentrations of DRPH ranged from 308 μg/L (MW-17) to 1030 μg/L (MW-15) and monitoring wells MW-14 and MW-18 were not sampled due to the presence of SPH (GSM 1997).

In April 1998, GSM installed one groundwater monitoring well (MW-23) to evaluate soil and groundwater quality immediately downgradient of the former 9,500-gallon UST (Tank No. 26; Figure 5). GSM installed five extraction wells (RW-1 through RW-5) to the east of the Cardlock Facility and surrounding MW-18 in an effort to define the extent of SPH in groundwater. All six wells were advanced to a depth of 14 feet bgs. GSM conducted high-vacuum pilot testing and completed hydrogen peroxide treatments for groundwater. The report concluded that "high-vacuum extraction is not an appropriate remedial technology for the removal of free product from the site," and that "hydrogen peroxide treatments did not have any significant effects in reducing dissolved hydrocarbon concentrations" in groundwater (GSM 1998).

Groundwater monitoring reports from 1995 until 2009, as well as POS groundwater monitoring data tables dated 2001 to 2008, indicated that measurable SPH was present in monitoring wells MW 14, MW-18, and MW-19 and extraction wells RW-1 through RW-5.

5.1.3 The Car Wash and Body Shop Buildings (Buildings C-1 and C-2, IEC No. 10)

In 1990, Harding Lawson Associates (HLA 1990) conducted a subsurface investigation at the existing Building C-1 following the removal of a 5,000-gallon UST (known as Tank 115E) (Tank No. 28, Figure 5) from the northeast portion of the building (Figure 6C) in 1989. The UST was used for the storage of kerosene. During the UST removal by Meridian Excavating, a 3-foot-thick concrete pad and PCS were observed within the excavation area. Meridian collected two soil samples from outside the margins of the concrete pad at 13 feet bgs; the samples were analyzed for total fuel hydrocarbons (TFH) by modified EPA Method 8015 and total petroleum hydrocarbons (TPH) by EPA Method 418.1. The TFH analysis characterized the petroleum as number 1 diesel fuel (equivalent to kerosene). According to the HLA report, a 2,000-gallon AST used for kerosene storage (Tank No. 27; Figure 5) and a kerosene/water separator were located adjacent to the south and west, respectively, of the former UST.

HLA's subsurface investigation included the advancement of eight soil borings, four of which were completed as groundwater monitoring wells MW-115-1 through MW-115-4, to a maximum depth of 22.5 feet bgs. Groundwater was observed between 10 and 13 feet bgs. All of the soil and groundwater samples that were submitted to the laboratory were analyzed for TFH, and selected soil samples were analyzed for TPH. TFH was not detected in any of the groundwater samples. According to HLA's report, 3 of 11 soil samples contained concentrations of TFH that exceeded Ecology's "soil guidance cleanup level." Two samples were subsequently analyzed for TPH; the highest concentration was 31,360 mg/kg TPH in boring B-115-7 at a depth of 13 feet. What appeared to be SPH was observed in soil samples collected from B-115-6 and B-115-7 at depths at and above the water table. The locations of these borings is shown on Figure 6C. HLA concluded that the approximate area of PCS was 50 by 30 feet and to a depth of approximately 13 feet bgs. No additional subsurface investigation reports were available for this area.

The body shop building was originally constructed to refuel and service imported cars at Terminal 115 and was equipped with a 10,000-gallon gasoline UST and dispensing equipment (Tank No. 30). The UST was operational from 1971 until 1978 and the UST system was removed in 1989 by Meridian Excavation & Wrecking and Northwest EnviroService (POS 1989c). A UST site assessment was completed at the time of excavation and no contamination was reportedly encountered. The UST was decommissioned prior to excavation, and 740 gallons of gasoline were removed from the UST. No evidence of corrosion was observed on the UST, and no staining was evident on any areas of the excavation. Five confirmation samples were collected from the excavation. None of the soil samples contained detectable concentrations of petroleum hydrocarbons, with the exception of the north sidewall sample, which contained a concentration of total petroleum hydrocarbons of 28 mg/kg. No further remedial activities were considered necessary at the site.

5.1.4 Maintenance Shop UST (Building W-2, IEC 12)

In 1993, a 6,000-gallon diesel-containing UST (Tank No. 33) was removed from the vicinity of the Maintenance Building (Building W-2). During the course of the UST removal, PCS was discovered within the excavation. Soil was overexcavated until the concentration of DRPH in soils collected from the excavation sidewalls and floor was below the MTCA Method A CUL. Approximately 220 tons of soil were removed from the site and disposed of in an approved receiving facility. Groundwater was infiltrating the excavation and was pumped and disposed of. Groundwater discovered in the excavation contained concentrations of DRPH at 8 mg/kg, which is above the MTCA Method A CUL. In 1994, three groundwater monitoring wells were installed in the vicinity of Tank No. 33. The borings were completed to a depth of 25 to 27 feet bgs as monitoring wells. Monitoring wells MW05 and MW06 were installed in the vicinity of the UST, and MW07 was installed approximately 50 feet to the east of the UST. No detectable concentration of DRPH above laboratory reporting limits was detected in any soil sample. The concentration of ORPH in soil was in excess of the 2001 MTCA Method A CUL for MW06 at 5 feet bgs and was not detected above laboratory detection limits for MW05 and MW07 at depths of 5 and 10 feet bgs, respectively. The concentrations of ORPH and DRPH in groundwater were below the MTCA Method A CULs in all three monitoring wells. Detectable concentrations of DRPH were found in all of the wells. A concentration of ORPH was detected in MW05.

No sampling events have been conducted in the vicinity of the Maintenance Building or Tank No. 33 since 1994.

5.1.5 Terminal 115 North (IEC No. 14)

In 1987, Ecology conducted a Toxic Substances Control Act (TSCA) inspection of MRI, a tin reclamation and recycling facility located on Terminal 115 North (Ecology 1987). The Ecology inspector noted the presence of 13 bulk ASTs, 5 of which were double-walled (Tank No. 40; Figure 5) on concrete pads located on the north side of the facility, as shown on Figure 6D. The ASTs were used for the storage of sulfuric acid, sodium hydroxide, and spent electrowinning solution. According to the inspector’s report, surface water from the tank farm drained to a stormwater drain that flowed into the LDW. Spills within the plant were reportedly collected in a sump and recycled back into the production process (EPA 1988). Spills in the vicinity of the storage tanks were reportedly collected in a series of sumps and trenches and pumped to a pretreatment area prior to discharge to the sanitary sewer. The inspector stated that MRI was in violation of state water quality control regulations because the facility did not have an adequate secondary containment for the tank farm in the event of a large spill event and subsequent surface water runoff.

A 1997 Site Hazard Assessment (SHA) conducted by Seattle-King County Department of Public Health (SKCDPH 1998) stated that the tin reclamation and recycling facility had operated under the names M & T Chemical, MRI (affiliated with American Can), Proler International (Proler), and Proler Recycling, and was, at the time of the SHA, owned by Schnitzer Steel Industries, Inc. (Schnitzer). According to the SHA, the facility conducted detinning activities from 1963 to 1997. SKCDPH collected three soil samples near the railroad spur area of the site and analyzed them for RCRA 8 metals, tin, and zinc. One of the three samples contained a concentration of 470 mg/kg for lead, which exceeded the MTCA Method A CUL for lead in soil.

In 1999, Schnitzer sent a letter to the POS (Schnitzer 1999b) referencing subsurface investigations conducted by Proler in 1991, as well as a UST removal and site assessment overseen by ENSR Consulting and Engineering (ENSR). The letter stated that in 1991 Proler had analyzed a composite soil sample for zinc, lead, chromium, cadmium, and tin at the site. The sample was composited from 15 sampling locations across the site, each of which was collected at a depth of 2 feet bgs. According to the letter, the composite soil sample did not contain concentrations of metals above the MTCA Method C CULs for industrial sites. Proler also collected 36 samples of the black mud generated by the detinning process, composited the samples into 6 samples, and analyzed them for RCRA metals in accordance with the Toxicity Characteristic Leaching Procedure (TCLP), as well as tin and zinc. The letter indicated that none of the samples contained concentrations of metals that were “above levels that would classify the black mud as dangerous waste in the State of Washington.” Proler also conducted another subsurface investigation in 1997, which included collecting two samples of the black mud that were analyzed for TCLP metals, evaluating static acute fish toxicity test to evaluate the black mud, and collecting one surface water sample that had been in contact with the black mud (Schnitzer 1999a, 1999b). The letter indicated that all fish survived the 96-hour test, and based on these results, the black mud would not be designated as a dangerous waste under the State of Washington dangerous waste regulations. The surface water sample was below MTCA Method C Groundwater and Surface Water CULs for aluminum, cadmium, lead, tin, and zinc.

The Schnitzer letter also referenced two tanks formerly located at the site: a 250-gallon AST used for storing diesel fuel (Tank No. 39) and a 1,100-gallon UST used for storing heating oil (Tank No. 38; Figure 5). The tanks were removed by 1992, and a “moderate fuel odor” was reported by ENSR. A subsurface investigation in the former UST area was conducted by ENSR in 1993 (Schnitzer 1999b). The investigation included four soil borings; the samples were collected at 5 and 8 feet bgs. Only one sample reportedly contained a detectable concentration of heating oil at 66 mg/kg, which was below the MTCA Method A CUL.

In 2009, Landau Associates, Inc. (Landau 2009) completed an Environmental Investigation Report for the POS Terminal 115 North. The purpose of the investigation was to evaluate potential contaminant source areas at the site and to evaluate migratory pathways from these potential source areas to the LDW. Landau concluded in the report that potential migratory pathways from the site to Glacier Bay (located to the north of the site and within the LDW) include groundwater and the existing storm drain system. Soil was not considered a potential pathway; however, leaching of contaminants from soil to groundwater was noted as an indirect pathway for contaminants to enter Glacier Bay.

Landau advanced 11 borings (boring DP-1 and monitoring wells MW-1 through MW-10) at the site (Figure 6D) and concluded in their report that metals, PAHs, acetone, and lube oil-range petroleum hydrocarbons were present at levels that exceed MTCA Method A, B, and/or C screening levels in soil, groundwater, and/or storm drain solids throughout the site. However, arsenic was the only contaminant found in groundwater samples collected from monitoring wells MW-9 and MW-27 (a previously installed well) located immediately adjacent to Glacier Bay.

Further work to characterize the nature and extent of the releases at Terminal 115 North and the adjacent property to the north is ongoing under an Ecology directed AO.

5.1.6 Terminal 115 Berth 1 Sediment Sampling

Chemicals of concern (COCs) identified in the sediment within the LDW include, but are not limited to, PCBs, PAHs, metals, dioxins, and phthalates.

In 2009, Anchor QEA, LLC collected a series of sediment grab samples (T115-SS01 through T115-SS05) in the vicinity of Berth 1 prior to conducting maintenance dredging activities (Figure 6E). The results of samples collected during the event were compared to the Sediment Quality Standards (SQS) and the Dredge Material Management Program sediment standards (DMMP); only one analyte exceeded the criteria (butylbenzyl phthalate, which was detected in a sediment sample [T115-SS05; Anchor 2009a] collected at a depth of 0 to 10 centimeters [cm]).

Upon completion of the construction and dredging activities that followed the 2009 sediment sampling event, Science and Engineering for the Environment LLC (Science and Engineering) conducted a post-dredge subsurface characterization event in 2010.. Sediment samples were collected from stations SC01 through SC04 at depths ranging from 0 to 4 feet. Data were compared to Dredged Material Management Program (DMMP) screening levels. The following analytes exceeded the DMMP screening levels:

- Butylbenzyl phthalate (SC02 from 1 to 2 feet, SC03 [SC032] from 0 to 1 foot)
- Flouranthene (SC01 from 3 to 4 feet)
- Pyrene (SC01 from 3 to 4 feet, SC03 [SC032] from 1 to 2 feet)
- Benzo(a)anthracene (SC03 [SC032] from 1 to 2 feet)
- Chrysene (SC03 [SC032] from 1 to 2 feet)
- Total high molecular weight polycyclic aromatic hydrocarbons (HPAHs) (SC01 from 2 to 4 feet, SC02 from 3 to 4 feet, and SC03 [SC032] from 1 to 2 feet)
- Total PCBs (SC01 and SC02 from 0 to 4 feet, SC03 [SC032] from 0 to 3 feet, and SC04 [SC043] from 0 to 1 foot)
- Total dioxins Toxicity Equivalency Quotient (SC01 from 1 to 4 feet, SC02 and SC03 [SC032] from 0 to 4 feet)

In an effort to mitigate exposure to the contaminants identified in the post-dredge sediment, a sand cap was placed over the exposed material. Sand within the first 0 to 10 cm of the cap was analyzed for the COCs identified above, and none of the samples contained concentrations of COCs in excess of the screening levels. The results of both phases of the characterization are discussed in detail within Science and Engineering's post-Dredge Subsurface Sediment Characterization and Sand Cover Monitoring Report, dated June 25, 2010. A 3-year sand cap monitoring program has been established to evaluate the ongoing effectiveness of the cap in providing a barrier to the contaminated sediment below.

Ecology's pending Lower Duwamish Waterway RM 1.6 to 2.1 West Data Gaps Report will include consolidated sediment data, including Berth 1 data, compared to the Sediment Quality Standards (SQS) and the Washington State Sediment Cleanup Screening Level (CSL) per Washington Administrative Code 173-204-320.

5.2 OFF-PROPERTY INVESTIGATIONS

The following sections summarize previous off-property subsurface investigations conducted in the vicinity of Terminal 115.

5.2.1 First Avenue Bridge Landfill

A large-scale investigation of the vicinity of the First Avenue Bridge was completed in 1994 in association with the redesign of public streets south of Terminal 115 (Dames & Moore 1994). Soil borings were advanced on Terminal 115, as well as on the south-adjoining properties and within tidal flats along the LDW, and a monitoring well was installed in the vicinity of the Seafreeze loading dock (MW-19). No petroleum hydrocarbons or solvents were encountered at concentrations above their respective detection limits in groundwater samples collected and analyzed from MW-19. A groundwater sample collected from MW-19 contained a concentration of 13 µg/L total lead, which exceeded the MTCA Method A CUL; however, concurrent analyses for dissolved lead did not reveal concentrations above the reporting limit. Concentrations of cadmium, arsenic, mercury, and chromium in the groundwater sample collected from MW-19 were below applicable MTCA Method A CULs and/or laboratory reporting limits.

Sediment samples were collected southwest of Terminal 115 near the First Avenue Bridge as part of the study. With the exception of mercury, the samples collected near the southern Terminal 115 property boundary were found to contain concentrations of metals, TPH, and VOCs below applicable MTCA Method A soil CULs. Mercury was detected at a concentration of 5.2 mg/kg in a tidal flat sample collected at 5 feet bgs. This concentration is, however, within the range of background mercury concentrations commonly found in the LDW, which are cited as ranging from 0.012 to 28.8 mg/kg. VOCs and TPH were detected in soil and groundwater samples collected from areas to the south of the First Avenue Bridge and on the eastern banks of the LDW. These localized areas of contamination were reported to be hydrologically crossgradient, involved soil impacts only, or were limited in nature.

5.2.2 Boeing Building 1-01 (IEC No. 15.01)

Boeing Building 1-01 was constructed in 1929 and was used as an administrative building, a metallurgical laboratory, and later by Foss Environmental as an office and spill response center. A tank removal form and letter indicates that in 1991, a 4,000-gallon diesel UST (Tank No. 1; Figure 5) was removed from the property (POS 1991). The location of the tank was not provided on the removal form. O'Sullivan Construction completed the tank removal and collected soil stockpile samples. No contamination was reportedly discovered during the investigation. No other information regarding the tank was reported.

In 1998, two additional USTs were removed from the southwestern portion of the property (SD&C 1998). The tanks included a 3,000-gallon Bunker C UST and a 1,000-gallon diesel UST (Tank Nos. 2 and 3; Figure 5). The 1,000-gallon UST was associated with a limited subsurface release of diesel fuel. Remedial activities included the removal of PCS and 110 gallons of petroleum-impacted groundwater from the excavations. Overexcavation of PCS could not be completed due to the proximity of the Southwest Michigan Avenue underground utilities. PCS was left in place until 2002, when Urban Redevelopment and Foss Redevelopment oversaw the subsequent removal of 45 tons of PCS from the former excavation areas. Compliance monitoring was completed in 2003, and confirmation soil and groundwater samples collected from the site indicated that concentrations of DRPH were at or below the MTCA Method A CUL (Urban Redevelopment 2003).

5.2.3 Al Bolser Tire Store (IEC No. 15.02)

A tire repair facility, which included a sales office, repair garage, and fuel-dispensing pump islands, operated on a west-adjoining property across West Marginal Way Southwest at 6515 West Marginal Way Southwest. A gasoline UST with a capacity of 5,264 gallons was removed from the site in 2006 (Filco 2006). A stockpile sample contained detectable concentrations of GRPH, ethylbenzene, and total xylenes below applicable MTCA Method A CULs. No other stockpile or excavation samples contained detectable concentrations of petroleum hydrocarbons, and the excavation was backfilled with the stockpiled soil.

5.2.4 Reichhold/Glacier NW Agreed Order Site (IEC Nos. 15.04 and 15.05)

Subsurface investigations of environmental quality on the north-adjoining property have been conducted since 1985. A detailed discussion of the investigations is provided in the 2008 *Remedial Activities Summary Report* (Shaw 2008) and the 2009 draft *Summary of Existing Information and Data Gaps Report* (ERM 2009). The site is managed under an AO between Ecology, Reichhold, and Glacier NW. Confirmed and suspected sources of contamination at the property include the historical operation of an arsenic-based wood-preservation plant, a charcoal and gas mask production plant, a chemical factory, and a cement storage and distribution facility. Sediment characterization studies have been conducted in the vicinity of the Reichhold/Glacier NW site since 1998.

5.2.4.1 Subsurface Investigations at Reichhold/Glacier NW

As a result of historical use of the property, several COCs and areas of contamination were identified. The locations of a former PCP production facility, tank farm, wastewater impoundment, water treatment tank, PCP pilot production areas, a septic tank, and wastewater drainage ditches were identified as areas containing highly elevated soil and groundwater concentrations of chlorinated phenols, including PCP (RETEC 1996, SAIC 2007, Shaw 2008, ERM 2009).

These historical release areas were primarily located on the central and northern portions of the property. Arsenic was detected in soil and groundwater in an undefined area located on the central portion of the property, extending south to the property boundary adjoining Terminal 115 (ERM 2009, Landau 2009). The area of arsenic contamination, although of unknown source in previous investigations, appears to coincide with the areas of operation of the Mineralized Cell Wood Preserving Company's operations in 1937 and 1938, according the 1937 aerial photographs, Kroll Maps, and historical phone directories. Furthermore, the Mineralized Cell Wood Preserving Company is an identified potential source of arsenic contamination in the Boeing Isaacson site's AO (Ecology 2010b). PCP was detected in soil and groundwater above the MTCA Method C CULs in soil and groundwater near the former pilot-scale production areas of the property and the former wastewater impoundment. Concentrations of PCP in soil reached 1,000 mg/kg in soil boring GP-16, approximately 100 feet north of Terminal 115 (Shaw 2008, ERM 2009). A soil sample collected from boring GP-15, which was advanced between soil boring GP-16 and the northern Terminal 115 property boundary, exhibited PCP concentrations below laboratory reporting limits. Groundwater concentrations of PCP and related phenolic compounds did not exceed detection limits of 1 µg/L and 5 µg/L, respectively, in monitoring wells located on along the northern Terminal 115 property boundary (MW3S, MW3D, MW18, MW20, and MW24 through MW26) (ERM 2009).

Trace pesticides and phthalates were confirmed in soil beneath the property, and elevated concentrations of DRPH and GRPH were identified in soil in localized areas across the property. Silver and arsenic were confirmed to be above MTCA Method A, B, and/or C CULs in both soil and groundwater (Shaw 2008, ERM 2009).

Approximately 3 to 5 feet of fill material consisting of silt, sand, and “concrete debris” comprise the shallow subsurface; no mention of CKD was made in any reports or boring logs prepared for the property. A perched groundwater zone was observed at depths of 4 to 13 feet bgs. Lower hydrologic units below the perched zones were confined to clay/silt layers defined as aquitards. The general flow of the perched layer was reported to be toward the southeast, defining Terminal 115 as downgradient of the Reichhold/Glacier NW site. Deeper groundwater within the lower lithologic layers was found to flow in a northeasterly direction (RETEC 1996, Shaw 2008, ERM 2009).

5.2.4.2 Remedial Activities at Reichhold/Glacier NW

Pilot-scale testing of treatment methods to address COCs on the Reichhold/Glacier NW site began in 1997. An ozone sparging system was installed to remediate the PCP plume in groundwater, and a hydrogen peroxide injection and groundwater removal system was evaluated for the treatment of arsenic contamination in groundwater. The systems operated from 2000 until 2006. The treatment processes were highly successful in the remediation of groundwater concentrations of PCP and arsenic in groundwater. Monitoring well MW-13, for example, experienced a drop in PCP concentrations from a pretreatment high of 8,040 µg/L to a post-treatment concentration in 2007 of 569 µg/L. In the impoundment area, a PCP peak of 63.2 µg/L in pretreatment wells decreased to 2 µg/L after treatment in four of five groundwater samples collected at the site.

5.2.5 Glacier Bay Sediment Sampling

Significant sediment impacts have been reported by Ecology in Glacier Bay, located north of Terminal 115 and east of the Reichhold/Glacier NW site. According to the 2007 Ecology Glacier Bay Data Gaps Report, dioxin and furan concentrations confirmed in the offshore sediments of Glacier Bay are higher than at any other area in the LDW (SAIC 2007). The following are COCs associated with sediments that have exceeded the applicable SQS in Glacier Bay: arsenic, mercury, zinc, copper, lead, antimony, tributyltin, dioxins/furans, PCBs, phthalates, PAHs, 1,2-dichlorobenzene, PCP, benzyl alcohol, and organo-tin products.

The portion of the LDW located along the Reichhold/Glacier NW site has been identified as a source control area by Ecology, and continued sediment sampling is planned to assess source control options and the full extent of sediment impacts at the site.

Ecology’s pending Lower Duwamish Waterway RM 1.6 to 2.1 West Data Gaps Report, and Ecology’s Glacier Bay Source Control Area Summary of Existing Data and Identification of Data Gaps Report (SAIC 2007) includes consolidated sediment data, including Glacier Bay data, compared to the Sediment Quality Standards (SQS), as defined in WAC 173-204-320, and the Washington State Sediment Cleanup Screening Level (CSL), as defined in WAC 173-204-520.

5.2.6 Duwamish Waterway Sediment Sampling

Evaluations of sediment quality within the LDW have been conducted since the 1970s. A detailed discussion of the investigation activities conducted prior to 2003 is provided in the Windward Phase 1 Remedial Investigation (RI) (Windward 2003). These and subsequent sampling events conducted in the vicinity of Terminal 115 are discussed below.

Approximately 30 sediment samples were collected along the shoreline of Terminal 115 during the RI and previous sampling events (Figure 6, Windward 2010). The following analytes exceeded the SQS in sediment samples collected along the shoreline of Terminal 115 (Figures 6 and 6E):

- HPAHs
- Metals, including arsenic, copper, mercury, and zinc
- PCBs
- Dioxins
- Phthalates, including dimethyl phthalate, butylbenzyl phthalate, bis(2-ehylhexyl)phthalate, and di-n-octyl phthalate

Ecology's pending Lower Duwamish Waterway RM 1.6 to 2.1 West Data Gaps Report will include consolidated sediment data compared to the Washington State Sediment Cleanup Screening Levels (CSL), as defined in WAC 173-204-520, and the Sediment Quality Standards (SQS), as defined in WAC 173-204-320

6.0 ISSUES OF ENVIRONMENTAL CONCERN

The following section provides a synopsis of each of the IECs identified in preceding sections (Table 1, Figure 4). Current tenant operations and a further discussion of source control strategies are discussed in detail in Ecology's pending Terminal 115 Data Gaps Report. The potential of the IECs to impact the LDW and require source control actions is discussed in Section 7.0 below.

6.1 SOUTHERN WATERFRONT BLOCKS PETROLEUM SITES

The following IECs, which are located on the southeast corner of Terminal 115, are summarized below and discussed in greater detail in Section 3.3. No environmental investigations have taken place in the vicinity of the historical automotive service stations that formerly existed on the southern portions of Terminal 115.

- **Standard Oil Station (IEC No. 1).** The retail gasoline service station, which operated at the southeast portion of Terminal 115 between 1923 and 1965, was equipped with a UST system and an automotive repair and lubrication facility.
- **Refinery Building (IEC No. 2)** Although the exact nature of the facility is unknown, the use and storage of petroleum products is possible.
- **Richfield Service Station Site (IEC No. 3).** The retail gasoline service station and repair facility were equipped with two 500-gallon USTs, a 1,000-gallon UST, and a hydraulic lift. It operated on the southeast portion of Terminal 115 between 1938 and 1964.

6.2 BOEING PLANT 1

The IECs listed below include those identified in association with the former Boeing Plant 1 operations.

6.2.1 World War I-Era Boeing Plant 1 Site

As discussed in Section 3.4.1, numerous IECs have been identified in association with the historical uses of the World War I-era Boeing Plant 1 site. No subsurface investigations have been completed in the vicinity of the facilities, which include the following:

- **Assembly Building (Building 1-03, IEC No. 4.01).** Building 1-03 was originally constructed to assemble large seaplanes. During the 1930s and 1940s, the assembly building was used to assemble component parts that were later sent to Boeing Plant 2 and Boeing Plant 3 for final assembly. According to Sanborn Maps and the 1942 Boeing site plan, an oil house was located 30 feet to the west of Building 1-03.
- **Boiler House and Dry Kiln (Buildings 1-06 and 1-10, IEC No. 4.02).** The dry kiln and boiler house were located on the waterfront of the World War I-era Boeing Plant 1. These buildings were involved in the drying and treating of wood and the production of heat for the Boeing plant.
- **Transformer House (Building 1-07, IEC No. 4.03).** The transformer house was built as an addition to the boiler house in 1928. Tax record photographs indicate that the transformer was rated for 26,000 volts.
- **Old Assembly Building (Building 1-08, IEC No. 4.04).** The old assembly building was constructed in 1918 and was originally used for the assembly of parts before crating and delivery. The 1942 Boeing site plan and the 1950 Sanborn Map indicate the use of the building as welding, paint spraying, crating, materials testing, shipping, and a plaster shop.
- **Paint Spraying Shop (Building 1-04, IEC No. 4.05).** The paint spraying and plating shop was constructed in 1918 and contained facilities for spraying paint and plating airplane parts. The 1942 Boeing site plan and the 1950 Sanborn Map indicate that the westernmost portion of the building was used primarily for paint spraying and the remainder of the building was used for “anodic treatment.” Paint spraying and anodic treatment of airplane parts involve the use and likely discharge of hexavalent chromium, cyanide, paint products, cutting oil, and various other metals and chemicals.
- **Maintenance Welding Building (Building 1-12, IEC No. 4.06).** Welding and unspecified storage of equipment have been documented to have occurred at this site.

6.2.2 Machine Shop (Building 1-02)

The following are IECs associated with Building 1-02 as discussed in Section 3.4.2 and discussed below.

- **Main Factory Building (Building 1-02, IEC No. 4.07).** The main building contained brazing and welding facilities, a machine shop, a sheet metal shop, heat treating facilities, an assembly room for airplane components, and metal cutting, burning, and grinding shops. In addition, welding equipment fuel was stored in a structure to the west of the building.

- **Former Engine Testing Facility (Building 1-02, IEC No. 4.07).** The facility was equipped with three 5,000-gallon USTs that were removed in 1994 (Tanks Nos. 5-7). GRPH contamination was discovered in stockpiled soil removed from the UST excavation, and SPH was observed on groundwater. No further subsurface investigations have taken place at the site. Apparent monitoring well monuments were observed in the area of the former USTs during the site reconnaissance; however, the current status of the wells was not evaluated.
- **Buried fuel dispenser and gasoline tank (Tank No. 8, IEC No. 4.08).** According to the 1942 Boeing site plan, the UST system was located to the southwest of Building 1-02. Several transformers also were located in the vicinity of Building 1-02.
- **Compressor House (Building 1-39, IEC No. 4.09).** The compressor house was constructed adjacent to the west of Building 1-02 by 1952, and according to aerial photographs, it was demolished by 1978. The area of the former compressor house has not been investigated, and the widespread use of chlorinated solvents and lubrication oil is suspected.

6.2.3 Eastern Test Facilities

The following are IECs identified previously in Section 3.3.3. No subsurface investigations have been conducted to evaluate the environmental quality of soil and groundwater in the vicinity of these IECs, which include the following:

- **Hammer Shop (Building 1-29, IEC No. 4.10).** The hammer shop and foundry building was constructed to the east of Building 1-02 in 1936 and was involved in the forming of structural metal components for airplane components. Metal tailings and waste materials would have resulted from the production of metal components.
- **Static Test Building (Building 1-40, IEC No. 4.11).** The static test building area was an area documented to contain several ASTs. As the areas surrounding Building 1-40 are reportedly associated with testing engines, fuel pumps, and structural components, the likelihood of the use and storage of fuel in these areas is high. In addition, Building 1-40 also was utilized as a foundry.
- **Brick Incinerator (Building 1-42, IEC No. 4.12).** According to aerial photographs and Boeing site plans produced between 1942 and 1963, a brick incinerator operated on the eastern waterfront from at least 1938 until the demolition of Boeing Plant 1.
- **Storage Buildings (IEC No. 4.13).** The buildings located to the west of Building 1-40 were used for the storage of paint, rivets, and lubrication oil. A drum storage yard was also listed in the vicinity of the storage buildings. According to aerial photographs, the storage buildings were demolished and replaced by 1946 with

Building 1-41, the fuel-pump testing building; two USTs, which were reportedly filled with sand and closed in place, were located to the west of the building.

- **Engine Testing Facility (Building 1-34, IEC No. 4.14).** According to the 1942 Boeing site plan, the engine test facility also included a fuel tank test shed located to the south of the building.
- **Steam Plant (Building 1-30, IEC No. 4.15).** According to tax records and Boeing site plans, the steam plant was equipped with a 20,000-gallon diesel fuel UST located adjacent to the northwest of the building. The steam plant operated until 1970 and was demolished by 1976, at which time the UST was also closed in place.
- **Lift Station (IEC No. 4.16).** The lift station building pumped waste water into a force main prior to discharging the water to sewer outfalls. Wastewater generated at the site during the operation of the lift station included chromates and cyanide, and many other COCs are suspected to have entered the waste stream.
- **Sandblasting Area (Building 1-44, IEC No. 4.17).** According to aerial photographs and the 1957 and 1963 Boeing site plans, as well as archived tax records, sandblasting took place in this area until 1970. Sandblasting is associated with elevated concentrations of arsenic, cadmium, and other heavy metals.
- **Acid Test Building (Building 1-45, IEC No. 4.18).** The acid test building was located to the east of Building 1-40, directly abutting the LDW The structure was demolished by 1978.

6.2.4 Western Test Facilities/Hazardous Materials Storage Area

The following include the IECs identified in Section 3.4.4 and 3.4.5:

- **Test Revetment (Building 1-50, IEC No. 4.19).** Revetments are often used for aircraft storage; however, aircraft were neither assembled nor stored at Terminal 115 after 1941. Similarly constructed test revetments utilized by Boeing were used for aircraft munitions testing and engine testing. The test revetment was demolished in 1966.
- **Fuel Test Lab (Building 1-21, IEC No. 4.20).** The 1955-vintage fuel test lab contained five separated test rooms. According to a Boeing drawing (Boeing 1958), a 3,000-gallon UST containing gasoline was installed between the test lab and the fuel storage building (Building 1-22) and a dispenser was installed near the tank. No decommissioning records were observed for the 1958-vintage UST and dispensing systems.
- **Fuel Storage Facility (Building 1-22, IEC No. 4.21).** The fuel storage building was used for the storage of flammable materials, and a 1960 photograph of the building indicated the presence of multiple unknown barrels and a fuel dispenser. In addition, a flammable materials storage shed was constructed in 1964, and archived records indicate that USTs were located beneath the concrete slab foundation. The structure appears to the north of Building 1-22 in the Boeing 1963 site plan. According to aerial photographs, Building 1-22 was demolished by 1973.

- **Acid Storage (Building 1-26, IEC No. 4.22).** The acid storage building contained waste acid and alkali materials that were stored in drums.
- **Hazardous Materials Storage (Building 1-27, IEC No. 4.23).** No data were available regarding the type or quantity of the materials stored within Building 1-27 or of the containers that were used to store the materials. However, various potentially hazardous chemicals have been listed in previous sections and were possibly stored in this building.
- **Paint Storage (Building 1-23, IEC No. 4.24).** A paint storage building (Building 1-23) was located to the west of Building 1-05. In the 1961 aerial photograph, Building 1-23 appears to have been demolished.
- **Seafreeze Tanks (Tank No. 9, IEC No. 5).** The Seafreeze building was constructed on the former site of Boeing Plant 1 in 1978. According to a 1980 Seafreeze blueprint, a 4,000-gallon diesel UST was installed at the southwest corner of the building. In 1994, EMCON conducted an environmental assessment following the removal of three abandoned 6,000-gallon USTs encountered during construction activities near the southwest corner of the Seafreeze facility. These three USTs are unrelated to the UST identified in the 1980 blueprint. Soil samples collected during the excavation activities contained concentrations of GRPH, DRPH, ORPH, and total xylenes that exceeded their respective 2001 MTCA Method A CULs. SPH was observed floating on the groundwater within the UST excavation.

6.3 SOUTHWEST TANK FARM AREAS AND FORMER KLINKER GRAVEL

The following IECs, which are located on the southwestern portion of Terminal 115, are summarized below and discussed in greater detail in Sections 3.5 and 3.6:

- **Former SAV-MOR Gas and Auto Salvage (IEC No. 6).** The historical repair facility, retail gasoline station, and auto salvage yard operated on the southwest portion of Terminal 115 between 1930 and 1967. The service station included two fuel dispensers and a service garage (grease shed) installed with a hydraulic lift. No subsurface investigations have been conducted in the vicinity of the site.
- **Material Reclamation Smelter (IEC No. 7).** Archived tax records indicate that an aluminum smelter equipped with an 8,000-gallon UST was constructed in 1952 at 6730 West Marginal Way. According to historical photographs and reverse directories, the site was occupied by Materials Reclamation and Maralco Aluminum as an aluminum smelter from 1952 through 1985. In 1994, in preparation for the installation of a fuel dispensing station, geotechnical borings were advanced at the property. SPH was observed in groundwater, and extensive soil contamination was confirmed. In 1995, the UST, which was reported to have a capacity of 9,500 gallons, was removed. Additionally, the tank was confirmed to be a buried tanker rail car that had been modified to serve as an underground heating oil tank. Soil and groundwater contamination was discovered in the floor and sidewalls of the excavation, as well as surrounding the product piping. Soil was overexcavated and disposed of off the property, with the exception of soil underlying the building structural supports. Contaminated soil that was left in place was to be removed with the installation of the fuel

dispensing facility; however, no subsequent evaluation of soil and groundwater quality as a result of the smelter operations has reportedly been conducted.

- **Cardlock Facility (IEC No. 8).** Property records indicate that the current gasoline- and diesel-dispensing station was installed in 1996. Groundwater monitoring has been conducted at the property since 1995, the results of which are discussed further in Section 5.1.2. The site is currently occupied by a restaurant building and a commercial fleet refueling station containing seven fuel-dispensing pump islands and three 10,000-gallon USTs. No information regarding surface water, soil, or groundwater impacts associated with the current use and storage of gasoline and diesel in association with the existing commercial fleet vehicle refueling station were observed. However, the risk for a release to the subsurface exists.
- **Klinker/Ready-Mix Graystone Division (IEC No. 9).** According to aerial photographs taken in 1922, what appears to be a sand and gravel mining and mixing plant was in operation along West Marginal Way Southwest near the west-central portion of Terminal 115. Water from the nearby slough was used as wash water for sluicing gravel and sand into a sorting box to be used as sanitary fill by the City of Seattle. The operation reportedly produced considerable amounts of fine silt that was discharged into Turning Basin No. 1. Aerial photographs taken between 1946 and 1965 indicate that the areas surrounding the Klinker site became increasingly silted and the shoreline expanded progressively to the east over time. The cement loading, mixing, and dock facilities were removed by 1971 after the infilling of Turning Basin No. 1.

6.4 CENTRALTERMINAL 115 FACILITIES

The following IECs are associated with current and former operations across Terminal 115. They are summarized below and discussed in greater detail in Section 3.7.

- **Car Wash Building (Building C-1, IEC No. 10).** This structure is currently present on Terminal 115 and is used as a repair and maintenance shop. The building was equipped with subsurface troughs and reclaiming pits for the catchment of gray water before the water was discharged to the sewer system. To the west of the building, a 2,000-gallon UST and a 5,000-gallon UST, both of which were used for the storage of kerosene, were installed at the property in 1971 to fuel a heating device in the car wash and to collect kerosene from a separator system. The 5,000-gallon UST (Tank No. 28) was removed in 1989. Soil samples collected during excavation activities contained concentrations of TPH that exceeded the MTCA Method A CULs. No investigations of the active AST (Tank No. 29) located at the facility have been conducted.
- **Body Shop Building (Building C-2, IEC No. 10).** The building initially was constructed with a 10,000-gallon UST (Tank No. 30) and fuel-dispensing pump island. The UST and fuel dispenser were removed in 1989. No evidence of petroleum contamination was discovered in the course of UST removal activities.
- **Maintenance Building (Building W-2, IEC No. 12).** The 1972-vintage structure was utilized for repair services and was equipped with a 6,000-gallon UST (Tank No. 33) that originally contained diesel. The UST was connected to a fuel dispenser located approximately 100 feet to the northeast of Building W-2. The UST contained diesel fuel in 1993 and was replaced in

1994 by a 6,000-gallon diesel UST (Tank No. 34). In addition, a 400-gallon, concrete AST containing gasoline and a 300-gallon metal lined AST containing diesel (Tank Nos. 32 and 31, respectively) are currently located near the building and are connected with fuel dispensers.

- **Terminal Office Building (Building A-5, IEC No. 13).** The office building was constructed in 1971. According to 1975 drawings, the building was equipped with a fueling facility that was located approximately 40 feet to the west of the building. The fuel facility was equipped with two fuel-dispensing pump islands, a 1,000-gallon gasoline UST, and a 2,000-gallon diesel fuel UST (Tank Nos. 36 and 35, respectively). According to UST closure documents, both USTs were removed in 1990. A 1,100-gallon diesel UST (Tank No. 38) was installed in 1993 in the place of the former USTs. Fuel dispensers are not currently present, and the UST has not been used since its installation.

6.5 FILL MATERIAL (IEC NO.11)

As discussed in Section 3.9, much of Terminal 115 has been altered with the addition of fill. Fill material was introduced to the site from a variety of sources, such as dredge spoils from the LDW and other unknown off-property sources.

The periods of fill activities at the property include the following:

- In 1916 and 1917, the portion of the Duwamish River located in the vicinity of Terminal 115 was channelized. Foss Island was created from a combination of dredge spoils and natural banks during this time.
- In 1928, dredge ships deposited spoils onto the southern portions of Terminal 115.
- In 1935, dredge spoils from the LDW were deposited on Terminal 115 North and the north-adjoining property.
- In the early 1950s, Klinker expanded the shoreline in the vicinity of its operations on West Marginal Way Southwest and McAllister's Slough was partially filled by the City of Seattle and property owners. In addition, in 1953, a large dewatering lagoon was constructed on Foss Island.
- In the late 1950s, light-colored fill material was deposited on Terminal 115. The filling activities connected Foss Island to the land directly east of West Marginal Way Southwest. Fill material was deposited across all of Foss Island, as well as areas to the north and west of Turning Basin No. 1. Reclaimed land was occupied by a concrete barge loading facility.
- In 1963, the shoreline was expanded in the vicinity of Terminal 115 North, which brought the shoreline to the eastern extent of the Terminal 115 North property boundary. The land reclaimed was utilized as settling ponds for a detinning plant that operated on the property.
- Between 1965 and 1969, two large dewatering lagoons were constructed using light-colored fill material. These dewatering lagoons were located on and to the west of the former Foss Island. A large stockpile of light-colored material was observed in the center of Foss Island between the dewatering lagoons.
- Between 1969 and 1971, the remainder of Terminal 115 was infilled and graded.

- Between 1973 and 1976, the Boeing Plant 1 facilities were demolished, fill material was added to the former building sites, and the area was graded.

6.6 TERMINAL 115 NORTH (IEC NO. 14)

Terminal 115 North, located on the northern portion of Terminal 115 has one IEC associated with the former operations of M&T Chemical and MRI, as summarized below and discussed in greater detail in Section 3.8.

Reverse directories and aerial photographs indicate that the first developed use of Terminal 115 North was in 1963, when a detinning plant was constructed. The plant recycled metals by dissolving the waste metal in solution with caustic lye and separating it from solution via electrowinning. The plant was equipped with two 16-ton cranes, a plating room, a boiler room, 13 ASTs, a 250-gallon AST used for storing diesel fuel, a 1,100-gallon UST used for storing heating oil, and a detinning area where the caustic lye and metals materials were mixed in a chamber. The UST was removed in 1992. The plant also included two evaporation/settling ponds intended to capture waste sludge for further extraction of metals. These evaporation/settling ponds were unlined and included dikes to prevent loss of material. Waste water was pumped into the sanitary sewer located near the facility (Ecology 1998). The stormwater on the site appears to have been discharged into the Duwamish River until 1991, when stormwater was diverted to the King County Metro system (Metro 1991). Due to the failure of the site to meet wastewater discharge limits in 1996, all process wastewater and stormwater was reused on site (Ecology 1998).

Further subsurface investigation work is proposed for the site, and a full characterization of the site is ongoing under an Ecology-supervised AO.

6.7 OFF-PROPERTY ISSUES OF ENVIRONMENTAL CONCERN

Several industrial uses on adjoining properties have been identified as IECs, which are summarized below and discussed in greater detail in Section 4.0:

- **Administrative Building (Building 1-01, IEC No. 15.01).** Boeing Building 1-01 was constructed in 1929 and used as an administrative building, a metallurgical laboratory, and an office and spill response center. A tank removal form and letter indicate that in 1991 a 4,000-gallon diesel UST was removed from the property and no contamination was discovered during the investigation. No other information regarding the tank was reported. In 1998, two additional USTs were removed from the southwestern portion of the property. The tanks included a 1,000-gallon diesel UST and a 3,000-gallon Bunker C UST. The 1,000-gallon UST was associated with a limited subsurface release of diesel fuel. PCS was left in place until 2002, when it was overexcavated. Compliance monitoring was completed in 2003, and confirmation soil and groundwater samples collected from the site indicated that concentrations of DRPH were at or below MTCA Method A CULs.
- **Klinker/Al Bolser Tire Store (IEC No. 15.02).** A sand and gravel mining and cement mixing operation existed on the west-adjoining property from the 1920s through the 1950s. The presence of CKD on the site has been documented in previous reports and historical maps and aerial photographs. In addition, a tire repair facility, which included a sales office, repair garage, and fuel-dispensing pump islands, operated on a west-adjoining property across

West Marginal Way Southwest at 6515 West Marginal Way Southwest. A gasoline UST with a capacity of 5,264 gallons was removed from the site in 2006. A stockpile sample contained detectable concentrations of GRPH, ethylbenzene, and total xylenes below applicable MTCA Method A CULs. No other stockpile or excavation samples contained detectable concentrations of petroleum hydrocarbons, and the excavation was backfilled with the stockpiled soil.

- **Aluminum and Bronze Fabrication (IEC No. 15.03).** According to archived tax records and aerial photographs, the property located at 6301 West Marginal Way Southwest was initially developed with a single-family residence in the 1910s. The wood-framed, one-story residence was heated by a stove. It was demolished in 1964 and replaced by the currently existing 1964-vintage, aluminum and bronze smelting facility. The smelting facility was originally heated by an oil-burning furnace. No investigations have been conducted to evaluate soil and groundwater quality in the vicinity of the operational smelter.
- **Reichhold (IEC No. 15.04).** According to environmental reports, tax archive records, and aerial photographs of the area, the north-adjoining Reichhold/Glacier NW property was initially developed as an arsenic-based wood-preservation plant in 1937. In 1943, a factory that produced copper-impregnated charcoal filters for use in U.S. Army gas masks was located on the site. The charcoal filter factory was leased to Reichhold in 1947 for use as a pilot-scale factory of plywood resins and wood-treating agents. The factory was involved in the production and use of formaldehyde, epoxies, phenols, polychlorinated phenolic compounds, and other chemicals until 1960. The factory was equipped with thirteen 25,000-gallon, chemical ASTs. In addition, a railway spur that was used to store chemical storage train cars was located near the tank farm. A pilot-scale PCP production facility was located on the northern portion of the factory grounds. The former locations of the PCP production facility, tank farm, wastewater impoundment, water treatment tank, PCP pilot production areas, a septic tank, and wastewater drainage ditches were identified as areas containing highly elevated soil and groundwater concentrations of chlorinated phenols, including PCP. Arsenic was identified in soil and groundwater beneath the central portion of the property, extending south to the property boundary adjoining Terminal 115, and beyond. Trace pesticides and phthalates were confirmed in soil beneath the property, and elevated concentrations of DRPH and GRPH were identified in soil in localized areas across the property. Silver and arsenic were confirmed to be above MTCA Method A, B and/or C CULs in both soil and groundwater.
- **Glacier NW (IEC No. 15.05).** A cement storage, shipping, and processing facility was built on the Glacier NW property in 1967. Cement silos, loading bays, processing equipment, and washing racks were installed on the property. The current dock located at the property was installed in 1980. The embayment created by the Terminal 115 apron and the former LDW shoreline located to the north of Terminal 115 is regularly dredged by Glacier NW, the current owner of the property. The property is currently used as a cement shipping site equipped with storage, loading, and processing facilities. Investigation of confirmed subsurface contamination at the site is ongoing under an Ecology-supervised AO.

7.0 POTENTIAL PATHWAYS OF CONTAMINATION

The pathways described in Ecology's Source Control Strategy, the applicability of each pathway to Terminal 115, and an evaluation of the pathways as they relate to the IECs are discussed below. Current tenant operations and evaluation of the stormwater pathway as it pertains to the current tenant operations are discussed in detail in Ecology's pending Terminal 115 Data Gaps Report.

7.1 SOURCE CONTROL STRATEGY PATHWAYS

Prior to developing source control management strategies, a preliminary evaluation of the applicability of each pathway identified in the Lower Duwamish Waterway Source Control Strategy (http://www.ecy.wa.gov/pubs/0409043.pdf) and their relevance to Terminal 115 was conducted, as summarized below. The pathways considered to be of concern for potential impacts to LDW sediments are presented conceptually on Figure 8.

7.1.1 Direct Discharges

The direct discharge of pollutants to the waterway from commercial, industrial, private, and municipal outfalls may impact sediment quality, depending on the origin and character of the effluent. Many of these discharges are permitted under the NPDES. Permitted discharges, regardless of whether they exceed applicable permit levels, may result in sediment contamination. Permitted industries include sand and gravel facilities, boatyards, shipyards, and other facilities.

Terminal 115 Applicability:

- Three tenants on Terminal 115 currently operate and discharge stormwater under an ISWGP; the remaining areas of Terminal 115 operate and discharge stormwater under a GPMS. Stormwater outfalls and other subsurface infrastructure are discussed in Section 2.4.2 above, and stormwater discharge and management is discussed above in Section 2.4.3.
- Because Terminal 115 discharges stormwater to private and municipal outfalls, this potential pathway to the LDW sediments is considered complete.

7.1.2 Stormwater Pathway

Stormwater enters the waterway directly from properties adjacent to the waterway and via storm drains and pipes, ditches, and creeks. Stormwater pollution is generated when rain contacts pollutants that have accumulated in or on exposed soil and other surfaces, or comes from illegal discharges or illicit connections to storm sewers. Contaminated solids that collect in storm drains/pipes, ditches, or creeks may be carried to the waterway by stormwater. In the LDW area, 80 industrial sites are authorized to discharge under the general NPDES permit for industrial stormwater. In addition, three individual NPDES permits are active for given industrial operations in the area. The City of Seattle and King County are municipal NPDES permittees for stormwater.

Terminal 115 Applicability:

- Same as Direct Discharge above.

- This potential pathway to the LDW sediments is considered complete.

7.1.3 Combined Sewer Overflows

Combined Sewer Overflow (CSO) events are combined discharges of stormwater, municipally permitted industrial discharges, and untreated sewage that are released directly into the waterway during heavy rainfall, when the sewers have reached their capacity. CSO discharges can carry chemicals that impact sediments. The City of Seattle and King County are municipal NPDES permittees for CSOs.

Terminal 115 Applicability:

- Terminal 115 tenants Shultz Distributing, Inc. and Seafreeze discharge to the King County sanitary sewer, which is connected to two CSOs located on and in the vicinity of Terminal 115.
- The Terminal 115 CSO/SD is located in the vicinity of the northern property boundary, on Terminal 115 North, and is an uncontrolled 48-inch-diameter Metro King County overflow outfall. The discharge is delivered to the LDW. Since 2006, the CSO has average 2.5 overflow events per year, averaging 3.52 million gallons (MG) per year between 2003 and 2007. Control measures including a 0.5 MG storage tank are expected to be completed by 2027 (King County 2009).
- The West Michigan Regulator/CSO is located in the vicinity of the First Avenue South Bridge, located approximately 100 feet south of Terminal 115. The CSO is a 36-inch-diameter, deep water, uncontrolled Metro King County overflow outfall which discharges into the LDW. The overflow average since 1991 is 4.8 events per year. The average overflow volume between 2001 and 2007 was 1.23 MG per year. No specific control measures for this CSO are planned at this time; however, control is currently expected to be completed by 2027 (King County 2008).
- This potential pathway to LDW sediments is considered complete.

7.1.4 Groundwater

Contaminated groundwater may enter directly into the LDW via seeps or it may infiltrate into storm drains/pipes, ditches, or creeks that discharge to the waterway.

Terminal 115 Applicability:

- The presence of shallow groundwater has been confirmed at Terminal 115 (Section 2.3.2).
- Active and abandoned subsurface storm drains/pipes are situated in confirmed and potentially contaminated areas of Terminal 115, as described in Section 2.4.2 above.
- This potential pathway to LDW sediments is considered complete.

