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# Technical Memorandum

Prepared for: Kenan Advantage Group, Inc.

Project title: Vancouver, Washington Tanker Spill

Project no.: 151008

**Technical Memorandum**

Subject: Confirmatory Soil Sampling and Analysis Plan/Quality Assurance Project Plan

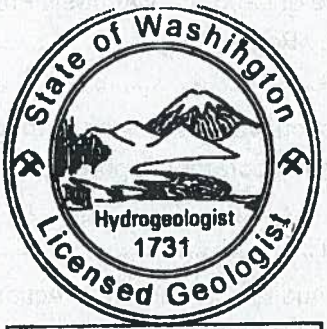
Date: October 9, 2018

To: Washington State Department of Ecology, Voluntary Cleanup Program

From: Carolyn Roth, Project Manager, Brown and Caldwell

Prepared by: _____
Carolyn Roth, Project Manager

Reviewed by: _____
Martha Knowlton, Vice President




*Limitations:*

# Table of Contents

# List of Figures



# List of Tables

# List of Abbreviations

| | |
|---|---|
| °C | degree(s) Celsius |
| AS | air sparge |
| BC | Brown and Caldwell |
| bgs | below ground surface |
| BTEX | benzene, toluene, ethylbenzene, and total xylenes |
| COC | chain of custody |
| CoV | City of Vancouver |
| CSV | comma-separated values |
| DI | deionized |
| Ecology | Washington State Department of Ecology |
| EDD | electronic data deliverable |
| EPA | U.S. Environmental Protection Agency |
| HASP | health and safety plan |
| HAZWOPER | Hazardous Waste Operations and Emergency Response |
| HS | heavy sheen |
| ID | identifier |
| IDW | investigation-derived waste |
| KAG | Kenan Advantage Group, Inc. |
| MS | moderate sheen |
| MTCA | Model Toxics Control Act |
| MTCA-A | Model Toxics Control Act Method A |
| NRC | NRC Environmental Services Inc. |
| NS | no sheen |
| NWTPH-Gx | Northwest total petroleum hydrocarbon gasoline-range organics |
| Pace | Pace Analytical Services, Inc. |
| PID | photoionization detector |
| ppm | part(s) per million |
| PQL | practical quantitation limit |
| PPE | personal protective equipment |
| QAPP | Quality Assurance Project Plan |
| QA/QC | quality assurance/quality control |
| RPD | relative percent difference |
| SAP | Sampling and Analysis Plan |
| SB | soil boring |
| Site | KAG fuel spill site |
| SS | slight sheen |
| SVE | soil vapor extraction |
| TBD | to be decided |
| USCS | Unified Soil Classification System |
| VOC | volatile organic compound |
| WSDOT | Washington State Department of Transportation |

# Section 1: Introduction

On December 13, 2013, a tanker truck accident at the Kenan Advantage Group, Inc. (KAG) fuel spill site (Site) in Vancouver, Washington, released approximately 3,300 gallons of gasoline. Since that time, hydrocarbon remediation efforts have been performed, and Brown and Caldwell (BC) now proposes soil sampling (see Figure 1).

This Sampling and Analysis Plan and Quality Assurance Project Plan (SAP/QAPP) presents the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with BC's proposed soil sampling.

## 1.1 Project Definition

This SAP/QAPP provides guidance to field and project personnel who are involved in hydrocarbon characterization activities to ensure that data quality is maintained. Any future changes to the hydrocarbon characterization program (e.g., changes in soil locations, sampling frequency, and or chemical analyses) will be described in addenda to this SAP/QAPP.

This report describes specific protocols for sampling, sample handling and storage, chain of custody (COC), and laboratory and field analyses, and was developed in accordance with the Washington State Department of Ecology's (Ecology) *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Ecology's *Guidance for Remediation of Petroleum Contaminated Sites*, and U.S. Environmental Protection Agency's (EPA's) *Guidance for Quality Assurance Project Plans* (Ecology 2004, 2011; EPA 2002).

