Estimating the Extent of Soil Contamination During a Redevelopment Excavation

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EXECUTIVE SUMMARY

From October 2014 to March 2015, I provided excavation oversight services to a client that owns property with substantial environmental concerns. The property in question is located near Downtown Seattle and was formerly occupied by the State's first coal gasification plant. The plant operated from 1888 to 1908 and produced coal gas for municipal use. A coal tar like substance with a characteristically high benzene concentration was a byproduct of the coal gasification process and heavily contaminated at or below the surface grade of the plant as shown in previous investigations on the property. Once the plant ceased operation in 1908 the property was left vacant until 1955 when the site was filled in and a service station was built on the property. The main goal of the excavation was not to achieve cleanup on the property, but to properly remove what contaminated soil was encountered during the redevelopment excavation. Areas of concern were identified prior to the commencement of the excavation and an estimation of the extent of contamination on the property was developed. "Hot spots" of contaminated soil associated with the fill placed after 1955 were identified as areas of concern. However, the primary contaminant plume below the property was likely sourced from the coal gasification plant, which operated at an approximate elevation of 20 feet. We planned to constrain the extents of the soil contamination below the property as the redevelopment excavation progressed.

As the redevelopment excavation was advanced down to an elevation of approximately 20 feet, soil samples were collected to bound the extents of contamination in the upper portion of the site. The hot spots, known pockets of carcinogenic polycyclic aromatic hydrocarbons (cPAH) located above 20 feet elevation, were excavated as part of the redevelopment excavation. Once a hot spot was excavated, soil samples were collected from the north, south, east, west and bottom sidewalls of the hot spot excavation to check for remaining cPAH. Additionally, four underground storage tanks (USTs) associated with the service station were discovered and subsequently removed. Soil samples were also collected from the resulting UST excavation sidewalls to check for remaining petroleum hydrocarbons. Once the excavation reached its final excavation depth of 20 to 16 feet in elevation, bottom of excavation samples were collected on a 35 foot by 35 foot grid to test for concentrations of contaminants remaining onsite. Once the redevelopment excavation was complete, soils observed from borings drilled for either structural elements, geotechnical wells, or environmental wells were checked for any evidence of contamination using field screening techniques. Evidence of contamination was used to identify areas below the final excavation grade which had been impacted by the operation of the coal gasification plant.

Samples collected from the excavation extents of hot spots and USTs show that it was unlikely that any contamination traveled from the post-1955 grade down to the pre-1955

grade. Additionally, the lack of benzene in the bottom of excavation samples suggests that a release from the coal gasification plant occurred below the redevelopment excavation's final elevations of 20 to 16 feet. Qualitative data collected from borings for shoring elements and wells indicated that the spatial extent of the subsurface contaminant plume was different than initially estimated. Observations of spoils show that soil contamination extends further to the southwest and not as far to the east and north than originally estimated. Redefining the extent of the soil contamination beneath the property will allow further subsurface investigations to focus on collecting quantitative data in areas that still represent data gaps on the property, and passing over areas that have shown little signs of contamination. This information will help with the formation of a remediation plan should the need to clean up the site arise in the future.

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INTRODUCTION

Development in downtown Seattle, Washington is increasing at a rapid pace due to an increase in technology sector jobs in the area. Due to the high demand for housing in the city, lots that may have not been profitable to develop ten years ago are now being developed. Environmental contamination on a property is one condition that can drastically increase the cost of development. The disposal costs, logistics, litigation, and safety concerns that accompany developing a contaminated property can drive away potential investors. These concerns, in addition to state and federal laws, make environmental consultants invaluable resources for developers who are considering developing a property with environmental concerns.

A considerable amount of investigation goes into planning environmental excavations. Environmental consultants often start by combing property records and other historical sources to find information related to the past land use and environmental history of a property. This information gathering process and the associated report is called a Phase I Environmental Site Assessment. However the records gathered can be incomplete or inaccurate and a Phase I report will often call out these uncertainties. A Phase II investigation would then be used to further investigate areas of concern highlighted by the Phase I review. Combined, these investigations allow environmental consultants to form a Cleanup Action Plan. However, there is always some degree of uncertainty concerning the extent of contamination when forming cleanup plans, making the planning process difficult and increasing the importance of conservative estimations.

From October 2014 to March 2015, I provided excavation oversight services to a client that owns property with substantial environmental concerns. The property in question is located near downtown Seattle and was formerly occupied by the state's first coal gasification plant. The plant operated in the late 1800's and produced coal gas for municipal use. A coal tar derivative was a byproduct of the coal gasification process and heavily contaminated the old surface grade of the plant. Based on samples collected during Phase II investigations, this byproduct contained characteristically high concentrations of benzene, a hazardous chemical regulated under Washington State's Department of Ecology's Model Toxics Control Act (MTCA). Once the coal gasification plant ceased operation in the early 1900's, the entire area was covered with over 20 feet of fill. After the regrade, the property was occupied from 1955 until the 1960's by a gasoline and automobile service station, which included the use of four underground storage tanks (UST) for fuel storage. Our client intends to redevelop the property which includes an excavation down to depths of 16 foot elevation from a street grade of approximately 43 foot elevation.

My responsibility as the site's field geologist was to observe the property's redevelopment excavation and ensure that any impacted soil was handled in an appropriate manner. The client's main goal was not to achieve cleanup on the site, but to properly remove what contaminated soil was encountered. As with any other large-scale environmental excavation, areas of concern were identified prior to the commencement of the excavation and an estimation of the extent of contamination on property was developed. However, as with many other environmental excavations, estimations can be refined to more accurately portray the extents of contamination on the property as new information becomes available. The primary contaminant plume below the property was likely sourced from the coal gasification plant which operated at an approximate elevation of 20 feet. It was hoped that the extent of soil contamination could be constrained with further subsurface information as the redevelopment excavation progressed. Having a better idea of where the plume is located would make it easier to remediate the plume, should that need to occur in the future.

SCOPE OF WORK

The goals of this project include the following:

1. Review data available prior to development of the property.
2. Review initial extent of contamination estimation and identify data gaps.
3. Collect data during the redevelopment excavation.
4. Collect additional data from subsurface elements extending below the bottom of the redevelopment excavation.
5. Develop new below-property soil contamination extent.

Task 1—Review and discuss information collected prior to property redevelopment

In addition to a Phase I Environmental Site Investigation, several Phase II Subsurface Site Investigations took place on the property. These investigations provided crucial data for creating a conceptual site model and drafting a cleanup action plan.

I will review the information and data collected during these investigations to provide background information on the property. This task will serve as a review of the kind of data that is available to consultants prior to starting an excavation. Types of data that I will review include the location and concentrations of contaminants contained in soil samples collected on the property.

Task 2— Review initial extent of soil contamination estimation and identify data gaps

After reviewing the data collected during the Phase I and Phase II investigations, I reviewed the initial estimated extent of the soil contamination on the property. I then reviewed any data gaps as identified in the Limitations section of this report.

Task 3—Redevelopment excavation

The redevelopment excavation extended from the street grade of approximately 43 feet NAVD88 down to elevations a low as 16 feet NAVD88. Known contaminants at concentrations above Washington's Department of Ecology's Model Toxics Control Act (MTCA) Method A Cleanup levels within the redevelopment excavation's extents included benzene, carcinogenic polycyclic aromatic hydrocarbons (cPAH), and various metals. "Hot spots" of impacted soil were identified during the Phase II investigations and were removed and exported as contaminated soil during the excavation. These hot spots were 10-foot by 10-foot by 10-foot cubes of soil that were to be treated as contaminated soil. Soil samples were collected from the sides and bottom of these cubes and analyzed for the contaminants of concern. If any of the samples came back with concentrations of contaminants above their respective MTCA Method A cleanup levels, the hot spot excavation would be extended until a sample with contaminant concentrations below Method A cleanup levels was collected.

Bottom and sidewall samples were also collected from the extent of the redevelopment excavation where possible based on a 35 by 35-foot grid. These samples provided information on what contaminants are still present onsite and will help constrain the extent of the on-property soil contamination.

Task 4—Additional investigation

During the redevelopment excavation, the proposed building's foundation was redesigned to a Mat Slab foundation from a Geopeir foundation due to geotechnical concerns. Unfortunately, the Geopeir installation process would have provided a considerable amount of information that could have been used to bound the extent of the soil contamination beneath the property. Because of this, an additional subsurface investigation was planned to coincide with the installation of seven dual phase extraction wells in order to gather the data required to refine the property's conceptual model. However, due to time constraints and well installation difficulties, the scope of the investigation had to be scaled back. Regardless, useful qualitative data were collected during the well installation process.