7.1.5 Erosion/Leaching

Waterway bank soil, contaminated fill, waste piles, landfills, and surface impoundments may release contaminants directly to the LDW through erosion, via soil erosion to stormwater, or by leaching to groundwater.

Terminal 115 Applicability:

- Terminal 115 has some limited exposed waterway bank soil and unpaved surfaces that may be susceptible to erosion (Figure 3).
- Terminal 115 has confirmed shallow groundwater and subsurface storm drain systems, as described above.
- Approximately two-thirds of Terminal 115 is comprised of fill, the majority of which has unknown origin.
- This potential pathway to LDW sediments is considered complete.

7.1.6 Spills, Dumping, Leaks, and Inappropriate Housekeeping/Management Practices

Spills, dumping, and leaks within the Terminal 115 property may result in contaminant releases to soil, groundwater, and/or stormwater that may impact sediments. Dumping material such as wood waste or debris directly into the waterway may also impact sediments. Inappropriate management practices either within the storm drain or CSO basins tributary or directly adjacent to the LDW increase the risk of sediment contamination.

Terminal 115 Applicability:

- Terminal 115 operations currently include some limited handling of potential contaminants, such as oils and grease, cleaners, and hazardous material cargo, that have the potential to spill, be dumped, leak, or be handled inappropriately.
- Acknowledging the close proximity of Terminal 115 to the LDW and the confirmed presence of groundwater and subsurface drainage features, this potential pathway to LDW sediments is considered complete.

7.1.7 Waterway Operations and Traffic

Contaminants from riverside docks, wharves, and piers, discharges from vessels (gray, bilge, ballast or other waters), fuel releases, and other spills may impact sediments. Inappropriate general housekeeping and management practices for waterside construction, vessel fueling, hull maintenance, wastes and other materials at marinas and small boatyards may also impact sediment quality.

Terminal 115 Applicability:

- Terminal 115 waterway operations primarily involve the loading and unloading of cargo to/from non-powered barges. There are no marine vessel maintenance or fueling operations at the property. There is potential for spills to occur from the barges, cargo, or loading vehicles.
- Terminal 115 does have some wood piers that may contain creosote. A majority of the pier columns at Terminal 115 have been upgraded to steel.

- This potential pathway to LDW sediments is considered complete.

7.1.8 Atmospheric Deposition

Air pollution can enter the waterway directly or through stormwater, and become a potential source of sediment contamination. Air pollution can be localized, such as paint over-spray, sand-blasting, and fugitive dust and particulates from loading/unloading of raw materials such as sand, gravel, and concrete, or it can be widely-dispersed from vehicle emissions and industrial smokestacks.

Terminal 115 Applicability:

- Terminal 115 operations that may result in localized air pollution (e.g., sandblasting and painting) are very limited and performed within containments.
- Cargo loaded and unloaded at the facility is primarily containerized, and no known raw materials handling is performed as part of the current tenant operations.
- Terminal 115 does not have any industrial smokestacks, and vehicle emissions from vehicles operating at the property are not considered significant.
- Potential contaminants associated with exposed (non-paved) surfaces at Terminal 115 and surrounding properties can become airborne. Airborne particulates can migrate to the LDW via wind dispersion.
- Off-site-generated airborne contaminants collected on the paved surfaces at Terminal 115 can collect and migrate to the LDW via the stormwater system.
- This potential pathway to LDW sediments is considered complete.

7.2 PATHWAYS EVALUATION

The following section provides a preliminary evaluation of the potential for contaminants to migrate to the LDW via the applicable pathways as a result of conditions at the IECs discussed in Section 6.0. A summary of the IECs and the applicable pathways is presented in Table 1.

7.2.1 Southern Waterfront Blocks Petroleum Sites (IEC Nos. 1, 2, 3)

The IECs identified in association with the former Southern Waterfront Blocks Petroleum sites include the use, storage, and/or distribution of petroleum hydrocarbons. To date, no subsurface investigations have been conducted on this area of Terminal 115 to assess whether a release of petroleum hydrocarbons to the subsurface has occurred. If a release of petroleum hydrocarbons to soil and/or groundwater has occurred in this area, there is potential for contaminants to migrate to the LDW via the groundwater pathway.

7.2.2 Boeing Plant 1 (IEC No. 4)

The IECs identified in association with the former Boeing Plant 1 operations may have included the use and/or storage of materials including cyanide, chromates, industrial bases and acids, solvents, petroleum hydrocarbons (including jet fuel, avgas, gasoline, cutting oil, lubrication oil, diesel fuel, bunker fuel, and other distillates), PCBs, petroleum-based paints, and metals. To date, no subsurface investigations have been conducted on the former Boeing Plant 1 area of Terminal 115 to assess whether a release of hazardous materials to the subsurface has occurred, with the exception of the former Boeing/Seafreeze UST removal and associated investigations, A release of petroleum hydrocarbons to subsurface soil and groundwater has been confirmed in the vicinity of the former Boeing/Seafreeze USTs, as well as a release of CVOCs and metals from an unknown source confirmed in groundwater samples collected from nearby monitoring wells (EMCON 1995). Contaminated soil and groundwater have the potential to migrate to the LDW via the groundwater and stormwater pathways. However, considering the distance of the Boeing/Seafreeze UST release from the LDW (1,068 feet) a release to the waterway via the groundwater pathway is considered unlikely. The extent of the Seafreeze UST release, or any other Boeing-related releases, has not been fully characterized and the potential risk of migration to the LDW has not been assessed.

7.2.3 Southwest Tank Farm Areas and Former Klinker Gravel (IEC Nos. 8 and 9)

The former SAV-MOR retail gasoline station and auto salvage may have included the use, storage, and/or distribution of petroleum hydrocarbons and/or metals. To date, no subsurface investigations have been conducted on this area of Terminal 115 to evaluate whether a release of contaminants to the subsurface has occurred. If a release of contaminants to soil and/or groundwater has occurred in this area, there is potential for contaminants to migrate to the LDW via the groundwater and stormwater pathways. However, considering the distance of the SAV-MOR site from the LDW (1,406 feet) a release to the waterway via the groundwater pathway is considered unlikely.

The former material reclamation smelter may have used and/or stored metals and petroleum hydrocarbons. To date, no subsurface investigations have been conducted to evaluate the environmental quality of soil and groundwater as a result of the former smelter operations. However, investigations documenting the removal and closure of the former buried rail car and 600-gallon heating oil UST confirmed a release of petroleum hydrocarbons to subsurface soil and groundwater. Contaminants have the potential to migrate to the LDW via the groundwater pathway. Considering the distance of the release from the LDW (1,378 feet west), a majority of the site is capped by asphalt, and that stormwater infrastructure is unconnected with the contaminated zone, a release to the waterway via the groundwater, erosion/leaching, stormwater, and air pollution pathways is considered unlikely. However, additional site characterization and a formal evaluation of the potential risk of migration to the LDW is warranted, given the confirmed impacts associated with the site.

The operational Cardlock Facility uses, stores, and distributes petroleum hydrocarbons. While several investigations have confirmed a release of petroleum hydrocarbons to the subsurface in the vicinity of the facility as a result of former operations, no evaluation of the existing UST system has been conducted. Contaminated soil and groundwater have the potential to migrate to the LDW via the groundwater and stormwater pathways. Considering the distance of the release from the LDW (1,265 feet west) and the licensed UST facility is regularly tested for tightness, a release to the waterway via the groundwater pathway is considered unlikely.

The former Klinker/Ready-Mix Graystone Division site may have used and stored petroleum hydrocarbons and/or concrete products containing metals. To date, no subsurface investigations have been conducted on the former concrete mixing and storage yard, former barge loading terminal, or fill operations in this area of Terminal 115 to confirm or dismiss a release of hazardous materials to the exposed surface or subsurface. If present, contaminated soil and groundwater have the potential to migrate to the LDW via the groundwater, stormwater, erosion/leaching, and air pollution pathways.

7.2.4 Car Wash and Body Shop Buildings (Buildings C-1 & C-2, IEC No. 10)

The Car Wash Building (Building C-1) included the use and storage of petroleum hydrocarbons. A localized release of petroleum hydrocarbons to soil and groundwater has been confirmed in the vicinity of the former USTs. Contamination has the potential to migrate to the LDW via the groundwater pathway. However, considering the distance of the release from the LDW (890 feet) a release to the waterway is considered unlikely.

The Body Shop Building (Building C-2) included the use and storage of gasoline for the refueling of vehicles imported to the facility. Petroleum-contaminated soil and groundwater was not discovered during the removal of a 10,000-gallon UST or the associated dispensing equipment. If a release of contaminants to soil and/or groundwater is discovered in this area, there would be potential for contaminants to migrate to the LDW via the groundwater pathway. As the decommissioning of the UST and dispensing equipment at Building C-2 was free of contamination during removal, no other sources of contamination are known to exist at Building C-2, and considering the distance of any potential release from the LDW (800 feet west), a release to the waterway via the groundwater pathway is considered unlikely.

7.2.5 Terminal Office Building (Building A-5, IEC No. 13)

The Terminal Office Building (Building A-5) formerly used, stored, and/or distributed petroleum hydrocarbons. To date, no subsurface investigations have been conducted on this area of Terminal 115 to evaluate whether a release of contaminants to the subsurface has occurred. If a release of contaminants to soil and/or groundwater has occurred in this area, there would exist a potential for contaminants to migrate to the LDW via the groundwater pathway. As no contamination was discovered during the decommissioning of two USTs in 1990 and the current UST at the site has been inactive since its installation, a release to the waterway via the groundwater pathway is considered unlikely.

7.2.6 Maintenance Building (Building W-2, IEC No. 12)

The Terminal Maintenance Building (Building W-2) currently uses, distributes, and stores petroleum hydrocarbons. The ASTs located at this site include secondary containment. During UST decommissioning in 1993, soil and groundwater contamination was discovered. The subsequent subsurface investigation confirmed the presence of diesel- and oil-range petroleum contamination of soil and groundwater in the vicinity of the removed UST. Concentrations of DRPH or ORPH in soil and groundwater samples taken from 50 feet downgradient from the former UST were below MTCA Method A CULs. The UST removed in 1993 was replaced by a diesel-containing UST. Considering the site is asphalt-paved, contamination resulting from the former UST has not been discovered beyond the vicinity of the UST, the active AST systems are properly maintained and contained, and the stormwater system located at the site includes oil-water separators, a release to the waterway via the groundwater and stormwater pathways is unlikely. However, additional site characterization and a formal evaluation of the potential risk of migration to the LDW is warranted, given the confirmed impacts and active fuel storage and dispensing system located at the site.

7.2.7 Fill Activities (IEC No. 11)

Fill material was deposited across Terminal 115 between 1915 and 1971. Fill material has included dredge spoils, excavated earth, sanitary landfill, concrete and cement products, and other material of unknown origin. The filling operations primarily occurred between the 1950s and 1970s. Several areas of historical filling activity remain unpaved, such as in the western portion of the loading terminal. Acknowledging the various sources of fill listed previously in this report, metals, petroleum hydrocarbons, creosote, and solvents are contaminants that are potentially associated with fill material. No investigations have been conducted to assess impacts associated with the fill material used at Terminal 115. If a release of contaminants to soil and/or groundwater has occurred on filled areas of Terminal 115, there is potential for contaminants to migrate to the LDW via the groundwater, erosion/leaching, stormwater, and air pollution pathways, due to leaching of contaminants to the groundwater from the fill, the release of contaminants from fill to surface water in unpaved areas, the erosion of fill materials from the banks of T115, and the conveyance of fill via wind in unpaved areas of T115. The potential for a release has not been fully characterized, and migration to the LDW has not been confirmed or dismissed.

7.2.8 Terminal 115 North (IEC No. 14)

Terminal 115 North was historically the site of a metals recycling facility from the 1960s until the 1990s. In 2010, the POS signed an AO with Ecology to perform RI/FS activities. The work associated with the AO is expected to perform any required cleanup actions and subsequent source controls. Pending any change in the AO, the Terminal 115 North site's source control strategies are to be managed by the AO participants. Preliminary analysis of the source control strategies, current environmental conditions, and data gaps have been produced for the POS in the 2009 Landau *Environmental Investigation Report* (Landau 2009) and the 2010 GeoEngineers Data Gaps Memorandum (GeoEngineers 2010). The POS is completing a characterization of available source control strategies under the AO rubric.

7.2.9 Boeing Administration Building (Building 1-01, IEC No. 15.01)

The Boeing Administration Building (Building 1-01) is located to the south of the Terminal 115 property, and historically used and stored heating oil. A release of petroleum hydrocarbons to subsurface soil and groundwater has been confirmed in the vicinity of the former heating oil USTs near the building. During subsequent subsurface investigations and remedial activities, soil and groundwater concentrations were below applicable MTCA Method A CULs. Furthermore, groundwater flows south, away from the nearest property boundary with Terminal 115. Contamination may have the potential to migrate to the LDW via the groundwater pathway, but not by means of conveyance through the Terminal 115 site. The extent of the release has not been fully characterized; however, the potential for migration to Terminal 115 has been dismissed, and the site does not represent a source control issue for Terminal 115.

7.2.10 Klinker /Al Bolser Tire Store (IEC No. 15.02)

The former Klinker/Al Bolser Tire Store included the use and storage of petroleum hydrocarbons and cement products. To date, no known subsurface investigations have been conducted on the Klinker site to evaluate whether a release of hazardous materials to the subsurface has occurred, with the exception of a UST site assessment performed during the removal of a 5,500-gallon UST and associated dispensing equipment formerly located at the Al Bolser Tire Store. No contamination was discovered as a result of this investigation. The contamination of soil or groundwater at the site as a result of the operation of a repair garage or a gravel and cement production and loading facility remains unassessed. If a release of contaminants to the soil and/or groundwater has occurred at the site, the potential for these contaminants to migrate to the Terminal 115 property, and subsequently to the LDW, via the groundwater, erosion/leaching, stormwater, and air pollution pathways exists.

7.2.11 Aluminum and Bronze Fabrication (IEC No. 15.03)

The aluminum and bronze fabrication smelter that has existed to the west of Terminal 115 since 1967 included the use and storage of metal products, and it is suspected to have included the use and storage of solvents and petroleum hydrocarbons. No known subsurface investigations have been conducted at the site to evaluate whether a release of petroleum hydrocarbons, solvents, or metals to the subsurface has occurred. If a release of petroleum hydrocarbons to soil and/or groundwater has occurred at this site, there is potential for contaminants to migrate to Terminal 115 via the groundwater, erosion/leaching, stormwater, and air pollution pathways. The site has not been fully characterized, and migration to Terminal 115, and subsequently to the LDW, has not been confirmed or dismissed.

7.2.12 Reichhold/Glacier NW. (IEC Nos. 15.04 and 15.05)

The Reichhold/Glacier NW site was occupied by a chemical production plant and cement terminal that was involved in the use, storage, and production of chlorinated phenolic compounds, as well as the storage and distribution of cement products. In addition, fill material has been historically deposited on the site, the majority of which is unpaved. Numerous subsurface investigations have confirmed the presence of soil, sediment, and groundwater impacts of PAHs, dioxins, polychlorinated phenols, phenols, formaldehyde, metals, phthalates, furans, petroleum hydrocarbons, chlorinated solvents, and pesticides. Contaminated soil and groundwater have the potential to migrate to the Terminal 115 property via the groundwater, stormwater, erosion/leaching, and air pollution pathways. Considering the proximity of the site to Glacier Bay and Terminal 115 (adjoining), continued releases of contaminants to the LDW and Terminal 115 North are considered likely.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Terminal 115 has a long history of industrial use, which began in approximately 1909. Operations have included dredging and filling, numerous Boeing Plant 1 operations, retail gasoline stations, vehicle maintenance and salvage, gravel and concrete/cement production, and tin reclamation. Terminal 115 is currently occupied by a number of seafood facilities, cargo storage and transfer operations, vehicle and container maintenance facilities, rail fabrication, warehouses, construction storage, and a retail gasoline station. Upgrades and improvements to infrastructure at Terminal 115 have occurred with each change of tenant operations. As a result, a majority of the terminal is either paved with asphalt or capped with a building slab or a roof cover. Furthermore, several subsurface investigations and sediment sampling events have been conducted at the property to evaluate the potential for environmental impacts as a result of past and current operations.

This diverse current and operational history of the site has resulted in a number of issues of environmental concern that will be considered in the formulation and implementation of an effective, long-term source control strategy. However, the potential risk of a release from many of the IECs identified for Terminal 115 has not been evaluated, and several confirmed releases at Terminal 115 have not been fully characterized. A comprehensive evaluation of contamination pathways impacting the portions of the LDW along Terminal 115 cannot be completed until the potential environmental impacts associated with current and former operations at Terminal 115 have been assessed and characterized. In addition, source control strategies are being developed at the Terminal 115 North site as part of an AO between the POS and Ecology. Source control action items may be identified by Ecology to address the data gaps associated with the potential pathways in order to assess the potential for sediment recontamination.

9.0 BIBLIOGRAPHY

Advanced Environmental Technologies. 1991. *MRI Corporation at 6000 West Marginal Way S.W. Historical Management Practices*. June 19.

Aerial Photographs of the Property and Adjoining Areas for the years 1946, 1953, 1961, 1965, 1970, 1973, 1978, 1981, 1983, 1989, 1995, and 2001. Reviewed at the University of Washington Map Library, Seattle, Washington.

Aerial Photographs of the Property and Adjoining Areas for the years 1929 and 1964. Reviewed at Seattle Public Utilities Engineering Records Vault, Seattle, Washington.

Anchor QEA, LLC. 2009a. *Port of Seattle, Terminal 115, Slope Area Surface Sediment Characterization Report.* October.

________. 2009b. *Quality Assurance Program Plan, Port of Seattle Terminal 115, Post-Dredge Subsurface Sediment Characterization.* June.

________. 2009c. *Sand Cover Monitoring Plan, Port of Seattle Terminal 115.* June.

Anderson-Birkeland-Anderson Consulting Engineers (ABA). 1962. "Floor Plans: M. & T. Chemicals Inc. Detinning Plant – Seattle." November 15.

Bagley, C.B. 1916. *History of Seattle.* Chicago: S.J. Clarke Publishing Co.

Baist's Real Estate Atlases (Baist's Atlases). Seattle Area Maps for the Years 1905, 1908, and 1912.

Barber, Lawrence. "Chemical Agent Preserves Wood – Big Timbers Used in Dock Construction Treated." *The Oregonian.* Page 14. August 1, 1937.

Boeing Aircraft Company (Boeing). 1942. "Plant No. 1, Seattle, Wash." [Site Plan] June 2.

Boeing Airplane Company (Boeing). 1952. "Plant 1, General Layout Showing Air Distribution System." December 10.

Boeing Airplane Company (Boeing). 1958. "Underground Fuel Tank 3000 Gal Capacity – Move Gasoline Pump." Drawing No. 101-000-1033. July 28.

The Boeing Company (Boeing). 1963. "Plot Plan: Former Plant I, Terminal 115.

Columbia Environmental Inc. (Columbia). 1995. *UST Closure Report, Port of Seattle, Terminal 115, Southwest Front Street & West Marginal Way Southwest, Seattle, WA 98106.* September.

________. 1996a. *Hand Auger Sampling, Port of Seattle, Terminal 115, Southwest Front Street & West Marginal Way Southwest, Seattle, Washington.* March 8.

________. 1996b. *Soil Sampling, Port of Seattle. Terminal 115, Southwest Front Street & West Marginal Way Southwest, Seattle, Washington.* September 5.

________. 1997. *Monitoring Well Installation, Soil, and Groundwater Sampling, Port of Seattle, Terminal 115, Southwest Front Street & West Marginal Way Southwest, Seattle, Washington.* January 13.

Dames & Moore. 1994. *Site Investigation Report, Hazardous Waste Assessment, State Route 99 – First Avenue South Bridge Project, Seattle, Washington*. March 10.

Dragovich, J.D., P.T. Pringle, and T.J. Walsh (Dragovich et al.). 1994. "Extent and Geometry of the Mid-Holocene Osceola Mudflow in the Puget Lowland: Implications for Holocene Sedimentation and Paleogeography." *Washington Geology.* 22: 3–26.

EMCON. 1995. *Underground Storage Tank Decommissioning and Soil Assessment Report, Terminal 115, Port of Seattle, Seattle, Washington.* February 12.

ENSR Consulting and Engineering. 1991. *MRI Corporation, Seattle, Washington, Waste Characterization Program*. March.

Environmental Science & Engineering, Inc. 1994. *Groundwater Assessment, Port of Seattle, Terminal 115, West Marginal Way, Seattle, Washington 98134*. August 4.

ERM. 2009. *Summary of Existing Information and Data Gaps Report: Glacier Northwest Inc. – Reichhold, Inc. Site, Seattle, Washington*. October.

Filco Company Inc. 2006. *UST Removal, 6515 West Marginal Way SW, Seattle, Washington*. March 17.

Foster, Richard F. 1945. *Sources of Pollution in the Duwamish-Green River Drainage Area*. December 6.

GeoEngineers, Inc. (GeoEngineers). 2010. Memorandum Regarding Terminal 115 North Data Summary, Data Gap Identification, and Approach for Source Evaluation Study. From John Herzog with GeoEngineers. To Brick Spangler with the Port of Seattle. April 9.

GeoScience Management, Inc. (GSM). 1995a. *Subsurface Investigation, Port of Seattle Terminal 115 Property.* July 2.

________. 1995b. Letter Regarding Summary of Product Recovery Operations, Port of Seattle - Terminal 115 Site, 6730 West Marginal Way South, Seattle, WA. From Howard W. Small, RG, CPG , Project Manager at GeoScience Management, Inc. To Kathy Bahnick, Port of Seattle, Environmental Engineering. December 16.

________. 1996. *Letter Report Documenting Removal of 600-Gallon Fuel Oil Underground Storage Tank, Terminal 115, Seattle, Washington.* December 18.

________. 1997. Letter Regarding April 4, 1997 Groundwater Sampling Data, Port of Seattle, Terminal 115, Seattle, Washington. From Howard W. Small, RG, CPG, Project Manager for GeoScience Management, Inc. To Kathy Bahnick, Port of Seattle, Environmental Engineering. April 23.

________. 1998. *Results of Additional Monitoring and Extraction Well Installation, Wellhead Repair, High-Vacuum Extraction Pilot Testing, and Hydrogen Peroxide Treatments, Port of Seattle Terminal 115, Seattle, Washington.* April 30.

Harbor Engineering Company. "Port of Seattle Marine Facilities, Northland Marine Services, Inc. Terminal 115 Modifications: Site Layout & Access." Sheet No. G1.3. Undated.

Harding Lawson Associates (HLA). 1990. *Underground Storage Tank Investigation in the Vicinity of the Car Wash Building, Terminal 115, for the Port of Seattle.* December 5.

Harper-Owes. 1985. *Duwamish Ground Water Studies Waste Disposal Practices and Dredge and Fill History*. March.

HartCrowser, Inc. 1995. Letter Regarding Request for Initial Review of Proposed RI/FS for Independent Cleanup Reichhold/Lone Star Site, 5900 West Marginal Way, Seattle, Washington. To. Mr. Ching-Pi Wang, PE with the Washington Department of Ecology, Northwest Regional Office. August 3.

Historical Photographs of the Property and Adjoining Areas for the years 1922 and 1924. Reviewed at the Museum of Flight Library.

Historical Photograph of the Property and Adjoining Area for the year 1957. Reviewed at National Archives.

Horton Dennis & Associates, Inc. 1971. "Port of Seattle: ATA Survey, TBC Plant No. 1." February 16.

Kelly Pittelko Fritz and Forssen Consulting Engineers (KPFF). 1971a. "Port of Seattle, Marine Facilities T115, Foss-Alaska Barge Facility: Plot Plan." Drawing No. 250-654. June 8. As-Built Revisions September 1975.

________. 1971b. "Port of Seattle, Marine Facilities T115, Foss-Alaska Barge Facility: Container Yard Site Plan." Drawing No. 250-655. June 8. As-Built Revisions September 1975.

________. 1971c. "Port of Seattle, Marine Facilities T115, Foss-Alaska Barge Facility: Maintenance Building Mech. Schedules & Details." Drawing No. 250-714. June 8. As-Built Revisions October 1975.

King County Department of Natural Resources and Parks. 2008. *CSO Control Plan Update*. June.

________. 2009. *Comprehensive Sediment Quality Summary Report for CSO Discharge Locations*. December.

Kroll Map Company, Inc. Atlases of Seattle (Kroll Maps). Reviewed at Seattle Public Library, Central Branch, Seattle, Washington.

Landau Associates (Landau). 2009. *Environmental Investigation Report, Port of Seattle Terminal 115 North, Seattle, Washington*. December 31.

Lane, Polly. "Terminal 115 Work to Begin." *The Seattle Times.* April 11, 1971. Sec. C2.

Leo A. Daly & Associates (Leo Daly). 1957. "Sewer Layout: Sewer Facilities Plant I Modernization, Seattle, Washington, Boeing Airplane Company." April 26.

METRO. 1991. Letter Regarding Permit Application for MRI, Division of Proler International Corporation. From Bruce R. Burrow. To Doug Knutsen with Washington State Department of Ecology. August 13.

Parametrix, Inc. 1990. *Phase II Site Assessment, 5900 West Marginal Way, Seattle, Washington.* August.

Perkins Coie. 2008. Letter Regarding Reichhold/Glacier Northwest Site: Reichhold Inc.'s Description of Operations at the Seattle Plant, 5900 W. Marginal Way SW. From Travis A. Exstrom with Perkins Coie. To Ms. Donna Ortiz De Anaya with Washington State Department of Ecology. September 19.

Phoinix Corporation, The. 2006. *Stormwater Inspection Report, Terminal 115*. December 5.

________. 2007. *Outfall Verification Report*. September 18.

Pinnacle GeoSciences. 2002. *Historical Review Report, First Avenue South Bridge, Exchange Properties—Parcels D & E, Seattle, Washington.* August 15.

Port of Seattle (POS). "Marine Facilities, 1994 Aerial Topographic Survey of Marine Properties, Terminal 115 – North." Port of Seattle No. HM-9401-C-47. Undated.

Port of Seattle (POS). "Marine Facilities Lower Duwamish Industrial District, Terminal No. 115 – Development Unit No. 1: Demolition Plan." Drawing No. 250-335. Undated.

________. "Marine Facilities Lower Duwamish Industrial District, Terminal No. 115 – Development Unit No. 1: Phase I – Plan." Drawing No. 250-336. Undated.

________. "Sanitary Sewer Plan & Sewage Lift Stations." Marine Facilities, Terminal 115, Phase IV Fill, Utilities and Paving. Port of Seattle No. 115-7505-C-8. 1-26-76 As Built Drawing. Undated.

________. "Marine Facilities, Lower Duwamish Industrial District, Terminal No. 115 – Development Unit No. 1: Lease Area Alterations." Drawing No. 250-348. Undated.

________. 1970. "L.D.I.D.D. Terminal No. 115 Development Unit No. 2, Yard Improvements & Utilities: North Sanitary Sewer." Drawing No. 250-574. September.

________. 1971. "Longshoremen's Restroom Sewer Plan." Marine Facilities, T115, Foss-Alaska Barge Facility. Port of Seattle No. 250-717A. September 22.

________. 1972a. "Lower Duwamish Industrial District, Terminal No. 115 – Development Unit No. 1: Existing Site Plan." Drawing No. 250-334. As Built. July 31.

________. 1972b. "Marine Facilities Lower Duwamish Industrial District, Terminal No. 115 – Development Unit No. 1: Phase II – Plan." Drawing No. 250-337. As Built. August 1.

________. 1974. "Marine Facilities, L.D.I.D.D. Terminal No. 115 Development Unit No. 2, Yard Improvements & Utilities: Drainage Plan, South Storage Area." Drawing No. 250-584. As Built. November.

________. 1975. “Marine Facilities T115, Fuel Dispensing Facility: Plan, Sections, Elevation, Panel Diagrams.” Drawing No. 115-7507-ME-1. November 5.

________. 1987. Letter Regarding Terminal 115 Site Inspection, Preliminary Assessment Screening—Follow-up Inspection, November 3, 1987. From George Blomberg with POS. To Robert M. Duffner with Ecology and Environmental, Inc. December 3.

________. 1989a. Record of Closure of Underground Storage Tank: Tank T115B. July 18.

________. 1989b. Record of Closure of Underground Storage Tank: Tank T115L. July 18.

________. 1989c. Check List for Permanent Closure of Underground Storage Tank(s): Tank T115D. December 19.

________. 1991. *Record of Closure of Underground Storage Tank*. December 30.

________. 1994. “Marine Facilities, Terminal 115, Lafarge Temporary Storage Silo MUP: Vicinity Map.” Port of Seattle No. 115-9001-C-1 by DeGross Aerial Mapping. June 25.

________. 1999. Letter Regarding Environmental Assessment for Proler T115 Property. From Kathy Bahnick with the Port of Seattle. To James Jakubiak with Schnitzer.

Puget Sound Regional Archives. Tax Rolls for Seattle, State of Washington.

Regional Sediment Evaluation Team (RSET). 2006. *Sediment Evaluation Framework for the Pacific Northwest.* <http://www.nws.usace.army.mil/publicmenu/DOCUMENTS/DMMO/RSET_Interim_Final.pdf>.

________. 2009. *Sediment Evaluation Framework for the Pacific Northwest.* <http://www.nwp.usace.army.mil/pm/e/rset/sef/2009-Final_SEF.pdf>. May.

Remediation Technologies, Inc. (RETEC). 1996a. Letter Regarding Preliminary Fingings for the Reichhold/Lone Star Site. From Paul Grabau, Hydrogeologist and Hans Stroo, Principal, both with RETEC. To Al Jeroue at Reichhold Chemicals, Inc. and Shawn Carter at Lone Star Northwest. February 27.

________. 1996b. Letter Regarding Findings for the Geoprobe Arsenic Investigation at the Reichhold/Lone Star Site. From Paul Grabau, Hydrogeologist and Hans Stroo, Principal, both with RETEC. To Al Jeroue at Reichhold Chemicals, Inc. and Shawn Carter at Lone Star Northwest. April 16.

________. 1996c. *Remedial Investigation Report, Lone Star/Reichhold Site, Seattle, Washington.* May.

________. 1996d. *Preliminary Feasibility Study for the Reichhold/Lone Star Facility, Seattle, Washington.* September.

The RETEC Group (RETEC). 1996. *Remedial Investigation Report: Lone Star/Reichhold Site, Seattle, Washington*. May.

Sanborn Map Company, Inc., The Fire Insurance Maps of Seattle for the years 1929 and 1950. Reviewed at Seattle Public Library, Seattle, Washington.

Schnitzer Steel Industries, Inc. (Schnitzer). 1999a. Letter Regarding Ecology Storm Water Permit SO3-000262, Proler International Corp. From Jim Jakubiak, Environmental Administrator for Schnitzer. To Ron Devitt, Ecology, Northwest Regional Office, Water Quality Department. June 25.

________. 1999b. Letter Regarding Environmental Assessment for Proler T115 Property. From James Jakubiak, Environmental Administrator for Schnitzer. To. Kathy Bahnick with the Port of Seattle. June 25.

Science and Engineering for the Environment, LLC (Science and Engineering). 2007. Lower Duwamish Waterway Glacier Bay Source Control Area. *Summary of Existing Information and Identification of Data Gaps.* Prepared for the Washington State Department of Ecology. June.

________. 2010. *Post-Dredge Subsurface Sediment Characterization and Sand Cover Monitoring Report, Port of Seattle, Washington, Terminal 115, Berth 1*. June 25.

Science Applications International Corporation (SAIC). 2007. *Lower Duwamish Waterway Glacier Bay Source Control Area. Summary of Existing Information and Identification of Data Gaps*. June.

Seafreeze Investment Corporation. 1980. Diesel Tank Blueprint (Illegible Details in Title).

Seattle Department of Planning and Development (DPD). 2010a. Archived Building Permits and Plans Associated with the Property. Reviewed at DPD, Seattle, Washington.

________. 2010b. Sewer Cards Documenting Location and Inspection Dates Associated with the Municipal Sanitary Sewer in the Property Vicinity. Reviewed online at <http://web1.seattle.gov/dpd/sidesewercardsv2/>.

Seattle-King County Department of Public Health (SKCDPH). 1998. Letter Regarding a Site Hazard Assessment Conducted November 7, 1979, at the MST chemical at Terminal 115 Site. From Peter Isaksen, Environmental Health Specialist with SKCDPH. To the Port of Seattle Property Manager. February 17.

Shannon & Wilson, Inc. (Shannon & Wilson). 1991. *First Avenue Bridge Hazardous Waste and Waste Discipline Report.* June.

Shaw Environmental & Infrastructure, Inc. (Shaw). 2003. *July 2003 Additional Investigation Results, Reichhold/LoneStar Site, 5900 West Marginal Way, Seattle, Washington.* October 31.

________. 2008. *Remedial Activities Summary Report, For: Former Reichhold/Glacier Northwest Site, 5900 West Marginal Way S.W., Seattle, Washington.* April.

Slotta Design & Construction (SD&C). 1998. *Underground Storage Tank site Assessment Report, Foss Environmental and Infrastructure Corporate Offices, 200 SW Michigan Avenue, Seattle, Washington.* April 13.

Spitzer, Paul. 1999. "Harsh Ways: Edward W Heath and the Shipbuilding Trade." *Pacific Northwest Quarterly Vol. 90 No 1*.

State of Washington Pollution Control Commission (SWPCC). 1955. *An Investigation of Pollution in the Green-Duwamish River.*

Troost, K.G., and D.B. Booth (Troost and Booth). 2008. "Geology of Seattle and the Seattle Area, Washington." *Reviews in Engineering Geology*. November 1. 20:1–36.

U.S. Army Corps of Engineers (USACE). 1930. Memorandum Regarding a complaint by Miss Sandgren to Mr. Carpenter, stating that Klinker Sand and Gravel Company was dumping refuse into the Duwamish River. From R.A. Davies, Assistant Engineer. To Major Butler.

________. 1935. "Duwamish Waterway, Seattle Harbor, Wash., Proposed Dredging." U.S. Engineer Office, Seattle, Wash. File No. E-12-2-61.1. September 9.

________. 1994. *Archives Search Report – Seattle Chemical Warfare Service Plant*. June.

U.S. Environmental Protection Agency (EPA). 1988. *Site Inspection Report, Port of Seattle – Terminal 115, Seattle, Washington*. Report completed through EPA contractor Ecology and Environment. January.

Urban Redevelopment, LLC. 2002. *VCP Site Closure Report, Former Diesel UST Location, Parcel B at Terminal 115, Seattle, Washington.* December 2.

________. 2003. *Addendum to: VCP Site Closure Report, Groundwater Compliance Monitoring, Former Diesel UST Location, Parcel B at Terminal 115, Seattle, Washington*. February 10.

Washington State Department of Archeology and Historic Preservation. 2010. Phone interview. October 22.

Washington State Department of Ecology (Ecology). 1987. *TSCA Inspection Report*. February 26.

________. 2007. Letter Regarding Glacier Northwest Terminal Facility Located at 5900 West Marginal Way SE, Seattle. To Matthew Hinck with Glacier Northwest. January 26.2004. Lower Duwamish Waterway Source Control Strategy. Reviewed online at <http://www.ecy.wa.gov/pubs/0409043.pdf>. January.

________. 2008. Source Control Areas Map. Reviewed online at <http://www.ecy.wa.gov/programs/tcp/sites/lower_duwamish/source_control/sourceControlAreas.html>. October.

________. 2010a. An Investigation of Pollution in the Green-Duwamish River. Tech Bulletin No. 20. Summer 1955. Reviewed online at <http://www.ecy.wa.gov/programs/tcp/sites/lower_duwamish/combined_sewer_outfall/1955_historic_map_1955_(a).pdf>.

________. 2010b. In the Matter of Remedial Action by: The Boeing Company. Agreed Order No. DE 7088. Signed January 20.

Windward Environmental, LLC. 2003. *Lower Duwamish Waterway Remedial Investigation, Phase 1 Remedial Investigation Report.* Prepared for Lower Duwamish Waterway Group.

________. 2004. *Lower Duwamish Waterway Remedial Investigation, Task 8: Phase 2 Remedial Investigation Work Plan.* Prepared for Lower Duwamish Waterway Group.

________. 2010. *Lower Duwamish Waterway Remedial Investigation, Remedial Investigation Report, Final.* Prepared for Lower Duwamish Waterway Group. Available online at http://www.ldwg.org/rifs_docs2.htm#t7. July 9.

Wood/Harbinger, Inc. (Wood/Harbinger). 1991. “Port of Seattle Marine Facilities, Terminal 115 Fuel Tank Demolition: Demolition Plan.” Drawing No. 115-9102-01. September 10.

10.0 LIMITATIONS

The services described in this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, expressed or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others or the use of segregated portions of this report.

Port of Seattle

FIGURES

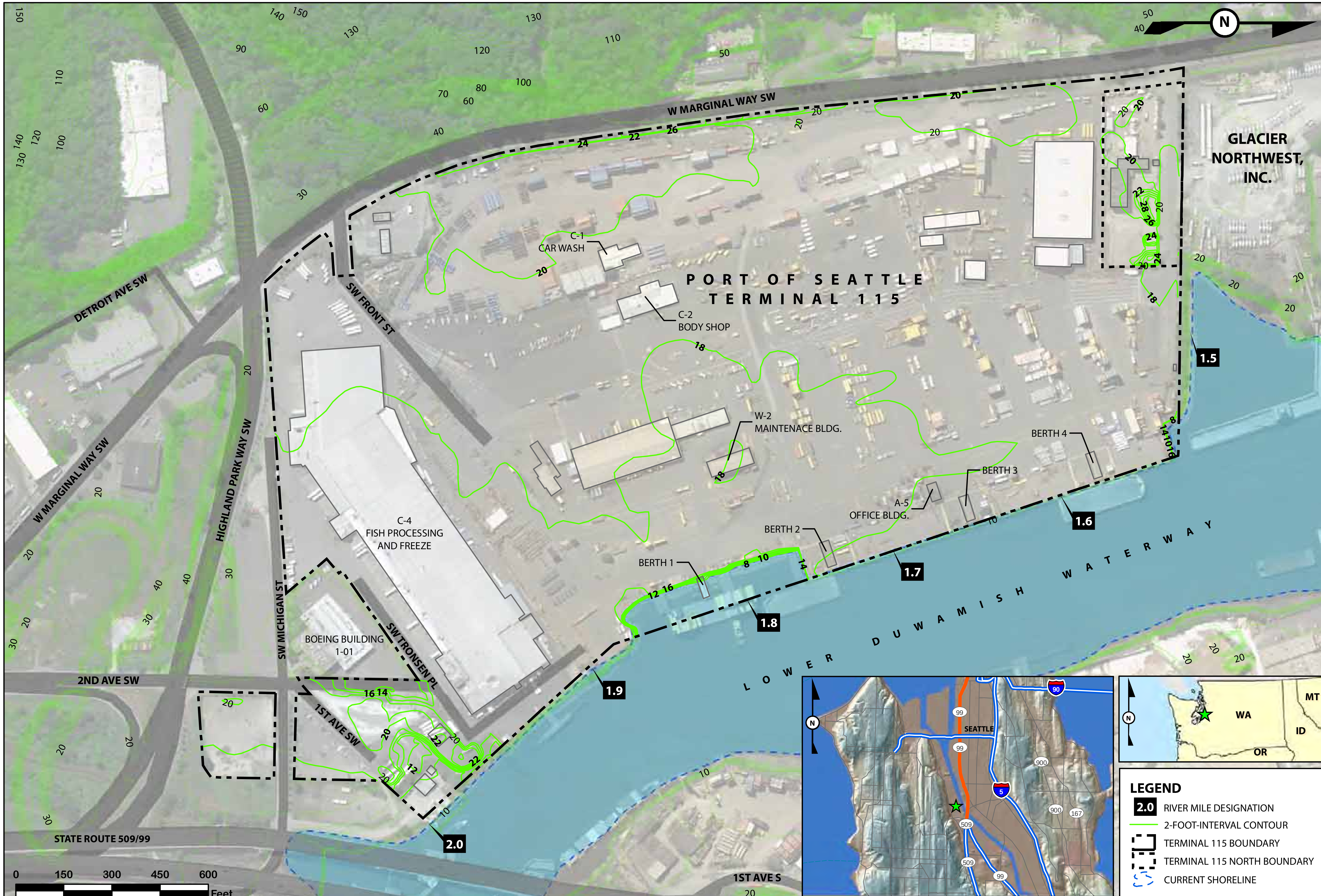

FIGURE 1
SITE VICINITY MAP

PROJECT NUMBER:.... 0675-001-01
ADDRESS:..................... WEST MARGINAL WAY SW
CITY, STATE:................ SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:......... NAC
CHECKED BY:..... CMC

SoundEarth Strategies

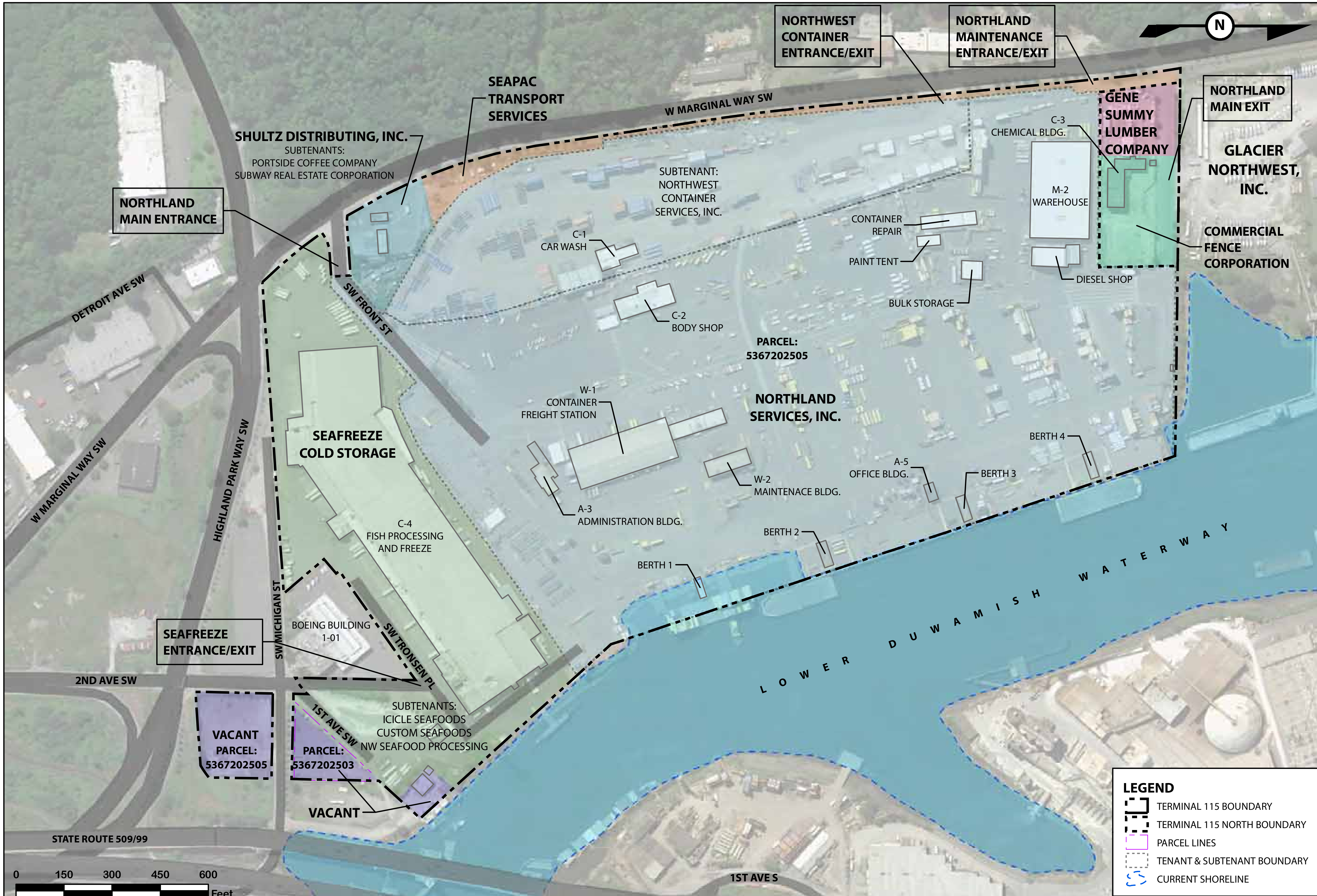

FIGURE 2
CURRENT SITE CONFIGURATION MAP

PROJECT NUMBER:.... 0675-001-01
ADDRESS:.................... WEST MARGINAL WAY SW
CITY, STATE:.................. SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:........ NAC
CHECKED BY:..... CMC

SoundEarth Strategies

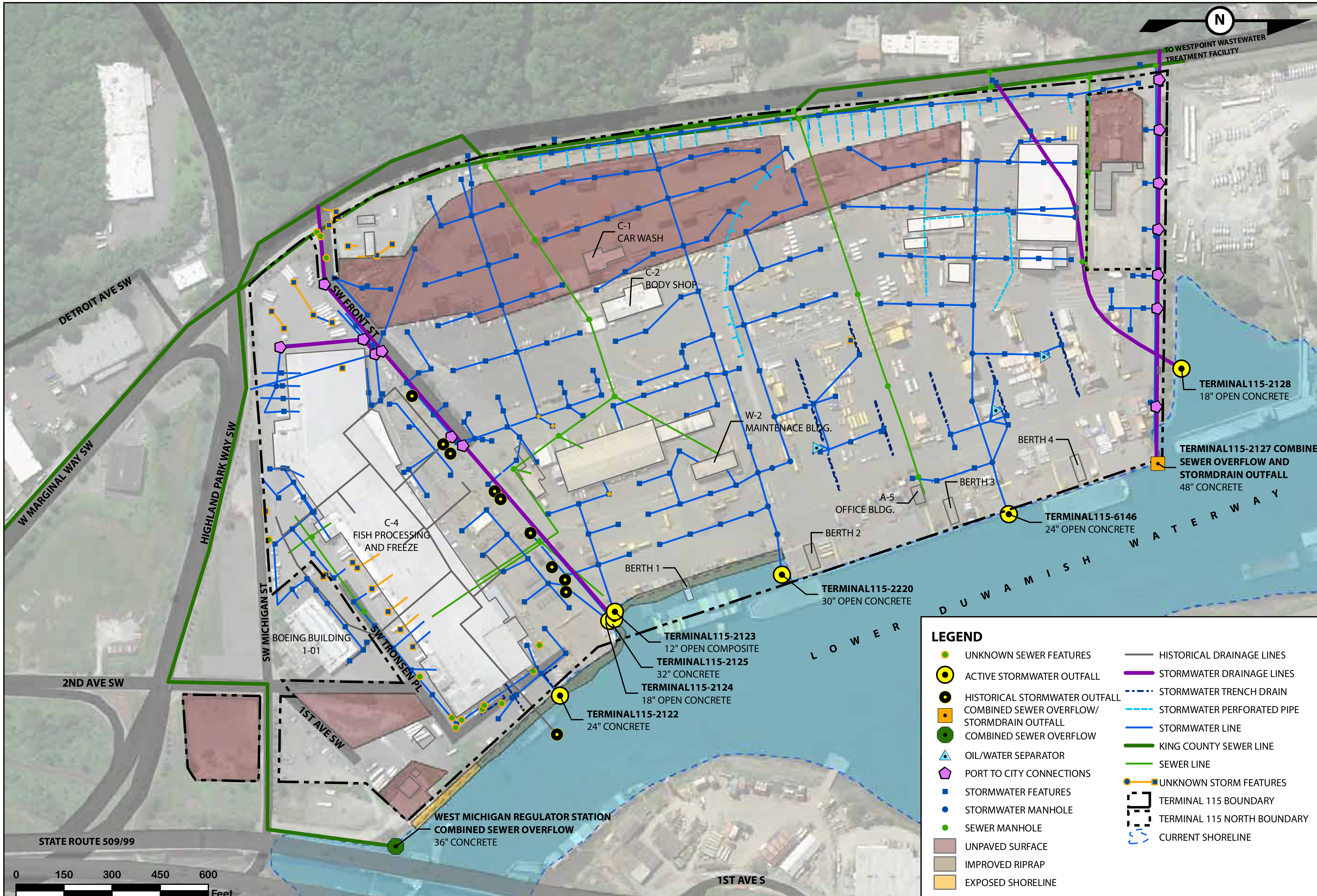

FIGURE 3
STORMWATER AND SEWER INFRASTRUCTURE MAP

PROJECT NUMBER:..... 0675-001-01
ADDRESS:..................... WEST MARGINAL WAY SW
CITY, STATE:................ SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:........ NAC
CHECKED BY:..... CMC

SoundEarth Strategies

IEC Identification

IEC #	Name
1	Standard Oil
2	"Refinery Building"
3	Richfield Oil Gas Station
4	Boeing Plant #1
5	Seafreeze/Boeing USTs
6	Auto Salvage Yard/Sav-Mor Service Station
7	Materials Reclamation Smelter
8	Southwest Tank Yard/Cardlock Facility
9	Klinker Gravel/Ready Mix
10	Buildings C1 & C2/Carwash
11	Landfill Activities
12	Building M2/Maintenance Building
13	Building A5/Marine Office Building
14	Tin Reclamation - T115N
15	Off-Property IECs
15.01	Boeing Building 1-01 USTs
15.02	Tire Shop
15.03	Foundry
15.04	Reichhold Chemical
15.05	Glacier NW/Kaiser