## 1.2 Project Background

The December 12, 2013, accident occurred on NE 18th Street immediately east of the intersection of NE 18th Street and NE 118th Avenue in Vancouver, Washington (see Figure 1). A fuel truck owned and operated by KAG overturned and released approximately 3,300 gallons of gasoline. Product traveled west along NE 18th Street, impacting the south ditch line, which ultimately drains through a culvert and into a drywell located on the north side of NE 18th Street. Product also entered the Mission Hills apartment complex stormwater system and may have impacted drywells located in the northwest corner of the apartment complex (NRC 2014a).

NRC Environmental Services Inc. (NRC) performed emergency response activities that resulted in recovering approximately 580 gallons of fuel, including excavating affected soils in the southern ditch line adjacent to NE 18th Street. Select soil samples collected from the ditch on the south side of NE 18th Street following excavation exceeded Model Toxics Control Act Method A (MTCA-A) cleanup levels for Northwest total petroleum hydrocarbon gasoline-range organics (NWTPH-Gx) and benzene, toluene, ethylbenzene, and total xylenes (BTEX) (NRC 2014b).

BC performed soil borings (SBs) to complete hydrocarbon-impacted soil characterization and to monitor groundwater remediation. Table 1 is a summary of analytical results for soil samples collected at the site. An SVE system was installed to help remediate contaminated soils around the drywell. The drywell and culvert were removed during this installation process. NRC completed targeted excavation at the culvert and surface soils on the north side of NE 18th Street in January 2017, in advance of a City of Vancouver (CoV) road widening project. Figure 2 shows soil investigation sample locations.

An air-sparge/soil vapor extraction (AS/SVE) system was installed in Spring 2017. Figure 2 shows AS and SVE well locations in relation to the sample locations. The system comprises nine SVE wells, seven AS wells, two control vaults, and one equipment trailer. The AS/SVE system operated between April 2017 and February 2018, at which time the system was shut down temporarily to perform a rebound test (BC 2018). The AS/SVE system was turned back on 3 months later in May 2018. Samples were collected from the

system influent vapor and indicated low concentrations, showing negligible hydrocarbon mass contaminant extraction, therefore, the AS/SVE system was permanently shut down.

Site soil delineation has been completed and active remediation appears to have successfully removed most of the hydrocarbon contamination. As a result, BC proposes to collect confirmation soil samples to demonstrate that remediation efforts are complete. The following sections describe the locations and procedures for the proposed confirmation soil samples.

