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A Report Prepared for:

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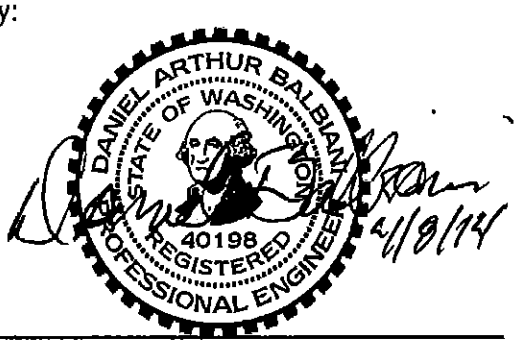
REMEDIAL INVESTIGATION/FEASIBILITY STUDY AND INTERIM CLEANUP ACTION REPORT BROADSTONE CAPITOL HILL 11TH & UNION DEVELOPMENT SITE SEATTLE, WASHINGTON

APRIL 8, 2014

By:



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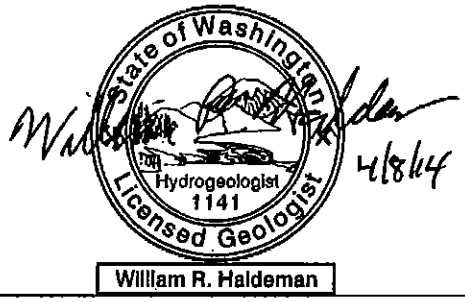

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1.0 INTRODUCTION

This remedial investigation/feasibility study (RI/FS) and interim cleanup action (ICA) report has been prepared on behalf of Broadstone Capital Hill Venture LLC (BCH) to summarize the environmental conditions at the 11th & Union Development (Property), document the evaluation of cleanup action alternatives, present the selected cleanup action, and document the ICA. The Property is currently addressed as 1406 and 1416 10th Avenue and 1401 and 1405 11th Avenue in Seattle, Washington (Figure 1). As part of the development of the Property, the address will be changed to 1414 10th Avenue, Seattle, Washington.

Environmental investigation results conducted at the Property identified petroleum-impacted soil and groundwater beneath the Property and limited volatile organic compounds (VOCs) in groundwater in the southern portion of the Property. These impacts originated from a former leaking underground storage tank (LUST), which was removed from the Property in1990, as well as from unknown sources potentially associated with historical automotive repair and manufacturing operations at the Property. On behalf of BCH, PES Environmental, Inc. (PES), prepared a Cleanup Action Plan (CAP; PES 2013a) that was submitted to the Washington Department of Ecology (Ecology) under the Voluntary Cleanup Program (VCP). The site was assigned VCP No. NW2703. The CAP was submitted to Ecology requesting an opinion regarding the adequacy of the proposed cleanup actions to be completed during redevelopment of the Property. In advance of issuing the opinion letter, Ecology's representatives stated that Ecology would require additional information prior to rendering an opinion on the proposed CAP, and that the impending opinion letter would detail the additional work required. A portion of the required information included production of an RI/FS report. BCH and PES explained that the redevelopment schedule would preclude the completion of the additional work prior to the start of construction. PES prepared an addendum to the CAP (PES, 2013b) indicating that the additional work requested by Ecology would be performed concurrent with redevelopment construction. Ecology issued its opinion in a letter dated June 13, 2013 (Ecology, 2013), which specified the additional characterization work required (delineation of petroleum hydrocarbons in soil and groundwater and completion of an RI/FS report) and indicated that "removal and disposal of source material is the most effective and preferred remedial method to address Property soil contamination." Based on the correspondence with Ecology and the construction schedule, BCH completed the RI/FS and selected a cleanup alternative. The cleanup alternative included excavation of impacted soil for the construction of the subsurface garage, over-excavation in selected areas to remove soil exceeding MTCA standards, amending the clean backfill with oxygen releasing pellets, and monitored natural attenuation of impacted groundwater. This report presents the RI/FS and work completed to date.

For the purpose of this report, the word "Site" refers to an area where contamination has been deposited, stored, or come to be located, consistent with the definition of "site" or "facility" in the Washington State Department of Ecology (Ecology) Model Toxics Control Act (MTCA) Cleanup Regulation (Chapter 173-340 of the Washington Administrative Code [WAC]). "Property" refers to the 11th & Union Development property in general, including any or all of the parcels discussed in Section 2.1.

1.1 Purpose

The RI's objectives were to characterize the nature and extent of contamination associated with the Site, to provide sufficient information to determine whether existing conditions at the Site indicate that cleanup actions may be necessary to protect human health and the environment, and to assess compliance with applicable regulatory requirements. Information collected during the RI was used in the FS to develop potential cleanup action alternatives, concluding with a recommended cleanup action. The purposes of the cleanup action sections of this document are to document the cleanup conducted during Property redevelopment and describe the cleanup action activities to be implemented after Property redevelopment. To that end, this report (1) summarizes the Site history and characterization, (2) presents a conceptual site model (CSM), (3) identifies exposure pathways and receptors, (4) identifies cleanup levels and regulatory requirements for the Site, (5) describes the areas exceeding cleanup levels and regulatory requirements, (6) develops and evaluates cleanup action alternatives (CAAs), (7) recommends a cleanup action, (8) details the ICA, and (9) outlines the cleanup activities remaining.

1.2 Report Organization

Section 1 – Introduction: Describes the background, purpose, and the organization of the report.

Section 2 – Site Identification and Description: Provides a summary of Site discovery and regulatory status, a description of the Property and vicinity, and a summary of the physical setting and climate.

Section 3 – Property Development and History: Provides a summary of the past, current, and planned future uses of the Property, the area zoning and infrastructure, and potential sources of contamination at the Property and in the vicinity.

Section 4 – Environmental Investigation and Interim Action Summary: Describes the results of investigations and interim remedial actions conducted at the Property.

Section 5 – Natural Conditions: Provides a summary of the surface water hydrology, regional and Property geology, and regional and Property hydrogeology.

Section 6 – Contaminant Occurrence and Movement: Describes the soil and groundwater chemistry results.

Section 7 – Conceptual Site Model: Provides a summary of the conceptual site model.

Section 8 – Defining Cleanup Levels and Areas Exceeding Cleanup Levels: Summarizes the media cleanup levels, points of compliance, constituents of concern, and areas of the Site exceeding cleanup levels.

Section 9 – Feasibility Study Scoping: Summarizes the applicable regulatory requirements and cleanup action objectives.

Section 10 – Identification and Screening of Remedial Technologies: Identifies potential cleanup technologies and screens the technologies to determine those most likely to be effective at the Site.

Section 11 – Development of Cleanup Action Alternatives: Assembles the retained technologies into a range of preliminary CAAs.

Section 12 – Evaluation of Cleanup Action Alternatives: Evaluates the CAAs against the criteria defined in WAC 173-340-360, compares the alternatives to each other, discusses the preferred CAA and rationale for the preference, and describes the implementation of the preferred CAA.

Section 13 – Interim Cleanup Action: Describes the cleanup action activities completed during Property redevelopment.

Section 14 – Future Cleanup Action Activities: Describes the cleanup action activities to be completed after Property redevelopment.

Section 15 – References: Lists the sources of information referenced in the document.

2.0 SITE IDENTIFICATION AND DESCRIPTION

2.1 Site Discovery and Regulatory Status

Environmental impacts to soil and groundwater were first noted during removal of a 6,000-gallon diesel underground storage tank (UST) in the southwestern portion of the Property in 1990. After cleanup actions in 1993, Ecology issued a No Further Action (NFA) determination for the associated UST cleanup in October 1993. Additional investigation was conducted at the Property in 2012 as part of pre-development due diligence activities, and petroleum and VOC impacts were identified in soil and groundwater. The Property was enrolled in the VCP in 2013, with VCP No. NW2703 assigned to the Site.

2.2 Property Location and Description

The Property is located at 1406 and 1416 10th Avenue and 1401 and 1405 11th Avenue in Seattle, Washington (Figure 1). The Property consists of seven parcels totaling 1.02 acres (approximately 44,000 square feet) encompassing the southern half of the block bounded by East Pike Street to the north, East Union Street to the south, 10th Avenue to the west, and 11th Avenue to the east (Figure 2). The legal description of the Property is provided in Appendix A. Prior to redevelopment, four commercial structures occupied the northwestern, southern, and southeastern portions of the Property. The remainder of the Property consisted of asphalt and gravel surface drives and parking areas that are depressed up to approximately 10 feet below the surrounding street grades. The elevations of the parking areas, which were accessed via a paved drive from 10th Avenue, were within 1 to 2 feet of the basement floor elevations in the surrounding buildings. Currently, the Property is undergoing redevelopment, and the four on-site structures and parking lots were removed in 2013.

2.3 Neighborhood Setting

The Property is located in the Capitol Hill neighborhood east of Seattle's central business district. The neighborhood is a mixture of retail businesses, commercial businesses, service industry, and residences. The area within a few blocks of the Property is populated with mixed businesses, restaurants, apartments, and Seattle University.

2.4 Physiographic Setting and Topography

The Property is located within the Puget Lowland physiographic province, a broad, low-lying region situated between the Cascade Range to the east and the Olympic Mountains to the west. Alluvial valleys and plains, and glacially formed or modified hills and ridges dominate the lowland. The Property lies on the glacial deposits forming Capitol Hill, with the lowlands of Puget Sound to the west and Lake Washington to the east. The elevation of the top of Capitol Hill ranges from about 100 to 400 feet above mean sea level (amsl), with the Property at an elevation of approximately 290 feet amsl. The Property lies in a saddle, with the ground surface

relatively flat in the immediate vicinity of the Property and rising within a few blocks to the east and west of the Property.

2.5 Climate

Air masses originating over the Pacific Ocean strongly affect the climate of the Puget Sound Lowland, with generally overcast, cool, damp, and mild weather during the autumn, winter, and spring, and warm and dry weather during the summer. The annual precipitation ranges from about 30 to over 60 inches in the lowland. The average annual precipitation in the Seattle area is about 36 inches, with approximately three-quarters of it falling between October and March.

3.0 PROPERTY DEVELOPMENT AND HISTORY

3.1 Past Property Uses and Facilities

The following businesses have historically operated at the Property: an auto body shop, a paint shop, an auto repair facility, a machine shop, a blacksmith and forging shop, an automotive parts manufacturing facility, a bakery, and various warehouse and office-type businesses. Copies of the historical Phase I Environmental Site Assessments (ESAs; RZA, 1994; Kleinfelder, 1996; EA, 1999; and ATC, 2012a) that provide the historical Property owners and businesses were provided in the CAP.

Prior to redevelopment activities, the Property was improved with four commercial structures (Figure 2). The first three abutted each other, and the fourth was detached:

- One two-story 26,276-square-foot office building with a basement (1406 10th Avenue) occupied the southwest portion of the Property. The building was constructed in 1915 and was most recently vacant;
- A single-story 14,080-square-foot commercial building with a basement (1401 11th Avenue) occupied the southeast portion of the Property. The building was constructed in 1920 and most recently served as an office for a greeting card company;
- A single-story 19,450-square-foot commercial building with a basement (1405 11th Avenue) occupies the parcel immediately north of building at 1401 11th Avenue. The building was constructed in 1920 and most recently served as a warehouse for a greeting card company; and
- A detached single-story, 7,320-square-foot building with a basement (1416 and 1418 10th Avenue) occupies the northwest corner of the Property. This building was built in 1913 and was most recently vacant.

The Property also contained three parcels without buildings (Figure 2):

- A 4,864-square-foot unpaved lot located immediately north of the building located at 1405 11th Avenue and used for parking for that building;
- A 5,120-square-foot paved parking lot located at 1400 10th Avenue, immediately north of the building at 1406 10th Avenue; and
- A 3,840-square-foot paved parking lot located at 1400 10th Avenue, immediately south of the building at 1416 10th Avenue;

3.2 Current Property Use and Planned Redevelopment

The redevelopment of the Property includes the demolition of all of the existing on-site structures, with the exception of the brick façades of the 1406 10th Avenue, 1401 11th Avenue, and 1405 11th Avenue buildings along East Union Street and 11th Avenue. This demolition was completed in 2013. Construction of an 8-story building, including street level retail units,

approximately 248 residential units, and one floor of belowground parking, has been initiated. The top of the garage floor slab is at approximately elevation 283.75 feet (all elevations relative to the North American Vertical Datum of 1988 [NAVD 88]. Construction of the belowground parking level required excavation of the entire Property to an elevation of approximately 282.5 feet, which is approximately 6 to 9 feet below the prior basement floor surface elevations (288.07 to 290.59 feet) and approximately 14 feet below the adjacent East Union Street grade (approximately elevation 297 feet).

3.3 Zoning and Surrounding Infrastructure

The Property vicinity is zoned NC3P-65, a larger neighborhood commercial zone consisting of commercial, multi-story mixed use, and residential structures having a 65-foot height limit. The Property is surrounded by paved two-lane surface streets, with bus service along East Union Street. Seattle City Light provides electrical service to the area, Puget Sound Energy supplies natural gas, and Seattle Public Utilities provides water, sewer, stormwater drainage, and solid waste services. A review of Ecology's well log database and water rights tracking system, the Washington State Department of Health's public water system database, and the King County Groundwater Protection Program groundwater monitoring well database on August 1, 2013, found no records of groundwater or surface water beneficial use within a 1-mile radius of the Property.

3.4 Potential Sources of Contamination

Environmental Associates, Inc. (EA, 1999) and ATC (2012a) identified the following potential historical sources of contamination at the Property (see Figure 2), based on historical record and aerial photography review:

- **1406 10th Avenue:** Davis and Hoffman Inc., an automobile repair business identified between 1920 and 1980;
- **1408 10th Avenue:** Shaw and Merell Inc., an automobile repair business identified in 1951 in a former building located immediately north of the 1406 10th Avenue building;
- **1416 10th Avenue:** Mosey and Mosey Inc., an automobile repair business identified between 1920 and 1940 and specialty Automotive Warehouse Inc., an automobile repair business identified between 1951 and 1980;
- **1401 11th Avenue:** Joe Engler Automotive Repair, an automobile repair business, operated between 1930 and 1937; Thompson Bros Auto Rebuild (at 1020 East Union Street), an automobile repair business, operated between 1943 and 1953; and Jack Fuller's Auto Rebuild (at 1020 East Union Street), an automobile repair business, operated between 1954 and 1956; and
- **1405 11th Avenue:** Eleventh Avenue Garage, an automobile repair business identified in 1920.

The Ruth Ashbrook Bakery, historically located at 1416 10th Avenue was also listed in a number of databases with regard to a release associated with a former 6,000-gallon diesel UST (see Section 4.2.1 below). EA (1999) noted that the bakery operated between 1951 and 1985.

3.5 Potential Sources of Contamination from Neighboring Properties

EA (1999) and ATC (2012a) identified the following potential sources of contamination from neighboring properties (see Figures 1 and 2):

- **1001 East Union Street:** German Auto Repair (formerly Kessler Auto Repair), a current automobile repair business located south of the southwestern building on the Property;
- **1023/1035 East Union Street:** Former Texaco gasoline station located south of the Property across East Union Street that was operational by 1936 and was demolished between 1956 and 1960;
- **1118 East Madison Street:** Former Chevron gasoline station located southeast of the Property that was operational by 1936 and was demolished between 1969 and 1974;
- **1520 10th Avenue:** A1 Brake located one block north of the Property, with confirmed soil contamination and suspected groundwater contamination by metals and petroleum hydrocarbons; and
- **1525 11th Avenue:** Former REI store, an outdoor retailer located one block north of the Property, with confirmed soil contaminated by petroleum hydrocarbons.

4.0 ENVIRONMENTAL INVESTIGATION AND INTERIM ACTION SUMMARY

This section identifies the documents containing the results of environmental investigations that describe the soil and groundwater conditions at the Property. A brief summary of the investigations is also provided. Additional details regarding the previous investigations can be found in the source documents that have been previously submitted to Ecology.

4.1 Environmental Investigations

The Property has been the subject of a number of environmental and geotechnical investigations beginning in 1990:

- *Remediation of Subject Property: 1416 – 10th East, Seattle, Washington, Commonly Known as Ruth Ashbrook Bakery Property*, dated October 10, 1993 and prepared by Nurseryman Products, Inc. (NPI, 1993a);
- *Final Clean-Up Report for the Ruth Ashbrook Bakery Property, 1416 – 10th Avenue East (Between Union and Pike), Seattle, Washington*, dated October 13, 1993 and prepared by Nurseryman Products, Inc. (NPI, 1993b);
- *Phase I Environmental Site Assessment, Salvation Army Commercial Property, 1401 11th Avenue East, Seattle, Washington,* dated January 1994 and prepared by RZA AGRA, Inc. (RZA, 1994).
- *Phase I Environmental Site Assessment, 1415 11th Avenue, Seattle, Washington*, dated December 13, 1996 and prepared by Kleinfelder, Inc. (Kleinfelder, 1996).
- *Phase I Environmental Audit, Two Commercial Buildings, 1416 through 1418 – 10th Avenue, 1401 – 11th Avenue/1414 – 10th Avenue, Seattle, Washington,* dated August 16, 1999 and prepared by Environmental Associates, Inc. (EA, 1999).
- *Phase I Environmental Site Assessment of 11th & Union Proposed Development,* dated February 7, 2012 and prepared by ATC Associates Inc. (ATC, 2012a);
- *Geotechnical Report – Final Proposed Development, 11th Avenue & E. Union Street, Seattle, Washington,* dated July 9, 2012 and prepared by PanGEO Incorporated (PanGEO, 2012); and
- *Amended Limited Phase II Subsurface Investigation Report, 11th & Union Proposed Development,* dated October 1, 2012 and prepared by ATC Associates Inc. (ATC, 2012b).

The Phase I ESA conducted at the Property by ATC in February 2012 (ATC, 2012a) identified several recognized environmental conditions (RECs) that were determined to require additional investigation. A follow-up limited Phase II subsurface investigation (ATC, 2012b) was performed in February and March 2012 that included the following activities:

- Drilling and sampling 31 borings (26 direct-push borings, 2 hand auger borings, and 3 hollow-stem auger geotechnical borings) ranging in depths from 1.5 to 30.3 feet below ground surface (bgs);

- Installation of 5 groundwater monitoring wells (MW-1 though MW-5) ranging in depths from 12 to 26 feet bgs. The wells consisted of nominal 2-inch diameter polyvinyl chloride (PVC) wells, with well screens set at depths ranging from 2 to 12 feet bgs and 16 to 26 feet bgs (top of screen elevations ranging from 282.1 to 287.1 feet and bottom screen elevations ranging from 272.1 to 277.1 feet). The well screen slots were 0.010 inches wide, the annular space around the well screens was filled with 10 x 20 silica sand, and the annular space above the sand pack was filled with bentonite chips and a traffic-rated well monument set flush with grade;
- Collection of 103 soil samples, which were analyzed for one or more of the following analytes: petroleum hydrocarbons using Ecology Methods NWTPH-HCID and NWTPH-Dx; and VOCs using EPA Method 8021 or 8260. These laboratory analytes were selected based on the compounds detected during the 1993 overexcavation of the UST basin. Soil samples were collected using methods consistent with EPA Method 5035A if they were to be analyzed for VOCs; and
- Collection and analysis of 24 groundwater samples from temporary wells within soil borings and 5 groundwater samples from monitoring wells. The groundwater grab samples were collected from "first free water encountered" within the soil borings, which ranged in depths from 8 to 20 feet bgs; the samples were collected using a peristaltic pump and high-density polyethylene (HDPE) tubing set within the temporary PVC well screen. The monitoring well groundwater samples were using a peristaltic pump and HDPE tubing whose intake was set in the well screen interval; the wells were purged at low flow rates, and the samples were collected after the field parameters (pH, specific conductance, oxidation-reduction potential [ORP], and turbidity) had stabilized. The groundwater samples were analyzed for one or more of the following analytes: petroleum hydrocarbons using Ecology Methods NWTPH-HCID and NWTPH-Dx; and VOCs using EPA Method 8260.

The locations of the soil borings and monitoring wells are shown on Figure 2. Detailed field procedures are in the limited Phase II report (ATC, 2012b) previously submitted to Ecology (PES, 2013a). The boring and well logs are provided in Appendix B.

4.2 Interim Actions

Two related interim actions were conducted at the Property in the 1990s: removal of an UST and subsequent over-excavation of the UST basin and on-site treatment of the soil.

4.2.1 Underground Storage Tank Removal

In October 1990, a 6,000-gallon diesel UST, located north-adjacent to the 1406 10th Avenue building (Figure 2) and approximately 100 cubic yards of surrounding petroleum-contaminated soil (PCS) were removed from the Property (NPI, 1993a). Confirmation soil sampling from the UST excavation bottom indicated that residual PCS was present beneath the excavation; however, no additional excavation was done at the time.

4.2.2 1993 Overexcavation and Soil Remediation

Follow-up environmental remedial activities, conducted in March and August 1993, included the overexcavation of the 1990 UST excavation area (Figure 2) and on-site bioremediation of overexcavated soil and groundwater (volumes unspecified). Excavated contaminated soil was laid on site in a layer of 8 to 10 inches thick and treated by bioremediation (NPI, 1993a). Additional information regarding the location and design of the bioremediation area were not provided in the report. Bioremediation stockpile samples reported initial total petroleum hydrocarbon levels (TPH) as high as 11,000 milligrams per kilogram (mg/kg) that were all bio-remediated down to levels below 10 mg/kg. Upon completion of the bioremediation, soil was returned to the excavation. Confirmation samples collected from the 1993 excavation indicated that residual diesel range PCS remained on the Property beneath the building south of the excavation and former UST area (1406 10th Avenue) at levels ranging between 330 mg/kg and 3,800 mg/kg (ATC, 2012a). These soils were inaccessible due to the presence of the building.

At the time of 1993 excavation, the groundwater was "determined to be contaminated by diesel fuel and low levels of tetrachloroethylene (PCE)" (NPI, 1993a). Contaminated groundwater collected in the excavation was treated by pumping through a carbon filter unit and then reportedly re-circulated through the excavation until several rounds of confirmation sampling indicated that contaminants were below the specified regulatory levels (NPI, 1993a). Prior to backfilling of the 1993 excavation, a concrete containment wall between the former UST impacted soil and the existing building (1406 10th Avenue) was installed as well as a water collection system to treat petroleum and VOCs detected in groundwater from the base of the UST excavation. Based on the 1993 remedial investigation results, a limited amount (approximately 75 cubic yards) of residual petroleum-impacted soil was determined to remain beneath the adjacent building. Ecology issued an NFA determination dated October 22, 1993 for the associated UST (Ecology, 1993).

5.0 NATURAL CONDITIONS

5.1 Geology

5.1.1 Regional Geology

The Puget Sound Region is underlain by a thick accumulation of Quaternary sediment of alluvial and glacial origin. The shallowest sediments consist primarily of inter-layered and/or sequential river, lake, fan, and terrace deposits of sand, silt, and clay deposited on top of Pleistocene glacial deposits. The uplands in the Puget Sound Lowland are thought to have been largely formed during the last glacial advance between 14,000 and 18,000 years ago (Jones, 1999; Vaccaro and others, 1998), with a complete glacial sequence (from youngest to oldest) consisting of recessional deposits (outwash and lake deposits), ice-contact deposits, ablation till, till, advance outwash, glacial marine deposits, and glacial lake deposits. Older interglacial and glacial deposits are found below the lake deposits. The thickness of the unconsolidated sediments above bedrock is estimated to be greater than 3,000 feet in the vicinity of the Property (Jones, 1998).

A complex interbedded sequence of unconsolidated sediments was encountered during geotechnical explorations for the light rail alignment on Capitol Hill (Shannon & Wilson, 2006), including recessional outwash, ablation till, till, advance outwash, and glacial and interglacial lake deposits. According to the most recent geologic map of the Seattle area (Troost and others, 2005), the Property vicinity is underlain by glacial recessional outwash deposits generally consisting of loose to dense, fine to coarse sand and gravel, with localized discontinuous silt, silty sand, and fine sand lenses. Other nearby deposits include till, meltout till, ice-contact deposits, and advance outwash.

5.1.2 Property Geology

Figures 3 and 4 provide geologic cross sections that are based on the lithologies described on the boring and well logs (Appendix B). Figure 2 shows the locations of the cross sections. The predominant lithology encountered in the borings was silty sand, with lesser amounts of clayey sand, clay, silt, and sand. Geotechnical borings BH-1 through BH-3 encountered (1) surficial fill consisting of silt with some sand and clay, ranging in thickness from 2.5 to 9 feet, (2) underlying 6 to 10-foot-thick ice contact deposits consisting of medium stiff sandy clayey silt and medium dense silty sand, and (3) glacial till consisting of dense to very dense silty fine to medium sand with gravel at the deepest depths drilled (PanGeo, 2012). Borings drilled by ATC encountered generally similar lithologies, including silty sand, clayey fine sand, sand, clay, and silt. Based on the cross sections, the soil is coarser (silty sand and sand) beneath the western part of the Property and somewhat finer (silty sand to clay) in the central and southeastern part of the Property.

5.2 Surface Water Hydrology

The Property lies in the Cedar Sammamish Watershed, a northwest-southeast trending watershed extending from the Cascade foothills to Puget Sound through King County. Major surface water bodies in the watershed include the Cedar and Sammamish Rivers, Lake Sammamish, Lake Washington, and Lake Union. The closest surface water bodies to the Property are Elliott Bay 1.2 miles to the southwest, Lake Union 1.3 miles to the northwest, and Lake Washington 1.8 miles to the east (Figure 1).

5.3 Hydrogeology

5.3.1 Regional Hydrogeology

The principal aquifers in the Puget Sound Region are in glacial outwash deposits and alluvial deposits, with the thickness of the unit highly variable (Vaccaro and others, 1998). In the Puget Sound Region, shallow groundwater flow direction often mimics the surface topography, flowing from areas of high elevation to areas of low elevation. Flow within an aquifer is typically horizontal, and flow across confining units is generally vertical, except near recharge and discharge areas, where increased downward and upward groundwater flow, respectively, occurs.

5.3.2 Property Hydrogeology

Groundwater was encountered in Property monitoring wells at depths ranging from 2.39 to 13.44 feet below the top of well casing and at elevations ranging from 283.84 to 285.78 feet, respectively. Based on depth to water levels collected on April 3, 2012, by ATC (ATC, 2012b), groundwater flows to the northwest (Figure 5). PES measured the depth to groundwater in the monitoring wells on August 6, 2012, and confirmed groundwater flow was to the northwest (Figure 6). Depth to water measurements and calculated groundwater elevations for both monitoring events are presented in Table 2. The groundwater gradient is extremely low (less than 0.006 feet/foot) and subsequent groundwater elevations on May 8 and July 31, 2013, have indicated flat to southeasterly or southerly groundwater flow. However, as noted in Table 2, the MW-1 groundwater elevations on those dates were anomalously high and may be erroneous; due to the questionable data, groundwater contour maps for those dates are not presented. Groundwater elevations may vary depending on seasonal fluctuations, local subsurface conditions, and other factors. Groundwater yield within some of the borings and monitoring wells (MW-4 and MW-5) was reportedly very low and appeared to be associated with small lenses of fine sand with silt.

6.0 CONTAMINANT OCCURRENCE AND MOVEMENT

This section presents a summary of the soil and groundwater chemistry data generated during investigations conducted at the Property.

6.1 Soil Conditions

The results of the soil samples analysis are summarized in Table 3, and results of selected compounds detected above cleanup levels are shown graphically on Figure 7. The laboratory reports are provided in the Phase II subsurface investigation report (ATC, 2012b). A summary of the findings of the soil investigations are provided below:

- Diesel-range hydrocarbons were detected in soil in three areas of the Property: (1) near the former UST located just north of the 1406 10th Avenue building (borings B-2, B-8, and B-17), (2) in the southeastern portion of the Property (beneath buildings 1406 10th Avenue, 1401 11th Avenue, and 1405 11th Avenue, including borings B-10, B-12 through B-14, B-18 through B-22, B-254, MW-4, and MW-5), and (3) in the northern gravel parking lot (boring HA-1). Near the former UST and beneath buildings 1406 10th Avenue, 1401 11th Avenue, and 1405 11th Avenue, petroleum hydrocarbons were detected in samples ranging in depths from 3 to 10 feet bgs, with the highest concentrations detected in the 3-foot sample in boring B-2 adjacent to the former UST. In HA-1, petroleum hydrocarbons were detected at 1.5 feet bgs at a very low concentration, not exceeding MTCA Method A cleanup levels (CULs); the TPH results in the remaining samples in that area were below the laboratory method reporting limit (MRL) to a depth of 15 feet bgs. In total for the Property, concentrations of diesel- and oil-range hydrocarbons exceeded the CUL of 2,000 mg/kg for unrestricted land use in 7 of the 70 soil samples analyzed.

- Oil-range hydrocarbons were detected in soil in only two Property borings (B-2 and B-18 beneath the 1406 10th building). Oil-range hydrocarbons were detected near the MRL in the B-2 sample collected at 3 feet bgs, and samples collected at 4 and 8 feet within boring B-18 contained oil-range hydrocarbons in exceedance of the MTCA Method A CUL of 2,000 mg/kg for unrestricted land use. In total for the Property, concentrations of oil-range hydrocarbons exceeded the CUL of 2,000 mg/kg for unrestricted land use in 2 of the 70 soil samples analyzed.

- Limited petroleum- related VOCs were detected in soil samples from one boring (B-2), including benzene, xylenes, ethylbenzene, and naphthalene. With the exception of benzene, these constituents were detected at concentrations below their respective MTCA Method A CULs. Benzene was detected in two soil samples (B-2 at 3 and 6 feet) at concentrations (0.273 and 0.122 mg/kg, respectively) that exceeded the MTCA Method A CUL of 0.03 mg/kg for unrestricted land use.

- Chlorinated VOCs (PCE, trichloroethylene [TCE], and vinyl chloride) were not detected in any of the 66 soil samples analyzed for those constituents.

In summary, the soil sampling results indicate that there was one known source and potentially one unknown source of soil contamination identified at the Property. The former UST appears to be the known source of the petroleum hydrocarbons and VOCs in soil found at the north end of the 1406 10th Avenue building. The source area of the southern Property contamination is not known, but based on historical tenant information and soil data, it appears the source may be associated with historical automotive operations within the three southern buildings. The low detection of petroleum hydrocarbons at boring HA-1 appears to be limited in extent both vertically and horizontally and was likely associated with the parking of automobiles in this area.

The areas with the highest TPH concentrations were generally located near the former UST and in the southern contamination area (beneath buildings 1406 10th Avenue, 1401 11th Avenue, and 1405 11th Avenue). The soil results generally indicate that soil impacts do not appear to extend beyond the Property boundaries.

6.2 Groundwater Conditions

The results of the groundwater sample analyses are summarized in Tables 4 and 5, and selected results of the most frequently detected compounds are shown graphically on Figure 8. The laboratory reports are provided in the Phase II subsurface investigation report (ATC, 2012b). A summary of the findings of the groundwater investigations is provided below:

- Groundwater in the southern portion of the Property contains concentrations of diesel-range hydrocarbons above the MTCA Method A CUL (500 micrograms per liter [µg/L]) similar to the distribution of diesel found in soil. The highest concentrations of diesel in groundwater were detected in grab samples from borings B-21 (961,000 µg/L), B-12 (547,000 µg/L), and B-24 (121,000 µg/L) in the southeast central portion of the Property. Groundwater sample results from temporary wells or borings are commonly assumed to be biased high, mainly due to insufficient development of the temporary sampling points prior to groundwater sample collection and from the incorporation of impacted sediments into the samples. The groundwater samples collected from the monitoring wells had lower diesel concentrations, ranging from 202 to 94,700 µg/L. MW-5 (located in the southeastern corner of the Property) contained the highest detected diesel concentration (94,700 µg/L) collected from the groundwater monitoring wells.

- Oil-range hydrocarbons (as heavy fuel oil fraction) were detected above the MTCA Method A CUL (500 µg/L) in one groundwater grab sample (B-18) and below the CUL in one groundwater monitoring well (MW-2).

- Benzene, ethylbenzene, and xylenes were detected in the grab groundwater sample from one temporary boring (B-2). With the exception of benzene, these constituents were detected at low concentrations below their respective MTCA Method A CULs. Benzene was detected at a concentration of 12.5 µg/L, which exceeded the MTCA Method A CUL of 5 µg/L for unrestricted land use. Benzene was not detected in groundwater samples collected from the monitoring wells.

- PCE, TCE, and vinyl chloride were detected in groundwater beneath the central portion of the Property, northeast of the former UST (B-8 and MW-1). TCE was also detected south of the 1406 10th Avenue building (BH-1/MW-3 co-located sampling points); the TCE concentration detected in the sample from boring BH-1 exceeded the CUL, but TCE did not exceed the CUL in the sample from monitoring well MW-3. Vinyl chloride was detected in B-21 located in the southwest corner of the 1405 11th Avenue building. The distribution of these VOCs appears to be discontinuous and limited in extent to these three areas. The areas where one or more of these constituents exceed their respective cleanup levels is limited to the central portion of the Property (i.e., MW-1, B-8, and B-21).

7.0 CONCEPTUAL SITE MODEL

The CSM presented in this section identifies potential or suspected sources of hazardous substances, types and concentrations of contaminants, potentially contaminated media, and actual or potential exposure pathways and receptors. Figure 9 provides an illustration of the CSM.

7.1 Sources and Transport Mechanisms

7.1.1 Contaminant Sources

The former UST appears to be the primary source of the petroleum hydrocarbons and VOCs in soil found at the north end of the 1406 10th Avenue building. The primary source of the southern Property contamination is not known, but based on historical tenant information and soil data, it appears the primary source in this area may be associated with historical automotive operations within the three southern buildings. The secondary and tertiary sources of contamination include contaminated soil and groundwater, respectively.

7.1.2 Transport Mechanisms

The primary transport mechanisms include spills and leaks from the primary sources that may have occurred historically. Other potential transport mechanisms include flow of spilled or leaked product to groundwater, advective flow of contaminants in water that has moved through contaminated soil, flow of contaminated groundwater, and vaporization of VOCs from contaminated soil or groundwater.

Based on the infrequent VOC detections and the relatively low VOC concentrations, transport of VOCs through vaporization is not considered to be likely. While flow of spilled or leaked product or waste was what likely contaminated soil and potentially groundwater initially, given the removal of the UST and the cessation of automotive operations at the Property, it is likely that all pure-phase product originally released into the unsaturated zone has migrated into the saturated zone or adsorbed onto unsaturated soil. Therefore, pure-phase migration in the unsaturated soil is not considered an active migration pathway. Transport of contaminants by water moving through contaminated soil or by flow of contaminated groundwater is possible; however, unless a leaking pipe is present, the lack of a water source above contaminated soil due to the overlying buildings and paving likely limits the downward transport of contamination. Since the horizontal hydraulic gradient is low and the hydraulic conductivity of the geologic materials (silty sand and finer) is likely only moderate, the horizontal movement of contaminants in groundwater is likely limited.

7.2 Exposure Media, Pathways, and Receptors

Based on the investigation results (Section 6), the beneficial uses of groundwater (Section 3.4), the Property layout, and the development in the area, PES has identified the following exposure media, pathways, and receptors.

7.2.1 Soil

Prior to redevelopment, the vast majority of the Property was covered by pavement or building foundations. Property soil sampling data indicate that diesel- or oil-range petroleum hydrocarbons were present in soil near the former UST and beneath portions of the buildings in the southeastern part of the Property. The only potential exposure pathway/receptor for contaminants in soil is site worker exposure through dermal contact or ingestion of contaminated soil during site maintenance or construction activities that disturb the existing structures or pavement (e.g., soil excavation). There is no indication that soil contamination beneath the Property extends any significant distance off-Property, so no complete exposure pathway exists for off-site receptors.

7.2.2 Groundwater

There is the potential for maintenance or construction workers at the Property to be exposed to contaminants in groundwater through dermal contact or the consumption of contaminated groundwater during activities that contact groundwater. There is currently no use of groundwater on the Property for potable purpose nor is there a reasonable likelihood of future use of Property groundwater. Given the possibility of groundwater flow to the south or southeast and the location of wells MW-4 and MW-5 to the south Property boundary, there is the possibility that groundwater impacts extend off-Property to the south/southeast. However, there is no consumptive use of groundwater within 1 mile of the Property so no complete groundwater exposure pathway exists for off-site receptors and the future potential is very low. Monitoring wells will be installed in adjacent rights of way during redevelopment of the Property to confirm the lateral extent of groundwater impacts.

7.2.3 Indoor Air

Given the infrequent VOC detections, the relatively low VOC concentrations, and the semivolatile nature of the petroleum hydrocarbons detected at the Property, the indoor air exposure pathway is incomplete. Based on the removal of the contaminated soil and the construction of a ventilated subsurface parking garage, this pathway will remain incomplete after redevelopment.