Task 5—Report Preparation

After analyzing data collected during the redevelopment excavation and additional investigation, the estimated extent of soil contamination below the property was developed. The new estimated extent was then compared to the initial estimated extent that was prepared for this report.

BACKGROUND

Historical use of the property

Two coal gas holding tanks were located on property and were used in the operation of the state's first coal gasification plant between the years of 1888 and 1908. The tanks themselves were 3 and 7 stories tall and held a combined volume of 1,000,000 cubic feet of coal gas. The coal gasification process did not occur on the property but at an adjoining

location. Coal gas was produced by coking coal and collecting the off-gases from the blast furnaces. The coal gas would then be piped into the holding tanks. From the holding tank, the gas could be distributed throughout the city to be used for municipal heating and lighting. Coal gas was used in the United States in the late 1800's to the mid 1900's primarily due to the relatively high cost of oil.

Once the coal gas tanks had been demolished, the property was left vacant for approximately 50 years at a lot elevation of approximately 20 feet. Between 1930 and 1955, the property had been filled to an approximate elevation of 43 feet. A gasoline and service station which included the use of two pump islands and four 3,000 gallon underground storage tanks (USTs) operated on the property from 1955 to 1965. The service station was demolished in 1965 and replaced with a parking lot. Prior to the commencement of the redevelopment excavation, it was unknown if the service station's USTs were still located on the property or if they had been removed during the demolition activities.

Previous investigations

SoundEarth Strategies performed subsurface investigations at the property in August and September of 2010. Locations of the borings advanced during the investigations on the property can be found on Figure 1. Tables 1 and 2 show the analytical results of soil samples collected during the Phase II investigations. Table 1 contains the concentrations of petroleum-derived contaminants (GRPH, DRPH/ORPH, and BTEX) while Table 2 contains the concentrations of cPAHs in soil samples collected from the borings. Samples from borings B03 and B09 at elevations of 10 to 0 feet NAVD88 contained concentrations of gasoline-range petroleum hydrocarbons (GRPH); diesel-range petroleum hydrocarbons (DRPH); oil-range petroleum hydrocarbons (ORPH); benzene, toluene, ethylbenzene, and total xylenes (BTEX); at concentrations in excess of their MTCA Method A cleanup levels. Benzene was found to be present in unusually high concentrations. CPAHs were also found to be above their MTCA Method A cleanup levels at elevations of 10 to 0 feet in borings B04 and B09, and in borings B04, B06, and B09 at elevations ranging from 37 to 27 feet.

The relatively low concentrations of cPAHs detected above pre-1955-grade (approximately 20 feet elevation) are considered to be associated with the historical fill activities. The higher concentrations of GRPH, DRPH, BTEX and cPAHs detected below the pre-1955-grade are likely associated with the former coal gas holding tanks located on the property and the operation of the nearby coal gasification plant.

Source and significance of high benzene concentrations

Coal tar is a common byproduct of the coal gasification process and was generally considered as a waste product at the time. Coal tar could have been dumped or spilled directly onto the ground surrounding the plant's operations. As the coal tar degraded BTEX and PAHs would diffuse into the subsurface with benzene being present in particularly high concentrations. In fact, the first industrial-scale method for producing benzene was pioneered by Charles Mansfield in 1845 by isolating the chemical from coal tar (Travis, 2008).

The characteristically high benzene concentrations detected in soil samples from below 20 feet elevation on the property were important due to the way that contaminated soils are handled and disposed of once removed from the ground. Contaminated soil is considered a generated waste once that soil is no longer in place, meaning that it has been removed from the location where the soil was first contaminated. Once a contaminated soil is generated, it is subject to many state and federal rules dictating where and how the soil can be disposed of. Generally, soil contaminated with chemicals associated with petroleum hydrocarbons is considered "Non-hazardous Solid Wastes" under the federal government's Resource Conservation and Recovery Act (RCRA) (US EPA, 2013). This non-hazardous distinction allows for relatively inexpensive disposal cost at many disposal sites. However, when generated waste contains concentrations of contaminants that cause the soil to exhibit certain characteristics (ignitable, corrosive, reactive, and/or toxic) it is treated as a hazardous waste under Subtitle C of RCRA (US EPA, 2004). Once a generated waste is given the hazardous waste distinction, the number of disposal facilities able to accept the waste is severely reduced and disposal costs are significantly increased.

Benzene, normally a non-hazardous waste, is considered a hazardous waste once it passes a toxicity threshold determined by the Toxicity Characteristic Leaching Procedure (TCLP). The TCLP is performed in a laboratory and acts to simulate landfill conditions, specifically the percolation of water through solid wastes. Over time, water can mobilize contaminants contained within solid wastes and act to further spread harmful chemicals. In the case of benzene-contaminated soil, the soil is considered to be hazardous waste if a concentration of more than 0.5 mg/l (ppm) is obtained from TCLP testing (US EPA, 2004). Tests are increasingly likely to be above this limit at higher concentrations of benzene in soil. The concentration of benzene in a soil sample must be at least 10 mg/l in order to fall above the 0.5 mg/l TCLP limit. This 10 mg/l minimum is derived from the dilution of soil by a 20:1 liquid-to-soil ratio as employed during the TCLP procedure.

GEOLOGIC SETTING

The property sits above historic tide flats that were historically situated along the shoreline. Much of the soil that will be encountered within the property will be anthropogenic fill that was placed in the area during various fill events in Downtown Seattle's history. Native soils underlying the fill are generally shoreline or marine deposits and pre-Olympia nonglacial deposits (Troost et al, 2005). These deposits are generally characterized as dense mixtures of silt, sand, gravel and clays. During SoundEarth's subsurface investigation in 2010, fill material consisting of silty sand with brick, wood, glass and asphalt debris was observed down to an approximate elevation of 0 feet NAVD88 (SoundEarth, 2010).

Nearby subsurface investigations advanced borings down to an approximate elevation of -120 feet NAVD88 (Hart-Crowser & Landau Associates Inc, 1996). Notable finds include a 15 foot thick layer of clayey silt that was encountered at an elevation of -20 feet and extremely dense glacially overridden material from an elevation of -80 to -120 feet. The soils encountered from -20 to -80 foot elevation generally consist of a silty sand and a 1 to 3 foot thick peat layer.

Groundwater was encountered at approximately 12 feet elevation during excavation activities on the property. The ground water at this elevation is likely perched on top of the dense native soils at approximately 10 foot elevation that underlay the fill on the property. Landau Associates & Hart Crowser encountered two distinct hydrologic layers during their 1996 subsurface investigation of a near by property. These hydrologic zones include a shallow groundwater layer within the fill materials and a deeper, sub-sea level groundwater layer in the underlying glacial deposits.

METHODS AND ASSUMPTIONS

Excavation

The redevelopment excavation was advanced from the starting parking lot grade of approximately 43 foot elevation down to elevations ranging from approximately 22 to 12 feet elevation. The excavation was advanced in phases, starting at the east end of the property and moving westward in order to maintain the construction site's street level entrance as long as possible. All excavation was be performed by an excavation contractor using track-mounted hydraulic excavators.

Sampling Procedures

As the excavation proceeded, an environmental consultant was onsite to observe excavation activities. The environmental consultant screened excavated soils for any evidence of petroleum or other contamination based on visual or olfaction observations. Visual

observations included soil that was stained gray by contact with hydrocarbons. Olfactory observations were generally noted by characteristic gasoline, diesel, or creosote odors. If an area of soil was encountered with visible staining and/or noted odors, excavation in that area was halted and headspace screening took place. A photoionization detector (PID) is a handheld instrument capable of quantifying the concentration of volatile organic compounds (VOCs) to the parts per million (ppm) in the air space around the instrument's intake. In order to collect PID reading of a given soil sample, a small handful of soil must be placed in an air-tight space such as a polyethylene bag. Once the soil sample is sealed within the bag, any soil clods present in the sample need to be broken up to release any trapped volatiles present in the soil. Additionally, if required by the weather, the soil needs to be slowly warmed to room temperature to volatize any remaining VOCs. Once the VOCs have had a sufficient amount of time, generally a minute, to partition into the head space of the sample bag, the PID's intake can then be inserted into the bag's headspace. The PID's intake needs to remain in the bag's headspace for at least 30 seconds, at which time the highest concentration detected by the PID is noted as the recorded value. This value isn't meant to accurately quantify the concentration of contaminants in the soil, but rather to act as an indicator of relative concentration. For example, it is reasonable to expect that a soil sample with a 100 ppm headspace reading to have a higher contaminant concentration than would a sample with 50 ppm headspace reading.