**Table 1. Summary Analytical Table - Soil**

| Constituent of Concern | | | | 1,2-Dibromoethane | 1,2-Dichloroethane | 2-Methylnaphthalene | Benzene | Ethylbenzene | MTBE | Naphthalene | Toluene | Xylenes, m & p | Xylene, o | Xylenes, total | Lead | n-Hexane | TPH Gx |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method A Soil Cleanup Levels for Unrestricted Land Use | | | | NA | NA | NA | 0.03 | 6 | 0.1 | 5 | 7 | NA | NA | 9 | 250 | NA | 30 |
| Unit | | | | µg/kg | | | | | | | | | | | mg/kg | | |
| Location | Depth (ft bgs) | Sample ID | Date | | | | | | | | | | | | | | |
| MW-01 | 39 | MW1-39.0-030314 | 3/3/2014 | NA | NA | NA | < 18 | < 18 | NA | NA | < 18 | < 36 | < 18 | NA | NA | NA | < 7.1 |
| | 56 | MW1-56.0-030314 | 3/3/2014 | NA | NA | NA | < 22 | < 22 | NA | NA | < 22 | < 44 | < 22 | NA | NA | NA | < 8.8 |
| | 99 | MW1-99.0-030314 | 3/3/2014 | NA | NA | NA | < 15 | < 15 | NA | NA | < 15 | < 30 | < 15 | NA | NA | NA | < 6.1 |
| MW-02 | 24 | MW2-24.0-031014 | 3/10/2014 | NA | NA | NA | < 13 | < 13 | NA | NA | < 13 | < 26 | < 13 | NA | NA | NA | < 5.2 |
| | 76 | MW2-76.0-031014 | 3/10/2014 | NA | NA | NA | < 13 | < 13 | NA | NA | < 13 | < 26 | < 13 | NA | NA | NA | < 5.3 |
| | 84 | MW2-84.0-031014 | 3/10/2014 | NA | NA | NA | < 18 | < 18 | NA | NA | < 18 | < 36 | < 18 | NA | NA | NA | < 7.2 |
| MW-03 | 21 | MW3-21.0-030714 | 3/7/2014 | NA | NA | NA | < 16 | < 16 | NA | NA | < 16 | < 33 | < 16 | NA | NA | NA | **8.5** |
| | 21 | MW3-21.0-030714-B | 3/7/2014 | NA | NA | NA | < 16 | < 16 | NA | NA | < 16 | < 31 | < 16 | NA | NA | NA | **6.7** |
| | 56.8 | MW3-56.8-030714 | 3/7/2014 | NA | NA | NA | < 19 | < 19 | NA | NA | < 19 | < 37 | < 19 | NA | NA | NA | < 7.4 |
| | 65 | MW3-65.0-030714 | 3/7/2014 | NA | NA | NA | < 17 | < 17 | NA | NA | < 17 | < 34 | < 17 | NA | NA | NA | < 6.9 |
| MW-04 | 43 | MW4-43.0-031714 | 3/17/2014 | NA | NA | NA | < 14 | < 14 | NA | NA | < 14 | < 27 | < 14 | NA | NA | NA | < 5.5 |
| | 74 | MW4-74.0-031714 | 3/17/2014 | NA | NA | NA | < 16 | < 16 | NA | NA | < 16 | < 31 | < 16 | NA | NA | NA | < 6.2 |
| | 84 | MW4-84.0-031714 | 3/17/2014 | NA | NA | NA | < 14 | < 14 | NA | NA | < 14 | < 29 | < 14 | NA | NA | NA | < 5.7 |
| MW-05 | 112.5 | MW5-112.5-032014 | 3/20/2014 | NA | NA | NA | < 17 | < 17 | NA | NA | < 17 | < 34 | < 17 | NA | NA | NA | < 6.8 |
| | 112.5 | MW5-112.5-032014-B | 3/20/2014 | NA | NA | NA | < 18 | < 18 | NA | NA | < 18 | < 36 | < 18 | NA | NA | NA | < 7.3 |
| | 154.5 | MW5-154.5-032014 | 3/20/2014 | NA | NA | NA | < 20 | < 20 | NA | NA | < 20 | < 39 | < 20 | NA | NA | NA | < 7.8 |
| | 170 | MW5-170.0-032014 | 3/20/2014 | NA | NA | NA | < 15 | < 15 | NA | NA | < 15 | < 31 | < 15 | NA | NA | NA | < 6.2 |
| | 185 | MW5-185.0-032414 | 3/24/2014 | NA | NA | NA | < 13 | < 13 | NA | NA | < 13 | < 26 | < 13 | NA | NA | NA | < 5.3 |
| MW-06 | 6 | MW6-6.0-031214 | 3/12/2014 | NA | NA | NA | **90000** | **140000** | NA | NA | **500000** | **600000** | **240000** | NA | NA | NA | **12000** |
| | 26 | MW6-26.0-031214 | 3/12/2014 | NA | NA | NA | **26000** | **39000** | NA | NA | **150000** | **160000** | **61000** | NA | NA | NA | **3200** |
| | 27 | MW6-27.0-031214 | 3/12/2014 | NA | NA | NA | **22000** | **45000** | NA | NA | **140000** | **180000** | **66000** | NA | NA | NA | **4100** |
| | 27 | MW6-27.0-031214-B | 3/12/2014 | NA | NA | NA | **7600** | **23000** | NA | NA | **57000** | **89000** | **36000** | NA | NA | NA | **2400** |
| | 44 | MW6-44.0-031214 | 3/12/2014 | NA | NA | NA | < 18 | < 18 | NA | NA | **30** | < 35 | < 18 | NA | NA | NA | < 7.0 |
| | 59 | MW6-59.0-031214 | 3/12/2014 | NA | NA | NA | **66** | < 15 | NA | NA | **52** | **69** | **16** | **85** | NA | NA | < 6.0 |
| | 79 | MW6-79.0-031214 | 3/12/2014 | NA | NA | NA | < 17 | < 17 | NA | NA | < 17 | < 34 | < 17 | NA | NA | NA | < 6.9 |
| MW-07 | 40 | MW-7/38-40 | 10/23/2014 | NA | NA | < 64 | < 15 | < 15 | < 30 | < 64 | < 15 | < 30 | < 15 | NA | NA | NA | < 6.1 |
| | 54 | MW-7/52-54 | 10/23/2014 | NA | NA | < 62 | < 21 | < 21 | < 42 | < 62 | < 21 | < 42 | < 21 | NA | NA | NA | < 8.4 |
| SB-01 | 14.7 | SB1-14.7-031414 | 3/14/2014 | NA | NA | NA | < 15 | < 15 | NA | NA | < 15 | < 30 | < 15 | NA | NA | NA | < 6.1 |
| | 34 | SB1-34.0-031414 | 3/14/2014 | NA | NA | NA | < 13 | < 13 | NA | NA | < 13 | < 26 | < 13 | NA | NA | NA | < 5.2 |
| | 54 | SB1-54.0-031414 | 3/14/2014 | NA | NA | NA | < 14 | < 14 | NA | NA | < 14 | < 29 | < 14 | NA | NA | NA | < 5.8 |