7.2.4 Terrestrial Ecological Evaluation

The Property qualifies for an exclusion from a terrestrial ecological evaluation pursuant to WAC 173-340-7491(1)(c)(i) because (1) the Property does not contain any of the hazardous substances of concern listed in WAC 173-340-7491(1)(c)(ii) and (2) there is not 1.5 acres of contiguous undeveloped land on the Property or within 500 feet of the Property. A terrestrial ecological evaluation form is provided in Appendix C.

7.2.5 Summary of Exposure Pathways and Receptors

The current potential exposure pathways include:

- Property maintenance or construction worker exposure (through dermal contact or ingestion) to contaminated soil during site maintenance activities that disturb the existing structures or pavement (e.g., soil excavation); and
- Property maintenance or construction worker exposure (through dermal contact or ingestion) during site maintenance activities that contact groundwater.

These pathways have been addressed during redevelopment by the removal of contaminated soil exceeding cleanup levels and through the in-situ treatment of contaminated residual perched groundwater after construction.

8.0 DEFINING CLEANUP LEVELS AND AREAS EXCEEDING CLEANUP LEVELS

8.1 Chemicals of Concern and Cleanup Levels

Based on the analytical results, the chemicals of concern (COCs) at the Property are as follows:

- **Soil.** COCs for soil include diesel- and oil-range hydrocarbons and benzene. These COCs were detected either the most frequently and/or at the highest concentrations. Other VOCs (ethylbenzene and xylenes) detected at the Property were infrequently detected (i.e., once or twice) and found at low concentrations below MTCA CULs. PCE, TCE, and vinyl chloride were not detected in any of the samples analyzed.

- **Groundwater.** COCs for groundwater include diesel- and oil-range hydrocarbons, benzene, PCE, TCE, and vinyl chloride. These COCs were detected the most frequently and at higher concentrations. Other VOCs (ethylbenzene, xylenes, and naphthalene) detected at the Property were infrequently detected (i.e., once) and found at low concentrations below MTCA CULs.

MTCA Method A CULs were selected for use in this cleanup because the cleanup actions are straightforward and only involve a limited number of contaminants. The CULs for soil COCs were selected as the Method A CUL for unrestricted land use presented in Table 740-1 of WAC 173-340-900. The CULs for groundwater COCs were established as the lowest value of the following: (1) the Method A groundwater CUL for protection of human health presented in Table 720-1 of WAC 173-340-900 and (2) concentrations established under applicable federal or state laws including maximum contaminant levels (MCLs) established under the Safe Drinking Water Act (CFR 141) and MCLs established by the Washington State Board of Health (Chapter 296-290 WAC). CULs for groundwater and soil COCs are shown in Tables 3 though 5.

8.2 Areas Exceeding Cleanup Levels

The following summarizes the areas where concentrations of COCs exceeded CULs in soil and/or groundwater.

8.2.1 Soil

Figure 7 graphically depicts the areas where COCs (petroleum hydrocarbons and/or VOCs) were detected in soil at concentrations greater than CULs based on the sampling results shown in Table 3. As shown on Figure 7, the areas exceeding CULs were located primarily beneath the former UST area north of the 1406 10th Avenue building and in the southeastern portion of the Property. Boring B-2 near the former UST area contained diesel-range hydrocarbons and benzene above CULs to at least 6 feet below the basement floor (approximately elevation 282 feet). Diesel-range hydrocarbons were also found beneath the 1401 and 1405 11th Avenue buildings at depths of 3 to 10 feet below the basement floors (approximately elevations 280 to 287 feet). Heavy fuel oil was present above its cleanup level in an isolated area around B-18 at a depth of 8 feet below the basement floor (approximately elevation 280 feet).

8.2.2 Groundwater

Figure 8 graphically depicts the areas where COCs (diesel-range hydrocarbons and intermittent detections of PCE and related VOCs) were detected in groundwater at concentrations greater than CULs. In general, the area exceeding groundwater CUL for diesel-range hydrocarbons was very similar to the area where soil exceeded CULs, with minor differences along the eastern boundary of the northwestern plume and the western boundary of the southeastern plume. The areas where groundwater concentrations exceeded CULs for PCE, TCE, vinyl chloride, and/or benzene (B-2, MW-1, B-8, and B-21) were contained within the two areas where groundwater exceeded the CUL for diesel-range hydrocarbons.

Diesel-range hydrocarbons were detected at concentrations exceeding the diesel CUL in at least one location near the former UST area (B-2) and at 10 locations (MW-4, MW-5, B-12, B-13, B-18, B-19, B-20, B-21, B-22, and B-24) in the southeastern portion of the Property. These samples were collected from either temporary wells or groundwater monitoring wells with 10-foot screens set from depths ranging from 2 to 26 feet.

One or more of the following VOCs (PCE, TCE, vinyl chloride, or benzene) were detected at five locations (MW-1, MW-3/BH-1, B-2, B-8, and B-21) at concentrations exceeding the respective CULs. Benzene was detected only once (B-2) and vinyl chloride twice (B-2 and B-21) at concentrations that exceeded the respective CULs (5 µg/L and 0.2 µg/L). PCE was detected in two samples (B-8 and MW-1) at concentrations (35.5 µg/L and 20.1 µg/L, respectively) exceeding the CUL of 5 µg/L. Three of four TCE detections (B-8, BH-1, and MW-1) exceeded the CUL (5 µg/L). The groundwater sample from boring BH-1 contained the highest detected concentration of TCE at 24.7 µg/L; however, this result was not confirmed by the results for permanent monitoring well MW-3 that was installed immediately adjacent to the location of boring BH-1. The TCE result in MW-3 (1.09 µg/L) was well below the TCE CUL of 5 µg/L, indicating groundwater in this area does not exceed CULs.

9.0 FEASIBILITY STUDY SCOPING

9.1 Purpose

BCH and PES conducted a feasibility study to develop and evaluate cleanup action alternatives (CAAs) and select a final cleanup action for the Property. The scope of this process included the following major steps:

- Determine cleanup goals and levels;
- Identify areas requiring cleanup and rationale for remedial actions;
- Identify applicable regulations and standards;
- Define cleanup action objectives (CAOs);
- Identify remedial actions related to development of the Property;
- Identify and screen cleanup action technologies;
- Develop and evaluate CAAs; and
- Select the preferred alternative.

This section describes the first five steps, including reviewing CULs previously developed in Section 8, identifying areas that required cleanup, identifying applicable regulations and standards, identifying remedial actions related development of the Property, and defining CAOs. Section 10 identifies potentially applicable cleanup action technologies and screens the technologies on the basis of the CAOs and site-specific information. Section 11 describes the development of a range of potentially applicable CAAs, while Section 12 describes the detailed evaluation of these alternatives and presents the alternative selected and implemented by BCH.

9.2 Cleanup Levels

As described in Section 8, Method A CULs were selected for use in this cleanup because the remedial actions are straightforward and only involve a limited number of contaminants. Cleanup levels for groundwater and soil COCs are shown in Tables 3 through 5. COCs for soil include diesel- and oil-range hydrocarbons and benzene; and the COCs for groundwater include diesel- and oil-range hydrocarbons, benzene, PCE, TCE, and vinyl chloride.

9.3 Areas Requiring Cleanup

As described in Section 8, the results of the Property investigations indicated that soil containing diesel or heavy fuel at concentrations exceeding CULs was limited to the areas below portions of the 1406 10th Avenue and 1401 and 1405 11th Avenue buildings and was located between approximately elevations 280 and 288 feet. As shown on Figures 7 and 8, the two areas where groundwater exceeds CULs for COCs were co-located with the soil contamination but extended beyond the limits of the soil exceeding CULs (i.e. the area exceeding groundwater CULs

encompassed all of the area exceeding soil CULs). Groundwater was encountered at approximately elevation 285 feet.

As described in Section 5.1.2, soil consists of silty sand, with lesser amounts of clayey sand, clay, silt, and sand. The approximate volume of soil above CULs was estimated to be roughly 3,300 to 3,800 cubic yards, and the approximate volume of groundwater above CULs was estimated to be between 90,000 to 110,000 gallons. These estimates were based on the soil and groundwater sample concentrations, depths, and estimated areas above CULs shown on Figures 7 and 8, and groundwater elevations shown on Figures 5 and 6.

9.4 Applicable Regulatory Requirements

The MTCA cleanup regulations require that the selection of cleanup levels and cleanup actions comply with applicable local, state, and federal laws (WAC 173-340-710). The primary applicable, relevant, and/or appropriate requirement (ARAR) is the MTCA Cleanup Regulation (WAC 173-340). Additional ARARs that were considered include the following:

- Washington Ground Water Quality Standards (WAC 173-201) establish standards to protect groundwater quality (e.g., MCLs) and beneficial uses;
- Washington Dangerous Waste Regulations (WAC 173-303) establish procedures and standards related to the definition, management, and disposal of dangerous wastes. The management of excavated contaminated soil from the Property would be conducted in accordance with these regulations to the extent that any dangerous wastes are discovered or generated during the cleanup action;
- Washington Criteria for Municipal Solid Waste Landfills (Chapter 173-351 WAC) establish a comprehensive program for solid waste management including proper handling and disposal of soil that could be managed as solid waste instead of dangerous waste;
- Federal Clean Water Act National Pollutant Discharge Elimination System (NPDES) Permit and State Construction Stormwater General Permit. Construction activities that disturb one or more acres of land typically need to obtain an NPDES Construction Stormwater General Permit from Ecology. A substantive requirement would be to prepare a stormwater pollution prevention plan (SWPPP) prior to the earthwork activities. The SWPPP would document planned procedures designed to prevent stormwater pollution by controlling erosion of exposed soil and by containing soil stockpiles and other materials that could contribute pollutants to stormwater;
- Washington Industrial Safety and Health Act Regulations (WAC 296-62) contain health and safety training requirements for on-site workers/OSHA;
- Hazardous Waste Operations (Chapter 296-843 WAC) contain safety requirements for workers conducting investigation and cleanup operations at sites containing hazardous materials. These requirements would be applicable to on-site cleanup activities and would be addressed in a site health and safety plan prepared specifically for these activities; and

- Washington Water Well Construction Regulations (WAC 173-160) establish state standards for installing, maintaining, and decommissioning groundwater monitoring and recovery wells.

9.5 Cleanup Action Objectives

CAOs are media-specific goals that provide the framework for developing and evaluating CAAs and form the basis for evaluating potential cleanup technologies and actions for the Property. CAOs are based on an evaluation of the data collected during previous investigations and on the CULs and potential exposure pathways and receptors established in Section 7. The focus of the CAOs is protection of human health. Terrestrial ecological-based CAOs were not developed, consistent with the TEE.

9.5.1 Soil Cleanup Action Objectives

The CAOs for soil were as follows:

- Control incidental ingestion of and dermal contact with contaminated soil by future on-site construction and maintenance workers when conducting activities that disturb the existing structures or pavement (e.g., soil excavation, monitoring well installation); and
- Prevent migration of COCs from site soil to groundwater at concentrations greater than CULs.

9.5.2 Groundwater Cleanup Action Objectives

The CAO for groundwater was to control incidental ingestion of and dermal contact with contaminated groundwater by future on-site construction and maintenance workers when conducting activities that contact groundwater (e.g., soil excavation, monitoring well installation).

9.6 Property Redevelopment

As described in Section 3.3, the redevelopment of the Property included the demolition of all of the on-site structures (with the exception of the brick façades of the 1406 10th Avenue, 1401 11th Avenue, and 1405 11th Avenue buildings along East Union Street and 11th Avenue) and construction of an 8-story building including street level retail units, approximately 248 residential units, and one level of below-ground parking. Construction of the below-ground parking level requires excavation of the entire Property to an elevation of approximately 282.5 feet, which is approximately 6 to 9 feet below the basement floor surface elevations (288.07 to 290.59 feet) and approximately 14 feet below the adjacent East Union Street grade (approximately elevation 297 feet). Excavation to this depth removed the upper 2.5 feet of the saturated zone and removed all of the soil exceeding CULs except for at three locations: near borings B-18, B-24, and MW-5 where soil exceeding CULs extends to elevations at or below elevation 281 to 280 feet. Excavation for building footings and additional over-excavation removed additional volume of soil exceeding CULs. One of the larger footings, the 1,800 square

foot stairwell foundation encompassing boring B-18, extends to elevation 277.3 feet, and removes soil exceeding CULs within its footprint. The locations of building footings are shown on Figure 10.

Portions of the remedial excavation extended below the water table. Given the relatively low permeability of the silty sand and clayey fine sand and silts underlying the Property, groundwater entering the excavation was managed using ditching and sumping methods. In addition, incidental precipitation that accumulated within the excavation prior to backfilling and groundwater that accumulated within the excavation prior to backfilling were collected, temporarily stored on site in a Baker tank, and discharged to the sanitary sewer under Revised Letter of Authorization 11441-02 from the King County Industrial Waste Program (KCIW).

10.0 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

Cleanup action technologies are actions that could be implemented to address, whether alone or in combination with other technologies, one or more of the CAOs listed in Section 9.5. This section describes the process and the results of identifying and screening potentially applicable technologies for achieving the CAOs.

Once identified, the potentially applicable technologies were screened based on the estimated effectiveness, implementability, and overall applicability. In general, technologies with a low overall applicability were screened out, and technologies with a medium or high applicability were retained.

10.1 Preliminary Technology Identification

The potentially applicable technologies considered are listed in Table 6 and described below. This list of technologies was compiled based on the nature of the contaminants, the environmental media impacted (soil and/or groundwater), and the types of exposures that need to be addressed (as defined by the CAOs). In general, PES considered technologies that have been proven effective at full-scale for similar contaminants, although some technologies in earlier stages of development were also considered.

10.1.1 Institutional Controls

Institutional controls are legal or administrative measures or actions that reduce exposure to contaminants that are above acceptable health risk levels. Examples of institutional controls include restrictive covenants, groundwater use restrictions, land use restrictions, and groundwater monitoring requirements. Institutional controls are typically implemented in addition to another technology when that technology leaves COCs on site at concentrations greater than CULs for some period of time.

10.1.2 Engineering Controls

Engineering controls are physical measures that prevent or minimize exposure to contaminated soil or reduce the mobility or migration of site contaminants. The most common engineering control involves installing and maintaining a surface barrier or cap cover, which minimizes groundwater infiltration and prevents direct contact with soil. Engineering controls are typically implemented in addition to another technology when that technology leaves COCs on site at concentrations greater than CULs for some period of time.

10.1.3 Monitored Natural Attenuation

Monitored natural attenuation (MNA) refers to the reliance on natural attenuation processes (within the context of a carefully controlled and monitored site cleanup approach) to achieve site-specific cleanup objectives within a time frame that is reasonable compared to that offered by other more active methods. Natural attenuation of site related contaminants occurs through a

combination of physical, chemical, and biological processes, including volatilization, dispersion, dilution, sorption, oxidation, reduction, and biodegradation. All of these processes contribute to a measurable reduction of the concentrations of contaminants within the plume. MNA involves long-term groundwater sampling and analysis to demonstrate that natural attenuation processes are reducing the mass, toxicity, volume, and/or the concentration of chemicals in site soil, groundwater, or both. MNA may be implemented as a stand-alone remedial technology or in combination with other remedial technologies, such as excavation of soil contamination. Potential exposure to contaminated groundwater would require implementation of institutional controls if contamination would remain on site at levels greater than CULs.

10.1.4 Enhanced Aerobic Biodegradation

Enhanced aerobic bioremediation typically consists of adding oxygen and nutrients to increase the rate of the intrinsic biodegradation in soil and groundwater. Petroleum degrading bacteria may also be added to supplement the indigenous bacterial populations. Dissolved oxygen (DO) is typically the limiting factor in aerobic biodegradation of petroleum impacted soil and groundwater, and increasing DO concentrations in groundwater is often enough to stimulate the rate of biological activity. Adequate concentrations of naturally occurring nutrients and bacteria are commonly available to support the increased biological activity when DO increased; however, it is a relatively common practice to supplement with nutrients and bacteria to stimulate the initial rates of biodegradation. It is important to have a good understanding of site lithology in order to design an appropriate grid for distributing oxygen throughout the contaminated media. Sites with lower permeability soil (e.g., silty sand and silt) will require a more dense distribution grid than sites with higher permeability soil (e.g., sand and gravel).

Common methods of increasing DO in soil and groundwater include biosparging, bioventing, air sparging, and deployment of specialized chemical compounds, which when submerged, are designed to slowly release oxygen and increase groundwater DO over an extended time period (e.g., 3 to 12 months). Biosparging, bioventing, and air sparging rely on blowers and compressors to provide the pressure gradients via remediation wells to move air through the contaminated media. Oxygen releasing compounds, however, work passively and rely on groundwater advection to distribute the DO. Oxygen releasing compounds are readily available and typically contain well-buffered sources of dissolved oxygen (e.g., magnesium peroxide or calcium peroxide) and inorganic nutrients. The compounds may be deployed in dry form (powder, 3 to 10 mm pellets, and replaceable filter socks) in monitoring wells, borings, trenches, or excavations, or as a liquid slurry form that may be directly injected to the subsurface using direct-push drilling and injection equipment. These compounds are designed for one-time use and can be replaced when the source of oxygen is depleted. The spent product becomes an inert hardened mass that is commonly allowed to remain in the subsurface after the oxygen source is depleted.

10.1.5 Source Removal

Source removal is typically conducted as a soil treatment technology; however, it can also result in effective groundwater remediation by removing the contaminant source to groundwater and by removing contaminated porewater (when excavating below the groundwater table). Source

removal as a groundwater treatment remedy would consist of soil excavation to remove soil contaminants that are currently resulting in groundwater contamination. Source removal would require groundwater monitoring following implementation to confirm that both the soil above CULs and the soil source to groundwater have been effectively removed and groundwater concentrations are less than cleanup standards following implementation. Compliance with CULs may not occur immediately and may require a short time frame for subsurface conditions to stabilize. Partial source removal may be combined with in-situ treatment technologies or MNA to achieve CAOs, and may require institutional controls if contamination remains on site at levels greater than CULs.

10.1.6 Air Sparging and Soil Vapor Extraction

Air sparging is used to treat groundwater contaminated with volatile and certain semivolatile contaminants. Compressed air is injected into the contaminated aquifer through injection wells, where it bubbles upward through channels in the soil column, creating an air stripping effect that moves chemicals in groundwater to the air bubble that migrates to the vadose zone where it can be recovered and treated. Air sparging also provides a source of DO to increase the rate of intrinsic biodegradation in soil and groundwater. Air sparging is limited by contaminant depths and works best in homogenous sandy soil formations that limit preferential pathways for airflow.

Air sparging is generally coupled with soil vapor extraction (SVE), a process that extracts soil vapor from unsaturated soil in the vadose zone by applying a vacuum to the subsurface, to further extract and contain volatile contaminants from groundwater and the soil. SVE flow rates are typically two to three times greater than air sparging flow rates to ensure complete capture and prevent migration of injected air and resulting soil vapors. The vacuum is applied via a blower connected to extraction wells screened in the area of contamination. Soil vapor extracted from the subsurface is processed through a treatment system, typically including filters for particulate removal, condensate removal, and treatment by oxidation or carbon filtration.

10.1.7 Pump and Treat

Pump and treat involves pumping contaminated groundwater from the subsurface. Groundwater is then treated before it is discharged. Treatment is generally conducted by air stripping or filtration via activated carbon. Groundwater pump and treat can slowly reduce chemical concentrations in saturated soil by increasing the diffusion of soil contamination into groundwater. However, groundwater pumping will have limited or no effect on soil contamination in the vadose zone. Extraction system design and treatment are dependent on the site characteristics and chemical type. Extraction wells may be screened at different levels or intervals to maximize the system effectiveness; however, restoration time frames for pump and treat systems are often very long. When the contamination source area is large, pump and treat cannot significantly accelerate the removal of mass because the source areas often leach chemicals into groundwater for long periods of time.

10.2 Technology Screening

This section includes screening of the potentially applicable technologies listed in Section 10.1. The process rejects or retains technologies based on the following criteria:

- Effectiveness – technology's ability to meet one or more of the CAOs;
- Implementability – accounts for constraints or difficulties in implementing the technology and ability to assess and verify the technology's continued effectiveness; and
- Relative Cost – overall cost of the technology relative to other technologies that address the same CAOs and with similar effectiveness and implementability.

The screening process for the potentially applicable technologies is detailed in Table 7, and the retained technologies are summarized below.

10.3 Summary of Retained Technologies

Based on the technology screening, the technologies listed below were retained for development of alternatives to address soil and groundwater contamination. Note that each of these technologies included Property redevelopment related source removal. As described in Section 9.6, the Property redevelopment included excavation of the entire Property to an elevation of approximately 282.5 feet, which is approximately 6 to 9 feet below the prior basement floors. Excavation to this depth removed all soil exceeding CULs except for three locations (B-18, B-24, and MW-5 shown on Figure 7), including the removal of the upper 2.5 feet of the saturated zone, resulting in removing sources of petroleum groundwater impacts as well as the entrained groundwater contaminants. Excavation for building footings (Figure 10) removed additional contamination in select areas.

10.3.1 Institutional Controls

Institutional controls were retained for further evaluation for implementation in combination with any technology that leaves contamination in place. Institutional controls that could be implemented for groundwater could include current and future restrictions on groundwater withdrawals and use. Institutional controls that could be implemented for soil would include access restrictions and worker protection measures. When used in combination with other remedial technologies, institutional controls would successfully achieve CAOs, and could be implemented given the site physical conditions.

10.3.2 Monitored Natural Attenuation

MNA was retained for further evaluation as a groundwater treatment technology because natural attenuation processes would reduce residual contaminant concentrations over time through degradation, dilution, and dispersion; monitoring would ensure that the groundwater risk is reducing over time. Because the existing site data (Sections 6 and 7) indicate that groundwater

CULs are already being attained at the Property line, MNA does not result in an increased risk to human health and the environment. Exposure to contaminated groundwater would require implementation of institutional controls to manage pathways while contamination remains on site at levels greater than CULs. When used in combination with institutional controls and Property development excavation, MNA would successfully achieve the site CAOs and could be implemented given the site physical conditions.

10.3.3 Enhanced Aerobic Biodegradation Using Oxygen Releasing Compounds

Enhanced aerobic biodegradation using oxygen releasing compounds was retained for further evaluation as a groundwater treatment technology because the slow release of oxygen and nutrients will help to increase the rate of intrinsic biodegradation of residual petroleum hydrocarbons in soil and groundwater. Potential implementation methods include mixing dry pelletized products into development excavation backfill soil which will be placed below the water table, and/or future slurry injections (into groundwater) following completion of the development project. Installation of subsurface slotted injection piping during development construction, with multiple injections, was considered. When used in combination with Property development excavation, enhanced biodegradation using oxygen releasing compounds would successfully achieve the site CAOs and could be implemented given the site physical conditions.

10.3.4 Source Removal

Source removal was retained for further evaluation as a soil and groundwater treatment technology. Excavation of contaminated soil would immediately reduce the contaminant mass on the Properties, and would remove ongoing sources of contaminants to groundwater. Over-excavation (below elevation 282.5 feet) in areas of soil and groundwater contamination would remove remaining sources of soil exceeding CULs, and remove the source of petroleum groundwater impacts as well as removing the entrained groundwater contaminants. Source removal could be implemented given the site physical conditions, and once the source has been removed, the remaining dissolved contaminants would attenuate naturally relatively quickly and achieve the site CAOs.

11.0 DEVELOPMENT OF CLEANUP ACTION ALTERNATIVES

11.1 Approach to CAA Development

CAAs are combinations of technologies designed to meet the CAOs. The retained technologies from the screening process were assembled into three CAAs that address the CAOs and meet MTCA's minimum requirements to the extent practicable. This section presents a detailed description of the three CAAs with respect to conceptual design, implementation, and estimated cost. The conceptual design was developed in sufficient detail to evaluate the effectiveness, performance, and estimated restoration timeframe in the detailed evaluation of CAAs presented in this section, and to conduct the detailed comparative evaluation of the alternatives presented in Section 12.

The costs of the CAAs discussed below were developed by accounting for capital costs as well as recurring and future costs. Capital costs include work plans, design reports, other Ecology-required documents, and construction to implement the remedy. Recurring and future costs include operations and maintenance (O&M) and groundwater monitoring. Cost details for each alternative are provided in Appendix D. These cost estimates do not include the investigation-related project costs incurred to date. All costs are presented in 2013 dollars.

A construction contingency cost of 20 percent was added to each alternative to reflect a level of uncertainty in the estimated costs given the conceptual design of the CAAs. The contingency on capital cost reflects uncertainty in design, permitting, and construction costs. Consistent with industry standards, these cost estimates should be considered to represent the actual CAA implementation cost within a range of minus 30 percent to plus 50 percent of the estimated cost. The cost estimates are rounded to the nearest $10,000.

Although BCH and PES have selected and implemented Alternative 2 (which incorporates Alternative 1), all three alternatives are fully explained below to provide Ecology with information on the selection process.

11.2 Alternative 1 – Overexcavation and MNA

The redevelopment of the Property included excavation of the entire Property to an elevation of approximately 282.5 feet to accommodate one level of sub-grade parking. Alternative 1 included overexcavating contaminated soil within the three areas exceeding groundwater CULs, off-site disposal of contaminated soil generated during excavation activities, and backfilling overexcavated areas with clean fill. Figure 10 shows the proposed elevation of the planned excavation base by area, which was determined based on the following data and assumptions:

- **Area 1:** Area near the former UST and beneath the 1406 10th Avenue building (includes sampling locations B-2, B-8, and MW-1). The bottom of the excavation immediately in Area 1 extends to approximately 7 feet bgs or elevation 281 feet, 1 foot below the deepest soil sample exceeding CULs (6 feet bgs). In addition, this excavation depth was intended to remove the saturated soil (upper 4 feet) that contained elevated concentrations of COCs found in groundwater at this location;

- **Area 2:** Area east of the former UST and beneath portions of the 1406 10th Avenue and 1401/1405 11th Avenue buildings. The bottom of the excavation immediately south of the former UST extended to a depth of approximately 8 feet bgs or elevation 281 feet. In addition, this excavation depth was intended to remove the saturated soil that contained elevated concentrations of COCs (diesel and heavy oil) found in groundwater at this location; and
- **Area 3:** Southeast portion of the Property beneath the 1401 11th Avenue building. The base of the excavation in Area 3 extended to at least 11 feet bgs (elevation 279 feet) in an area around MW-5, which is 1 foot below the deepest soil sample exceeding CULs. In addition, this excavation depth was intended to remove the saturated soil that contained elevated concentrations of COCs found in groundwater in this area.

In this alternative, once the planned excavations limits (laterally and vertically) are achieved, confirmation samples are collected at the base and sidewalls of the planned excavations to determine if CULs have been achieved. The results of the confirmation soil samples are used to guide additional excavation required to meet CULs at the limits of the excavation. After clean limits are achieved, the excavation would be backfilled with clean fill material to elevation 282.5 feet.

PES's experience indicates that removal of the upper 4 to 6 feet of the saturated zone (or approximately to elevation 279 to 281 feet) is an effective method to remove the source of petroleum groundwater impacts as well as removing the entrained groundwater contaminants. Once the source has been removed, the remaining dissolved contaminants will attenuate naturally and relatively quickly. MNA performance monitoring will be conducted to document the continued attenuation and degradation of residual groundwater contamination below CULs. To facilitate the MNA monitoring and to demonstrate groundwater cleanup levels have been achieved five new monitoring wells will be installed: one well (MW-6) will be installed through the parking garage floor near pre-construction well MW-5 (well with the highest concentrations) and 4 wells will be installed in the sidewalks on the east, south, and west Property boundaries. Monitoring wells MW-1, MW-2, MW-4, and MW-5 were destroyed during construction; as a result, a total of six monitoring wells will be including in the monitoring program (MW-3 and MW-6 through MW-10). The duration of Alternative 1 is estimated at between 3 and 4 years.

The estimated costs for implementing Alternative 1 are summarized in Appendix D and include both capital costs and recurring and O&M costs. For the purposes of developing the costs for this alternative, a 4-year implementation period was assumed.

Capital costs include the following:

- Decommissioning of monitoring wells MW-1, MW-2, MW-4, and MW-5 within the excavation areas;
- Excavation of approximately 2,990 cubic yards of contaminated soil exceeding CULs concurrent with the excavation for Property development to an elevation of 282.5 feet;
- Overexcavation of approximately 660 cubic yards of soil within the areas exceeding groundwater CULs to an elevation of approximately 281 feet, approximately 1.5 feet

deeper than proposed development excavation base, and approximately 8 to 10 feet below the pre-development building base to remove soil containing residual contaminated groundwater within the saturated soil pore space;

- Off-site disposal of contaminated soil at a permitted facility;
- Collection and analysis of confirmation soil samples from the excavation bottom and sidewalls to demonstrate soil cleanup levels have been achieved or to identify areas requiring additional excavation;
- Backfilling and compaction of overexcavated Areas 1, 2, and 3 with clean fill material to development elevation of 282.5 feet;
- Management and proper disposal of impacted groundwater or incident precipitation collected during excavation activities, or accumulating in the under-slab and footing drainage system;
- Installation and development of four groundwater monitoring wells around the excavation perimeter (MW-7, MW-8, MW-9, and MW-10) and one well (MW-6) within the existing area of groundwater contamination above CULs (see Figure 10). The perimeter wells will be monitored to confirm CUL attainment at the Property boundary, and the interior well will be used to demonstrate that groundwater within the existing plume area is degrading naturally due to source removal;
- Preparation of an MNA work plan that describes the procedures for evaluating MNA's effectiveness at the site and the on-going monitoring procedures. The work plan will include monitoring of three wells (MW-6, MW-7, and either MW-8 or MW-9) along a flow path for groundwater COCs and degradation parameters consistent with Ecology's *Guidance on Remediation of Petroleum-Contaminated Ground Water By Natural Attenuation* (Ecology, 2005);
- Long-term performance monitoring in all six wells (MW-3, MW-6, MW-7, MW-8, MW-9, and MW-10) to assess MNA's performance during implementation. Each monitoring event will include water level monitoring and analysis of groundwater of the following constituents:
    - **COCs** – TPH, BTEX, TCE, and PCE;
    - **Field parameters** – DO, redox potential, pH, conductivity, and temperature; and
    - **MNA degradation parameters in three select wells** – nitrate; ferrous iron, sulfate, methane, and alkalinity.
- Groundwater confirmation monitoring to demonstrate that CULs have been achieved. Four quarters of confirmation monitoring will begin when groundwater performance monitoring indicates achievement of CULs; and
- Reporting including annual progress reports, and preparation of a final cleanup action report, and submitting a request for an NFA opinion from Ecology.

Recurring O&M costs include the following:

- MNA performance groundwater monitoring for a period of 3 years. Monitoring will be conducted quarterly in Year 1, and semiannually in Years 2 and 3;
- Confirmation groundwater monitoring for 1 year (Year 4);
- Decommissioning the existing monitoring well network; and
- Preparation of a cleanup action report and request for NFA opinion from Ecology.

Total capital costs are expected to be approximately $510,000, recurring O&M costs are estimated at approximately $70,000, and the total estimated present worth (PW) for this alternative is $580,000.

11.3 Alternative 2 – Overexcavation, Backfill Amendment, and MNA

Alternative 2 consists of the elements described in Alternative 1 but adds amending the clean backfill in Areas 2 and 3 with oxygen releasing compound pellets (Figure 11). The backfill in Area 1 would not be amended with oxygen releasing compound because the relatively low concentrations anticipated in residual groundwater in this area are expected to degrade naturally. ORC-Advanced® (ORC-A) pellets from Regenesis were considered for this project. The manufacturer recommends application of ORC-A pellets at an approximate rate of 0.2 percent by weight. The pellets have an extended release period that will provide up to 12 months of DO and inorganic micronutrients to stimulate biological activity and enhance biodegradation of residual dissolved hydrocarbons petroleum hydrocarbons in groundwater. The ORC-A pellets would be applied at the same elevations where impacted soil with contamination above CULs had been previously located. ORC-A pellets have special health, safety, and handling requirements due to their corrosive nature and must be kept dry, out of the heat, and away from incompatible materials prior to mixing into the clean backfill.

Similar to Alternative 1, MNA performance monitoring would be conducted to document the continued attenuation and degradation of residual groundwater contamination below CULs. The duration of Alternative 2 was estimated at between 1 and 2 years.

The estimated costs for implementing Alternative 2 are summarized in Appendix D and include both capital costs and recurring O&M costs. For the purposes of developing the costs for this alternative, a 2-year implementation period was assumed.

Capital costs include the following:

- Decommissioning of four monitoring wells;
- Property development excavation and overexcavation of areas with groundwater concentrations above CULs;
- Off-site disposal (at a permitted facility) of 3,650 cubic yards of contaminated soil generated during Property development excavation and overexcavation of Areas 1, 2, and 3;

- Collection and analysis of confirmation soil samples from the excavation bottom and sidewalls to demonstrate soil CULs have been achieved or to identify areas requiring additional excavation;
- Backfilling and compaction of Areas 2 and 3 with clean fill material that has been amended with approximately 4,000 pounds of oxygen releasing compound pellets;
- Management of contaminated groundwater and stormwater that accumulates within the excavation and the under-slab and footing drainage system;
- Installation of five new monitoring wells; and
- Preparation of a monitoring work plan.

Recurring O&M costs include the following:

- Quarterly MNA performance groundwater monitoring for a period of 1 year;
- Quarterly confirmation groundwater monitoring for 1 year (Year 2);
- Decommissioning the existing monitoring well network; and
- Preparation of a cleanup action report and request for NFA opinion from Ecology.

Total capital costs are expected to be approximately $590,000, recurring O&M costs are estimated at approximately $50,000, and the total estimated PW for this alternative is $640,000.

11.4 Alternative 3 – Overexcavation, Enhanced In-Situ Bioremediation, and MNA

Alternative 3 consists of the elements described in Alternative 1 but instead of application of ORC pellets, this alternative includes installation of approximately 380 lineal feet of a slotted injection piping network at the base of the overexcavation in Areas 2 and 3 (Figure 12), and one round oxygen releasing compound slurry injection. The injection piping would not be installed beneath Area 1 because the relatively low concentrations anticipated in residual groundwater are expected to degrade naturally. ORC-A powder from Regenesis would be mixed to form an 8.5 percent by weight slurry. The slurry injection would provide up to 12 months of dissolved oxygen and inorganic micronutrients to stimulate biological activity and enhance biodegradation of residual petroleum hydrocarbons in groundwater. Each run of slotted injection piping will include an access vault at one end to facilitate injection of the ORC-A slurry. Similar to the pellets, ORC-A powder has special health, safety, and handling requirements due to its corrosive nature and must be kept dry, out of the heat, and away from incompatible materials prior to mixing with water. In addition, ORC-A powder is a fine mesh material that requires specialized mixing equipment and spray water to minimize airborne dust.

The slotted injection piping would be installed at invert piping elevation of 277.5 feet. The injection piping would be approximately 7 to 8 feet below the current groundwater elevation (or 11 to 13 feet below the current ground surface) and would be expected to be at the base or slightly beneath the elevation of the existing groundwater plume. The permanent injection piping network would allow for more than one slurry injection if needed. Due to the location of the pipes and nature of the ORC application, injecting ORC as a slurry would not provide the

same even and targeted distribution as placing ORC in pellet form, likely resulting in a longer restoration time frame.

Similar to Alternatives 1 and 2, MNA performance monitoring would be conducted to document the continued attenuation and degradation of residual groundwater contamination below CULs. The duration of Alternative 3 is estimated at 2 to 3 years (or 1 to 2 years after injection of the ORC-A slurry).

The estimated costs for implementing Alternative 3 are summarized in Appendix D and include both capital costs and recurring O&M costs. For the purposes of developing the costs for this alternative, a 3-year implementation period was assumed.

Capital costs include the following:

- Decommissioning four monitoring wells;
- Property development excavation and overexcavation of areas with groundwater concentrations above CULs;
- Off-site disposal (at a permitted facility) of 3,650 cubic yards of contaminated soil generated during Property development excavation and overexcavation of Areas 1, 2, and 3;
- Collection and analysis of confirmation soil samples from the excavation bottom and sidewalls to demonstrate soil cleanup levels have been achieved or to identify areas requiring additional excavation;
- Management of contaminated groundwater and stormwater that accumulates within the excavation and the under-slab and footing drainage system;
- Installation of 380 lineal feet of 2-inch-diameter slotted injection piping below the base of the overexcavated areas, and 6 flush-with-grade access vaults;
- Installation of five new monitoring wells; and
- Preparation of an MNA work plan;

Recurring O&M costs include the following:

- Preparation of an injection work plan;
- One injection of ORC-A slurry at the beginning of Year 2;
- Quarterly MNA performance groundwater monitoring for 2 years;
- Confirmation groundwater monitoring for 1 year (Year 3);
- Decommissioning the existing monitoring well network; and
- Preparation of a cleanup action report and request for NFA opinion from Ecology.

Total capital costs are expected to be approximately $570,000, recurring O&M costs are estimated at approximately $100,000, and the total estimated PW for this alternative is $670,000.