Remedial Excavation Procedures

If evidence of contamination was identified in the area's soil samples, a remedial excavation was recommended. Soil exhibiting evidence of contamination was excavated and stockpiled on top of plastic sheeting in order to prevent further spread of contaminants. The excavator continued to remove impacted soil until the expected vertical and lateral bounds of the contamination was reached. These extents were defined as soil that no longer exhibited any evidence for contamination by field screening techniques. A sample was then collected from each sidewall and the bottom of the remedial excavation and sent to an environmental laboratory for analysis for the suspected contaminants of concern (COCs). If a soil sample's analysis returned with all concentrations of COCs below their respective MTCA Method A Soil Cleanup Levels, then the sample would act as a "Confirmation sample" and mark that bound of the remedial excavation. If a soil sample's analysis returned with a COC above its respective MTCA Method A Soil Cleanup level, then the sample acted as a "Performance sample" and that excavation sidewall or bottom was still considered to be impacted. The remedial excavation was then extended two feet in the direction of the collected performance sample and a new sidewall or bottom sample was collected. Once all sidewall and bottom samples were confirmation samples, the lateral and vertical extent of the contamination was considered to be bounded.

"Hot Spot" excavations proceeded in much the same manner as remedial excavations. However, in general, the COCs that warranted the creation of a hotspot do not exhibit evidence of contamination that can be observed by field screening methods. When cPAHs or metals were detected in concentrations above the MTCA Method A cleanup levels, an excavation of 1000 cubic feet of soil was considered contaminated for the purpose of waste disposal and was centered at the location where a contaminated sample was collected during the Phase II investigations on the property. Sidewall and bottom samples were collected from the extents of the hotspot excavations and served as either confirmation or performance samples based on laboratory results. The hotspot of contamination was considered removed once all sidewall samples were confirmation samples.

As the excavation proceeded downward, solider piles and lagging were installed to support the surrounding structures and in-place soils. Solider piles are wide-flanged H-beams of differing strengths that are placed in to auger-advanced borings and encased in either grout or cement. Forty solider piles were installed at various depth to facilitate the shoring wall construction. These piles were installed along the perimeter of the property and reached depths of up to -12 feet elevation. Due to the piles' close proximity to the suspected contaminant plume beneath the property, soils brought to the surface during pile installation were screened for evidence of contamination.

Once the final excavation depths were reached, bottom of excavation soil samples were collected from a 35-foot by 35-foot cell grid. Samples were collected from the center of the grid cell whenever possible. Samples were also collected form the excavation sidewalls where soil was accessible. Soil samples were collected with a stainless steel spoon and composited in a stainless steel bowl. Like all other soil samples, the soil was transferred into laboratory prepared sample containers and transported to a laboratory for testing.

Additional Investigation

Seven extraction wells were installed to an elevation of up to -15 feet as part of a sub-foundation vapor intrusion mitigation system. Additionally, three geotechnical borings and eight dewatering wells were installed. As borings and wells were installed, spoils brought to the surface were screened for evidence of contamination. Spoils that exhibited signs of contamination were placed into stockpiles on top of a plastic sheet and sampled. This process provided qualitative data on the lateral extent of the contaminant plume beneath the property and limited quantitative data on the concentration of contaminants at the various well locations.

RESULTS

Upper Zone Excavation (43 to 21 feet elevation)

Underground storage tanks

During the upper zone excavation, four underground storage tanks (USTs) were encountered at approximately 38 feet in elevation. Each, tank was, 6 feet in diameter and approximately 13 feet long, with a capacity of 3000 gallons, and appeared to be in good condition. These tanks were associated with the service station that operated on the property from 1955 to 1965. Once the USTs were removed, the resulting excavation was treated like a remedial excavation and sidewall/bottom samples were collected. The locations of the removed USTs and the samples collected from the resulting excavations can be found on Figure 2. A summary of the analytical data collected during UST excavations can be found on Table 3. UST02 and UST04 had samples with concentrations of benzene above the MTCA Method A clean up level of 0.03 mg/kg. UST02's southern bottom of excavation sample (UST02-B02-32) collected at 32 feet elevation had a concentration of 0.25 mg/kg benzene. UST04's south sidewall sample (UST04-SSW01-34) collected at 34 feet elevation had a concentration of 0.034 mg/kg. Both the UST02 and UST04 excavations were advanced two feet in the direction that the exceedance was detected and new samples were collected. New samples collected (UST02-B02-30 and UST04-SSW02-34) were non-detect for all analytes. None of the samples collected from the extents of the excavation for UST01 and UST03 contained any analytes above their respective MTCA Method A Soil Cleanup levels.

Hot spot excavations

Hot spots HS-1, HS-3 and HS-4 were excavated and sampled for cPAHs as part of the redevelopment excavation. Hot spots HS-2 and HS-5 were only partially excavated due to part of their volumes being located beneath the final depth of the redevelopment excavation. HS-1 was not sampled due to construction logistics and safety concerns. The locations of the hot spots and the samples collected from the resulting excavations can be found on Figure 2. A summary of the analytical data collected during hot spot excavations can be found on Table 4. Once the designated 1000 cubic feet of soil was removed at the hot spot location, the resulting excavation was treated like a remedial excavation and sidewall/bottom samples were collected. HS-3 had samples with concentrations of benzo(a)pyrene, a cPAH, above MTCA Method A cleanup levels of 0.1 mg/kg. The southern sidewall sample (HS03-36SSW) collected at 36 feet elevation had a concentration of 1.30 mg/kg benzo(a)pyrene and the western sidewall sample (HS03-36WSW) collected at 36 feet elevation had a concentration of 0.240 mg/kg benzo(a)pyrene. The HS-3 excavation was advanced two feet to the south and the west and new samples were collected. New samples collected (HS03-SSW2-36 and HS03-WSW2-36)

were non-detect for cPAHs. None of the Samples collected from the extents of the excavation for HS-4 contained any analytes above their respective MTCA Method A Soil Cleanup levels.

Bottom-of- redevelopment excavation samples

The locations of the bottom-of-redevelopment excavation samples collected can be found on Figure 3. A summary of the bottom-of-redevelopment excavation analytical data can be found on Table 5. Samples E04-20, C04-20, D4SSW01-22, C4SSW01-22, B4SSW01-22, and A301-15 contained concentrations of Benzo(a)pyrene above the MTCA Method A clean up level of 0.1 mg/kg. All other samples were below Method A clean up level for all analytes. All samples were non-detect for benzene.

Lower Zone Discoveries (Sub 21 feet in elevation)

During the redevelopment excavation a ring approximately 80 feet in diameter with 2-foot-thick walls constructed of bricks was discovered at an approximate elevation of 21 feet elevation. The ring had been filled in with soil and extended down to an elevation of at least 15 feet as revealed by test pits. Based on its location, the ring is likely the base or foundation of the western-most coal gas holding tank. The location of the ring, which approximately lines up with the former coal gas tank, can be found on Figure 4.

Qualitative data

Shoring elements

Locations of the shoring elements and a summary of qualitative data can be found on Figure 4. None of the perimeter shoring elements showed any definitive evidence for contamination. The eastern toe piles (ETP-1 through ETP-6) showed no evidence of contamination by field screening techniques from approximately 15 to -12 feet elevation. The northern western toe piles (WTP-1 through WTP-4) showed no evidence of contamination by field screening techniques. The spoils brought up from the southern western toe piles (WTP-5 and WTP-6) had slight to moderate creosote-like odor and brown staining from approximately 13 to 5 feet elevation. Spoils from elevations 5 to -5 feet did not show evidence of contamination.