**Table 1. Summary Analytical Table - Soil**

| Constituent of Concern | | | | 1,2-Dibromoethane | 1,2-Dichloroethane | 2-Methylnaphthalene | Benzene | Ethylbenzene | MTBE | Naphthalene | Toluene | Xylenes, m & p | Xylene, o | Xylenes, total | Lead | n-Hexane | TPH Gx |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method A Soil Cleanup Levels for Unrestricted Land Use | | | | NA | NA | NA | 0.03 | 6 | 0.1 | 5 | 7 | NA | NA | 9 | 250 | NA | 30 |
| Unit | | | | µg/kg | | | | | | | | | | | mg/kg | | |
| Location | Depth (ft bgs) | Sample ID | Date | | | | | | | | | | | | | | |
| SB-02 | 10 | SB2-10.0-031414 | 3/14/2014 | NA | NA | NA | **96** | **22** | NA | NA | **220** | **110** | **38** | **148** | NA | NA | < 5.9 |
| | 20 | SB2-20.0-031414 | 3/14/2014 | NA | NA | NA | **73** | **15** | NA | NA | **180** | **84** | **36** | **120** | NA | NA | < 5.7 |
| | 39.7 | SB2-39.7-031414 | 3/14/2014 | NA | NA | NA | < 14 | < 14 | NA | NA | < 14 | < 27 | < 14 | NA | NA | NA | < 5.4 |
| | 48.5 | SB2-48.5-031414 | 3/14/2014 | NA | NA | NA | < 12 | < 12 | NA | NA | < 12 | < 25 | < 12 | NA | NA | NA | < 5.0 |
| | 55 | SB2-55.0-031414 | 3/14/2014 | NA | NA | NA | < 15 | < 15 | NA | NA | < 15 | < 30 | < 15 | NA | NA | NA | < 6.0 |
| SB-03 | 1.5 | SB3-1.5-031414 | 3/14/2014 | NA | NA | NA | < 15 | < 15 | NA | NA | < 15 | < 30 | < 15 | NA | NA | NA | < 6.0 |
| | 30 | SB3-30.0-031414 | 3/14/2014 | NA | NA | NA | < 14 | < 14 | NA | NA | < 14 | < 27 | < 14 | NA | NA | NA | < 5.5 |
| | 30 | SB3-30.0-031414-B | 3/14/2014 | NA | NA | NA | < 13 | < 13 | NA | NA | < 13 | < 26 | < 13 | NA | NA | NA | < 5.2 |
| | 54.5 | SB3-54.5-031414 | 3/14/2014 | NA | NA | NA | < 13 | < 13 | NA | NA | < 13 | < 26 | < 13 | NA | NA | NA | < 5.1 |
| SB-04 | 14.8 | SB4-14.8-031314 | 3/13/2014 | NA | NA | NA | < 16 | < 16 | NA | NA | < 16 | < 31 | < 16 | NA | NA | NA | < 6.2 |
| | 31 | SB4-31.0-031314 | 3/13/2014 | NA | NA | NA | < 15 | < 15 | NA | NA | < 15 | < 30 | < 15 | NA | NA | NA | < 5.9 |
| | 54 | SB4-54.0-031314 | 3/13/2014 | NA | NA | NA | < 16 | < 16 | NA | NA | < 16 | < 31 | < 16 | NA | NA | NA | < 6.3 |
| SB-05 | 14 | SB5-14.0-031314 | 3/13/2014 | NA | NA | NA | < 17 | < 17 | NA | NA | < 17 | < 34 | < 17 | NA | NA | NA | < 6.8 |
| | 33.2 | SB5-33.2-031314 | 3/13/2014 | NA | NA | NA | < 16 | < 16 | NA | NA | < 16 | < 32 | < 16 | NA | NA | NA | < 6.3 |