12.0 EVALUATION OF CLEANUP ACTION ALTERNATIVES

This section provides a detailed evaluation of the CAAs developed in Section 11. The criteria used for analyzing and evaluating the CAAs are presented below in Section 12.1. The evaluations of each individual CAA against these criteria and a comparative analysis of the CAAs are presented in Section 12.2, the evaluation is summarized and the recommended CAA is presented in Section 12.3.

12.1 Evaluation Criteria

MTCA is the primary regulation that outlines the procedure for conducting the FS. MTCA requires that CAAs be compared against a number of criteria to evaluate the adequacy of each alternative in achieving the intent of the regulations. These criteria also serve as a basis for comparing the relative merits of each of the CAAs. Consistent with MTCA, the alternatives were evaluated below with respect to compliance with threshold requirements, permanence, restoration timeframe, and consideration of public concerns. In addition to these criteria, Ecology's expectations for cleanup actions listed in WAC 173-340-370 were also considered.

12.1.1 Threshold Requirements

All cleanup actions are required to meet the following threshold requirements specified in WAC 173-340-360 (2):

- **Protect human health and the environment.** This criterion evaluates how the cleanup action, as a whole, achieves and maintains protection of human health and the environment;
- **Comply with cleanup standards.** This criterion requires that a cleanup action achieve CULs at the specified point of compliance;
- **Comply with applicable state and federal laws.** The selected cleanup action must comply with all applicable laws; and
- **Provide for compliance monitoring.** All cleanup actions must provide compliance monitoring consisting of one or more of the following: protection monitoring, performance monitoring, and/or conformation sampling.

12.1.2 Requirement for a Permanent Solution to the Maximum Extent Possible

The evaluation process for determining whether a cleanup action uses permanent solutions to maximum extent practicable is defined in WAC 173-340-360(3). Since all of the alternatives met the definition of a permanent cleanup action contained in WAC 173-340-200 (a cleanup action where cleanup standards are met without any further cleanup actions being required), a disproportionate cost analysis (DCA) was not required per WAC 173-340-360(3)(e)(ii)(B). However, a DCA is included to determine if the incremental increase in costs of a cleanup alternative over that of a lower cost alternative is justified by providing a corresponding incremental increase in human health and environmental benefits. If the incremental increase in

costs is determined to be disproportionate to the benefits, the lower cost alternative will be preferred over the more expensive CAA. This process provides a mechanism for balancing the net benefit of the cleanup action with its costs, while ensuring that human health and the environment are adequately protected. This evaluation uses the following criteria described in WAC 173-340-360(3)(f) to determine which CAA is the most permanent solution:

- Protectiveness;
- Permanence;
- Cost;
- Effectiveness over the long term;
- Management of short-term risks;
- Technical and administrative implementability; and
- Consideration of public concerns.

Based on the evaluation of these criteria, and as required by WAC 173-340-360(3)(e)(ii), the alternatives were ranked from the most to the least permanent solution, and then compared based on cost to determine if the benefits provided by a higher cost alternative (as defined by the permanence of the alternative) outweigh the incremental increase in cost of the alternative. The alternatives were compared in this manner and the alternative that provides the best balance of permanence and cost was selected for implementation.

12.1.3 Requirement for a Reasonable Restoration Time Frame

MTCA specifies that the selected cleanup action should "provide for a reasonable restoration time frame" per factors listed in WAC 173-340-360(4)(b), with the definition of reasonable being determined on a case-by-case basis. For this evaluation, restoration for groundwater is defined as achieving cleanup and/or action levels at the applicable point(s) of compliance. Restoration time frames estimated in this report are approximate, based on best professional judgment, and are intended for use in comparisons of the relative effectiveness of the alternatives. Under MTCA, preference is given to alternatives that, when compared to other alternatives for effectiveness, can be implemented in a shorter restoration timeframe.

12.1.4 Requirement for Consideration for Public Concerns

Consideration for public concerns is an inherent part of the cleanup process under MTCA (WAC 173-340-600). There are no known site-specific concerns by the public and none were expected to arise during implementation of any of the alternatives.

12.2 Evaluation and Comparison of Alternatives

This section evaluates and compares each of the proposed alternatives relative to the criteria discussed above. Each of the CAAs described in Section 11 would achieve the three CAOs presented in Section 9.5 and would meet all of the threshold requirements. Each alternative was therefore a viable and appropriate cleanup alternative under MTCA. Although BCH and PES

have selected and implemented Alternative 2, all three alternatives are discussed below to provide Ecology with a summary of the selection process.

12.2.1 Threshold Requirements

For each alternative to achieve threshold requirements, it must adequately protect human health and the environment, comply with cleanup standards, comply with state and federal laws, and provide for compliance monitoring. Each of the three alternatives would achieve the threshold requirements as follows:

- **Protect human health and the environment.** Each of the alternatives would be protective of human health and environment resulting in removal of soil contaminants exceeding CULs in Property soil, which will control leaching of contaminants to groundwater. The soil excavation activities would also be protective of Property workers who might contact the soil during subsequent construction activities because all soil exceeding cleanup levels would be removed. Alternative 1 relied on natural attenuation to degrade residual groundwater contamination, and Alternatives 2 and 3 utilized ORC-A to enhance the rate of aerobic biodegradation of residual petroleum hydrocarbons in groundwater. Each alternative included compliance monitoring and institutional controls to prevent use of shallow groundwater for drinking during remedy implementation.

- **Comply with cleanup standards.** Each of the alternatives would comply with the cleanup standards. All three alternatives would meet soil cleanup standards on-Property through the excavation of contaminated soil above CULs. All three alternatives were expected to initially achieve compliance with groundwater through the removal of the source materials in soil, and to meet groundwater cleanup standards at the point of compliance over the long term through natural attenuation (Alternative 1) and enhanced aerobic biodegradation (Alternatives 2 and 3).

- **Comply with applicable state and federal laws.** Each of the alternatives would comply with applicable state and federal laws.

- **Provide for compliance monitoring.** Each of the alternatives included compliance monitoring. Soil confirmation samples would be collected at the base and sidewalls of the excavations. Groundwater performance monitoring would be conducted during remedy implementation, and confirmation monitoring would be conducted when CULs are achieved.

12.2.2 Disproportionate Cost Analysis

The purpose of the DCA is to determine if the costs of a cleanup alterative are disproportionate to the human health and environmental benefits achieved by the cleanup action. The three alternatives are evaluated below using DCA criteria, and the evaluation is summarized in Table 8.

- **Protectiveness.** Factors that affect the overall protectiveness of human health and the environment include the degree to which existing risks are reduced, time required to reduce risk at the site and attain cleanup standards, on-site and off-site risks resulting from implementing the alternative, and improvement of the overall environmental quality. All of the alternatives would achieve protection of human health and the environment on-Property by excavating the contaminated soil to attain CULs that are protective of unrestricted land uses. The alternatives were expected to significantly reduce existing risks and improve environmental in a relatively short timeframe through removal of contaminated soil, and each alternative was expected to achieve groundwater compliance over the long term. Alternative 1 was the least protective, primarily resulting from the longest relative restoration timeframe. Alternative 2 was the most protective because it has the shortest time frame resulting from direct application of ORC-A pellets into the overexcavation backfill at the same elevation where impacted soil with contamination above CULs had been previously located. The Alternative 3 restoration time frame was expected to be longer due to the lack of even distribution of ORC slurry; however, permanent injection piping would be available for additional rounds of ORC-A slurry injections if needed. Alternative 3, however, was less protective compared to Alternative 2 due to injections at the bottom or beneath the residual groundwater plume and by the increased potential for corrosive airborne dust generation during slurry mixing.

- **Permanence.** Permanence is the degree to which the alternative permanently reduces the toxicity, mobility, or volume of hazardous substances, including the characteristics and quantity of treatment residuals generated. All three alternatives provided a high level of permanence through excavation and off-site disposal of contaminated soil exceeding CULs. Alternatives 2 and 3 provided a higher level of permanence compared to Alternative 1 by treating of residual petroleum hydrocarbons in groundwater through enhanced in-situ bioremediation. All three alternatives would generate the same volume of contaminated soil and groundwater requiring off-site disposal. Alternative 2 would generate the least volume of residual purge water during groundwater monitoring and requiring off-site disposal, and Alternative 1 would generate the most volume. Therefore, Alternative 2 was ranked as providing a higher level of permanence over Alternative 3 because it will achieve cleanup levels in a slightly shorter time frame.

- **Cost.** The cost to implement an alternative includes the cost of construction and the net present value of any long-term costs. The estimated lifetime costs for Alternatives 1 through 3 were $580,000, $640,000, and $670,000, respectively. These costs were further evaluated against the relative environmental benefit described in Section 12.2.3 and summarized in Table 8.

- **Effectiveness Over the Long Term.** Long-term effectiveness includes the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on site greater than CULs, and the effectiveness of controls in place to manage risk while contaminants remain in place. Each of the alternatives was considered to be effective over the long term because all exposure pathways would be effectively mitigated and each

alternative provides measures to reduce the residual risk posed by residuals. Contaminated soil removal above and below groundwater is a reliable treatment method and typically provides a high degree of certainty by removing primary source materials greater than CULs within a relative short period of time. Alternative 1 provided the lowest level of long-term effectiveness because it relied solely on natural attenuation processes to treat residual contaminants in groundwater, whereas Alternatives 2 and 3 utilized ORC-A to enhance the rate of aerobic biodegradation of residual petroleum hydrocarbons.

- **Management of Short-Term Risks.** Short-term risk includes the risk to human health and the environment associated with the alternative during construction and implementation. All three alternatives were expected to equally manage the limited short-term risks associated with each remedial action. The remedial construction activities would be conducted consistent with state and federal worker protection regulations and will use industry standard health and safety procedures to protect workers during construction activities. A health and safety plan would be developed outlining the specific requirements to protect remedial construction workers, including appropriate use of personal protective equipment and engineering controls.

- **Technical and Administrative Implementability.** Implementability is based on whether an alternative is technically possible, meets administrative and regulatory requirements, and if all necessary services, supplies, and facilities are readily available. The administrative implementability of all three alternatives was essentially the same because they include similar institutional control for limiting the use of groundwater as drinking water. The technologies proposed in each of the alternatives are commonly used at similar sites and services, supplies and facilities are readily available. A construction wastewater discharge permit is reasonably obtained prior to cleanup action implementation. Alternative 1 would be slightly more implementable than Alternative 2 due to slightly higher technical difficulty with evenly blending ORC-A pellets into the clean backfill. Alternative 3 would be less implementable than Alternative 2 due to corrosive dust control requirements and construction coordination issues for the slurry injection.

- **Consideration of Public Concerns.** Includes whether the community has concerns regarding the alternative and, if so, to what extent the alternative addresses those concerns. As described in Section 12.1.4, there were no known site-specific concerns by the public and none were expected to arise during implementation of any of the alternatives.

12.2.3 Disproportionate Cost Analysis Summary

The DCA for Alternatives 1, 2, and 3 is summarized and quantified in Table 8. Since all of the alternatives met the definition of a permanent cleanup action, the DCA was used to determine that Alternative 2 would provide the greatest degree benefit and is the baseline alternative for the DCA. As identified in Table 8, Alternative 2 received the highest overall weighted benefit score and the lowest cost per unit benefit ratio. Alternative 2 received the highest ranking largely due

to its protectiveness and permanence and is ranked (or tied for) the highest in all criteria except for technical implementability. Alternative 1 technical implementability ranked higher than Alternatives 2 and 3, mainly because the alternative does not include the additional tasks of backfill amendment or slurry injection included in the other two alternatives. Alternative 3 was ranked slightly lower than Alternative 2 in overall benefit, was the most expensive of the three alternatives, and thus had the highest cost to benefit ratio. Alternative 1 had the lowest overall benefit and ranked lowest of the three alternatives in protectiveness, permanence, and effectiveness over the long term.

12.2.4 Restoration Time Frame

Each alternative involved both short term and longer term actions that, when combined, result in the cleanup in reasonable restoration time frames. Based on site conditions and best professional judgment, the estimated restoration time frame was estimated at 3 to 4 years for Alternative 1, and 1 to 2 years for Alternative 2, and 2 to 3 years for Alternative 3. The estimated short-term actions included the removal of the primary sources of contamination and off-site disposal. Longer-term actions in Alternative 1 included allowing residual dissolved phase groundwater contamination to degrade naturally, and Alternatives 2 and 3 included enhancing biodegradation or residual contamination using oxygen release compounds. Each of the alternatives would meet Ecology's requirements for conducting cleanup actions at residential properties in that all of the contaminated soil exceeding CULs would be removed, and included on-going monitoring to confirm groundwater meets its CULs. The availability of municipal water supply and institutional controls would be effective in preventing use of shallow drinking water for drinking. The toxicity of site contaminants is moderate, and natural processes that reduce concentrations have been documented to occur at similar sites.

12.3 Recommended Cleanup Action

Alternative 2 was selected as the preferred cleanup alternative based on the above evaluation of each alternative, which includes compliance with the MTCA threshold requirements and other MTCA requirements, and the results of the DCA. Alternative 2 consists of the planned development excavation (removing soil to an elevation of approximately 282.5 feet), overexcavation of contaminated soil within areas exceeding groundwater CULs, off-site disposal of contaminated soil generated during excavation activities, and backfilling of overexcavated areas with clean fill amended with ORC-A pellets. Alternative 2 includes excavation of the contaminated soil and some contaminated groundwater, and the amended backfill will provide a long-term source of DO and inorganic micronutrients to stimulate biological activity and enhance biodegradation of residual hydrocarbons petroleum hydrocarbons in groundwater. Alternative 2 achieves each of the three CAOs and each of the threshold requirements, uses permanent solutions to the maximum extent practicable, and provides for a reasonable restoration time frame. The rationale for recommending Alternative 2 over Alternatives 1 and 3 is based on relatively subtle differences:

- Alternative 2 has the shortest restoration timeframe primarily due to application of ORC-A pellets directly into excavation backfill at the same elevation where impacted soil with contamination above CULs had been previously located, and is expected to result in greater benefit over ORC-A slurry injections at a lower elevation; and

- Alternative 2 ranks highest (or tied for highest) in the five of the six DCA criteria, and has the highest overall weighted score, and has the lowest unit cost per benefit ratio.

Implementation of Alternative 2 includes the general steps outlined below.

- Preparation of a work plan including a soil and groundwater management plan and a site health and safety plan;
- Decommissioning monitoring wells within the limits of Property development;
- Excavation of contaminated soil above CULs and disposal off site, collection of soil confirmation samples to confirm compliance with soil CULs at the horizontal and vertical limits of the excavations, and backfilling to elevation 282.5 feet with a mixture of clean fill and ORC-A pellets; and
- Installation of monitoring wells MW-6 through MW-10 and initiation of compliance groundwater monitoring and reporting.

Alternative 2 is expected to achieve groundwater CULs in all Site monitoring wells shortly after excavation and backfilling.

13.0 INTERIM CLEANUP ACTION

Based on the completion of the RI/FS and the selection of Alternative 2, BCH began implementing the selected alternative concurrent with redevelopment. This section describes the portions of the selected cleanup action that have been completed to date.

Property redevelopment was initiated in July 2013. All redevelopment excavation has been completed, and the components of Alternative 2 associated with the redevelopment excavation have also been completed, including well decommissioning, contaminated soil excavation, soil overexcavation, compliance monitoring, ORC-A application, and installation of one monitoring well with the Property footprint. Following are summaries of the cleanup actions completed to date.

13.1 Well Decommissioning

Monitoring wells on the Property were decommissioned prior to soil excavation. On July 31, 2013, Holt Services Inc. (Holt) of Edgewood, Washington, decommissioned MW-1, MW-2, MW-4, and MW-5 consistent with WAC 173-160-460. Holt decommissioned the wells by removing the surface monuments, filling the PVC screen and casing with bentonite chips, and finishing the surface of each well with concrete.

13.2 Soil Excavation

Soil excavation and related shoring and foundation work was conducted between July 2013 and January 2014. JR Hayes & Sons Inc. (Hayes) of Maple Valley, Washington, performed the earthwork and PES conducted the environmental oversight.

13.2.1 Soil Removal and Management

Soil was excavated to the depths required for construction or the planned overexcavation depths (see below). In addition to removing contaminated soil exceeding cleanup levels, soil containing detectable concentrations of petroleum hydrocarbons (referred to as "gray soil") was also being removed to support the redevelopment construction. Both types of contaminated soil (i.e. exceeding cleanup levels and gray soil) were typically managed similarly and disposed of at the same facility.

In general, soil exceeding cleanup levels in each of the three identified areas was placed in a central stockpile so that it could be loaded directly into trucks waiting on either the west or east sides of the properties. During excavation of areas with clean soil (i.e. no detectable contaminants), PES conducted field screening including field observations of possible impacts (e.g., color, sheen), soil odor, and photoionization (PID) measurements. If field screening indicated the possibility of impacts, the soil was placed in a lined stockpile. Soil samples were collected from each stockpile to confirm the status of the stockpile (clean or contaminated), and the soil was transported to the appropriate facility based on the soil classification. Stockpile

samples were analyzed for diesel- and oil-range hydrocarbons, and based on the results soil was classified as follows:

- **Clean Soil:** If no diesel- or oil-range hydrocarbons were detected, the soil in the stockpile was classified as clean;
- **Class II Soil:** If diesel- or oil-range hydrocarbons were detected but were below 450 mg/kg, the soil in the stockpile was classified as Class II soil; and
- **Class III Soil:** If diesel- or oil-range hydrocarbons were detected between 450 and 20,000 mg/kg, the soil in the stockpile was classified as Class III soil.

Clean soil was hauled to the Hayes facility in Maple Valley. Contaminated soil was transported to the CEMEX facility in Everett, Washington, for landfill disposal if categorized as Class II soil or for thermal treatment if categorized as Class III soil. A total of 13,312 tons of Class II soil and 5,205 tons of Class III soil (including the overexcavation areas) were removed from the Property and disposed of at the CEMEX facility. All of the Class II soil represents soil that contained petroleum hydrocarbons but at concentrations below the MTCA Method A cleanup level of 2,000 mg/kg.

13.2.2 Overexcavation

Consistent with the Alternative 2 CAA, soil was overexcavated in Areas 1, 2, and 3 (Figure 13). When the intended overexcavation limits were reached, confirmation soil samples were collected, as discussed in Section 13.4. Based on the results of the confirmation samples in the planned overexcavation areas (Areas 1, 2, and 3), these areas did not need to be excavated deeper than planned.

Based on field screening of soil, soil characterization samples collected during construction excavation, and USTs discovered during excavation (see Section 13.3), additional areas were overexcavated. These areas were overexcavated until field screening indicated that hydrocarbons in soil at the base of the excavation were likely relatively clean; soil samples were then collected to confirm that soil at the base was below Method A CULs. Figure 13 presents the limits of the unplanned overexcavation areas, including the areas where Class II and Class III soil were removed. Section 13.4 discusses the results of the confirmation soil sampling.

13.2.3 Soil Sampling

Soil samples were collected periodically to characterize soil as it was excavated from the Property, from the soil stockpiles, and at the limits of the excavation in contaminated areas. Soil samples were collected using clean stainless steel spoons. Samples were placed in laboratory prepared glass jars with Teflon-lined lids. Samples were placed in laboratory supplied insulated coolers and delivered with chain-of-custody forms to the laboratory for analysis of diesel- and oil-range hydrocarbons using Ecology Method NWTPH-Dx.

13.2.4 Water Management and Sampling

Water that collected during excavation at the Property (generated from rainfall and during excavating below the groundwater table) was collected in temporary sumps dug into the base of the excavation and then pumped into aboveground tanks for storage and settling of sediment. The water in the storage tank was initially tested to confirm that VOC and hydrocarbon concentrations met KCIW discharge limits and periodically tested for pH, settleable solids, and fats, oils, and grease (FOG) consistent with an approved discharge authorization. Water collected in the aboveground storage tanks was discharged directly to the sanitary sewer consistent with the discharge authorization. All collected water met the discharge limits without pre-treatment. A total of 161,275 gallons of excavation water was discharged to the sanitary sewer during the contaminated soil removal activities.

13.3 UST Decommissioning

Three USTs were discovered during redevelopment excavation (Figure 13). The tanks were uncovered, and UST decommissioning was overseen by a certified UST assessor from Tank Wise LLC. Each UST was emptied and cleaned by Marine Vacuum Services, Inc, tested by Sound Testing, and inspected by the Seattle Fire Marshal before removal and transport off site. All tank rinse water was transported off site for disposal. Following is a summary of each UST:

- **UST No 1:** This UST was located in the northwest corner of the Property, under the 1416 10th Avenue building. The 1,765 gallon UST was discovered and uncovered on September 16, 2013, and was removed on September 17. Approximately 1,200 gallons of black oil were removed from the UST during decommissioning. The UST contained visible corrosion with multiple holes. One base sample (CF-A1-100113) was collected on October 1, 2013, at elevation 282 directly under the UST. Neither diesel nor oil was detected above the laboratory MRLs in the base sample (Table 9). Two nearby sidewall samples (SW-WP-15-284 and SW-NP-3-284) collected at the edge of the development excavation contained either diesel or oil below the MTCA Method A CULs;

- **UST No 2:** This UST was located under the north side of the 1405 11th Avenue building. The approximately 2,000 gallon UST was discovered and uncovered, cleaned, tested, inspected, and removed on September 26, 2013. Approximately 2,000 gallons of water and 10 gallons of oily sludge were removed from the tank during decommissioning. Two sidewall samples (SP-2-092613-N and SP-2-092613-S) were collected and one base sample (UST-2-092613) was collected under the UST. Only the base sample was submitted for analysis of diesel and oil since the UST was located in the middle of the development excavation and the soil surrounding it on the north and east sides had already been removed prior to discovery. Neither diesel nor oil was detected above the laboratory MRLs in the base sample (Table 9). The soil to the south and west of UST No. 2 was removed, stockpiled, and subsequently disposed of as Class II soil. Samples of the bottom from this area did not detect diesel or oil; and

- **UST No 3:** This UST was located under the east side of the 1405 11th Avenue building. The approximately 3,000 gallon UST was discovered on October 10, 2013, and uncovered, cleaned, tested, inspected, and removed on October 11. One base sample (CF-D10-280) was collected on October 22, 2013, at the bottom of the excavation directly under the UST. Neither diesel nor oil was detected above the laboratory MRLs in the sample (Table 9). Soil surrounding this tank was excavated and disposed of as Class III, and confirmation samples were collected from the shoring wall located to the east and from the excavation bottom.

13.4 Compliance Monitoring

Confirmation soil samples were collected from the bottom and sidewalls of the contaminated areas once the required excavation depths were obtained or field screening indicated that the remaining soil was relatively clean. A total of 71 confirmation samples were collected and analyzed for diesel- and heavy oil-range hydrocarbons. Of the 71 confirmation samples, 37 samples were collected at the base of the excavation, and 34 were collected along the sidewalls of the excavation. In some instances, sidewall samples were collected from the interior of the development boundaries to demonstrate that the contaminated soil had been removed and that further excavation of soil in these areas could be managed as clean soil for disposal purposes.

The confirmation soil sampling results are summarized in Table 9 and on Figure 13. The concentrations of diesel and/or heavy oil in every sample collected at the bottom of the excavation were below the MTCA Method A CUL for diesel and oil (2,000 mg/kg). In 25 of the 37 excavation bottom samples analyzed, the concentrations of both diesel- and heavy oil-range hydrocarbons were below the laboratory MRLs. The concentrations of diesel and/or heavy oil in all but two of the final sidewall samples were below the Method A CULs. These two samples (SW-F11-BW-282 and SW-D11-283) were located along the east boundary of the development (Figure 13) and were collected from the development sidewall during the installation of the lagging for the shoring wall. Further excavation of this material could not be accomplished because it would have undermined the shoring. The concentrations in these two samples were 2,850 mg/kg and 4,600 mg/kg. Technically, both of these samples were collected from beyond the Property boundary because the shoring system excavations extended to the Property boundary.

Based on the results, all contaminated soil exceeding MTCA Method A CULs on the Property has been removed and properly disposed. There appears to be a limited amount of soil exceeding cleanup levels extending beneath the sidewalk at depth along a potion of the eastern Property line. The extent of this material is currently unknown, but will be evaluated once the construction activities in this area have been completed and access can be obtained.

13.5 ORC Application

On December 20, 2013, and January 4, 2014, PES observed the excavation subcontractor Hayes amend the clean fill in Areas 2 and 3 with ORC-A pellets. Hayes applied 3,606 pounds of ORC-A pellets in Area 2 and 342 pounds in Area 3 Hayes mechanically mixed the ORC-A

pellets into the backfill using a small tracked excavator bucket until the pellets were evenly mixed. The mixed material was then spread across the base of the excavation with the blade of the tracked excavator and compacted prior to surface completion.

13.6 Well Installation

On January 17, 2014, Cascade Drilling, L.P. installed monitoring well MW-6 with a hollow stem auger drill rig equipped with 4-inch inside diameter (i.d.) augers. The location of MW-6 is inside the Property boundary and is shown on Figures 10 through 12. To minimize the potential for heaving sand to affect the completion of the monitoring well, a wood plug was used to block the base of the auger during drilling; when the final drilling depth was reached, the auger was filled with water and the wood block was knocked out the bottom of the auger. MW-6 was installed consistent with WAC 173-160. The nominal 2-inch-diameter well was screened with 0.010-inch machine slotted Schedule 40 PVC well screen between 5 and 15 feet bgs and Schedule 40 PVC blank casing above that. The annulus between the well casing and the borehole was backfilled concurrent with casing withdrawal. The filter pack around the screen consisted of #2/16 Monterey Sand, which was placed up to approximately 1.5 feet above the top of the well screen. Bentonite chips were poured from approximately 2 to 3.5 feet bgs, and a concrete surface seal was used to set a flush-with-grade steel well monument. As-built well construction details, including the Ecology well tag number and materials used to construct the well, are included on the well log in Appendix B.

14.0 FUTURE CLEANUP ACTION ACTIVITIES

This section describes the work that will be performed to complete the cleanup action prior to requesting a no further action determination from Ecology. After redevelopment has proceeded to the point that the sidewalks around the Property can be accessed, additional monitoring well installation and compliance monitoring will be initiated.

14.1 Well Installation

Four monitoring wells will be installed in the sidewalks around the Property to allow for compliance monitoring. The monitoring well locations are shown on Figures 10 through 13. MW-7 will be installed in the sidewalk on the north side of East Union Street approximately 50 feet west of 11th Avenue. MW-8 and MW-9 will be installed in the sidewalk on the east side of 10th Avenue approximately 100 and 175 feet north of East Union Street, respectively. MW-10 will be installed in the sidewalk on the west side of 11th Avenue approximately 85 feet north of East Union Street. Similar to MW-6, the nominal 2-inch-diameter wells will be installed consistent with WAC 173-160, with screens installed between approximately 15 and 25 feet bgs, sand filter packs, bentonite chip annular seals, and flush-with-grade steel monuments set in concrete. Each monitoring well will be developed (by surging, bailing, and pumping) and surveyed prior to use in compliance monitoring.

14.2 Compliance Monitoring

After installation and development of the compliance monitoring wells, the six monitoring wells (MW-3 and MW-6 through MW-10) will be monitored quarterly to establish the effectiveness of the cleanup action (source removal and MNA). Monitoring will include water level measurement and groundwater sampling. All samples will be analyzed for the COCs (PCE and breakdown products, and diesel- and oil-range hydrocarbons). Additionally, one temporary boring will be installed in the sidewalk west of 11th Avenue to confirm the soil and groundwater conditions east of an area of impacted soil at the edge of the final excavation limits. The boring will be installed east of confirmation sample SW-F11-BW-282 (Figure 13), and soil and groundwater samples (if possible) will be collected in the boring.

Given the volume of soil removed during Property redevelopment and the application of ORC-A, PES anticipates that the effectiveness of the cleanup action will be confirmed with 1 year of monitoring, but performance monitoring will be continued longer if necessary (until cleanup levels are met). Confirmation monitoring will be conducted once cleanup levels have been met and will be conducted for a period of 1 year. Confirmation monitoring will consist of water level measurement and groundwater sampling, as in performance monitoring.

14.3 Reporting

After confirmation monitoring has been completed, a report summarizing the final clean action will be prepared and submitted to Ecology. The report will include a request for a No Further Action determination from Ecology.

15.0 CONCLUSION

An RI/FS was conducted at the BCH 11th & Union Development Property in Seattle, Washington. The RI determined the Property hydrogeology and nature and extent of contamination. A conceptual site model and cleanup levels were developed, and an FS was conducted that identified and evaluated three CAAs. The primary components of the selected CAA (excavation and off-site disposal of contaminated soil and targeted application of ORC-A pellets in excavation backfill) were completed during the initial stages of Property redevelopment. All contaminated soil above CULs at the Property was removed during that phase of the CA. The CA tasks yet to be completed include evaluation of a limited amount of soil exceeding CULs extending beneath the sidewalk at depth along a potion of the eastern Property line, installation of four compliance monitoring wells, and compliance monitoring of groundwater.

16.0 REFERENCES

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Table 1

Monitoring Well Completions
Broadstone Capitol Hill Property
Seattle, Washington

Well	Date Installed	Northing	Easting	Monitoring Point Elevation	Surface Casing Rim Elevation	Ground Surface Elevation	Well Type	Monument	Boring Depth	Screen Depth	Filter Pack Depth	Seal Depth
MW-1	3/30/2012	227,236.19	1,274,000.70	289.74	290.12	291.11	3/4" Sch 40 PVC, 0.010" slots	Flush	16	6 - 16	5 - 16	0 - 5
MW-2	3/30/2012	227,167.01	1,274,033.80	287.60	287.86	287.84	3/4" Sch 40 PVC, 0.010" slots	Flush	12	2 - 12	0.5 - 12	0 - 0.5
MW-3	3/30/2012	227,141.05	1,274,005.87	297.43	298.16	298.12	3/4" Sch 40 PVC, 0.010" slots	Flush	26	16 - 26	13.5 - 26	0 - 13.5
MW-4	3/29/2012	227,158.07	1,274,066.95	289.53	289.83	289.81	3/4" Sch 40 PVC, 0.010" slots	Flush	12	2 - 12	1.5 - 12	0 - 1.5
MW-5	3/29/2012	224,159.36	1,274,146.68	289.41	289.77	289.76	3/4" Sch 40 PVC, 0.010" slots	Flush	15	5 - 15	4 - 15	0 - 4

Notes:

North side of the well completions (top of PVC, surface casing rim, and ground surface adjacent to well) surveyed.
Northing/Easting in feet relative to the Washington State Plane System, North Zone (NAD 83/91).
Monitoring point (top of well casing) in feet relative to the North American Vertical Datum (NAVD 88), based upon SNV-2501 (elevation = 306.95 feet).
All depths shown in feet below ground surface.
Flush = completion flush with grade.

Table 2

Summary of Groundwater Elevations
Broadstone Capitol Hill Property
Seattle, Washington

Well	Date	Time	Northing	Easting	Monitoring Point Elevation	Depth to Water	Groundwater Elevation
MW-1	4/3/2012	1530	227,236.19	1,274,000.70	289.74	4.63	285.11
	8/6/2012	0327	227,236.19	1,274,000.70	289.74	5.51	284.23
	5/8/2013	–	227,236.19	1,274,000.70	289.74	5.11	284.63
	7/31/2013	0925	227,236.19	1,274,000.70	289.74	3.96	285.78
MW-2	4/3/2012	1635	227,167.01	1,274,033.80	287.60	2.39	285.21
	8/6/2012	0315	227,167.01	1,274,033.80	287.60	3.00	284.60
	5/8/2013	–	227,167.01	1,274,033.80	287.60	3.11	284.49
	7/31/2013	0930	227,167.01	1,274,033.80	287.60	3.75	283.85
MW-3	4/3/2012	1600	227,141.05	1,274,005.87	297.43	12.03	285.40
	8/6/2012	0331	227,141.05	1,274,005.87	297.43	12.80	284.63
	5/8/2013	–	227,141.05	1,274,005.87	297.43	12.75	284.68
	7/31/2013	0900	227,141.05	1,274,005.87	297.43	13.44	283.99
MW-4	4/3/2012	1455	227,158.07	1,274,066.95	289.53	4.22	285.31
	8/6/2012	0320	227,158.07	1,274,066.95	289.53	4.80	284.73
	5/8/2013	–	227,158.07	1,274,066.95	289.53	5.08	284.45
	7/31/2013	0920	227,158.07	1,274,066.95	289.53	5.69	283.84
MW-5	4/3/2012	1220	224,159.36	1,274,146.68	289.41	4.07	285.34
	8/6/2012	0323	224,159.36	1,274,146.68	289.41	4.36	285.05
	5/8/2013	–	224,159.36	1,274,146.68	289.41	4.84	284.57
	7/31/2013	0915	224,159.36	1,274,146.68	289.41	5.44	283.97

Notes:

1. Northing/Easting in feet relative to the Washington State Plane System, North Zone (NAD 83/91).
2. Monitoring point (top of well casing) in feet relative to the North American Vertical Datum (NAVD 88), based upon SNV-2501 (elevation = 306.95 feet).
3. All depths shown in feet below the monitoring point (top of PVC casing).
4. The MW-1 water levels measured on 5/8/2013 and 7/31/2013 may be erroneous based on the anomalously high calculated groundwater elevations, which are inconsistent with the calculated groundwater elevations for the other four wells on those dates. The MW-1 water levels on those dates may also indicatee a source of recharge to shallow groundwater in that area (e.g., a leaky water pipe or storm drain).
5. – = not available.