Geotechnical borings and dewatering wells

Locations of geotechnical borings and a summary of qualitative data can be found on Figure 4. Spoils from dewatering wells DW01 through DW04 had moderate to strong creosote-like odor and brown staining. Dewatering wells DW05 through DW08 exhibited no or slight odor and no staining. All dewatering wells were installed within perimeter of the brick ring. Geotechnical borings GT01 and GT03 were drilled within the brick ring and showed evidence of

contamination starting at approximately 0 feet elevation. Two inches of a black, tar-like substance with a strong hydrocarbon odor was encountered at -1.5 feet elevation in GT03. Analytical results indicated that the black substance, possibly coal tar, had a benzene concentration of 580 mg/kg. GT02 was located outside and to the west of the brick ring and showed no evidence of contamination by field screening techniques.

Extraction wells

Locations of extraction well borings and a summary of qualitative data can be found on Figure 4. Spoils from borings B28, B29, B30, B31, and B32 had moderate to strong hydrocarbon odor as well as brown to black staining. Borings B28, B29, B31 and B32 were located within the brick ring, B30 was not. B27 and B33, both located outside of the brick ring, showed no evidence of contamination by field screening techniques. Samples were collected and analyzed from specific depths in boring B33. Samples B33-10 and B33-25 collected at 8 and -7 feet elevation respectively were non-detect for GRPH, DRPH/ORPH and BTEX. Sample B33-37.5 collected at -19.5 feet elevation contained a benzene concentration of 0.069 kg/mg.

DISCUSSION

Upper zone excavations

Confirmation samples collected from hot spot and UST excavations show that the extent of contamination was bounded at those locations. The bounded hot spots show that elevated cPAH concentrations are not continuous throughout the fill placed post-1955. These scattered patches of contamination indicate that the cPAHs were unlikely to have originated from a single source, but are the product of multiple fill events. The bounded extents of the contamination sourced from the USTs show that any leaks from the USTs were minor in nature. Considering that no contamination was detected below 30 feet elevation in the vicinity of the USTs, the contamination located below 20 feet elevation is unlikely to be related to any historical release from the service station from 1955 to 1965.

Bottom-of-redevelopment excavation samples

Of the six bottom-of-redevelopment excavation samples with elevated concentrations of cPAHs, five of the samples are located within grid row 4 at either 20 or 22 feet elevation on the southern edge of the property (Figure 3). The sixth sample is located in grid cell A3 at 15-foot elevation, on the western edge of the property. Considering that PAHs are related to burning of coal and production of coal tar, it is not unreasonable to assume that the contamination present on these southern bottom of excavation samples could be a product of the coal gasification plant (MDEP, 2002). These contaminated sample locations are near the estimated historic locations of buildings related to the coal gasification plant. Buildings that are

estimated to be near the southern edge of the property include the coal gas governor in grid cell A3, a gas works building in grid cells D4 and the coal gas tank formally located in the center of the site. However, the exact elevation at which the coal gasification plant operated is unknown and could have been between 18 and 23 feet elevation (SoundEarth, 2010). It is also possible that the elevated concentrations of cPAHs are sourced from fill brought onto the property, much like the concentrations observed in the post-1955 fill.

While the source of cPAHs in the soil at the bottom of the excavation may be unknown, the absence of benzene in all collected samples is telling. Given that the subsurface soil contamination is characterized by high concentrations of benzene, it is reasonable to assume that any coal tar release occurred below the elevations of the bottom-of-redevelopment excavation samples that were collected.

Qualitative Data

All of the borings that did not show any evidence for petroleum or coal tar contamination can be considered as a bound on the extent of the soil contamination below the property. B27, B33 and WTP4 are all significant "clean" points considering that the original soil contamination extent had estimated those locations would contain petroleum-impacted soil. These clean points reduce the contaminated soil extent to the northwest and east. The petroleum impacted spoils observed during the boring of WTP6 indicates that the contaminated soil likely extends further to the southwest than initially estimated. The lack of contamination in spoils from ETP1 – ETP6, DW05 – DW08 and WTP1 –WTP03 support the original estimation of limited soil contamination to the north and east. The contamination below the property appears to be related to the brick ring discovered at approximately 21 feet elevation. It is possible that the western coal gas tank is the source of the soil contamination beneath the property and the brick foundation of the tank acted to channel the contamination by preventing its spread in all directions. Evidence of this assertion can observed by the relative proximity of the contaminated borings DW03 and DW04 to the uncontaminated boring B33 which are separated by the brick ring. The original soil contamination extent and a revised soil contamination extent can be found on Figure 4.

CONCLUSIONS

The main environmental goal on the property was to ensure proper management of soil wastes, not to fully characterize the extent of the subsurface contamination. However, even with limited qualitative data it was possible to refine the estimated extent of the plume. As demonstrated, observations of boring spoils show that the extent of subsurface contamination on the property is generally further southwest and less to the east then initially estimated. This information will allow for any further subsurface investigations to focus on collecting

quantitative data in areas that still represent data gaps on the property and passing over areas that have shown little signs of contamination.

LIMITATIONS

This property was in the process of being developed during the field work and information gathering phase of this report. Quality and amount of data was limited to what was available as part of the redevelopment process. Locations of qualitative subsurface data points were limited to structurally or system-designed subsurface elements.

A general lack of soil type information below -10 feet elevation is a significant data gap. The difference between a silt or sand layer located just below -10 feet elevation could have a significant impact on the vertical extent of the subsurface plume. Additionally, lacking quantitative data below -10 feet elevation prevents bounding of the plume's vertical extent. The property also lacks groundwater characterization. However, considering the development in the area, it is unclear if current groundwater conditions would even accurately represent historical groundwater conditions while the coal gasification plant was still operational.