| | 33.2 | SB5-33.2-031314-B | 3/13/2014 | NA | NA | NA | < 14 | < 14 | NA | NA | < 14 | < 28 | < 14 | NA | NA | NA | < 5.7 |
| | 55 | SB5-55.0-031314 | 3/13/2014 | NA | NA | NA | < 14 | < 14 | NA | NA | < 14 | < 27 | < 14 | NA | NA | NA | < 5.5 |
| SB-06 | 17 | SB6-17.0-031114 | 3/11/2014 | NA | NA | NA | < 15 | < 15 | NA | NA | < 15 | < 30 | < 15 | NA | NA | NA | < 6.0 |
| | 27 | SB6-27.0-031114 | 3/11/2014 | NA | NA | NA | < 14 | < 14 | NA | NA | < 14 | < 29 | < 14 | NA | NA | NA | < 5.8 |
| | 54 | SB6-54.0-031114 | 3/11/2014 | NA | NA | NA | < 13 | < 13 | NA | NA | < 13 | < 26 | < 13 | NA | NA | NA | < 5.2 |
| | 64 | SB6-64.0-031114 | 3/11/2014 | NA | NA | NA | < 17 | < 17 | NA | NA | < 17 | < 34 | < 17 | NA | NA | NA | < 6.9 |
| SB-07 | 19.5 | SB7-19.5-030614 | 3/6/2014 | NA | NA | NA | < 13 | < 13 | NA | NA | < 13 | < 26 | < 13 | NA | NA | NA | < 5.3 |
| | 24.5 | SB7-24.5-030614 | 3/6/2014 | NA | NA | NA | < 12 | < 12 | NA | NA | < 12 | < 23 | < 12 | NA | NA | NA | < 4.7 |
| | 29 | SB7-29.0-030614 | 3/6/2014 | NA | NA | NA | < 14 | < 14 | NA | NA | < 14 | < 28 | < 14 | NA | NA | NA | < 5.5 |
| | 29 | SB8-29.0-030614 | 3/6/2014 | NA | NA | NA | < 22 | < 22 | NA | NA | < 22 | < 44 | < 22 | NA | NA | NA | < 8.8 |
| | 30-32 | SB-7/30-32 | 10/21/2014 | NA | NA | **4700** | **5400** | **53000** | **540** | **9800** | **130000** | **220000** | **89000** | NA | NA | NA | **6000** |
| | 44-46 | SB-7/44-46 | 10/21/2014 | NA | NA | < 63 | < 16 | < 16 | < 32 | < 63 | < 16 | < 32 | < 16 | NA | NA | NA | < 6.4 |
| | 60-62 | SB-7/60-62 | 10/21/2014 | NA | NA | < 63 | < 22 | < 22 | < 43 | < 63 | < 22 | < 43 | < 22 | NA | NA | NA | < 8.6 |
| SB-08 | 18.4 | SB8-18.4-030614 | 3/6/2014 | NA | NA | NA | < 15 | < 15 | NA | NA | < 15 | < 30 | < 15 | NA | NA | NA | < 5.9 |
| | 26 | SB8-26.0-030614 | 3/6/2014 | NA | NA | NA | < 18 | < 18 | NA | NA | < 18 | < 35 | < 18 | NA | NA | NA | < 7.0 |
| | 29 | SB8-29.0-030614 | 3/6/2014 | NA | NA | NA | < 22 | < 22 | NA | NA | < 22 | < 44 | < 22 | NA | NA | NA | < 8.8 |
| | 30-32 | SB-8/30-32 | 10/23/2014 | NA | NA | < 65 | < 13 | < 13 | < 26 | < 65 | < 13 | < 26 | **27** | **27** | NA | NA | < 5.2 |
| | 50-52 | SB-8/50-52 | 10/23/2014 | NA | NA | < 63 | < 15 | < 15 | < 31 | < 63 | < 15 | < 31 | < 15 | NA | NA | NA | < 6.2 |