Table 3

Summary of 2012 Soil Analytical Results
Broadstone Capitol Hill Property
Seattle, Washington

Boring ID	Sample ID	Sample Depth (ft below grade)[1]	Estimated Sample Elevation (ft NAVD88)	Sample Date	Total Petroleum Hydrocarbons[2] in mg/kg					Select Volatile Organic Compounds (VOCs)[3] in mg/kg							
					Diesel (Fuel Oil)	Heavy Oil	Heavy Fuel Oil	Gasoline	Gasoline Range Organics	Benzene	Toluene	Ethylbenzne	Xylenes	TCE	Vinyl Chloride	PCE	Naphthalene
MTCA Method A Cleanup Levels[4]					**2,000**	**2,000**	**2,000**	**100 (30)[5]**	**100 (30)[5]**	**0.03**	**7**	**6**	**9**	**0.03**	**0.67[6]**	**0.05**	**5**
B-1	B-1-3	3	285	2/2/2012	<20.0	<50.1	ND	--	--	<0.0192	<0.0192	<0.0289	<0.0384	<0.0289	<0.00192	<0.0192	<0.0289
	B-1-6	6	282	2/2/2012	<15.5	<38.7	ND	--	--	<0.0168	<0.0168	<0.0253	<0.0336	<0.0253	<0.00168	<0.0168	<0.0253
	B-1-8	8	280	2/2/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
B-2	B-2-3	3	285	2/2/2012	**8,780**	**40.9**	ND	--	--	**0.273**	<0.0169	**1.07**	**0.1085**	<0.0253	<0.00169	<0.0169	**0.0272**
	B-2-6	6	282	2/2/2012	**1,500**	<48.1	ND	--	--	**0.122**	<0.0252	**3.11**	**0.0467**	<0.378	<0.00252	<0.0252	<0.0378
	B-2-9	9	279	2/2/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
B-3	B-3-3	3	285	2/2/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
	B-3-6	6	282	2/2/2012	<19.9	<49.8	ND	--	--	<0.0214	<0.0214	<0.0322	<0.0418	<0.0322	<0.00214	<0.0214	<0.0322
	B-3-8	8	280	2/2/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
B-4	B-4-3	3	285	2/2/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
	B-4-6	6	282	2/2/2012	<20.5	<51.1	ND	--	--	<0.0214	<0.0214	<0.321	<0.0418	<0.0321	<0.00214	<0.0214	<0.0321
	B-4-8	8	280	2/2/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
B-5	B-5-4	4	292	2/2/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
	B-5-8	8	288	2/2/2012	<24.1	<60.2	ND	--	--	<0.0262	<0.0262	<0.0393	<0.0524	<0.0262	<0.00262	<0.0262	<0.0262
	B-5-12	12	284	2/2/2012	<17.6	<44.1	ND	--	--	<0.0173	<0.0173	<0.0262	<0.0346	<0.0260	<0.00173	<0.0173	<0.0173
	B-5-16	16	280	2/2/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
	B-5-20	20	276	2/2/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
B-6	B-6-4	4	290	2/3/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
	B-6-8	8	286	2/3/2012	<20.8	<52.0	ND	--	--	<0.0192	<0.0192	<0.0287	<0.0384	<0.0287	<0.00192	<0.0192	<0.0192
	B-6-12	12	282	2/3/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
	B-6-16	16	278	2/3/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
B-7	B-7-4	4	288	2/3/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
	B-7-8	8	284	2/3/2012	<17.8	<44.6	ND	--	--	<0.0155	<0.0155	<0.0232	<0.0310	<0.0232	<0.00155	<0.0155	<0.0232
	B-7-12	12	280	2/3/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
	B-7-16	16	276	2/3/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
B-8	B-8-8	8	281	2/3/2012	**126**	<51.9	ND	--	--	<0.0185	<0.0185	<0.0277	<0.0370	<0.0277	<0.00185	<0.0185	<0.0277
	B-8-12	12	277	2/3/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
	B-8-16	16	273	2/3/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
B-9	B-9-4	4	295	2/3/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
	B-9-8	8	291	2/3/2012	<22.6	<56.6	ND	--	--	<0.0238	<0.0238	<0.0357	<0.0476	<0.0357	<0.00238	<0.0238	<0.0238
	B-9-12	12	287	2/3/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
	B-9-16	16	283	2/3/2012	--	--	--	--	--	--	--	--	--	--	--	--	--
B-10	B-10-3	3	286.8	2/7/2012	<22.2	<55.6	ND	--	--	<0.0219	<0.0219	<0.0329	<0.0438	<0.0329	<0.00219	<0.0219	<0.0219
	B-10-6	6	283.8	2/7/2012	**695**	<56.4	ND	--	--	--	--	--	--	--	--	--	--
	B-10-8.5	8.5	281.3	2/7/2012	<20.9	<52.3	ND	--	--	--	--	--	--	--	--	--	--
B-11	B-11-3	3	286.8	2/7/2012	<20.2	<50.4	--	--	--	<0.0175	<0.0175	<0.0263	<0.0350	<0.0263	<0.00175	<0.0175	<0.0175

Table 3

Summary of 2012 Soil Analytical Results
Broadstone Capitol Hill Property
Seattle, Washington

Boring ID	Sample ID	Sample Depth (ft below grade)[1]	Estimated Sample Elevation (ft NAVD88)	Sample Date	Total Petroleum Hydrocarbons[2] in mg/kg					Select Volatile Organic Compounds (VOCs)[3] in mg/kg							
					Diesel (Fuel Oil)	Heavy Oil	Heavy Fuel Oil	Gasoline	Gasoline Range Organics	Benzene	Toluene	Ethylbenzne	Xylenes	TCE	Vinyl Chloride	PCE	Naphthalene
MTCA Method A Cleanup Levels[4]					**2,000**	**2,000**	**2,000**	**100 (30)[5]**	**100 (30)[5]**	**0.03**	**7**	**6**	**9**	**0.03**	**0.67[6]**	**0.05**	**5**
B-12	B-12-3	3	287.7	2/7/2012	<21.3	<53.2	ND	--	--	<0.0250	<0.0250	<0.0376	<0.0500	<0.0376	<0.00250	<0.0250	<0.0376
	B-12-6	6	284.7	2/7/2012	**679**	<52.4	ND	--	--	<0.0191	<0.0191	<0.0286	<0.0282	<0.0286	<0.00191	<0.0191	<0.0286
	B-12-9	9	281.7	2/7/2012	**211**	<44.7	ND	--	--	<0.0180	<0.0180	<0.0270	<0.0360	<0.0270	<0.00180	<0.0180	<0.0270
B-13	B-13-3	3	287.7	2/7/2012	<21.6	<54.0	ND	--	--	<0.0222	<0.0222	<0.0333	<0.0444	<0.00222	<0.0333	<0.0222	<0.0333
	B-13-6	6	284.7	2/7/2012	**534**	<53.7	ND	--	--	<0.0266	<0.0266	<0.0399	<0.0532	<0.0399	<0.00266	<0.0266	<0.0399
	B-13-9	9	281.7	2/7/2012	**198**	<41.5	ND	--	--	<0.0223	<0.0223	<0.0334	<0.0446	<0.0334	<0.00223	<0.0223	<0.0334
B-14	B-14-3	3	286.8	2/7/2012	<21.6	**291**	ND	--	--	<0.0200	0.0219	<0.0300	<0.0400	<0.0300	<0.00200	<0.0200	<0.0200
	B-14-6	6	283.8	2/7/2012	**2,310**	<44.1	ND	--	--	--	--	--	--	--	--	--	--
	B-14-9	9	280.8	2/7/2012	<23.7	<59.3	ND	--	--	--	--	--	--	--	--	--	--
B-15	B-15-3	3	287	3/30/2012	--	--	--	--	--	--	--	--	--	<0.0296	<0.00197	<0.0197	--
	B-15-6	6	284	3/30/2012	--	--	--	--	--	--	--	--	--	<0.0219	<0.00146	<0.0146	--
	B-15-9	9	281	3/30/2012	--	--	--	--	--	--	--	--	--	<0.0246	<0.00164	<0.0164	--
B-16	B-16-3	3	286	3/30/2012	<22.0	<55.0	ND	--	--	--	--	--	--	<0.0304	<0.00202	<0.0202	--
	B-16-6	6	283	3/30/2012	<20.1	<50.2	ND	--	--	--	--	--	--	<0.0261	<0.00174	<0.0174	--
	B-16-9	9	280	3/30/2012	<18.3	<45.7	ND	--	--	--	--	--	--	<0.0282	<0.00188	<0.0188	--
B-17	B-17-3	3	284	3/30/2012	**111**	<53.9	ND	--	--	--	--	--	--	<0.0310	<0.00207	<0.0310	--
	B-17-6	6	281	3/30/2012	**312**	<48.5	ND	--	--	--	--	--	--	<0.0288	<0.00192	<0.0192	--
	B-17-9	9	278	3/30/2012	<17.7	<44.4	ND	--	--	--	--	--	--	<0.0240	<0.00160	<0.0160	--
B-18	B-18-4	4	284	3/28/2012	<19.7	<49.3	**2,940**	--	--	--	--	--	--	<0.0224	<0.00149	<0.0149	--
	B-18-8	8	280	3/28/2012	<20.4	<50.9	**2,830**	--	--	--	--	--	--	<0.0278	<0.00186	<0.0186	--
B-19	B-19-3	3	287.7	3/29/2012	<21.0	<52.5	ND	--	--	--	--	--	--	<0.0313	<0.00209	<0.0209	--
	B-19-6	6	284.7	3/29/2012	**66.5**	<50.6	ND	--	--	--	--	--	--	<0.0229	<0.00153	<0.0153	--
	B-19-9	9	281.7	3/29/2012	<19.1	<47.7	ND	--	--	--	--	--	--	<0.0275	<0.00184	<0.0184	--
B-20	B-20-4	4	285.8	3/28/2012	<23.5	<58.8	ND	--	--	--	--	--	--	--	--	--	--
	B-20-7	7	282.8	3/28/2012	**994**	<48.9	ND	--	--	--	--	--	--	--	--	--	--
	B-20-10	10	279.8	3/28/2012	<19.1	<47.9	ND	--	--	--	--	--	--	--	--	--	--
	B-20-13	13	276.8	3/28/2012	<18.8	<46.9	ND	--	--	--	--	--	--	--	--	--	--
	B-20-15	15	274.8	3/28/2012	<18.8	<47.1	ND	--	--	--	--	--	--	--	--	--	--
B-21	B-21-4	4	285.8	3/29/2012	<22.0	<54.9	ND	--	--	--	--	--	--	<0.0375	<0.00250	<0.0250	--
	B-21-8	8	281.8	3/29/2012	**1,820**	<50.4	ND	--	--	--	--	--	--	<0.0328	<0.00219	<0.0219	--
	B-21-11	11	278.8	3/29/2012	<17.6	<44.0	ND	--	--	--	--	--	--	<0.0245	<0.001663	<0.0163	--
B-22	B-22-3	3	287.7	3/29/2012	**2,550**	<482	ND	--	--	--	--	--	--	--	--	--	--
	B-22-6	6	284.7	3/29/2012	**58.7**	<47.2	ND	--	--	--	--	--	--	--	--	--	--
	B-22-9	9	281.7	3/29/2012	<18.8	<47.0	ND	--	--	--	--	--	--	--	--	--	--

Table 3

Summary of 2012 Soil Analytical Results
Broadstone Capitol Hill Property
Seattle, Washington

Boring ID	Sample ID	Sample Depth (ft below grade)[1]	Estimated Sample Elevation (ft NAVD88)	Sample Date	Total Petroleum Hydrocarbons[2] in mg/kg					Select Volatile Organic Compounds (VOCs)[3] in mg/kg							
					Diesel (Fuel Oil)	Heavy Oil	Heavy Fuel Oil	Gasoline	Gasoline Range Organics	Benzene	Toluene	Ethylbenzne	Xylenes	TCE	Vinyl Chloride	PCE	Naphthalene
MTCA Method A Cleanup Levels[4]					**2,000**	**2,000**	**2,000**	**100 (30)[5]**	**100 (30)[5]**	**0.03**	**7**	**6**	**9**	**0.03**	**0.67[6]**	**0.05**	**5**
B-23	B-23-4	4	285.8	3/29/2012	<23.3	<58.3	ND	--	--	--	--	--	--	--	--	--	--
	B-23-8	8	281.8	3/29/2012	<19.9	<49.8	ND	--	--	--	--	--	--	--	--	--	--
	B-23-11	11	278.8	3/29/2012	<21.4	<53.6	ND	--	--	--	--	--	--	--	--	--	--
B-24	B-24-4	4	285.8	3/29/2012	**1,640**	<52.4	ND	--	--	--	--	--	--	--	--	--	--
	B-24-8	8	281.8	3/29/2012	**4,500**	<505	ND	--	--	--	--	--	--	--	--	--	--
	B-24-11	11	278.8	3/29/2012	<18.1	<45.3	ND	--	--	--	--	--	--	--	--	--	--
B-25	B-25-4	4	284	3/28/2012	--	--	--	--	--	--	--	--	--	<0.0198	<0.00132	<0.0132	--
	B-25-8	8	280	3/28/2012	--	--	--	--	--	--	--	--	--	<0.0243	<0.00162	<0.0162	--
	B-25-10	10	278	3/28/2012	--	--	--	--	--	--	--	--	--	<0.0191	<0.00128	<0.0128	--
B-26	B-26-4	4	284	3/28/2012	--	--	--	--	--	--	--	--	--	<0.0229	<0.00153	<0.0153	--
	B-26-8	8	280	3/28/2012	--	--	--	--	--	--	--	--	--	<0.0238	<0.00158	<0.0158	--
	B-26-10	10	278	3/28/2012	--	--	--	--	--	--	--	--	--	<0.0182	<0.00121	<0.0121	--
HA-1	HA-1-1.5	1.5	290.3	2/2/2012	**68.7**	<53.5	ND	--	--	<0.0172	<0.0172	<0.0258	<0.0344	<0.0258	<0.00172	<0.0172	<0.0258
HA-2	HA-2-1.5	1.5	290.4	2/2/2012	<21.3	<53.2	ND	--	--	<0.0163	<0.0163	<0.0244	<0.0326	<0.0244	<0.00163	<0.0244	<0.0163
PB-1 (BH-3)	PB-1-5	5	286.4	2/24/2012	<46.2	<92.3	ND	<18.5	ND	<0.0232	<0.0232	<0.0348	<0.0232	<0.0348	<0.00232	<0.0232	<0.0348
	PB-1-10	10	281.4	2/24/2012	<44.0	<88.1	ND	<17.6	ND	<0.202	<0.0202	<0.0303	<0.0202	<0.0303	<0.00202	<0.0202	<0.0303
	PB-1-15	15	276.4	2/24/2012	<41.6	<83.3	ND	<16.7	ND	<0.0166	<0.0166	<0.0249	<0.0166	<0.0249	<0.00166	<0.0166	<0.0249
PB-2 (BH-2)	PB-2-5	5	286.9	2/24/2012	<50.9	<102	ND	<20.4	ND	<0.0198	<0.0198	<0.0298	<0.0198	<0.0298	<0.00198	<0.0198	<0.0298
	PB-2-10	10	281.9	2/24/2012	<50.4	<101	ND	<20.2	ND	<0.086	<0.0186	<0.0279	<0.0186	<0.0279	<0.00186	<0.0186	<0.0279
	PB-2-15	15	276.9	2/24/2012	<48.7	<97.4	ND	<19.5	ND	<0.0167	<0.0167	<0.0251	<0.0167	<0.0251	<0.00167	<0.0167	<0.0251
PB-3 (BH-1)	PB-3-15	15	282.4	2/24/2012	<46.9	<93.8	ND	<28.1	ND	<0.0159	<0.0159	<0.0238	<0.0159	<0.0238	<0.00159	<0.0159	<0.0238
	PB-3-20	20	277.4	2/24/2012	<45.3	<90.5	ND	<27.2	ND	<0.0181	<0.0181	<0.0271	<0.0181	<0.0271	<0.00181	<0.0181	<0.0271
	PB-3-25	25	272.4	2/24/2012	<47.4	<94.9	ND	<28.5	ND	<0.0161	<0.0161	<0.0241	<0.0161	<0.0241	<0.00161	<0.0161	<0.0241
MW-1	MW-1-3	3	287	3/30/2012	--	--	--	--	--	--	--	--	--	<0.0222	<0.00148	<0.0148	--
	MW-1-6	6	284	3/30/2012	--	--	--	--	--	--	--	--	--	<0.0271	<0.00181	<0.0181	--
	MW-1-9	9	281	3/30/2012	--	--	--	--	--	--	--	--	--	<0.0270	<0.00180	<0.0180	--
	MW-1-12	12	278	3/30/2012	--	--	--	--	--	--	--	--	--	<0.0237	<0.00158	<0.0158	--
MW-2	MW-2-4	4	284	3/30/2012	--	--	--	--	--	--	--	--	--	<0.0259	<0.00173	<0.0173	--
	MW-2-8	8	280	3/30/2012	--	--	--	--	--	--	--	--	--	<0.0294	<0.00196	<0.0196	--
	MW-2-12	12	276	3/30/2012	--	--	--	--	--	--	--	--	--	<0.0299	<0.00199	<0.0199	--
MW-3	MW-3-4	4	293.4	3/30/2012	--	--	--	--	--	--	--	--	--	<0.0134	<0.000896	<0.00896	--
	MW-3-8	8	289.4	3/30/2012	--	--	--	--	--	--	--	--	--	<0.0273	<0.00182	<0.0182	--
	MW-3-12	12	285.4	3/30/2012	--	--	--	--	--	--	--	--	--	<0.0258	<0.00172	<0.0172	--
	MW-3-16	16	281.4	3/30/2012	--	--	--	--	--	--	--	--	--	<0.0234	<0.00156	<0.0156	

Table 3

Summary of 2012 Soil Analytical Results
Broadstone Capitol Hill Property
Seattle, Washington

Boring ID	Sample ID	Sample Depth (ft below grade)[1]	Estimated Sample Elevation (ft NAVD88)	Sample Date	Total Petroleum Hydrocarbons[2] in mg/kg					Select Volatile Organic Compounds (VOCs)[3] in mg/kg							
					Diesel (Fuel Oil)	Heavy Oil	Heavy Fuel Oil	Gasoline	Gasoline Range Organics	Benzene	Toluene	Ethylbenzne	Xylenes	TCE	Vinyl Chloride	PCE	Naphthalene
MTCA Method A Cleanup Levels[4]					**2,000**	**2,000**	**2,000**	**100 (30)[5]**	**100 (30)[5]**	**0.03**	**7**	**6**	**9**	**0.03**	**0.67[6]**	**0.05**	**5**
MW-4	MW-4-4	4	286	3/29/2012	**1,000**	<51.8	ND	--	--	--	--	--	--	--	--	--	--
	MW-4-8	8	282	3/29/2012	<19.4	<48.5	ND	--	--	--	--	--	--	--	--	--	--
	MW-4-10	10	280	3/29/2012	<18.3	<45.7	ND	--	--	--	--	--	--	--	--	--	--
MW-5	MW-5-3	3	287	3/29/2012	**1,520**	<53.8	ND	--	--	--	--	--	--	--	--	--	--
	MW-5-6	6	284	3/29/2012	**473**	<58.4	ND	--	--	--	--	--	--	--	--	--	--
	MW-5-10	10	280	3/29/2012	**2,270**	<483	ND	--	--	--	--	--	--	--	--	--	--

Notes:

All analytical results reported in miligrams per kilogram (mg/kg) or parts per million (ppm).
TCE = Trichloroethylene.
PCE - Tetrachloroethylene.
MTCA - Washington State Department of Ecology Model Toxics Control Act.
ND = Analyte not detected in chromatogram.
-- = Not analyzed.
< = Not detected at or above the laboratory method reporting limit (MRL).
Bold denotes consituent detected at or above the laboratory MRL.
Shaded denotes concentration detected above MTCA Method A cleanup level.
Sample Depth reported feet below grade (ground surface for exterior borings and finished floor elevation for interior borings).
1 = Sample depth represents feet below grade (ground surface for exterior borings and finished floor elevation for interior borings)..
2 = Analytical results by gas chromatography by Washington State Department of Ecology Methods NWTPH-Dx and NWTPH-HCID.
3 = Analytical results by gas chromatography and mass spectrometry by EPA Method 8260.
4 = MTCA Method A soil cleanup level for unrestricted land use unless otherwise specified.
5 = MTCA Method A soil cleanup level for gasoline range organics for unrestricted land uses is 100 mg/kg for soil with benzene, toulene, ethylbenezene, and/or xylenes present at concentrations greater than 1% and 30 mg/kg for all other mixtures.
6 = MTCA Method B cleanup level for direct contact for carcingenicity for vinyl chloride in soil.

Table 4

Summary of 2012 Temporary Boring Groundwater Analytical Results
Broadstone Capitol Hill Property
Seattle, Washington

Sample No.	Total Depth of Boring (ft)[1]	Sample Date	Total Petroleum Hydrocarbons[2] in µg/L					Select Volatile Organic Compounds (VOCs)[3] in µg/L							
			Diesel (Fuel Oil)	Heavy Oil	Heavy Fuel Oil	Gasoline	Gasoline Range Organics	Benzene	Toluene	Ethylbenzene	Xylenes	TCE	Vinyl Chloride	PCE	Naphthalene
MTCA Method A Cleanup Levels			**500**	**500**	**500**	**1,000 (800)[4]**	**1,000 (800)[4]**	**5**	**1,000**	**700**	**1,000**	**5**	**0.2**	**5**	**160**
B-1	8	2/2/2012	**138**	<100	ND	--	--	<1.00	<1.00	<1.00	<2.00	<1.00	<0.200	<1.00	<1.00
B-2	9	2/2/2012	**6,090**	<100	ND	--	--	**12.5**	<1.00	**95.8**	**1.64**	<1.00	<0.200	<1.00	<1.00
B-3	8	2/2/2012	<50.0	<100	ND	--	--	<1.00	<1.00	<1.00	<2.00	<1.00	<0.200	<1.00	<1.00
B-4	8	2/2/2012	<50.0	<100	ND	--	--	<1.00	<1.00	<1.00	<2.00	<1.00	<0.200	<1.00	<1.00
B-5	20	2/2/2012	<50.0	<100	ND	--	--	<1.00	<1.00	<1.00	<2.00	<1.00	<0.200	<1.00	<1.00
B-6	16	2/3/2012	**69.3**	<100	ND	--	--	<1.00	<1.00	<1.00	<2.00	<1.00	<0.200	<1.00	<1.00
B-7	16	2/3/2012	**75.4**	<100	ND	--	--	<1.00	<1.00	<1.00	<2.00	<1.00	<0.200	<1.00	<1.00
B-8	16	2/3/2012	**249**	<100	ND	--	--	<1.00	<1.00	<1.00	<2.00	**7.74**	**0.490**	**35.5**	<1.00
B-9	16	2/3/2012	**116**	<100	ND	--	--	<1.00	<1.00	<1.00	<2.00	<1.00	<0.200	<1.00	<1.00
B-12	9	2/7/2012	**547,000**	<500	ND	<400	ND	<1.00	<1.00	<1.00	<2.00	<1.00	<0.200	<1.00	**12.9**
B-13	9	2/7/2012	**2,330**	<500	ND	<400	ND	<1.00	<1.00	<1.00	<2.00	<1.00	<0.200	<1.00	<1.00
B-16	12	2/24/2012	**177**	<100	ND	--	--	--	--	--	--	<1.00	<0.200	<1.00	--
B-17	12	3/30/2012	**286**	<100	ND	--	--	--	--	--	--	<1.00	<0.200	<1.00	--
B-18	10	3/28/2012	<5,000	<10,000	**194,000**	--	--	--	--	--	--	<1.00	<0.200	<1.00	--
B-19	10	3/30/2012	**3,560**	<100	ND	--	--	--	--	--	--	<1.00	<0.200	<1.00	--
B-20	15	3/28/2012	**1,250**	<100	ND	--	--	--	--	--	--	<1.00	<0.200	<1.00	--
B-21	11	3/29/2012	**961,000**	<100,000	ND	--	--	--	--	--	--	<1.00	**0.410**	<1.00	--
B-22	10	3/29/2012	**6,720**	<100	ND	--	--	--	--	--	--	<1.00	<0.200	<1.00	--
B-24	11	3/29/2012	**121,000**	<10,000	ND	--	--	--	--	--	--	<1.00	<0.200	<1.00	--
B-25	10	3/28/2012	--	--	ND	--	--	--	--	--	--	<1.00	<0.200	<1.00	--
B-26	10	3/28/2012	<50.0	--	ND	--	--	--	--	--	--	<1.00	<0.200	<1.00	--
BH-1 (PB-3)[5]	18	2/24/2012	<500	<500	ND	<400	ND	<1.00	<1.00	<1.00	<1.00	**24.7**	<0.200	<1.00	<1.00
BH-2 (PB-2)[5]	10	2/24/2012	<500	<500	ND	<400	ND	<1.00	<1.00	<1.00	<1.00	<1.00	<0.200	<1.00	<1.00
BH-3 (PB-1)[5]	10	2/24/2012	<500	<500	ND	<400	ND	<1.00	<1.00	<1.00	<1.00	<1.00	<0.200	<1.00	<1.00

Notes:

All analytical results reported in micrograms per liter (mg/L) or parts per billion (ppb).
TCE = Trichloroethylene.
PCE = Tetrachloroethylene.
MTCA = Washington State Department of Ecology Model Toxics Control Act.
ND = Analyte not detected in chromatogram.
-- = Not analyzed.
< = Not detected at or above the laboratory method reporting limit (MRL).
Bold denotes consituent detected at or above the laboratory MRL.
Shaded denotes concentration detected above MTCA Method A cleanup level.
1 = Sample depth represents feet below grade (ground surface for exterior borings and finished floor elevation for interior borings).
2 = Analytical results by gas chromatography by Washington State Department of Ecology Methods NWTPH-HCID and NWTPH-Dx.
3 = Analytical results by gas chromatography and mass spectrometry by EPA Method 8260.
4 = Cleanup value of 1,000 µg/L for gasoline mixtures without benzene present and 800 mg/L for gasoline mixtures with detectable benzene present.
5 = Geotechnical borings PB-1, PB-2, & PB-3 renamed by PanGeo BH-3, BH-2, & BH-1, respectively.

Table 5

Summary of 2012 Monitoring Well Groundwater Analytical Results
Broadstone Capitol Hill Property
Seattle, Washington

Monitoring Well ID	Sample Date	Total Petroleum Hydrocarbons[1]		Select Volatile Organic Compounds[2]		
		Diesel (Fuel Oil)[3]	Heavy Oil	TCE	Vinyl Chloride	PCE
MTCA Method A Cleanup Levels		**500**	**500**	**5**	**0.2**	**5**
MW-1	4/3/2012	**759**	<100	**7.56**	<0.200	**20.1**
MW-2	4/3/2012	**202**	**214**	<1.00	<0.200	<1.00
MW-3	4/3/2012	**235**	<100	**1.09**	<0.200	<1.00
MW-4	4/3/2012	**6,120**	<100	<1.00	<0.200	<1.00
MW-5	4/3/2012	**94,700**	<10,000	<1.00	<0.200	<1.00

Notes:

All analytical results reported in micrograms per liter (µg/L) or parts per billion (ppb).
TCE = Trichloroethylene.
PCE = Tetrachloroethylene.
MTCA = Washington State Department of Ecology Model Toxics Control Act.
< = Not detected at or above the laboratory method reporting limit (MRL).
Bold denotes consituent detected at or above the laboratory MRL.
Shaded denotes concentration detected above the MTCA Method A cleanup level.
1 = Analytical results by gas chromatography by Washington State Department of Ecology Methods NWTPH-HCID and NWTPH-Dx.
2 = Analytical results by gas chromatography and mass spectrometry by EPA Method 8260.
3 = Analytical results by gas chromatography by Washington State Department of Ecology Method NWTPH-Dx with silica gel cleanup.

Table 6

Preliminary Cleanup Action Technologies
Broadstone Capitol Hill Property
Seattle, Washington

Technology Category	Preliminary Technology
Institutional Controls (Soil and Groundwater)	Land-Use Restrictions Worker Protection Measures Access Restrictions
Engineering Controls (Soil and Groundwater)	Surface Barrier or Cap
Biological Treatment (Saturated Soil and Groundwater)	Monitored Natural Attenuation Enhanced Aerobic Biodegradation - Oxygen Releasing Compounds - Biosparging
Physical Treatment (Soil and Groundwater)	Source Removal - Excavation and Disposal Air Sparging and Soil Vapor Extraction Pump and Treat

Table 7

Cleanup Action Technology Screening
Broadstone Capitol Hill Property
Seattle, Washington

Technology	Description	General Applicability/Limitations	Comments Specific to Broadstone Capitol Hill Properties			Retained?
			Effectiveness[a]	Implementability[b]	Relative Remediation Cost[c]	
Institutional Controls (Soil and Groundwater)						
Water- and Land-Use Restrictions	Restrict use of groundwater for domestic or industrial purposes where contaminant concentrations are above regulatory limits. Define requirements to limit exposure if land use changes.	**Applicability.** Common controls to reduce exposure. **Limitations.** Can be difficult to implement for off-site locations.	**Medium to High.** Can prevent human exposure to contaminated soil and groundwater on-site.	**Easy.** Easy to implement on site.	**Capital:** Low **O&M:** Low **Overall:** Low	Yes
Worker Protection Measures	Health and safety techniques such as personal protective equipment, monitoring, and planning are implemented to protect workers involved subsurface activities.	**Applicability.** Common controls to reduce exposure. **Limitations.** None.	**Medium to High.** Can prevent human exposure to contaminated soil and groundwater on-site.	**Easy.** Easy to implement on site.	**Capital:** Low **O&M:** Low **Overall:** Low	Yes
Access Restrictions	Restrict access by unauthorized personnel to site.	**Applicability.** Common controls to reduce exposure. **Limitations.** None.	**Medium.** Can prevent human exposure to contaminated soil and groundwater on-site.	**Easy.** Easy to implement on site.	**Capital:** Low **O&M:** Low **Overall:** Low	Yes
Engineering Controls (Soil and Groundwater)						
Surface Barrier or Cap	Construct and maintain a surface barrier to control contact with contaminated soil and to reduce the mobility or migration of site contaminants by preventing infiltration of precipitation.	**Applicability.** Surface barriers and caps are well established technologies. **Limitations.** None.	**Low.** The planned 8-story building with below ground parking level will eliminate the need for capping because the development will be very effective at controlling direct contact with potentially contaminated soils and preventing infiltration of precipitation.	**Moderately Difficult.** Surface barriers or capping in addition to the planned development would be difficult to design, and coordinate with the functionality of the 8-story building systems (structural, envelope, etc).	**Capital:** Moderate **O&M:** Low **Overall:** Moderate	No
Biological Treatment (Saturated Soil and Groundwater)						
Monitored Natural Attenuation	Natural processes such as dilution, volatilization, biodegradation, adsorption, and chemical reactions are used to reduce contaminant concentrations, potentially to acceptable levels.	**Applicability.** Common element of cleanup programs for fuel hydrocarbons and halogenated VOCs. Can be used as a stand alone technology or to manage residual contamination following site stabilization and source control activities. **Limitations.** Long-term monitoring required until groundwater COC concentrations are in compliance with CULs.	**Low to Medium.** Site data indicate ongoing natural attenuation is occurring in soil and groundwater due to limited presence of contaminants in downgradient and off property soil and groundwater samples. Degradation rate and ultimate concentrations that can be attained are unknown.	**Easy to Moderately Difficult.** Does not cause impacts to site operations and can be implemented under planned site use conditions. Contributes to achievement of CAOs when used in combination with other technologies.	**Capital:** Low **O&M:** Low/Moderate **Overall:** Low	Yes

Table 7

Cleanup Action Technology Screening
Broadstone Capitol Hill Property
Seattle, Washington

Technology	Description	General Applicability/Limitations	Comments Specific to Broadstone Capitol Hill Properties			Retained?
			Effectiveness[a]	Implementability[b]	Relative Remediation Cost[c]	
Enhanced Aerobic Biodegradation - Oxygen Releasing Compounds	Distribute chemical products which slowly release oxygen and nutrients to increase groundwater dissolved oxygen over an extended time period (e.g., 3 to 12 months) and increase the rate of intrinsic biodegradation in soil and groundwater.	**Applicability.** Commonly used for passive soil and groundwater remediation of fuel related hydrocarbons. Readily available through remediation vendors. **Limitations.** Works passively so it is important to have a good understanding of site lithology in order to design an appropriate grid for distributing oxygen throughout the contaminated media. Sites with lower permeability soils (e.g., silty sands and silts) will require a more dense distribution grid than sites with higher permeability soils (e.g., sands and gravels). Chemical products are an oxidizing material, corrosive (pH 11 – 13), and care is required to keep separate from incompatible materials, kept dry, and protected from heat sources and direct sunlight until use. Personal protective gear is recommended during material handling, distribution, and mixing.	**Low to Medium.** Volatile aromatic fuel hydrocarbons will readily biodegrade in the presence of dissolved oxygen. Semi-volatile fuel hydrocarbons (diesel, heavy oil, and fuel oils) will biodegrade more slowly.	**Moderately Difficult.** The products may be deployed in dry form (powder, 3-10 mm pellets) in trenches or excavations during backfilling, or may be deployed in a liquid slurry form (made onsite using powder form and water) and injected into the subsurface post development. Post development application would require installation of a subsurface slotted piping distribution network and use of injection pumps to deliver the product. These products are designed for one-time use and replacement may be required when the source of oxygen is depleted (e.g., 3 to 12 months). Mixing of powder material into a slurry requires specialized equipment and spray water to manage airborne dust.	**Capital:** Moderate **O&M:** Low/Moderate **Overall:** Moderate	Yes
Enhanced Aerobic Biodegradation - Biosparging	Air is injected into groundwater at limited flow rates and pressures to increase dissolved oxygen and increase the rate of intrinsic biodegradation in soil and groundwater.	**Applicability.** Target contaminants for biosparging include VOCs and fuels. **Limitations.** Effectiveness requires uniform flow of air through saturated soil. Sites with lower permeability soils (e.g., silty sands and silts) will require a more dense distribution grid than sites with higher permeability soils (e.g., sands and gravels).	**Low to Medium.** Volatile aromatic fuel hydrocarbons will readily biodegrade in the presence of dissolved oxygen. Semi-volatile fuel hydrocarbons (diesel, heavy oil, and fuel oils) will biodegrade more slowly.	**Moderately Difficult.** Requires an air compressor, slotted in injection piping network, and flush grade access vaults on the parking level. . Important to distribute a low pressures and match the rates of injection to microbial oxygen uptake to prevent uncontrolled movement of potentially dangerous vapors. Requires monthly O&M to maintain and ensure proper operation.	**Capital:** Moderate **O&M:** Moderate **Overall:** Moderate	No
Physical Treatment (Saturated Soil and Groundwater)						
Source Removal - Excavation and Off-Site Disposal	Soil is removed with construction equipment and transported off-site for proper disposal.	**Applicability.** Commonly used for soil remediation. **Limitations**. Minimal limitations in areas readily accessible with construction equipment. Can be expensive to implement due to land disposal costs. May require shoring if open cuts cannot be made. Dewatering and/or water management and disposal may be required for excavations which extend below the groundwater table.	**High.** Results in short term removal of contaminated soil and reducing contaminant mass in a short timeframe. Excavation in areas of impacted groundwater removes the ongoing source of contaminants to groundwater. Potential to achieve CAOs as a stand alone technology.	**Moderate.** Soil excavation and dewatering will be conducted as part of planned redevelopment, and combined with insitu treatment technologies or MNA. is likely to achieve CAOs. Over-excavation below the elevation of planned redevelopment in areas of impacted groundwater may achieve CAOs as a stand alone technology.	**Capital:** High **O&M:** None **Overall:** Moderate	Yes

Table 7

Cleanup Action Technology Screening
Broadstone Capitol Hill Property
Seattle, Washington

Technology	Description	General Applicability/Limitations	Comments Specific to Broadstone Capitol Hill Properties			Retained?
			Effectiveness[a]	Implementability[b]	Relative Remediation Cost[c]	
Air Sparging and Soil Vapor Extraction	Air is injected into groundwater to volatilize contaminants and soil vapors are extracted from the vadose zone by applying a vacuum to the subsurface, to further extract and contain volatile chemicals from groundwater and the soils. May include treatment of extracted vapors.	**Applicability.** Commonly applied for remediation of VOCs and fuels. Air sparging removal mechanisms can include stripping and enhanced bioremediation. Aeration can promote aerobic biodegradation in soil and groundwater. **Limitations.** Effectiveness requires uniform flow of air through saturated soil. Heterogeneous soils can result in non-uniform treatment and uncontrolled movement of potentially dangerous vapors. Oxygen could cause oxidation and precipitation of iron in groundwater. SVE flow rates are typically 2 to 3 times greater than air sparging flow rates to ensure complete capture and prevent migration of injected air and resulting soil vapors. High saturation and fine textures limit SVE airflow and require higher vacuums.	**Low to Medium.** Concepts of air sparging and SVE are well understood. Volatile fuel hydrocarbons will be readily removed from soil and groundwater. Semi-volatile fuel hydrocarbons (diesel, heavy oil, and fuel oils) will generally be more amenable to biodegradation rather difficult typical air sparging and SVE processes. Low permeability saturated soils and limited contaminant mass remaining following development related excavation limits the cost effectiveness of this technology.	**Difficult.** Requires an extensive network of air sparging wells installed at least 10 feet below groundwater, air sparging conveyance lines, SVE collection piping network, and flush grade access vaults on the parking level. Shallow depth to water and building footings will limit the influence area of individual SVE collection pipes. Equipment soundproofing and dedicated equipment room/area will be required. Residual liquids may require treatment/disposal.	**Capital:** Moderate to High **O&M:** Moderate **Overall:** Moderate	No
Pump and Treat	Groundwater is pumped to extract contaminants and generate hydraulic gradients that contain the contaminant plume. Extracted groundwater is treated above ground.	**Applicability.** Common for achieving hydraulic control and recovering contaminant mass. **Limitations.** Source-area remediation by pump-and-treat alone is typically slow. Site hydrogeology and sorption processes are typical limitations. Costs of installation and operation are typically moderate to high. Biofouling and precipitation of inorganics (e.g., iron) can adversely affect system performance. Extracted groundwater must be treated and discharged.	**Low to Medium.** Concepts of groundwater pumping are well understood. Low permeability soils will limit pumping rates and limit contaminant transfer to extracted groundwater. Shallow contaminants may become smeared downward during groundwater extraction. Limited contaminant mass remaining following development related excavation limits the cost effectiveness of this technology.	**Moderately Difficult.** Requires extraction wells or trenches, groundwater conveyance piping, and flush grade access vaults on the parking level. Extraction pumps and treatment equipment requires routine O&M and monitoring. Dedicated equipment room/area and treated water discharge permit will be required.	**Capital:** Moderate to High **O&M:** Moderate/High **Overall:** Moderate	No

Notes:

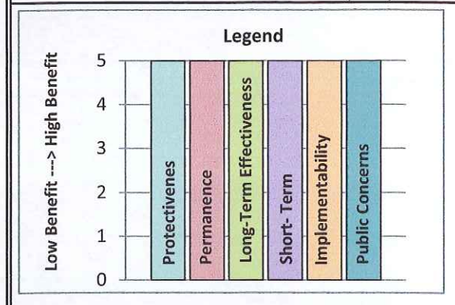
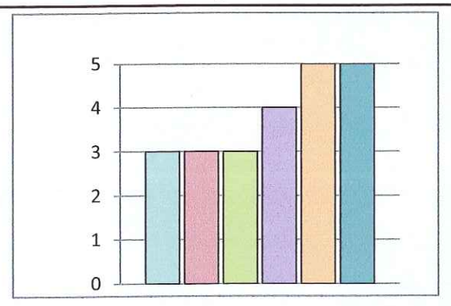
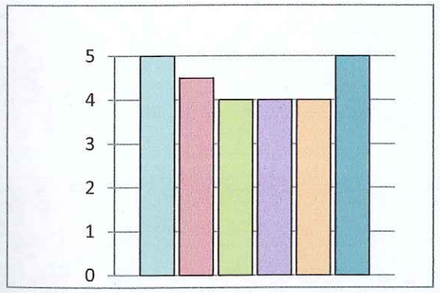
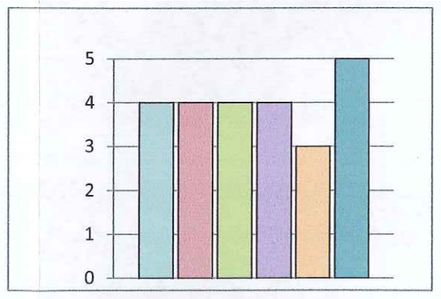
a Preliminary effectiveness ratings of high, medium, and low reflect estimated relative effectiveness of the technology to treat the site contaminants and meet CAOs.

b Implementability rating of easy, moderately difficult, and difficult reflect estimated relative complexity of implementing the technology.

c Relative remediation costs for capital, O&M, and overall costs compared to other technologies evaluated.