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Appendix A

FIGURES

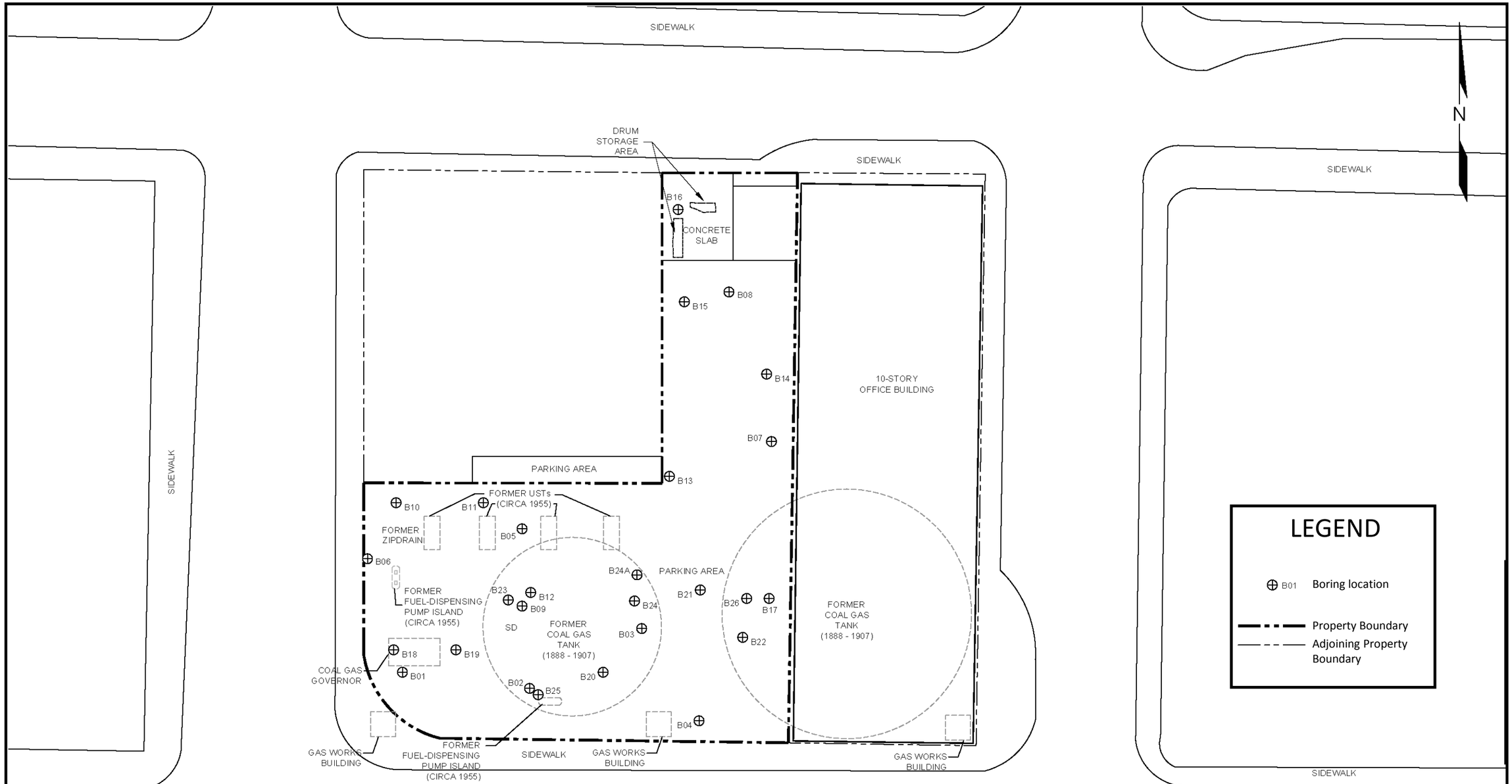

FIGURE 1: PRE-DEVELOPMENT SUBSURFACE SAMPLING LOCATIONS AND HISTORICAL FEATURES

0 20 40 80

APPROXIMATE SCALE IN FEET

A-1

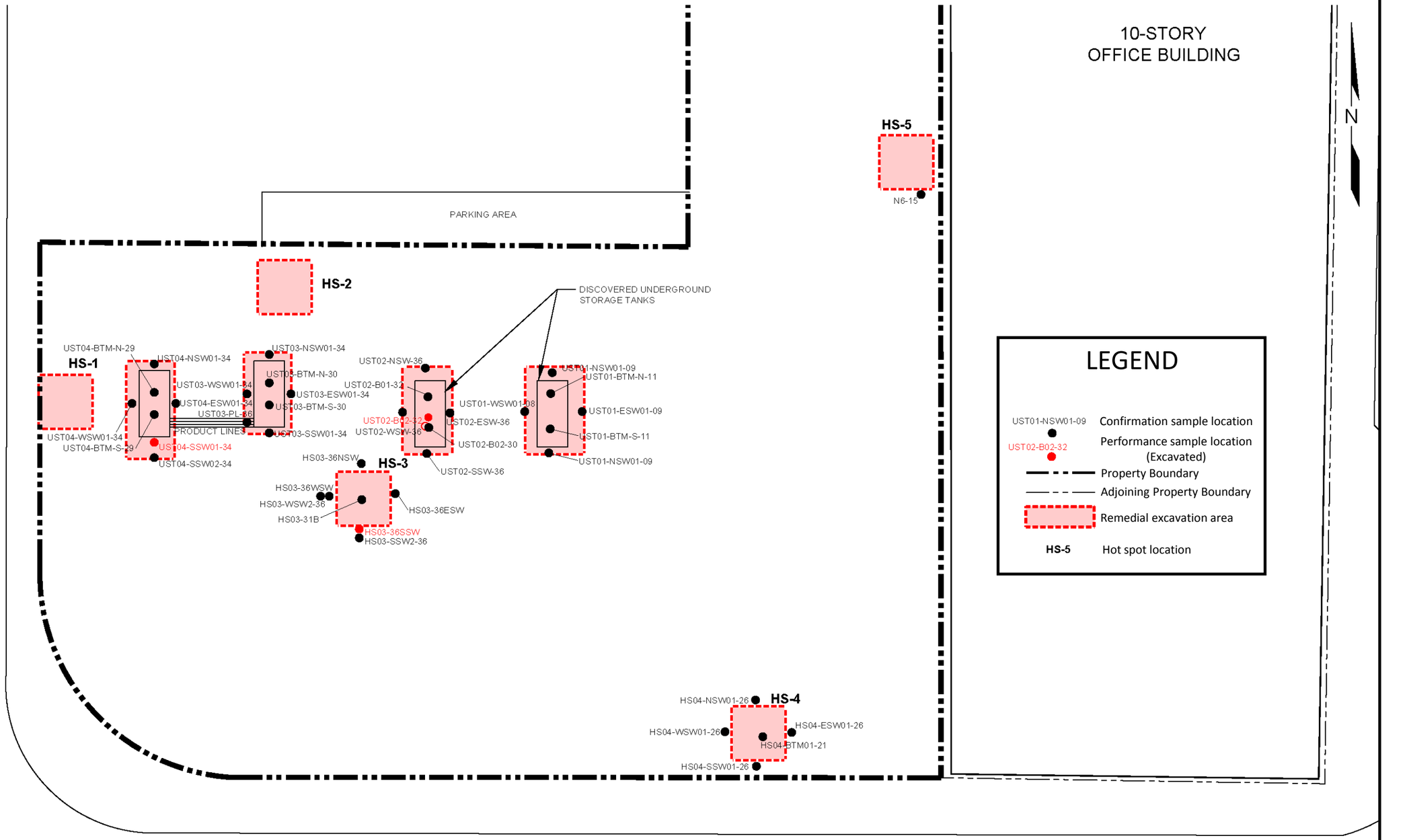

FIGURE 2: UPPER ZONE FEATURES .

0 10 20 40

APPROXIMATE SCALE IN FEET

A-2

SIDEWALK

SIDEWALK

SIDEWALK

SIDEWALK

SIDEWALK

N

CONCRETE SLAB

SEATTLE PUBLIC UTILITIES SHED

10-STORY OFFICE BUILDING

CINSW01-17

PARKING AREA

DINSW01-17

EINSW01-18

FORMER USTs (CIRCA 1955)

A101-16

B101-16

C101-16

DI01-16

E1-17

EIESW01-18

FORMER ZIPDRAIN

E2ESW-18

E02-19

PARKING AREA

A201-15

FORMER FUEL-DISPENSING PUMP ISLAND (CIRCA 1955)

B201-16

C201-16

D02-19

FORMER COAL GAS TANK (1888 - 1907)

FORMER COAL GAS TANK (1888 - 1907)

A301-15

E03-20

COAL GAS GOVERNOR

B03-19

C03-19

D03-19

A401-18

B401-18

C04-20

D04-20

E04-20

FORMER FUEL-DISPENSING PUMP ISLAND (CIRCA 1955)

B4SSW01-22

C4SSW01-22

D4SSW01-22

E4SSW01-22

GAS WORKS BUILDING

GAS WORKS BUILDING

GAS WORKS BUILDING

SIDEWALK

1

2

3

4

A

B

C

D

E

LEGEND

- Samples with all analytes below MTCA Method A cleanup levels
- Sample locations with analytes above MTCA Method A cleanup levels
- Property boundary
- Adjoining property boundary
- 4 / A — 35’ x 35’ sample grid cell