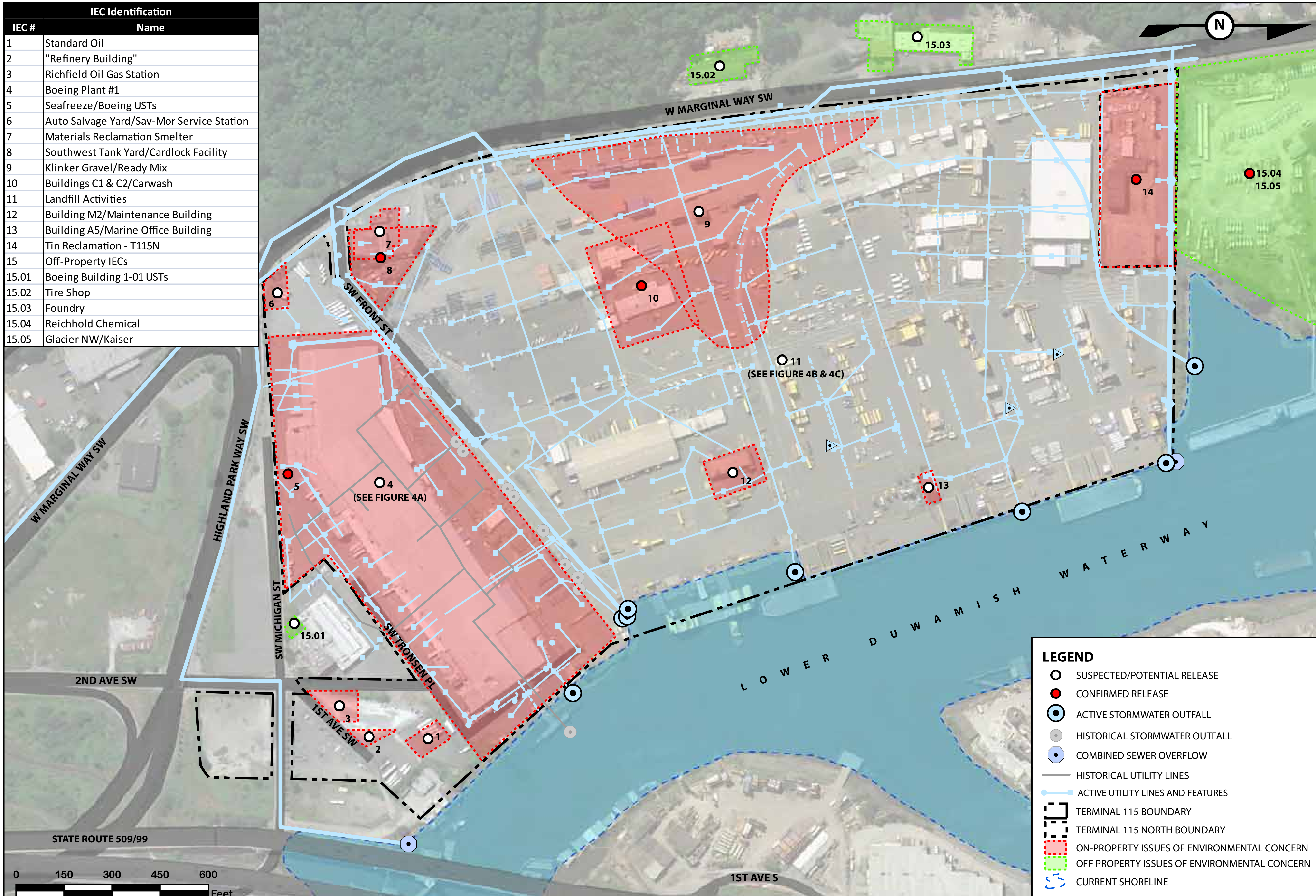

FIGURE 4
ISSUES OF ENVIRONMENTAL CONCERN
MASTER FIGURE

PROJECT NUMBER:.... 0675-001-01
ADDRESS:.................. WEST MARGINAL WAY SW
CITY, STATE:............. SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:........ NAC
CHECKED BY:..... CMC

SoundEarth Strategies

Building Identification

Building #	Building Name
1-01	Administration Building
1-02	Main Factory Building
1-03	Assembly Building
1-04	Plating & Paint Shop
1-05	Factory and Maintenance
1-06	Boiler House/Test Warehouse
1-07	Transformer House
1-08	Paint Spraying, Welding, Maintenance Shop, and Materials Testing
1-09	Cafeteria
1-10	Dry Klin/Spray Paint Shop
1-11	Structural Test Shop
1-12	Maintenance Welding Shop
1-13	Pattern Shop
1-14	Time Office and First Aid
1-18	Miscellaneous Storage
1-20	Paint Storage
1-21	Fuel Test Lab
1-22	Fuel Storage (includes fuel dispenser and storage tank)
1-23	Paint Storage
1-25	Maintenance Storage
1-26	Waste Acid Storage Facility
1-27	Hazardous Materials Storage
1-29	Hammer Shop & Aluminum Foundry
1-30	Steam Plant and UST
1-32	Maintenance Storage
1-34	Structural Test Office
1-35	Turbine Production Storage
1-37	Gate House
1-39	Compressor House
1-40	Static Test Building
1-41	Test Shed
1-42	Incinerator
1-43	Toilet Building
1-44	Sandblast Building
1-45	Acid Test Building
1-48	Tank Testing
1-50	Revetment
1-51	Hydro Test Tank

Tank Identification

Tank #	Contents	Capacity (Gallons)	Type	Status	Description
1	Diesel	4,000	UST	Removed	Boeing 1-01 Heating Oil Tank
2	Bunker C	3,000	UST	Removed	Boeing 1-01 Heating Oil Tank
3	Diesel	1,000	UST	Removed	Boeing 1-01 Heating Oil Tank
4	Unknown	Unknown	UST	Unknown	Concrete Fuel Tank 4
5	Suspected Jet Fuel/Avgas	5,000	UST	Unknown	Boeing 1-02 Engine Testing USTs
6	Suspected Jet Fuel/Avgas	5,000	UST	Unknown	Boeing 1-02 Engine Testing USTs
7	Suspected Jet Fuel/Avgas	5,000	UST	Unknown	Boeing 1-02 Engine Testing USTs
8	Unknown	Unknown	UST	Unknown	Buried Fuel Tanks & Dispenser
10	Suspected Jet Fuel/Avgas	6,000	UST	Removed	Unknown Boeing USTs
11	Suspected Jet Fuel/Avgas	6,000	UST	Removed	Unknown Boeing USTs
12	Suspected Jet Fuel/Avgas	6,000	UST	Removed	Unknown Boeing USTs
13	Gasoline	3,000	UST	Removed	Boeing 1-21 UST
14	Unknown	Unknown	Unknown	Unknown	Boeing Personal Tank
15	Unknown	Unknown	Unknown	Unknown	Boeing Tank B-5
16	Bunker/Diesel	4,200	UST	Unknown	Boeing 1-11 UST
17	Diesel	20,000	UST	Closed In Place	Steam Plant Tank
18	Unknown	Unknown	Unknown	Closed In Place	Boeing 1-41 Storage Tanks
19	Unknown	Unknown	Unknown	Closed In Place	Boeing 1-41 Storage Tanks
20	Unknown	Unknown	AST	Removed	Boeing 1-40 ASTs
21	Unknown	Unknown	AST	Removed	Boeing 1-40 ASTs

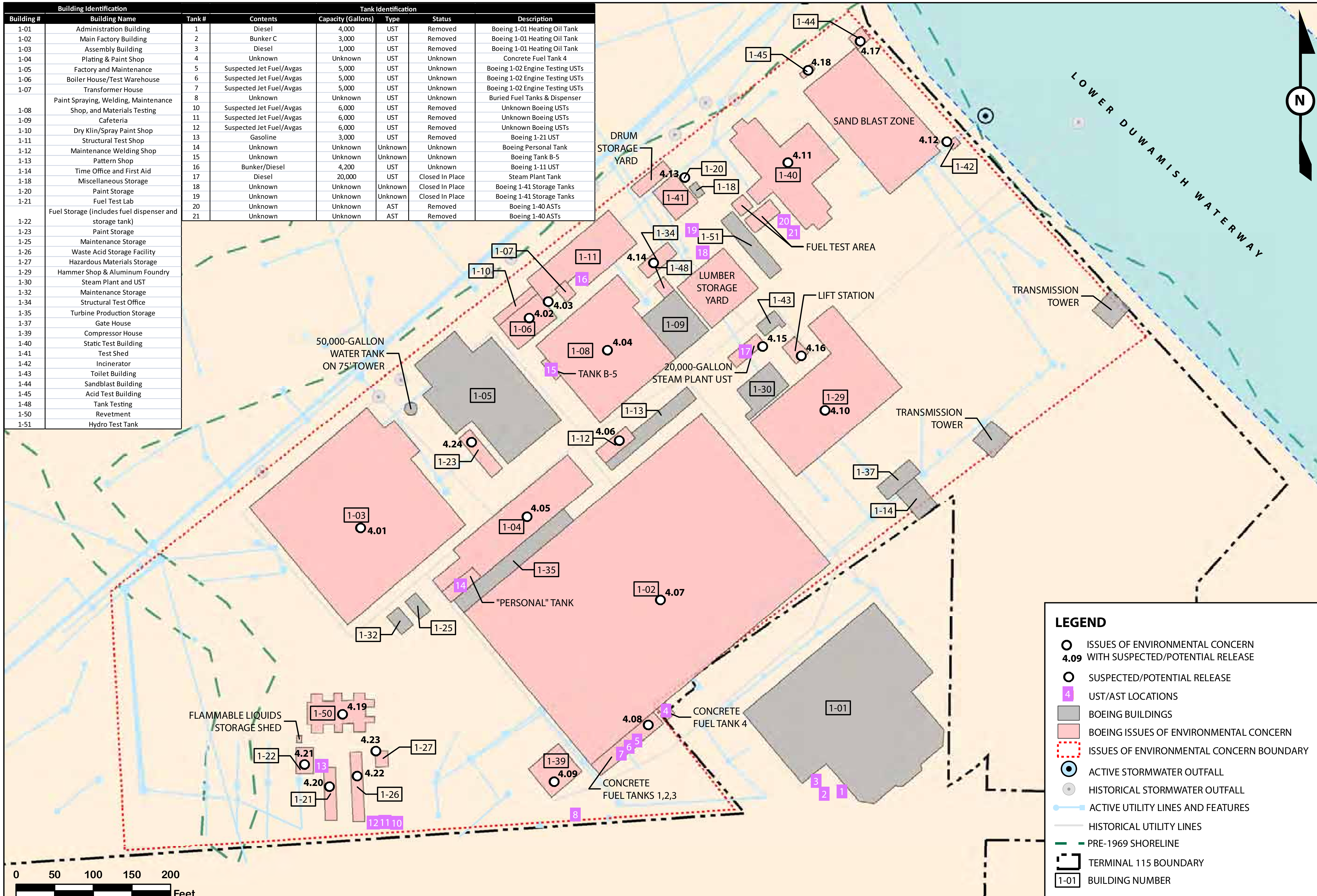

FIGURE 4A

FORMER BOEING PLANT COMPOSITE

PROJECT NUMBER:..... 0675-001-01
ADDRESS:..................... WEST MARGINAL WAY SW
CITY, STATE:.................. SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:........ NAC
CHECKED BY:..... CMC

SoundEarth Strategies

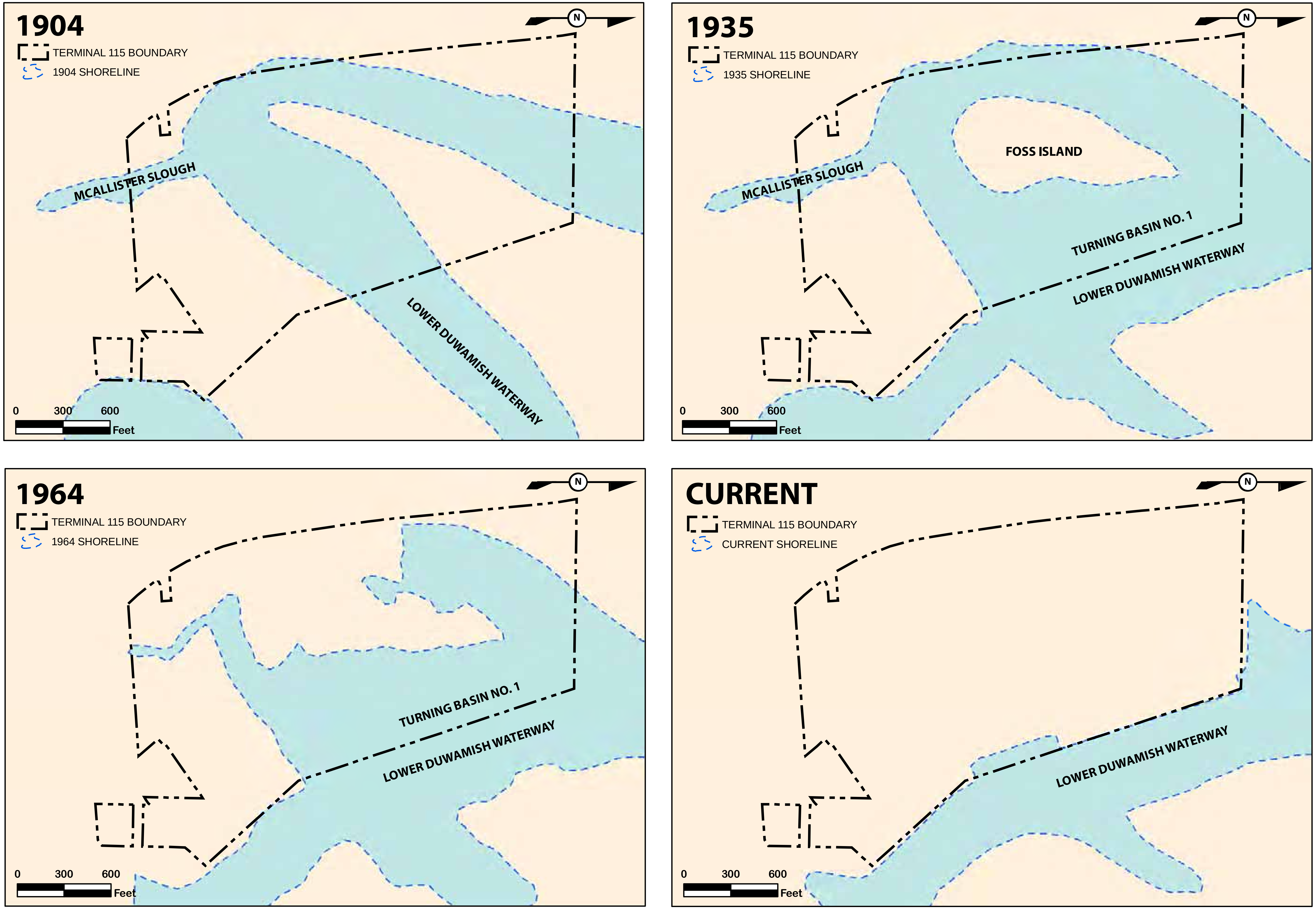

FIGURE 4B
HISTORICAL SHORELINE DIAGRAM

PROJECT NUMBER:..... 0675-001-01
ADDRESS:..................... WEST MARGINAL WAY SW
CITY, STATE:................. SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:........ NAC
CHECKED BY:...... CMC

SoundEarth Strategies

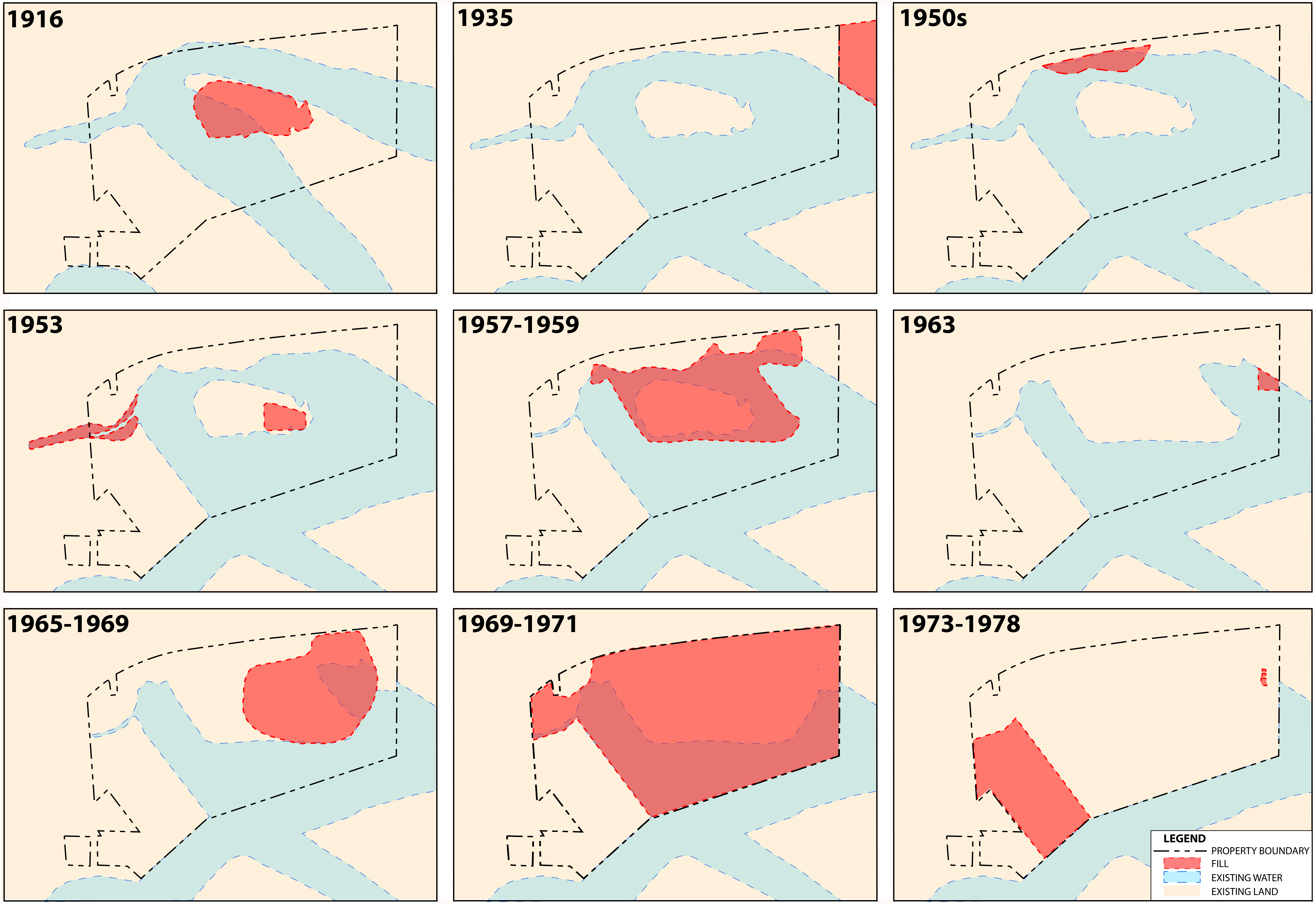

FIGURE 4C
HISTORICAL FILL AREAS

PROJECT NUMBER:.... 0675-001-01
ADDRESS:..................... WEST MARGINAL WAY SW
CITY, STATE:.................. SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:........ NAC
CHECKED BY:..... CMC

SoundEarth Strategies

Tank Identification						
Tank #	Contents	Capacity (Gallons)	Type	Status	Description	Port Designation
1	Diesel	4,000	UST	Removed	Boeing 1-01 Heating Oil Tank	T-115L
2	Bunker C	3,000	UST	Removed	Boeing 1-01 Heating Oil Tank	--
3	Diesel	1,000	UST	Removed	Boeing 1-01 Heating Oil Tank	--
4	Unknown	Unknown	UST	Unknown	Concrete Fuel Tank 4	--
5	Suspected Jet Fuel/Avgas	5,000	UST	Unknown	Boeing 1-02 Engine Testing USTs	--
6	Suspected Jet Fuel/Avgas	5,000	UST	Unknown	Boeing 1-02 Engine Testing USTs	--
7	Suspected Jet Fuel/Avgas	5,000	UST	Unknown	Boeing 1-02 Engine Testing USTs	--
8	Unknown	Unknown	UST	Unknown	Buried Fuel Tanks & Dispenser	--
9	Diesel	4,000	UST	Unknown	Unknown Seafreeze UST	--
10	Suspected Jet Fuel/Avgas	6,000	UST	Removed	Unknown Boeing USTs	T-115Q
11	Suspected Jet Fuel/Avgas	6,000	UST	Removed	Unknown Boeing USTs	T-115R
12	Suspected Jet Fuel/Avgas	6,000	UST	Removed	Unknown Boeing USTs	T-115O
13	Gasoline	3,000	UST	Removed	Boeing 1-21 UST	T-115 I
14	Unknown	Unknown	Unknown	Unknown	Boeing Personal Tank	--
15	Unknown	Unknown	Unknown	Unknown	Boeing Tank B-5	--
16	Bunker/Diesel	4,200	UST	Unknown	Boeing 1-11 UST	--
17	Diesel	20,000	UST	Closed In Place	Steam Plant Tank	T-115H
18	Unknown	Unknown	Unknown	Closed In Place	Boeing 1-41 Storage Tanks	T-115F
19	Unknown	Unknown	Unknown	Closed In Place	Boeing 1-41 Storage Tanks	T-115G
20	Unknown	Unknown	AST	Removed	Boeing 1-40 ASTs	--
21	Unknown	Unknown	AST	Removed	Boeing 1-40 ASTs	--
22	Diesel	10,000	UST	Active	Cardlock UST	--
23	Diesel	10,000	UST	Active	Cardlock UST	--
24	Diesel	10,000	UST	Active	Cardlock UST	--
25	Diesel	600	UST	Removed	Smelter Heating Oil UST	T-115S
26	Diesel	9,500	UST	Removed	Smelter Tanker Truck UST	T-115P
27	Kerosene	2,000	AST	Removed	Car Wash Kerosene Tanks	--
28	Kerosene	5,000	UST	Removed	Car Wash Kerosene Tanks	T-115E
29	Diesel	1,000	AST	Active	Building C-1 Diesel Dispenser	--
30	Gasoline	10,000	UST	Removed	Building C-2 refueling tank	T-115D
31	Diesel	1,000	AST	Active	T115 Building M-2 Tanks	--
32	Gasoline	1,000	AST	Active	T115 Building M-2 Tanks	--
33	Diesel	6,000	UST	Removed	T115 Building M-2 Tanks	T-115C
34	Diesel	6,000	UST	Active	T115 Building M-2 Tanks	T-115N
35	Diesel	1,100	UST	Not in Service	T115 Building A-5 Tanks	T-115M
36	Diesel	2,000	UST	Removed	T115 Building A-5 Tanks	T-115A
37	Gasoline	1,000	UST	Removed	T115 Building A-5 Tanks	T-115B
38	Diesel/Bunker Fuel	1,100	UST	Removed	T115-North Heating Oil Tank	--
39	Diesel	250	AST	Removed	T115-North Diesel Tank	--
40	H2S04, NaOH, chemical wastes	13 Bulk ASTs	AST	Removed	T115-North Chemical Storage	--

-- = no applicable Port designation is known
closed in place = tank decomissioned in place before 1980
Not in Service = Tank is not decomissioned, however does not store fuel products
Suspected Jet Fuel/Avgas = Analytical results and/or historical data suggests that the tanks stored an aviation fuel

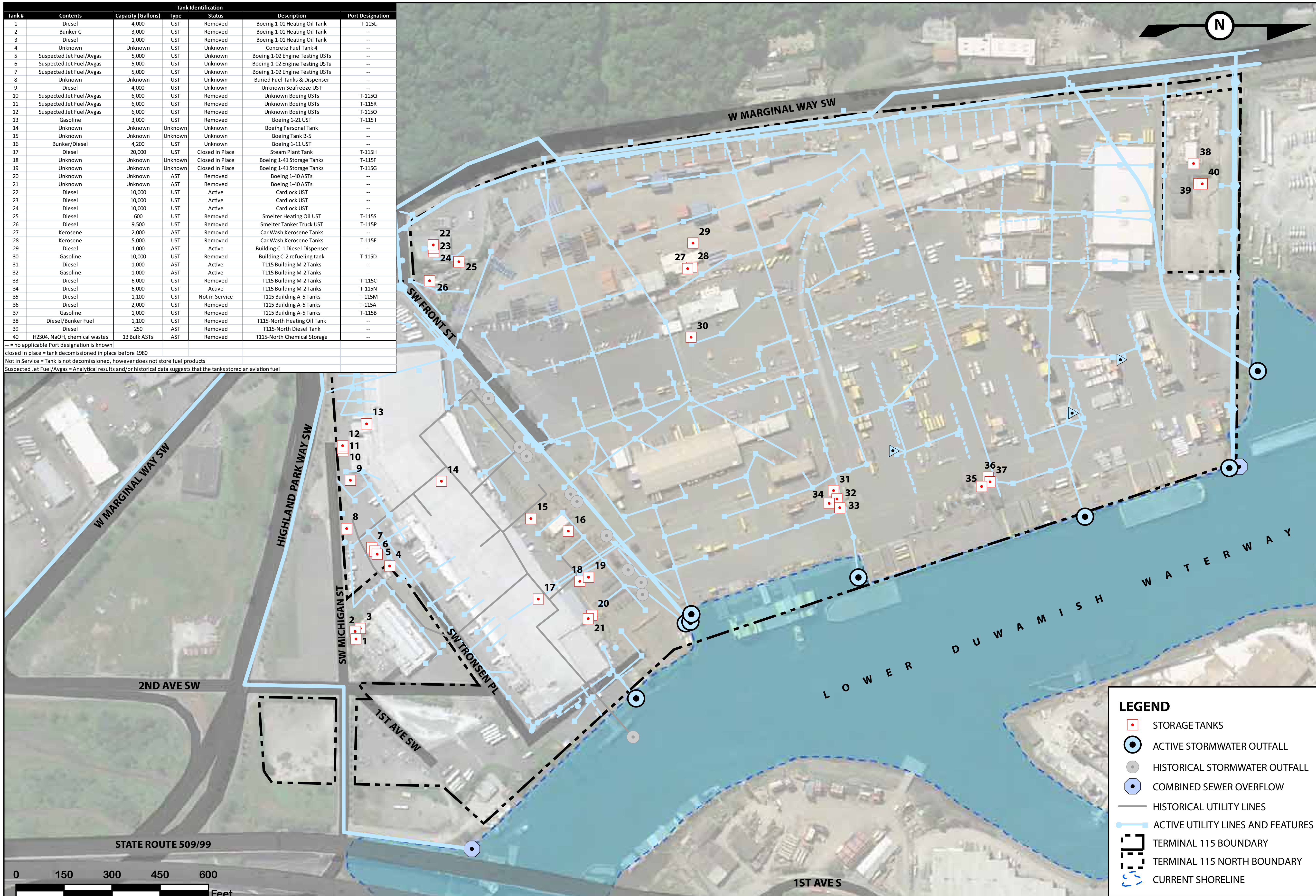

FIGURE 5
STORAGE TANK LOCATIONS MAP

PROJECT NUMBER:.... 0675-001-01
ADDRESS:................... WEST MARGINAL WAY SW
CITY, STATE:................ SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:........ NAC
CHECKED BY:..... CMC

SoundEarth Strategies

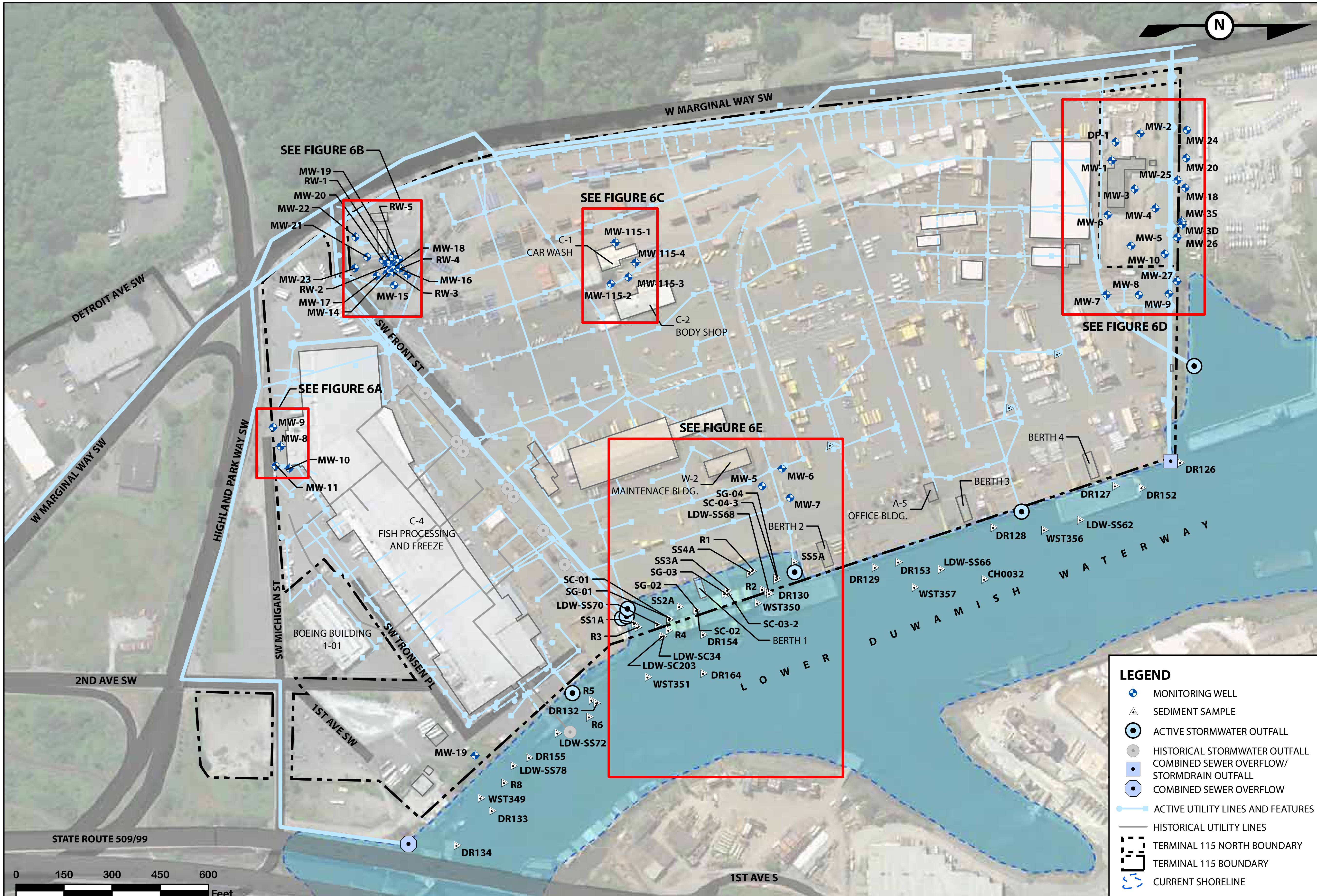

FIGURE 6
INVESTIGATION AREAS MAP
MASTER FIGURE

PROJECT NUMBER:..... 0675-001-01
ADDRESS:..................... WEST MARGINAL WAY SW
CITY, STATE:................ SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:........ NAC
CHECKED BY:..... CMC

SoundEarth Strategies

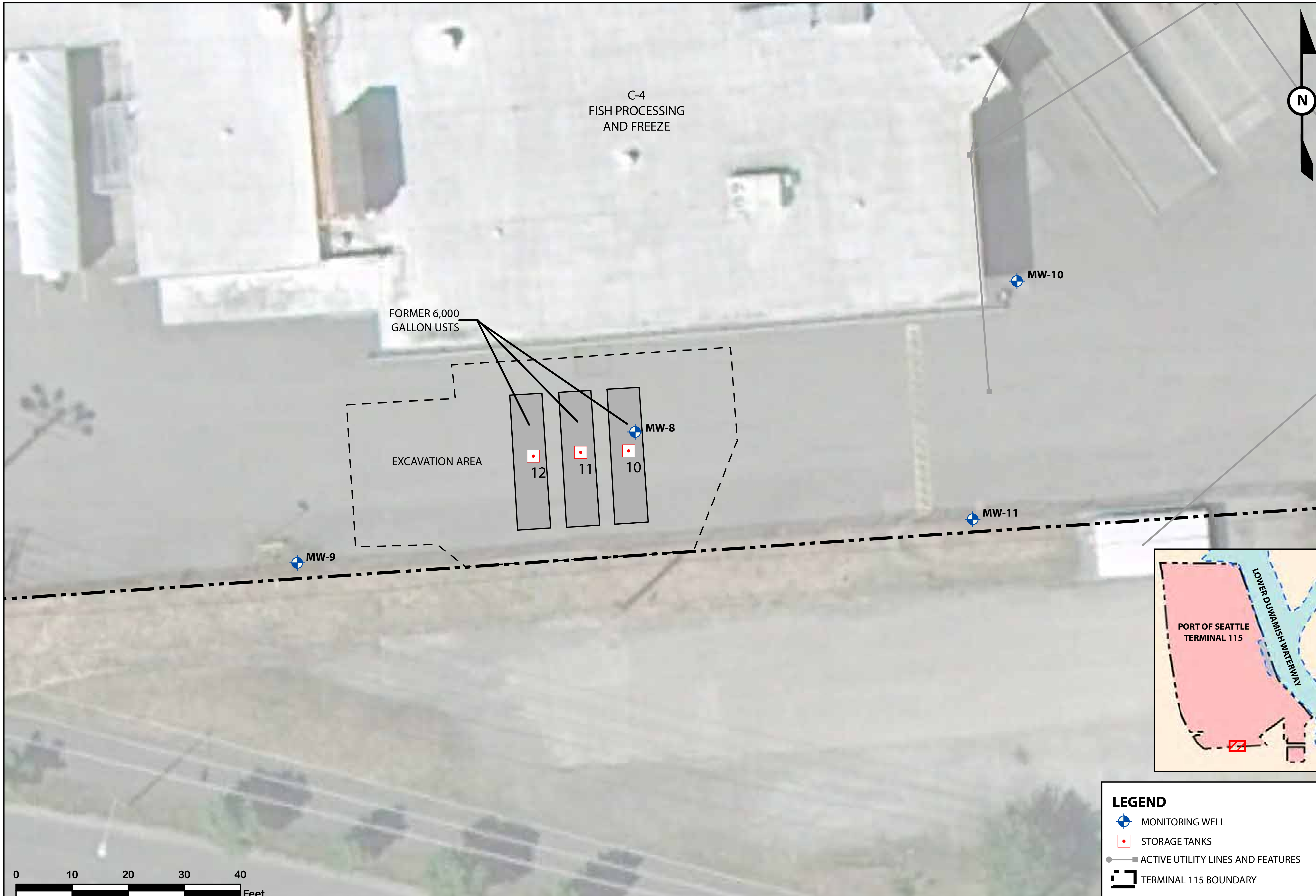

FIGURE 6A
INVESTIGATION AREAS MAP
SEAFREEZE/BOEING USTS

PROJECT NUMBER:..... 0675-001-01
ADDRESS:..................... WEST MARGINAL WAY SW
CITY, STATE:.................. SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:........ NAC
CHECKED BY:..... CMC

SoundEarth Strategies

FIGURE 6B
INVESTIGATION AREAS MAP
CARDLOCK FACILITY
SHULTZ DISTRIBUTING

PROJECT NUMBER:.... 0675-001-01
ADDRESS:...................... WEST MARGINAL WAY SW
CITY, STATE:................. SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:....... NAC
CHECKED BY:..... CMC

SoundEarth Strategies

FIGURE 6C
INVESTIGATION AREAS MAP
BUILDING C-1 CARWASH FACILITY

PROJECT NUMBER:.... 0675-001-01
ADDRESS:..................... WEST MARGINAL WAY SW
CITY, STATE:................. SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:........ NAC
CHECKED BY:..... CMC

SoundEarth Strategies

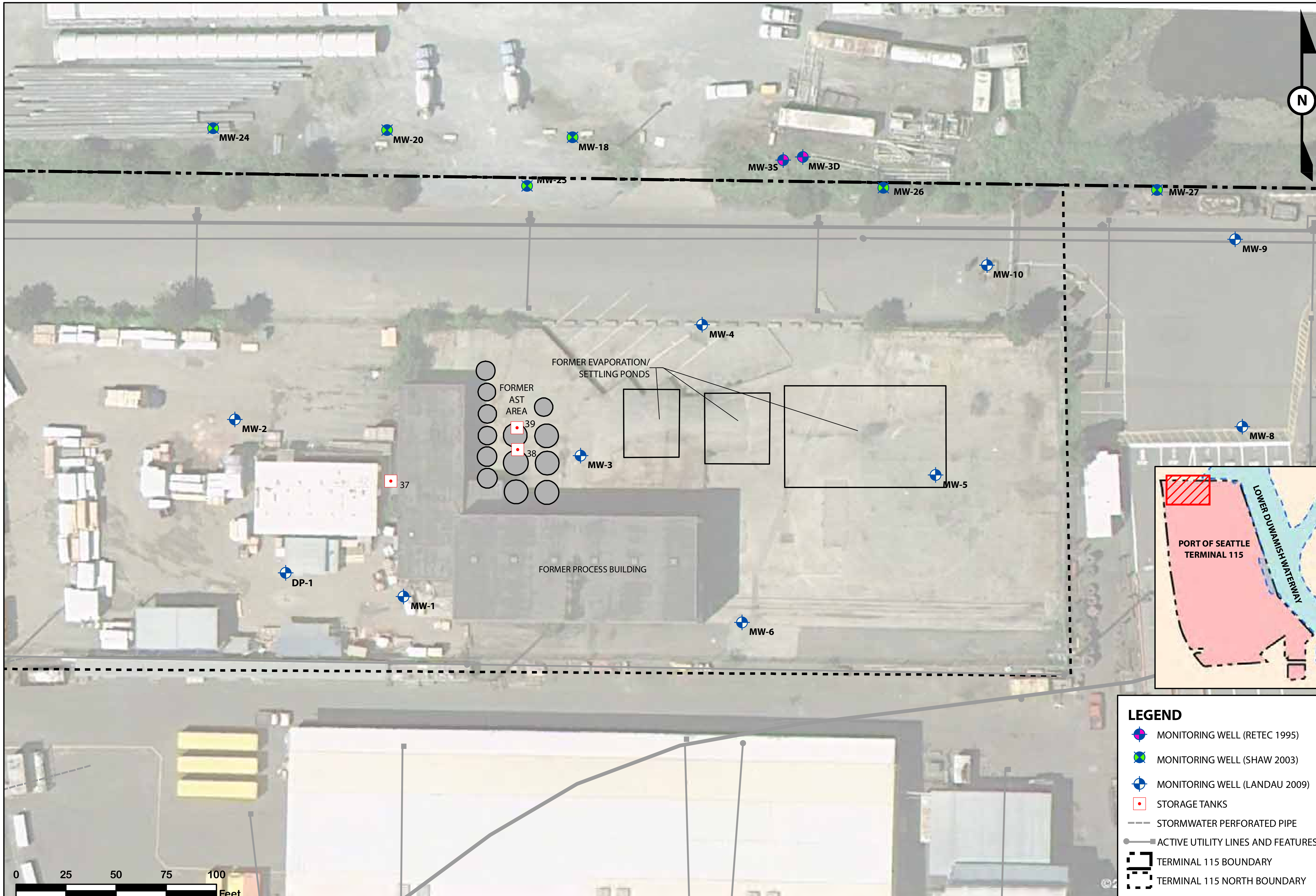

FIGURE 6D
INVESTIGATION AREAS MAP
TERMINAL 115 NORTH

PROJECT NUMBER:.... 0675-001-01
ADDRESS:.................... WEST MARGINAL WAY SW
CITY, STATE:................. SEATTLE, WASHINGTON

DATE: 11/1/10
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FIGURE 6E
INVESTIGATION AREAS MAP
BERTH 1

PROJECT NUMBER:.... 0675-001-01
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CITY, STATE:................ SEATTLE, WASHINGTON

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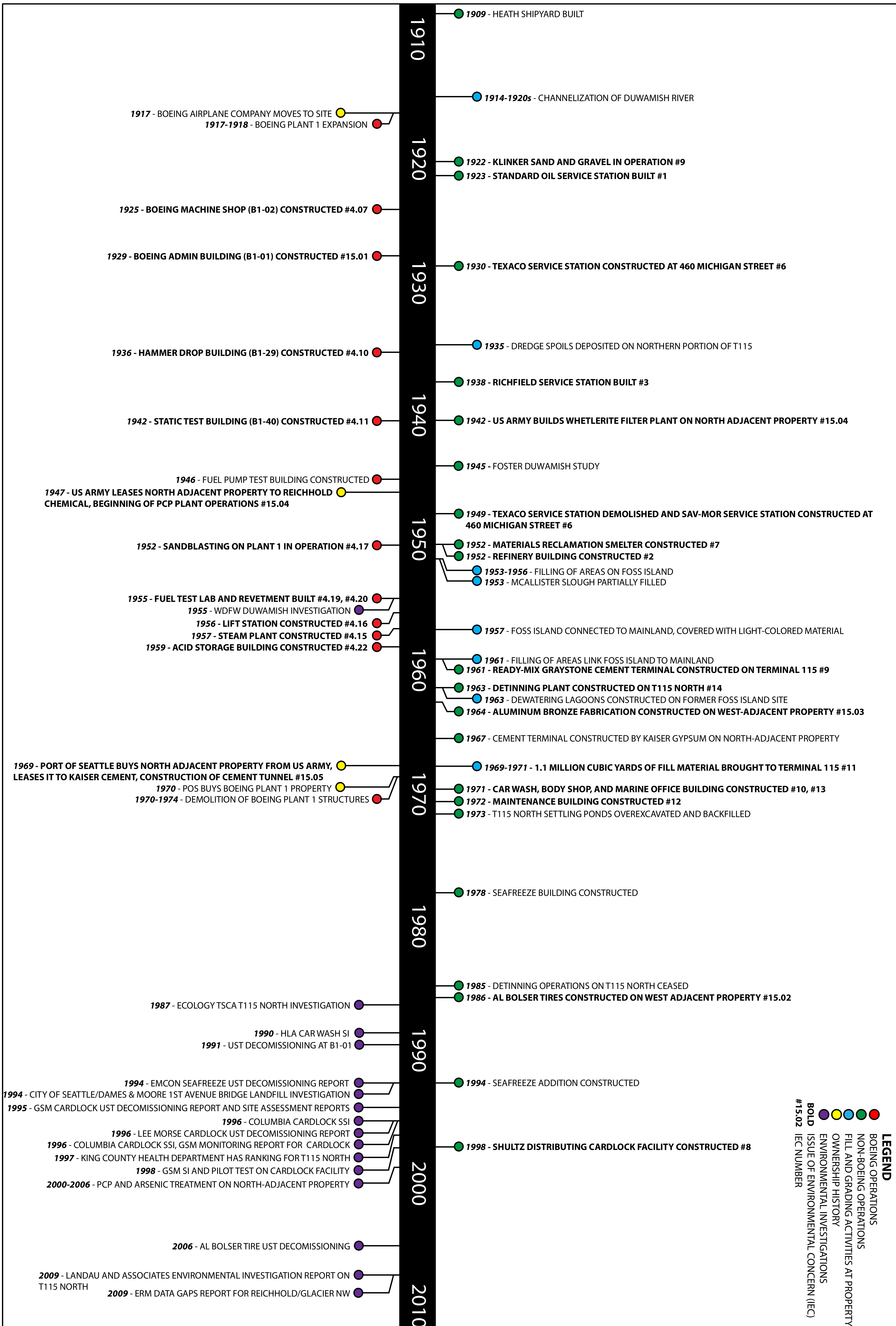

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DATE: 11/1/10
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PROJECT NUMBER:.... 0675-001-01
ADDRESS:..................... WEST MARGINAL WAY SW
CITY, STATE:................. SEATTLE, WASHINGTON

FIGURE 7
HISTORICAL TIMELINE MAP

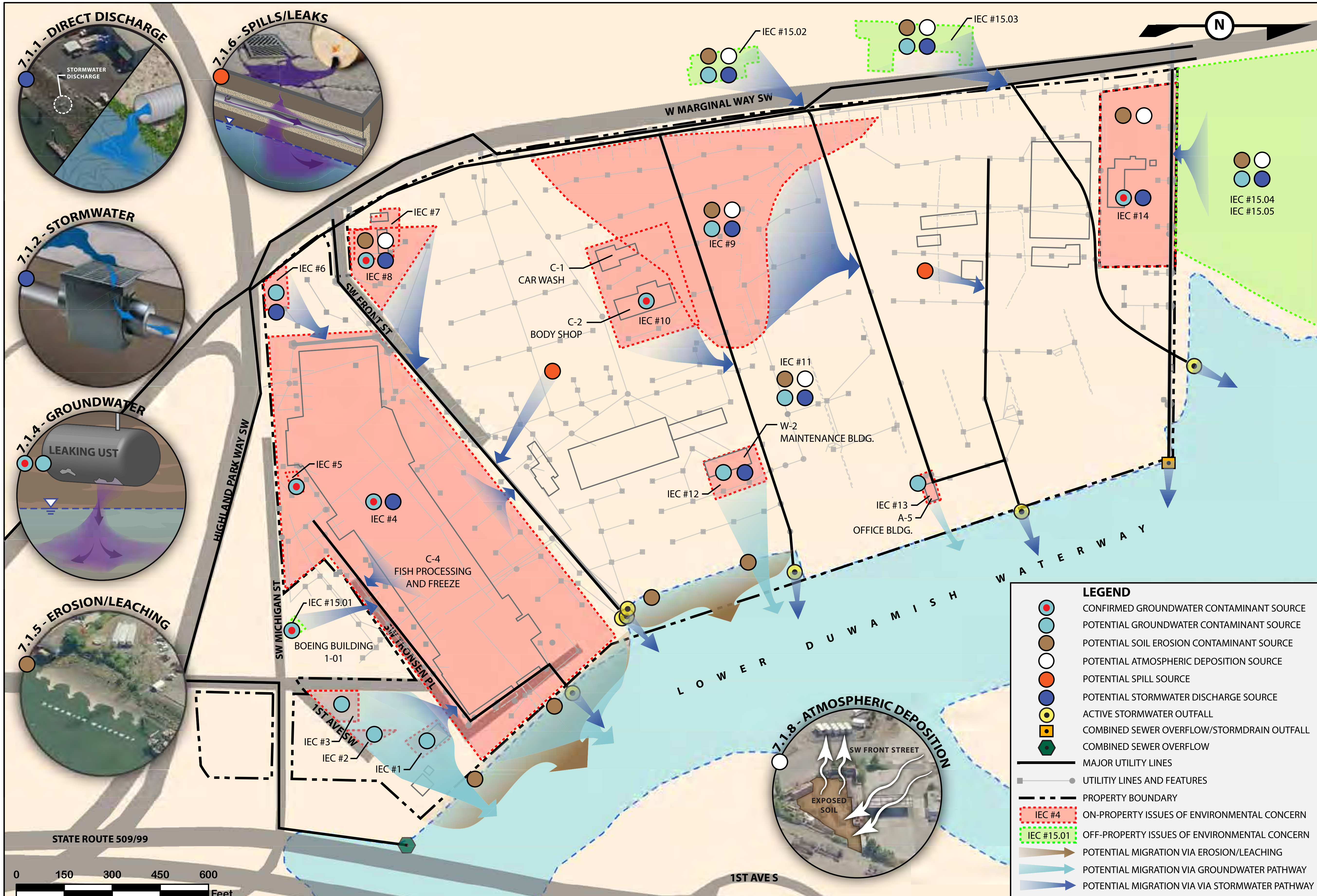

FIGURE 8
CONCEPTUAL SITE MODEL

PROJECT NUMBER:.... 0675-001-01
ADDRESS:.................... WEST MARGINAL WAY SW
CITY, STATE:................ SEATTLE, WASHINGTON

DATE: 11/1/10
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Port of Seattle

TABLE

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Table 1
IEC Information and Potential Migration Pathways
Port of Seattle Terminal 115
6700 West Marginal Way Southwest
Seattle, Washington

IEC Number	Name	Location and Distance to LDW	Operations and Dates	Environmental Investigations	Confirmed COCs	Potential COCs	Source Control Media Affected - Surface Water - GW - Soil - Sediments	Potential Pathways - Direct Discharge/Stormwater - GW -Atmosphereic Deposition -Erosion/Leaching	Comments/Data Needs
1	Standard Oil	• Formerly in the southeast corner of Terminal 115 • Approximate distance to LDW = 187 feet • River Mile 1.9	Former Petroleum Sales 1920s-1960s	None	None	Petroleum Hydrocarbons, PAHs	Confirmed: None Potential: Groundwater, Soil	• Groundwater	Subsurface Investigation may be warranted.
2	104 W Michigan Building (Refinery Building)	• Formerly in the southeast corner of Terminal 115 • Approximate distance to LDW = 309 feet • River Mile 1.9	Former Refining of Unknown Product 1952-1964	None	None	Petroleum Hydrocarbons, PAHs	Confirmed: None Potential: Groundwater, Soil	• Groundwater	Subsurface Investigation may be warranted.
3	Richfield Oil	• Formerly in the southeast corner of Terminal 115 • Approximate distance to LDW = 384 feet • River Mile 1.9	Former Petroleum Sales 1938-1964	None	None	Petroleum Hydrocarbons, PAHs	Confirmed: None Potential: Groundwater, Soil	• Groundwater	Subsurface Investigation may be warranted.
4	Boeing Plant #1	• Formerly occupied the south end of Terminal 115 • Approximate distance to LDW = 45 feet • River Mile 1.85-1.95	Former Airplane Manufacturing 1917-1970	None	None	Petroleum Hydrocarbons, Metals, Solvents, acids/caustics (pH)	Confirmed: None Potential: Groundwater, Soil, Sediment, Surface Water	• Groundwater • Direct Discharge/Stormwater	Subsurface Investigation may be warranted.
5	Seafreeze/Boeing USTs	• Formerly located on the south-central portion of Terminal 115 • Approximate distance to LDW = 1,068 feet • River Mile 1.9	Three 6,000 gallon Jet Fuel USTs decommissioned by removal in 1995. Operation dates unknown	EMCON, 1995	Petroleum Hydrocarbons, VOCs, metals	None suspected in association with former operation	Confirmed: Groundwater, Soil Potential: None	• Groundwater	Full extent of release has not been characterized. Active and abandoned stormwater features and utility lines exist in the vicinity of the release.
6	Auto Salvage Yard/Sav-Mor Service Station	• Formerly located in the southwest corner of Terminal 115 • Approximate distance to LDW = 1,406 feet • River Mile 1.95	Former Auto Wrecking, Auto Service, and Petroleum Sales 1930-1963	None	None	Petroleum Hydrocarbons, Metals, Solvents, PAHs	Confirmed: None Potential: Groundwater, Soil, Surface Water	• Direct Discharge/Stormwater • Groundwater	Subsurface Investigation may be warranted.
7	Materials Reclamation Smelter	• Formerly located in the southwest corner of Terminal 115 • Approximate distance to LDW = 1,378 feet • River Mile 1.9	Former Aluminum Smelter 1952-1985	GSM 1995-1998 Columbia 1995-1997	Petroleum Hydrocarbons	Potential: Metals	Confirmed: Groundwater, Soil Potential: Surface Water	• Groundwater • Erosion/Leaching • Atmosphereic Deposition • Direct Discharge/Stormwater	Release is not fully characterized. Active stormwater features and utility lines exist in the vicinity of the release.
8	Southwest Tank Yard/Cardlock Facility	• Formerly located in the southwest corner of Terminal 115 • Approximate distance to LDW = 1,265 feet • River Mile 1.9	Current Petroleum Sales 1998-present	Same as above	Petroleum Hydrocarbons	None suspected in association with current operation	Confirmed: Groundwater, Soil Potential: None	• Groundwater • Direct Discharge/Stormwater	A potential release associated with the current Cardlock Facility operations has not been assessed.
9	Klinker/Ready Mix	• Formerly located in the west central area of Terminal 115 • Approximate distance to LDW = 1,078 feet • River Mile 1.7-1.95	Former Gravel Loading and Marine Transport/Concrete Manufacturing 1922 (est) - 1969	None	None	Metals, pH	Confirmed: None Potential: Groundwater, Soil, Surface Water	• Groundwater • Erosion/Leaching • Atmosphereic Deposition • Direct Discharge/Stormwater	Subsurface investigation of suspected COCs may be warranted concurrent with other investigations.
10	Buildings C-1/Car Wash & C-2/Body Shop	• Formerly located in the central area of Terminal 115 • Approximate distance to LDW = 890 feet • River Mile 1.7	Former Car Wash and Body Shop 1971-1990	HLA 1990 POS 1989	Kerosene (diesel)	Lube-oil, gasoline, metals, solvents	Confirmed: Groundwater, Soil Potential: None	• Groundwater	The Building C-1 release is localized and does not appear to be in direct contact with any utilities that may provide a migration pathway. No impacts associated with Building C-2 were discovered during UST decommissioning
11	Fill Activities	• Nearly the entire site, excluding some southern portions of the property • Approximate distance to LDW = 0 feet • River Mile 1.55	Historical filling to expand functional land space 1916-1971	None	None	Metals, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, pH	Confirmed: None Potential: Groundwater, Soil, Sediment, Surface Water	• Groundwater • Erosion/Leaching • Atmosphereic Deposition • Direct Discharge/Stormwater	Subsurface investigation of suspected COCs may be warranted concurrent with other investigations.
12	Building M-2/Maintenance Building	• Currently located in the central area of Terminal 115 • Approximate distance to LDW = 281 feet • River Mile 1.7	Current Vehicle Maintenance 1972-Present	Environmental Science and Engineering, 1994	None	Petroleum Hydrocarbons, Solvents, metals	Confirmed: Groundwater, Soil Potential: Surface Water	• Groundwater • Direct Discharge/Stormwater	Further subsurface investigation or groundwater assessment may be warranted.