Table 8

Disproportionate Cost Analysis Summary
Broadstone Capitol Hill Property
Seattle, Washington

Evaluation Category	Potential Corrective Action Alternatives		
	Alternative 1	**Alternative 2**	**Alternative 3**
Alternative Description	• Development excavation plus over excavation within the areas exceeding groundwater CULs will result in removal of all soil exceeding CULs, will remove of the upper 4 feet of the saturated zone removing sources of petroleum groundwater impacts, and will remove the entrained groundwater contaminants. The overexcavated area will be backfilled with clean fill. • Includes MNA following excavation to allow residual contaminants in groundwater to degrade below CULs.	• Excavation as described in Alternative 1. Includes amending the clean backfill with ORC-A pellets to provide up to 12 months of dissolved oxygen and nutrients to enhance aerobic biodegradation of residual petroleum hydrocarbons in groundwater to below CULs.	• Excavation and clean backfill as described in Alternative 1. Includes installing an injection piping network at the base of the overexcavation in Areas 2 and 3, and one round oxygen releasing compound slurry injection to provide up to 12 months of dissolved oxygen and nutrients to enhance aerobic biodegradation of residual petroleum hydrocarbons in groundwater to below CULs.
Compliance with MTCA Threshold Requirements	Yes	Yes	Yes
Restoration Timeframe	3 to 4 years	1 to 2 years	2 to 3 years
Estimated Implementation Cost	$580,000	$640,000	$670,000
Relative Rankings for Permanence using Disproportionate Cost Analysis			
Protectiveness (30%)	3	5	4
Permanence (20%)	3	4.5	4
Long-Term Effectiveness (20%)	3	4	4
Short-Term Risk Management (10%)	4	4	4
Implementability (10%)	5	4	3
Consideration of Public Concerns (10%)	5	5	5
Comparative Overall Benefit				
Overall Alternative Weighted Score	3.5	4.5	4.0
Cost per Benefit Ratio (per $100,000)	1.66	1.42	1.68

Notes:
1. Comparative benefit ranking scoring criteria: High = 5, Medium-High = 4, Medium = 3, Medium Low = 2, Low = 1
2. The disproportionate cost analysis criteria are weighted to benefit alternatives which are have the highest likelihood of protecting human health and the environment over the long term. Protectiveness (30%) is weighted highest, and permanence (20%) and long term effectiveness (20%) are weighted evenly, but slightly lower. The remaining criteria, short-term risk management (10%), technical and administrative implementability (10%), and consideration for public concerns (10%) are evenly weighted.
3. Cost per benefit ratio is calculated by dividing the total alternative cost (in $100,000's) by the overall alternative score. Lower value indicates the most benefit for the associated cost.

Table 9

Final Confirmation Soil Sampling Results
Broadstone Capitol Hill Development Property
Seattle, Washington

Confirmation Sample Type	Sample ID	Date	Time	Diesel (mg/kg)		Heavy Oil (mg/kg)		Diesel Range Organics (mg/kg)
MTCA Method A Cleanup Level for Unrestricted Land Use				2,000		2,000		2,000
Sidewall Samples	SW-WP-15-284	10/01/13	1530	22.1	U	**228**		**81.9**
	SW-NP-3-284	10/01/13	1535	**443**		**429**		NR
	SW-ET6-283	10/11/13	13130	23.9	U	59.8	U	NR
	SW-G5-282	10/18/13	1430	22.0	U	54.9	U	NR
	SW-F3-283	10/18/13	1420	22.6	U	56.5	U	NR
	SW-UST1-S-284	10/18/13	1300	22.8	U	57.1	U	NR
	SW-DHT3-282	10/19/13	1305	**2,260**		50.7	U	NR
	SW-E2-282	10/19/13	1310	22.1	U	55.4	U	NR
	SW-E4-282	10/21/13	1310	22.0	U	55.1	U	NR
	SW-E5-281	10/21/13	1325	20.7	U	55.0	U	NR
	SW-D2-282	10/22/13	1300	**864**		**90.5**		NR
	SW-D4-282	10/22/13	1310	20.8	U	52.0	U	NR
	SW-G9-280	10/24/13	1045	21.8	U	54.6	U	NR
	SW-G10-280	10/24/13	1100	24.7	U	61.7	U	NR
	SW-DHT4-281	10/24/13	1115	20.9	U	52.3	U	**50.0**
	SW-D1-280	10/26/13	1100	22.7	U	56.8	U	NR
	SW-G6-282	10/26/13	945	22.1	U	55.3	U	NR
	SW-G10-BW-289	11/05/13	815	19.8	U	49.5	U	NR
	SW-G8-BW-289	11/05/13	825	**1,620**		**72.4**		NR
	SW-G6-BW-289	11/05/13	830	19.6	U	48.9	U	NR
	SW-G11-BW-289	11/05/13	840	22.0	U	55.0	U	NR
	SW-G11-BW-288	11/05/13	845	20.5	U	51.2	U	NR
	SW-G5-BW-289	11/05/13	820	23.4	U	58.4	U	NR
	SW-F11-BW-282	11/08/13	1130	**2,850**		55.8	U	NR
	SW-G8-BW-278	11/11/13	940	19.4	U	48.5	U	NR
	SW-G10-BW-279	11/11/13	1015	23.0	U	57.6	U	NR
	SW-G6A-BW-276	11/11/13	955	19.5	U	48.8	U	NR
	SW-G6B-BW-276	11/11/13	1130	18.6	U	46.5	U	NR
	SW-F11-BW-279	11/11/13	1350	22.0	U	55.1	U	NR
	SW-F11-BW-281	11/14/13	1430	**58.8**		58.9	U	NR
	SW-D11-281	11/15/13	1230	23.3	U	58.2	U	NR
	SW-B11-283	11/18/13	1415	**719**		61.4	U	NR
	SW-D11-283	11/18/13	1355	**4,600**		54.2	U	NR
	SW-G11-EastWall-280	11/18/13	1315	24.5	U	61.1	U	NR
	SW-G11-SouthWall-280	11/1813	1320	24.3	U	60.7	U	NR
Bottom Samples	S-HA1-2ft	09/18/13	0900	21.9	U	54.9	U	NR
	UST-2-092613	09/26/13	1335	21.1	U	52.8	U	NR
	CF-A1-100113	10/01/13	1525	22.1	U	55.4	U	NR
	CF-E1-281	10/19/13	1300	**401**		46.0	U	NR
	CF-E2-282	10/19/13	1315	23.0	U	57.6	U	NR
	CF-E3-281	10/21/13	1300	22.5	U	56.2	U	NR
	CF-D4-281	10/21/13	1305	20.5	U	51.3	U	NR
	CF-F5-281	10/21/13	1315	22.3	U	55.7	U	NR
	CF-G5-281	10/21/13	1320	22.0	U	55.0	U	NR
	CF-D5-281	10/21/13	1330	**320**		**61.9**		NR
	CF-G6-281	10/21/13	1335	**177**		48.3	U	NR

Table 9

Final Confirmation Soil Sampling Results
Broadstone Capitol Hill Development Property
Seattle, Washington

Confirmation Sample Type	Sample ID	Date	Time	Diesel (mg/kg)	Heavy Oil (mg/kg)	Diesel Range Organics (mg/kg)
MTCA Method A Cleanup Level for Unrestricted Land Use				**2,000**	**2,000**	**2,000**
Bottom Samples (continued)	CF-F6-281	10/21/13	1340	**133**	49.4 U	NR
	CF-E6-281	10/21/13	1345	**424**	51.5 U	NR
	CF-D6-281	10/21/13	1400	20.6 U	51.4 U	NR
	CF-C6-281	10/21/13	1405	20.7 U	51.7 U	NR
	CF-C7-281	10/22/13	745	21.8 U	54.4 U	NR
	CF-D7-281	10/22/13	750	24.0 U	60.1 U	NR
	CF-E7-281	10/22/13	755	**1,930**	48.3 U	NR
	CF-F7-281	10/22/13	800	**154**	46.7 U	NR
	CF-G7-281	10/22/13	805	68.3 U	48.2 U	NR
	CF-C8-281	10/22/13	810	**218**	52.7 U	NR
	CF-D8-281	10/22/13	815	**155**	57.8 U	NR
	CF-E8-281	10/22/13	820	**27.5**	52.4 U	NR
	CF-F8-281	10/22/13	825	**82.9**	53.5 U	NR
	CF-G8-281	10/22/13	830	**357**	55.2 U	NR
	CF-E9-281	10/22/13	835	21.4 U	53.4 U	NR
	CF-F9-281	10/22/13	840	22.7 U	56.7 U	NR
	CF-G9-281	10/22/13	845	23.8 U	59.4 U	NR
	CF-D10-280	10/22/13	850	21.9 U	54.7 U	NR
	CF-E10-281	10/22/13	855	21.2 U	53.0 U	NR
	CF-F10-281	10/22/13	900	23.3 U	58.2 U	NR
	CF-G10-281	10/22/13	905	23.6 U	59.0 U	NR
	CF-B7-281	10/24/13	1000	22.0 U	55.1 U	NR
	CF-D9-281	10/24/13	1015	23.5 U	58.8 U	NR
	CF-G9-279	10/24/13	1030	20.7 U	51.6 U	NR
	CF-E5-281	10/24/13	1130	20.4 U	51.1 U	NR
	CF-D1-279	10/26/13	1130	22.0 U	54.9 U	NR

Notes:

U - Indicates that the compound was not detected at or above the listed method reporting limit.

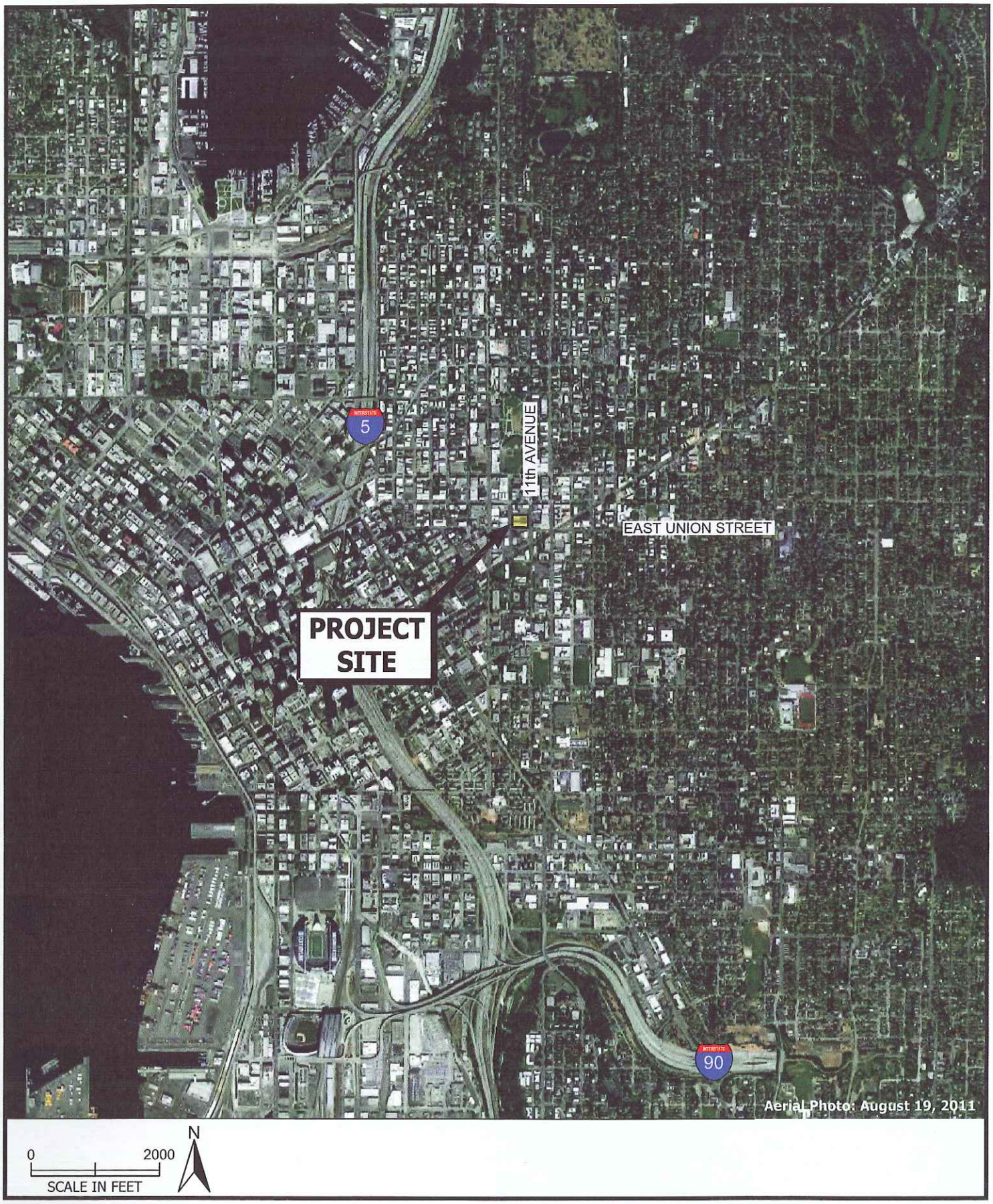
NR - Not reported.

The reporting of diesel-range organics indicates the presence of unresolved compounds eluting from dodecane through tetracosane (C12-C24).

Bold type indicates that the compound was detected above the method reporting limit.

Gray shading indicates that the area represented by this sample was subsequently overexcavated and retested with results below method reporting limits.

Blue shading indicates that the sample exceeds the applicable Method A cleanup level.



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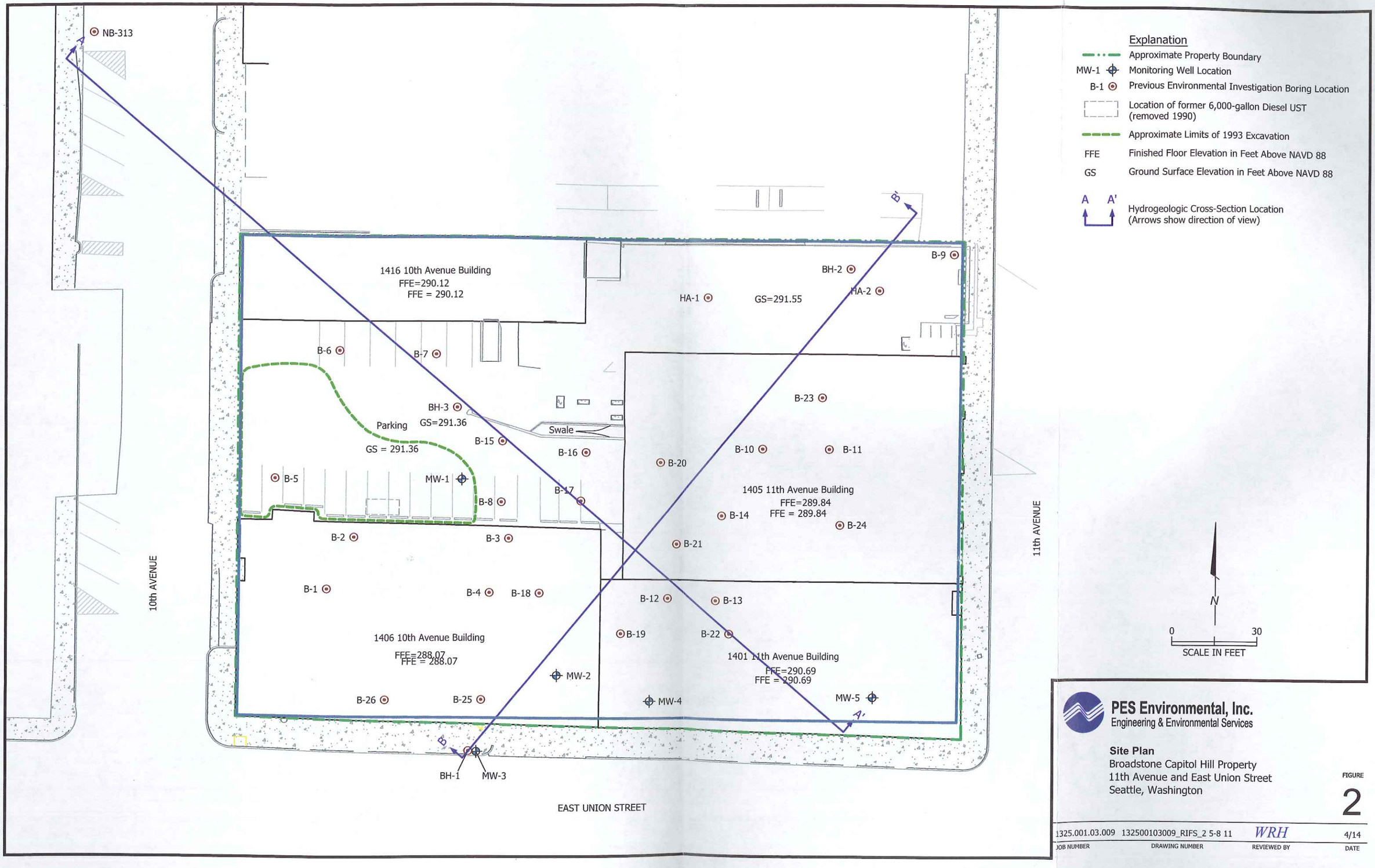
Site Location Map
Broadstone Capitol Hill Property
11th Avenue and East Union Street
Seattle, Washington

FIGURE
1

1325.001.03.009	132500103009_RIFS_1	WRH	4/14
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



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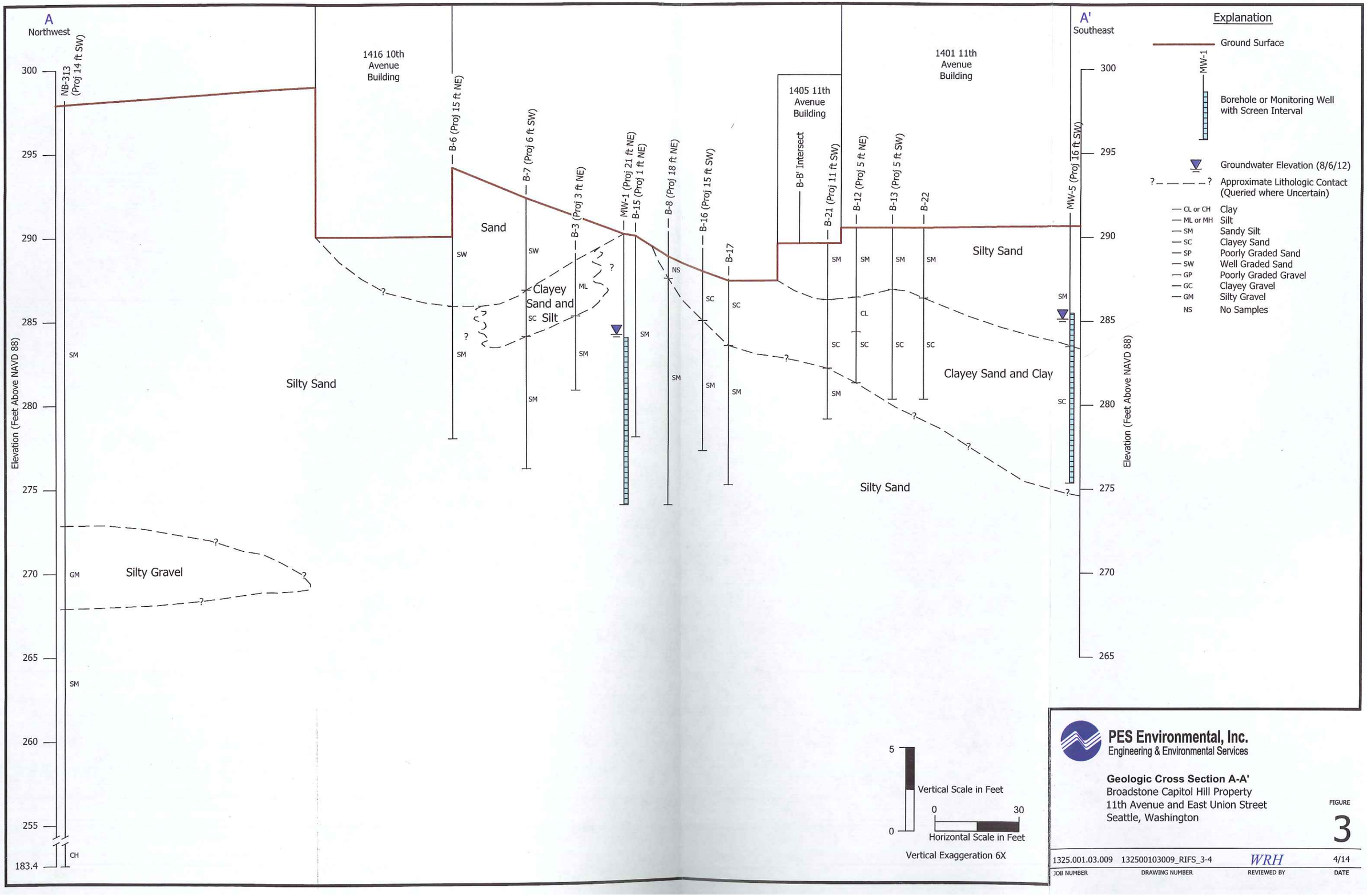
Site Plan
Broadstone Capitol Hill Property
11th Avenue and East Union Street
Seattle, Washington

FIGURE
2

1325.001.03.009	132500103009_RIFS_2 5-8 11	WRH	4/14
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



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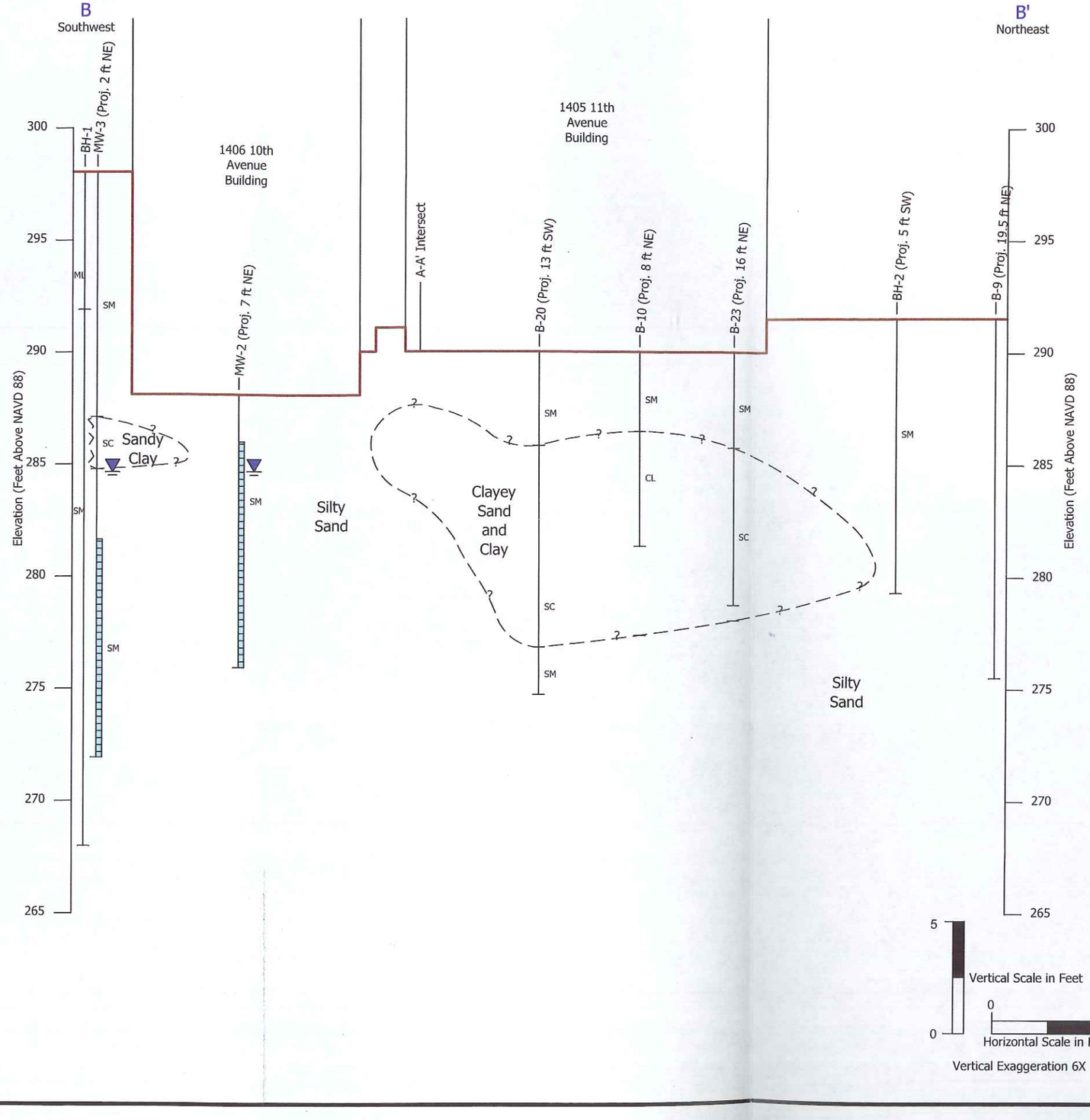
Geologic Cross Section A-A'
Broadstone Capitol Hill Property
11th Avenue and East Union Street
Seattle, Washington

FIGURE
3

1325.001.03.009	132500103009_RIFS_3-4	WRH	4/14
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



Explanation

- Ground Surface
- MW-1 — Borehole or Monitoring Well with Screen Interval
- Groundwater Elevation (8/6/12)
- ?– – – –? Approximate Lithologic Contact (Queried where Uncertain)

CL or CH	Clay
ML or MH	Silt
SM	Sandy Silt
SC	Clayey Sand
SP	Poorly Graded Sand
SW	Well Graded Sand
GP	Poorly Graded Gravel
GC	Clayey Gravel
GM	Silty Gravel
NS	No Samples

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Geologic Cross Section B-B'
Broadstone Capitol Hill Property
11th Avenue and East Union Street
Seattle, Washington

FIGURE 4

JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE
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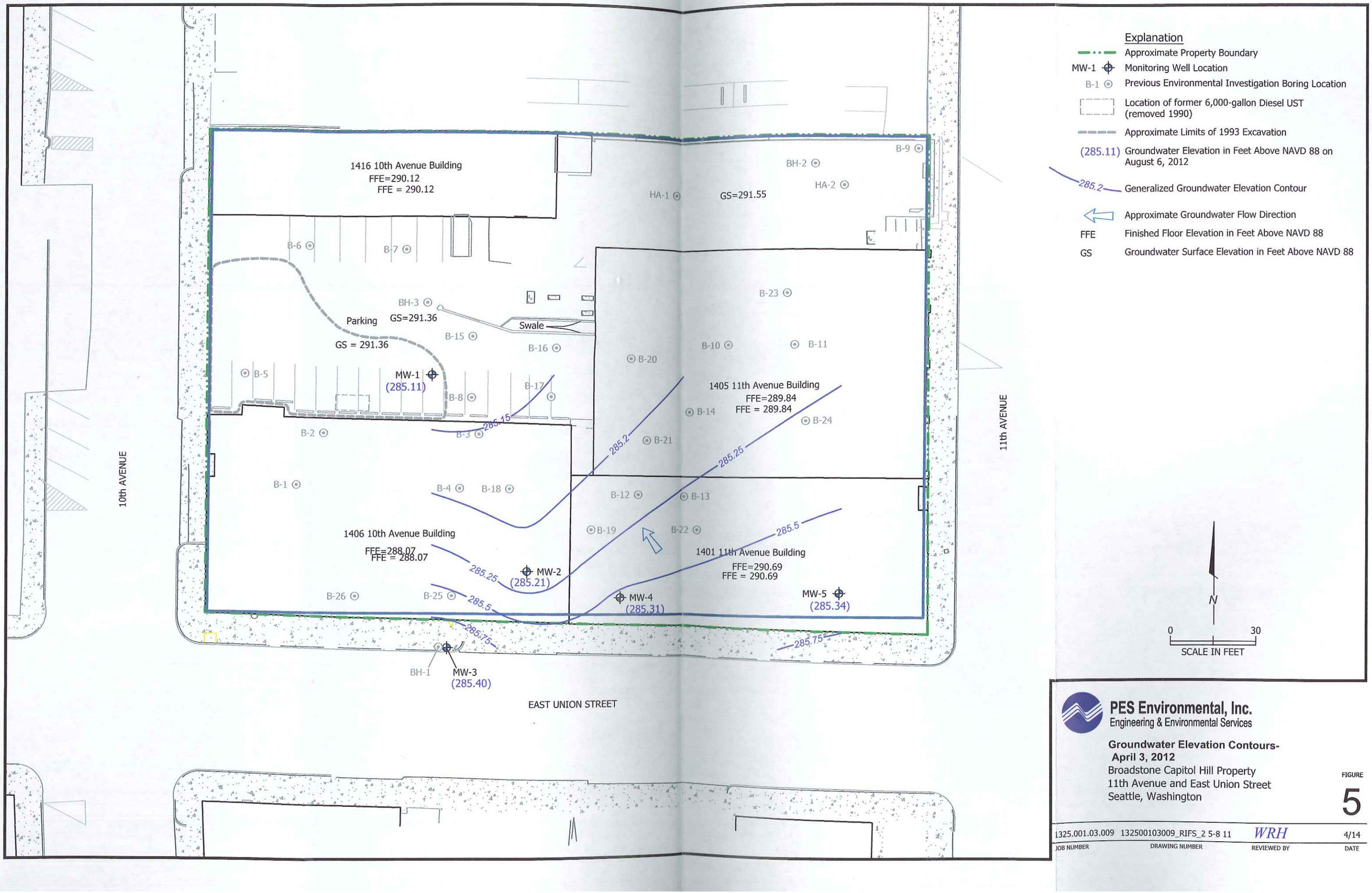

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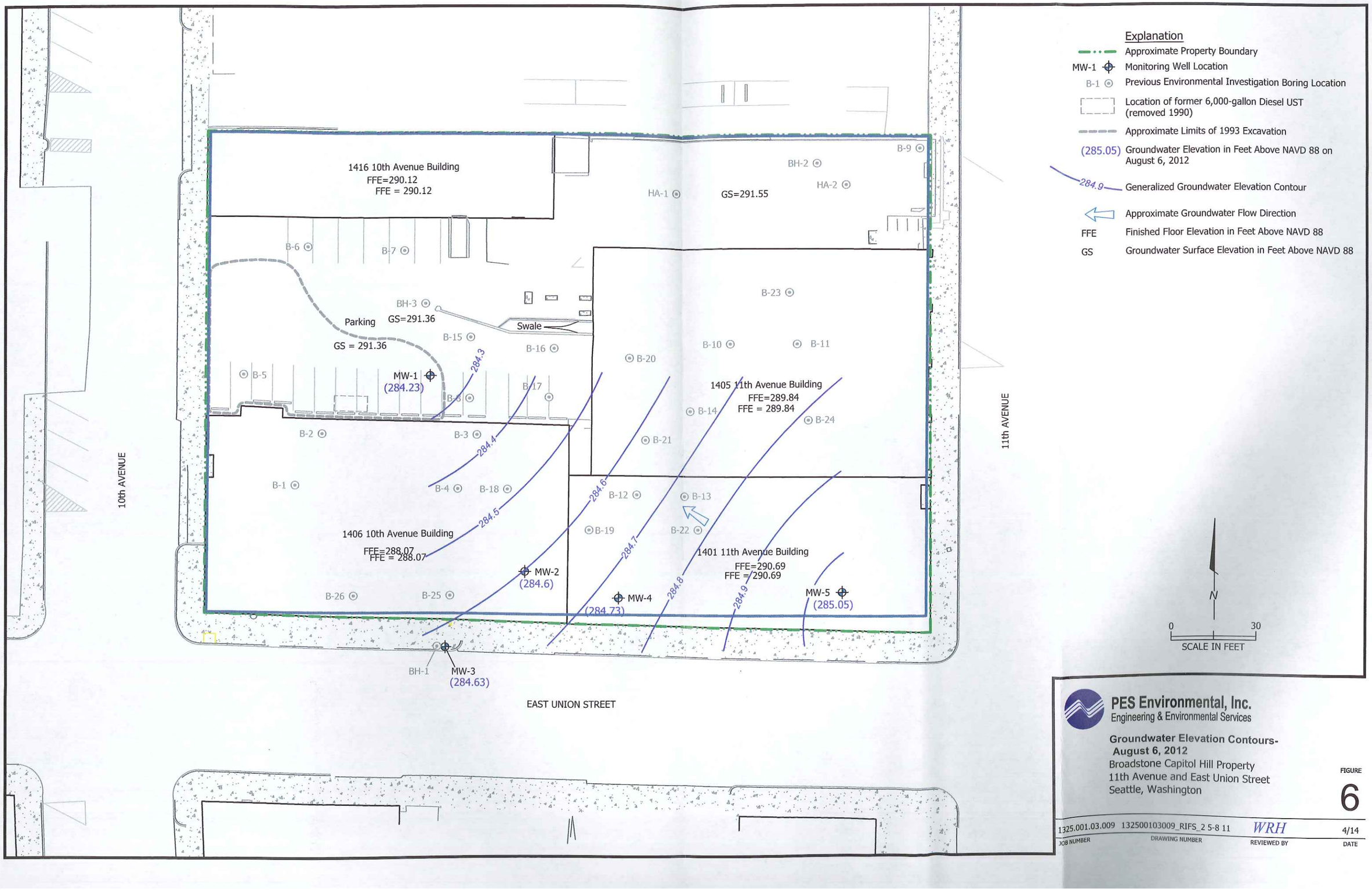
Groundwater Elevation Contours- April 3, 2012
Broadstone Capitol Hill Property
11th Avenue and East Union Street
Seattle, Washington

FIGURE
5

1325.001.03.009	132500103009_RIFS_2 5-8 11	WRH	4/14
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



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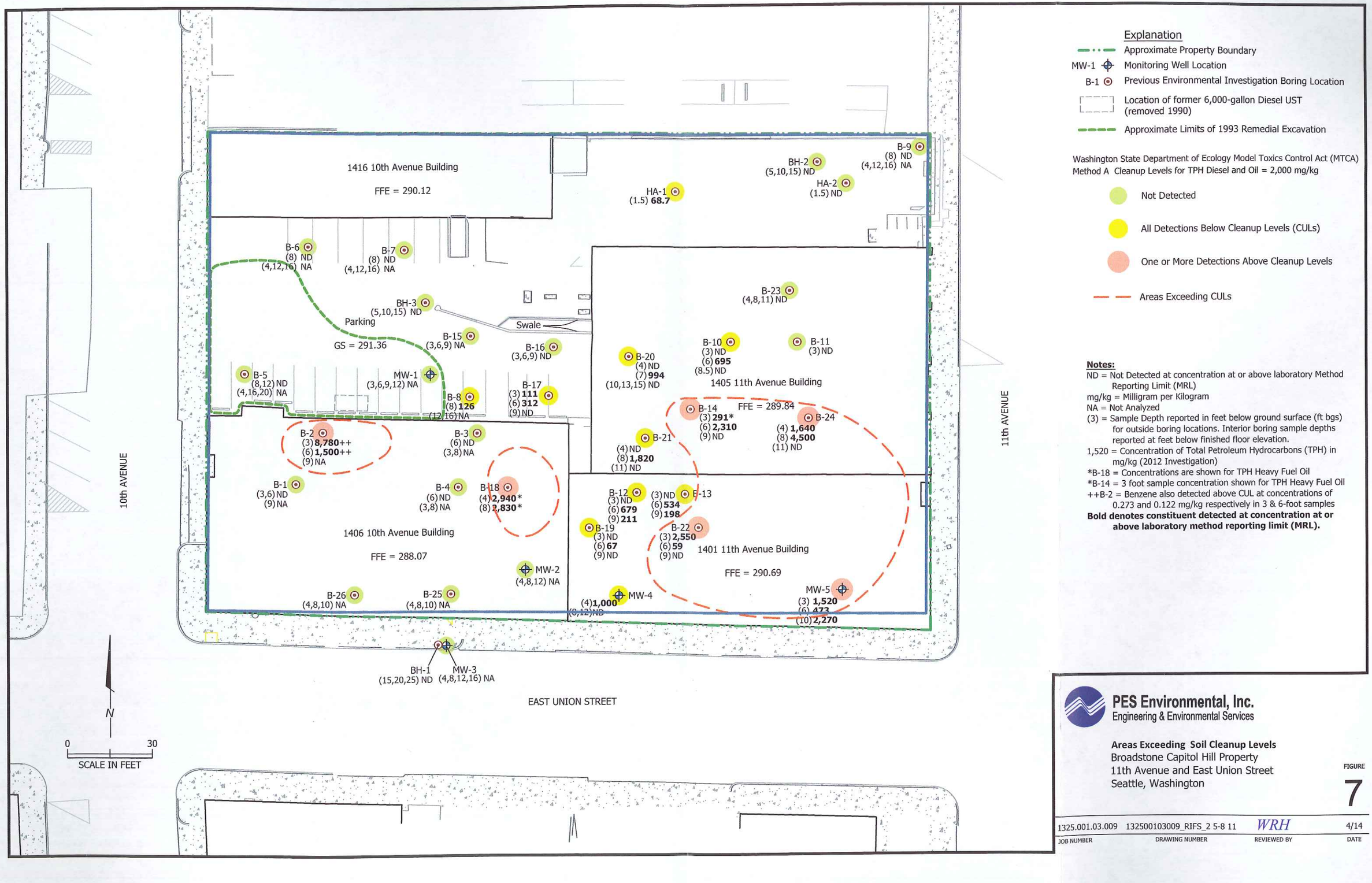
Groundwater Elevation Contours- August 6, 2012
Broadstone Capitol Hill Property
11th Avenue and East Union Street
Seattle, Washington

FIGURE
6

1325.001.03.009	132500103009_RIFS_2 5-8 11	WRH	4/14
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



Explanation

- Approximate Property Boundary
- MW-1 — Monitoring Well Location
- B-1 — Previous Environmental Investigation Boring Location
- Location of former 6,000-gallon Diesel UST (removed 1990)
- Approximate Limits of 1993 Remedial Excavation

Washington State Department of Ecology Model Toxics Control Act (MTCA) Method A Cleanup Levels for TPH Diesel and Oil = 2,000 mg/kg

- Not Detected
- All Detections Below Cleanup Levels (CULs)
- One or More Detections Above Cleanup Levels
- Areas Exceeding CULs

Notes:

ND = Not Detected at concentration at or above laboratory Method Reporting Limit (MRL)
mg/kg = Milligram per Kilogram
NA = Not Analyzed
(3) = Sample Depth reported in feet below ground surface (ft bgs) for outside boring locations. Interior boring sample depths reported at feet below finished floor elevation.
1,520 = Concentration of Total Petroleum Hydrocarbons (TPH) in mg/kg (2012 Investigation)
*B-18 = Concentrations are shown for TPH Heavy Fuel Oil
*B-14 = 3 foot sample concentration shown for TPH Heavy Fuel Oil
++B-2 = Benzene also detected above CUL at concentrations of 0.273 and 0.122 mg/kg respectively in 3 & 6-foot samples
Bold denotes constituent detected at concentration at or above laboratory method reporting limit (MRL).