FIGURE 3: BOTTOM OF EXCAVATION SAMPLE LOCATIONS

0 20 40 80

APPROXIMATE SCALE IN FEET

A-3

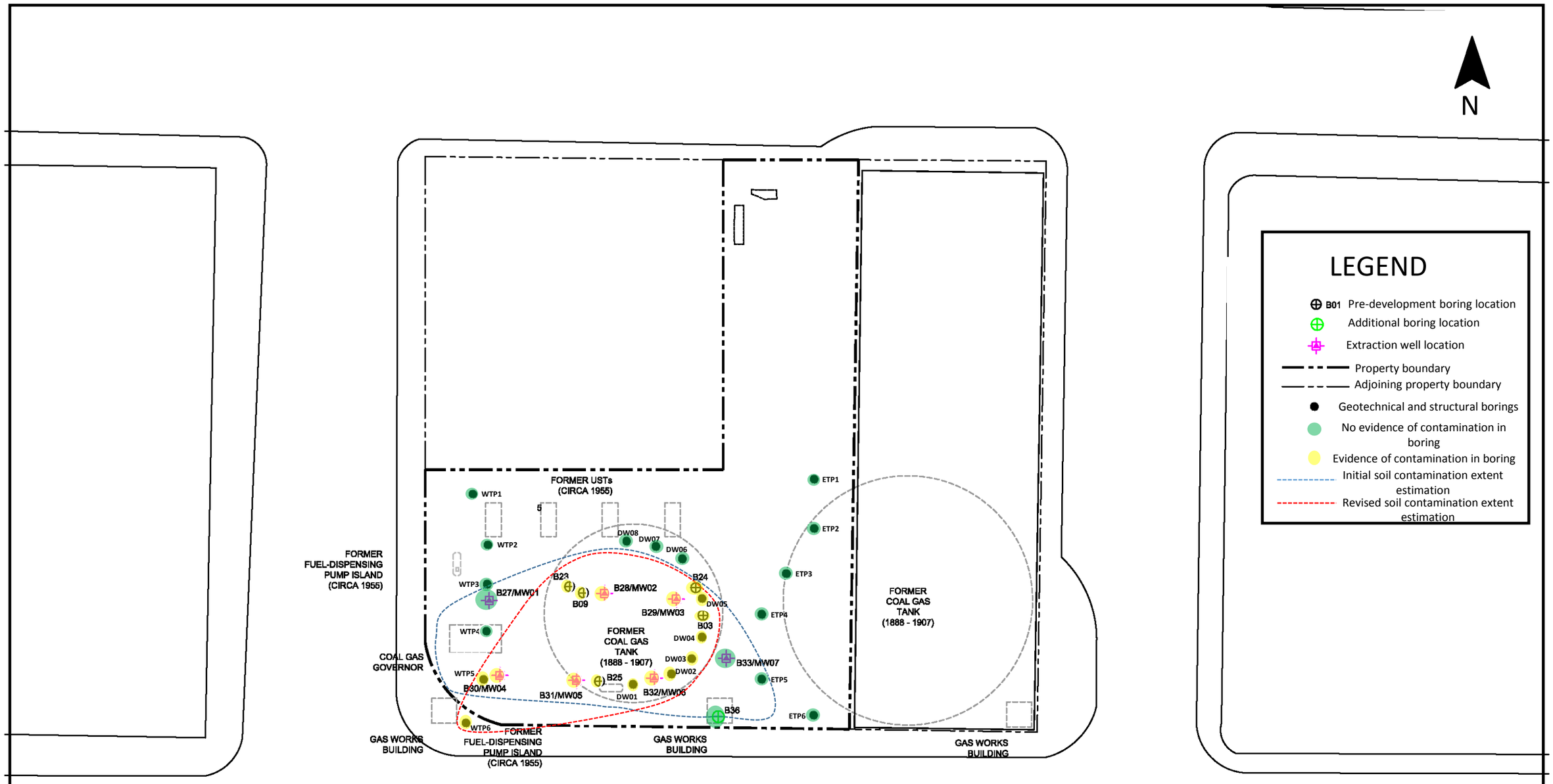

FIGURE 4: SUMMARY OF QUALITATIVE DATA AND SOIL CONTAMINATION EXTENT

A-4

Appendix B

TABLES

Table 1
Subsurface Investigation Sample Data - GRPH, DRPH/ORPH and BTEX

Boring ID	Sample ID	Date Sampled	Depth (feet bgs)	Elevation (feet NAVD88)	Analytical Results (mg/kg)						
					DRPH[1]	ORPH[1]	GRPH[2]	Benzene[3] [4]	Toluene[3] [4]	Ethyl benzene[3] [4]	Total Xylenes[4]
SoundEarth August-September 2010 Subsurface Investigation											
B01	B01-07	08/31/10	7	35	--	--	--	--	--	--	--
	B01-18		18	24	--	--	--	--	--	--	--
	B01-31		31	11	620	<250	18	**0.42**	<0.02	1.1	0.68
B02	B02-06	08/31/10	6	36	--	--	--	--	--	--	--
	B02-17		17	25	--	--	--	--	--	--	--
	B02-27		27	15	<50	<250	<5	<0.02	<0.02	<0.02	<0.06
B03	B03-07	08/31/10	7	35	--	--	--	--	--	--	--
	B03-14.5		14.5	27.5	--	--	--	--	--	--	--
	B03-31		31	11	**2,200**	390	**11,000**	**150**	**580**	**450**	**820**
B04	B04-06	08/31/10	6	36	--	--	--	--	--	--	--
	B04-14		14	28	--	--	--	--	--	--	--
	B04-32		32	10	<50	<250	24	**0.034**	<0.02	0.77	0.58
B05	B05-06	08/31/10	6	36	--	--	--	--	--	--	--
	B05-14		14	28	--	--	--	--	--	--	--
	B05-22		22	20	<50	<250	<5	<0.02	<0.02	<0.02	<0.06
B06	B06-06	09/01/10	6	36	--	--	--	--	--	--	--
	B06-16		16	26	--	--	--	--	--	--	--
	B06-22		22	20	--	--	--	--	--	--	--
	B06-29.5		29.5	12.5	<50	<250	<5	<0.02	<0.02	<0.02	<0.06
B07	B07-8.5	09/01/10	8.5	33.5	--	--	--	--	--	--	--
	B07-15		15	27	--	--	--	--	--	--	--
	B07-22		22	20	<50	<250	9.4	**0.052**	<0.02	<0.02	<0.06
B08	B08-06	09/01/10	6	36	--	--	--	--	--	--	--
	B08-14		14	28	--	--	--	--	--	--	--
	B08-19		19	23	97	<250	5.5	**0.069**	<0.02	<0.02	<0.06
B09	B09-06	09/01/10	6	36	--	--	--	--	--	--	--
	B09-18		18	24	--	--	--	--	--	--	--
	B09-26		26	16	<50	<250	<5	<0.02	<0.02	<0.02	<0.06
	B09-43		43	-1	**47,000**	6,900	**14,000**	**300**	**750**	**160**	**1,200**
MTCA Method A Cleanup Levels[5]					**2,000**	**2,000**	**30/100[a]**	**0.03**	**7**	**6**	**9**
SoundEarth March 2014 Supplemental Subsurface Investigation											
B10/B11/B12	B10-05/B11-05/B12-05 Comp	03/05/14	5	37	<50	<250	<2	<0.03	<0.05	<0.05	<0.15
B10/B11/B12	B10-15/B11-15/B12-15 Comp	03/05/14	15	27	<50	<250	<2	<0.03	<0.05	<0.05	<0.15
B13/B17/B21	B13-05/B17-05/B21-05 Comp	03/05-06/14	5	37	<50	<250	<2	<0.03	<0.05	<0.05	<0.15
B13/B17/B21	B13-15/B17-15/B21-15 Comp	03/05-06/14	15	27	<50	<250	<2	<0.03	<0.05	<0.05	<0.15
B14/B15/B16	B14-05/B15-05/B16-05 Comp	03/05/14	5	37	<50	<250	<2	<0.03	<0.05	<0.05	<0.15
B18/B19	B18-05/B19-05 Comp	03/05-06/14	5	37	<50	<250	<2	<0.03	<0.05	<0.05	<0.15
B18/B19	B18-15/B19-15 Comp	03/05-06/14	15	27	<50	<250	<2	<0.03	<0.05	<0.05	<0.15
B11	B11-25	03/05/14	25	17	500	1,100	<2	<0.02	<0.02	<0.02	<0.06
MTCA Method A Cleanup Levels[5]					**2,000**	**2,000**	**30/100[6]**	**0.03**	**7**	**6**	**9**
SoundEarth June 2014 Supplemental Subsurface Investigation											
B23	B23-36	06/26/14	36	6	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	B23-43	06/26/14	43	-1	**20,000**	<5,000	**4,200**	**190**	**270**	**38**	**390**
	B23-51	06/26/14	51	-9	<50	<250	16	0.88	0.88	0.57	1.3
B24	B24-36	06/26/14	36	6	<50	<250	2.8	0.29	<0.02	0.097	0.14
	B24-45	06/26/14	45	-3	**18,000**	<5,000	**11,000**	**640**	**680**	**28**	**980**
B24A	B24A-56	06/27/14	56	-14	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
B25	B25-26	06/26/14	26	16	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	B25-41	06/27/14	41	1	**5,400**	1,300	**2,800**	**150**	**220**	**44**	**270**
	B25-51	06/27/14	51	-9	3,700	810	620	33	45	6.9	63
B26	B26-21	06/27/14	21	21	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	B26-36	06/27/14	36	6	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	B26-41	06/27/14	41	1	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	B26-46	06/27/14	46	-4	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	B26-51	06/27/14	51	-9	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	B26-56	06/27/14	56	-14	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
MTCA Method A Cleanup Levels[5]					**2,000**	**2,000**	**30/100[6]**	**0.03**	**7**	**6**	**9**

NOTES:

Results measured in mg/kg.

Red indicates concentration exceeding the MTCA Method A cleanup level.

[1]Samples analyzed by Method NWTPH-Dx.

[2]Samples analyzed by Method NWTPH-GX.

[3]Samples analyzed by EPA Method 8021B.

[4]Samples analyzed by EPA Method 8260C.