SoundEarth Strategies

Table 1
IEC Information and Potential Migration Pathways
Port of Seattle Terminal 115
6700 West Marginal Way Southwest
Seattle, Washington

IEC Number	Name	Location and Distance to LDW	Operations and Dates	Environmental Investigations	Confirmed COCs	Potential COCs	Source Control Media Affected (■ - Surface Water ■ - GW ■ - Soil ■ - Sediments)	Potential Pathways (● - Direct Discharge/Stormwater ○ - GW ○ -Atmosphereic Deposition ● -Erosion/Leaching)	Comments/Data Needs
13	Building A-5/Marine Office Building	• Currently located in the east central area of Terminal 115 • Approximate distance to LDW = 141 feet • River Mile 1.6	Current Administrative and Former Fueling area 1971-Present	None	None	Petroleum Hydrocarbons	Confirmed: None Potential: Groundwater, Soil, Sediment	• Groundwater • Direct Discharge/Stormwater	UST decomissioning may be warranted.
14	Tin Reclamation - T115N	• Formerly located in the northwest corner of Terminal 115 • Approximate distance to LDW = 56 feet • River Mile 1.55-1.6	Former Tin Reclamation Facility 1963-1985	Ecology 1987 SKCDPH 1998 Schnitzer 1999 Landau 2009	Total and Dissolved Metals	Other metals, TBT, PAHs, solvents, petroleum hydrocarbons	Confirmed: Groundwater, Soil Potential: Surface Water	• Groundwater • Erosion/Leaching • Atmosphereic Deposition • Direct Discharge/Stormwater	Metals, PCP, and other COCs are likely migrating onto the property via the groundwater pathway.
15	**Off-Property IECs**								
• **15.01**	Boeing Building 1-01 USTs	• Former Boeing administrative building adjacent to the south property boundary of Terminal 115 (Figure 5) • Approximate distance to LDW = 628 feet • Approximate distance to Terminal 115 = 94 feet • River Mile 1.9	Former Boeing Administrative Building 1929-1990	POS 1991 SD&C 1998 Urban Redevelopment 2002-2003	Heating Oil (diesel)	None currently known	Confirmed: Groundwater, Soil Potential: None	• Groundwater	Petroleum hydrocarbons may be migrating onto Terminal 115 via the groundwater and/or stormwater pathways. Stormwater drain lines in the vicinity of the former USTs connect to the Terminal 115 stormwater system, which drain to the LDW.
• **15.02**	Al Bolser Tire Stores	• Formerly located on the west side of West Marginal Way Southwest • Approximate distance to LDW = 1,500 feet • Approximate distance to Terminal 115 = 66 feet • River Mile 1.6	Former Tire Reseller, Installation, and Maintenance 1986-2006	Filco 2006	None	Petroleum Hydrocarbons, metals	Confirmed: None Potential: Groundwater, Soil, Surface Water	• Groundwater • Erosion/Leaching • Atmosphereic Deposition • Direct Discharge/Stormwater	None
• **15.03**	Foundry	• Formerly located on the west side of West Marginal Way • Approximate distance to LDW = 1,453 feet • Approximate distance to Terminal 115 = 66 feet • River Mile 1.55	Current Metals Foundry 1964-Present	None	None	Metals	Confirmed: None Potential: Groundwater, Soil, Surface Water	• Groundwater • Erosion/Leaching • Atmosphereic Deposition • Direct Discharge/Stormwater	None
• **15.04**	Reichhold	• Formerly located north adjacent to Terminal 115N • Approximate distance to LDW = 0 feet • Approximate distance to Terminal 115 = 0 feet • River Mile 1.4 to 1.55	Former Resin and Chemical Manufacturing 1944-1961	Parametrix 1985, 1990 ACOE 1994 RETEC 1996 Shaw 2008 ERM 2009	Phthalates, PAHs, pesticides, polychlorinated phenolic compounds, phenol, formaldehyde, metals, petroleum hydrocarbons, solvents	Dioxins, herbicides	Confirmed: Groundwater, Soil, Sediment Potential: Surface Water	• Groundwater • Direct Discharge/Stormwater • Erosion/Leaching • Atmosphereic Deposition	Metals, PCP, and other COCs are likely migrating onto Terminal 115 and to the LDW via the groundwater pathway.
• **15.05**	Glacier NW/Kaiser	• Currently located north adjacent to Terminal 115N • Approximate distance to LDW = 0 feet • Approximate distance to Terminal 115 = 0 feet • River Mile 1.4 to 1.55	Current Concrete Manufacturing 1969-present	Same as above	Metals	None currently known	Confirmed: Groundwater, Soil, Sediment Potential: Surface Water	• Groundwater • Direct Discharge/Stormwater • Erosion/Leaching • Atmosphereic Deposition	Metals, PCP, and other COCs are likely migrating onto Terminal 115 and to the LDW via the groundwater pathway.

NOTES:
ACOE = U.S. Army Corps of Engineers
COC = chemical of concern
Columbia = Columbia Environmental Inc.
Ecology = Washington State Department of Ecology
ERM = Environmental Resources Management
est = estimated
Filco = Filco Company Inc.
Glacier NW = Glacier Northwest, Inc.
GSM = GeoScience Management, Inc.
GW = Groundwater
HLA = Harding Lawson Associates
Klinker = Klinker Sand & Gravel Company
Landau = Landau Associates
LDW = Lower Duwamish Waterway
PAH = polycyclic aromatic hydrocarbon
Parametrix = Parametrix, Inc.
PCP - Pentachlorophenol
POS = Port of Seattle
Reichhold = Reichhold, Inc.
RETEC - Remediation Technologies, Inc.
SC = source control
Schnitzer = Schnitzer Steel industries, Inc.
SD&C = Slotta Design and Construction
Shaw = Shaw Environmental & Infrastructure, Inc.
SKCDPH = Seattle-King County Department of Public Health
SPH = separate-phase hydrocarbon
TBT = tributyltin
UST = underground storage tank

Port of Seattle

APPENDIX A

Historical Photographs

APPENDIX A: PHOTO A-1

1922-1929

PROJECT NUMBER:.... 0675-001-01
ADDRESS:.................. WEST MARGINAL WAY SW
CITY, STATE:.............. SEATTLE, WASHINGTON

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APPENDIX A: PHOTO A-2

1936-1938

PROJECT NUMBER:..... 0675-001-01
ADDRESS:...................... WEST MARGINAL WAY SW
CITY, STATE:................. SEATTLE, WASHINGTON

DATE: 11/1/10
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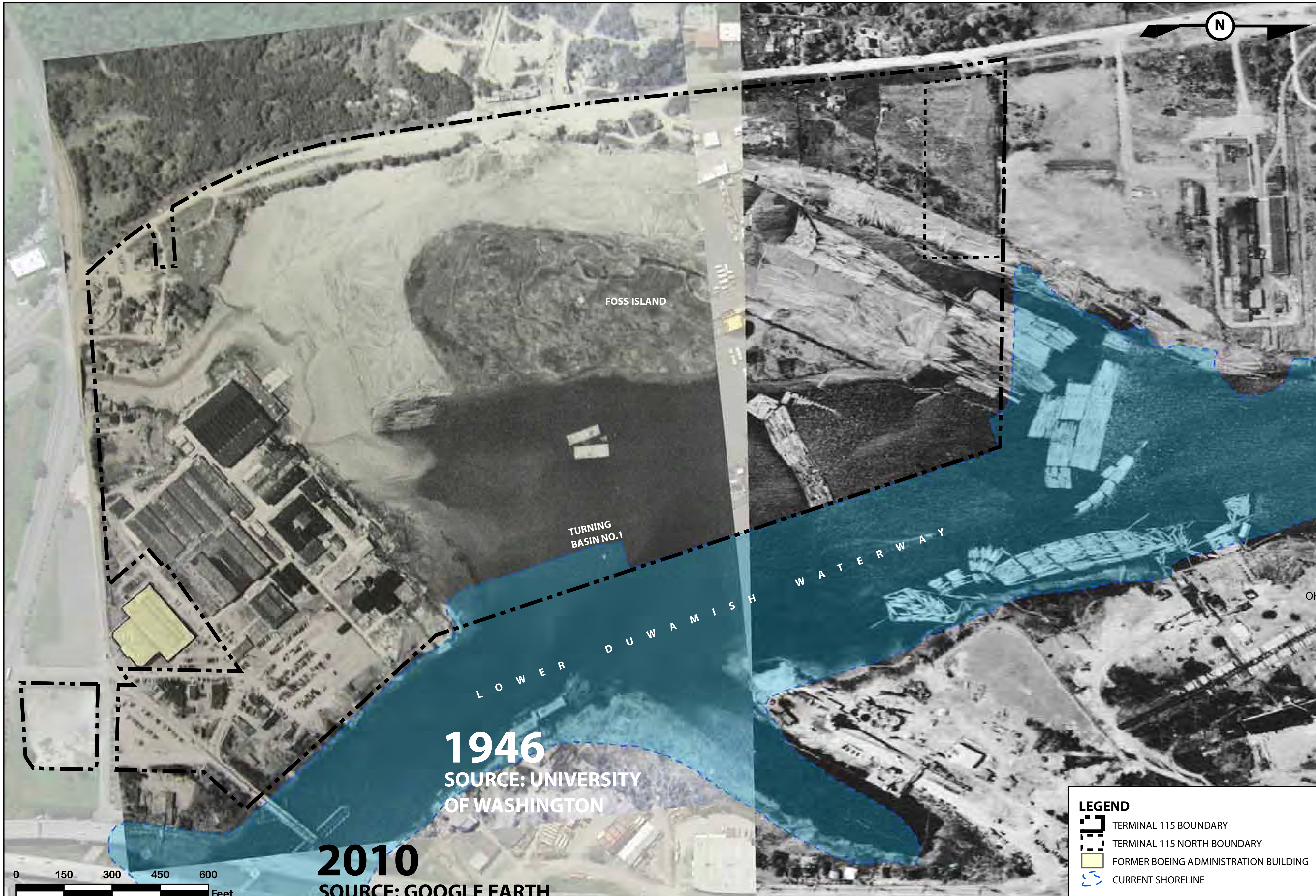

APPENDIX A: PHOTO A-3

1946

PROJECT NUMBER:..... 0675-001-01
ADDRESS:..................... WEST MARGINAL WAY SW
CITY, STATE:................. SEATTLE, WASHINGTON

DATE: 11/1/10
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CHECKED BY:...... CMC

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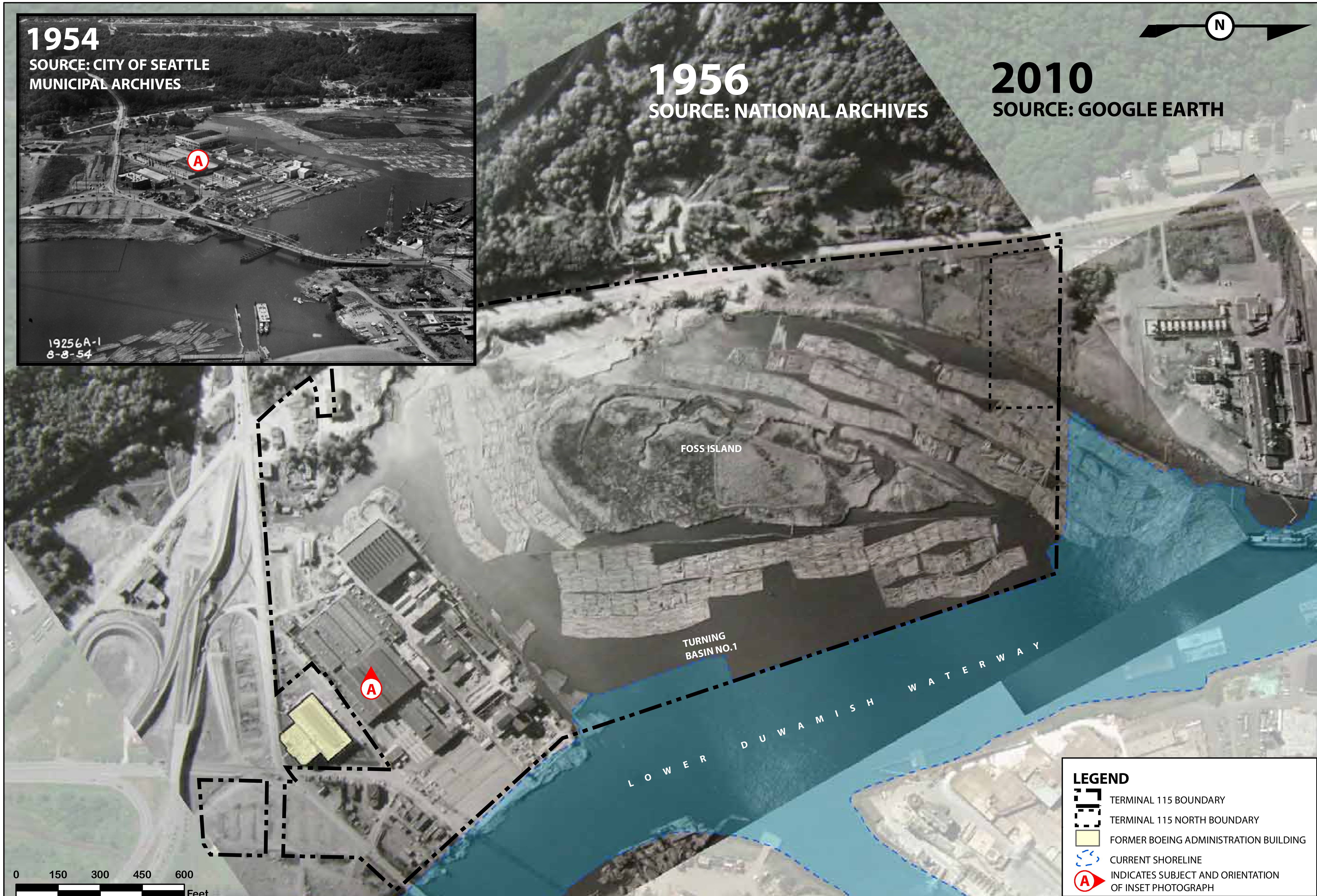

APPENDIX A: PHOTO A-4
1954-1956

PROJECT NUMBER:..... 0675-001-01
ADDRESS:...................... WEST MARGINAL WAY SW
CITY, STATE:.................. SEATTLE, WASHINGTON

DATE: 11/1/10
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APPENDIX A: PHOTO A-5

1961

PROJECT NUMBER:.... 0675-001-01
ADDRESS:.................. WEST MARGINAL WAY SW
CITY, STATE:.............. SEATTLE, WASHINGTON

DATE: 11/1/10
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CHECKED BY:..... CMC

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APPENDIX A: PHOTO A-6

1963-1968

PROJECT NUMBER:..... 0675-001-01
ADDRESS:..................... WEST MARGINAL WAY SW
CITY, STATE:................ SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:........ NAC
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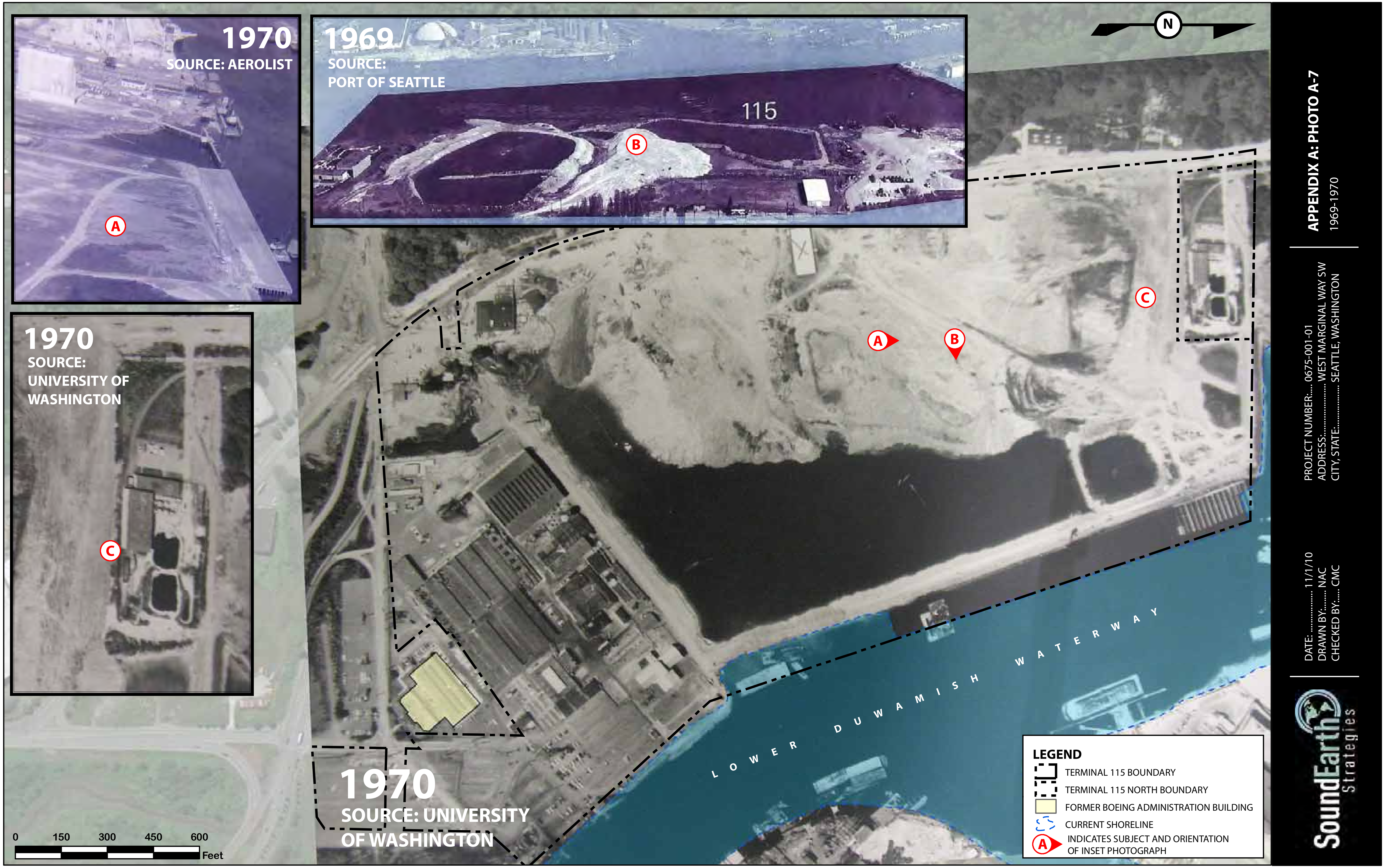

1970
SOURCE: AEROLIST
A
1969
SOURCE:
PORT OF SEATTLE
115
B
1970
SOURCE:
UNIVERSITY OF
WASHINGTON
C
N
A
B
C
LOWER DUWAMISH WATERWAY
1970
SOURCE: UNIVERSITY
OF WASHINGTON
0 150 300 450 600
Feet
LEGEND
TERMINAL 115 BOUNDARY
TERMINAL 115 NORTH BOUNDARY
FORMER BOEING ADMINISTRATION BUILDING
CURRENT SHORELINE
A INDICATES SUBJECT AND ORIENTATION OF INSET PHOTOGRAPH
APPENDIX A: PHOTO A-7
1969-1970
PROJECT NUMBER:.... 0675-001-01
ADDRESS:.................. WEST MARGINAL WAY SW
CITY, STATE:................ SEATTLE, WASHINGTON
DATE: 11/1/10
DRAWN BY:........ NAC
CHECKED BY:..... CMC
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APPENDIX A: PHOTO A-8

1970-1978

PROJECT NUMBER:..... 0675-001-01
ADDRESS:........................ WEST MARGINAL WAY SW
CITY, STATE:.................. SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:........ NAC
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APPENDIX A: PHOTO A-9

1990-1994

PROJECT NUMBER:.... 0675-001-01
ADDRESS:..................... WEST MARGINAL WAY SW
CITY, STATE:................. SEATTLE, WASHINGTON

DATE: 11/1/10
DRAWN BY:........ NAC
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APPENDIX A: PHOTO A-10
2002

PROJECT NUMBER:.... 0675-001-01
ADDRESS:..................... WEST MARGINAL WAY SW
CITY, STATE:................. SEATTLE, WASHINGTON

DATE: 11/1/10
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CHECKED BY:...... CMC

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Port of Seattle

Appendix B
IEC Reference Materials

Port of Seattle

APPENDIX B IS INCLUDED IN THE ATTACHED CD

Port of Seattle

Appendix C
Reports by Others

Port of Seattle

APPENDIX C IS INCLUDED IN THE ATTACHED CD

APPENDIX B
Letter from Onsite Environmental to Port of Seattle

OnSite
Environmental Inc.

14648 NE 95th Street, Redmond, WA 98052 • (425) 883-3881

March 8, 2013

Brick Spangler
Port of Seattle (Pier 69)
2711 Alaskan Way
Seattle, WA 98121

Re: Port of Seattle, North Terminal 115

Dear Brick,

We are looking forward to working with you and GeoEngineers on the North Terminal 115 project. I wanted to follow-up with you on the discussion you and GeoEngineers had with the Department of Ecology about the target reporting limits. The target reporting limits (PQLs) that were submitted with the Quality Assurance Project Plan were the lowest levels we can reliably achieve. Modifications were made to our standard operating procedures for these methods, both on the extraction and on the instrument side, to achieve these levels. Also, please note that these target reporting limits are dependent on the matrix of the sample, and may not be achievable if a sample contains interferences, or has a percent moisture greater than 40%.

Let me know of you have any questions, or would like to discuss further.

Thanks,

Blair Goodrow
Marketing Director
OnSite Environmental, Inc.

APPENDIX C
Sampling And Analysis Plan

Sampling and Analysis Plan (SAP)

Remedial Investigation/Feasibility Study
Port of Seattle North Terminal 115

for
Washington State Department of Ecology on Behalf of Port of Seattle

May 9, 2013

GeoEngineers

Plaza 600 Building
600 Stewart Street, Suite 1700
Seattle, Washington 98101
206.728.2674

Sampling and Analysis Plan (SAP)

Remedial Investigation/Feasibility Study
Port of Seattle North Terminal 115

Project No. 0303-112-00

May 9, 2013

Approved By:

Signature: Date: May 9, 2013
John M. Herzog, PhD, Principal, GeoEngineers

Signature: Date: May 9, 2013
Iain H. Wingard, Project Manager, GeoEngineers

Signature: Date: May 9, 2013
Garrett R. Leque, LG, Field Coordinator, GeoEngineers

GRL:IHW:JMH:cn

DISTRIBUTION LIST

Brick E. Spangler
Port of Seattle
206.787.3193
spangler.b@portseattle.org

Donna Ortiz De Anaya
State of Washington Department of Ecology
Northwest Regional Office
Toxics Cleanup Program
425.649.7231
dort461@ecy.wa.gov

Table of Contents

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been developed for Remedial Investigation (RI) exploration activities at the Port of Seattle North Terminal 115 (the Site) located at 6000 West Marginal Way SW in Seattle, Washington. This SAP serves as the primary guide for standard operating procedures for field work into RI activities.

The RI is being conducted by the Port of Seattle (Port) to satisfy requirements of an Agreed Order (No. DE 8099) issued for the Site by the Washington State Department of Ecology (Ecology). The objectives of the RI are discussed in the Remedial Investigation/Feasibility Study (RI/FS) Work Plan (Work Plan). Project quality assurance and quality control is discussed in the Quality Assurance Project Plan (QAPP) presented in Appendix D of the Work Plan. A site-specific Health and Safety Plan (HASP) will be used for RI field activities and is presented in Appendix D of the Work Plan.

2.0 BACKGROUND

2.1. Problem Definition

Historical activities at the Site have included filling and industrial operations associated with tin reclamation. Tin reclamation facilities located at the Site have included process buildings, settling ponds, above ground and underground storage tanks, and rail lines. Additionally, filling and industrial activities have also been performed on adjacent properties. Previous environmental investigations conducted at the Site by the Port and other parties have detected metals, volatile and semi-volatile organic compounds (VOCs and SVOCs) including polycyclic aromatic hydrocarbons (PAHs), and petroleum hydrocarbons, in soil and/or groundwater at the Site. Metals and PAHs have also been detected in storm water solids collected at the Site.

Soil and groundwater investigations will be completed to characterize the nature and extent of soil and groundwater contamination at the Site and to provide sufficient information to select a cleanup action, if necessary. Sampling and analysis of stormwater catch basin solids is also being completed to evaluate whether the storm water collection system at the Site is a potential transport mechanism for contaminants in Site soil and groundwater to the Lower Duwamish Waterway (LDW).

2.2. Site Description

The North Terminal 115 property is located at 6000 West Marginal Way SW in Seattle, Washington, on the west bank of the Lower Duwamish Waterway (LDW). The property is approximately 2 acres in size and is located on the northwestern portion of the Port's Terminal 115. The Site is bordered to the north by Glacier Northwest and west by West Marginal Way SW. Northland Services Inc. leases the portion of Terminal 115 east and south of the Site. The LDW is located to the east and northeast of the Site.

The Site is currently owned by the Port and currently leased to the Gene Summy Lumber Co. which distributes untreated lumber and the Commercial Fence Corp., a fence supplier. A relatively small portion is leased to SeaPac along the western boundary to provide access to Terminal 115. Site topography is generally flat and most of the Site is paved with either asphalt or concrete. Stormwater runoff at the Site is collected in catch basins and is then discharged to the LDW via a 48-inch storm drain located near the northern property boundary. Chain link fencing encompasses the property except where the asphalt road enters from West Marginal Way SW.

2.3. Site History

The Site was originally part of the Duwamish River estuary. The river was channelized in the late 1800s and early 1900s and the Site property was created by filling the former shoreline of the Duwamish River. From 1963 to 1998, the Site was used for tin reclamation by various companies. As stated above, facilities located at the Site used for tin reclamation have included process buildings, settling ponds, above ground and underground storage tanks, and rail lines.

Waste streams generated by tin reclamation processes included spent plating solution and black mud filtrate which were disposed of to the sanitary sewer. A third waste stream, black mud, was also produced and was captured onsite in settling ponds located in the eastern portion of the Site until about 1972 when the lagoons were filled and paved over. From 1972 to 1991, the black mud was further reclaimed, dewatered, and stockpiled onsite and then shipped off site. In 1998, tin reclamation operations ceased. As stated above, the Site is currently leased to the Gene Summy Lumber Co. which distributes untreated lumber, the Commercial Fence Corp., a fence supplier, and SeaPac to provide access to Terminal 115.

2.4. Project Description and Schedule

Investigation activities will be completed within 12 months following Ecology's approval of the Final RI/FS Work Plan. Sampling and analysis at the Site will be performed to characterize the nature and extent of soil and groundwater contamination at the Site and to provide sufficient information to select a cleanup action, if necessary. The activities also include assessment of stormwater catch basin solids to evaluate whether the stormwater collection system at the Site is a potential transport mechanism for contaminants in Site soil and groundwater to the LDW. Proposed sample locations are shown on Figures 1 through 4. Selected samples will be submitted for chemical analysis to OnSite Environmental, Inc. for one or more of the following:

- Priority pollutant metals (antimony, arsenic, beryllium, cadmium, chromium, copper, mercury, nickel, lead, selenium, silver, thallium and zinc) and barium and tin by EPA Method 6020A and 7471B.
- Semi-volatile organic compounds (SVOCs) by EPA Method 8270D/SIM.
- Volatile organic compounds (VOCs) by EPA Method 8260C.
- Polychlorinated biphenyls (PCBs) by EPA Method 8082A.
- Gasoline-range petroleum hydrocarbons by Ecology Method NWTPH-Gx.
- Diesel- and heavy oil-range petroleum hydrocarbons by Ecology Method NWTPH-Dx.
- Soil pH by SW 846-9045C.
- Dioxins and furans by EPA Method 1613/8290.

The chemical analyses to be performed are presented in Tables 1 through 3. Project objectives, procedures, organization, functional activities, and specific quality assurance and quality control activities designed to achieve data quality goals established for the project are outlined in the Quality Assurance Project Plan (QAPP) (Appendix D of the Work Plan).

3.0 REMEDIAL INVESTIGATION PROCEDURES

Field investigations during the RI will consist primarily of the following:

- Advancing of borings and excavating test pits and obtaining soil samples for chemical analysis to characterize soil conditions.
- Installation of shallow groundwater monitoring wells.
- Conduct four rounds of water sampling from new and existing groundwater monitoring wells for chemical analysis to characterize groundwater conditions.
- Obtain stormwater catch basin solids samples from existing Site catch basins for chemical analysis to characterize stormwater catch basin solids conditions.
- Perform slug tests and a tidal study to measure hydraulic conductivity and monitor groundwater levels and to determine groundwater follow direction.

The following sections describe the field procedures to be employed during the RI.

3.1. Soil Investigation

Soil borings and test pit excavations will be used to characterize Site lithology and to collect soil samples for chemical analyses. Hollow stem auger (HSA) borings will be advanced for installation of groundwater monitoring wells. Soil boring and soil sample collection methods to be used during the RI investigation are described below. The soil investigation will consist of obtaining soil samples from 17 direct-push borings (B-1 through B-17), three test pits explorations (TP-1 through TP-3) and 14 HSA borings (MW-2D, MW-4D, MW-10D, MW-19D and MW-11 through MW-20) at the approximate locations shown on Figure 1.

Prior to the completion of any soil exploration, an underground utility locate (public and private) will be conducted in the area of the proposed exploration locations to identify any subsurface utilities and/or potential underground physical hazards. A public utility locate (one-call) will be performed, and a private utility locating company will be contracted to mark underground utilities in the vicinity of the proposed explorations. An air knife (vacuum truck) may be used to clear soil from the surface at selected exploration locations, if utilities are not able to be clearly identified on Site. A hand auger will be used to attempt to collect soil samples from the surface of borings where an air knife is used to clear drilling locations.

3.1.1. Direct-Push Borings and Soil Sampling

Direct-push borings for obtaining soil samples will be advanced using a truck-mounted Geoprobe® direct-push drilling rig. The direct-push borings will be advanced to approximately 1 foot below the fill/native soil contact (approximately 4 to 8 feet below ground surface [bgs] in borings B-1 through B-3 and 1 foot below the surface of the aquitard or approximately 20 feet bgs in borings B-4 through B-17). Borings will be completed by a licensed driller in the state of Washington. A representative from GeoEngineers' staff will select the soil samples, examine and classify the soils encountered and prepare a detailed log of each exploration.

Soil samples will be obtained from borings advanced using direct-push drilling equipment. Continuous soil cores will be obtained from the direct-push borings using a 2.0- to 2.5-inch-diameter core barrel with acetate liners. The core barrels are driven with a pneumatic hammer in 4-foot intervals.

Soil from the continuous core will be visually classified in general accordance with ASTM D 2488 and screened in the field for the presence of contamination. Field screening will consist of visual observation for the presence of contamination (i.e., staining, etc.), water sheen testing, and organic vapor monitoring. Field screening procedures are presented in Section 3.4. Observations of soil and groundwater conditions and soil field screening results for each exploration will be included on a boring log.

A minimum of three soil samples will be collected from each direct push boring for potential chemical analysis. In general, samples will be collected from the fill horizon(s), at the water table (where the exploration depth is sufficient to encounter the water table), the native soil horizon and/or where there is field screening evidence of contamination. Soil samples submitted for analysis will be obtained from discrete lithologic zones or the smallest interval necessary, and include no more than an interval of approximately 1 foot thick of homogeneous material. Samples selected for analysis will be placed in containers provided by the analytical laboratory. Each sample container will be securely capped, labeled, and placed in a cooler with ice immediately upon collection as described in the QAPP (Appendix D of the Work Plan). Table 1 presents the soil sampling locations, investigation location purpose, depth, and anticipated sample horizons and analyses, and Figures 2A, 2B and 2C provide a visual representation of the information in Table 1.

Soil samples to initially be submitted for chemical analyses will be selected based on field screening results, location of the groundwater table and/or target soil horizon (i.e., fill or native soil). In general, soil with the greatest evidence of contamination based on the field screening will initially be submitted for chemical analysis from each location. Additional samples with no evidence or lesser evidence of contamination will be collected and archived for potential follow-up analysis based on the analytical results from the initial samples. Analysis will be performed on additional samples from a given investigation location when supplemental data is needed to characterize or delineate contamination present in the initial sample(s) that were analyzed.

Soil cuttings (unused soil core) from borings completed during the RI will be placed in labeled and sealed 55-gallon drums. The drums will be stored temporarily at a secure location on Port property pending receipt of analytical results and off-site disposal at a permitted facility.

Drilling and sampling equipment will be decontaminated using the procedures described in the QAPP (Appendix D of the Work Plan).

3.1.2. Test Pit Explorations and Soil Sampling

Test pit explorations for obtaining soil samples will be completed using a backhoe or excavator. The test pits will be completed to approximately 1 foot below the fill/native soil contact or approximately 6 feet bgs in exploration TP-1 and between approximately 6 and 10 feet bgs in explorations TP-2 and TP-3. Test pits will be completed by an earthwork contractor contracted to the Port or GeoEngineers. A representative from GeoEngineers' staff will select the exploration locations, examine and classify the soils encountered and prepare a detailed log of each exploration.

Soil samples will be obtained from the excavation equipment (i.e., backhoe or excavator) or hand tools such as spades or stainless steel trowels. Samples obtained from backhoe or excavator buckets will be from the center of the bucket or from an area of soil that the surface of the bucket has not touched. Soil will be visually classified in general accordance with American Society of Testing and Materials (ASTM) D-2488 and screened in the field for the presence of contamination. Field screening will consist of visual observation for the presence of contamination (i.e., staining, etc.), water sheen testing, and organic vapor monitoring. Field screening procedures are presented in Section 3.4. Observations of soil and groundwater conditions and soil field screening results for each exploration will be included on a boring log.

A minimum of three soil samples will be collected from each test pit for potential chemical analysis. In general, samples will be collected from the fill horizon, at the water table (where the exploration depth is sufficient to encounter the water table), the native soil horizon and/or where there is field screening evidence of contamination. Soil samples submitted for analysis will be obtained from discrete lithologic zones or the smallest interval necessary, and include no more than an interval of approximately 1 foot thick of homogeneous material. Samples selected for analysis will be placed in containers provided by the analytical laboratory. Each sample container will be securely capped, labeled, and placed in a cooler with ice immediately upon collection as described in the QAPP (Appendix D of the Work Plan). Table 1 presents the soil sampling locations, investigation location purpose, depth, and anticipated sample horizons and analyses.

Soil samples to initially be submitted for chemical analyses will be selected based on field screening results, location of the groundwater table and/or target soil horizon (i.e., fill or native soil). In general, soil with the greatest evidence of contamination based on the field screening will initially be submitted for chemical analysis from each location. Additional samples with no evidence or lesser evidence of contamination will be collected and archived for potential follow-up analysis based on the analytical results from the initial samples. Analysis will be performed on additional samples from a given investigation location when supplemental data is needed to characterize or delineate contamination present in the initial sample(s) that were analyzed.

Soil generated during each test pit exploration will be temporarily stockpiled adjacent to the exploration. Following the completion of each test pit, stockpiled soil will be returned and compacted using the bucket of the excavation equipment.

3.1.3. Hollow Stem Auger Borings

HSA borings for obtaining soil samples will be drilled using a truck-mounted HSA drilling rig. The HSA borings will be advanced to approximately 1 foot below the surface of the aquitard or approximately 20 feet bgs in borings MW-11 through MW-20. HSA borings at MW-2D and MW-4D, will be advanced to approximately 12 feet below the bottom of the aquitard which is anticipated to be between 25 and 35 feet bgs. HSA boring at MW-10D and MW-19D will be advanced to depths similar to the depths of borings at MW-2D and MW-4D, HSA borings will be completed by a licensed driller in the state of Washington. A representative from GeoEngineers' staff will select the exploration locations, examine and classify the soils encountered and prepare a detailed log of each exploration.

Soil samples will be obtained from borings advanced using HSA drilling equipment. Continuous soil core samples will be obtained from the HSA borings using a 2.5-inch-diameter split-barrel sampler. Soil from the continuous core will be visually classified in general accordance with American Society of Testing and Materials (ASTM) D-2488 and screened in the field for the presence of contamination. Field screening will consist of visual observation for the presence of contamination (i.e., staining, etc.), water sheen testing, and organic vapor monitoring. Field screening procedures are presented in Section 3.4. Observations of soil and groundwater conditions and soil field screening results for each exploration will be included on a boring log.

A minimum of three soil samples will be collected from each HSA boring for potential chemical analysis. In general, samples will be collected from the fill horizon, at the water table (where the exploration depth is sufficient to encounter the water table), the native soil horizon and/or where there is field screening evidence of contamination. Soil samples submitted for analysis will be obtained from discrete lithologic zones or the smallest interval necessary, and include no more than an interval of approximately 1 foot thick of homogeneous material. Samples selected for analysis will be placed in containers provided by the analytical laboratory. Each sample container will be securely capped, labeled and placed in a cooler with ice immediately upon collection as described in the QAPP (Appendix D of the Work Plan). Table 1 presents the soil sampling locations, investigation location purpose, depth, and anticipated sample horizons and analyses, and Figures 2A, 2B and 2C provide a visual representation of the information in Table 1.

Soil samples to initially be submitted for chemical analyses will be selected based on field screening results, location of the groundwater table and/or target soil horizon (i.e., fill or native soil). In general, soil with the greatest evidence of contamination based on the field screening will initially be submitted for chemical analysis from each location. Additional samples with no evidence or lesser evidence of contamination will be collected and archived for potential follow-up analysis based on the analytical results from the initial samples. Analysis will be performed on additional samples from a given investigation location when supplemental data is needed to characterize or delineate contamination present in the initial sample(s) that were analyzed.

Soil cuttings (unused soil core) from borings completed during the RI will be placed in labeled and sealed 55-gallon drums. The drums will be stored temporarily at a secure location on Port property pending receipt of analytical results and offsite disposal at a permitted facility.

Drilling and sampling equipment will be decontaminated using the procedures described in the QAPP (Appendix D of the Work Plan).

3.2. Groundwater Investigation

Four quarters of groundwater sampling will be performed at 24 to 27 locations (depending on potential access restrictions to an adjacent property) to collect samples representative of groundwater conditions at the Site. Information obtained from previous Site investigations was used to support selection of the proposed groundwater sample locations. The groundwater sampling locations are presented in Figure 2.

Samples will be collected from existing Site monitoring wells MW-1 through MW-10 and potentially from GMW-25 through GMW-27 (based on access) and proposed monitoring wells MW-2D, MW-4D, MW-10D, MW-19D and MW-11 through MW-19 and submitted for chemical analysis. Procedures for monitoring well installation, well development, water level measurement and groundwater sample collection are described below.

3.2.1. Monitoring Well Construction

Drilling and construction of the monitoring wells will be conducted by a Washington State licensed driller in accordance with the Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 Washington Administrative Code [WAC]; Ecology, 2006). Installation of the monitoring wells will be observed by a GeoEngineers representative, who will maintain a detailed log of the materials and depths of the wells. Monitoring well borings will be drilled using a truck-mounted HSA rig.

Wells will be constructed of 2-inch-diameter, flush-threaded Schedule 40 polyvinyl chloride (PVC) casing with machine-slotted PVC screen (0.010-inch). The top of the well screens of all but four wells (i.e., MW-2D, MW-4D, MW-10D and MW-19D) will be located approximately 5 feet above the observed groundwater level, or within 2 feet of the ground surface, whichever is deeper. The wells' location and the potential for influence on groundwater levels in the well from changes in water levels in the LDW will be considered when placing the well screen. The well screen intervals may be modified based on field screening results or variations in soil type. The well screens at MW-2D and MW-4D will be placed beneath the bottom of the aquitard, which is an anticipated screen interval of approximately 25 feet to 35 feet bgs. The well screens for MW-10D and MW-19D will be set at similar elevations (i.e., approximately 25 to 35 feet bgs). Screened intervals of approximately 10-foot length are anticipated for all wells.

Following placement of the well screen and casing in the borehole, a filter pack will be installed around the well screen. The filter pack will extend from the bottom of the well to a minimum of 1 foot above the top of the screen. Filter pack material will consist of commercially prepared 10-20 silica sand.

A bentonite seal at least 1 foot thick will be placed above the sand pack to about 1.5 feet bgs. The surface of each well will be completed with a concrete seal and surface pad extending from the top of the bentonite seal to slightly above the ground surface. Locking steel flush-mount monuments will be cemented in place from the surface to a depth of about 1.5 feet bgs.

3.2.2. Monitoring Well Development

Each monitoring well will be developed to remove water introduced into the well during drilling (if any), stabilize the filter pack and formation materials surrounding the well screen, and restore the hydraulic connection between the well screen and the surrounding soil. The well screen will be gently surged with a decontaminated stainless steel bailer several times after installation. Development will continue until a minimum of five casing volumes of water have been removed and turbidity of the discharged water is relatively low. The goal of well development will be to reduce the turbidity content of the water to approximately 25 nephelometric turbidity unit (NTU). Up to 10 well volumes of water will be removed from the wells in an effort to attain the 25 NTU goal. The removal rate and volume of groundwater removed will be recorded during well development procedures. Water that is removed from the well during well development activities will be stored on Port property in labeled 30-gallon or 55-gallon drums, pending off-site disposal. Depths to water in the monitoring wells will be measured prior to development.

3.2.3. Water Level Measurements

Water level measurements will be obtained at each monitoring well prior to purging and sample collection. All water levels will be measured using an electronic water level indicator and will be recorded to the nearest 0.01 foot. Measurements will be taken from the top of the well casing.

3.2.4. Groundwater Sampling

Groundwater samples will be obtained using low-flow/low-turbidity sampling techniques to minimize the suspension of sediment in the samples. Groundwater samples will be obtained from monitoring wells using a peristaltic pump and disposable polyethylene tubing. Groundwater will be pumped at approximately 0.5 liter per minute using a peristaltic pump attached to tubing placed within the screened interval. A Horiba U-22 water quality measuring system with a flow-through cell will be used to monitor the following water quality parameters during purging: electrical conductivity, dissolved oxygen, pH, salinity, total dissolved solids, turbidity, oxidation-reduction potential and temperature. Ambient groundwater conditions will have been reached once these parameters vary by less than 10 percent on three consecutive measurements. The stabilized field measurements will be documented on the field log (for subsequent use in the RI). If parameters do not stabilize, samples will be collected after three well-volumes of water have been purged from the well. Following well purging, the flow-through cell will be disconnected and groundwater samples will be collected in laboratory-prepared containers. Table 2 provides the groundwater sample analyses. Samples to be analyzed for VOCs will be obtained using EPA guidance for using peristaltic pumps to collect VOC samples. EPA recommends using the “soda straw” method which involves allowing the flexible tubing to fill by either lowering it into the water column (A) or by filling it with suction applied to the pump head (B). For Method A, the tubing is removed from the well after filling and the sample is allowed to drain into the sample vial. For Method B, after running the pump and filling the tubing with sample, the pump speed is reduced and the flow direction is reversed to push the sample out of the tubing into the sample vials. The samples will be placed into a cooler with ice and logged on the chain-of-custody form using the procedures described in the QAPP (Appendix D of the Work Plan).

Purge water removed from the monitoring wells and decontamination water generated during all sampling activities will be stored on Site in labeled and sealed 55-gallon drums. The drums will be stored temporarily at a secure location on Port property pending receipt of analytical results and off-site disposal at a permitted facility.

3.2.5. Survey

Each monitoring well location and casing rim and ground surface elevation will be surveyed relative to a temporary or permanent benchmark. Elevations will be surveyed using a laser level which has an accuracy of 0.01 foot. Monitoring well location positions will be surveyed with equipment that has an accuracy of 0.1 foot.

3.2.6. 72-hour Tidal Study

Water levels in monitoring wells will be recorded using a combination of pressure transducers with internal data loggers and an electronic water level indicator. The data collection will include continuous (every 15 minutes) transducer-based water level measurements in wells and in the LDW. The data logger will be programmed to automatically convert pressure changes to water levels. If possible, a vented transducer will be used that internally corrects for fluctuations in atmospheric pressure. Procedures for conducting the 72-hour tidal study are summarized below:

- At each monitoring well, a pressure transducer will be lowered into the well and securely fastened to the top of the well casing for the duration of the monitoring period. A transducer will also be established in the LDW at a secured location.
- The transducers will be set to record the height of the water column above the transducer at 15-minute intervals.
- Pressure transducers will be rated to a minimum 15 pounds per square inch (psi) range capable of measuring a water level change of 23 feet with a resolution of 0.01 foot.
- Depth to water will also be measured from the top of the well casing to the nearest 0.01 foot with a manual electronic water level indicator. Depth-to-water level will be manually measured a minimum of four times during the monitoring period.
- At the end of the monitoring period, the pressure transducers will be removed and the water level data will be uploaded to a computer.

Similar procedures will be used to monitor surface water levels in the LDW.

3.2.7. Hydraulic Conductivity Testing

The groundwater hydraulic conductivity at the Site will be estimated using slug tests. Slug tests will be performed in selected monitoring wells to identify the range of hydraulic conductivities present. Slug tests can be performed prior to or following the 72-hour tidal study. The well location and tidal stage will be considered when performing and interpreting the slug tests to minimize the interference of tidal fluctuations on the aquifer and the determination of the hydraulic conductivities.

Slug tests will be performed using a PVC slug rod, a down-hole pressure transducer as described above, and a water level indicator in general accordance with ASTM D 4044-99. The general procedure for conducting the slug tests in monitoring wells is summarized below:

- At each monitoring well, the static depth of groundwater will be measured prior to placing the pressure transducer near the bottom of the well.
- After stabilization of the groundwater level (from the displacement of the transducer) the slug rod will be quickly lowered into the well until it is submerged in the water column.
- The recovery of the perturbed water level will be monitored until it has returned to within 95 percent of the initial head indicated by the transducer prior to the introduction of the slug rod.
- Once the water level has re-equilibrated, the slug rod will be quickly removed from the water column and the groundwater level will be monitored for recovery.
- After the water level has recovered to within tolerance (95 percent) depth to groundwater will be manually measured again and the transducer will be removed and the well secured.

The slug test response data will be analyzed using the Bouwer and Rice Method (Bouwer and Rice, 1976, Bouwer, 1989).

3.3. Stormwater Catch Basin Solids Investigation

Stormwater catch basin solids samples will be used to evaluate whether the stormwater conveyance system is a potential pathway for contaminant migration from the Site to the LDW. Stormwater catch basin solids sampling will be performed at all accessible locations on the T115N site. Samples from CB-313, CB-322, CB-323, CB-324 and CB-328 will be analyzed. Samples from the remaining accessible onsite catch basins will be archived. The stormwater catch basin solids sample locations initially analyzed (i.e. samples from CB-313, CB-322, CB-323, CB-324 and CB-328) were positioned to analyze samples of from potential source areas located on the Site. Information obtained from previous Site investigations and alignment of the 48-inch Seattle Public Utility (SPU) storm drain line were used to support selection of the proposed stormwater catch basin solids sample locations to be analyzed. The catch basin locations are presented in Figure 3, and the analyses to be performed are presented in Table 3. The archived samples will be analyzed as necessary based on the results of samples from CB-313, CB-322, CB-323, CB-324 and CB-328.

The investigation and sampling of Site stormwater catch basin solids will be performed by obtaining samples using a stainless steel spoon or, where necessary, will be obtained using a sampler attached to an extension arm to reach into deeper catch basins. One sample will be collected from each catch basin for chemical analysis. Samples will be placed in containers provided by the analytical laboratory. Each sample container will be securely capped, labeled and placed in a cooler with ice immediately upon collection as described in the QAPP (Appendix D).

Stormwater catch basin solids samples will be screened in the field for the presence of contamination. Field screening will consist of visual observation for the presence of contamination (i.e., staining, etc.), water sheen testing and organic vapor monitoring.