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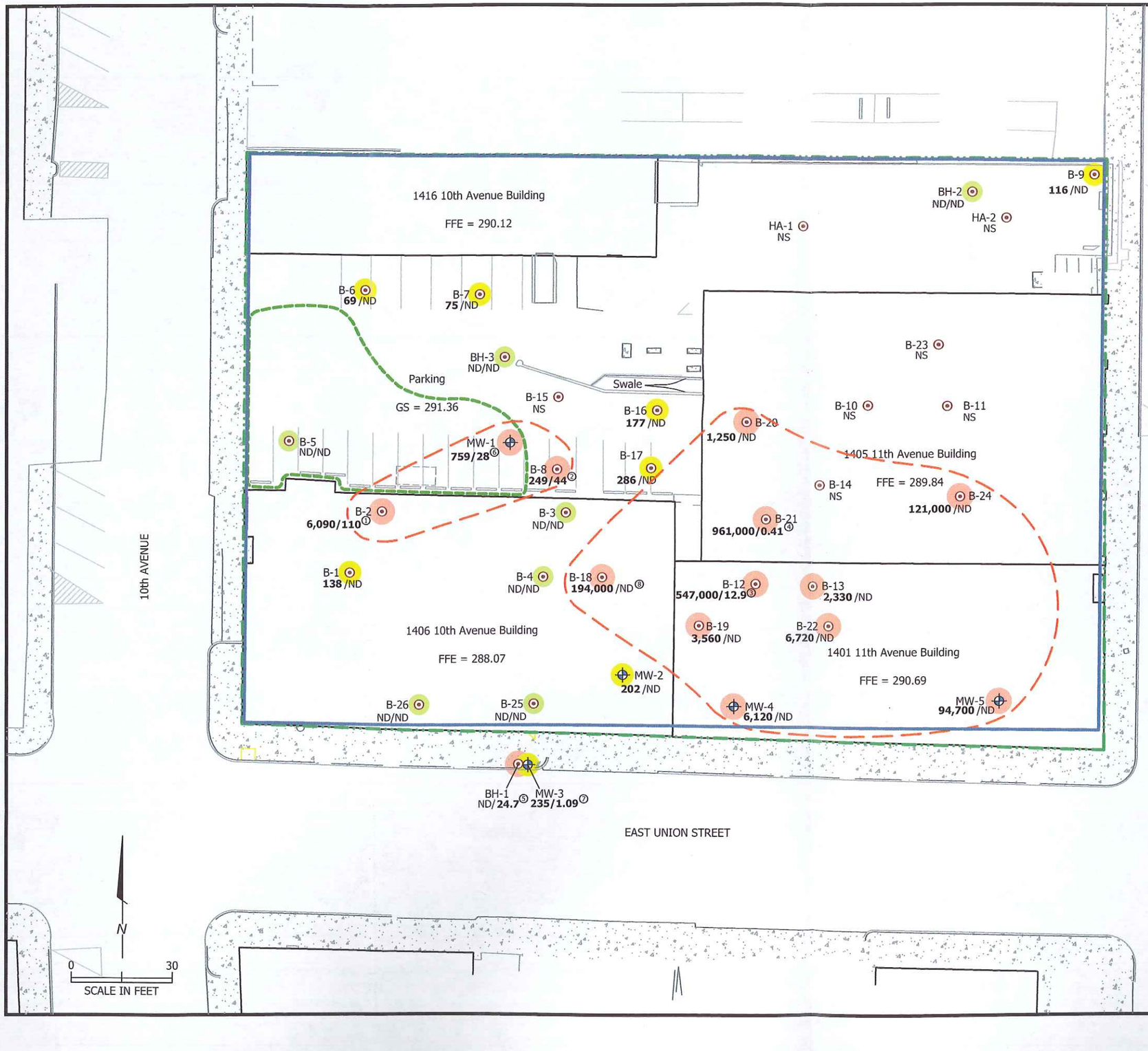
Areas Exceeding Soil Cleanup Levels
Broadstone Capitol Hill Property
11th Avenue and East Union Street
Seattle, Washington

FIGURE 7

1325.001.03.009	132500103009_RIFS_2 5-8 11	WRH	4/14
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



Explanation

- Approximate Property Boundary
- MW-1 — Monitoring Well Location
- B-1 — Previous Environmental Investigation Boring Location
- Location of former 6,000-gallon Diesel UST (removed 1990)
- Approximate Limits of 1993 Remedial Excavation

Applicable Washington State Department of Ecology Model Toxics Control Act (MTCA) Method A Cleanup Levels:
TPH Diesel and Oil = 500 µg/L
Benzene = 5 mg/L
Ethylbenzene = 700 mg/L
Xylenes = 1,000 µg/L
TCE = 5 µg/L
VC = 0.2 µg/L
PCE = 5 µg/L
Naphthalene = 160 µg/L

- Not Detected
- All Detections Below Cleanup Levels
- One or More Detections Above Cleanup Levels
- Areas Exceeding CULs

NS = Not Sampled
NA = Not Analyzed
ND = Not Detected at concentration at or above laboratory Method Reporting Limit (MRL)
759/27.6 = Concentration of Total Petroleum Hydrocarbons (TPH)/Total Volatile Organic Compounds (VOCs) in micrograms per Liter (µg/L) (2012 Investigation)
TCE = Trichloroethylene
PCE = Tetrachloroethylene
VC = Vinyl Chloride
Bold denotes constituent detected at concentration at or above laboratory method reporting limit (MRL).

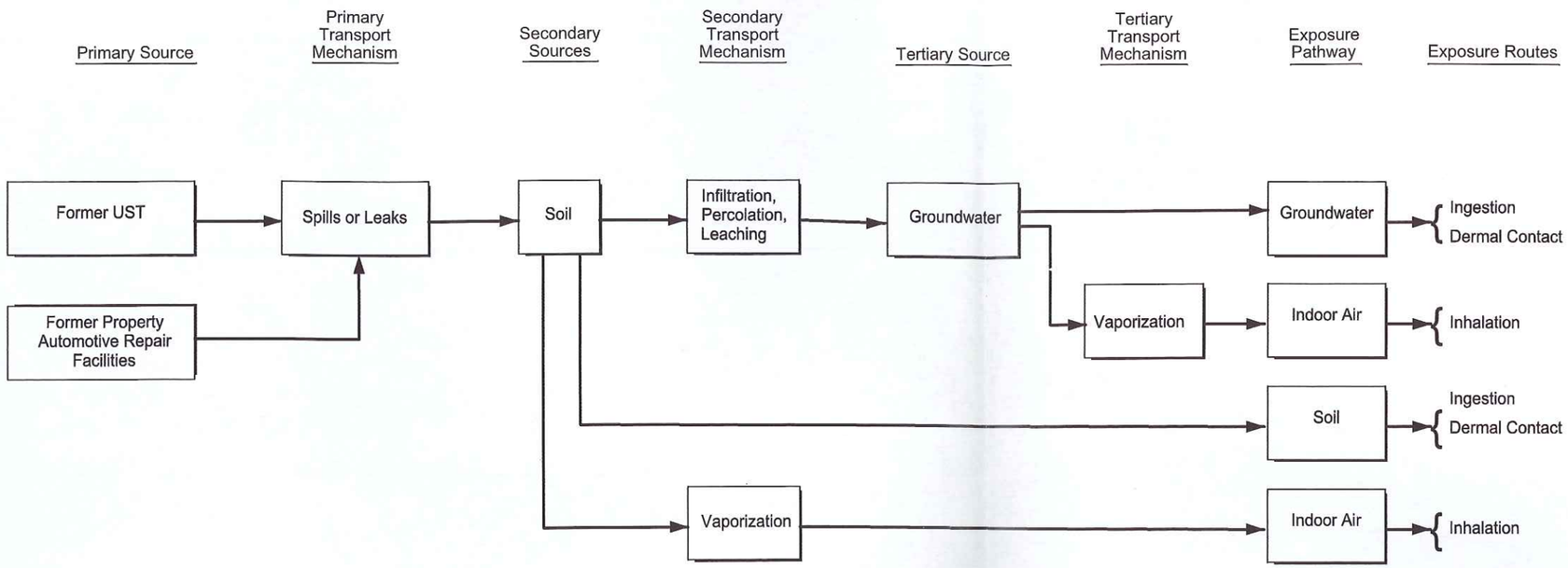
① B-2 - Total VOC's detected: Benzene (12.5 µg/L); ethylbenzene (95.8 µg/L); and xylenes (1.64 µg/L).
② B-8 - Total VOC's detected: TCE (7.74 µg/L); VC (0.49 µg/L); and PCE (35.5 µg/L).
③ B-12 - Total VOC's detected: Naphthalene (12.9 µg/L).
④ B-21 - Total VOC's detected: VC (0.41 µg/L).
⑤ BH-1 - Total VOC's detected: TCE (24.7 µg/L).
⑥ MW-1 - Total VOC's detected: TCE (7.56 µg/L) and PCE (20.1 µg/L).
⑦ MW-3 - Total VOC's detected: TCE (1.09 µg/L).
⑧ B-18 - Constituent is TPH-Heavy Oil.
⑨ MW-2 - TPH-Heavy Oil also detected at 214 µg/L

PES Environmental, Inc.
Engineering & Environmental Services

Areas Exceeding Groundwater Cleanup Levels
Broadstone Capitol Hill Property
11th Avenue and East Union Street
Seattle, Washington

FIGURE
8

1325.001.03.009	132500103009_RIFS_2 5-8 11	WRH	4/14
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



RECEPTORS	
On-Site	Off-Site
Worker	Worker/ Resident
O	X
X	X
O	X
X	X

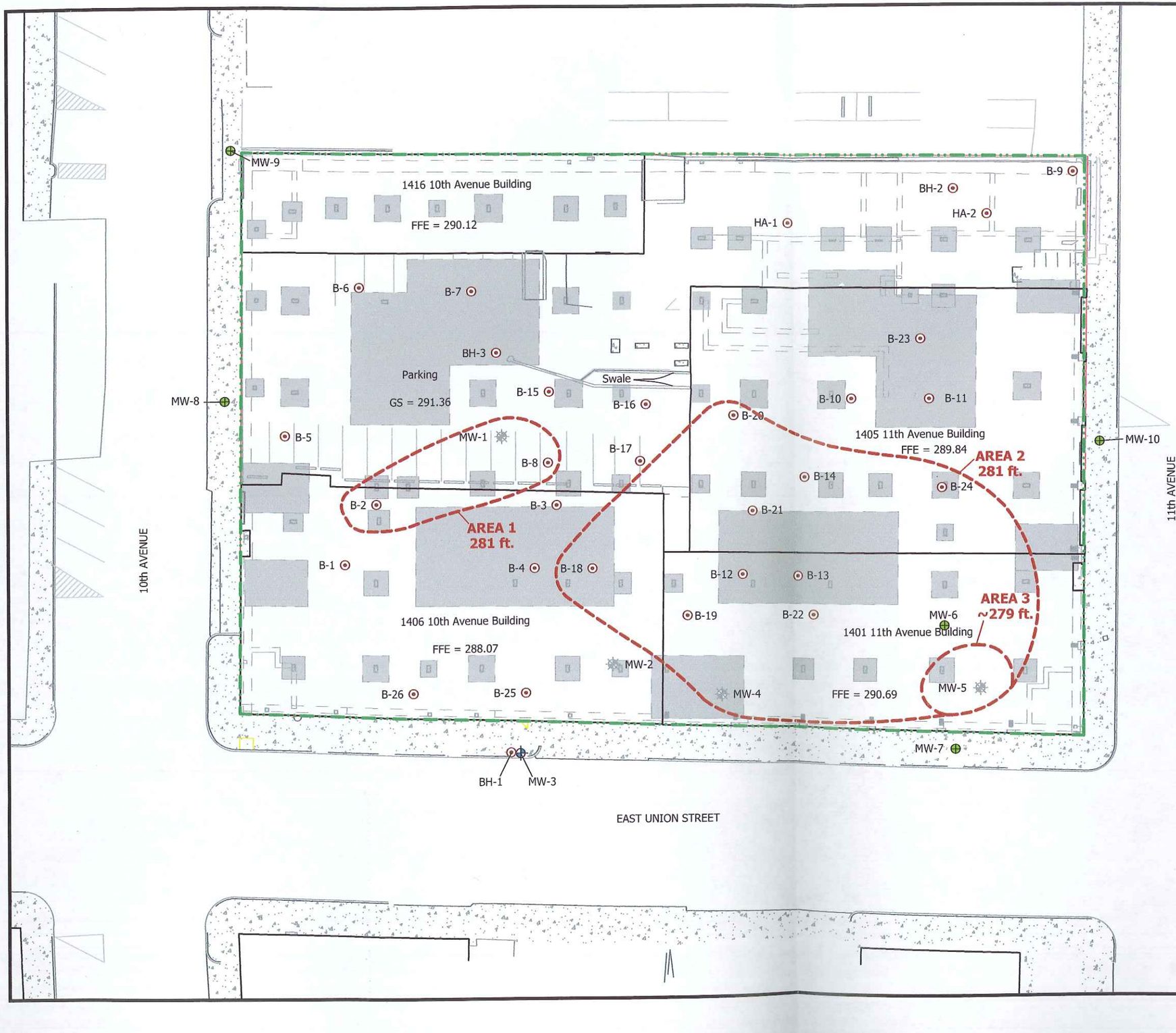
LEGEND:
- ● Current Complete Pathway
- O Potential Pathway
- X Incomplete Pathway

PES Environmental, Inc.
Engineering & Environmental Services

Conceptual Site Model
Broadstone Capitol Hill Property
11th Avenue and East Union Street
Seattle, Washington

FIGURE 9

1325.001.03.001	132500103009_RIFS_9	WRH	4/14
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



Explanation

- Approximate Property Boundary
- MW-6 — Proposed Groundwater Monitoring Well Location
- Well to be Abandoned during Excavation
- MW-1 — Monitoring Well Location
- B-1 — Previous Environmental Investigation Boring Location
- FFE — Finished Floor Elevation of Existing Building in Feet Above NAVD 88
- GS — Existing Groundwater Surface Elevation in Feet above NAVD 88
- 281 ft. — Overexcavation Area and Approximate Depth of base in NAVD 88
- Approximate Location of Future Building Interior Footings

Notes:

1. Approximate locations of interior footings for columns, stairwells, and elevators for the future building are shown. Perimeter footings and gradebeams for walls are not shown.
2. Drawing Reference: Perbix Bykonen, Foundation Plan, Ph. I, Correction I, Sheet S2.00.

N

0 30

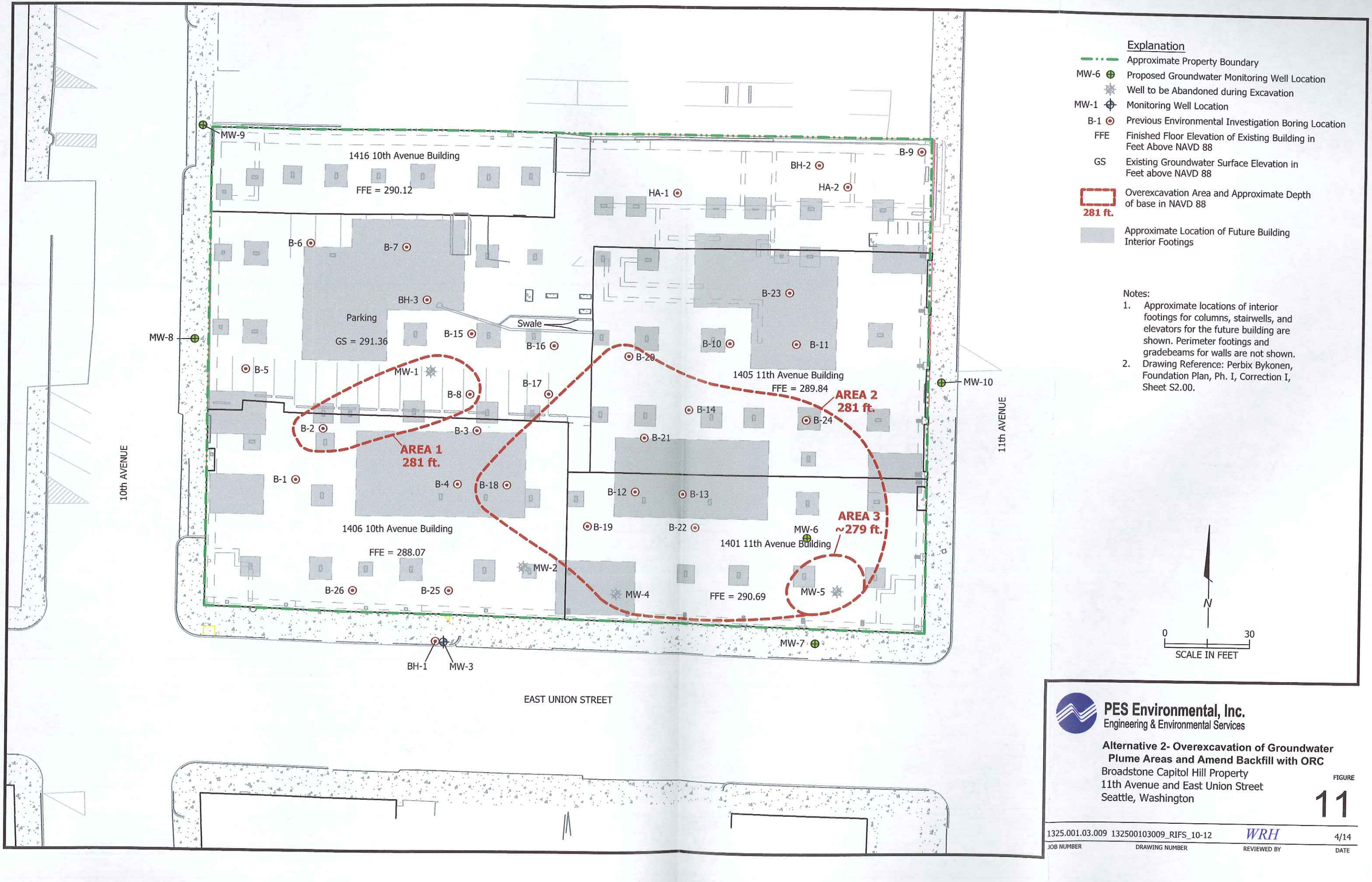
SCALE IN FEET

PES Environmental, Inc.
Engineering & Environmental Services

Alternative 1- Overexcavation of Groundwater Plume Areas
Broadstone Capitol Hill Property
11th Avenue and East Union Street
Seattle, Washington

FIGURE
10

1325.001.03.009	132500103009_RIFS_10-12	WRH	4/14
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



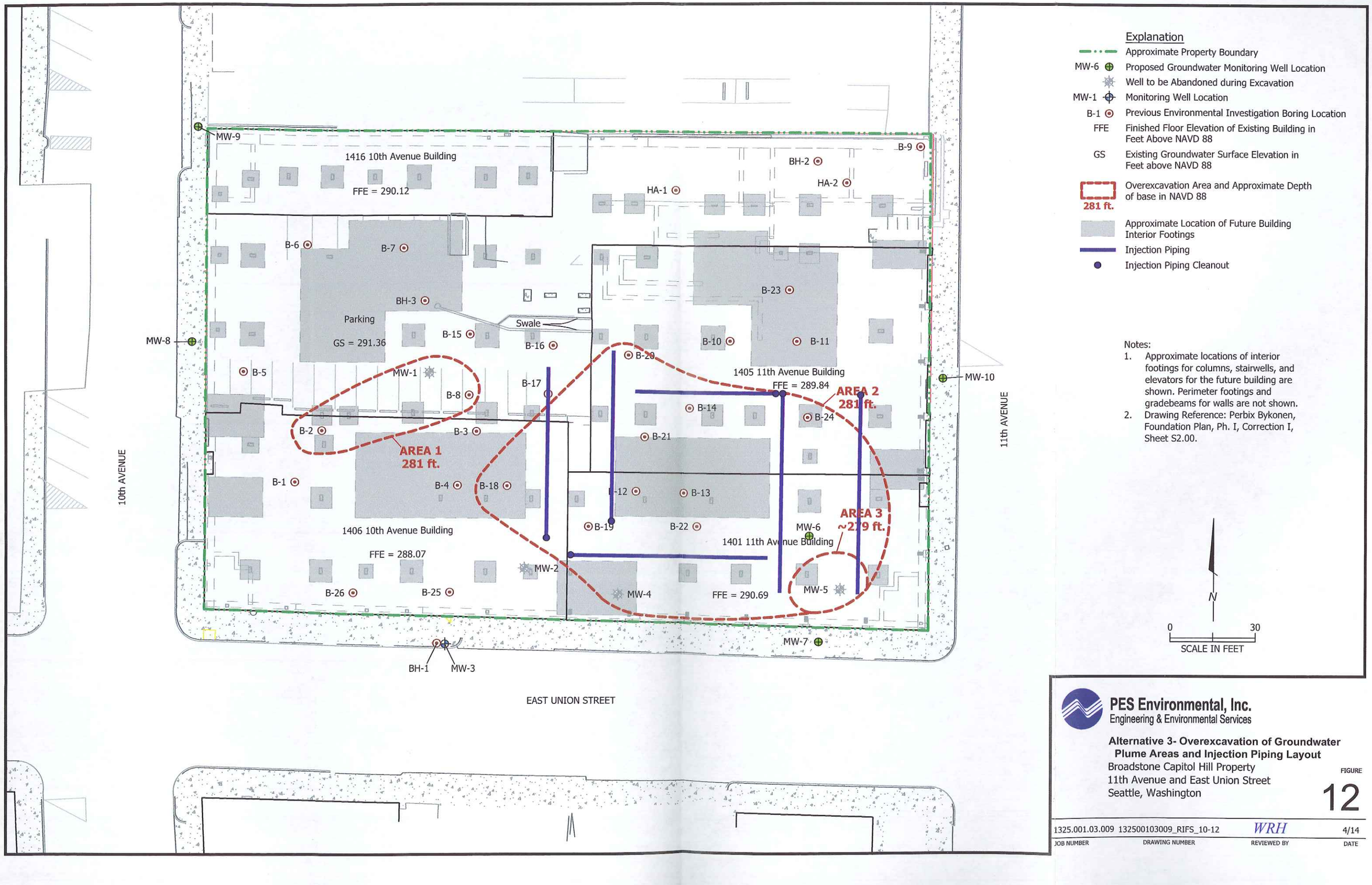
PES Environmental, Inc.
Engineering & Environmental Services

Alternative 2- Overexcavation of Groundwater Plume Areas and Amend Backfill with ORC

Broadstone Capitol Hill Property
11th Avenue and East Union Street
Seattle, Washington

FIGURE
11

1325.001.03.009	132500103009_RIFS_10-12	WRH	4/14
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE

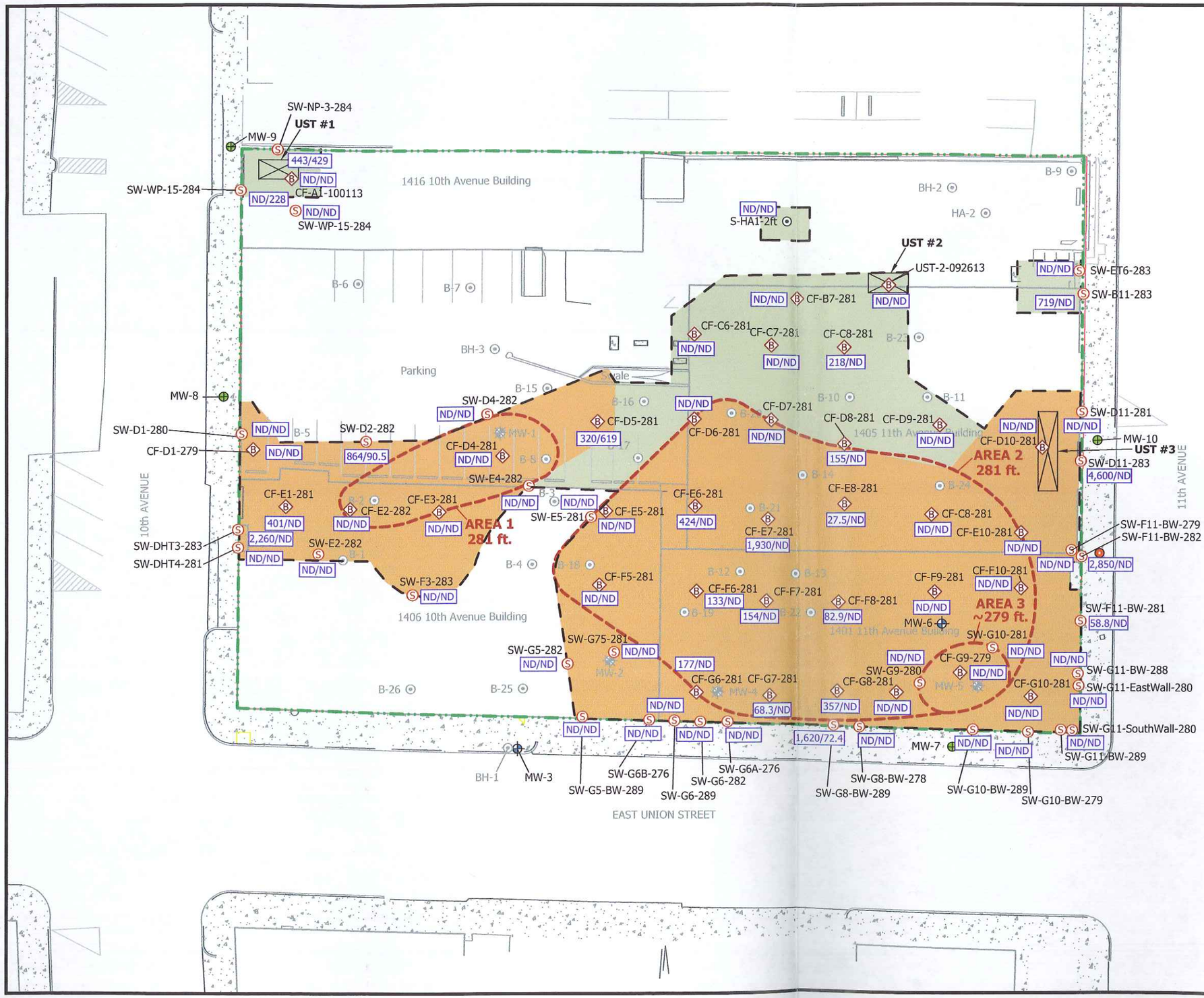


PES Environmental, Inc.
Engineering & Environmental Services

Alternative 3- Overexcavation of Groundwater Plume Areas and Injection Piping Layout
Broadstone Capitol Hill Property
11th Avenue and East Union Street
Seattle, Washington

FIGURE
12

1325.001.03.009	132500103009_RIFS_10-12	WRH	4/14
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



PES Environmental, Inc.
Engineering & Environmental Services

Final Soil Confirmation Sample Locations
Broadstone Capitol Hill Property
11th Avenue and East Union Street
Seattle, Washington

FIGURE
13

1325.001.03.009	132500103009_RIFS_13	WRH	4/14
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE

APPENDIX A

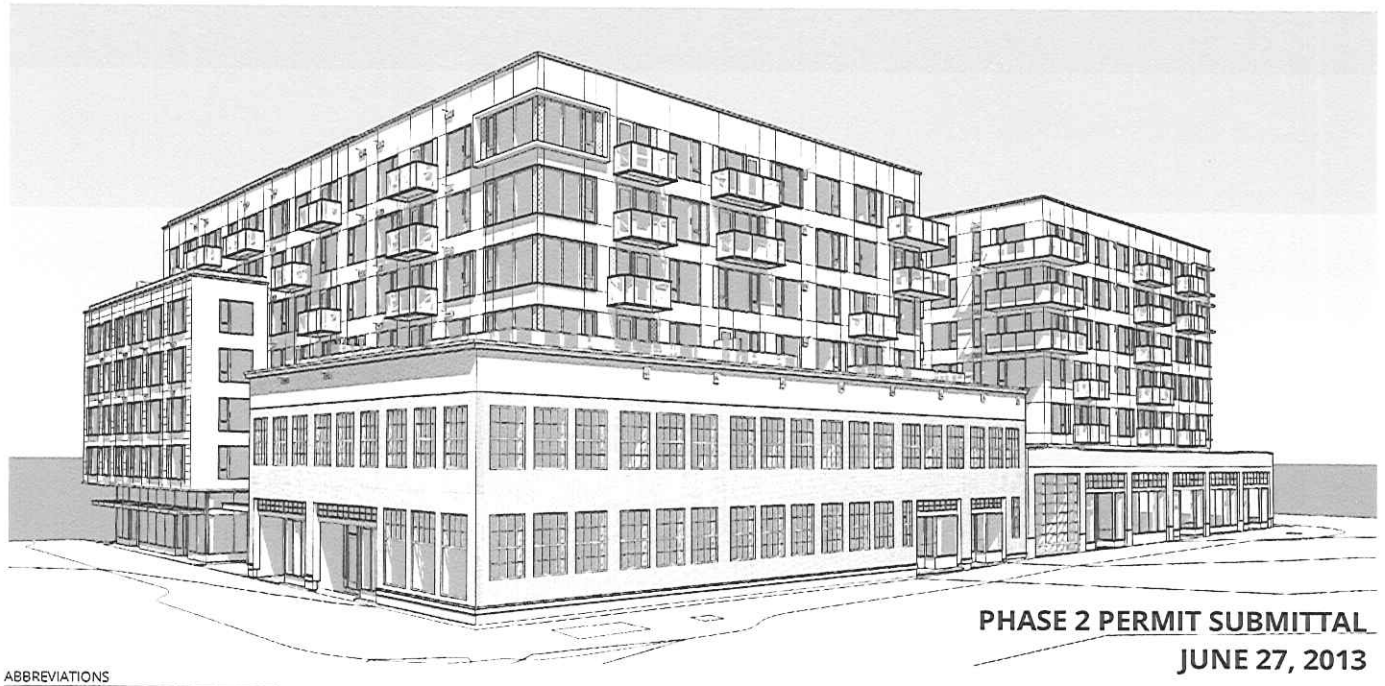
APPENDIX A

LEGAL DESCRIPTION OF THE PROPERTY

Legal Description of the Property

Lots 1, 2, 3, 10, 11, and 12, Block 4, John H. Nagle's second addition to the city of Seattle, according to the plat thereof recorded in Volume 5 of Plats, Page 67, in King County, Washington: except that portion of Lots 1 and 12 condemned in King County Superior Court Cause No. 61476 for East Union Street as provided by Ordinance No. 17972 for the city of Seattle.