[5]MTCA Method A Cleanup Levels, Table 740-1 of Section 900 of Chapter 173-340 of the Washington Administrative Code, revised November 2007.

[6]30 mg/kg when benzene is present, 100 mg/kg when benzene is absent.

-- = not analyzed

< = not detected at a concentration exceeding the laboratory reporting limit

bgs = below ground surface

DRPH = diesel-range petroleum hydrocarbons

EPA = U.S. Environmental Protection Agency

GRPH = gasoline-range petroleum hydrocarbons

mg/kg = milligrams per kilogram

MTCA = Washington State Model Toxics Control Act

NAVD88 = North American Vertical Datum of 1988

NWTPH = Northwest Total Petroleum Hydrocarbon

ORPH = oil-range petroleum hydrocarbons

Table 2
Subsurface Investigation Sample Data - cPAHs

Sample Location	Sample ID	Date Sampled	Depth (feet bgs)	Elevation (feet NAVD88)	Analytical Results (milligrams per kilogram)[1] [2]							Total Toxic Equivalent Concentration[3]
					Benzo(a)anthracene (TEF 0.1)	Chrysene (TEF 0.01)	Benzo(a)pyrene (TEF 1)	Benzo(b)fluoranthene (TEF 0.1)	Benzo(k)fluoranthene (TEF 0.1)	Indeno(1,2,3-cd)pyrene (TEF 0.1)	Dibenz(a,h)anthracene (TEF 0.1)	
SoundEarth August-September 2010 Subsurface Investigation												
B01	B01-07	08/31/10	7	35	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
	B01-18		18	24	0.013	0.018	0.018	0.023	< 0.01	0.021	< 0.01	0.025
	B01-31		31	11	0.055	0.075	0.051	0.059	0.016	0.031	< 0.01	0.068
B02	B02-06	08/31/10	6	36	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
	B02-17		17	25	0.030	0.066	0.030	0.0420	0.011	0.032	< 0.01	0.042
B03	B03-07	08/31/10	7	35	0.028	0.034	0.041	0.0480	0.016	0.036	< 0.01	0.052
	B03-14.5		14.5	27.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
	B03-31		31	11	27	27	**28**	35	11	21	< 10	**38**
B04	B04-06	08/31/10	6	36	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
	B04-14		14	28	0.070	0.090	0.082	0.1100	0.043	0.070	0.016	**0.107**
	B04-32		32	10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
B05	B05-06	08/31/10	6	36	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
	B05-14		14	28	< 0.01	0.017	< 0.01	0.0180	< 0.01	< 0.01	< 0.01	0.009
	B05-22		22	20	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
B06	B06-06	09/01/10	6	36	0.014	0.018	0.012	0.0190	< 0.01	0.013	< 0.01	0.009
	B06-16		16	26	0.18	0.23	**0.22**	0.3300	0.096	0.18	0.028	**0.302**
	B06-22		22	20	0.048	0.055	0.053	0.0670	0.020	0.039	< 0.01	0.071
	B06-29.5		29.5	12.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
B07	B07-08.5	09/01/10	8.5	33.5	0.016	0.032	0.021	0.0270	< 0.01	0.023	< 0.01	0.029
	B07-15		15	27	0.032	0.039	0.039	0.0430	0.019	0.037	< 0.01	0.053
	B07-22		22	20	< 0.01	< 0.01	< 0.01	0.0110	< 0.01	0.012	< 0.01	0.012
B08	B08-06	09/01/10	6	36	0.047	0.056	0.050	0.0600	0.020	0.039	< 0.01	0.067
	B08-14		14	28	0.022	0.032	0.026	0.0330	0.015	0.024	< 0.01	0.036
B09	B09-06	09/01/10	6	36	0.081	0.11	0.097	0.1400	0.040	0.071	0.015	**0.132**
	B09-18		18	24	0.012	0.018	0.013	0.0180	< 0.01	0.017	< 0.01	0.019
	B09-26		26	16	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
	B09-43		43	-1	210	220	**220**	240	70	130	22	**289**
MTCA Method A Cleanup Level for Soil[4]					**NE**	**NE**	**0.1**	**NE**	**NE**	**NE**	**NE**	**0.1**
SoundEarth March 2014 Supplemental Subsurface Investigation												
B11	B11-25	03/05/14	25	17	16	21	**20**	19	8	12	2	**26**
B22	B22-40	03/06/14	40	2	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
B10-B11-B12 Composite	~~B10-05/B11-05/B12-05~~ Composite	03/05/14	5	37	0.017	0.027	0.026	0.033	0.011	0.024	< 0.01	0.035
B10-B11-B12 Composite	~~B10-15/B11-15/B12-15~~ Composite	03/05/14	15	27	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
B13-B17-B21 Composite	~~B13-05/B17-05/B21-05~~ Composite	03/05-06/14	5	37	0.013	0.014	0.013	0.014	< 0.01	< 0.01	< 0.01	0.017
B13-B17-B21 Composite	~~B13-15/B17-15/B21-15~~ Composite	03/05-06/14	15	27	0.02	0.03	0.03	0.03	< 0.01	0.02	< 0.01	0.035
B14-B15-B16 Composite	~~B14-05/B15-05/B16-05~~ Composite	03/05/14	5	37	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
B18-B19 Composite	B18-05/B19-05 Comp	03/05-06/14	5	37	0.017	0.022	0.018	0.025	0.010	0.014	< 0.01	0.025
B18-B19 Composite	B18-15/B19-15 Comp	03/05-06/14	15	27	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
B20-B22 Composite	B20-05/B22-05 Comp	03/06/14	5	37	0.017	0.023	0.020	0.028	< 0.01	0.015	< 0.01	0.027
B20-B22 Composite	B20-15/B22-20Comp	03/06/14	15 / 20	24.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
MTCA Method A Cleanup Level for Soil[4]					**NE**	**NE**	**0.1**	**NE**	**NE**	**NE**	**NE**	**0.1**
SoundEarth June 2014 Supplemental Subsurface Investigation												
B23	B23-43	06/26/14	43	-1	20	23	**19**	18	6	11	2	**25**
B24	B24-45	06/26/14	45	-3	26	27	**23**	20	8	14	2	**30**
B26	B26-46	06/27/14	46	-4	0.02	0.02	0.02	0.02	< 0.01	< 0.01	< 0.01	0.022
MTCA Method A Cleanup Level for Soil[4]					**NE**	**NE**	**0.1**	**NE**	**NE**	**NE**	**NE**	**0.1**

NOTES:

Red indicates concentrations exceeding the MTCA Method A cleanup level.

[1]Samples analyzed by EPA Method 8270D SIM GC/MS-SIM.

[2]Toxicity equivalency factors obtained from Table 708-2 of Section 900 of Chapter 173-340 of the Washington Administrative Code, revise

[3]Analytical result for each individual cPAH is multiplied by TEF and all seven cPAH values are added. When analytical result is reported as less than the LRL, half the LRL is used for the calculation.

[4]MTCA Method A Cleanup Levels, Table 740-1 of Section 900 of Chapter 173-340 of the Washington Administrative Code, revised Novem

-- = not analyzed/not applicable

bgs = below ground surface

cPAH = carcinogenic polycyclic aromatic hydrocarbon

EPA = U.S. Environmental Protection Agency

LRL = lower reporting limit

MTCA = Washington State Model Toxics Control Act

NAVD88 = North American Vertical Datum of 1988

NE = not established

SoundEarth = SoundEarth Strategies, Inc.