3.4. Field Screening

The potential presence of contamination in soil and stormwater catch basin samples will be evaluated using field screening techniques. Field screening results will be recorded on the field logs and the results will be used as a general guideline to delineate areas of possible contamination. In addition, screening results will be used as a basis for selecting soil samples for chemical analysis. The following screening methods will be used: 1) visual screening; 2) water sheen screening; and 3) headspace vapor screening.

3.4.1. Visual Screening

The soil and stormwater catch basin solids will be observed for any physical evidence of indicative of possible contamination including unusual color, staining and/or odor.

3.4.2. Water Sheen Screening

Water sheen screening involves placing a portion of the soil and stormwater catch basin solids samples in a pan containing distilled water, and observing the water surface for signs of sheen. This is a relatively sensitive, qualitative field screening method that can help identify the presence or absence of petroleum hydrocarbons and other contaminants, sometimes at concentrations lower than regulatory cleanup guidelines. The following sheen classifications will be used:

Classification	Identifier	Description
No Sheen	(NS)	No visible sheen on the water surface.
Slight Sheen	(SS)	Light, colorless, dull sheen; spotty to globular; spread is irregular, not rapid; sheen dissipates rapidly; areas of no sheen remain.
Moderate Sheen	(MS)	Light to heavy sheen; may have some color/iridescence; globular to stringy; spread is irregular to flowing, may be rapid; few remaining areas of no sheen on the water surface.
Heavy Sheen	(HS)	Heavy sheen with color/iridescence; stringy; spread is rapid; entire water surface may be covered with sheen; sheen flows off the sample.

3.4.3. Headspace Vapor Screening

This is a semi-quantitative field screening method that can help identify the presence or absence of VOCs in soil samples. A portion of the soil and stormwater catch basin samples will be placed in a resealable plastic bag. Ambient air will be captured in the bag; the bag will be sealed and then shaken gently to expose the soil to the air trapped in the bag. The bag will remain closed for approximately 5 minutes at ambient temperature before the headspace vapors are measured. Vapors present within the sample bag's headspace will be measured by inserting the probe of a PID with a 10.6 electron volt (eV) lamp through a small opening in the bag, taking care not to clog the probe with soil. The maximum PID reading (in part per million [ppm]) and the ambient air temperature will be recorded on the field log for each sample. The PID will be calibrated to 100 ppm isobutylene each day prior to soil sampling. No soil sample used for headspace screening will be submitted to the laboratory for chemical analysis.

3.5. Decontamination

Drilling and non-disposable sampling equipment will be decontaminated using the procedures described in the QAPP (Appendix D of the Work Plan).

3.6. Sample Handling

Sample handling procedures, including labeling, container and preservation requirements and holding times are described in QAPP (Appendix D of the Work Plan).

3.7. Disposal of Investigation-Derived Materials

3.7.1. Soil

Soil cuttings from borings completed during the investigation will be placed in labeled and sealed 55-gallon drums. The drums will be temporarily stored on Site at a secure location pending receipt of analytical results and off-site disposal at a permitted facility. Each drum will be labeled with the following information:

- Material/media (i.e., soil, water, etc.) contained in the drum;
- Source of the material in the drum (i.e., investigation locations and depths where appropriate);
- Date material was generated; and
- Name and telephone number of GeoEngineers contact person.

3.7.2. Groundwater and Decontamination Water

Development and purge water removed from the monitoring wells and decontamination water generated during all sampling activities will be placed in labeled and sealed 55-gallon drums. The drums will be temporarily stored on Site at a secure location pending receipt of analytical results and off-site disposal at a permitted facility.

3.7.3. Disposition of Incidental Waste

Incidental waste generated during sampling activities includes items such as gloves, plastic sheeting, sample tubing, paper towels and similar expended and discarded field supplies. These materials are considered *de minimis* and will be disposed of in a local trash receptacle or county disposal facility.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance/quality control (QA/QC) procedures and standards that will be implemented during RI activities are presented in the QAPP (Appendix D of the Work Plan). The purpose of this document is to describe analysis and quality control procedures that will be implemented to produce chemical and field data that are representative, valid and accurate for use in evaluating the cleanup action alternatives.

5.0 REFERENCES

Bouwer, H., "Slug Test – An Update," *Ground Water, 1989,* 27:15-20.

Bouwer, H. and M.R. Rice., "A Slug Test Determining the Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells," *Water Resources Research* 1976, 12:423-428.

ENSR Consulting and Engineering. “MRI Corporation, Seattle, Washington Waste Characterization Program,” dated March 12, 1991.

Landau Associates, Inc., “Environmental Investigation Report, Port of Seattle Terminal 115 North Seattle, Washington,” dated December 21, 2009.

Seattle-King County Public Health (SKCDPH), “A Site Hazard Assessment,” dated February 1998.

Washington State Department of Ecology (Ecology), “Minimum Standards for Construction and Maintenance of Wells”, Chapter 173-160 WAC, update November 2006.

TABLE 1

SUMMARY OF SAMPLING APPROACH, OBJECTIVES AND ANALYSES - SOIL

SAMPLING AND ANALYSIS PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Sample Location	Characterization Objectives for Investigation Location							Soil Investigation Total Depth (feet)	Target Soil Sample Horizons					Minimum Number of Samples Collected[3]	Number of Samples Analyzed						
	Fill	Former Ponds	Former ASTs	Process Buildings	Rail Lines	Former UST	Arsenic in Soil		Fill[1]	Water Table[2]	Native Surface	Top of Aquitard	Lower Sand Layer		Metals[4] (EPA 6000/7000)	SVOCs[5] (EPA 8270D/SIM)	VOCs[5] (EPA 8260C)	PCBs[4] (EPA 8082A)	TPH[5] (NWTPH-Gx, Dx)	Soil pH[5] (SW 846 - 9045C)	Dioxins/Furans[4] (EPA 1613/8290)
Direct Push Borings																					
B-1	■				■			4 to 8	■		■			3	2-3	2-3				2-3	
B-2	■				■			4 to 8	■		■			3	2-3	2-3				2-3	
B-3	■				■			4 to 8	■		■			3	2-3	2-3				2-3	
B-4	■				■			~20	■	■	■	■		5	3-5	4-5	4-5	1-5		4-5	
B-5	■			■		■		~20	■	■	■	■		5	3-5	4-5	4-5		4-5	4-5	
B-6	■		■	■		■		~20	■	■	■	■		5	3-5	4-5	4-5	1-5	4-5	4-5	
B-7	■		■	■		■		~20	■	■	■	■		5	3-5	4-5	4-5		4-5	4-5	
B-8	■		■	■		■		~20	■	■	■	■		5	3-5	4-5	4-5		4-5	4-5	
B-9	■		■	■				~20	■	■	■	■		5	3-5	4-5	4-5		4-5	4-5	
B-10	■	■	■					~20	■	■	■	■		5	3-5	4-5				4-5	
B-11	■	■						~20	■	■	■	■		5	3-5	4-5	4-5		4-5	4-5	
B-12	■		■	■				~20	■	■	■	■		5	3-5	4-5	4-5	1-5		4-5	
B-13	■	■						~20	■	■	■	■		5	3-5	4-5	4-5	1-5		4-5	
B-14	■	■		■				~20	■	■	■	■		5	3-5	4-5				4-5	
B-15	■	■					■	~20	■	■	■			4	3-4	4	4			4	
B-16	■	■						~20	■	■	■			4	3-4	4	4		4	4	
B-17	■			■				~20	■	■	■			4	3-4	4	4			4	
Test Pit Excavations																					
TP-1	■				■			~6	■		■			3	2-3	2-3	2-3	1-3		2-3	
TP-2	■				■	■		6 to 10	■	■	■			4	2-4	3-4	3-4		3-4	3-4	
TP-3	■				■	■		6 to 10	■	■	■			4	2-4	3-4	3-4		3-4	3-4	
Hollow Stem Auger																					
MW-2D	■				■	■		30-35	■	■	■	■	■	6	3-6	5-6	5-6		5-6	5-6	
MW-4D	■	■	■					30-35	■	■	■	■	■	6	3-6	5-6	5-6			5-6	
MW-10D	■	■						30-35	■	■	■	■	■	5	3-5	5	5	1-5		5	1-5
MW-19D	■	■						30-35	■	■	■	■	■	5	3-5	5	5	1-5		5	1-5
MW-11	■				■		■	~20	■	■	■	■		5	3-5	4-5	4-5			4-5	1-5
MW-12	■						■	~20	■	■	■	■		5	3-5	4-5				4-5	
MW-13	■	■	■	■			■	~20	■	■	■	■		5	3-5	4-5	4-5	1-5		4-5	1-5
MW-14	■						■	~20	■	■	■	■		5	3-5	4-5	4-5			4-5	
MW-15	■	■	■	■				~20	■	■	■	■		5	3-5	4-5				4-5	1-5
MW-16	■	■	■	■				~20	■	■	■	■		5	3-5	4-5	4-5			4-5	
MW-17	■	■						~20	■	■	■			4	3-4	4	4			4	
MW-18	■	■					■	~20	■	■	■			4	3-4	4	4		4	4	
MW-19								~20						0[6]							
MW-20	■				■			~20	■	■	■	■		5	3-5	4-5	4-5		4-5	4-5	

Notes:

[1] The fill to be characterized will include the sampleable portion (i.e. the minus 3/4-inch fraction) of railroad ballast, where encountered.

[2] The water table sample will be sampled across the water table observed at time of drilling.

[3] See Typical Soil Sample Collection Schematics (Figures 2A, 2B and 2C).

[4] The number of samples analyzed from each location for metals, PCBs and dioxins/furans is based on archiving of selected sample intervals for potential future analysis (within hold times). The minimum number of samples indicated will be analyzed, with additional sample intervals analyzed where supplemental data is needed to characterize or delineate contamination present based on the initial sample(s) that were analyzed.

[5] The number of samples analyzed from each location for SVOCs, VOCs, TPH and pH is based on fill thickness at the location. In general, where fill is observed to be greater than approximately several feet thick, an additional fill sample will be analyzed.

[6] Soil samples will be collected from the adjacent well MW-19D.

See Figure 2 for soil sample locations.

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TABLE 2

SUMMARY OF SAMPLING APPROACH, OBJECTIVES AND ANALYSES - GROUNDWATER

SAMPLING AND ANALYSIS PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Sample Location	Characterization Objectives for Investigation Location								Anticipated Well Screen Interval (feet bgs)[1]	Groundwater Analyses[2]			
	Fill	Former Ponds	Former ASTs	Process Buildings	Rail Lines	Former UST	Arsenic in Groundwater	Investigate Vertical Extent		Metals (EPA 200.8/7470)	SVOCs (EPA 8270D/SIM)	VOCs (EPA 8260C)	TPH (NWTPH-Gx, Dx)
New Monitoring Wells													
MW-2D								■	25-35	4	4	4	
MW-4D							■	■	25-35	4	4	4	
MW-10D	■						■	■	25-35	4	4	4	
MW-19D	■	■		■				■	25-35	4	4		
MW-11	■				■		■		5-15	4	4		
MW-12	■						■		5-15	4	4		4
MW-13	■	■	■	■			■		5-15	4	4	4	4
MW-14	■						■		5-15	4	4	4	
MW-15	■	■	■	■					10-20	4	4	4	
MW-16	■	■	■	■					5-15	4	4	4	
MW-17	■	■							5-15	4	4	4	4
MW-18	■	■					■		5-15	4	4		4
MW-19	■	■							5-15	4	4		4
MW-20	■				■				5-15	4	4		4
Existing Monitoring Wells													
MW-1	■			■	■	■	■		8-13	4	4	4	4
MW-2	■				■	■	■		10-15	4	4	4	4
MW-3	■	■	■	■		■	■		8-18	4	4	4	4
MW-4	■	■					■		7-12	4	4	4	
MW-5	■	■					■		7-17	4	4	4	4
MW-6	■	■		■			■		7-12	4	4	4	4
MW-7	■	■					■		7-12	4	4	4	4
MW-8	■	■					■		9-14	4	4	4	
MW-9	■	■					■		11-16	4	4		
MW-10	■	■					■		7-12	4	4	4	
GMW-25	■						■		5-15	4	4		
GMW-26	■						■		5-15	4	4		
GMW-27	■						■		5-15	4	4		

Notes:

[1] The anticipated well screen interval is approximate and is based on a limited number of subsurface explorations previously performed at the site; actual well screen intervals will be determined in the field and will be based on the interval best suited to characterize the nature and extent of contamination, and based on the judgement of the field geologist or engineer.

[2] Four rounds of groundwater monitoring will be performed.

See Figure 3 for groundwater sample locations

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TABLE 3

SUMMARY OF SAMPLING APPROACH, OBJECTIVES AND ANALYSES - STORMWATER CATCH BASIN SOLIDS

SAMPLING AND ANALYSIS PLAN

PORT OF SEATTLE NORTH TERMINAL 115

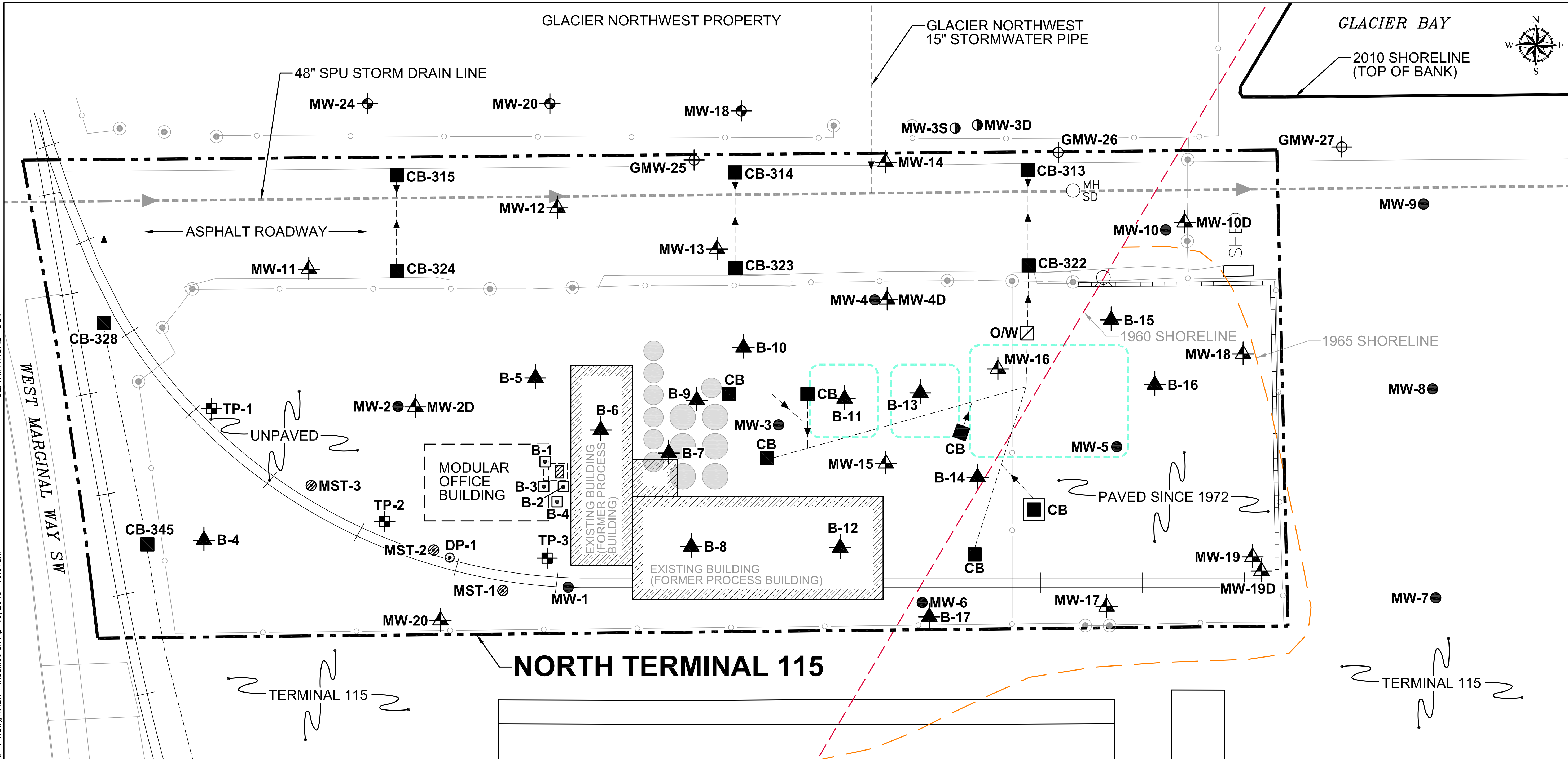
SEATTLE, WASHINGTON

Sample Location	Stormwater Catch Basin Solids Analyses					
	Metals (EPA 6000/7000)	SVOCs (EPA 8270D/SIM)	VOCs (EPA 8260C)	PCBs (EPA 8082A)	TPH (NWTPH-Gx, Dx)	Dioxins/Furans (EPA 1613/8290)
CB-313	1	1	1	1	1	1
CB-322	1	1	1	1	1	1
CB-323	1	1	1	1	1	1
CB-324	1	1	1	1	1	1
CB-328	1	1	1	1	1	1
Other CBs[1]	0-1	0-1	0-1	0-1	0-1	0-1

Notes:

[1] Remaining Site catch basins (i.e., CB-314, 315, 345 and six unnamed catch basins) may be analyzed based on the results from CB-313, 322, 323, 324, and 328.

See Figure 4 for catch basin solids samples locations.



Notes

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Reference: Base CAD drawing provided by Port of Seattle. Locations of historic features from SAIC 2007, Landau 2009, and historic aerial photos (1960 and 1965).

Legend

- B-5 — Proposed new boring
- MW-11 — Proposed new boring completed as monitoring well
- TP-1 — Proposed new test pit
- MW-1 — Monitoring well (Landau, 2009)
- GMW-25 — Monitoring well on North Terminal 115 property boundary (Shaw, 2003)
- DP-1 — Direct push boring (Landau, 2009)
- MW-18 — Monitoring well (Shaw, 2003)
- MW-3S — Monitoring well (Retec, 1996)
- MST-1 — Estimated location of soil sample (SKCDPH, 1998)
- B-1 — Soil boring (ENSR, 1992)
- CB-323 — Proposed catch basin to be sampled
- CB-314 — Catch basin, stormwater pipe, and flow direction
- O/W — Oil / water separator
- CB — Large catch basin
- North Terminal 115 boundary
- 48" SPU storm drain line
- 2010 Shoreline (top of bank)
- Fence with gate
- Ecology block wall
- Railroad tracks

Historical Feature

- 1960 Shoreline
- 1965 Shoreline
- Approximate location of former evaporation / settling ponds
- Approximate location of former underground heating oil storage tank
- Approximate location of excavation zone
- Former aboveground storage tank

50 0 50
FEET

RI/FS Sample Locations

Port of Seattle - North Terminal 115
Seattle, Washington

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Figure 1

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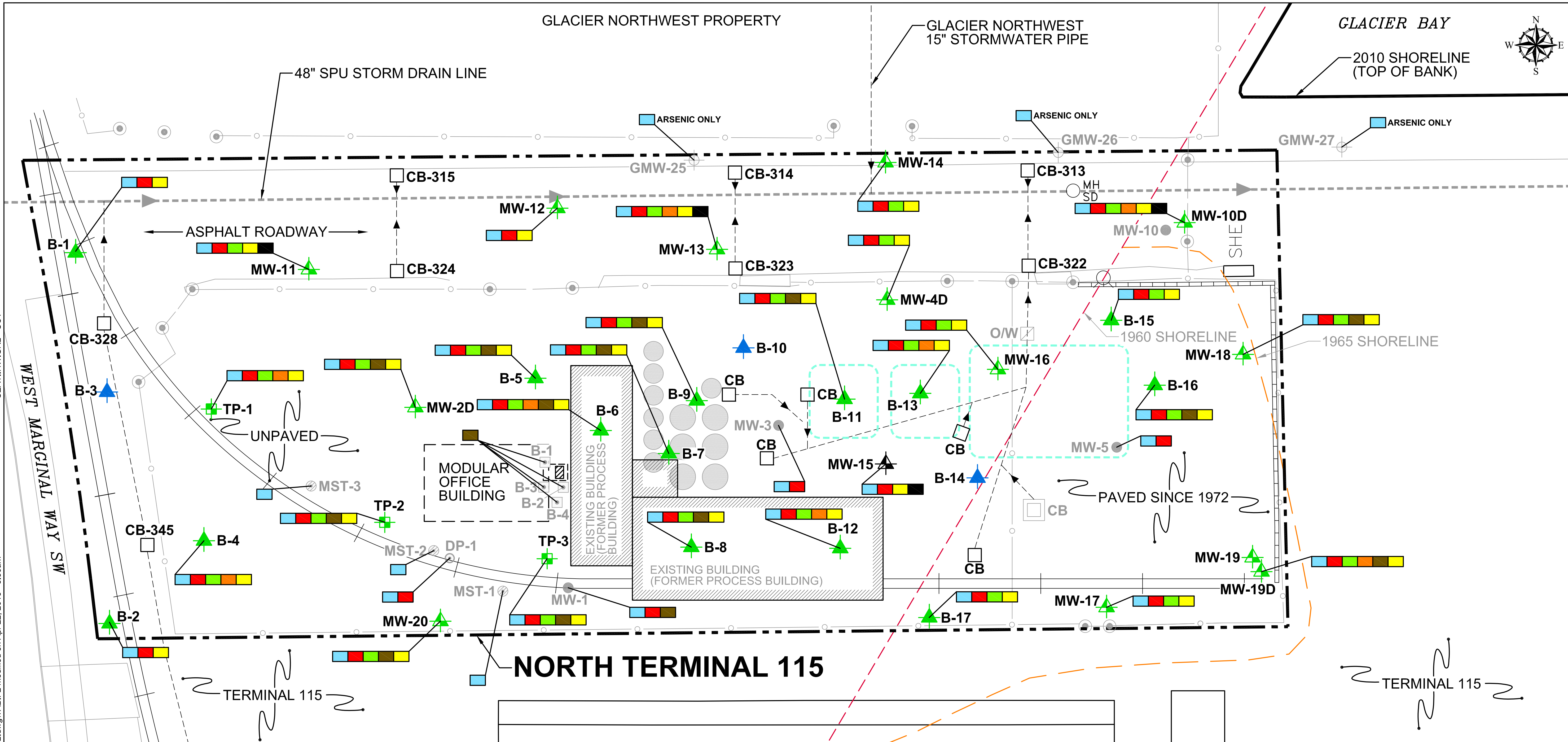

Legend

- B-5 Proposed new boring to be sampled and analyzed
- MW-11 Proposed new monitoring well to be sampled and analyzed
- TP-1 Proposed new test pit to be sampled and analyzed
- B-3 Proposed new boring to be sampled and archived
- MW-1 Previous boring/monitoring well with soil sampling and analysis
- DP-1 Previous direct push boring with soil sampling and analysis
- MST-1 Previous soil sample with soil sampling and analysis
- GMW-25 Previous boring/monitoring well with soil sampling and analysis
- B-1 Previous soil boring with soil sampling and analysis

- CB-314 Catch basin, stormwater pipe, and flow direction
- O/W Oil / water separator
- CB Large catch basin
- North Terminal 115 boundary
- 48" SPU storm drain line
- 2010 Shoreline (top of bank)
- Fence with gate
- Ecology block wall
- Railroad tracks

Soil Analyses

PCBs, VOCs, TPH, PP Metals, barium, and tin, Dioxins/Furans, SVOCs, Soil pH

Note: Color indicates analysis to be performed at proposed sample location and analysis that was performed at previous sample location.

Historical Feature

- 1960 Shoreline
- 1965 Shoreline
- Approximate location of former evaporation / settling ponds
- Approximate location of former underground heating oil storage tank
- Approximate location of excavation zone
- Former aboveground storage tank

50 0 50
FEET

Notes

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Soil Sample Locations

Port of Seattle - North Terminal 115
Seattle, Washington

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Figure 2

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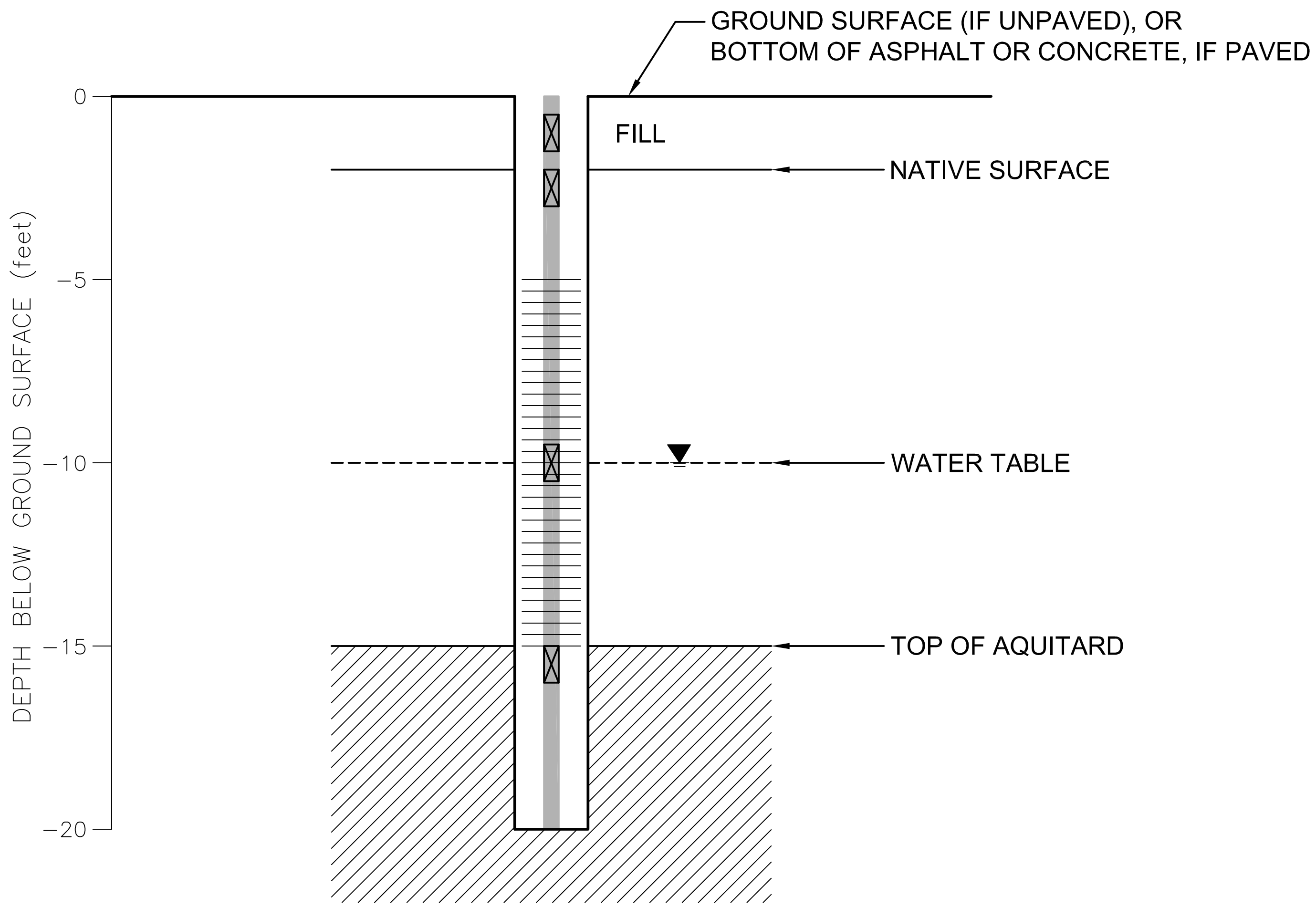
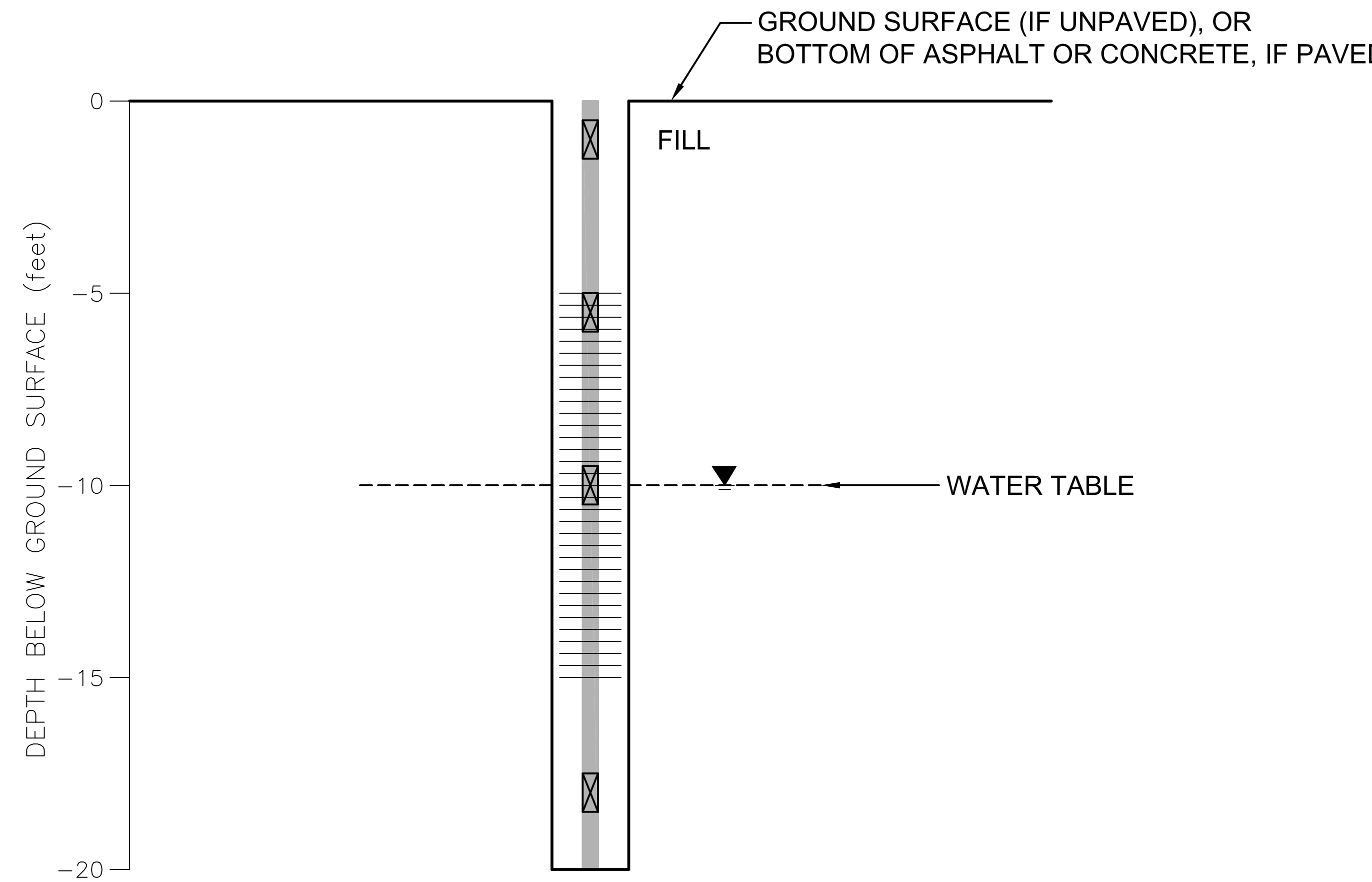
"WESTERN" WELL INSTALLATION



"EASTERN" WELL INSTALLATION



LEGEND

- DEFAULT SAMPLE INTERVAL TO BE COLLECTED: UP TO 1-FOOT LONG SOIL SAMPLE INTERVAL (SHORTER IF THINNER LAYERS OBSERVED)
- SUPPLEMENTAL DISCRETE SAMPLES THAT MAY BE COLLECTED BASED ON FIELD SCREENING OR OBSERVED LITHOLOGY
- APPROXIMATE 10' WELL SCREEN SCREENED ACROSS THE WATER TABLE OBSERVED AT TIME OF DRILLING

HORIZONTAL SCALE: NO SCALE
VERTICAL SCALE: 1" = 5'

Note:
1. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Drawing created from sketch provided by GeoEngineers' personnel.

Typical Soil Sample Collection Schematic

Port of Seattle - North Terminal 115
Seattle, Washington

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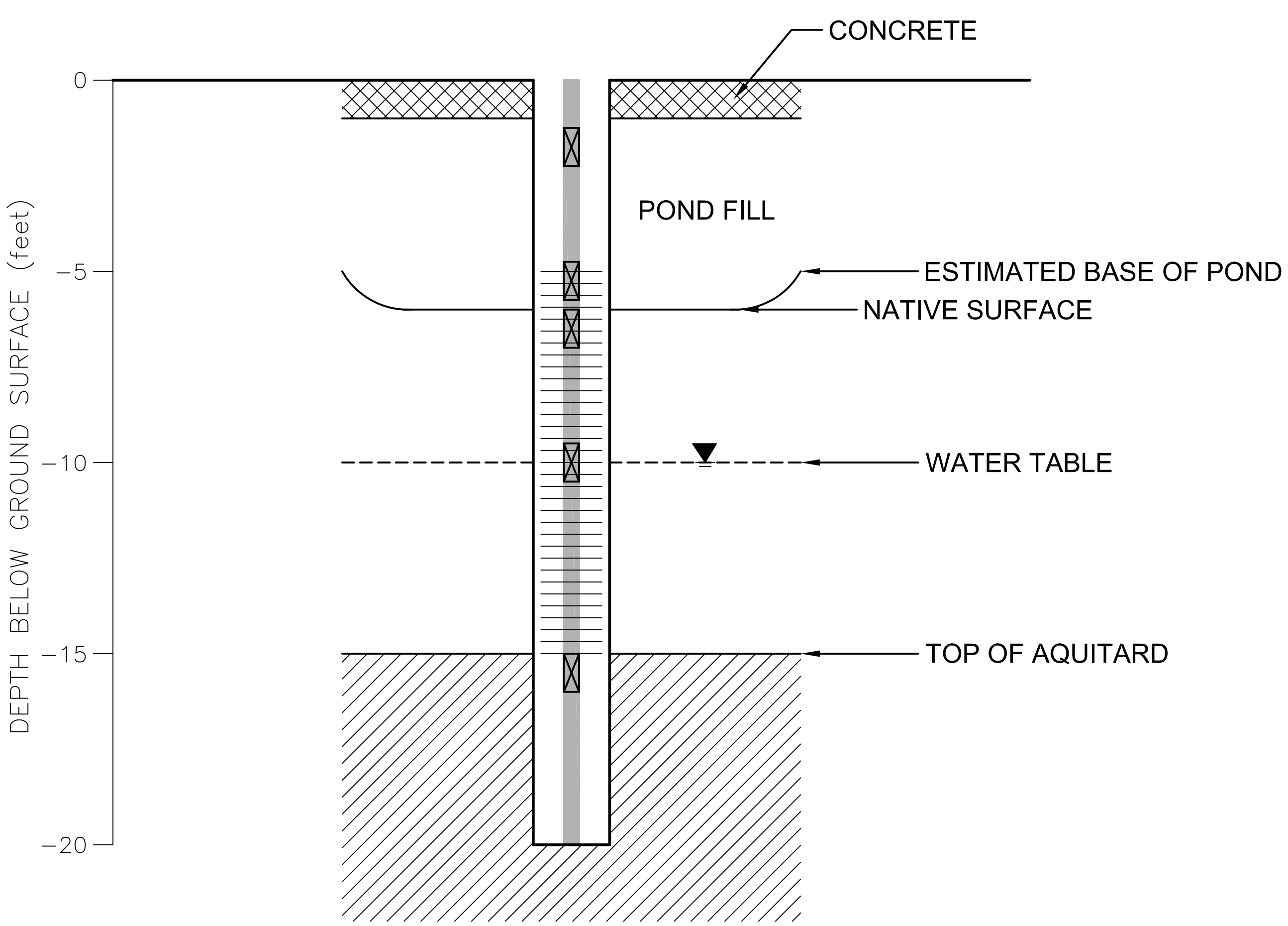
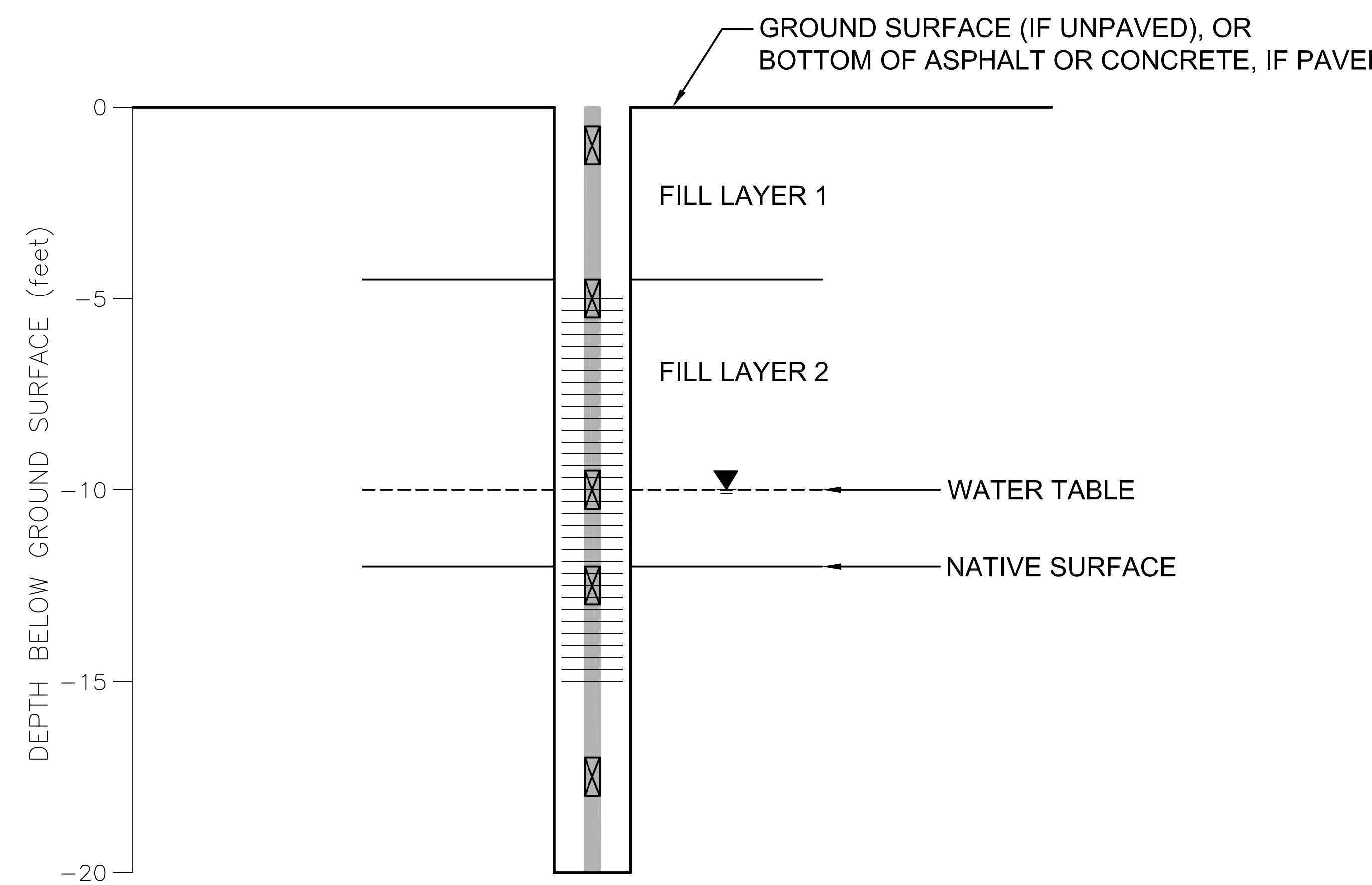
Figure 2A

"POND" WELL INSTALLATION



"THICK FILL" WELL INSTALLATION



LEGEND

DEFAULT SAMPLE INTERVAL TO BE COLLECTED: UP TO 1-FOOT LONG SOIL SAMPLE INTERVAL (SHORTER IF THINNER LAYERS OBSERVED)

SUPPLEMENTAL DISCRETE SAMPLES THAT MAY BE COLLECTED BASED ON FIELD SCREENING OR OBSERVED LITHOLOGY

APPROXIMATE 10' WELL SCREEN SCREENED ACROSS THE WATER TABLE OBSERVED AT TIME OF DRILLING

HORIZONTAL SCALE: NO SCALE
VERTICAL SCALE: 1" = 5'

Note:
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Reference: Drawing created from sketch provided by GeoEngineers' personnel.

Typical Soil Sample Collection Schematic

Port of Seattle - North Terminal 115
Seattle, Washington

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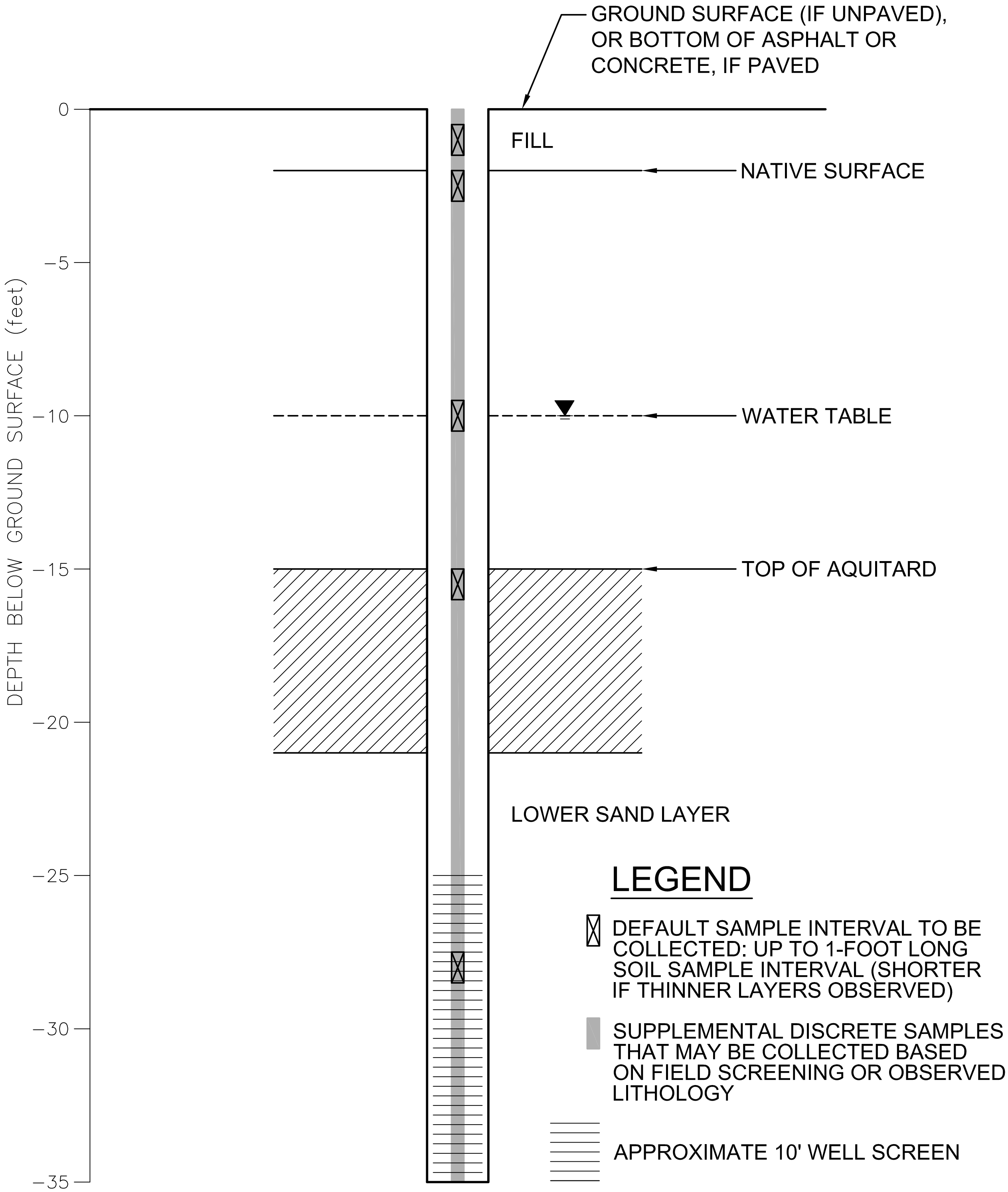
Figure 2B

"DEEP" WELL INSTALLATION



HORIZONTAL SCALE: NO SCALE
VERTICAL SCALE: 1" = 5'

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Reference: Drawing created from sketch provided by GeoEngineers' personnel.

Typical Soil Sample Collection Schematic	
Port of Seattle - North Terminal 115 Seattle, Washington	
GEOENGINEERS	**Figure 2C**

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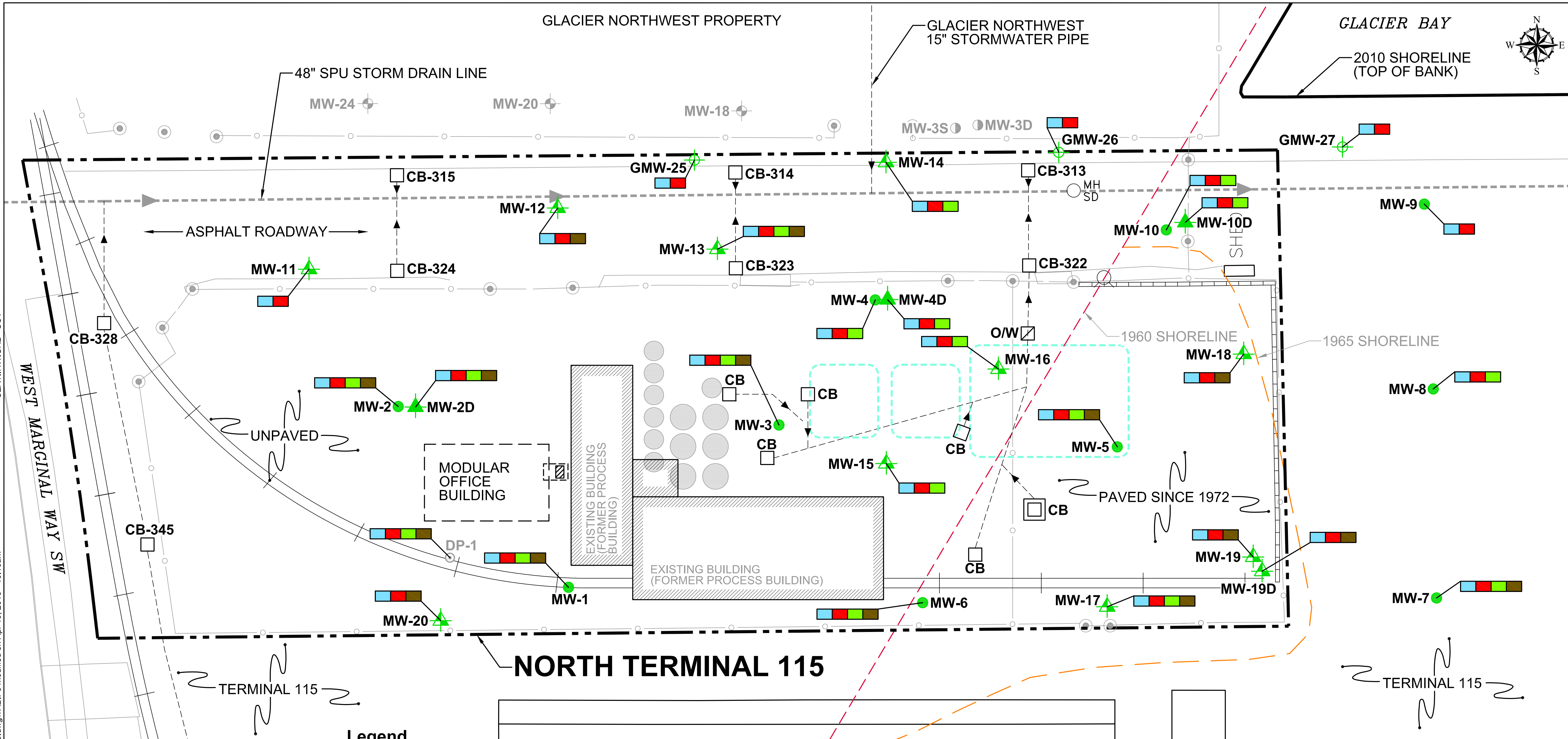

Legend

- MW-11 — Proposed new monitoring well to be sampled and analyzed
- MW-2D — Proposed new deep monitoring well to be sampled and analyzed
- MW-1 — Existing monitoring well to be sampled and analyzed
- GMW-25 — Existing monitoring well to be sampled and analyzed
- DP-1 — Previous direct push boring with groundwater sampling and analysis
- MW-18 — Monitoring well (Shaw, 2003)
- MW-3S — Monitoring well (Retec, 1996)

Groundwater Analyses

PP Metals, barium, and tin — VOCs — SVOCs — TPH

Note: Color indicates analysis to be performed at proposed sample location and analysis that was performed at previous sample location.