BROADSTONE CAPITOL HILL
SEATTLE, WA



PHASE 2 PERMIT SUBMITTAL
JUNE 27, 2013

PROJECT TEAM

ABBREVIATIONS

SYMBOLS LEGEND

SITE INFORMATION AND SPECIFICATIONS

LEGAL DESCRIPTION OF THE SITE

VICINITY MAP

CONCEPT IMAGES

RETAIN 3 FACADES

TWO SEPARATE TOWERS

ADDITIVE SIDECARS

Ankrom Moisan

PERSIS DYKONEN

Broadstone Capitol Hill

Broadstone Capitol Hill Venture LLC

TITLE SHEET

PHASE 2 PERMIT SUBMITTAL

06/27/2013

113750

As Indicated

A0.00

APPENDIX B

BORING AND WELL LOGS

BORING LOG #: B-1; Page 1 of 1

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Cascade Drilling
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	B-1
Boring Depth:	8'	Surface Elevation:	--
GW Encountered:	6'	Start Date:	2/2/12
Static GW Level:	5.5'	End Date:	2/2/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
						4" concrete at surface	
1					SM	Silty sand; tan/brown; dry; very dense; not cohesive; no odor	
2							
3				1.2		Fine sand with clay; tan/brown; wet; very dense; medium cohesive; no odor	
4							
5							
6	▽			1.0			
7						saturated at 6.0'	
8				1.1		refusal at 8.0'	
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-2; Page 1 of 1

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Cascade Drilling
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	B-2
Boring Depth:	10'	Surface Elevation:	--
GW Encountered:	4'	Start Date:	2/2/12
Static GW Level:	4'	End Date:	2/2/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
						4" concrete at surface	
1					ML	Sandy clay; greenish gray; dry; slightly dense; medium	
						cohesive; strong product odor	
2							
3				423			
4	V					wet at 4.0'	
5							
6				772		less dense; saturated; strong product odor	
7							
8							
9				12.5			
						no recovery 9-10'	
10						refusal at 10'	
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-3; Page 1 of 1

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Cascade Drilling
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	B-3
Boring Depth:	10'	Surface Elevation:	--
GW Encountered:	5'	Start Date:	2/2/12
Static GW Level:	6'	End Date:	2/2/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
						4" concrete at surface	
1					ML	Sandy clay; tan; dry; very dense; fragile; no odor	
2							
3				1.2			
4					SM	Silty sand; tan/brown; medium dense; moist; slightly cohesive; no odor	
5							
6 ▽				0.9		wet at 6'	
7						saturated at 7'	
8				1.1		refusal at 8'	
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-4; Page 1 of 1

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Cascade Drilling
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	B-4
Boring Depth:	8.0'	Surface Elevation:	--
GW Encountered:	5'	Start Date:	2/2/12
Static GW Level:	5'	End Date:	2/2/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
						4" concrete at surface	
1					ML	Clayey sand; tan/brown; dry; medium dense; no odors	
2							
3				1.2			
4						Sandy clay; gray/tan; medium dense; moist; no odor	
5	▽						
6				1.4			
7					SC	Silty sand; tan; wet; medium dense; no odors	
8				1.1		saturated at 7'	
9						refusal at 8'	
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-5; Page 1 of 1

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Cascade Drilling
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	B-5
Boring Depth:	20'	Surface Elevation:	--
GW Encountered:	12'	Start Date:	2/2/12
Static GW Level:	12'	End Date:	2/2/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
						4" asphalt at surface	
1					SM	Silty sand; tan/gray; loose; dry; low density; no odor	
2							
3							
4				1.2			
5							
6					SC	Clayey sand; reddish brown; dry; slightly cohesive; moderate density; no odors	
7							
8							
9							
10					ML	Sandy clay; tan/brown; dry; moderately cohesive; very dense; no odors	
11							
12 ▽					SM	Silty sand; tan; wet; moderately cohesive; moderately dense; no odors	
13							
14							
15							
16						Silty sand; tan/gray; saturated; loose; low density; no odors	
17							
18							
19							
20						boring terminated at 20'	

BORING LOG #: B-6; Page 1 of 1

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Cascade Drilling
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	B-6
Boring Depth:	16'	Surface Elevation:	--
GW Encountered:	8'	Start Date:	2/3/12
Static GW Level:	8'	End Date:	2/3/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
						4" asphalt at surface	
1					SW	Sand with some gravels; dark gray; dry; some red; loose	
2							
3							
4				0.5			
5							
6							
7							
8				0.5			
					SM	Silty sand with clay; tan/gray; moist; medium density;	
9						moderately cohesive; moist; no odors	
10							
11							
12	▽			0.6			
						wet at 12'	
13							
14							
15							
16				0.4			
						refusal at 16'	
17							
18							
19							
20							

BORING LOG #: B-7; Page 1 of 1

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Cascade Drilling
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	B-7
Boring Depth:	16'	Surface Elevation:	--
GW Encountered:	10'	Start Date:	2/3/12
Static GW Level:	10'	End Date:	2/3/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
						4" asphalt at surface	
1					SW	Sand with some gravels; dark brown; dry; loose	
2							
3							
4				0.4			
5							
6					SC	Clay sand; tan/gray; moderate density; moderately	
						cohesive; moist	
7							
8				0.5			
▽							
9					SM	Silty sand with clay; tan/gray; moist; medium density;	
						moderately cohesive; moist; no odors	
10							
11				0.4			
12							
						wet at 12'	
13				0.6			
14							
15							
16							
						boring terminated at 16'	
17							
18							
19							
20							

BORING LOG #: B-8; Page 1 of 1

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Cascade Drilling
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	B-8
Boring Depth:	16'	Surface Elevation:	--
GW Encountered:	10'	Start Date:	2/3/12
Static GW Level:	10'	End Date:	2/3/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1							
2							
3						No recovery 0'-4'	
4					SM	Silty sand; dark gray with gravel; dry; medium density;	
5						medium cohesive; no odors	
6						Slight product odor	
7							
8							
▽				1.2	SM	moist at 8'	
9							
10							
11							
12				0.6			
13					SM	Silty sand with clay; wet; very dense; moderately cohesive; some gravel; no odors	
14							
15							
16				0.5			
17						boring terminated at 16'	
18							
19							
20							

BORING LOG #: B-9; Page 1 of 1

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Cascade Drilling
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	B-9
Boring Depth:	16'	Surface Elevation:	--
GW Encountered:	8'	Start Date:	2/3/12
Static GW Level:	8'	End Date:	2/3/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1					SM	Silty sand; dark brown; dry; loose; no odors	
2				0.2			
3							
4					SM	Dark brown; moist; moderately cohesive; moderate density	
5							
6				0.3			
7							
8	▽				SM	Gray with some clay; moist; very dense; highly cohesive; no odors	
9							
10				0.4			
11							
12					SM	Wet at 12'	
13					SM	Saturated below 12'	
14							
15				0.8			
16						boring terminated at 16'	
17							
18							
19							
20							

BORING LOG #: B-10; Page 1 of 1

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Cascade Drilling
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	B-10
Boring Depth:	8.5	Surface Elevation:	--
GW Encountered:	--	Start Date:	2/3/12
Static GW Level:	--	End Date:	2/3/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
					SM	Silty sand; brown; dry; loose; no odors	
1							
2							
3					CL	Clay with sand; blue/gray; dry; slight product odor;	
4						moderately cohesive	
5							
6					CL	Very dense; very cohesive; moist	
7							
8							
9						refusal at 8.5'	
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-11; Page 1 of 1

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Cascade Drilling
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	B-11
Boring Depth:	3'	Surface Elevation:	--
GW Encountered:	--	Start Date:	2/7/12
Static GW Level:	--	End Date:	2/7/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
						No recovery 0' - 1.5'	
1							
2					SM	Silty sand; dark brown; dry; loose; no odors	
3				3.6			
						refusal at 3'	
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-12; Page 1 of 1

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Cascade Drilling
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	B-12
Boring Depth:	9'	Surface Elevation:	--
GW Encountered:	6'	Start Date:	2/7/12
Static GW Level:	6'	End Date:	2/7/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1							
2					SM	Silty sand; dark brown; dry; loose; no odors	
3				0.9			
4					CL	Clay with sand; gray; dry; strong product odor; highly cohesive; very dense	
5							
6 ▽				7.9			
7					SC	Clayey sand; gray; saturated; strong product odor; very dense	
8				116.8			
9						refusal at 8.5'	
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-13; Page 1 of 1

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Cascade Drilling
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	B-13
Boring Depth:	10'	Surface Elevation:	--
GW Encountered:	8'	Start Date:	2/7/12
Static GW Level:	8'	End Date:	2/7/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
					SM	Silty sand; dark brown; dry; medium density; no odors	
1							
2							
3				5.4			
4					SC	Clayey sand; gray; moderate density; very cohesive;	
						moist; moderate product odor	
5							
6				82.1			
7					SC	Wet; strong product odor	
8	▽						
9				71.7			
10						saturated at 9.5'	
						refusal at 10'	
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-14; Page 1 of 1

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Cascade Drilling
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	B-14
Boring Depth:	9'	Surface Elevation:	--
GW Encountered:	6'	Start Date:	2/7/12
Static GW Level:	6'	End Date:	2/7/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1							
2				3.1	SM	Silty sand; dark brown; dry; medium density; no odors	
3							
4					SM	moist; strong product odor	
5					CL	Clay with sand; gray/blue; dense; strong product odor; wet	
6				155			
7					CL	Gray; strong product odor	
8							
9				24.0			
10						boring terminated at 9'	
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: PB-1; Page 1 of 2

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Boretec, Inc.
Location:	Seattle, WA	Drilling Method:	Auger
		Borehole Diameter:	8"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	PB-1
Boring Depth:	25'	Surface Elevation:	--
GW Encountered:	10'	Start Date:	2/24/12
Static GW Level:	10'	End Date:	2/24/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
						Asphalt cover	
1					SC	Clayey sand, blue gray, medium density, very cohesive, dry	
2					SM	Silty sand with some clay, brown, medium density, medium cohesive, dry	
3							
4							
5				1.2			
6							
7					SM	Silty sand with some clay, brown, medium density, medium cohesive, saturated	
8							
9							
10 ▽				1.9			
11							
12							
13							
14							
15				1.6	SM	Silty sand, brown-gray, loose, slightly cohesive, some pebbles, saturated	
16							
17							
18							
19							
20				1.2			

ATC Project Name: 11th & Union Ph II

ATC Project Number: 76.75424.0002

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
21						No recovery 21' - 25'	
22							
23							
24							
25							
26						Boring terminated at 25'	
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							

BORING LOG #: PB-2; Page 1 of 2

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Boretec, Inc.
Location:	Seattle, WA	Drilling Method:	Auger
		Borehole Diameter:	8"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	PB-2
Boring Depth:	25'	Surface Elevation:	--
GW Encountered:	10'	Start Date:	2/24/12
Static GW Level:	12'	End Date:	2/24/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
					SM	Silty sand, gray, medium density, slightly cohesive,	
1						dry, low recovery	
2					SC	Clayey sand, gray, very dense, medium cohesive, moist	
3							
4							
5				1.8			
6					SM	Silty sand, gray, medium dense, medium cohesive, wet	
7							
8							
9							
10	▽			21.0	SM	Silty sand, gray, medium dense, medium cohesive, moist	
11							
12							
13							
14							
15				1.6	SM	Silty sand, gray, medium dense, medium cohesive,	
16						saturated	
17							
18							
19							
20				1.2	SM	Silty sand, gray, medium dense, slightly cohesive, wet	

DRAFT BORING LOG #: PB-2; Page 2 of 2

ATC Project Name: 11th & Union Ph II

ATC Project Number: 76.75424.0002

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
21					SM	Silty sand, gray, medium dense, slightly cohesive, wet	
22				0.8			
23							
24							
25							
26						Boring terminated at 25'	
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							

BORING LOG #: PB-3; Page 1 of 2

ATC Project Name:	11th & Union Phase II	**Drilling Information**	
ATC Project Number:	76.75424.0002	Drilling Contractor:	Boretec, Inc.
Location:	Seattle, WA	Drilling Method:	Auger
		Borehole Diameter:	8"
		Sampler Type:	Acetate liner

Event Information

Logged by:	M. Newman	Well/Boring Designation:	PB-3
Boring Depth:	25'	Surface Elevation:	--
GW Encountered:	10'	Start Date:	2/24/12
Static GW Level:	12'	End Date:	2/24/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
					SC	Clayey soil, brown, medium dense, medium cohesive, dry	
1							
2							
3							
4							
5				0.9	SM	Sandy with some silt, loose, slightly dense, dry	
6							
7							
8							
9							
10 ▽				1.3	SM	Sandy with some silt and small cobbles, loose, slightly dense, some moisture/wet	
11							
12							
13							
14							
15				1.8	SM	Silty sand, gray, medium dense, medium cohesive, saturated	
16							
17							
18							
19							
20				2.6	SP	Sandy soil, gray, loose, slightly cohesive, saturated	

DRAFT BORING LOG #: PB-3; Page 2 of 2

ATC Project Name: 11th & Union Ph II

ATC Project Number: 76.75424.0002

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
21							
22							
23							
24							
25				1.8	SP	Sandy soil, gray, loose, slightly cohesive, saturated	
26							
27							
28							
29							
30				1.2			
31						Boring terminated at 30'	
32							
33							
34							
35							
36							
37							
38							
39							
40							

BORING LOG #: MW-1; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	MW-1
Boring Depth:	16.0'	Surface Elevation:	
GW Encountered	8.5'	Start Date:	3/30/12
Static GW Level:	8.0'	End Date:	3/30/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1				42.4	SM	0.0-4.0: SILTY SAND, tan/brown, 60% fine sand, 20% silt, 15% coarse sand, 5% gravel, moderate induration, slightly cohesive	Grout
2						Dry, NPO	
3							
4							Bentonite
5				48.3	SM	4.0-6.0: SILTY SAND, As above	
6						Dry; NPO	
7					SM	6.0-8.0: SILTY SAND, As above	
8						Dry; NPO	
9 ▽				51.2	SM	8.0-12.0: SILTY SAND, 50% fine sand, 20% coarse sand, 20% silt, 10% gravel	10/20 Sand
10						Wet at 8.5'; NPO	
11							
12				27.7	SM	12.0-16.0: SILTY SAND, as above	
13						Sautrated; NPO	
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: MW-2; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	MW-2
Boring Depth:	12.0'	Surface Elevation:	
GW Encountered	6.0'	Start Date:	3/30/12
Static GW Level:	4.5'	End Date:	3/30/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1					1.1	0.0-4.0: SILTY SAND, brown, fine sand 30% silt; 10% med sand, 10% coarse sand, 5-15% fine gravel, strong induration	Bentonite
2						Damp; NPO	
3							
4					1.9	4.0-8.0: MED SAND, 20% gravel, 20% silt, 15% fine sand, moderate induration, saturated, NPO	
5							
6 ▽					3.5		10/20 Sand
7							
8					4.4	8.0-12.0: MED SAND, as above, damp below 10.0'; NPO	
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: MW-3; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	MW-3
Boring Depth:	26.0"	Surface Elevation:	
GW Encountered	6.0"	Start Date:	3/30/12
Static GW Level:	12.0"	End Date:	3/30/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1				14.3	SM	0.0-4.0: SILTY SAND, tan/brown, 40% fine sand, 20% coarse sand, 15% silts, 15% clay, 10% gravel	
						Moist; NPO	
2							
3							
4				15.6	SM	4.0-8.0: SILTY SAND, tan/brown, 40% fine sand, 20% coarse sand, 20% silt, 10% clay, 10% gravel	
5							
6 ▽						Wet at 6'; NPO	
7							
8				20.2	SM	8.0-11.0: As above, saturated; NPO	
9							
10							
11				28.3	SC	11.0-13.0: CLAYEY SAND, tan, 30% fine sand, 20% coarse sand, 30% clay, 10% silts, 10% gravel	Bentonite
12						Moist; NPO	
13					SM	13.0-16.0: SILTY SAND, tan, 40% fine sand, 15% coarse sand, 20% clay, 20% silts, 15% gravel	
14						Moist; NPO	
15							
16				17.4	SM	16.0-20.0: SILTY SAND, tan, 40% fine sand, 15% coarse sand, 20% clay, 20% silt, 5% gravel	10/20 Sand
17						Moist; NPO	
18							
19							
20							

BORING LOG #: MW-3 ; Page 2 of 2

ATC Project Name: Alliance: 11th and Union

ATC Project Number: 76.75424.0004

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
21				14.8	SM	20.0-24.0: SILTY SAND, tan/grey, 40% fine sand, 30% silt, 20% coarse sand, 10% clay	10/20 Sand
						Moist; NPO	
22							
23							
24					SM	24.0-26.0: As above, NPO	
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							

BORING LOG #: MW-4; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	MW-4
Boring Depth:	12.0'	Surface Elevation:	
GW Encountered	6.0'	Start Date:	3/29/12
Static GW Level:	7.0'	End Date:	3/29/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
						0.0-1.0: Conrete	
1				230.0	SM	1.0-4.0: SILTY SAND, dark brown, slightly cohesive, weak induration, moist, FPO	Bento-nite
2							
3							
4					SC	4.0-5.0: CLAYEY SAND, olive, very cohesive, strong induration, wet, SPO	
5							
6				114.0	SM	5.0-9.0: SILTY SAND, moderately cohesive, moderate induration, 50% fine sand, 30% fine sand, 20% clay	10/20 Sand
7						Moist, FPO	
8							
9							
				928.0	SM	9.0-12.0: SILTY SAND, tan/olive, slightly cohesive, moderate induration, 50% fine sand, 20% coarse sand, 20% silts, 10% clay	
10							
11						Saturated; FPO	
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: MW-5; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	MW-5
Boring Depth:	15.0'	Surface Elevation:	
GW Encountered	4.0'	Start Date:	3/29/12
Static GW Level:	6.0'	End Date:	3/29/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
						0.0-1.0: Concrete Core	
1				79.2	SM	1.0-5.0: SILTY SAND, no induration, slightly cohesive, 60% fine sand, 25% silt, 15% clay,	Grout
2						Wet @ 4', SPO	Bentonite
3							
4 ▽							
5				182.0	SM	5.0-7.0: SILTY SAND, as above	
6						Saturated; SPO	
7					SC	7.0-9.0: CLAYEY SAND, olive/grey, moderately cohesive, severe induration	
8						Wet; FPO	
9				2552.0	SC	9.0-12.0: CLAYEY SAND, low recovery, as above, MPO	10/20 Sand
10							
11							
12						12.0-15.0: No recovery	
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-15; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	B-15
Boring Depth:	12.0'	Surface Elevation:	
GW Encountered	6'	Start Date:	3/30/12
Static GW Level:	5'	End Date:	3/30/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1				16.7	SM	0.0-4.0: SILTY SAND, tan/brown, modrate induration, 50% fine sand, 20% silts, 15% clay, 15% gravel	
						Dry, NPO	
4				37.5	SM	4.0-8.0: As Above	
6 ▽						Wet at 6'; NPO	
8				42.2		8.0-12.0: As above; Saturated; NPO	
12							Backfilled with Bentonite Chips
20							

BORING LOG #: B-16; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	B-16
Boring Depth:	12.0'	Surface Elevation:	
GW Encountered	5.0'	Start Date:	3/30/12
Static GW Level:	3.0'	End Date:	3/30/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1				26.8	SC	0.0-4.0: CLAYEY SAND, olive, very cohesive, moderate induration, 40% fine sand, 30% clay, 15% gravel, 15% silts	
						Moist, FPO	
2							
3							
4				41.4	SM	4.0-8.0: SILTY SAND, olive/grey, slightly cohesive, moderate induration, 40% fine sand, 20% coarse sand, 15% gravel, 15% silt, 10% clay	
5							
6 ▽						Wet at 6.0'; NPO	
7							
8				61.4	SM	8.0-12.0: SILTY SAND, as above	
9						Saturated, NPO	
10							
11							
12							Backfilled with Bentonite Chips
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-17; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	B-17
Boring Depth:	12.0'	Surface Elevation:	
GW Encountered	6.0'	Start Date:	3/31/12
Static GW Level:	3.0'	End Date:	3/31/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1				215.0	SC	0.0-4.0: CLAYEY SAND, olive, very cohesive, moderate induration, 40% fine sand, 30% clay, 15% gravel, 15% silt	
						Dry, FPO	
2							
3							
4							
				192.0	SM	4.0-8.0: SILTY SAND, tan/grey, not cohesive, moderate induration, 40% fine sand, 20% coarse sand, 20% silt, 10% clay, 10% gravel	
5							
6 ▽						Wet at 6.0', FPO	
7							
8							
				181.0	SM	8.0-12.0: SILTY SAND, as above	
9						Saturated, FPO	
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Backfilled with Bentonite Chips

BORING LOG #: B-18; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	B-18
Boring Depth:	10.0'	Surface Elevation:	
GW Encountered	6.0'	Start Date:	3/28/12
Static GW Level:	5.0'	End Date:	3/28/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1					SC	0.0-2.0: CLAYEY SAND; orange and tan, moderately cohesive, 30% fine sand, 30% clay, 25% coarse sand,15% gravel, dry, SPO	Backfilled with Bentonite Chips
2				90.8	SC	2.0-4.0: CLAYEY SAND; Blueish grey, very cohesive, moderately dense, 30% clay, 30% fine sand, 30% coarse sand, 10% gravel, moist, SPO.	
3							
4				390.0	SC	4.0-8.0: As Above, SPO	
5							
6 ▽						Saturated at 6.0'	
7							
8						8.0-10.0: No recovery	
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-19; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	B-19
Boring Depth:	10.0'	Surface Elevation:	
GW Encountered	8.0'	Start Date:	3/29/12
Static GW Level:	6.0'	End Date:	3/29/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
				38.6	SM	0.0-4.0: SILTY SAND, dark brown, moderately cohesive, moderate induration, 60% fine sand, 30% silt, 10% gravel	
1						Moist, NPO	
2							
3							
4				74.2	SM	4.0-7.0: SILTY SAND, olive, very cohesive, moderate induration, 50% fine sand, 20% silt, 20% clay, 10% gravel	
5						Moist, FPO	
6							
7				96.8	SM	7.0-10.0: SILTY SAND, as above, Saturated, FPO	
8	▽						
9							
10							Backfilled with Bentonite Chips
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-20; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	B-20
Boring Depth:	15.0'	Surface Elevation:	
GW Encountered	11.0'	Start Date:	3/28/12
Static GW Level:	11.0'	End Date:	3/28/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1				54.8	SM	0.0-4.0: SILTY SAND, dark brown,slightly cohesive, slight induration, 50% fine sand, 25% silt, 15% gravel, 10% clay	
						Moist, NPO	
2							
3							
4				279.0	SC	4.0-7.0: CLAYEY SAND; grey/olive, moderately cohesive, slight induration, 40% fine sand, 25% clay, 15% gravel	
5							
6						Wet; FPO	
7				155.0	SC	7.0-10.0: CLAYEY SAND, olive, moderately cohesive, moderate induration, 40% fine sand, 30% clay, 20% gravel, 10% silt	
8							
9						Wet; FPO	
10				117.0	SC	10.0-13.0: As above, Saturated, FPO	
11 ▽							
12							
13				102.0	SM	13.0-15.0: SILTY SAND; olive, 45% fine sand, 30% silt, 25% clay	
14						Saturated; FPO	
15							Backfilled with Bentonite Chips
16							
17							
18							
19							
20							

BORING LOG #: B-21; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	B-21
Boring Depth:	11.0'	Surface Elevation:	
GW Encountered	8.0'	Start Date:	3/29/12
Static GW Level:	8.0'	End Date:	3/29/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1				30.3	SM	0.0-4.0:SILTY SAND, dark brown, slightly cohesive, slight induration, 60% fine sand, 30% silt, 10% clay	
						Moist, NPO	
2							
3							
4				108.9	SC	4.0-8.0: CLAYEY SAND, olive, very cohesive, moderate induration, 40% fine sand, 30% clay, 15% silt, 15% coarse sand	
5							
6						Wet, SPO at 5.0'	
7							
8				27.4	SM	8.0-11.0: SILTY SAND, grey, not cohesive, slight induration, 30% fine sand, 30% coarse sand, 25% silt, 15% clay	
9							
10						Saturated; FPO	
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Backfilled with bentonite Chips

BORING LOG #:B-22; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	B-22
Boring Depth:	10.0'	Surface Elevation:	
GW Encountered	8.0'	Start Date:	3/29/12
Static GW Level:	6.0'	End Date:	3/29/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
				102.0	SM	0.0-4.0: SILTY SAND, dark brown, slight induration, slightly cohesive, 60% fine sand, 25% silt, 15% coarse sand	
1						Moist; FPO	
2							
3							
4				175.0	SC	4.0-7.0: CLAYEY SAND, olive/grey, severe induration, moderately cohesive, 40% fine sand, 25% clay, 15% coarse sand, 20% silts	
5							
6						Moist; FPO	
7				48.3	SC	7.0-10.0: CLAYEY SAND, as above	
8 ▽						Saturated; FPO	
9							
10							Backfilled with Bentonite Chips
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-23; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	B-23
Boring Depth:	11.0'	Surface Elevation:	
GW Encountered	9.0'	Start Date:	3/29/12
Static GW Level:	8.0'	End Date:	3/29/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1				1436.0	SM	0.0-4.0: SILTY SAND: tan/dark brown, not cohesive, slight induration, 50% fine sand, 30% silt, 20% gravel Dry; NPO	Backfilled with Bentonite Chips
2							
3							
4							
5				1140.0	SC	4.0-8.0: CLAYEY SAND; olve, very cohesive, moderate induration, 50% fine sand, 30% clay, 20% silt, Moist; MPO	
6							
7							
8				2715.0	SC	8.0-11.0: As above, Saturated, MPO	
9 ▽							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-24; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	B-24
Boring Depth:	11.0'	Surface Elevation:	
GW Encountered	8.0'	Start Date:	3/29/12
Static GW Level:	7.0'	End Date:	3/29/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
				174.0	SM	0.0-4.0: SILTY SAND; dark brown, not cohesive, slight induration,50% fine sand, 30% silts, 20% gravel	
1						Moist, FPO	
2							
3							
4					SM	4.0-5.0: as above	
				864.0	SC	5.0-8.0: CLAYEY SAND; olive grey, moderately cohesive,	
5						moderate induration, 50% fine sand, 30% clay, 20% silt	
6						Moist, SPO	
7							
8 ▽							
				138.0	SM	8.0-11.0: SILTY SAND; olive, severe induration, moderately	
9						cohesive, 40% fine sand, 30% silts, 20% clay, 10% coarse sand	
10						Wet, SPO	
11							Backfilled with Bentonite Chips
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-25; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	B-25
Boring Depth:	10.0'	Surface Elevation:	
GW Encountered	5.0'	Start Date:	3/28/12
Static GW Level:	4.5'	End Date:	3/28/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1				236.0	SM	0.0-4.0: SILTY SAND; grey, moderately cohesive, moderate induration, 50% fine sand, 30% silts, 10% clay, 10% gravel, Moist, FPO	Backfilled with Bentonite Chips
2							
3							
4							
5 ▽				68.2	SM	4.0-6.0: As above, Wet, FPO	
6							
7				149.0	SM	6.0-8.0: As above, Saturated, FPO	
8							
9				80.2	SM	8.0-10.0: As above, Saturated, FPO	
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

BORING LOG #: B-26; Page 1 of 1

ATC Project Name:	Alliance: 11th and Union	**Drilling Information**	
ATC Project Number:	76.75424.0004	Drilling Contractor:	ESN
Location:	Seattle, WA	Drilling Method:	Direct Push
		Borehole Diameter:	2"
		Sampler Type:	MacroCore

Event Information

Logged by:	Mark Newman	Well/Boring Designation:	B-26
Boring Depth:	10.0'	Surface Elevation:	
GW Encountered	6.0'	Start Date:	3/28/12
Static GW Level:	6.0'	End Date:	3/28/12
Notes:			

Depth (ft)	Recovery	Sample Interval	Blow Counts	PID/FID Readings	USCS Classification	Soil Classification/ Description	Well Construction
1				58.1	SM	0.0-4.0: SILTY SAND, light tan, moderate induration, 35% fine sand, 30% silt, 20% coarse sand, 10% gravel, 5% clay	Backfilled with Bentonite Chips
2						Moist, NPO	
3							
4							
5				139.0	SM	4.0-8.0: SILTY SAND; tan, moderately cohesive, moderate induration, 40% fine sand, 30% silts, 10% coarse sand, 10% coarse, 10% clay	
6 ▽						Wet @ 6.0'; NPO	
7							
8							
9				405.0	SM	8.0-10.0: As above, Saturated, NPO	
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

RELATIVE DENSITY / CONSISTENCY

SAND / GRAVEL			SILT / CLAY		
Density	SPT N-values	Approx. Relative Density (%)	Consistency	SPT N-values	Approx. Undrained Shear Strength (psf)
Very Loose	<4	<15	Very Soft	<2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Med. Dense	10 to 30	35 - 65	Med. Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	>50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	>30	>4000

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		GROUP DESCRIPTIONS	
Gravel 50% or more of the coarse fraction retained on the #4 sieve. Use dual symbols (eg. GP-GM) for 5% to 12% fines.	GRAVEL (<5% fines)	GW	Well-graded GRAVEL
		GP	Poorly-graded GRAVEL
	GRAVEL (>12% fines)	GM	Silty GRAVEL
		GC	Clayey GRAVEL
Sand 50% or more of the coarse fraction passing the #4 sieve. Use dual symbols (eg. SP-SM) for 5% to 12% fines.	SAND (<5% fines)	SW	Well-graded SAND
		SP	Poorly-graded SAND
	SAND (>12% fines)	SM	Silty SAND
		SC	Clayey SAND
Silt and Clay 50%or more passing #200 sieve	Liquid Limit < 50	ML	SILT
		CL	Lean SILT
		OL	Organic SILT or CLAY
	Liquid Limit > 50	MH	Elastic SILT
		CH	Fat CLAY
		OH	Organic SILT or CLAY
Highly Organic Soils		PT	PEAT

Notes: 1. Soil exploration logs contain material descriptions based on visual observation and field tests using a system modified from the Uniform Soil Classification System (USCS). Where necessary laboratory tests have been conducted (as noted in the "Other Tests" column), unit descriptions may include a classification. Please refer to the discussions in the report text for a more complete description of the subsurface conditions.

2. The graphic symbols given above are not inclusive of all symbols that may appear on the borehole logs. Other symbols may be used where field observations indicated mixed soil constituents or dual constituent materials.

DESCRIPTIONS OF SOIL STRUCTURES

Layered: Units of material distinguished by color and/or composition from material units above and below

Laminated: Layers of soil typically 0.05 to 1mm thick, max. 1 cm

Lens: Layer of soil that pinches out laterally

Interlayered: Alternating layers of differing soil material

Pocket: Erratic, discontinuous deposit of limited extent

Homogeneous: Soil with uniform color and composition throughout

Fissured: Breaks along defined planes

Slickensided: Fracture planes that are polished or glossy

Blocky: Angular soil lumps that resist breakdown

Disrupted: Soil that is broken and mixed

Scattered: Less than one per foot

Numerous: More than one per foot

BCN: Angle between bedding plane and a plane normal to core axis

COMPONENT DEFINITIONS

COMPONENT	SIZE / SIEVE RANGE	COMPONENT	SIZE / SIEVE RANGE
Boulder:	> 12 inches	Sand	
Cobbles:	3 to 12 inches	Coarse Sand:	#4 to #10 sieve (4.5 to 2.0 mm)
Gravel		Medium Sand:	#10 to #40 sieve (2.0 to 0.42 mm)
Coarse Gravel:	3 to 3/4 inches	Fine Sand:	#40 to #200 sieve (0.42 to 0.074 mm)
Fine Gravel:	3/4 inches to #4 sieve	Silt	0.074 to 0.002 mm
		Clay	<0.002 mm

TEST SYMBOLS

for In Situ and Laboratory Tests listed in "Other Tests" column.

CBR	California Bearing Ratio
Comp	Compaction Tests
Con	Consolidation
DD	Dry Density
DS	Direct Shear
%F	Fines Content
GS	Grain Size
Perm	Permeability
PP	Pocket Penetrometer
R	R-value
SG	Specific Gravity
TV	Torvane
TXC	Triaxial Compression
UCC	Unconfined Compression

SYMBOLS

Sample/In Situ test types and intervals


2-inch OD Split Spoon, SPT (140-lb. hammer, 30" drop)


3.25-inch OD Spilt Spoon (300-lb hammer, 30" drop)


Non-standard penetration test (see boring log for details)


Thin wall (Shelby) tube


Grab


Rock core


Vane Shear

MONITORING WELL


Groundwater Level at time of drilling (ATD)

Static Groundwater Level

Cement / Concrete Seal

Bentonite grout / seal

Silica sand backfill

Slotted tip

Slough

Bottom of Boring

MOISTURE CONTENT

Dry	Dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

LOG KEY.GPJ PANGEO.GDT 12/30/04

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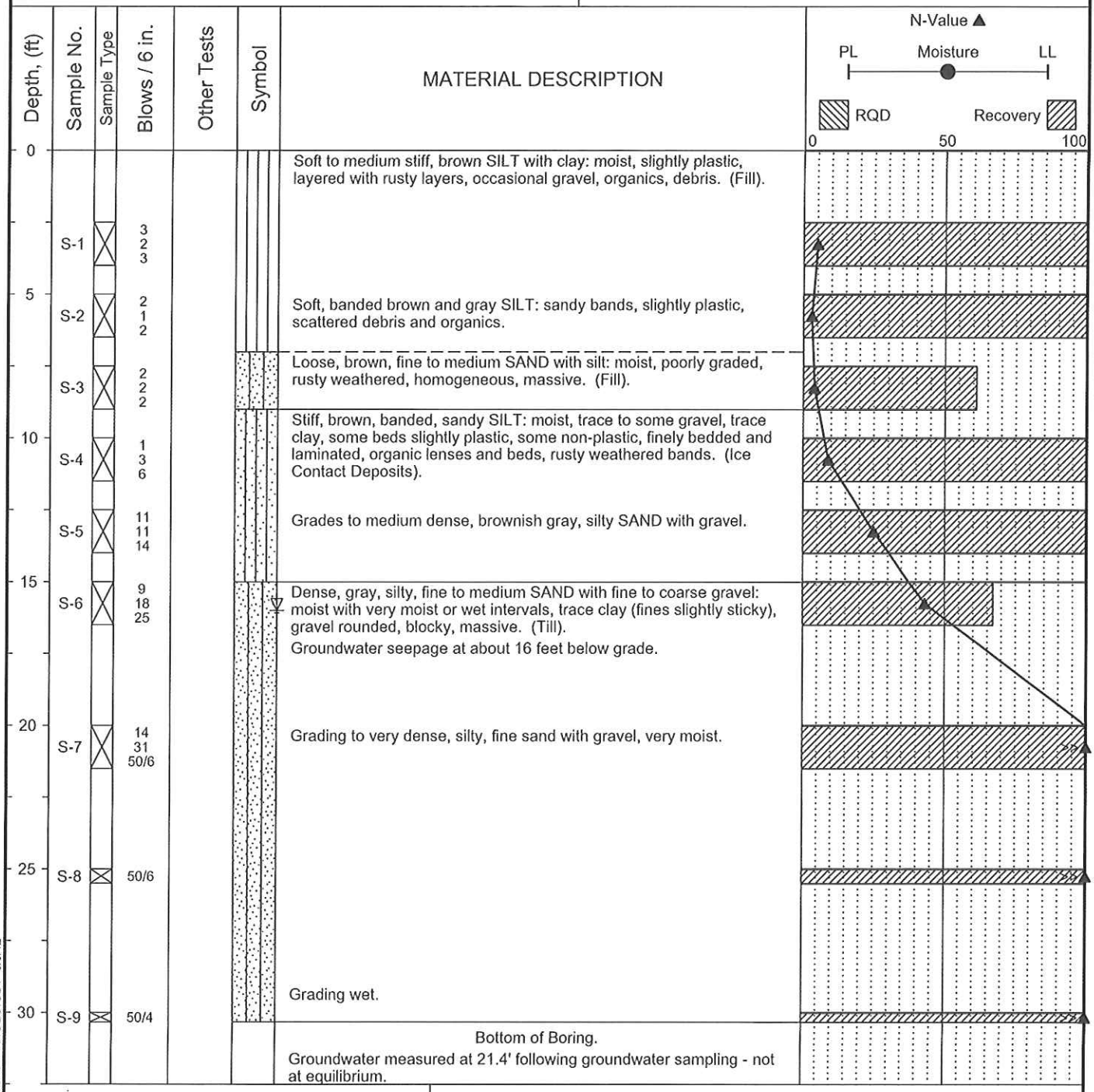
Phone: 206.262.0370

Terms and Symbols for Boring and Test Pit Logs

Figure A-1

Project:	11th & E. Union St.	Surface Elevation:	298.0ft
Job Number:	12-006	Top of Casing Elev.:	n/a
Location:	Seattle, Washington	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT



Completion Depth:	30.3ft
Date Borehole Started:	2/24/12
Date Borehole Completed:	2/24/12
Logged By:	S. Evans
Drilling Company:	Boretec, Inc

Remarks: South side of building at 1406 E. Union Street, in southwest corner of planter box in sidewalk, 82 feet east of southeast building corner, next to curb.

PanGEO INCORPORATED
Phone: 206.262.0370

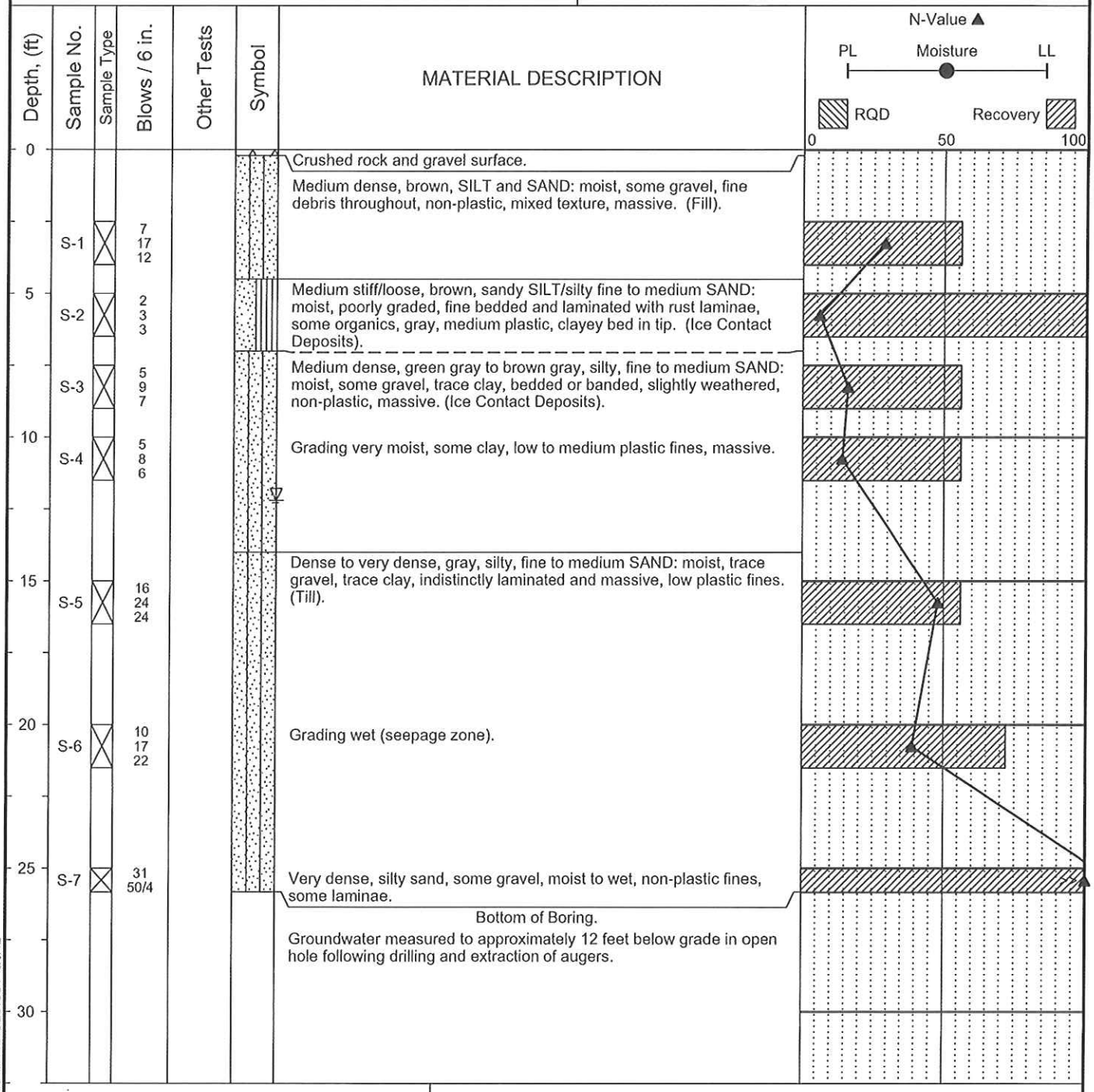
LOG OF TEST BORING BH-1

Figure A-2

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BOREHOLE 12-006_LOGS.GPJ PANGEO.GDT 3/9/12

Project:	11th & E. Union St.	Surface Elevation:	292.0ft
Job Number:	12-006	Top of Casing Elev.:	n/a
Location:	Seattle, Washington	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT



Completion Depth:	25.8ft
Date Borehole Started:	2/24/12
Date Borehole Completed:	2/24/12
Logged By:	S. Evans
Drilling Company:	Boretec, Inc

Remarks: In northeast corner of site, 31 feet north of north building wall at 1405 11th Avenue, 42 feet east of east side retaining wall, 7 feet south of cahin link fence.