TEF = toxicity equivalency factor

Table 3
Summary of Upper Zone Sample Data - USTs

Boring ID	Sample ID	Date Sampled	Depth (feet bgs)	Elevation (feet NAVD88)	Analytical Results (mg/kg)						
					DRPH[1]	ORPH[1]	GRPH[2]	Benzene[3] [4]	Toluene[3] [4]	Ethyl benzene[3] [4]	Total Xylenes[4]
SoundEarth October 2014 UST Removal											
UST01	UST01-BTM-N-11	10/15/14	11	31	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST01-BTM-S-11	10/15/14	11	31	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST01-ESW01-09	10/15/14	9	33	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST01-WSW01-09	10/15/14	9	33	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST01-NSW01-09	10/15/14	9	33	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST01-SSW01-09	10/15/14	9	33	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
UST02	UST02-ESW-36	10/23/14	6	36	<50	<250	<2	<0.02	<0.02	<0.02	0.082
	UST02-WSW-36	10/23/14	6	36	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST02-SSW-36	10/23/14	6	36	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST02-NSW-36	10/23/14	6	36	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST02-B01-32	10/23/14	10	32	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST02-B02-32	10/23/14	10	32	<50	<250	3.3	**0.25**	0.41	<0.02	0.24
	US02-B02-30	10/27/14	12	30	--	--	--	<0.02	<0.02	<0.02	<0.06
UST03	UST03-NSW01-34	11/07/14	8	34	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST03-SSW01-34	11/07/14	8	34	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST03-WSW01-34	11/07/14	8	34	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST03-ESW01-34	11/07/14	8	34	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST03-BTM-N-30	11/07/14	12	30	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST03-BTM-S-30	11/07/14	12	30	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST03-PL-36	11/07/14	6	36	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
UST04	UST04-NSW01-34	12/11/14	8	34	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST04-SSW01-34	12/11/14	8	34	<50	<250	<2	**0.034**	0.069	<0.02	<0.06
	UST04-WSW01-34	12/11/14	8	34	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST04-ESW01-34	12/11/14	8	34	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST04-BTM-N-29	12/11/14	13	29	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
	UST04-BTM-S-29	12/11/14	13	29	<50	<250	<2	<0.02	0.049	<0.02	0.079
	UST04-SSW02-34	12/11/14	8	34	<50	<250	<2	<0.02	<0.02	<0.02	<0.06
MTCA Method A Cleanup Levels[5]					**2,000**	**2,000**	**30/100[6]**	**0.03**	**7**	**6**	**9**

NOTES:

Results measured in mg/kg.

Red indicates concentration exceeding the MTCA Method A cleanup level.

[1]Samples analyzed by Method NWTPH-Dx.

[2]Samples analyzed by Method NWTPH-GX.

[3]Samples analyzed by EPA Method 8021B.

[4]Samples analyzed by EPA Method 8260C.

[5]MTCA Method A Cleanup Levels, Table 740-1 of Section 900 of Chapter 173-340 of the Washington Administrative Code, revised November 2007.

[6]30 mg/kg when benzene is present, 100 mg/kg when benzene is absent.

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

[ht]The sample was analyzed outside of normal hold time.

[pc] Sample not collected by EPA 5035 Method. Reported value is considered an estimate.

-- = not analyzed

< = not detected at a concentration exceeding the laboratory reporting limit

bgs = below ground surface

DRPH = diesel-range petroleum hydrocarbons

EPA = U.S. Environmental Protection Agency

GRPH = gasoline-range petroleum hydrocarbons

mg/kg = milligrams per kilogram

MTCA = Washington State Model Toxics Control Act

NAVD88 = North American Vertical Datum of 1988

NWTPH = Northwest Total Petroleum Hydrocarbon

ORPH = oil-range petroleum hydrocarbons

SoundEarth = SoundEarth Strategies, Inc.

Table 4
Summary of Upper Zone Sample Data - Hot Spots

Sample Location	Sample ID	Date Sampled	Depth (feet bgs)	Elevation (feet NAVD88)	Analytical Results (milligrams per kilogram)[1] [2]							Total Toxic Equivalent Concentration[3]
					Benzo(a)anthracene (TEF 0.1)	Chrysene (TEF 0.01)	Benzo(a)pyrene (TEF 1)	Benzo(b)fluoranthene (TEF 0.1)	Benzo(k)fluoranthene (TEF 0.1)	Indeno(1,2,3-cd)pyrene (TEF 0.1)	Dibenz(a,h)anthracene (TEF 0.1)	
2014 Excavation												
HS03	HS03-36NSW	10/23/14	6	36	0.046	0.048	0.056	0.051	0.017	0.048	< 0.01	0.073
	HS03-36SSW	10/23/14	6	36	0.91	1.00	**1.30**	1.40	0.45	0.92	0.18	**1.696**
	HS03-36ESW	10/23/14	6	36	0.057	0.070	0.071	0.073	0.026	0.049	0.010	0.093
	HS03-36WSW	10/23/14	6	36	0.130	0.170	**0.240**	0.240	0.092	0.190	0.045	**0.311**
	HS04-41B	10/23/14	11	31	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
	HS03-SSW2-36	10/27/14	6	36	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
	HS03-WSW2-36	10/27/14	6	36	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
HS04	HS04-NSW01-26	11/20/14	16	26	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
	HS04-SSW01-26	11/20/14	16	26	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
	HS04-ESW01-26	11/20/14	16	26	0.010	0.011	0.011	0.013	< 0.01	< 0.01	< 0.01	0.015
	HS04-WSW01-26	11/20/14	16	26	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
	HS04-BTM01-21	11/21/44	21	21	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.008
MTCA Method A Cleanup Level for Soil[4]					**NE**	**NE**	**0.1**	**NE**	**NE**	**NE**	**NE**	**0.1**

NOTES:

Red indicates concentrations exceeding the MTCA Method A cleanup level.

[1]Samples analyzed by EPA Method 8270D SIM GC/MS-SIM.

[2]Toxicity equivalency factors obtained from Table 708-2 of Section 900 of Chapter 173-340 of the Washington Administrative Code, r

-- = not analyzed/not applicable

bgs = below ground surface

cPAH = carcinogenic polycyclic aromatic hydrocarbon

EPA = U.S. Environmental Protection Agency

LRL = lower reporting limit

MTCA = Washington State Model Toxics Control Act

NAVD88 = North American Vertical Datum of 1988

NE = not established

SoundEarth = SoundEarth Strategies, Inc.

TEF = toxicity equivalency factor

Table 5
Summary of Bottom of Excavation Sample Data

Grid ID	Sample ID	Date Sampled	Depth (feet bgs)	Elevation (feet NAVD88)	Analytical Results (mg/kg)							
					DRPH[1]	ORPH[1]	GRPH[2]	Benzene[3] [4]	Toluene[3] [4]	Ethyl benzene[3] [4]	Total Xylenes[4]	Benzo(a)pyrene
Excavation Extent Confirmational Samples												
E04	E04-20	02/18/15	22	20	<50	<250	2.6	<0.03	0.074	<0.05	0.53	**0.250**
E03	E03-20	02/18/15	22	20	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	0.020
E02	E02-19	02/18/15	23	19	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
D03	D03-19	02/18/15	23	19	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
D04	D04-20	02/18/15	22	20	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	0.025
C04	C04-20	02/18/15	22	20	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	**0.150**
C03	C03-19	02/19/15	23	19	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
D02	D02-19	02/19/15	23	19	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
B03	B03-19	02/19/15	23	19	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
E01	E1-17	02/20/15	25	17	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
C1	C101-16	02/23/15	26	16	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
D1	D101-16	02/23/15	26	16	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
C2	C201-16	02/23/15	26	16	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
C1NSW	C1NSW01-17	02/23/15	25	17	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	0.063
D1NSW	D1NSW01-17	02/23/15	25	17	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
E1NSW	E1NSW01-18	02/23/15	24	18	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
E1ESW	E1ESW01-18	02/23/15	24	18	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
E2ESW	E2ESW01-18	02/23/15	24	18	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
E4SSW	E4SSW01-22	02/23/15	20	22	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
D4SSW	D4SSW01-22	02/23/15	20	22	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	**0.110**
C4SSW	C4SSW01-22	02/23/15	20	22	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	**0.690**
B4SSW	B4SSW01-22	02/23/15	20	22	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	**0.530**
B1	B101-16	02/26/15	26	16	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	0.011
B2	B201-16	03/05/15	26	16	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
B4	B401-18	03/05/15	24	18	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
A4	A401-18	03/05/15	24	18	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
A3	A301-15	03/27/15	27	15	<50	<250	2.5	<0.03	<0.05	<0.05	<0.15	**1.005**
A2	A201-15	03/27/15	27	15	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
A1	A101-16	03/27/15	26	16	<50	<250	<2	<0.03	<0.05	<0.05	<0.15	<0.01
MTCA Method A Cleanup Levels[5]					**2,000**	**2,000**	**30/100[a]**	**0.03**	**7**	**6**	**9**	**0.1**

NOTES:

Results measured in mg/kg.

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[1]Samples analyzed by Method NWTPH-Dx.

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[6]30 mg/kg when benzene is present, 100 mg/kg when benzene is absent.

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