- CB-314 — Catch basin, stormwater pipe, and flow direction
- O/W — Oil / water separator
- CB — Large catch basin
- North Terminal 115 boundary
- 48" SPU storm drain line
- 2010 Shoreline (top of bank)
- Fence with gate
- Ecology block wall
- Railroad tracks

Historical Feature

- 1960 Shoreline
- 1965 Shoreline
- Approximate location of former evaporation / settling ponds
- Approximate location of former underground heating oil storage tank
- Approximate location of excavation zone
- Former aboveground storage tank

50 0 50

FEET

Notes

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Groundwater Sample Locations

Port of Seattle - North Terminal 115
Seattle, Washington

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Figure 3

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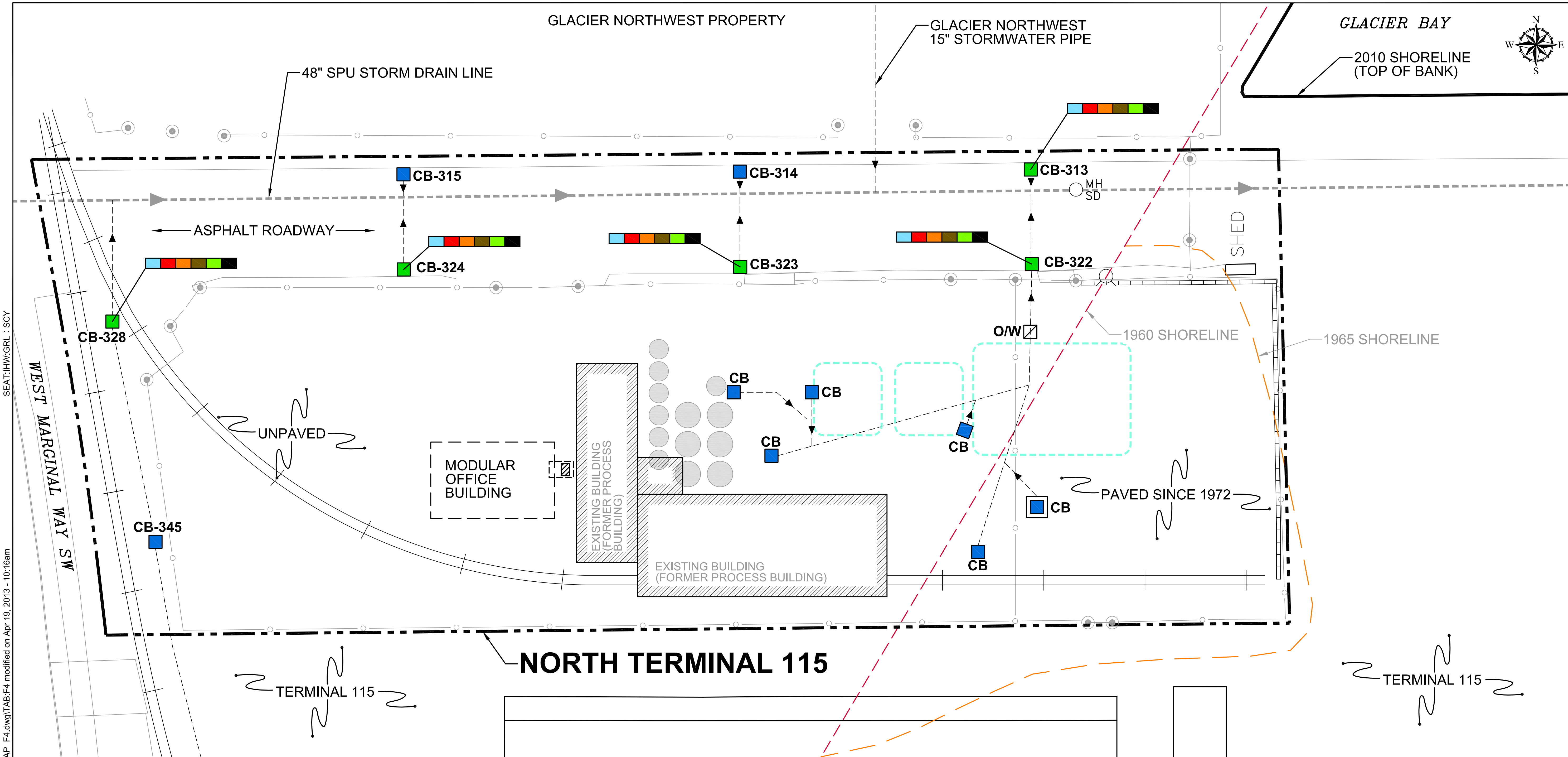

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Notes

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Reference: Base CAD drawing provided by Port of Seattle. Locations of historic features from SAIC 2007, Landau 2009, and historic aerial photos (1960 and 1965).

Legend

CB-323 Proposed catch basin solids to be sampled and analyzed

CB-315 Proposed catch basin solids to be sampled and archived for potential analysis

Analyses

PCBs, TPH, PP Metals, barium, and tin, Dioxins/Furans, SVOCs, VOCs

Note: Color indicates analysis to be performed at proposed sample location.

CB-314 Catch basin, stormwater pipe, and flow direction

O/W Oil / water separator

CB Large catch basin

North Terminal 115 boundary

48" SPU storm drain line

2010 Shoreline (top of bank)

Fence with gate

Ecology block wall

Railroad tracks

Historical Feature

1960 Shoreline

1965 Shoreline

Approximate location of former evaporation / settling ponds

Approximate location of former underground heating oil storage tank

Approximate location of excavation zone

Former aboveground storage tank

50 0 50

FEET

Stormwater Catch Basin Solids Sample Locations

Port of Seattle - North Terminal 115
Seattle, Washington

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Figure 4

Appendix D
Quality Assurance Project Plan

Quality Assurance Project Plan (QAPP)

Remedial Investigation/Feasibility Study
Port of Seattle North Terminal 115

for
Washington State Department of Ecology on Behalf of Port of Seattle

May 9, 2013

GeoEngineers

Plaza 600 Building
600 Stewart Street, Suite 1700
Seattle, Washington 98101
206.728.2674

Quality Assurance Project Plan (QAPP)
Remedial Investigation/Feasibility Study
Port of Seattle North Terminal 115

File No. 0303-112-00

May 9, 2013

Approved By:

Signature: Date: May 9, 2013

John M. Herzog, PhD, Principal, GeoEngineers

Signature: Date: May 9, 2013

Iain H. Wingard, Project Manager, GeoEngineers

Signature: Date: May 9, 2013

Garrett R. Leque, LG, Field Coordinator, GeoEngineers

Signature: Date: May 9, 2013

Mark J. Lybeer, Quality Assurance Leader, GeoEngineers

GRL:IHW:cn

DISTRIBUTION LIST

Brick E. Spangler
Port of Seattle
206.787.3193
spangler.b@portseattle.org

Donna Ortiz De Anaya
Washington State Department of Ecology
Northwest Regional Office
Toxics Cleanup Program
425.649.7231
dort461@ecy.wa.gov

Table of Contents

LIST OF TABLES

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) was developed for the Remedial Investigation (RI) sampling and analysis activities to be performed at the North Terminal 115 property (the Site) located at 6000 W. Marginal Way SW in Seattle, Washington. This QAPP serves as the primary guide for the integration of quality assurance (QA) and quality control (QC) functions into the RI sampling and analysis activities. The QAPP presents the objectives, procedures, organization, and specific quality assurance and quality control activities designed to achieve data quality goals established for the project. Environmental measurements will be conducted to produce data that are scientifically valid, of known and acceptable quality and that meet established objectives. QA/QC procedures will be implemented so that the precision, accuracy, representativeness, completeness and comparability (PARCC) of the data generated meet the specified data quality objectives.

The RI is being conducted by the Port of Seattle (Port) to satisfy requirements of an Agreed Order (No. DE 8099) issued for the Site by the Washington State Department of Ecology (Ecology). The objectives of the RI are discussed in the Remedial Investigation/Feasibility Study (RI/FS) Work Plan (Work Plan). Sampling procedures are outlined in the Sampling and Analysis Plan (SAP) included as Appendix C of the Work Plan. A Site-specific Health and Safety Plan (HASP) will be used for RI field activities and is presented in Appendix D of the Work Plan.

The QAPP was prepared following the EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5), Guidance for Quality Assurance Project Plans (USEPA, 2002), EPAs Contract Laboratory Program (USEPA, 2004) and guidelines and Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies (Ecology, 2004).

This QAPP is organized into the following sections:

Section 1 – Introduction

Section 2 – Project Management

Section 3 – Data Generation and Acquisition

Section 4 – Assessment and Oversight

Section 5 – Data Validation and Usability

Section 6 – References

2.0 PROJECT MANAGEMENT

2.1. Project Organization and Responsibilities

Descriptions of the responsibilities, lines of authority and communication for the key positions providing quality assurance and quality control are shown in Figure 2-1. The project organization facilitates the efficient production of project work, allows for an independent quality review, and permits resolution of any QA issues.

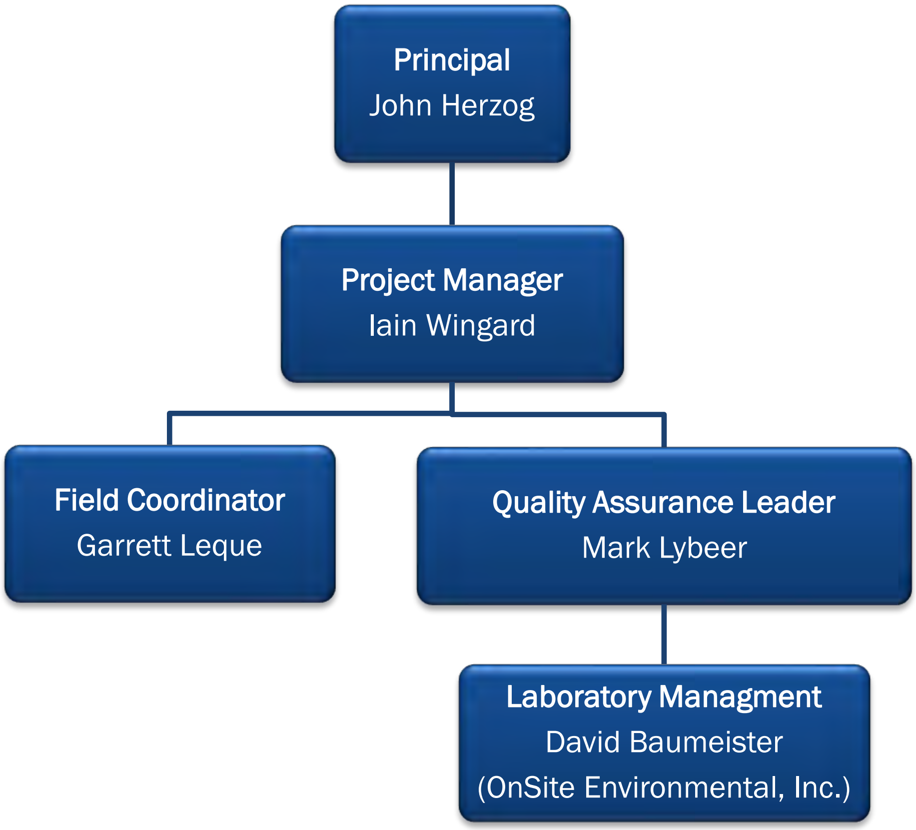


Figure 2-1. Project Organization Chart

2.1.1. Project Leadership and Management

The Principal–in-Charge is responsible to the Port for fulfilling contractual and administrative control of the project. The Principal-in-Charge's duties include defining the project approach and tasks, selecting project team members and establishing budgets and schedules. John Herzog (206.239.3252) is the Principal-in Charge.

The Project Manager's duties consist of implementing the project approach and tasks, overseeing project team members during performance of project tasks, , adhering to and communicating the status of budgets and schedules to the Principal-in-Charge, providing technical oversight, and providing overall production and review of project deliverables. Iain Wingard (253.722.2417) is the Project Manager for activities at the Site.

2.1.2. Field Coordinator

The Field Coordinator is responsible for the daily management of activities in the field. Specific responsibilities include the following:

- Provides technical direction to the field staff.
- Coordinates data collection activities to be consistent with information requirements.
- Supervises the collection of field data and submittal of samples for laboratory analysis.
- Assures that field information is correctly and completely reported.
- Implements and oversees field sampling in accordance with project plans.
- Supervises field personnel.
- Coordinates work with on-site subcontractors.
- Schedules sample shipment with the analytical laboratory.
- Monitors that appropriate sampling, testing, and measurement procedures are followed.
- Coordinates the transfer of field data, sample tracking forms, and log books to the Project Manager for data reduction and validation.
- Participates in QA corrective actions as required.

The Field Coordinator for RI exploration activities at the Site is Garrett Leque (253.312.7958).

2.1.3. Quality Assurance Leader

The GeoEngineers project Quality Assurance Leader is under the direction of Iain Wingard and John Herzog, who are responsible for the project's overall QA. The Project QA Leader is responsible for coordinating QA/QC activities as they relate to chemical analytical data. The QA Leader has the following responsibilities:

- Serves as the official contact for laboratory data QA concerns.
- Reviews the implementation of the QAPP and the adequacy of the data generated from a quality perspective.
- Maintains the authority to implement corrective actions as necessary.
- Reviews and approves the laboratory QA Plan.
- Evaluates the laboratory's final QA report for any condition that adversely impacts data generation.
- Ensures that appropriate sampling, testing, and analysis procedures are followed and that correct quality control checks are implemented.
- Monitors laboratory compliance with data quality requirements.

The Project QA Leader is Mark Lybeer (206.239.3227).

2.1.4. Laboratory Management

The subcontracted laboratories conducting sample analyses for this project are required to obtain approval from the QA Leader before the initiation of sample analysis to assure that the laboratory QA plan complies with the project QA objectives. The Laboratory's QA Coordinator administers the Laboratory QA Plan and is responsible for QC. Specific responsibilities of this position include:

- Ensure implementation of the QA Plan.
- Serve as the laboratory point of contact.
- Activate corrective action for out-of-control events.
- Issue the final QA/QC report.
- Administer QA sample analysis.
- Ensure that the laboratory Method Reporting Limits (MRLs) are equal to or less than the Site-specific cleanup levels.
- Comply with the specifications established in the project plans as related to laboratory services.
- Participate in QA audits and compliance inspections.

The chemical analytical laboratory Quality Assurance Coordinator is David Baumeister of OnSite Environmental, Inc. (425.883.3881).

2.1.5. Health and Safety

A Site-specific health and safety plan (HASP) will be used for RI field activities and is presented in Appendix D of the Work Plan. The Field Coordinator will be responsible for implementing the HASP during sampling activities. The Project Manager will discuss health and safety issues with the Field Coordinator on a routine basis during the completion of field activities.

The Field Coordinator will conduct a tailgate safety meeting each morning before beginning daily field activities. The Field Coordinator will terminate any work activities that do not comply with the HASP. Companies providing services for this project on a subcontracted basis will be responsible for developing and implementing their own HASP.

2.2. Problem Definition and Background

Historical activities at the Site have included filling and industrial operations associated with tin reclamation. Tin reclamation facilities located at the Site have included process buildings, settling ponds, above ground and underground storage tanks, and rail lines. Additionally, filling and industrial activities have also been performed on adjacent properties. Previous environmental investigations conducted at the Site by the Port and other parties have detected metals, volatile and semi-volatile organic compounds (VOCs and SVOCs) including polycyclic aromatic hydrocarbons (PAHs), and petroleum hydrocarbons, in soil and/or groundwater at the Site. Metals and PAHs have also been detected in storm water solids collected at the Site.

Soil and groundwater investigations will be completed to characterize the nature and extent of soil and groundwater contamination at the Site and to provide sufficient information to select a cleanup action, if necessary. Sampling and analysis of stormwater catch basin solids is also being completed to evaluate whether the storm water collection system at the Site is a potential transport mechanism for contaminants in Site soil and groundwater to the Lower Duwamish Waterway (LDW).

2.3. Site Description

The North Terminal 115 property is located at 6000 West Marginal Way SW in Seattle, Washington, on the west bank of the Lower Duwamish Waterway (LDW). The property is approximately 2 acres in size and located on the northwestern portion of the Port's Terminal 115. The Site is bordered to the north by Glacier Northwest and west by West Marginal Way SW. Northland Services Inc. leases the portion of Terminal 115 east and south of the Site. The LDW is located to the east and northeast of the Site.

The Site is currently owned by the Port and currently leased to the Gene Summy Lumber Co. which distributes untreated lumber and the Commercial Fence Corp., a fence supplier. A relatively small portion is leased to SeaPac along the western boundary to provide access to Terminal 115. Site topography is generally flat and most of the Site is paved with either asphalt or concrete. Stormwater runoff at the Site is collected in catch basins and is then discharged to the LDW via a 48-inch storm drain located near the northern property boundary. Chain link fencing encompasses the property except where the asphalt road enters from West Marginal Way SW.

2.4. Site History

The Site was originally part of the Duwamish River estuary. The river was channelized in the late 1800s and early 1900s and the Site property was created by filling the former shoreline of the Duwamish River. From 1963 to 1998, the Site was used for tin reclamation by various companies. As stated above, facilities located at the Site used for tin reclamation have included process buildings, settling ponds, above ground and underground storage tanks, and rail lines.

Waste streams generated by tin reclamation processes included spent plating solution and black mud filtrate which were disposed of to the sanitary sewer. A third waste stream, black mud, was also produced and was captured onsite in settling ponds located in the eastern portion of the Site until about 1972 when the lagoons were filled and paved over. From 1972 to 1991, the black mud was further reclaimed, dewatered, and stockpiled onsite and then shipped off site. In 1998, tin reclamation operations ceased. As stated above, the Site is currently leased to the Gene Summy Lumber Co. which distributes untreated lumber, the Commercial Fence Corp., a fence supplier and SeaPac to provide access to Terminal 115.

2.5. Project Description and Schedule

Investigation activities will be completed within 12 months following Ecology's approval of the Final RI/FS Work Plan. Sampling and analysis at the Site will be performed to characterize the nature and extent of soil and groundwater contamination at the Site and to provide sufficient information to select a cleanup action, if necessary. The activities also include assessment of stormwater catch basin solids to evaluate whether the storm water collection system at the Site is a potential transport mechanism for contaminants in Soil and groundwater to the LDW. Proposed sample locations are shown on Figures 6 through 9 of the Work Plan. Selected samples will be submitted for chemical analysis to OnSite Environmental, Inc. for one or more of the following:

- Priority pollutant metals (antimony, arsenic, beryllium, cadmium, chromium, copper, mercury, nickel, lead, selenium, silver, thallium and zinc) and barium and tin by EPA Method 6020A and 7471B.

- Semi-Volatile Organic Compounds (SVOCs) by EPA Method 8270D/SIM.
- Volatile Organic Compounds (VOCs) by EPA Method 8260C.
- Polychlorinated Biphenyl's (PCBs) by EPA Method 8082A.
- Gasoline-range petroleum hydrocarbons by Ecology Method NWTPH-Gx.
- Diesel- and heavy oil-range petroleum hydrocarbons by Ecology Method NWTPH-Dx.
- Soil pH by SW 846-9045C.
- Dioxins and Furans by EPA Method 1613/8290.

The chemical analyses to be performed are presented in Tables 3 through 5 of the Work Plan. Sampling procedures are outlined in the SAP (Appendix C of the Work Plan).

2.6. Quality Objectives and Criteria

The quality assurance objective for technical data is to collect environmental monitoring data of known, acceptable, and documentable quality. The QA objectives established for the project are:

- Implement the procedures outlined herein for field sampling, sample custody, equipment operation and calibration, laboratory analysis, and data reporting that will facilitate consistency and thoroughness of data generated.
- Achieve the acceptable level of confidence and quality required so that data generated are scientifically valid and of known and documented quality. This will be performed by establishing criteria for precision, accuracy, representativeness, completeness, and comparability, and by testing data against these criteria.

The sampling design, field procedures, laboratory procedures, and QC procedures are set up to provide high-quality data for use in this project. Specific data quality factors that may affect data usability include quantitative factors (bias, detection limits, precision, accuracy and completeness) and qualitative factors (representativeness and comparability). The measurement quality objectives (MQO) associated with the data quality factors are summarized in Table D-1 and are discussed below.

2.6.1. Detection Limits

Analytical methods have quantitative limitations at a given statistical level of confidence that are often expressed as the method detection limit (MDL). Although results reported near the MDL provide insight to Site conditions, quality assurance dictates that analytical methods achieve a consistently reliable level of detection known as the practical quantitation limit (PQL), which is typically demonstrated with the lowest point of a linear calibration. The contract laboratory will provide numerical results for all analytes and report them as detected above the PQL or undetected at the PQL.

The reporting limits for Site Chemicals of Potential Concern (COPCs) are presented in Table D-2 for soil and stormwater catch basin solids and Table D-3 for groundwater. These reporting limits were obtained from an Ecology-certified laboratory (OnSite Environmental, Inc.). Appendix B of the Work Plan includes a letter from Onsite Environmental to the Port of Seattle indicating that the PQLs are the lowest commonly available and technically reliable PQLs achievable. The reporting limits presented in Tables D-2 and D-3 are considered target reporting limits (TRLs) because several factors may influence final reporting limits. For example, matrix interferences, moisture, or other physical conditions of samples affect detection limits. Furthermore, analytical procedures may require sample dilutions or other practices to accurately quantify a particular analyte at concentrations above the range of the instrument. The effect is that other analytes could be reported as undetected but at a value higher than a specified TRL. Data users must be aware that high non-detect values, although correctly reported, can bias statistical summaries and careful interpretation is required to correctly characterize Site conditions.

2.6.2. Precision

Precision is the measure of mutual agreement among replicate or duplicate measurements of an analyte from the same sample and applies to field duplicate or split samples, replicate analyses, and duplicate spiked environmental samples (matrix spike duplicates). The closer the measured values are to each other, the more precise the measurement process. Precision error may affect data usefulness. Good precision is indicative of relative consistency and comparability between different samples. Precision will be expressed as the relative percent difference (RPD) for spike sample comparisons of various matrices and field duplicate comparisons for soil and stormwater catch basin solids and water samples. This value is calculated by:

$$RPD\,(\%) = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \; X\; 100,$$

Where

D_1 = Concentration of analyte in sample.

D_2 = Concentration of analyte in duplicate sample.

The calculation applies to split samples, replicate analyses, duplicate spiked environmental samples (matrix spike duplicates), and laboratory control duplicates. The RPD will be calculated for samples and compared to the applicable criteria. Precision can also be expressed as the percent difference (%D) between replicate analyses. Persons performing the evaluation must review one or more pertinent documents (USEPA, 1999; USEPA, 2004) that address criteria exceedances and courses of action. Project RPD goals for all analyses are 35 percent for water samples and 50 percent for soil and stormwater catch basin solids samples, unless the primary and duplicate sample results are less than 5 times the MRL, in which case RPD goals will not apply for data quality assessment purposes.

2.6.3. Accuracy

Accuracy is a measure of bias in the analytic process. The closer the measurement value is to the true value, the greater the accuracy. This measure is defined as the difference between the reported values versus the actual value and is often measured with the addition of a known compound to a sample. The amount of known compound reported in the sample, or percent recovery, assists in determining the performance of the analytical system in correctly quantifying the compounds of interest. Since most environmental data collected represent one point spatially and temporally rather than an average of values, accuracy plays a greater role than precision in assessing the results. In general, if the percent recovery is low, non-detect results may indicate that compounds of interest are not present when in fact these compounds are present. Detected compounds may be biased low or reported at a value less than actual environmental conditions. The reverse is true when recoveries are high. Non-detect values are considered accurate while detected results may be higher than the true value.

For this project, accuracy will be expressed as the percent recovery of a known surrogate spike, matrix spike, or laboratory control sample (blank spike), concentration:

$$Recovery\,(\%) = \frac{Spiked\ Result - Unspiked\ Result}{Known\ Spike\ Concentration}\ X\ 100$$

Persons performing the evaluation must review one or more pertinent documents (USEPA, 1999; USEPA, 2004) that address criteria exceedances and courses of action. Accuracy criteria for surrogate spikes, matrix spikes, and laboratory control spikes are found in Table D-1 of this QAPP.

2.6.4. Representativeness

Representativeness expresses the degree to which data accurately and precisely represent the actual Site conditions. The determination of the representativeness of the data will be performed by completing the following:

- Comparing actual sampling procedures to those delineated within the SAP and this QAPP.
- Comparing analytical results of field duplicates to determine the variations in the analytical results.
- Invalidating non-representative data or identifying data to be classified as questionable or qualitative.

Only representative data will be used in subsequent data reduction, validation, and reporting activities.

2.6.5. Completeness

Completeness establishes whether a sufficient amount of valid measurements were obtained to meet project objectives. The number of samples and results expected establishes the comparative basis for completeness. Completeness goals are 90 percent useable data for samples/analyses planned. If the completeness goal is not achieved an evaluation will be made to determine if the data are adequate to meet study objectives.

$$Completeness = \frac{number\ of\ valid\ measurements}{total\ number\ of\ data\ points\ planned}\ x\ 100$$

2.6.6. Comparability

Comparability expresses the confidence with which one set of data can be compared to another. Although numeric goals do not exist for comparability, a statement on comparability will be prepared to determine overall usefulness of data sets, following the determination of both precision and accuracy.

2.6.7. Holding Times

Holding times are defined as the time between sample collection and extraction, sample collection and analysis, or sample extraction and analysis. Some analytical methods specify a holding time for analysis only. For many methods, holding times may be extended by sample preservation techniques in the field. If a sample exceeds a holding time, then the results may be biased low. For example, if the extraction holding time for volatile analysis of soil sample is exceeded, then the possibility exists that some of the organic constituents may have volatilized from the sample or degraded. Results for that analysis would be qualified as estimated to indicate that the reported results may be lower than actual Site conditions. Holding times are presented in Table D-4.

2.6.8. Blanks

According to the *National Functional Guidelines for Organic Data Review* (USEPA, 1999), "The purpose of laboratory (or field) blank analysis is to determine the existence and magnitude of contamination resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks)." Trip blanks are placed with samples during shipment and travel with samples from the laboratory to the field and back to the laboratory. Method blanks are created during sample preparation and follow samples throughout the analysis process.

Analytical results for blanks will be interpreted in general accordance with *National Functional Guidelines for Organic Data Review* (USEPA, 1999) and professional judgment.

2.7. Special Training Requirements/Certification

The Superfund Amendments and Reauthorization Act of 1986 required the Secretary of Labor to issue regulations providing health and safety standards and guidelines for workers engaged in hazardous waste operations. Occupational Safety and Health Administration (OSHA) regulations (29 CFR 1910.120) require training to provide employees with the knowledge and skills necessary to enable them to perform their jobs safely and with minimum risk to their personal health. All sampling personnel will have completed the 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and 8-hour refresher courses, as necessary, to meet OSHA regulations.

2.8. Documentation and Records

2.8.1. Field observations

Field documentation provides important information about potential problems or special circumstances surrounding sample collection. Field personnel will maintain daily field logs. The field logs will be prepared on field report forms or in a bound logbook. Entries in the field logs and associated sample documentation forms will be made in waterproof ink, and corrections will consist of line-out deletions that are initialed and dated. Individual logbooks will become part of the project files at the conclusion of the field work.

At a minimum, the following information will be recorded during the collection of each sample.

- Sample location and description
- Site or sampling area sketch showing sample location and measured distances
- Sampler's name(s)
- Date and time of sample collection
- Designation of sample as composite or discrete
- Sample matrix (soil, stormwater catch basin solids, or water)
- Type of sampling equipment used
- Field instrument (e.g., PID) readings
- Field observations and details that are pertinent to the integrity/condition of the samples (e.g., weather conditions, performance of the sampling equipment, sample depth control, sample disturbance, etc.)
- Preliminary sample descriptions (e.g., lithologies, field screening results)
- Sample preservation
- Sample transport/shipping arrangements
- Name of recipient laboratory

In addition to the sampling information, the following specific information also will be recorded in the field log for each day of sampling.

- Sampling team members
- Time of arrival/entry on Site and time of Site departure
- Other personnel present at the Site
- Summary of pertinent meetings or discussions with regulatory agency or contractor personnel
- Deviations from sampling plans, QAPP procedures, and HASP
- Changes in field personnel and responsibilities with reasons for the changes
- Levels of safety protection
- Calibration readings for any field instruments used

The handling, use, and maintenance of field log books are the Field Coordinator's responsibility.

2.8.2. Analytical chemistry records

Laboratories will be responsible for internal checks on data reporting and will correct errors identified during the QA review. All laboratories must be accredited by Ecology for the required analytical methods. Close contact will be maintained with the laboratories to resolve any quality control problems in a timely manner. The laboratories will be required to provide the following:

- **Project narrative** – This summary, in the form of a cover letter, will present any problems encountered during any aspect of analysis. The summary will include, but not be limited to, a discussion of QC, sample shipment, sample storage, and analytical difficulties. Any problems encountered by the laboratory, and their resolutions, will be documented in the project narrative.

- **Records** – Legible copies of the chain-of-custody (COC) forms will be provided as part of the data package. This documentation will include the time of receipt and the condition of each sample received by the laboratory. Additional internal tracking of sample custody by the laboratory will also be documented.
- **Sample results** – The data package will summarize the results for each sample analyzed. The summary will include the following information, as applicable:
  - Field sample identification code and the corresponding laboratory identification code
  - Sample matrix
  - Date of sample extraction/digestion
  - Date and time of analysis
  - Weight and/or volume used for analysis
  - Final dilution volumes or concentration factor for the sample
  - Total solids in the samples
  - Identification of the instruments used for analysis
  - MDLs and RLs
  - All data qualifiers and their definitions
- **QA/QC summaries** – These summaries will contain the results of all QA/QC procedures. Each QA/QC sample analysis will be documented with the same information as that required for the sample results (see above). The laboratory will make no recovery or blank corrections. The required summaries are listed below.
  - The calibration data summary will contain the concentrations of the initial calibration and daily calibration standards and the date and time of analysis. The response factor, percent standard deviation (%RSD), RPDs, and retention time for each analyte will be listed, as appropriate. Results for standards analyzed at the RL to determine instrument sensitivity will be reported.
  - The internal standard area summary will report the internal standard areas, as appropriate.
  - The method blank analysis summary will report the method blank analysis associated with each sample and the concentrations of all compounds of interest identified in these blanks.
  - The surrogate spike recovery summary will report all surrogate spike recovery data for organic analyses. The names and concentrations of all compounds added, percent recoveries, and QC limits will be listed.
  - The matrix spike (MS) recovery summary will report the MS or MS duplicate (MSD) recovery data for analyses, as appropriate. The names and concentrations of all compounds added, percent recoveries, and QC limits will be included in the data package. The RPD for all MS/MSD analyses will be reported.
  - The laboratory replicate summary will report the RPD for all laboratory replicate analyses. The QC limits for each compound or analyte will be listed.

- The laboratory control sample (LCS) analysis summary will report the results of the analyses of the LCS. The QC limits for each compound or analyte will be included in the data package.
- The relative retention time summary will report the relative retention times for the primary and confirmational columns of each analyte detected in the samples, as appropriate.

EQuIS four-file format electronic data deliverables will be obtained from the laboratory and data will be submitted into Ecology's Environmental Information Management (EIM) system after data quality assessments are completed.

2.8.3. Data reduction

Data reduction is the process by which original data are converted or reduced to a specified format or unit to facilitate the analysis of the data. For example, a final analytical concentration may need to be calculated from a diluted sample result. Data reduction requires that all aspects of sample preparation that could affect the test result, such as sample volume analyzed or dilutions required, be taken into account in the final result. The laboratory personnel will reduce the analytical data for review by the Quality Assurance Leader and Project Manager.

During chemical analysis, samples are occasionally diluted after the initial analysis if the estimated concentration curve for one or more of the target analytes is above the calibration curve. In these instances, concentrations from the initial analysis will be identified as the "best result" for all target analytes other than the chemical(s) that was originally above the calibration range. The "best result" for this qualified analyte(s) will be taken from the diluted sample.

3.0 DATA GENERATION AND ACQUISITION

3.1. Sample Process Design

3.1.1. Soil Investigation

The objective of the soil investigation is to define the nature and extent of contamination in soil, where contamination comes to be located (Site). Soil sampling will be performed at multiple locations to collected samples representative of fill and native soil that may have been impacted by past Site activities. The proposed soil sample locations were positioned to collect soil samples to address identified data gaps and to provide comprehensive coverage of the Site. Information obtained from previous Site investigations was used to support selection of the proposed soil sample locations. The soil sampling locations are presented in Figure 7 of the Work Plan.

3.1.2. Groundwater Investigation

The objective of the groundwater investigation is to define the nature and extent of contamination in groundwater, where present. Groundwater sampling will be performed at approximately 24 to 27 locations (depending on access agreements) to collect samples representative of groundwater conditions at the Site. Information obtained from previous Site investigations was used to support selection of the proposed groundwater sample locations. The groundwater sampling locations are presented in Figure 8 of the Work Plan.

3.1.2.1. HYDRAULIC CONDUCTIVITY TESTING AND 72-HOUR TIDAL STUDY

Hydraulic conductivity testing and a 72-hour tidal study will be performed to characterize groundwater flow characteristics and gradients at the Site. The aquifer hydraulic conductivity will be estimated by conducting slug tests in selected monitoring wells at the Site. The 72-hour tidal study will be conducted to evaluate elevation changes in Site groundwater in response to water level changes in the LDW. Water level elevation data will be collected every 15 minutes in selected monitoring wells at the Site.

3.1.3. Catch Basin Investigation

The objective of the catch basin investigation is to evaluate whether the stormwater conveyance system is a potential pathway for contaminant migration from the Site to the LDW. Catch basin sampling will be performed at five locations to collect samples representative of material captured by the catch basin system. The proposed catch basin sample locations were positioned to collect samples of from potential source areas located on the Site. Information obtained from previous Site investigations and alignment of the 48-inch Seattle Public Utility (SPU) storm drain line were used to support selection of the proposed catch basin sample locations. The catch basin locations are presented in Figure 9 of the Work Plan.

3.2. Sample Methods

3.2.1. Sampling Equipment and Decontamination Procedures

Soil samples will be collected using coring/drilling equipment (i.e., hollow stem auger and/or direct push), excavation equipment (i.e., backhoe or excavator), and hand tools including stainless steel spoons and stainless steel mixing bowls. Groundwater samples will be collected from monitoring wells using submersible or peristaltic pumps and low-flow sampling procedures. Stormwater catch basin solids samples will be obtained using a stainless steel spoon or, where necessary, will be obtained using a sampler attached to an extension arm to reach into deeper catch basins.

Reusable sampling equipment that comes in contact with soil, stormwater catch basin solids or groundwater will be decontaminated before each use. Decontamination procedures for this equipment will consist of the following:

1. Washing with a brush and non-phosphate detergent solution (e.g., Liqui-Nox and distilled water),
2. Rinsing with distilled water, and
3. Wrapping or covering the decontaminated equipment with aluminum foil. Field personnel will limit cross-contamination by changing gloves between sampling locations.

Drilling equipment (auger, soil sampler, direct push barrel) which comes into contact with soil will be decontaminated before each use. Decontamination procedures for this equipment will consist of the following:

1. Washing with pressurized hot-water,
2. Wash with brush and non-phosphate detergent solution, and
3. Rinse with potable water.

Wash water used to decontaminate the reusable sampling equipment will be collected and stored on-site in 55-gallon drums.

3.2.2. Field Screening Procedures

The potential presence of contamination in soil samples will be evaluated using field screening techniques. Field screening results will be recorded on the field logs and the results will be used as a general guideline to delineate areas of possible contamination. In addition, screening results will be used as a basis for selecting soil samples for chemical analysis. The following screening methods will be used: (1) visual screening; (2) water sheen screening; and (3) headspace vapor screening.

3.2.2.1. VISUAL SCREENING

The soil will be observed for unusual color and/or staining indicative of possible contamination.

3.2.2.2. WATER SHEEN SCREENING

Water sheen screening involves placing a portion of the soil sample in a pan containing distilled water, and observing the water surface for signs of sheen. This is a relatively sensitive, qualitative field screening method that can help identify the presence or absence of petroleum hydrocarbons and other contaminants, sometimes at concentrations lower than regulatory cleanup guidelines. The following sheen classifications will be used:

Classification	Identifier	Description
No Sheen	(NS)	No visible sheen on the water surface.
Slight Sheen	(SS)	Light, colorless, dull sheen; spotty to globular; spread is irregular, not rapid; sheen dissipates rapidly; areas of no sheen remain.
Moderate Sheen	(MS)	Light to heavy sheen; may have some color/iridescence; globular to stringy; spread is irregular to flowing, may be rapid; few remaining areas of no sheen on the water surface.
Heavy Sheen	(HS)	Heavy sheen with color/iridescence; stringy; spread is rapid; entire water surface may be covered with sheen; sheen flows off the sample.

3.2.2.3. HEADSPACE VAPOR SCREENING

This is a semi-quantitative field screening method that can help identify the presence or absence of volatile organic compounds (VOCs) in soil samples. A portion of the soil sample will be placed in a resealable plastic bag. The bag will then be sealed capturing air in the bag. The bag is then shaken gently to expose the soil to the air trapped in the bag. The bag will remain closed for approximately 5 minutes at ambient temperature before the headspace vapors are measured. Vapors present within the sample bag’s headspace will be measured by inserting the probe of a photoionization detector (PID) through a small opening in the bag, taking care not to clog the probe with soil. The maximum PID reading (in parts per million [ppm]) and the ambient air temperature will be recorded on the field log for each sample. The PID will be calibrated to 100 ppm isobutylene each day prior to soil sampling. No soil sample used for headspace screening will be submitted to the laboratory for chemical analysis.

3.2.3. Sample Containers and Labeling

The Field Coordinator will establish field protocol to manage field sample collection, handling, and documentation. Soil, stormwater catch basin solids and groundwater samples will be placed in appropriate laboratory-prepared containers. Sample containers and preservatives are listed in Table D-4.

Sample containers will be labeled with the following information at the time of sample collection:

- Project name and number
- Type of sample preservative used (where applicable)
- Sample name, which will include a reference to date and sampling depth (if applicable)
- Date and time of collection

The sample collection activities will be noted in the field log books. The Field Coordinator will monitor consistency between sample containers/labels, field log books, and chain-of-custody (COC) forms.

3.3. Sample Handling and Custody

3.3.1. Sample Storage

Samples will be placed in a cooler with ice after they are collected. The objective of the cold storage will be to attain a sample temperature of 2 to 6 degrees Celsius. Holding times (Table D-4) will be observed during sample storage.

3.3.2. Sample Shipment

Samples will be transported and delivered to the analytical laboratory in the sample coolers. The samples will either be transported by field personnel, laboratory personnel, or by courier service. The Field Coordinator will ensure that the cooler has been properly secured using clear plastic tape and custody seals.

3.3.3. Chain-of-Custody Records

Field personnel are responsible for the security of samples from the time the samples are collected until the samples have been received by the courier service or laboratory personnel. A COC form will be completed for each group of samples being shipped to the laboratory. Information to be included on the COC form includes:

- Project name and number;
- Sample identification numbers;
- Date and time of sampling;
- Sample matrix (soil, stormwater catch basin solids and groundwater), preservative, and number of containers for each sample;
- Analyses to be performed;
- Names of sampling personnel;

- Project manager name and contact information including phone number; and
- Shipping information including shipping container number, if applicable.

The original COC form will be signed by a member of the field team. Field personnel will retain copies and place the original and remaining copies in a plastic bag. The plastic bag containing the COC form will be placed in the cooler before sealing the cooler for transport to the laboratory.

3.3.4. Laboratory Custody Procedures

The laboratory will follow their standard operating procedures (SOPs) to document sample handling from time of receipt (sample log-in) to reporting. Documentation will include, at a minimum, the analyst's name or initials, time, and date.

3.4. Analytical Methods

The methods of chemical analysis are identified in Table D-2 and D-3. All methods selected represent standard methods used for the analysis of these analytes in soil, stormwater catch basin solids and groundwater. The laboratory project manager will determine the remedy to be used if the project RLs cannot be attained, in consultation with GeoEngineers Quality Assurance Leader.

3.5. Quality Control

Table D-5 summarizes the types and frequency of QC samples to be analyzed, including both field QC and laboratory QC samples.

3.5.1. Field Quality Control

Field QC samples serve as a control and check mechanism to monitor the consistency of field sampling methods and the potential influence of off-site factors on project samples. Examples of off-site factors include airborne VOCs and contaminants that may be present in potable water used during drilling activities. Table D-5 summarizes the types and frequency of field QC samples to be analyzed and the following sections discuss field QC samples.

3.5.1.1. FIELD DUPLICATES

Field duplicates serve as a measure for precision. Under ideal field conditions, field duplicates (sometimes referred to as splits), are created by thoroughly mixing a volume of the sample matrix, placing aliquots of the mixed sample in separate containers, and identifying one of the aliquots as the primary sample and the other as the duplicate sample. Field duplicates measure the precision and consistency of laboratory analytical procedures and methods, as well as the consistency of the sampling techniques used by field personnel.

One field duplicate will be collected for every twenty soil and groundwater sample analyzed. For catch basin samples, one field duplicate will be collected.

3.5.1.2. TRIP BLANKS

Trip blanks consist of samples of reagent water that accompany samples to be analyzed for VOCs during sample storage in coolers and transport to the laboratory. They are used to assess potential contamination of samples during collection and transport due to the presence of VOCs in ambient air.

Trip blanks will be analyzed on a one per cooler basis.

3.5.2 Laboratory Quality Control

Laboratory QC procedures will be evaluated through a formal data quality assessment process. The analytical laboratory will follow standard analytical method procedures that include specified QC monitoring requirements. These requirements will vary by method, but generally include:

- Method blanks
- Internal standards
- Instrument calibrations
- Matrix spike/matrix spike duplicates (MS/MSD)
- Laboratory control samples/laboratory control sample duplicates (LCS/LCSD)
- Laboratory replicates or duplicates
- Surrogate/Labeled compounds

3.5.1.3. LABORATORY BLANKS

Laboratory procedures utilize several types of blanks, but the most commonly used blanks for QC monitoring are method blanks. Method blanks are laboratory QC samples that consist of either a soil-like material having undergone a contaminant destruction process, or reagent (contaminant-free) water. Method blanks are extracted and analyzed with each batch of environmental samples undergoing analysis. Method blanks are particularly useful during volatiles analysis since VOCs can be transported in the laboratory through the vapor phase. If a substance is detected in a method blank, then one (or more) of the following occurred:

- Sample containers, measurement equipment, and/or analytical instruments were not properly cleaned and contained contaminants.
- Reagents used in the process were contaminated with a substance(s) of interest.
- Volatile substances in ambient laboratory air with high solubility or affinities toward the sample matrix contaminated the samples during preparation or analysis.

It is difficult to determine which of the above scenarios took place if blank contamination occurs. However, it is assumed that the conditions that affected the blanks also likely affected the project samples. If target analytes are detected in method blanks, data validation guidelines assist in determining which substances in project samples are considered “real,” and which ones are attributable to the analytical process. Furthermore, the guidelines state, “. . . there may be instances where little or no contamination was present in the associated blank, but qualification of the sample is deemed necessary. Contamination introduced through dilution water is one example.”

3.5.1.4. CALIBRATIONS

Several types of instrument calibrations are used, depending on the analytical method, to assess the linearity of the calibration curve and assure that the sample results reflect accurate and precise measurements. The main calibrations used are initial calibrations, daily calibrations, and continuing calibration verification.

3.5.1.5. MATRIX SPIKE/MATRIX SPIKE DUPLICATES (MS/MSD)

MS/MSD samples are used to assess influences or interferences caused by the physical or chemical properties of the sample itself. For example, extreme pH can affect the results for semivolatile organic compounds. Or, the presence of a particular compound may interfere with accurate quantitation of another analyte. MS/MSD data is reviewed in combination with other QC monitoring data to determine matrix effects. In some cases, matrix effects cannot be determined due to dilution and/or high levels of related substances in the sample. A matrix spike is evaluated by spiking a project sample with a known amount of one or more of the target analytes, ideally at a concentration that is 5 to 10 times higher than the sample result. A percent recovery is then calculated by subtracting the un-spiked sample result from the spiked sample result, dividing by the known concentration of the spike, and multiplying by 100.

MS/MSD samples will be analyzed at a frequency of one MS/MSD per analytical batch. The samples for the MS/MSD analyses should be collected from a boring or sampling location that is believed to have only low-level contamination. A sample from an area of low-level contamination is needed because the objective of MS/MSD analyses is to determine the presence of matrix interferences, which can best be achieved with low levels of contaminants. Additional sample volume will be collected for the MS/MSD analyses as required by the laboratory.

3.5.1.6. LABORATORY CONTROL SAMPLE/ LABORATORY CONTROL SAMPLE DUPLICATES (LCS/LCSD)

Also known as blanks spikes, laboratory control samples (LCS) are similar to MS samples in that a known amount of one or more of the target analytes are spiked into a prepared sample medium, and a percent recovery of the spiked substances is calculated. The primary difference between LCS and MS samples is that the LCS uses a contaminant-free sample medium. For example, reagent water is typically used for LCS water analyses. The purpose of an LCS is to help assess the overall accuracy and precision of the analytical process including sample preparation, instrument performance, and analyst performance.

3.5.1.7. LABORATORY REPLICATES/DUPLICATES

Laboratories utilize MS/MSDs, LCS/LCSDs, and/or replicates to assess precision. Replicates are a second analysis of a field-collected environmental sample. Replicates can be split at varying stages of the sample preparation and analysis process and most commonly consist of a second analysis on the extracted media.

3.5.1.8. SURROGATES/LABELED COMPOUNDS

Surrogate spikes are used to verify proper extraction procedures and the accuracy of the analytical instrument. Surrogates are substances with characteristics similar to the target analytes. A known concentration of surrogate is added to the project sample and passed through the instrument and the percent recovery is calculated. Each surrogate used has acceptance limits (i.e., an acceptable range) for percent recovery. If a surrogate recovery is low, sample results may be biased low and depending on the recovery value, a possibility of false negatives may exist. Conversely, when recoveries are above the specified acceptance limits, a possibility of false positives exist, although non-detect results are considered accurate.

3.6. Instrument Testing, Inspection and Maintenance

The field coordinator will be responsible for overseeing the testing, inspection, and maintenance of all field equipment. The laboratory project manager will be responsible for laboratory equipment testing, inspection, and maintenance requirements. The calibration methods used in calibrating the analytical instrumentation are described in the following section.

3.7. Instrument Calibration and Frequency

3.7.1. Field Instrumentation

Field instrument calibration and calibration checks facilitate accurate and reliable field measurements. The calibration of field instruments used on the project will be checked and adjusted as necessary in general accordance with the manufacturer's recommendations. Methods and intervals of calibration checks and instrument maintenance will be based on the type of instrument, stability characteristics, required accuracy, intended use, and environmental conditions. The basic calibration check frequencies are described below.

The calibration of the PID used for headspace vapor screening will be checked at the start of each day it is used. If necessary (based on the calibration check results), the instrument will be calibrated in general accordance with the manufacturer's specifications. Calibration check and calibration results will be recorded in the field logbook.

3.7.2. Laboratory Instrumentation

For chemical analytical testing, calibration procedures will be performed in general accordance with the analytical methods used and the laboratory's SOPs. Calibration documentation will be retained at the laboratory.

All instrument calibrations and their appropriate chemical standards are to comply with the specific methods within EPA SW-846, Test Methods for Evaluating Solid Waste, Physical and Chemical Methods, 3rd Edition, December 1996 and the Laboratory SOPs. Calibration documentation, initial (ICALs) and continuing (CCALs), will be retained at the Laboratory.

3.8. Inspection of Supplies and Consumables

Supplies and consumables for the field sampling effort will be inspected upon delivery and accepted if the condition of the supplies is satisfactory. For example, jars will be inspected to ensure that they are the correct size and quantity and were not damaged in shipment.

3.9. Data Management

Laboratories will report data in formatted hardcopy and digital formats. Analytical laboratory measurements will be recorded in standard formats that display, at a minimum, the field sample identification, the laboratory identification, reporting units, data qualifiers, analytical method, analyte tested, analytical result, extraction and analysis dates, and quantitation limits. Each sample delivery group will be accompanied by sample receipt forms and a case narrative identifying data quality issues. Laboratory electronic data deliverable (EDD) requirements will be established by GeoEngineers, Inc. with the contract laboratory. The laboratory will send final analytical testing results to the Project Manager.

Chromatograms will be provided for samples analyzed using Ecology Method NWTPH-Gx, NWTPH-Dx. The laboratory will assure that the full height of all peaks appear on the chromatograms and that the same horizontal time scale is used to allow for comparisons to other chromatograms.

4.0 ASSESSMENT AND OVERSIGHT

4.1. Assessment and Response Actions

4.1.1. Review of Field Documentation and Laboratory Receipt Information

Documentation of field sampling data will be reviewed periodically for conformance with project QC requirements described in this QAPP. At a minimum, field documentation will be checked for proper documentation of the following:

- Sample collection information (date, time, location, matrices, etc.);
- Field instruments used and calibration data;
- Sample collection protocol;
- Sample containers, preservation, and volume;
- Field QC samples collected at the frequency specified;
- COC protocols; and
- Sample shipment information.

Sample receipt forms provided by the laboratory will be reviewed for QC exceptions. The final laboratory data package will describe (in the case narrative) the effects that any identified QC exceptions have on data quality. The laboratory will review transcribed sample collection and receipt information for correctness prior to delivering the final data package.

4.1.2. Response Actions for Field Sampling

The Field Coordinator, or a designee, will be responsible for correcting equipment malfunctions throughout the field sampling effort and resolving situations in the field that may result in nonconformance or noncompliance with the QAPP. All corrective measures will be documented in the field logbook.

4.1.3. Corrective Action for Laboratory Analyses

Laboratories are required to comply with their current written standard operating procedures. The laboratory project manager will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this QAPP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data to the laboratory project manager. A narrative describing the anomaly, the steps taken to identify and correct it, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, re-extraction) will be submitted with the data package.

5.0 DATA VALIDATION AND USABILITY

5.1. Data Review, Verification and Validation

The data validation and usability elements of the QAPP as detailed below address the QA/QC activities that occur after data collection and/or data generation is complete. Implementation of these elements ensures that the data conform to the specified criteria and will achieve the project objectives

The data are not considered final until validated. All data, including laboratory and field QC sample results, will be summarized in a data validation report. The data validation report will focus on data that did not meet the MQOs specified in Table D-1. The data validation reports will be included as an appendix to the final RI report. The data report will also describe any deviations from this QAPP and actions taken to address those deviations.

Level IIB laboratory data packages will be obtained for all soil, stormwater catch basin solids, groundwater and surface water samples. These data will be reviewed for the following QC parameters:

- Holding times and sample preservation
- Method blanks
- MS/MSD analyses
- LCS/LCSD analyses
- Surrogate spikes
- Duplicates/replicates
- Field/Lab duplicates
- Calibrations (Initial and Continuing)
- Internal Standards
- Instrument Tunes

In addition to these QC parameters, other documentation such as sample receipt forms and case narratives will be reviewed to evaluate laboratory QA/QC.

5.2. Verification and Validation Methods

Hard-copy laboratory reports will be method detection limit (MDL)-generated providing the analysis-specific information including final sample analytical results, reportable field and laboratory QA/QC analytical results, MDLs and MRLs. The laboratory data will also be reported via electronic media using the tabular outputting capabilities of standard software formats.

The term “reporting limit” will be used interchangeably with “quantitation limit” to mean the lowest concentration at which an analyte can be quantified subject to the quality control criteria of the analytical method. These terms are different from “MDL,” which refers to the lowest concentration that the analytical method can ideally detect.