PanGEO INCORPORATED
Phone: 206.262.0370

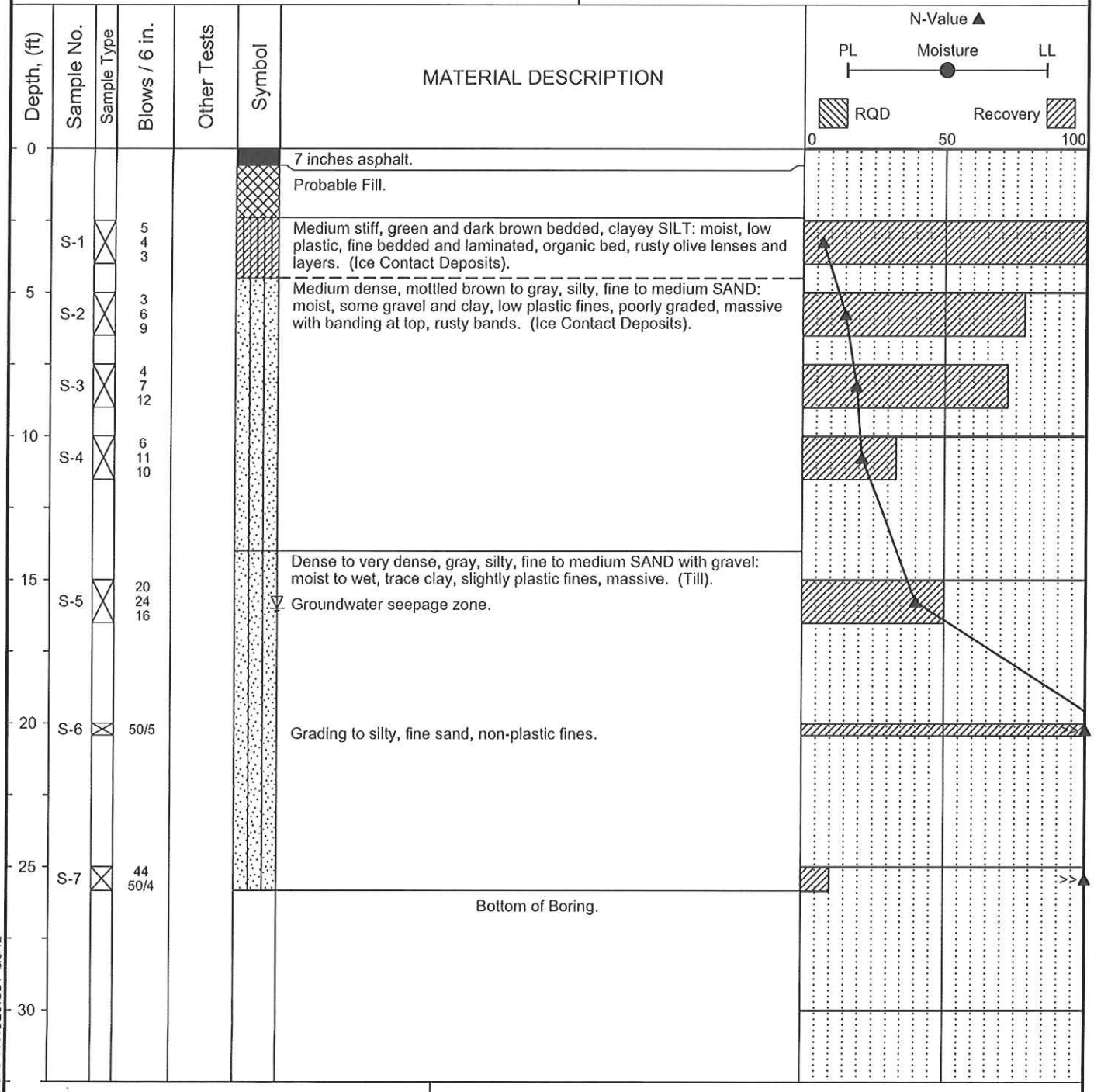
LOG OF TEST BORING BH-2

Figure A-3

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BOREHOLE 12-006_LOGS.GPJ PANGEO.GDT 3/9/12

Project:	11th & E. Union St.	Surface Elevation:	292.0ft
Job Number:	12-006	Top of Casing Elev.:	n/a
Location:	Seattle, Washington	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT



Completion Depth:	25.8ft
Date Borehole Started:	2/24/12
Date Borehole Completed:	2/24/12
Logged By:	S. Evans
Drilling Company:	Boretec, Inc

Remarks: In middle of pavement parking area, 41 feet north of building at 1406 10th Avenue, 59 feet east of building at 1405 11th Avenue, and 30 feet south of building at 1416 10th Avenue.

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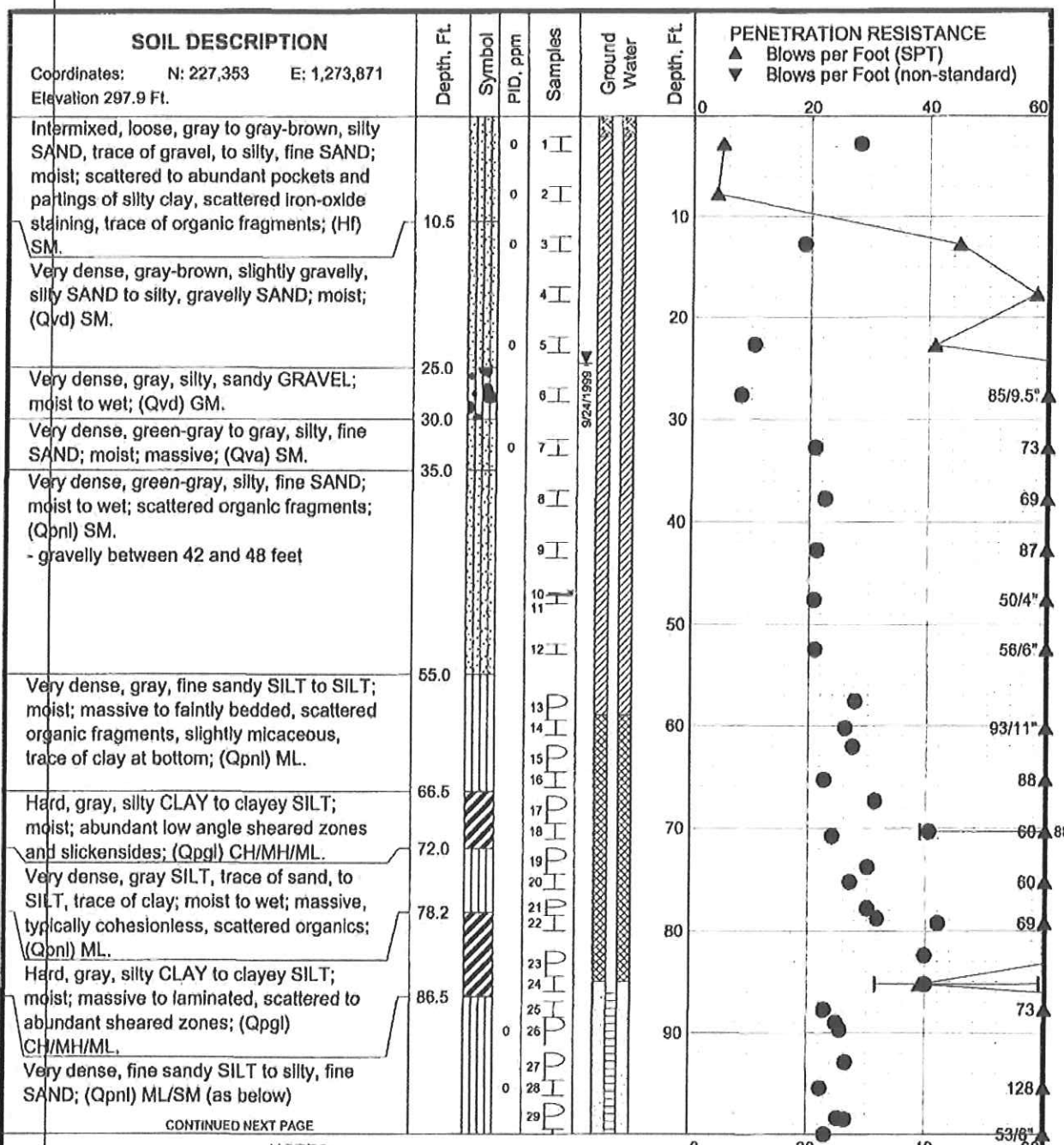
Phone: 206.262.0370

LOG OF TEST BORING BH-3

Figure A-4

The stratification lines represent approximate boundaries. The transition may be gradual.



NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.

Sound Transit
Central Link Light Rail
LB235 - GCR

LOG OF BORING NB-313

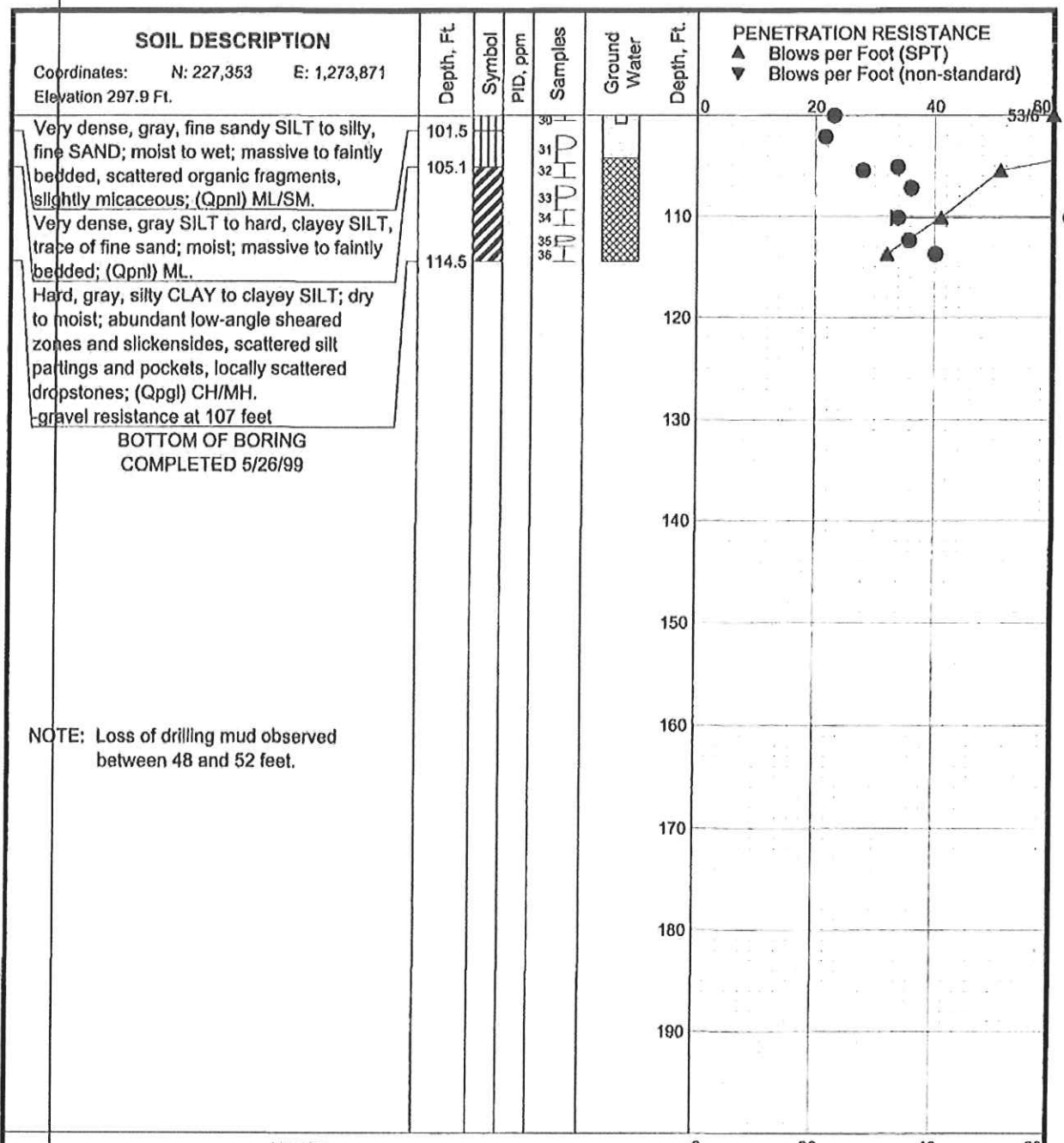
April 2002 W-8110-70

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-56
Sheet 1 of 2

DRAFT REV 3.1

RTA & WB100.GPJ WB100.GPJ 5/2/02 Log: DB Rev: TWH Typ: JBB



NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.

Sound Transit
Central Link Light Rail
LB235 - GCR

LOG OF BORING NB-313

April 2002 W-8110-70

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-56
Sheet 2 of 2

DRAFT REV 3.1

RTA_4 W8100.GPJ W8100.GPJ 5/2/02 Log: DB Rev: TWH Typ: JBB

Logged by: GM
Date: 10/30/06

Boring B-2

Elevation: 284.5 feet± *

(N) Blows/ft.	W (%)	Sample Number	Sample Type	Depth (ft.)	Graph	USCS	Soil Description
						Conc.	~6" thick concrete slab (3 1/2" over 2 1/2").
15	-	1	SPT			SM	Brown silty fine to medium SAND, moist, loose to medium dense, trace rounded gravel.
						SM	Light gray to light gray-brown silty fine to coarse SAND, moist, medium dense, trace rounded gravel.
28	-	2	SPT	5			- Becomes gravelly at ~7 1/2 feet.
						SM	Gray silty fine to coarse SAND, moist, dense, little fine rounded gravel.
49	8.3	3	SPT	10			
76/11"	-	4	SPT	15			- Becomes very dense.
50/2"	-	5	SPT	20		BOH	Boring terminated at 20 1/4 feet below existing grade. Groundwater encountered at 4'-10" during drilling. Boring backfilled with cuttings and bentonite chips.
				25			
				30			
				35			
				40			

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis, and judgement. They are not necessarily of other times and locations. We cannot accept responsibility for the use of interpretation by others of information presented on this log.

06-2748 / 11.14.06

Creative Engineering Options INC.
CEO
A Firm Practicing in the Geosciences

BORING LOG

Plate 10

Logged by: GM
Date: 10/30/06

Boring B-3

Elevation: 285.0 feet±

(N) Blows/ft.	W (%)	Sample Number	Sample Type	Depth (ft.)	Graph	USCS	Soil Description
						Conc.	~6" thick concrete slab (4" over 6").
10	10.6	1	SPT			SM	Gray-brown silty fine to coarse SAND, moist, loose to medium dense, trace fine rounded gravel.
						SM	Gray-brown to light gray silty fine to coarse SAND, wet, medium dense, trace to little rounded gravel.
24	-	2	SPT	5			
						SM	Light gray-brown to light gray silty fine to coarse SAND, moist, very dense, little rounded gravel.
65	-	3	SPT	10			
						SM	Gray silty fine to coarse SAND, moist, very dense, little rounded gravel.
50/4"	-	4	SPT	15			
50/5"	-	5	SPT	20		BOH	Boring terminated at 21.0 feet below existing grade. Groundwater encountered at 6'-1" during drilling. Boring backfilled with cuttings and bentonite chips.
				25			
				30			
				35			
				40			

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis, and judgement. They are not necessarily of other times and locations. We cannot accept responsibility for the use of interpretation by others of information presented on this log.

SEATTLE ENGINEERING DEPARTMENT
MATERIALS LABORATORY

GS 7.241

LOG OF TEST BORING

DATE 11-17-72 HOLE NO. 10

PROJECT LK UNION S #1-2 GRD. ELEV.

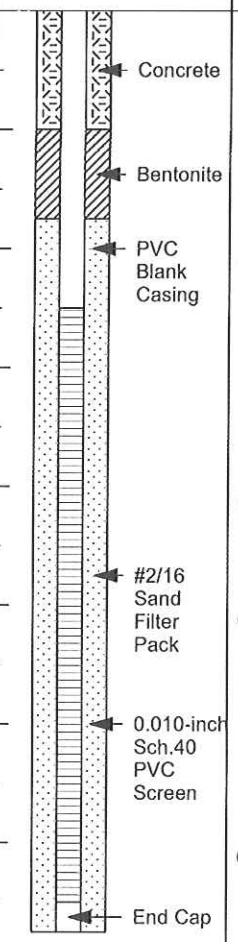
LOCATION 11TH AVE. & E. UNION 50° N. & 16° E. OF ℄

STRATA	DEPTH	SAMPLE NO.	BLOW COUNT	STD. PEN.	DESCRIPTION OF MATERIAL: COMPOSITION	CONSISTENCY	MOISTURE	COLOR	WATER LEVEL
LOOSE CLAYEY SILT					BRN CLAYEY SILTY SAND				
	5	A	2 3 3	6	CLAYEY SILT	LOOSE	MOIST	GRAY	
FIRM SILTY SAND w/GRAVEL & SILTY GRANULAR SAND & CLAYEY SILT LENS					6" SILTY SAND w/GRAVEL				
	10	B	3 4 13	17	6" SILTY GRAVELLY SAND	FIRM	MOIST	GRAY	
									11-28-72
	15	C	11 13 5	18	SILTY SAND w/GRAVEL	FIRM	MOIST	BRN	
					1" CLAYEY SILT IN TIP			GRAY	
					3" DECOMPOSED GRANITE		SAT	WHITE BLK	
V. COMP SILTY SAND w/GRAVEL & CLAYEY SILT LENSES		D	8 24 37	61	4" SILTY SAND w/GRAVEL	V. COMP	MOIST	BRN	
	20								11-17-72
		E	1 22 50	72	12" CLAYEY SILT	V. COMP	MOIST	GRAY	
					6" SILTY SAND w/GRAVEL		MOIST	GRAY	SAND
	25								

INSPECTOR HW KORTAS

PES Environmental, Inc.
Engineering & Environmental Services

LOG OF MONITORING WELL: MW-6



PID (PPM)	Sample ID	Blow Count	Sample Recovery	Sample Interval	Depth (Feet)	Graphic Log	Lithologic Description
					0		Concrete
					2		GRAYISH BROWN SILTY GRAVEL WITH SAND (GM), moist
0.0					4		
0.0					6		GRAY SILTY SAND (SM), moist, fine to coarse grained, trace gravel
0.0					8		
					10		@ 9 feet: BLUISH GRAY
0.0							@ 10 feet: wet
					12		
							@ 13 feet: no gravel
0.0					14		
					16		Bottom of boring @ 15.5 feet.
							Well Completion Details: Well constructed with 2-inch i.d. Schedule 40 PVC pipe and a 0.010-inch machine slotted screen with #2/16 Colorado Silica Sand.
					18		Total Well Depth: 15.5 feet. Well Sump/Endcap: 15 to 15.5 feet. Well Screen: 5 to 15 feet. Well Blank: 0 to 5 feet. Filter Pack: 3.5 to 15.5 feet (#2/16 Colorado Silica). Well Seal: 2 to 3.5 (hydrated bentonite chips). Surface Seal: 0 to 2 feet (concrete). Well Monument: Flush with grade steel monument.
					20		
					22		
					24		

Project: BCH - Capitol Hill
Project Number: 1325.001.03.007
Site Location: Seattle, Washington
Logged By: K. Springstead
Notes: Ecology Well Tag Number: BID 070

Total Drilled Depth: 15.5 feet
Diameter of Boring: 9-inches
Drill Date: 01/17/14
Drilled By: Cascade Drilling L.P.
Drill Method: Limited Access Hollow-Stem Auger

APPENDIX C

TERRESTRIAL ECOLOGICAL EVALUATION EXCLUSION FORM

DEPARTMENT OF ECOLOGY
State of Washington

Voluntary Cleanup Program

Washington State Department of Ecology
Toxics Cleanup Program

TERRESTRIAL ECOLOGICAL EVALUATION FORM

Under the Model Toxics Control Act (MTCA), a terrestrial ecological evaluation is necessary if hazardous substances are released into the soils at a Site. In the event of such a release, you must take one of the following three actions as part of your investigation and cleanup of the Site:

1. Document an exclusion from further evaluation using the criteria in WAC 173-340-7491.
2. Conduct a simplified evaluation as set forth in WAC 173-340-7492.
3. Conduct a site-specific evaluation as set forth in WAC 173-340-7493.

When requesting a written opinion under the Voluntary Cleanup Program (VCP), you must complete this form and submit it to the Department of Ecology (Ecology). The form documents the type and results of your evaluation. You still need to submit your evaluation as part of your cleanup plan or report.

If you have questions about how to conduct a terrestrial ecological evaluation, please contact the Ecology site manager assigned to your Site. For additional guidance, please refer to www.ecy.wa.gov/programs/tcp/policies/terrestrial/TEEHome.htm.

Step 1: IDENTIFY HAZARDOUS WASTE SITE

Please identify below the hazardous waste site for which you are documenting an evaluation.	
Facility/Site Name: Broadstone Capital Venture LLC	
Facility/Site Address: 1414 10th Avenue, Seattle, WA	
Facility/Site No: 17539	VCP Project No.: NW2703

Step 2: IDENTIFY EVALUATOR

Please identify below the person who conducted the evaluation and their contact information.		
Name: Daniel A. Balbiani, P.E.		Title: Principal Engineer
Organization: PES Environmental, Inc.		
Mailing address: 1215 Fourth Avenue, Suite 1350		
City: Seattle	State: WA	Zip code: 98161
Phone: (206) 529-3980	Fax: (206) 529-3985	E-mail: dbalbiani@pesenv.com

Step 3: DOCUMENT EVALUATION TYPE AND RESULTS

A. Exclusion from further evaluation.

1. Does the Site qualify for an exclusion from further evaluation?

☒ Yes *If you answered **"YES,"** then answer **Question 2.***

☐ No or Unknown *If you answered **"NO" or "UKNOWN,"** then skip to **Step 3B** of this form.*

2. What is the basis for the exclusion? *Check all that apply. Then skip to **Step 4** of this form.*

Point of Compliance: WAC 173-340-7491(1)(a)

☒ All soil contamination is, or will be,* at least 15 feet below the surface.

☐ All soil contamination is, or will be,* at least 6 feet below the surface (or alternative depth if approved by Ecology), and institutional controls are used to manage remaining contamination.

Barriers to Exposure: WAC 173-340-7491(1)(b)

☐ All contaminated soil, is or will be,* covered by physical barriers (such as buildings or paved roads) that prevent exposure to plants and wildlife, and institutional controls are used to manage remaining contamination.

Undeveloped Land: WAC 173-340-7491(1)(c)

☐ There is less than 0.25 acres of contiguous[#] undeveloped[±] land on or within 500 feet of any area of the Site and any of the following chemicals is present: chlorinated dioxins or furans, PCB mixtures, DDT, DDE, DDD, aldrin, chlordane, dieldrin, endosulfan, endrin, heptachlor, heptachlor epoxide, benzene hexachloride, toxaphene, hexachlorobenzene, pentachlorophenol, or pentachlorobenzene.

☒ For sites not containing any of the chemicals mentioned above, there is less than 1.5 acres of contiguous[#] undeveloped[±] land on or within 500 feet of any area of the Site.

Background Concentrations: WAC 173-340-7491(1)(d)

☐ Concentrations of hazardous substances in soil do not exceed natural background levels as described in WAC 173-340-200 and 173-340-709.

* An exclusion based on future land use must have a completion date for future development that is acceptable to Ecology.

[±] "Undeveloped land" is land that is not covered by building, roads, paved areas, or other barriers that would prevent wildlife from feeding on plants, earthworms, insects, or other food in or on the soil.

[#] "Contiguous" undeveloped land is an area of undeveloped land that is not divided into smaller areas of highways, extensive paving, or similar structures that are likely to reduce the potential use of the overall area by wildlife.

B. Simplified evaluation.

1. Does the Site qualify for a simplified evaluation?

☐ Yes *If you answered **"YES,"** then answer **Question 2** below.*

☐ No or Unknown *If you answered **"NO"** or **"UNKNOWN,"** then skip to **Step 3C** of this form.*

2. Did you conduct a simplified evaluation?

☐ Yes *If you answered **"YES,"** then answer **Question 3** below.*

☐ No *If you answered **"NO,"** then skip to **Step 3C** of this form.*

3. Was further evaluation necessary?

☐ Yes *If you answered **"YES,"** then answer **Question 4** below.*

☐ No *If you answered **"NO,"** then answer **Question 5** below.*

4. If further evaluation was necessary, what did you do?

☐ Used the concentrations listed in Table 749-2 as cleanup levels. *If so, then skip to **Step 4** of this form.*

☐ Conducted a site-specific evaluation. *If so, then skip to **Step 3C** of this form.*

5. If no further evaluation was necessary, what was the reason? *Check all that apply. Then skip to **Step 4** of this form.*

Exposure Analysis: WAC 173-340-7492(2)(a)

☐ Area of soil contamination at the Site is not more than 350 square feet.

☐ Current or planned land use makes wildlife exposure unlikely. Used Table 749-1.

Pathway Analysis: WAC 173-340-7492(2)(b)

☐ No potential exposure pathways from soil contamination to ecological receptors.

Contaminant Analysis: WAC 173-340-7492(2)(c)

☐ No contaminant listed in Table 749-2 is, or will be, present in the upper 15 feet at concentrations that exceed the values listed in Table 749-2.

☐ No contaminant listed in Table 749-2 is, or will be, present in the upper 6 feet (or alternative depth if approved by Ecology) at concentrations that exceed the values listed in Table 749-2, and institutional controls are used to manage remaining contamination.

☐ No contaminant listed in Table 749-2 is, or will be, present in the upper 15 feet at concentrations likely to be toxic or have the potential to bioaccumulate as determined using Ecology-approved bioassays.

☐ No contaminant listed in Table 749-2 is, or will be, present in the upper 6 feet (or alternative depth if approved by Ecology) at concentrations likely to be toxic or have the potential to bioaccumulate as determined using Ecology-approved bioassays, and institutional controls are used to manage remaining contamination.

C. Site-specific evaluation. A site-specific evaluation process consists of two parts: (1) formulating the problem, and (2) selecting the methods for addressing the identified problem. Both steps require consultation with and approval by Ecology. *See* WAC 173-340-7493(1)(c).

1. Was there a problem? *See* WAC 173-340-7493(2).

☐ Yes *If you answered **"YES,"** then answer **Question 2** below.*

☐ No *If you answered **"NO,"** then identify the reason here and then skip to **Question 5** below:*

- ☐ No issues were identified during the problem formulation step.
- ☐ While issues were identified, those issues were addressed by the cleanup actions for protecting human health.

2. What did you do to resolve the problem? *See* WAC 173-340-7493(3).

☐ Used the concentrations listed in Table 749-3 as cleanup levels. *If so, then skip to **Question 5** below.*

☐ Used one or more of the methods listed in WAC 173-340-7493(3) to evaluate and address the identified problem. *If so, then answer **Questions 3 and 4** below.*

3. If you conducted further site-specific evaluations, what methods did you use? *Check all that apply. See* WAC 173-340-7493(3).

- ☐ Literature surveys.
- ☐ Soil bioassays.
- ☐ Wildlife exposure model.
- ☐ Biomarkers.
- ☐ Site-specific field studies.
- ☐ Weight of evidence.
- ☐ Other methods approved by Ecology. If so, please specify:

4. What was the result of those evaluations?

- ☐ Confirmed there was no problem.
- ☐ Confirmed there was a problem and established site-specific cleanup levels.

5. Have you already obtained Ecology's approval of both your problem formulation and problem resolution steps?

☐ Yes If so, please identify the Ecology staff who approved those steps:

☐ No

Step 4: SUBMITTAL

Please mail your completed form to the Ecology site manager assigned to your Site. If a site manager has not yet been assigned, please mail your completed form to the Ecology regional office for the County in which your Site is located.

Northwest Region: Attn: Sara Nied 3190 160th Ave. SE Bellevue, WA 98008-5452	**Central Region:** Attn: Mark Dunbar 15 W. Yakima Ave., Suite 200 Yakima, WA 98902
Southwest Region: Attn: Scott Rose P.O. Box 47775 Olympia, WA 98504-7775	**Eastern Region:** Attn: Patti Carter N. 4601 Monroe Spokane WA 99205-1295

APPENDIX D

CLEANUP ACTION ALTERNATIVE COST ESTIMATES

Table D-1

Capital and Operation and Maintenance Costs
Alternative 1 - Overexcavation and MNA

Capital Costs				
ITEM	UNIT COST	UNITS	QTY	COST
Construction Costs				
1. Workplan, engineering, and permitting	$ 8,000	EA	1	$ 8,000
2. Monitoring well decommissioning	$ 600	EA	4	$ 2,400
3. Development excavation to 282.5 ft and overexcavation in Areas 1, 2, and 3				
a) Excavate and load soil from Areas 1, 2, and 3	$ 15	ton	1,000	$ 15,000
b) Shoring at south and east property boundary	$ 20,000	LS	1	$ 20,000
c) PCS contaminated waste soil disposal	$ 46	ton	5,500	$ 250,250
d) Wastewater management and disposal	$ 10,000	LS	1	$ 10,000
4. Import, place, and compact clean fill in overexcavation areas	$ 23	ton	1,200	$ 27,600
5. Oversight excavation and backfilling	$ 8,000	Week	6	$ 48,000
6. Construction report	$ 10,000	LS	1	$ 10,000
Other Capital Costs				
7. MNA work plan	$ 3,000	LS	1	$ 3,000
8. Monitoring well installation and development	$ 6,000	EA	5	$ 30,000
			Subtotal Capital Costs	**$ 424,250**
			Capital Cost Contingency (20%)	$ 84,850
			Total Capital Costs (2)	**$ 510,000**

Annual Costs				
ITEM	ANNUAL COST	UNITS	QTY	PW (1)
1. Performance monitoring and reporting (Year 1)	$ 20,000	LS	1	$ 20,000
2. Performance monitoring and reporting (Years 2 & 3)	$ 11,000	LS	2	$ 19,949
3. Confirmation monitoring (4 quarters)	$ 16,000	LS	1	$ 13,677
4. Cleanup action report, NFA request, and well abandonment	$ 17,000	LS	1	$ 14,532
			Total Annual Costs (2)	**$ 70,000**

Total Estimated Present Worth Cost		**$ 580,000**
Engineering Estimate Range	**-30%**	**$ 406,000**
	50%	**$ 870,000**

1 PW = present worth of the capital cost or series of future costs in 2013 dollars, assuming a 4% discount rate.

2 Total Capital and Total Annual Costs are rounded to the nearest $10,000

Table D-2

Capital and Operation and Maintenance Costs
Alternative 2 - Overexcavation, Backfill Amendment, and MNA

Capital Costs				
ITEM	UNIT COST	UNITS	QTY	COST
Construction Costs				
1. Workplan, engineering, and permitting	$ 8,000	EA	1	$ 8,000
2. Monitoring well decommissioning	$ 600	EA	4	$ 2,400
3. Development excavation to 282.5 ft and overexcavation in Areas 1, 2, and 3				
a) Excavate and load soil from groundwater plume area	$ 15	ton	1,000	$ 15,000
b) Shoring at south and east property boundary	$ 20,000	LS	1	$ 20,000
c) PCS contaminated waste soil disposal	$ 46	ton	5,500	$ 250,250
d) Wastewater management and disposal	$ 10,000	LS	1	$ 10,000
5. Procure oxygen releasing compound pellets	$ 13	pound	4,000	$ 52,000
6. Import, place, and compact clean fill in overexcavation areas	$ 23	ton	1,200	$ 27,600
7. Mix-in oxygen releasing compound pellets during backfilling	$ 12	ton	1,200	$ 14,400
8. Oversight excavation and backfilling	$ 8,000	Week	6	$ 48,000
9. Construction report	$ 10,000	LS	1	$ 10,000
Other Capital Costs				
10. MNA work plan	$ 3,000	LS	1	$ 3,000
11. Monitoring well installation and development	$ 6,000	EA	5	$ 30,000
			Subtotal Capital Costs	**$ 490,650**
			Capital Cost Contingency (20%)	$ 98,130
			Total Capital Costs (2)	**$ 590,000**

Annual Costs				
ITEM	ANNUAL COST	UNITS	QTY	PW (1)
1. Performance monitoring and reporting (Year 1)	$ 20,000	LS	1	$ 20,000
2. Confirmation monitoring (4 quarters)	$ 16,000	LS	1	$ 14,793
3. Cleanup action report, NFA request, and well abandonment	$ 17,000	LS	1	$ 15,717
			Total Annual Costs (2)	**$ 50,000**

Total Estimated Present Worth Cost		**$ 640,000**
Engineering Estimate Range	**-30%**	**$ 448,000**
	50%	**$ 960,000**

1 PW = present worth of the capital cost or series of future costs in 2013 dollars, assuming a 4% discount rate.

2 Total Capital and Total Annual Costs are rounded to the nearest $10,000

Table D-3

Capital and Operation and Maintenance Costs
Alternative 3 - Overexcavation, Enhanced In-situ Bioremediation, and MNA

Capital Costs				
ITEM	UNIT COST	UNITS	QTY	COST
Construction Costs				
1. Workplan, engineering, and permitting	$ 8,000	EA	1	$ 8,000
2. Monitoring well decommissioning	$ 600	EA	4	$ 2,400
3. Development excavation to 282.5 ft and overexcavation in Areas 1, 2, and 3				
a) Excavate and load soil from groundwater plume area	$ 15	ton	1,000	$ 15,000
b) Shoring at south and east property boundary	$ 20,000	LS	1	$ 20,000
c) PCS contaminated waste soil disposal	$ 46	ton	5,500	$ 250,250
d) Wastewater management and disposal	$ 10,000	LS	1	$ 10,000
4. Install 380 LF of slurry injection system trenches and piping	$ 48,000	LS	1	$ 48,000
6. Import, place, and compact clean fill in overexcavation areas	$ 23	ton	1,200	$ 27,600
8. Oversight excavation and backfilling	$ 8,000	Week	6	$ 48,000
9. Construction report	$ 10,000	LS	1	$ 10,000
Other Capital Costs				
10. MNA work plan	$ 3,000	LS	1	$ 3,000
11. Monitoring well installation and development	$ 6,000	EA	5	$ 30,000
			Subtotal Capital Costs	**$ 472,250**
			Capital Cost Contingency (20%)	$ 94,450
			Total Capital Costs (2)	**$ 570,000**

Annual Costs				
ITEM	ANNUAL COST	UNITS	QTY	PW (1)
1. Performance monitoring and reporting (Years 1 & 2)	$ 20,000	LS	2	$ 37,722
2. Inject oxygen releasing compound (Year 2)				
a) Injection work plan and UIC permitting	$ 3,000	LS	1	$ 2,774
b) Procure oxygen releasing compound powder	$ 13	LS	2,000	$ 24,038
c) Slurry injection and oversight	$ 10,000	LS	1	$ 9,246
3. Confirmation monitoring (4 quarters)	$ 16,000	LS	1	$ 14,224
4. Cleanup action report, NFA request, and well abandonment	$ 17,000	LS	1	$ 15,113
			Total Annual Costs (2)	**$ 100,000**

Total Estimated Present Worth Cost		**$ 670,000**
Engineering Estimate Range	**-30%**	**$ 469,000**
	50%	**$ 1,005,000**

1 PW = present worth of the capital cost or series of future costs in 2013 dollars, assuming a 4% discount rate.

2 Total Capital and Total Annual Costs are rounded to the nearest $10,000