Data validation qualifiers including "U," "J,", and "R" will be used following the reported laboratory results to explain data quality issues affecting the laboratory data to the data user. These qualifiers are explained as follows:

- "U" indicates that a compound was analyzed for but not detected. The associated numerical value is the estimated sample quantitation limit, which is corrected for dilution and percent moisture.
- "J" indicates that a compound was detected below the reporting limit and the value is estimated or the value was estimated by the validator because the of instrument bias reasons.
- If any target analytes are found in a laboratory method blank, it will be regarded as blank contamination. In these cases, the result of a given analyte in the method blank will be compared to any positive result of the same analyte in the associated field samples. If a field sample result is less than five times (ten times for common laboratory contaminants like acetone, phthalates, etc.) the result that is reported in the method blank, the result will be considered blank contamination. Accordingly, the result will be qualified as not-detected "U" at the elevated reporting limit.
- If there are two analyses reported by the laboratory for one sample (as in the case of dilutions), the validator will make a decision as to which analysis to use in the final assessment. As there should be only one reported result per analyte for a given sample, any extraneous results will be qualified as not-reportable "R" and will not be used.

5.3. Reconciliation with User Requirements

A data quality assessment will be conducted by the project Quality Assessment Leader to identify cases where the projects MQOs were not met.

6.0 REFERENCES

U.S. Environmental Protection Agency (USEPA). "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review," EPA-540/R-99/008, Office of Emergency and Remedial Response, US Environmental Protection Agency, Washington, DC, dated October 1999.

U.S. Environmental Protection Agency (USEPA). "Guidance for Quality Assurance Project Plans, EPA QA/R-5," EPA-240/R-02/009, Office of Emergency and Remedial Response, US Environmental Protection Agency, Washington, DC, dated December 2002.

U.S. Environmental Protection Agency (USEPA). "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," EPA 540-R-04-004, Office of Emergency and Remedial Response, US Environmental Protection Agency, Washington, DC, dated October 2004.

Washington State Department of Ecology (Ecology), "Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies," 04-03-030, dated July 2004.

TABLE D-1

MEASUREMENT QUALITY OBJECTIVES

QUALITY ASSURANCE PROJECT PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Laboratory Analysis	Reference Method	Laboratory Control Sample (LCS) %R Limits[1,2]		Matrix Spike - %R Limits[2]		SS %R Limits[1,2,3]	MS Duplicate Samples or Lab Duplicate RPD Limits[4]		Field Duplicate Samples RPD Limits[4]	
		Soil/Solids	Water	Soil/Solids	Water	Soil/Solids/Water	Soil/Solids	Water	Soil/Solids	Water
Gasoline-Range Hydrocarbons	Ecology NWTPH-Gx	50%-150%	50%-150%	NA	NA	50%-150%	≤30%	≤30%	≤50%	≤35%
Diesel- and Motor oil-range Hydrocarbons	Ecology NWTPH-Dx with acid/silica gel cleanup	50%-150%	50%-150%	NA	NA	50%-150%	≤40%	≤40%	≤50%	≤35%
VOCs	EPA 8260C	70%-130%	70%-130%	70%-130%	70%-130%	50%-150%	≤30%	≤30%	≤50%	≤35%
SVOCs	EPA 8270D/SIM	70%-130%	70%-130%	70%-130%	70%-130%	70%-130%	≤30%	≤30%	≤50%	≤35%
PCB Aroclors	GC/ECD EPA 8082A	70%-130%	70%-130%	70%-130%	70%-130%	70%-130%	≤40%	≤40%	≤50%	≤35%
Total Metals	EPA 6000/7000 Series/200.8	80%-120%	80%-120%	75%-125%	75%-125%	NA	≤20%	≤20%	≤50%	≤35%
Dioxins/Furans	EPA 1613/8290	70%-130%	NA	NA	NA	50%-150%	≤20%	NA	≤50%	NA
pH	SM4500-H/ EPA 9045C	NA	NA	NA	NA	NA	20% RSD	20% RSD	≤50%	≤35%
Total Solids (% wet wt.)	2540 B-97/PSEP (1986)	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Method numbers refer to EPA SW-846 Analytical Methods or Washington State Department of Ecology (Ecology) recommended analytical methods.

[1]Recovery ranges are estimates. Actual ranges will be provided by the laboratory when contracted.

[2]Percent recovery limits are expressed as ranges based on laboratory control limits. Limits will vary for individual analytes.

[3]Individual surrogate recoveries are compound-specific

[4]RPD control limits are only applicable if the primary and duplicate sample concentrations are greater than 5 times the method reporting limit (MRL). For results less than 5 times the MRL, the difference between the primary and duplicate samples must be less than 2X the MRL for soils/sediments and 1X the MRL for waters.

[5]Metals to be analyzed include antimony, arsenic, beryllium, cadmium, total chromium, copper, lead, mercury, nickel, silver, zinc and tin.

mg/kg = Milligrams per kilogram

ug/kg = Micrograms per kilogram

cPAHs = Carcinogenic polycyclic aromatic hydrocarbons

PCBs = Polychlorinated biphenyls

LCS = Laboratory control sample

SS = Surrogate standards

RPD = Relative percent difference

RSD = Relative standard deviation

MS = Matrix spike

NA = Not applicable

TABLE D-2

METHODS OF ANALYSIS AND TARGET REPORTING LIMITS FOR SOIL/STORMWATER CATCH BASIN SOLIDS SAMPLES

QUALITY ASSURANCE PROJECT PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Analyte	Analytical Method	Practical Quantitation Limit (PQL)
Metals (mg/kg)		
Antimony	EPA 6020A	5.0
Arsenic	EPA 6020A	0.5
Barium	EPA 6020A	2
Beryllium	EPA 6020A	0.5
Cadmium	EPA 6020A	0.2
Chromium (total)	EPA 6020A	0.5
Copper	EPA 6020A	0.2
Lead	EPA 6020A	0.5
Mercury	EPA 7471B	0.05
Nickel	EPA 6020A	0.5
Selenium	EPA 6020A	0.5
Silver	EPA 6020A	0.5
Thallium	EPA 6020A	0.25
Tin	EPA 6020A	1.0
Zinc	EPA 6020A	2.5
Petroleum Hydrocarbons (mg/kg)		
Gasoline-range	Ecology NWTPH-Gx	5
Diesel-range	Ecology NWTPH-Dx with acid/silica gel cleanup	25
Heavy oil-range	Ecology NWTPH-Dx with acid/silica gel cleanup	50
VOCs (µg/kg)		
Dichlorodifluoromethane	EPA 8260C	1.0
Chloromethane	EPA 8260C	5.0
Vinyl Chloride	EPA 8260C	1.0
Bromomethane	EPA 8260C	1.0
Chloroethane	EPA 8260C	5.0
Trichlorofluoromethane	EPA 8260C	1.0
1,1-Dichloroethene	EPA 8260C	1.0
Acetone	EPA 8260C	5.0
Iodomethane	EPA 8260C	5.0
Carbon Disulfide	EPA 8260C	1.0
Methylene Chloride	EPA 8260C	5.0
(trans) 1,2-Dichloroethene	EPA 8260C	1.0
Methyl t-Butyl Ether	EPA 8260C	1.0
1,1-Dichloroethane	EPA 8260C	1.0
Vinyl Acetate	EPA 8260C	5.0
2,2-Dichloropropane	EPA 8260C	1.0
(cis) 1,2-Dichloroethene	EPA 8260C	1.0
2-Butanone	EPA 8260C	5.0
Bromochloromethane	EPA 8260C	1.0
Chloroform	EPA 8260C	1.0
1,1,1-Trichloroethane	EPA 8260C	1.0
Carbon Tetrachloride	EPA 8260C	1.0
1,1-Dichloropropene	EPA 8260C	1.0
Benzene	EPA 8260C	1.0
1,2-Dichloroethane	EPA 8260C	1.0
Trichloroethene	EPA 8260C	1.0
1,2-Dichloropropane	EPA 8260C	1.0
Dibromomethane	EPA 8260C	1.0
Bromodichloromethane	EPA 8260C	1.0
2-Chloroethyl Vinyl Ether	EPA 8260C	5.0
(cis) 1,3-Dichloropropene	EPA 8260C	1.0
Methyl Isobutyl Ketone	EPA 8260C	5.0
Toluene	EPA 8260C	5.0
(trans) 1,3-Dichloropropene	EPA 8260C	1.0
1,1,2-Trichloroethane	EPA 8260C	1.0
Tetrachloroethene	EPA 8260C	1.0
1,3-Dichloropropane	EPA 8260C	1.0
2-Hexanone	EPA 8260C	5.0
Dibromochloromethane	EPA 8260C	1.0
1,2-Dibromoethane	EPA 8260C	1.0
Chlorobenzene	EPA 8260C	1.0
1,1,1,2-Tetrachloroethane	EPA 8260C	1.0
Ethylbenzene	EPA 8260C	1.0
m,p-Xylene	EPA 8260C	2.0
o-Xylene	EPA 8260C	1.0
Styrene	EPA 8260C	1.0
Bromoform	EPA 8260C	1.0
Isopropylbenzene	EPA 8260C	1.0
Bromobenzene	EPA 8260C	1.0
1,1,2,2-Tetrachloroethane	EPA 8260C	1.0
1,2,3-Trichloropropane	EPA 8260C	1.0
n-Propylbenzene	EPA 8260C	1.0
2-Chlorotoluene	EPA 8260C	1.0
4-Chlorotoluene	EPA 8260C	1.0
1,3,5-Trimethylbenzene	EPA 8260C	1.0

TABLE D-2

METHODS OF ANALYSIS AND TARGET REPORTING LIMITS FOR SOIL/STORMWATER CATCH BASIN SOLIDS SAMPLES

QUALITY ASSURANCE PROJECT PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Analyte	Analytical Method	Practical Quantitation Limit (PQL)
VOCs (µg/kg)		
tert-Butylbenzene	EPA 8260C	1.0
1,2,4-Trimethylbenzene	EPA 8260C	1.0
sec-Butylbenzene	EPA 8260C	1.0
1,3-Dichlorobenzene	EPA 8260C	1.0
p-Isopropyltoluene	EPA 8260C	1.0
1,4-Dichlorobenzene	EPA 8260C	1.0
1,2-Dichlorobenzene	EPA 8260C	1.0
n-Butylbenzene	EPA 8260C	1.0
1,2-Dibromo-3-chloropropane	EPA 8260C	5.0
1,2,4-Trichlorobenzene	EPA 8260C	1.0
Hexachlorobutadiene	EPA 8260C	5.0
Naphthalene	EPA 8260C	1.0
1,2,3-Trichlorobenzene	EPA 8260C	1.0
SVOCs (mg/kg)		
n-Nitrosodimethylamine	EPA 8270D	0.017
Pyridine	EPA 8270D	0.017
Phenol	EPA 8270D	0.017
Aniline	EPA 8270D	0.085
bis(2-chloroethyl)ether	EPA 8270D	0.017
2-Chlorophenol	EPA 8270D	0.017
1,3-Dichlorobenzene	EPA 8270D	0.017
1,4-Dichlorobenzene	EPA 8270D	0.017
Benzyl alcohol	EPA 8270D	0.017
1,2-Dichlorobenzene	EPA 8270D	0.017
2-Methylphenol (o-Cresol)	EPA 8270D	0.017
bis(2-Chloroisopropyl)ether	EPA 8270D	0.017
(3+4)-Methylphenol (m,p-Cresol)	EPA 8270D	0.017
n-Nitroso-di-n-propylamine	EPA 8270D	0.017
Hexachloroethane	EPA 8270D	0.017
Nitrobenzene	EPA 8270D	0.017
Isophorone	EPA 8270D	0.017
2-Nitrophenol	EPA 8270D	0.017
2,4-Dimethylphenol	EPA 8270D	0.017
bis(2-Chloroethoxy)methane	EPA 8270D	0.017
2,4-Dichlorophenol	EPA 8270D	0.017
1,2,4-Trichlorobenzene	EPA 8270D	0.017
Naphthalene	EPA 8270D-SIM	0.0067
4-Chloroaniline	EPA 8270D	0.017
Hexachlorobutadiene	EPA 8270D	0.017
4-Chloro-3-methylphenol	EPA 8270D	0.017
2-Methylnaphthalene	EPA 8270D-SIM	0.0067
1-Methylnaphthalene	EPA 8270D-SIM	0.0067
Hexachlorocyclopentadiene	EPA 8270D	0.017
2,4,6-Trichlorophenol	EPA 8270D	0.017
2,3-Dichloroaniline	EPA 8270D	0.017
2,4,5-Trichlorophenol	EPA 8270D	0.017
2-Chloronaphthalene	EPA 8270D	0.017
2-Nitroaniline	EPA 8270D	0.017
1,4-Dinitrobenzene	EPA 8270D	0.017
Dimethylphthalate	EPA 8270D	0.017
1,3-Dinitrobenzene	EPA 8270D	0.085
2,6-Dinitrotoluene	EPA 8270D	0.017
1,2-Dinitrobenzene	EPA 8270D	0.017
Acenaphthylene	EPA 8270D-SIM	0.0067
3-Nitroaniline	EPA 8270D	0.017
2,4-Dinitrophenol	EPA 8270D	0.085
Acenaphthene	EPA 8270D-SIM	0.0067
4-Nitrophenol	EPA 8270D	0.017
2,4-Dinitrotoluene	EPA 8270D	0.017
Dibenzofuran	EPA 8270D	0.017
2,3,5,6-Tetrachlorophenol	EPA 8270D	0.017
2,3,4,6-Tetrachlorophenol	EPA 8270D	0.017
Diethylphthalate	EPA 8270D	0.085
4-Chlorophenyl-phenylether	EPA 8270D	0.017
4-Nitroaniline	EPA 8270D	0.017
Fluorene	EPA 8270D-SIM	0.0067
4,6-Dinitro-2-methylphenol	EPA 8270D	0.085
n-Nitrosodiphenylamine	EPA 8270D	0.017
1,2-Diphenylhydrazine	EPA 8270D	0.017
4-Bromophenyl-phenylether	EPA 8270D	0.017
Hexachlorobenzene	EPA 8270D	0.017
Pentachlorophenol	EPA 8270D	0.083
Phenanthrene	EPA 8270D-SIM	0.0067
Anthracene	EPA 8270D	0.017

TABLE D-2

METHODS OF ANALYSIS AND TARGET REPORTING LIMITS FOR SOIL/STORMWATER CATCH BASIN SOLIDS SAMPLES

QUALITY ASSURANCE PROJECT PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Analyte	Analytical Method	Practical Quantitation Limit (PQL)
SVOCs (mg/kg)		
Carbazole	EPA 8270D	0.017
Di-n-butylphthalate	EPA 8270D	0.017
Fluoranthene	EPA 8270D	0.017
Benzidine	EPA 8270D	0.017
Pyrene	EPA 8270D-SIM	0.0067
Butylbenzylphthalate	EPA 8270D	0.017
bis-2-Ethylhexyladipate	EPA 8270D	0.017
3,3'-Dichlorobenzidine	EPA 8270D	0.017
Benzo[a]anthracene	EPA 8270D-SIM	0.0067
Chrysene	EPA 8270D-SIM	0.0067
bis(2-Ethylhexyl)phthalate	EPA 8270D	0.017
Di-n-octylphthalate	EPA 8270D	0.017
Benzo[b]fluoranthene	EPA 8270D-SIM	0.0067
Benzo[k]fluoranthene	EPA 8270D-SIM	0.0067
Benzo[a]pyrene	EPA 8270D-SIM	0.0067
Indeno[1,2,3-c,d]pyrene	EPA 8270D-SIM	0.0067
Dibenz[a,h]anthracene	EPA 8270D-SIM	0.0067
Benzo[g,h,i]perylene	EPA 8270D-SIM	0.0067
n-Decane	EPA 8270D	0.017
n-Octadecane	EPA 8270D	0.017
Benzoic acid	EPA 8270D	0.085
Polychlorinated Biphenyls (µg/kg)		
PCBs Aroclors	EPA 8082A GC/ECD	0.05
pH	EPA 9045C	1.0-12.45
Dioxins/Furans (ng/kg)		
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1613/EPA 8290	1.0
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	1613/EPA 8290	5.0
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	1613/EPA 8290	5.0
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	1613/EPA 8290	5.0
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	1613/EPA 8290	5.0
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	1613/EPA 8290	5.0
Octachlorodibenzo-p-dioxin (OCDD)	1613/EPA 8290	10.0
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	1613/EPA 8290	1.0
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	1613/EPA 8290	5.0
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	1613/EPA 8290	5.0
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	1613/EPA 8290	5.0
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	1613/EPA 8290	5.0
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	1613/EPA 8290	5.0
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	1613/EPA 8290	5.0
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	1613/EPA 8290	5.0
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	1613/EPA 8290	5.0
Octachlorodibenzofuran (OCDF)	1613/EPA 8290	10.0

Notes:

EPA = U.S. Environmental Protection Agency
VOC = Volatile organic compound
SVOC = Semivolatile organic compound
SIM = Selective ion monitoring
PCBs = Polychlorinated biphenyls
mg/kg = Milligrams per kilogram
µg/kg = Micrograms per kilogram
ng/kg = Nanograms per kilogram

TABLE D-3

METHODS OF ANALYSIS AND TARGET REPORTING LIMITS FOR WATER SAMPLES

QUALITY ASSURANCE PROJECT PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Analyte	Analytical Method	Practical Quantitation Limit (PQL)
Metals (µg/L)		
Antimony	EPA 200.8	5.5
Arsenic	EPA 200.8	3.3
Barium	EPA 200.8	5
Beryllium	EPA 200.8	10
Cadmium	EPA 200.8	0.2
Chromium (total)	EPA 200.8	2
Copper	EPA 200.8	2
Lead	EPA 200.8	1
Mercury	EPA 7470A	0.5
Nickel	EPA 200.8	2
Selenium	EPA 200.8	6
Silver	EPA 200.8	1
Thallium	EPA 200.8	2
Tin	EPA 200.8	5
Zinc	EPA 200.8	56
Petroleum Hydrocarbons (mg/L)		
Gasoline-range	Ecology NWTPH-Gx	0.1
Diesel-range	Ecology NWTPH-Dx with acid/silica gel cleanup	0.25
Heavy oil-range	Ecology NWTPH-Dx with acid/silica gel cleanup	0.40
VOCs (µg/L)		
Dichlorodifluoromethane	EPA 8260B	0.2
Chloromethane	EPA 8260B	1.0
Vinyl Chloride	EPA 8260B	0.2
Bromomethane	EPA 8260B	0.2
Chloroethane	EPA 8260B	1.0
Trichlorofluoromethane	EPA 8260B	0.2
1,1-Dichloroethene	EPA 8260B	0.2
Acetone	EPA 8260B	5.0
Iodomethane	EPA 8260B	1.0
Carbon Disulfide	EPA 8260B	0.2
Methylene Chloride	EPA 8260B	1.0
(trans) 1,2-Dichloroethene	EPA 8260B	0.2
Methyl t-Butyl Ether	EPA 8260B	0.2
1,1-Dichloroethane	EPA 8260B	0.2
Vinyl Acetate	EPA 8260B	2.0
2,2-Dichloropropane	EPA 8260B	0.2
(cis) 1,2-Dichloroethene	EPA 8260B	0.2
2-Butanone	EPA 8260B	5.0
Bromochloromethane	EPA 8260B	0.2
Chloroform	EPA 8260B	0.2
1,1,1-Trichloroethane	EPA 8260B	0.2
Carbon Tetrachloride	EPA 8260B	0.2
1,1-Dichloropropene	EPA 8260B	0.2
Benzene	EPA 8260B	0.2
1,2-Dichloroethane	EPA 8260B	0.2
Trichloroethene	EPA 8260B	0.2
1,2-Dichloropropane	EPA 8260B	0.2
Dibromomethane	EPA 8260B	0.2
Bromodichloromethane	EPA 8260B	0.2
2-Chloroethyl Vinyl Ether	EPA 8260B	1.0
(cis) 1,3-Dichloropropene	EPA 8260B	0.2
Methyl Isobutyl Ketone	EPA 8260B	2.0
Toluene	EPA 8260B	1.0
(trans) 1,3-Dichloropropene	EPA 8260B	0.2
1,1,2-Trichloroethane	EPA 8260B	0.2
Tetrachloroethene	EPA 8260B	0.2
1,3-Dichloropropane	EPA 8260B	0.2
2-Hexanone	EPA 8260B	2.0
Dibromochloromethane	EPA 8260B	0.2
1,2-Dibromoethane	EPA 8260B	0.2
Chlorobenzene	EPA 8260B	0.2
1,1,1,2-Tetrachloroethane	EPA 8260B	0.2
Ethylbenzene	EPA 8260B	0.2
m,p-Xylene	EPA 8260B	0.4
o-Xylene	EPA 8260B	0.2
Styrene	EPA 8260B	0.2
Bromoform	EPA 8260B	1.0
Isopropylbenzene	EPA 8260B	0.2
Bromobenzene	EPA 8260B	0.2
1,1,2,2-Tetrachloroethane	EPA 8260B	0.2
1,2,3-Trichloropropane	EPA 8260B	0.2
n-Propylbenzene	EPA 8260B	0.2
2-Chlorotoluene	EPA 8260B	0.2
4-Chlorotoluene	EPA 8260B	0.2
1,3,5-Trimethylbenzene	EPA 8260B	0.2

TABLE D-3

METHODS OF ANALYSIS AND TARGET REPORTING LIMITS FOR WATER SAMPLES

QUALITY ASSURANCE PROJECT PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Analyte	Analytical Method	Practical Quantitation Limit (PQL)
VOCs (µg/L)		
tert-Butylbenzene	EPA 8260B	0.2
1,2,4-Trimethylbenzene	EPA 8260B	0.2
sec-Butylbenzene	EPA 8260B	0.2
1,3-Dichlorobenzene	EPA 8260B	0.2
p-Isopropyltoluene	EPA 8260B	0.2
1,4-Dichlorobenzene	EPA 8260B	0.2
1,2-Dichlorobenzene	EPA 8260B	0.2
n-Butylbenzene	EPA 8260B	0.2
1,2-Dibromo-3-chloropropane	EPA 8260B	1.0
1,2,4-Trichlorobenzene	EPA 8260B	0.2
Hexachlorobutadiene	EPA 8260B	0.2
Naphthalene	EPA 8260B	1.0
1,2,3-Trichlorobenzene	EPA 8260B	0.2
SVOCs (µg/L)		
n-Nitrosodimethylamine	EPA 8270D	0.1
Pyridine	EPA 8270D	0.1
Phenol	EPA 8270D	0.1
Aniline	EPA 8270D	0.1
bis(2-chloroethyl)ether	EPA 8270D	0.1
2-Chlorophenol	EPA 8270D	0.1
1,3-Dichlorobenzene	EPA 8270D	0.1
1,4-Dichlorobenzene	EPA 8270D	0.1
Benzyl alcohol	EPA 8270D	0.1
1,2-Dichlorobenzene	EPA 8270D	0.1
2-Methylphenol (o-Cresol)	EPA 8270D	0.1
bis(2-Chloroisopropyl)ether	EPA 8270D	0.1
(3+4)-Methylphenol (m,p-Cresol)	EPA 8270D	0.1
n-Nitroso-di-n-propylamine	EPA 8270D	0.1
Hexachloroethane	EPA 8270D	0.1
Nitrobenzene	EPA 8270D	0.1
Isophorone	EPA 8270D	0.1
2-Nitrophenol	EPA 8270D	0.1
2,4-Dimethylphenol	EPA 8270D	0.1
bis(2-Chloroethoxy)methane	EPA 8270D	0.1
2,4-Dichlorophenol	EPA 8270D	0.1
1,2,4-Trichlorobenzene	EPA 8270D	0.1
Naphthalene	EPA 8270D-SIM	0.1
4-Chloroaniline	EPA 8270D	0.1
Hexachlorobutadiene	EPA 8270D	0.1
4-Chloro-3-methylphenol	EPA 8270D	0.1
2-Methylnaphthalene	EPA 8270D-SIM	0.1
1-Methylnaphthalene	EPA 8270D-SIM	0.1
Hexachlorocyclopentadiene	EPA 8270D	0.1
2,4,6-Trichlorophenol	EPA 8270D	0.1
2,3-Dichloroaniline	EPA 8270D	0.1
2,4,5-Trichlorophenol	EPA 8270D	0.1
2-Chloronaphthalene	EPA 8270D	0.1
2-Nitroaniline	EPA 8270D	0.1
1,4-Dinitrobenzene	EPA 8270D	0.1
Dimethylphthalate	EPA 8270D	0.1
1,3-Dinitrobenzene	EPA 8270D	0.1
2,6-Dinitrotoluene	EPA 8270D	0.1
1,2-Dinitrobenzene	EPA 8270D	0.1
Acenaphthylene	EPA 8270D-SIM	0.1
3-Nitroaniline	EPA 8270D	0.1
2,4-Dinitrophenol	EPA 8270D	1.0
Acenaphthene	EPA 8270D-SIM	0.1
4-Nitrophenol	EPA 8270D	0.1
2,4-Dinitrotoluene	EPA 8270D	0.1
Dibenzofuran	EPA 8270D	0.1
2,3,5,6-Tetrachlorophenol	EPA 8270D	0.1
2,3,4,6-Tetrachlorophenol	EPA 8270D	0.1
Diethylphthalate	EPA 8270D	0.1
4-Chlorophenyl-phenylether	EPA 8270D	0.1
4-Nitroaniline	EPA 8270D	0.1
Fluorene	EPA 8270D-SIM	0.1
4,6-Dinitro-2-methylphenol	EPA 8270D	0.5
n-Nitrosodiphenylamine	EPA 8270D	0.1
1,2-Diphenylhydrazine	EPA 8270D	0.1
4-Bromophenyl-phenylether	EPA 8270D	0.1
Hexachlorobenzene	EPA 8270D	0.1
Pentachlorophenol	EPA 8270D	0.5

TABLE D-3

METHODS OF ANALYSIS AND TARGET REPORTING LIMITS FOR WATER SAMPLES

QUALITY ASSURANCE PROJECT PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Analyte	Analytical Method	Practical Quantitation Limit (PQL)
SVOCs (µg/L)		
Phenanthrene	EPA 8270D-SIM	0.1
Anthracene	EPA 8270D-SIM	0.1
Carbazole	EPA 8270D	0.1
Di-n-butylphthalate	EPA 8270D	0.1
Fluoranthene	EPA 8270D	0.1
Benzidine	EPA 8270D	0.1
Pyrene	EPA 8270D-SIM	0.1
Butylbenzylphthalate	EPA 8270D	0.1
bis-2-Ethylhexyladipate	EPA 8270D	0.1
3,3'-Dichlorobenzidine	EPA 8270D	0.1
Benzo[a]anthracene	EPA 8270D-SIM	0.01
Chrysene	EPA 8270D-SIM	0.01
bis(2-Ethylhexyl)phthalate	EPA 8270D	0.1
Di-n-octylphthalate	EPA 8270D	0.1
Benzo[b]fluoranthene	EPA 8270D-SIM	0.01
Benzo[k]fluoranthene	EPA 8270D-SIM	0.01
Benzo[a]pyrene	EPA 8270D-SIM	0.01
Indeno[1,2,3-c,d]pyrene	EPA 8270D-SIM	0.01
Dibenz[a,h]anthracene	EPA 8270D-SIM	0.01
Benzo[g,h,i]perylene	EPA 8270D-SIM	0.01
n-Decane	EPA 8270D	2.0
n-Octadecane	EPA 8270D	0.1
Benzoic acid	EPA 8270D	0.5

Notes:

EPA = U.S. Environmental Protection Agency

VOC = Volatile organic compound

SVOC = Semivolatile organic compound

SIM = Selective ion monitoring

PCBs = Polychlorinated biphenyls

mg/L = Milligrams per liter

µg/L = Micrograms per liter

pg/L = Picograms per liter

TABLE D-4

TEST METHODS, SAMPLE CONTAINERS, PRESERVATION AND HOLDING TIMES

QUALITY ASSURANCE PROJECT PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Analysis	Method	Soil/Solids				Groundwater			
		Minimum Sample Size	Sample Containers	Sample Preservation	Holding Times[1]	Minimum Sample Size	Sample Containers	Sample Preservation	Holding Times[1]
Gasoline-Range Hydrocarbons	NWTPH-G	5 g	40mL glass vial (VOA)	Cool 4°C	14 days to extraction/analysis	40 mL	Three 40mL glass vial (VOA)	Cool 4°C, HCl to pH < 2	14 days to extraction/analysis
Diesel- and Oil-Range Hydrocarbons	Ecology NWTPH-Dx with acid/silica gel cleanup	100 g	8 or 16 oz amber glass wide-mouth with Teflon-lined lid	Cool 4°C	14 days to extraction 40 days from extraction to analysis	500mL	500mL amber glass with Teflon-lined lid	Cool 4°C, HCl to pH < 2	14 days to extraction 40 days from extraction to analysis
VOCs	EPA 8260C	10 g	Three 40mL glass vial (VOA)	Cool 4°C	14 days to extraction/analysis	40mL	Three 40mL glass vial (VOA)	Cool 4°C, HCl to pH < 2	14 days to extraction/analysis
SVOCs	EPA 8270D/SIM	100 g	4 or 8 oz glass wide mouth with Teflon-lined lid	Cool 4°C	14 days to extraction, 40 days from extraction to analysis	1 L	1 liter amber glass with Teflon-lined lid	Cool 4°C	7 days to extraction 40 days from extraction to analysis
PCBs	EPA 8082A	100 g	4 or 8 oz glass wide mouth with Teflon-lined lid	Cool 4°C	None	NA	NA	NA	NA
Metals[2]	EPA 6010/7060/7470/ 7471/7421	100 g	4 or 8 oz glass wide mouth with Teflon-lined lid	Cool 4°C	180 days/ 28 days for Mercury	500 mL	500mL poly bottle	HNO_3 - pH<2 (Dissolved metals preserved after filtration)	180 days (28 days for Mercury)
pH	SM4500-H/EPA 9045C	20 g	4 or 8 oz glass wide mouth with Teflon-lined lid	Cool 4°C	14 days	20 mL	60 mL HDPE	Cool 4°C	ASAP
Dioxins/furans	SW-846 8290	100 g	4 or 8 oz glass wide mouth with Teflon-lined lid	Cool 4°C	30 days	NA	NA	NA	NA

Notes:

[1] Holding times are based on elapsed time from date of collection.

[2] Metals to be analyzed include antimony, arsenic, beryllium, cadmium, total chromium, copper, lead, mercury, nickel, silver, zinc and tin.

VOC = Volatile organic compound

SVOC = Semivolatile organic compound

PCBs = Polychlorinated biphenyls

HCl = Hydrochloric acid

HNO_3 = Nitric acid

oz = Ounce

mL = Milliliter

L = Liter

g = Gram

TABLE D-5

QUALITY CONTROL SAMPLES - TYPE AND FREQUENCY

QUALITY ASSURANCE PROJECT PLAN

PORT OF SEATTLE NORTH TERMINAL 115

SEATTLE, WASHINGTON

Parameter	Field QC		Laboratory QC			
	Field Duplicates	Trip Blanks	Method Blanks	LCS	MS / MSD	Lab Duplicates
Gasoline-Range Hydrocarbons	1/20 groundwater/soil/solids samples	1/cooler	1/batch	1/batch	NA	1/batch
Diesel and Heavy Oil-Range Hydrocarbons	1/20 groundwater/soil/solids samples	NA	1/batch	1/batch	NA	1/batch
VOCs	1/20 groundwater/soil/solids samples	1/cooler	1/batch	1/batch	1 set/batch	NA
SVOCs	1/20 groundwater/soil/solids samples	NA	1/batch	1/batch	1 set/batch	NA
PCBs	1/20 groundwater/soil/solids samples	NA	1/batch	1/batch	1 set/batch	NA
Metals	1/20 groundwater/soil/solids samples	NA	1/batch	1/batch	1 set/batch	1/batch
pH	1/20 groundwater/soil/solids samples	NA	NA	NA	NA	1/batch
Dioxins/furans	1/20 soil/solids samples	NA	1/batch	1/batch	NA	NA

Notes:

An analytical lot or batch is defined as a group of samples taken through a preparation procedure and sharing a method blank, LCS, and MS/MSD (or MS and lab duplicate). No more than 20 field samples can be contained in one batch.

QC = Quality control

LCS = Laboratory control sample

MS = Matrix spike sample

MSD = Matrix spike duplicate sample

VOCs = Volatile organic compounds

SVOCs = Semivolatile organinc compounds

PCBs = polychlorinated biphenyls

Appendix E
Health and Safety Plan

Health and Safety Plan (HASP)

Remedial Investigation/Feasibility Study
Port of Seattle North Terminal 115

for

Washington State Department of Ecology on Behalf of Port of Seattle

June 14, 2012

GeoEngineers

Plaza 600 Building
600 Stewart Street, Suite 1700
Seattle, Washington 98101
206.728.2674

Table of Contents

SITE HEALTH AND SAFETY PLAN

Remedial Investigation/Feasibility Study
Port of Seattle North Terminal 115

This HASP is to be used in conjunction with the GeoEngineers Safety Program Manual. Together, the written safety programs and this HASP constitute the Site safety plan for this Site. This plan is to be used by GeoEngineers personnel on this Site and must be available on-site. If the work entails potential exposures to other substances or unusual situations, additional safety and health information will be included, and the plan will need to be approved by the GeoEngineers Health and Safety Manager. All plans are to be used in conjunction with current standards and policies outlined in the GeoEngineers Health and Safety Program Manual.

Liability Clause: If requested by subcontractors, this Site safety plan may be provided for informational purposes only. In this case, Form C-3 shall be signed by the subcontractor. Please be advised that this Site Safety Plan is intended for use by GeoEngineers Employees only. Nothing herein shall be construed as granting rights to GeoEngineers' subcontractors or any other contractors working on this Site to use or legally rely on this Site Safety Plan. GeoEngineers specifically disclaims any responsibility for the health and safety of any person not employed by them.

1.0 GENERAL PROJECT INFORMATION

Project Name:	Port of Seattle North Terminal 115
Project Number:	0303-112-00
Type of Project:	Remedial Investigation including drilling, test pit exploration, monitoring well installation, groundwater sampling, soil sampling, catch basin solids sampling and tidal study.
Start/Completion:	Within 12 Months following Ecology's approval of the Final RI/FS Work Plan
Subcontractors:	Utility Locate Contractor Drilling Contractor Excavation Contractor Survey Contractor

2.0 WORK PLAN

GeoEngineers will conduct an environmental investigation within a portion of Port of Seattle's (Port's) Terminal 115 (the Site). The purpose of the investigation is to characterize the nature and extent of soil and groundwater contamination at the Site and to provide sufficient information to select a cleanup action, if necessary. The activities also include assessment of catch basin solids to evaluate whether the storm water collection system at the Site is a potential transport mechanism for contaminants in Site media to the Lower Duwamish Waterway (LDW). As part of the investigation, our scope includes:

- Direct push, hollow stem auger and test pit explorations, soil sampling, and submitting samples to a laboratory for testing of metals, VOCs, SVOCs, PCBs, gasoline-range, diesel-range, and heavy oil-range petroleum hydrocarbons, soil pH and dioxins and furans.
- Installation and development of groundwater monitoring wells.
- Groundwater sampling from monitoring wells and submitting samples to a laboratory for testing of metals, VOCs, SVOCs, PCBs, gasoline-range, diesel-range, and lube oil-range petroleum hydrocarbons, and dioxins and furans.
- Catch basin solids sampling, and submitting samples to a laboratory for testing of metals, SVOCs, PCBs, gasoline-range, diesel-range, and heavy oil-range petroleum hydrocarbons.
- A 72-hour tidal study (down-well recording of water levels in a subset of monitoring wells over several tidal cycles).
- Site surveying.

2.1. Site Description

The North Terminal 115 property is generally located at 6000 West Marginal Way SW in Seattle, Washington, on the west bank of the Lower Duwamish Waterway (LDW). The property is approximately 2 acres in size and located on the northwestern portion of the Port's Terminal 115. The Site is bordered to the north by Glacier Northwest and west by West Marginal Way SW. Northland Services Inc. leases the portion of Terminal 115 east and south of the Site. The LDW is located to the east and northeast of the Site.

The Site is currently owned by the Port and currently leased to the Gene Summy Lumber Co. which distributes untreated lumber and the Commercial Fence Corp., a fence supplier. Site topography is generally flat and most of the Site is paved with either asphalt or concrete. Stormwater runoff at the Site is collected in catch basins and is then discharged to the LDW via a 48-inch storm drain located near the northern property boundary. Chain link fencing encompasses the property except where the asphalt road enters from West Marginal Way SW.

2.2. Site History

The Site was originally part of the Duwamish River estuary. The river was channelized in the late 1800s and early 1900s and the Site property was created by filling the former shoreline of the Duwamish River. From 1963 to 1998, the Site was used for tin reclamation by various companies. As stated above, facilities located at the Site used for tin reclamation have included process buildings, settling ponds, above ground and underground storage tanks, and rail lines.

Waste streams generated by tin reclamation processes included spent plating solution and black mud filtrate which were disposed of to the sanitary sewer. A third waste stream, black mud, was also produced and was captured on-site in settling ponds located in the eastern portion of the Site until about 1972 when the lagoons were filled with gravel and paved over. From 1972 to 1991, the black mud was further reclaimed, dewatered, and stockpiled on-site and then shipped off site. In 1998, tin reclamation operations ceased. At stated above, the Site is currently leased to the

Gene Summy Lumber Co. which distributes untreated lumber and the Commercial Fence Corp., a fence supplier.

2.3. List of Field Activities

Check the activities to be completed during the project

X	Site reconnaissance	X	Field Screening of Soil Samples
X	Exploratory Borings	X	Vapor Measurements
___	Construction Monitoring	X	Groundwater Sampling
X	Surveying	X	Groundwater Depth and Free Product Measurement
X	Test Pit Exploration	___	Product Sample Collection
X	Monitoring Well Installation	___	Soil Stockpile Testing
X	Monitoring Well Development	___	Remedial Excavation
X	Soil Sample Collection	___	Underground Storage Tank (UST) Removal Monitoring
___	Remediation System Monitoring	___	Recovery of Free Product

3.0 LIST OF FIELD PERSONNEL AND TRAINING

Anticipated field personnel include the following:

- Abhijit Johsi
- Robert Miyahira
- Robert Trahan
- Brian Anderson
- Garrett Leque

Field personnel will have appropriate training and up to date certifications.

Chain of Command	Title	Name	Telephone Numbers
1	Project Manager	Iain Wingard	(o) 253.772.2417 (c) 206.595.7402
2	HAZWOPER Supervisor	Robert Trahan	(o) 206.239.3253 (c) 206.240.2300
3	Field Engineer/Geologist	Abhijit Joshi	(o) 206.239.3256 (c) 425.223.9028
4	Site Safety and Health Supervisor*	Abhijit Joshi	(o) 206.239.3256 (c) 425.223.9028
5	Client Assigned Site Supervisor	TBD	
6	Health and Safety Program Manager	Wayne Adams	(o) 253.383.4940 (c) 253.350.4387
N/A	Subcontractor(s)	TBD	
N/A	Current Owner	Port of Seattle Representative Brick Spangler	(o) 206.787-3193 (c) 206.295-9538

* Site Safety and Health Supervisor – The individual present at a hazardous waste Site responsible to the employer and who has the authority and knowledge necessary to establish the Site-specific health and safety plan and verify compliance with applicable safety and health requirements.

4.0 EMERGANCY INFORMATION

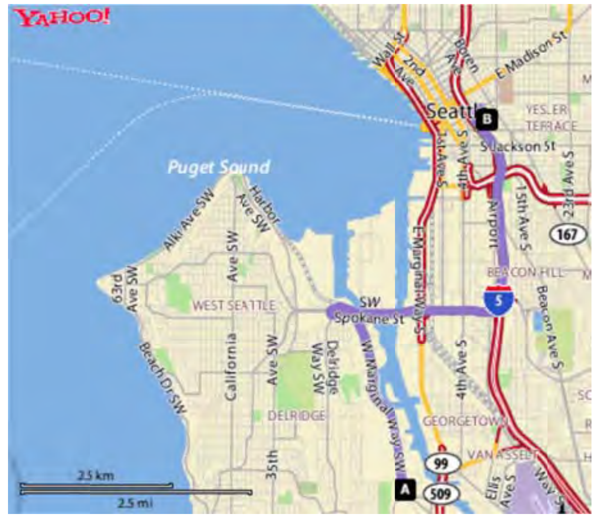
Hospital Name and Address: Harborview Medical Center
325 9th Ave (At Jefferson St)
Seattle, WA 98104

Phone Numbers (Hospital ER): Phone: (206) 731-3000

Distance: 6 Miles

Route to Hospital:

1. Start at 6700 W MARGINAL WAY SW, SEATTLE going toward NORTH ACCESS RD – go 2.38 mi
2. Continue on CHELAN AVE SW – go 515 ft
3. Turn L to take ramp onto WEST SEATTLE BRG toward I-5/WA-99 N - go 1.99 mi
4. Take L ramp onto I-5 N toward VANCOUVER BC – go 1.15 mi
5. Take exit #164A/DEARBORN ST/JAMES ST/MADISON ST/SPOKANE toward DEARBORN ST/JAMES ST - go 1.29 mi
6. Turn R on JAMES ST - go 0.12 mi
7. Turn R on 9TH AVE – go 0.15 mi
8. Arrive at 325 9TH AVE, SEATTLE, on the R.



5.0 STANDARD EMERGENCY PROCEDURES

- **Get help**
  - send another worker to phone 9-1-1 (if necessary)
  - as soon as feasible, notify GeoEngineers' Project Manager
- **Reduce risk to injured person**
  - turn off equipment
  - move person from injury location (if in life-threatening situation only)
  - keep person warm
  - perform CPR (if necessary)
- **Transport injured person to medical treatment facility (if necessary)** -
  - by ambulance (if necessary) or GeoEngineers vehicle
  - stay with person at medical facility
  - keep GeoEngineers manager apprised of situation and notify Human Resources Manager of situation

6.0 HAZARD ANALYSIS

A hazard assessment will be completed at every Site prior to beginning field activities. Updates will be included in the daily log. This list is a summary of hazards listed on the form.

6.1. Physical Hazards

X	Drill rigs and Concrete Coring, including working inside a warehouse
X	Backhoe
X	Trackhoe

______	Crane
X	Front End Loader
X	Excavations/trenching (1:1 slopes for Type B soil)
X	Shored/braced excavation if greater than 4 feet of depth
X	Overhead hazards/power lines
X	Tripping/puncture hazards (debris on-site, steep slopes or pits)
X	Unusual traffic hazard – Street traffic
X	Heat/Cold, Humidity
X	Utilities/utility locate

- Utility checklist will be completed as required for the location to preventing drilling or digging into utilities.
- Work areas will be marked with reflective cones, barricades and/or caution tape. High-visibility vests will be worn by on-site personnel to ensure they can be seen by vehicle and equipment operators.
- Field personnel will be aware at all times of the location and motion of heavy equipment in the area of work to ensure a safe distance between personnel and the equipment. Personnel will be visible to the operator at all times and will remain out of the swing and/or direction of the equipment apparatus. Personnel will approach operating heavy equipment only when they are certain the operator has indicated that it is safe to do so through hand signal or other acceptable means.
- Heavy equipment and/or vehicles used on this Site will not work within 20 feet of overhead utility lines without first ensuring that the lines are not energized. This distance may be reduced to 10 feet depending on the client and the use of a safety watch. Note: If it is later determined that overhead lines are a hazard on this job Site a copy the overhead lines safety section from the HASP Supplemental document will be attached.
- Personnel entry into unshored or unsloped excavations deeper than 4 feet is not allowed. Any trenching and shoring requirements will follow guidelines established in WAC 296-155, the Washington State Construction Standards or OSHA 1926.651 Excavation Requirements. In the event that a worker is required to enter an excavation deeper than 4 feet, a trench box or other acceptable shoring will be employed or the side walls of the excavation will be sloped according to the soil type and guidelines as outlined in DOSH/OSHA regulations. If the shoring/sloping deviates from that outlined in the WAC, it will be designed and stamped by a PE. Prior to entry, personnel will conduct air monitoring as described later in this plan. All hazardous encumbrances and excavated material will be stockpiled at least 2 feet from the edge of a trench or open pit. If concentrations of volatile gases accumulate within an open trench or excavation, the means of entering shall adhere to confined space entry and air monitoring procedures outlined under the air monitoring recommendations in this Plan and/or the GeoEngineers Health and Safety Program.
- Personnel will avoid tripping hazards, steep slopes, pits and other hazardous encumbrances. If it becomes necessary to work within 6 feet of the edge of a pit, slope or other potentially hazardous area, appropriate fall protection measures will be implemented by the Site Safety

and Health Supervisor in accordance with OSHA/DOSH regulations and the GeoEngineers Health and Safety Program.

- Cold stress control measures will be implemented according to the GeoEngineers Health and Safety Program to prevent frost nip (superficial freezing of the skin), frost bite (deep tissue freezing), or hypothermia (lowering of the core body temperature). Heated break areas and warm beverages shall be available during periods of cold weather.
- Heat stress control measures required for this Site will be implemented according to GeoEngineers Health and Safety Program with water provided on-site.

6.2. Engineering Controls

X Trench shoring (1:1 slope for Type B Soils)
X Location work spaces upwind/wind direction monitoring
X Other soil covers (as needed)
X Other (specify): Dust control for metals exposure

6.3. Chemical Hazards

CHEMICAL HAZARDS (POTENTIALLY PRESENT AT SITE)

SUBSTANCE	PATHWAYS
Petroleum Products Gasoline Diesel Heavy oil Waste oil Aromatic hydrocarbons (benzene, ethylbenzene, toluene, xylenes [BETX]) Naphthalenes or paraffins	Air/Soil/Water
Organic Compounds Chlorinated Hydrocarbons Polycyclic aromatic hydrocarbons (PAHs)	Air/Soil/Water
Metals Arsenic Copper Chromium Lead Mercury Nickel Tin Zinc	Air/Soil/Water
Polychlorinated Biphenyl's (PCBs)	Soil/Water
Dioxins and Furans	Soil/Water

SPECIFIC CHEMICAL HAZARDS AND EXPOSURES (POTENTIALLY PRESENT AT SITE)

COMPOUND/ DESCRIPTION	EXPOSURE LIMITS/IDLH	EXPOSURE ROUTES	SYMPTOMS/HEALTH EFFECTS
Arsenic	PEL 0.05 mg/m^3 IDLH 5.0 mg/m^3	Inhalation, skin absorption, skin and eye contact, ingestion	Ulceration of nasal septum; dermatitis; GI disturbances; peripheral neuropathy; respiratory irritation; hyperpigmentation of skin
Copper	PEL 1 mg/m^3 IDLH 100 mg/m^3	Inhalation, ingestion, skin and eye contact	Irritated eyes, nose, pharynx; nasal septum perforation; metallic taste; dermatitis
Chromium	PEL 1 mg/m^3 IDLH 250 mg/m^3	Inhalation, ingestion, skin and eye contact	Irritated eyes, skin respiratory system
Lead	PEL 0.05 mg/m^3 IDLH 100 mg/m^3	Inhalation, ingestion, skin and eye contact	Lassitude; insomnia; facial pallor; abnormalities; weight loss, malnutrition, constipation, abdominal pain; colic; anemia; gingival lead line; tremors; paralysis of the wrist and ankles; encephalopathy; kidney disease; irritated eyes; hypertension
Mercury	PEL 0.05 mg/m^3 IDLH 10 mg/m^3	Inhalation, skin absorption, skin and eye contact, ingestion	Irritated eyes, skin; cough, chest pain, dyspnea, bronchitis, pneumonia; tremors, insomnia, irritability, indecision, headache, lassitude; stomatitis, salivation; GI disturbances, abnormalities, low weight; proteinuria
Nickel	IDLH 10 mg/m^3	Inhalation, skin and eye Contact	Sensitization dermatitis, allergic asthma, pneumonitis; [potential occupational carcinogen]
Tin	PEL 2 mg/m^3 IDLH 100 mg/m^3	Inhalation, skin and eye contact	Irritated eyes and skin; respiratory system
Zinc	TLV/PEL none Treat as particles not otherwise specified and maintain levels below 3 mg/m3 respirable and 10 mg/m3 inhalable	Inhalation	Metal fume fever (usually onsets at 77-600 mg zinc/m3)

COMPOUND/ DESCRIPTION	EXPOSURE LIMITS/IDLH	EXPOSURE ROUTES	SYMPTOMS/HEALTH EFFECTS
Gasoline (Unleaded) — clear liquid with a characteristic odor	PEL 300 ppm TLV 300 ppm STEL 500 ppm	Ingestion, inhalation, skin absorption, skin and eye contact	Irritated eyes, skin, and mucous membrane; fatigue; blurred vision; dizziness; slurred speech; confusion; convulsions; headache; dermatitis
Diesel Fuel — liquid with a characteristic odor	None established by OSHA, but ACGIH has adopted 100 mg/m3 for a TWA (as total hydrocarbons)	Ingestion, inhalation, skin absorption, skin and eye contact	Irritated eyes, skin, and mucous membrane; fatigue; blurred vision; dizziness; slurred speech; confusion; convulsions; headache; dermatitis
Waste oil – may contain metals, gas, antifreeze and PAHs	Depends on the ancillary contaminants	Ingestion, inhalation, skin absorption, skin and eye contact	Depends on the ancillary contaminants.
Lube Oil/Mineral Oil – as a mist	The current OSHA PEL for mineral oil mist is 5 mg/m3 of air as an 8-hr TWA	If the oil is not a mist, then route of exposure is skin and eye contact	Exposure to oil mists can cause eye, skin and upper respiratory tract irritation.
Benzene	OSHA PEL 1 ppm Short term: 5 ppm ACGIH PEL 0.5 ppm	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritated eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen]
Toluene	PEL 100 ppm IDLH 500 ppm	Inhalation, absorption, ingestion, direct contact	Irritation to eyes, nose, exhaustion, confusion, dizziness, headaches, dilated pupils, euphoria, anxiety, teary eyes, muscle fatigue, insomnia, paresthesia, dermatitis, liver and kidney damage.
Ethyl benzene	PEL 100 ppm IDLH 800 ppm	Inhalation, ingestion, direct contact	Irritation to eyes, skin, respiratory system, burning
Xylenes	PEL 100 ppm IDLH 900 ppm	Inhalation, skin absorption, ingestion, direct contact	Irritation to eyes, skin, nose, throat, dizziness, excitement, drowsiness, incoordination, staggering gait, corneal vacuolization, anorexia, nausea, vomiting, abdominal

COMPOUND/ DESCRIPTION	EXPOSURE LIMITS/IDLH	EXPOSURE ROUTES	SYMPTOMS/HEALTH EFFECTS
Perchloroethylene (PCE)	PEL 100 ppm IDLH 150 ppm	Inhalation, absorption, ingestion, dermal contact	Irritation to eyes, nose, throat, nausea, flush face or neck, vertigo, dizziness, incoherence, headache, drowsiness, skin redness, liver damage.
Trichloroethylene (TCE)	PEL 100 ppm IDLH 1000 ppm	Inhalation, absorption, ingestion, dermal contact	Irritation to eyes, skin, headaches, vertigo, distorted vision, fatigue, giddiness, tremors, drowsiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia.
Vinyl Chloride	PEL 1 ppm	Inhalation, skin, and/or eye contact (liquid)	Lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen]
Polycyclic aromatic hydrocarbons (PAH) as coal tar pitch volatiles	PEL 0.2 mg/m^3 TLV 0.2 mg/m^3 REL 0.1 mg/m^3 IDLH 80 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Dermatitis, bronchitis, potential carcinogen
PCBs (as Arochlor 1254)—colorless to pale-yellow viscous liquid with a mild, hydrocarbon odor	PEL 0.5 mg/m^3 TLV 0.5 mg/m^3 REL 0.001 mg/m^3 IDLH 5.0 mg/m^3	Inhalation (dusts or mists), skin absorption, ingestion, skin and/or eye contact	Irritated eyes, chloracne, liver damage, reproductive effects, potential carcinogen
Dioxins/furans	See below	See below	See below

Notes:

IDLH = immediately dangerous to life or health

OSHA = Occupational Safety and Health Administration

ACGIH = American Conference of Governmental Industrial Hygienists

mg/m^3 = milligrams per cubic meter

TWA = time-weighted average (Over 8 hrs.)

PEL = permissible exposure limit

TLV = threshold limit value (over 10 hrs)

STEL = short-term exposure limit (15 min)

ppm = parts per million

Based on previous investigation data, it is anticipated that the metals listed above present the greatest risk to Site personnel through incidental inhalation and ingestion of soil particles. Previous sediment sampling also found concentrations of heavy metals which could result in exposures close to the PEL if conditions are dry and dusty. The inhalation/ingestion hazards should be significantly mitigated by wet conditions while excavating contaminated soil.

6.3.1. Dioxins/Furans

Generally, dioxin exposures to humans are associated with increased risk of severe skin lesions such as chloracne and hyperpigmentation, altered liver function and lipid metabolism, general weakness associated with drastic weight loss, changes in activities of various liver enzymes, depression of the immune system, and endocrine- and nervous-system abnormalities. It is a potent teratogenic and fetotoxic chemical in animals. A very potent promoter in rat liver cancers, 2,3,7,8-tetrachlorodibenzo-pdioxin (2,3,7,8-TCDD) causes cancers of the liver and other organs in animals. Populations occupationally or accidentally exposed to chemicals contaminated with dioxin have increased incidences of soft-tissue sarcoma and non-Hodgkin's lymphoma.

Dioxin-contaminated soil may result in dioxins occurring in a food chain. This is especially important for the general population. It has been estimated that about 98 % of exposure to dioxins is through the oral route. Exposure as a vapor is normally negligible because of the low vapor pressure typical of these compounds. In the 1980s, a concentration level of 1 ppb 2,3,7,8-TCDD in soil was specified as "a level of concern," based on cancer effects. However, recent studies indicate that end points other than cancer (such as those listed above) are also of concern based on a projected intake from 1 ppb 2,3,7,8-TCDD in soil. Human studies have shown alteration in delayed-type hypersensitivity after exposure to dioxins. NIOSH recommends respiratory protection at the “lowest feasible level.” Very little human toxicity data from exposure to tetrachlorodibenzodioxins (TCDDs) and/or polychlorinated dibenzodioxins (PCDDs) are available. Health-effect data obtained from occupational settings in humans are based on exposure to chemicals contaminated with dioxins. It produces a variety of toxic effects in animals and is considered one of the most toxic chemicals known. Most of the available toxicity data are from high-dose oral exposures to animals (including tumor production, immunological dysfunction, and teratogenesis).

Very little dermal and inhalation exposure data are available in the literature. It is important for field personnel to remember that although dioxins are toxic and carcinogenic, most of the information is based on exposure to high doses of liquid product. These products are not very volatile, so the major concern is on skin protection and inhalation/ingestion of soil particles. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a 20 ppm threshold limit value (TLV) for 1,4-dioxane (an example of numerous dioxin compounds), lists it as being absorbed through the skin, and lists it as potentially carcinogenic as well as toxic to liver and kidneys. This is typical of health effects for dioxin/furan compounds. Care should be taken especially in sampling product from drums and wells known to contain detectable levels of dioxins. Emphasis will be on working outside in well-ventilated areas using proper PPE (as discussed later in this plan). There is significant variability in dioxin lethality in animals. The signs and symptoms of dioxin poisoning in humans, however, are analogous to those observed in animals.

7.0 BIOLOGICAL HAZARDS AND PROCEDURES

Y/N	Hazard	Procedures
N	Poison Ivy or other vegetation	
TBD	Insects or snakes	Work gloves and long sleeve shirt
TBD	Used hypodermic needs or other infectious hazards	Do not pick up or contact
	Others: Bird droppings	Hard hat, gloves and long sleeve shirt

7.1. Additional Hazards

Update in Daily Report. Include evaluation of:

- *Physical Hazards* (excavations and shoring, equipment, traffic, tripping, heat stress, cold stress and others)
- Chemical Hazards (odors, spills, free product, airborne particulates and others present)
- Biological Hazards (snakes, spiders, other animals, discarded needles, poison ivy, pollen, bees/wasps and others present)

8.0 AIR MONITORING PLAN

Work upwind if at all possible.

Check instrumentation to be used:

X ___ Photoionization Detector (PID)

____ Other (i.e., detector tubes): ____

Check monitoring frequency/locations and type (specify: work space, borehole, breathing zone):

X ___ 15 minutes - Continuous during soil disturbance activities or handling samples

____ 15 minutes

____ 30 minutes

X ___ Hourly (in breathing zone during excavations, drilling, sampling)

Additional personal air monitoring for specific chemical exposure:

Dust/Metals

If drilling or excavation activities generate visible dust, the Site Safety and Health Supervisor will be notified immediately to assess the need for air monitoring and lab analysis for inhalable and respirable particulates.

PAHs

For napthalenes and polycyclic aromatic hydrocarbons, if PID monitoring indicates levels greater than 10 ppm over background for 5 minutes in the breathing zone, personnel shall upgrade to respirators with combination HEPA/organic vapor filters. Site personnel will wear respirators while doing any soil or product disturbance or sampling if there is dust or if there are odors. Naphthalene will be detected by the PID and has a distinct mothball smell.

Action levels:

- The workspace will be monitored using a photoionization detector (PID). These instruments must be properly maintained, calibrated and charged (refer to the instrument manuals for details). Zero this meter in the same relative humidity as the area in which it will be used and allow at least a 10-minute warm-up prior to zeroing. Do not zero in a contaminated area. The PID can be tuned to read chemicals specifically if there are not multiple contaminants on-site. It can be tuned to detect one chemical with the response factor entered into the equipment, but the PID picks up all volatile organic compounds (VOCs) present. The ionization potential (IP) of the chemical has to be less than the PID lamp (11.7 / 10.6eV), and the PID does not detect methane. The ppm readout on the instrument is relative to the IP of isobutylene (calibration gas), so conversion must be made in order to estimate ppm of the chemical on-site.
- An initial vapor measurement survey of the Site should be conducted to detect "hot spots" if contaminated soil is exposed at the surface. Vapor measurement surveys of the workspace should be conducted at least hourly or more often if persistent petroleum-related odors are detected. Additionally, if vapor concentrations exceed 5 ppm above background continuously for a 5-minute period as measured in the breathing zone, upgrade to Level C personal protective equipment (PPE) or move to a noncontaminated area.
- Standard industrial hygiene/safety procedure is to require that action be taken to reduce worker exposure to organic vapors when vapor concentrations exceed one-half the TLV. Because of the variety of chemicals, the PID will not indicate exposure to a specific PEL and is therefore not a preferred tool for determining worker exposure to chemicals. If odors are detected, then employees shall upgrade to respirators with Organic Vapor cartridges and will contact the Health and Safety Program Manager for other sampling options.

AIR MONITORING ACTION LEVELS

Contaminant	Activity	Monitoring Device	Frequency of Monitoring Breathing Zone	Action Level	Action
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes and in event of odors	Background to 5 ppm in breathing zone	Use Level D or Modified Level D PPE

Contaminant	Activity	Monitoring Device	Frequency of Monitoring Breathing Zone	Action Level	Action
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes and in event of odors	5 to 25 ppm in breathing zone	Upgrade to Level C PPE
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes	> 25 ppm in breathing zone	Stop work and evacuate the area. Contact Health and Safety Manager for guidance.
Combustible Atmosphere	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes	>10% LEL or >1,000 ppm	Depends on contaminant. The PEL is usually exceeded before the lower explosive limit (LEL).
Combustible Atmosphere	Environmental Remedial Actions	PID or 4-gas meter	Start of shift; prior to excavation entry; every 30 to 60 minutes	>10% LEL or >1,000 ppm	Stop work and evacuate the Site. Contact Health and Safety Manager for guidance.
Oxygen Deficient/ Enriched Atmosphere	Environmental Remedial Actions Confined Spaces	Oxygen meter or 4-gas meter	Start of shift; prior to excavation entry; every 30 to 60 minutes	<19.5>23.5%	Continue work if inside range. If outside range, evacuate area and contact Health and Safety Manager.

9.0 SITE CONTROL PLAN

Use this section to provide an up-to-date Site Control Plan for cleanup operations to minimize employee exposure to hazardous substances.

9.1. Traffic or Vehicle Access Control Plans

Traffic or vehicle access control plans are not expected to be needed for the investigation work. If interim actions will be conducted, Traffic or vehicle access control plans will be prepared as necessary.

9.2. Site Work Zones

In general, exclusion zones will be established around each sampling location and remedial construction work area, as applicable. These locations/areas are depicted on figures contained in the associated work plans.

Method of delineation/excluding non-site personnel

____X____ Fence

_________ Survey Tape

____X____ Traffic Cones

_________ Other

9.3. Buddy System

Personnel on-site should use the buddy system (pairs), particularly whenever communication is restricted. If only one GeoEngineers employee is on-site, a buddy system can be arranged with subcontractor/ contractor personnel.

9.4. Site Communication Plan

Positive communications (within sight and hearing distance or via radio) should be maintained between pairs on-site, with the pair remaining in proximity to assist each other in case of emergencies. The team should prearrange hand signals or other emergency signals for communication when voice communication becomes impaired (including cases of lack of radios or radio breakdown). In these instances, you should consider suspending work until communication can be restored; if not, the following are some examples for communication:

1. Hand gripping throat: Out of air, can't breathe.
2. Gripping partner's wrist or placing both hands around waist: Leave area immediately, no debate.
3. Hands on top of head: Need assistance.
4. Thumbs up: Okay, I'm all right: or I understand.
5. Thumbs down: No, negative.

9.5. Decontamination Procedures

Decontamination consists of removing outer protective Tyvek clothing and washing soiled boots and gloves using bucket and brush provided on-site in the contamination reduction zone. Inner gloves and respirator will then be removed, hands and face will be washed in either a portable wash station or a bathroom facility in the support zone. Employees will perform decontamination procedures and wash prior to eating, drinking or leaving the Site.

Sampling equipment will be decontaminated using wet decontamination procedures:

- Wash and scrub equipment with Alconox/Liquinox and tap water solution
- Rinse with tap water
- Rinse with distilled water
- Repeat entire procedure or any parts of the procedure as necessary.

In addition to wet decontamination procedures, other measures will be taken to prevent cross contamination.

These measures include changing out disposable gloves between each sampling location, using fresh paper towels at each sample location, and maintaining a clean work area. Downhole drilling equipment will be decontaminated using a hot-water, high-pressure washer. Decontamination water will be stored on-site in 55-gallon drums.

9.6. Waste Disposal or Storage

PPE disposal (specify): Used PPE to be placed in on-site drums pending characterization and disposal.

Drill cutting/excavated sediment disposal or storage:

__X__ On-site, pending analysis and further action

__X__ Secured (list method) __55-Gallon Drums________________________

______ Other (describe destination, responsible parties): ____________________

10.0 PERSONAL PROTECTIVE EQUIPMENT

PPE will consist of standard Level D equipment.

Air monitoring will be conducted to determine the level of respiratory protection.

- Half-face combination organic vapor/high efficiency particulate air (HEPA) or P100 cartridge respirators will be available on-site to be used as necessary. P100 cartridges are to be used only if PID measurements are below the Site action limit. P100 cartridges are used for protection against dust, metals and asbestos, while the combination organic vapor/HEPA cartridges are protective against both dust and vapor. Ensure that the PID or TLV will detect the chemicals of concern on-site.
- Level D PPE unless a higher level of protection is required will be worn at all times on the Site. Potentially exposed personnel will wash gloves, hands, face and other pertinent items to prevent hand-to-mouth contact. This will be done prior to hand-to-mouth activities including eating, smoking, etc.
- Adequate personnel and equipment decontamination will be used to decrease potential ingestion and inhalation.

Check applicable personal protection gear to be used:

__X__ Hardhat (if overhead hazards, or client requests)
__X__ Steel-toed boots (if crushing hazards are a potential or if client requests)
__X__ Safety glasses (if dust, particles, or other hazards are present or client requests)
__X__ Hearing protection (if it is difficult to carry on a conversation 3 feet away)
__X__ Rubber boots (if wet conditions)
__X__ Life Jackets (for work near/over water)

Gloves (specify):

__X__ Nitrile
__X__ Latex
_____ Liners
__X__ Leather

Protective clothing:

__X__ Tyvek (if dry conditions are encountered, Tyvek is sufficient)
_____ Saranex (personnel shall use Saranex if liquids are handled or splash may be an issue)
__X__ Cotton
__X__ Rain gear (as needed)
__X__ Layered warm clothing (as needed)

Inhalation hazard protection:

__X__ Level D
_____ Level C (respirators with organic vapor/HEPA or P100 filters)

10.1. Personal Protective Equipment Inspections

PPE clothing ensembles designated for use during Site activities shall be selected to provide protection against known or anticipated hazards. However, no protective garment, glove or boot is entirely chemical-resistant, nor does any PPE provide protection against all types of hazards. To obtain optimum performance from PPE, Site personnel shall be trained in the proper use and inspection of PPE. This training shall include the following:

- Inspect PPE before and during use for imperfect seams, non-uniform coatings, tears, poorly functioning closures or other defects. If the integrity of the PPE is compromised in any manner, proceed to the contamination reduction zone and replace the PPE.
- Inspect PPE during use for visible signs of chemical permeation such as swelling, discoloration, stiffness, brittleness, cracks, tears or other signs of punctures. If the integrity of the PPE is compromised in any manner, proceed to the contamination reduction zone and replace the PPE.
- Disposable PPE should not be reused after breaks unless it has been properly decontaminated.

10.2. Respirator Selection, Use and Maintenance

If respirators are required, Site personnel shall be trained before use on the proper use, maintenance and limitations of respirators. Additionally, they must be medically qualified to wear a respiratory protection in accordance with 29 CFR 1910.134. Site personnel who will use a tight-fitting respirator must have passed a qualitative or quantitative fit test conducted in accordance with an OSHA-accepted fit test protocol. Fit testing must be repeated annually or whenever a new type of respirator is used. Respirators will be stored in a protective container.

10.3. Respirator Cartridges

If Site personnel are required to wear air-purifying respirators, the appropriate cartridges shall be selected to protect personnel from known or anticipated Site contaminants. The respirator/cartridge combination shall be certified and approved by the National Institute for Occupational Safety and Health (NIOSH). A cartridge change-out schedule shall be developed based on known Site contaminants, anticipated contaminant concentrations and data supplied by the cartridge manufacturer related to the absorption capacity of the cartridge for specific contaminants. Site personnel shall be made aware of the cartridge change-out schedule prior to the initiation of Site activities. Site personnel shall also be instructed to change respirator cartridges if they detect increased resistance during inhalation or detect vapor breakthrough by smell, taste or feel, although breakthrough is not an acceptable method of determining the change-out schedule.

10.4. Respirator Inspection and Cleaning

The Site Safety and Health Supervisor shall periodically (weekly) inspect respirators at the project Site. Site personnel shall inspect respirators prior to each use in accordance with the manufacturer's instructions. In addition, Site personnel wearing a tight-fitting respirator shall perform a positive and negative pressure user seal check each time the respirator is donned, to ensure proper fit and function. User seal checks shall be performed in accordance with the GeoEngineers respiratory protection program or the respirator manufacturer's instructions.

11.0 ADDITIONAL ELEMENTS

11.1. Cold Stress Prevention

Working in cold environments presents many hazards to Site personnel and can result in frost nip (superficial freezing of the skin), frost bite (deep tissue freezing), or hypothermia (lowering of the core body temperature).

The combination of wind and cold temperatures increases the degree of cold stress experienced by Site personnel. Site personnel shall be trained on the signs and symptoms of cold-related illnesses, how the human body adapts to cold environments, and how to prevent the onset of cold-related illnesses. Heated break areas and warm beverages shall be provided during periods of cold weather.

11.2. Heat Stress Prevention

State and federal OSHA regulations provide specific requirements for handling employee exposure to heat stress. GeoEngineers' program complies with these requirements and will be implemented in all areas where heat stress is identified as a potential health issue.

General requirements for preventing heat stress apply to outdoor work environments from May 1 through September 30, annually, only when employees are exposed to outdoor heat at or above an applicable temperature listed in Table 1. To determine which temperature applies to each worksite, select the temperature associated with the general type of clothing or personal protective equipment (PPE) each employee is required to wear.

HEAT STRESS

Type of Clothing	Outdoor Temperature Action Levels
Nonbreathing clothes including vapor barrier clothing or PPE such as chemical resistant suits	52°
Double-layer woven clothes including coveralls, jackets and sweatshirts	77°
All other clothing	89°

Keeping workers hydrated in a hot outdoor environment requires that more water be provided than at other times of the year. GeoEngineers is prepared to supply at least one quart of drinking water per employee per hour. When employee exposure is at or above an applicable temperature listed in Table 1, Project Managers shall ensure that:

- A sufficient quantity of drinking water is readily accessible to employees at all times; and
- All employees have the opportunity to drink at least one quart of drinking water per hour.

11.3. Emergency Response

Indicate what Site-specific procedures you will implement.

- Personnel on-site should use the "buddy system" (pairs).
- Visual contact should be maintained between "pairs" on-site, with the team remaining in proximity to assist each other in case of emergencies.
- If any member of the field crew experiences any adverse exposure symptoms while on-site, the entire field crew should immediately halt work and act according to the instructions provided by the Site Safety and Health Supervisor.
- Wind indicators visible to all on-site personnel should be provided by the Site Safety and Health Supervisor to indicate possible routes for upwind escape. Alternatively, the Site Safety and Health Supervisor may ask on-site personnel to observe the wind direction periodically during Site activities.

- The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated should result in the evacuation of the field team, contact of the PM, and reevaluation of the hazard and the level of protection required.
- If an accident occurs, the Site Safety and Health Supervisor and the injured person are to complete, within 24 hours, an Accident Report for submittal to the PM, the Health and Safety Program Manager and Human Resources. The PM should ensure that follow-up action is taken to correct the situation that caused the accident or exposure.

11.4. Personnel Medical Surveillance

GeoEngineers employees are not in a medical surveillance program because they do not fall into the category of "Employees Covered" in OSHA 1910.120(f)(2), which states a medical surveillance program is required for the following employees:

1. All employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year;
2. All employees who wear a respirator for 30 days or more a year or as required by state and federal regulations;
3. All employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation; and Members of HAZMAT teams.

11.5. Sampling, Managing and Handling Drums and Containers

Drums and containers used during the cleanup shall meet the appropriate Department of Transportation (DOT), OSHA and U.S. Environmental Protection Agency (EPA) regulations for the waste that they contain. Site operations shall be organized to minimize the amount of drum or container movement. When practicable, drums and containers shall be inspected and their integrity shall be ensured before they are moved. Unlabeled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled. Before drums or containers are moved, all employees involved in the transfer operation shall be warned of the potential hazards associated with the contents.

Drums or containers and suitable quantities of proper absorbent shall be kept available and used where spills, leaks or rupture may occur. Where major spills may occur, a spill containment program shall be implemented to contain and isolate the entire volume of the hazardous substance being transferred. Fire extinguishing equipment shall be on hand and ready for use to control incipient fires.

11.5.1. Spill Containment Plans (Drum and Container Handling)

Drums will be fitted with secure lids to limit the potential for spills. A spill containment plan will be prepared if required by the client.

11.6. Entry Procedures for Tanks or Vaults (Confined Spaces)

GeoEngineers employees shall not enter confined spaces to perform work unless they have been properly trained and with hands-on experience in the use of retrieval equipment. If a project requires confined space entry, please include a copy of the confined space permit and include the training documentation in this HASP.

Trenches greater than 4 feet in depth with the potential for buildup of a hazardous atmosphere are considered confined spaces.

11.7. Sanitation

Washrooms are assumed to be present in on-site buildings. If necessary, portable toilets will be provided during work activities.

11.8. Lighting

Field work will be generally conducted during daylight hours; artificial lighting is not anticipated to be necessary.

11.9. Excavation, Trenching and Shoring

All employees working on project sites where there is an excavation greater than 4 feet in depth shall be trained in excavation safety and shall utilize safe procedures. OSHA designates a 5-foot depth for instituting excavation safety procedures; however GeoEngineers will use the more conservative depth of 4 feet as specified by states such as Washington, Oregon and California. This program is for the protection of employees while working in excavations; however, employees should not enter excavations if there is an alternative.

GeoEngineers employees often do not have stop work authority on projects controlled by other contractors. However, any GeoEngineers employee, regardless of job title, working in the field will be responsible for contacting the Project Manager if they observe practices on the job Site that are serious safety violations that are not under their control. They will document the unsafe practices and will contact the Site safety coordinator as identified by the client. If no one is on-site, the Project Manager, once notified, will contact the client. This action establishes GeoEngineers' commitment to Site health and safety on all job Sites as our duty of care to the public, contractors and clients.

GeoEngineers is responsible for its subcontractors and will also be providing inspections and corrections of any work that subcontractors perform around excavations.

12.0 DOCUMENTATION TO BE COMPLETED FOR HAZWOPER PROJECTS

The following forms shall be completed:

- FORM C-1 HEALTH AND SAFETY BRIEFING
- FORM C-2 SITE SAFETY PLAN – GEOENGINEERS' EMPLOYEE ACKNOWLEDGMENT
- FORM C-3 SUBCONTRACTOR AND SITE VISITOR SITE SAFETY FORM

In addition, the following forms are required for Hazardous Waste Operations and Emergency Response (HAZWOPER) projects:

- Field Log
- Health and Safety Plan acknowledgment by GeoEngineers employees (Form C-2)
- Contractor's Health and Safety Plan Disclaimer (Form C-3)
- Conditional forms available at GeoEngineers office: Accident Report

The Field Log is to contain the following information:

- Updates on hazard assessments, field decisions, conversations with subcontractors, client or other parties, etc.;
- Air monitoring/calibration results, including: personnel, locations monitored, activity at the time of monitoring, etc.;
- Actions taken;
- Action level for upgrading PPE and rationale; and
- Meteorological conditions (temperature, wind direction, wind speed, humidity, rain, snow, etc.).

13.0 APPROVALS

1. Plan Prepared	____________________ Signature	June 14, 2012 Date
2. Plan Approval	____________________ PM Signature	June 14, 2012 Date
3. Health & Safety Officer	Wayne Adams Health & Safety Program Manager	June 14, 2012 Date

FORM C-1
HEALTH AND SAFETY PRE-ENTRY BRIEFING
PORT OF SEATTLE NORTH TERMINAL 115
FILE NO. 0303-112-00

Inform employees, contractors and subcontractors or their representatives about:

- The nature, level and degree of exposure to hazardous substances they're likely to encounter;
- All Site-related emergency response procedures; and
- Any identified potential fire, explosion, health, safety or other hazards.

Conduct briefings for employees, contractors and subcontractors, or their representatives as follows:

- A pre-entry briefing before any Site activity is started; and
- Additional briefings, as needed, to make sure that the Site-specific HASP is followed.

Make sure all employees working on the Site are informed of any risks identified and trained on how to protect themselves and other workers against the Site hazards and risks

Update all information to reflect current sight activities and hazards.

All personnel participating in this project must receive initial health and safety orientation. Thereafter, brief tailgate safety meetings will be held as deemed necessary by the Site Safety and Health Supervisor.

The orientation and the tailgate safety meetings shall include a discussion of emergency response, Site communications and Site hazards.

Company Employee

Date	Topics	Attendee	Name	Initials

FORM C-2
SITE SAFETY PLAN – GEOENGINEERS' EMPLOYEE ACKNOWLEDGMENT
PORT OF SEATTLE NORTH TERMINAL 115
FILE NO. 0303-112-00

(All GeoEngineers' Site workers shall complete this form, which should remain attached to the Safety Plan and filed with other project documentation).

I hereby verify that a copy of the current Safety Plan has been provided by GeoEngineers, Inc., for my review and personal use. I have read the document completely and acknowledge an understanding of the safety procedures and protocol for my responsibilities on site. I agree to comply with all required, specified safety regulations and procedures.

Print Name	Signature	Date

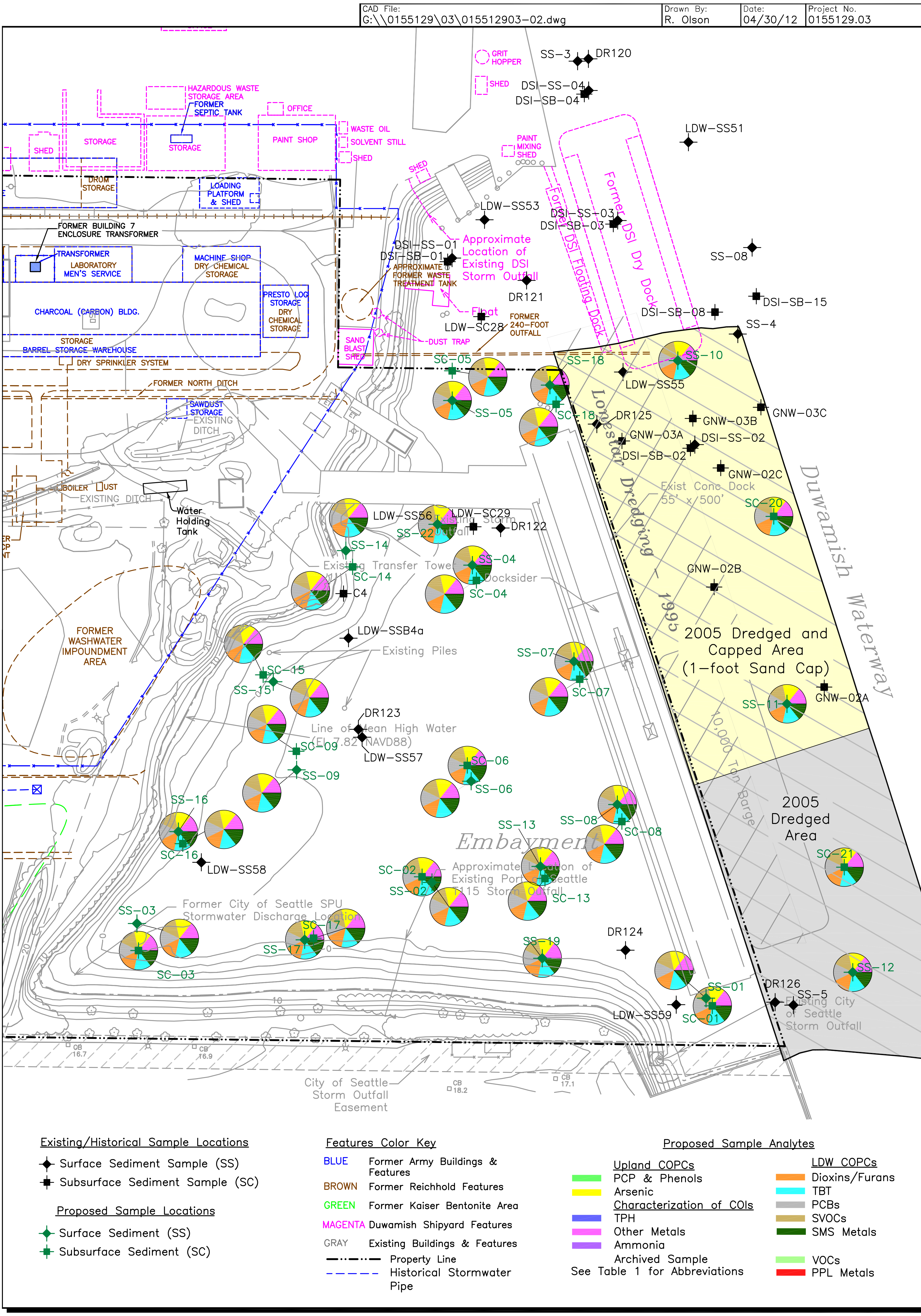
FORM C-3
SUBCONTRACTOR AND SITE VISITOR SITE SAFETY FORM
PORT OF SEATTLE NORTH TERMINAL 115
FILE NO. 0303-112-00

I verify that a copy of the current Site Safety Plan has been provided by GeoEngineers, Inc. to inform me of the hazardous substances on site and to provide safety procedures and protocols that will be used by GeoEngineers' staff at the Site. By signing below, I agree that the safety of my employees is the responsibility of the undersigned company.

Print Name	Signature	Firm	Date

Appendix F

Sediment Sampling and Analysis Plan
(Glacier Northwest, Inc., December 2011)



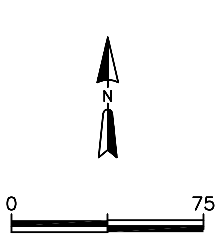


Figure 1
Sediment Sample Locations
Glacier Northwest, Inc. - Reichhold, Inc. Site
5900 West Marginal Way SW
Seattle, Washington

ERM 04/12

Table 1
Remedial Investigation Sediments Sampling Matrix
Glacier Northwest, Inc. - Reichhold, Inc. Site
5900 West Marginal Way SW
Seattle, Washington

Location ID	Sample Location Coordinates		Sample Frequency				Upland COPCs	Characterization of COIs				Sediment COPCs								Conventional Parameters		
Analyte							As	Cr	Cu	Ag	Zn	Cd	Pb	Hg	TBT (pore water)	TBT (bulk)	Dioxins/ Furans	PCB Aroclors	SVOCs	TOC	Grain Size	Field Screening
USEPA Method	Latitude	Longitude	Minimum Number of Samples	Maximum Number of Samples	Sample Interval	Archived Samples	USEPA 6010B/6020							USEPA 7471A	Krone/ 8270-SIM	Krone/ 8270-SIM	AXYS Method	USEPA 8082B	USEPA 8270D/ 8270-SIM	USEPA 9060	PSEP or equivalent	Various
SED-SS-01	47.5484	122.3404	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-01	47.5484	122.3404			0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
			3	5	4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SS-02	47.5486	122.3413	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-02	47.5486	122.3414			0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
			3	5	4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SS-03	47.5485	122.3423	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-03	47.5485	122.3423			0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
			3	5	4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SS-04	47.5493	122.3412	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-04	47.5493	122.3412			0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
			3	5	4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SS-05	47.5497	122.3413	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-05	47.5497	122.3413			0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
			3	5	4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SS-06	47.5488	122.3412	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-06	47.5489	122.3412			0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
			3	5	4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SS-07	47.5491	122.3409	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-07	47.5491	122.3409			0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
			3	5	4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X

Table 1
Remedial Investigation Sediments Sampling Matrix
Glacier Northwest, Inc. - Reichhold, Inc. Site
5900 West Marginal Way SW
Seattle, Washington

Location ID			Sample Frequency				Upland COPCs	Characterization of COIs				Sediment COPCs								Conventional Parameters		
Analyte	Sample Location Coordinates						As	Cr	Cu	Ag	Zn	Cd	Pb	Hg	TBT (pore water)	TBT (bulk)	Dioxins/ Furans	PCB Aroclors	SVOCs	TOC	Grain Size	Field Screening
USEPA Method	Latitude	Longitude	Minimum Number of Samples	Maximum Number of Samples	Sample Interval	Archived Samples	USEPA 6010B/6020							USEPA 7471A	Krone/ 8270-SIM	Krone/ 8270-SIM	AXYS Method	USEPA 8082B	USEPA 8270D/ 8270-SIM	USEPA 9060	PSEP or equivalent	Various
SED-SS-08	47.5488	122.3407	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-08	47.5488	122.3407	3	5	0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SS-09	47.5489	122.3418	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-09	47.5489	122.3418	3	5	0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SS-10	47.5498	122.3406	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SS-11	47.5490	122.3402	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SS-12	47.5484	122.3399	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SS-13	47.5487	122.3410	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-13	47.5486	122.3410	3	5	0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SS-14	47.5493	122.3416	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-14	47.5493	122.3416	3	5	0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SS-15	47.5491	122.3419	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-15	47.5491	122.3419	3	5	0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SS-16	47.5487	122.3422	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-16	47.5487	122.3421	3	5	0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X

Table 1
Remedial Investigation Sediments Sampling Matrix
Glacier Northwest, Inc. - Reichhold, Inc. Site
5900 West Marginal Way SW
Seattle, Washington

Location ID	Sample Location Coordinates		Sample Frequency				Upland COPCs	Characterization of COIs				Sediment COPCs								Conventional Parameters		
Analyte							As	Cr	Cu	Ag	Zn	Cd	Pb	Hg	TBT (pore water)	TBT (bulk)	Dioxins/ Furans	PCB Aroclors	SVOCs	TOC	Grain Size	Field Screening
USEPA Method	Latitude	Longitude	Minimum Number of Samples	Maximum Number of Samples	Sample Interval	Archived Samples	USEPA 6010B/6020							USEPA 7471A	Krone/ 8270-SIM	Krone/ 8270-SIM	AXYS Method	USEPA 8082B	USEPA 8270D/ 8270-SIM	USEPA 9060	PSEP or equivalent	Various
SED-SS-17	47.5485	122.3417	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-17	47.5485	122.3417	3	5	0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SS-18	47.5497	122.3410	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-18	47.5497	122.3409	3	5	0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SS-19	47.5485	122.3410	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
SED-SC-20	47.5494	122.3402	3	5	0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SC-21	47.5487	122.3400	3	5	0-1 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					1-2 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					2-4 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					4-6 ft	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					6-8 ft		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
					8 ft to refusal (2 ft increments)	Archive	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
SED-SS-22	47.5494	122.3413	1	1	0-10 cm		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
			71	**105**			**122**	**122**	**122**	**122**	**122**	**122**	**122**	**122**	**20**	**102**	**122**	**122**	**122**	**122**	**122**	**122**

Notes:
Samples to be analyzed for Sediment Management Standards analytes listed on Table 1 of WAC 173-204-320.
Archived samples will be frozen.
COI = Constituent of Interest
COPC = Constituent of Potential Concern
USEPA = United States Environmental Protection Agency
PSEP = Puget Sound Estuary Protocols
TOC = Total Organic Carbon
SVOC = Semivolatile Organic Compounds
SVOCs include phenols, phthalates, and polycyclic aromatic hydrocarbons
VOC = Volatile Organic Compounds

Notes (continued):
PCB = Polychlorinated biphenyls
# - Cd, Pb and Hg metals also grouped in Priority Pollutant Metals (adjacent site COIs) constituent list.
AXYS Method = USEPA Method 1613B (i.e., AXYS MLA-017)
SIM = Selective Ion Method for polycyclic aromatic hydrocarbons

Field Screening = Organic vapors will be quantified using a photoionization detector. Descriptions of soil sample texture, composition, color, consistency, moisture content, recovery, odor and presence of staining will be documented using the Unified Soil Classification system.

Analytes Key
As Arsenic
Cd Cadmium
Cr Chromium
Cu Copper
Pb Lead
Hg Mercury
Ag Silver
TBT Tributyltin
Zn Zinc

APPENDIX G
Public Participation Plan
Prepared by Ecology for the Site

DEPARTMENT OF
ECOLOGY
State of Washington

PUBLIC PARTICIPATION PLAN

PORT OF SEATTLE N TERMINAL 115
SEATTLE, WASHINGTON

Prepared by
Washington State Department of Ecology
3190 160th Avenue SE
Bellevue, WA 98008-5452

JANUARY, 2011

Introduction

The Washington State Department of Ecology (Ecology) developed this public participation plan according to the Model Toxics Control Act (MTCA). This plan is designed to promote meaningful community involvement during the investigation and cleanup of the Port of Seattle N Terminal 115 site. The site is located in Seattle, Washington next to the Lower Duwamish Waterway (LDW). This plan describes the tools Ecology will use to inform the public about site cleanup activities, and the ways the community can become involved in this process.

Ecology and the potentially liable person (PLP), Port of Seattle, negotiated a legal agreement called an Agreed Order that formally describes their working relationship. Under the Agreed Order the PLP will conduct a Remedial Investigation (RI) and Feasibility Study (FS) and prepare a Draft Cleanup Action Plan (CAP) at the site. The Remedial Investigation/Feasibility Study (RI/FS) is required under WAC 173-340-350 and is part of the cleanup process for this site. The RI will determine the nature and extent of contamination in the upland area soil, groundwater, stormwater, stormwater solids, and seeps. The Feasibility Study will use the results of the RI to evaluate and select cleanup action alternatives for the site.

Cleanup actions may be identified during this RI or FS process that will eliminate or minimize current releases of contamination to the Lower Duwamish Waterway (LDW) or actions that are necessary to prevent an imminent threat to human health or the environment. Ecology will consider implementing such cleanup actions as interim actions under the existing Agreed Order.

Project Description

Location

This site is located at 6000 W. Marginal Way SW in Seattle, Washington on the west bank of the Lower Duwamish Waterway (see figure on page 4). The site is located in the northwest corner of a larger King County tax parcel that makes up Terminal 115. The

Site Background

The site is owned by the Port of Seattle. The Port purchased the property in 1969 and currently leases this property to two tenants: Gene Summy Lumber Co. which distributes building materials, and Commercial Fencing, a fence supplier. Past operations at this site include tin reclamation facilities, such as Metals Recycling, Inc., and M & T Chemicals.

Potential Contaminants of Concern

Contamination at this site is due to past industrial activities. Contamination at this site has been noted in soil, groundwater, and stormwater solids.

The contaminants of concern in the soil are:

- Metals including copper, lead, arsenic, mercury, zinc
- carcinogenic Poly-Aromatic Hydrocarbons (cPAHs)

The contaminants of concern in the groundwater are:

- Metals including arsenic, cadmium, chromium, copper, lead, mercury, and zinc
- Semi-Volatile Compounds (SVOCs)
- carcinogenic Poly-Aromatic Hydrocarbons (cPAHs)
- lube oil range hydrocarbons

The contaminants of concern in the stormwater solids are:

- Metals, including zinc

Previous Cleanup Work

Previous investigations include a Site Hazard Assessment (SHA) conducted by the Seattle –King County Department of Public Health in 1997 which included the collection of three soil samples from the unpaved railroad spur area and resulted in detecting several metals including barium, cadmium, chromium, lead, zinc and tin.

In 2000, EPA and Ecology entered into an Administrative Order on Consent with King County, the Port of Seattle, the City of Seattle, and The Boeing Company. This legal agreement requires these four parties perform a Remedial Investigation (RI) and Feasibility Study (FS) of sediment contamination in the waterway. Information about the RI/FS for the LDW site is located at http://yosemite.epa.gov/r10/cleanup.nsf/sites/lduwamish.

EPA is leading the RI/FS work, and Ecology is leading source control efforts for the Lower Duwamish Waterway site. The source control efforts will prevent recontamination of the waterway after cleanup. Source control is the process of finding and then stopping or reducing releases of pollution to the river from various sources such as direct discharges via piped outfalls, bank erosion from adjacent properties, surface runoff from adjacent properties, groundwater discharge, air deposition, and spills. It includes identifying and managing sources of contamination to waterway sediments in coordination with sediment cleanups.

Ecology is coordinating these source control efforts with the City of Seattle, King County, the Port of Seattle, the City of Tukwila, and EPA. Ecology partners with these other agencies through the Source Control Work Group. Their work includes a business inspection program; monitoring sediments from storm drain systems; permitting to prevent direct discharges to the waterway; contaminated site cleanups; and testing various household products/materials to determine if they contain chemicals found in waterway sediments.

As part of these source control efforts, Ecology is developing Source Control Action Plans (SCAPs) for the 24 subbasins (or source control areas) that drain to the LDW site. The SCAPS identify potential contamination sources and the actions needed to keep sediments from being contaminated again after cleanup occurs. In addition, the SCAPs describe source control actions that are planned or currently underway, and sampling and monitoring activities that will be conducted to identify additional sources.

community involvement coordinators may participate in community meetings and events as needed. Ecology will coordinate with the DRCC throughout the public involvement process. This may include such activities as coordination for public meetings and sharing drafts of documents with DRCC for review, as appropriate.

Ecology's goal is to be transparent to the community and all other stakeholders. This will be done by posting electronic documents on Ecology's website for stakeholder review at key points in the Port of Seattle N Terminal 115site cleanup process. The stakeholders will be able to see the planned schedule for the next phase of work at the Port of Seattle N Terminal 115 site by reviewing the Agreed Order for the site.

Community Profile

For decades much of the land along to the LDW has been industrialized. Current commercial and industrial operations include cargo handling and storage, marine construction, boat manufacturing, marina operations, concrete manufacturing, paper and metals fabrication, food processing, and airplane parts manufacturing.

Although the LDW is viewed primarily as an industrial corridor, two residential neighborhoods border the banks of the river: South Park and Georgetown. The South Park neighborhood is on the western shore of the LDW, and the Georgetown neighborhood is on the eastern side of the Duwamish Waterway. The residents of the community are well known for their commitment to neighborhood issues particularly related to the ongoing site cleanups along the LDW. A description of these communities is provided below.

South Park Community Description

The South Park neighborhood is located in South Seattle, on the west bank of the LDW. Native Americans of the Duwamish Tribe were the first residents of South Park who lived on the shores of the Duwamish River for thousands of years. This area was once a small farming town composed of Italian and Japanese farmers who supplied fresh produce to Seattle's Pike Place Market. South Park became part of the City of Seattle in wholesale trade, transportation and utilities; construction/resources; manufacturing; and services.

Georgetown Community Description

The Georgetown neighborhood is located in South Seattle, on the east side of the LDW across the river from South Park. Georgetown is Seattle's oldest neighborhood, settled by Luther Collins in 1851. It was incorporated as the City of Georgetown from 1904-1910, and later annexed by the City of Seattle.

According to records from 2005, just over 1,100 people live in Georgetown. The largest local employers in Georgetown are in the arts, entertainment, and recreation industries. The Georgetown neighborhood is home to large employers such as The Boeing Company and King County International Airport.

The community is host to local events such as art walks, an annual Arts and Garden Tour. The neighborhood is home to historic buildings such as the Old Georgetown City Hall, and the Georgetown Steam Plant. The South Seattle Community College has recently revitalized its Georgetown Campus and is home to the Puget Sound Industrial Excellence Center Apprenticeship and Education Center. The campus offers more than 25 apprenticeship programs including masonry, meat cutters, electricians, iron workers, and cosmetology. The neighborhood is also home to The Georgetown Community Council which meets once a month and is very active in the community.

Key Community Concerns and Issues

Ecology and EPA conducted interviews with community members, environmental organizations, and community organizations in October 2002 for the LDW site Community Involvement Plan. The Port of Seattle N Terminal 115 site is located within the larger LDW site. Ecology conducted an abbreviated version of community interviews in 2006 and determined that the concerns raised in 2002 were still pertinent. In 2008 stakeholder groups provided comments to EPA and Ecology on the LDW including oil, antifreeze and fertilizers; unreported spills and illegal dumping; and pumping of waste into the river or groundwater. There is concern that permits for discharges to the river are not being enforced or will be revised to be less strict. There is concern that sources of PCBs are not being addressed and that calculated cleanup levels for many contaminants will not be strict enough. There is also concern that the current efforts to control ongoing sources of pollution will not be enough to actually control the sources.

- **Economics:** Some people interviewed are concerned about contamination lowering property values. Others are concerned that businesses will leave the area due to the designation of the LDW as a Superfund site.

- **Cleanup:** Some people are concerned that South Park and the businesses on the water will be affected by cleanup activities, such as increased truck or barge traffic and potential accidents. There are concerns about the costs of damages to natural resources and the possibility that parties responsible for contamination will do some early cleanup activities but nothing more.

- **Information:** Several people expressed concern about a lack of warning signs for fishermen and recreational users and suggested that such signs should be installed. People are concerned about whether adequate information reaches the Spanish-speaking and other non-English-speaking communities and whether the average person and immigrants understand the risks.

- **Image:** While some people described the LDW neighborhood as an industrial area, others are concerned that it is perceived as a dumping ground.

- **Tribal Rights:** Some community members are concerned that the tribal rights to harvest fish and shellfish in the LDW are not being honored at a level protective of these treaty rights.

During a comment period, the public can submit comments in writing, orally, and via e-mail. After formal comment periods, Ecology reviews all comments received and may respond in a document called a Responsiveness Summary.

Ecology will consider the need for changes or revisions based on input from the public. If significant changes are made, then a second comment period may be held. If no significant changes are made, then the draft document(s) will be accepted and finalized.

Future public comment periods will be held for other documents and legal agreements that are developed for the site.

Public Meetings and Hearings

Public meetings may be held at key points during the investigation and cleanup process. Public comment is accepted during public meetings. Ecology also may offer public meetings for actions expected to be of particular interest to the community. These meetings will be held at locations convenient to the community.

Information Repositories

Information repositories are places where the public may read and review site information, including documents that are the subject of public comment.

Ecology has established two repositories for the Port of Seattle Terminal N 115.

- Washington State Department of Ecology, 3190 160th Avenue SE, Bellevue, WA 98008, (425) 649-7190. Please call for an appointment.
- Seattle Public Library, South Park Branch, 8604 Eight Ave S. at Cloverdale St. Seattle, WA

Site information also will be posted on Ecology's web site at: http://www.ecy.wa.gov/programs/tcp/sites/PortOfSeattleN_Term115/Terminal115_hp.html to announce public comment periods, public meetings, hearings, or other information for the site.

Public Participation Plan Update

This public participation plan may be updated as the project proceeds. If a substantial update is necessary, the revised plan will be submitted to the public for comment.

Points of Contact

If you have questions or need more information about this plan or the Port of Seattle N Terminal 115 site, please contact:

Donna Ortiz de Anaya, Site Manager
Washington State Department of Ecology
3190 160th Avenue SE
Bellevue, WA 98008
Tel: (425) 649-7231
Email: dort461@ecy.wa.gov

Facility: Any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly-owned treatment works), well, pit, pond, lagoon, impoundment, ditch, landfill, storage container, motor vehicle, rolling stock, vessel, or aircraft; or any site or area where a hazardous substance, other than a consumer product in consumer use, has been deposited, stored, disposed or, placed, or otherwise come to be located.

Feasibility Study (FS): A study to develop and evaluate alternative cleanup actions for a site. A comment period on the draft report is required. Ecology selects the preferred alternative after reviewing the FS and receiving public comment.

Groundwater: Water found beneath the earth's surface that fills pores between materials such as sand, soil, or gravel. In aquifers, groundwater occurs in sufficient quantities that it can be used for drinking water, irrigation, and other purposes.

Hazardous Substance: Certain categories of substances defined by law and regulation that pose a threat to human health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.

Hazardous Waste Site: Any facility where there has been a confirmation of a release or threatened release of a hazardous substance that requires remedial action.

Independent Cleanup Action: Any remedial action conducted without Ecology oversight or approval, and not under an order or decree.

Information Repository: A file containing current information, technical reports, and reference documents available for public review. The information repository is usually located in a public building that is convenient for local residents such as a public school, city hall, or library.

Interim Action: Any remedial action that partially addresses the cleanup of a site.

Model Toxics Control Act (MTCA): Washington State's law that governs the investigation, evaluation and cleanup of hazardous waste sites. Refers to RCW 70.105D. It was approved by voters at the November 1988 general election and known is as Initiative 97. The implementing regulation is WAC 173-340.

Monitoring Wells: Special wells drilled at specific locations on or off hazardous waste sites where groundwater can be sampled at selected depths and studied to determine the direction of groundwater flow and the types and amounts of contaminants present.

Natural Background: The concentration of hazardous substance consistently present in the environment which has not been influenced by localized human activities.

Remedial Investigation/Feasibility Study (RI/FS). In both cases, a comment period on the draft report is required.

Remedial Investigation/Feasibility Study: Two distinct but related studies. They are usually performed at the same time, and together referred to as the "RI/FS." They are intended to:

-Gather the data necessary to determine the type and extent of contamination;
-Establish criteria for cleaning up the site;
-Identify and screen cleanup alternatives for remedial action; and
-Analyze in detail the technology and costs of the alternatives.

Responsiveness Summary: A summary of oral and/or written public comments received by Ecology during a comment period on key documents, and Ecology's responses to those comments. The Responsiveness Summary is mailed, at a minimum, to those who provided comments and its availability is published in the Site Register.

Site: Any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, landfill, storage container, motor vehicle, rolling stock, vessel, or aircraft; or any site or area where a hazardous substance, other than a consumer product in consumer use, has been deposited, stored, disposed of, or placed, or otherwise come to be located.

Site Hazard Assessment (SHA): An assessment to gather information about a site to confirm whether a release has occurred and to enable Ecology to evaluate the relative potential hazard posed by the release. If further action is needed, an RI/FS is undertaken.

Site Register: Publication issued every two weeks of major activities conducted statewide related to the study and cleanup of hazardous waste sites under the Model Toxics Control Act. To receive this publication, please call (360) 407-7200.

Superfund: The federal government's program to clean up the nation's uncontrolled hazardous waste sites.

Surface Water: Lakes, rivers, ponds, streams, inland waters, salt waters, and all other non-underground waters and courses within the state of Washington or under the jurisdiction of the state of Washington.

TCP: Toxics Cleanup Program at Ecology

Total Petroleum Hydrocarbons (TPH): A scientific measure of the sum of all petroleum hydrocarbons in a sample (without distinguishing one hydrocarbon from another). The "petroleum hydrocarbons" include compounds of carbon and hydrogen that are derived from naturally occurring petroleum sources or from manufactured petroleum products (such as refined oil, coal, and asphalt).