**Table 1. Summary Analytical Table - Soil**

| Constituent of Concern | | | | 1,2-Dibromoethane | 1,2-Dichloroethane | 2-Methylnaphthalene | Benzene | Ethylbenzene | MTBE | Naphthalene | Toluene | Xylenes, m & p | Xylene, o | Xylenes, total | Lead | n-Hexane | TPH Gx |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method A Soil Cleanup Levels for Unrestricted Land Use | | | | NA | NA | NA | 0.03 | 6 | 0.1 | 5 | 7 | NA | NA | 9 | 250 | NA | 30 |
| Unit | | | | µg/kg | | | | | | | | | | | mg/kg | | |
| Location | Depth (ft bgs) | Sample ID | Date | | | | | | | | | | | | | | |
| SB-09 | 18.5 | SB9-18.5-030614 | 3/6/2014 | NA | NA | NA | < 16 | < 16 | NA | NA | < 16 | < 32 | < 16 | NA | NA | NA | < 6.5 |
| | 25 | SB9-25.0-030614 | 3/6/2014 | NA | NA | NA | < 23 | < 23 | NA | NA | < 23 | < 46 | < 23 | NA | NA | NA | < 9.2 |
| | 29 | SB9-29.0-030614 | 3/6/2014 | NA | NA | NA | < 16 | < 16 | NA | NA | < 16 | < 32 | < 16 | NA | NA | NA | < 6.4 |
| | 30-32 | SB-9/30-32 | 10/22/2014 | NA | NA | **4200** | **7800** | **80000** | **490** | **9800** | **190000** | **340000** | **140000** | **480000** | NA | NA | **8900** |
| | 43-45 | SB-9/43-45 | 10/22/2014 | NA | NA | < 64 | < 14 | < 14 | < 29 | < 64 | **21** | < 29 | < 14 | NA | NA | NA | < 5.8 |
| | 60-62 | SB-9/60-62 | 10/22/2014 | NA | NA | < 61 | < 16 | < 16 | < 32 | < 61 | < 16 | < 32 | < 16 | NA | NA | NA | < 6.3 |
| SB-10 | 50-52 | SB-10/50-52 | 10/22/2014 | NA | NA | < 61 | < 20 | < 20 | < 39 | < 61 | < 20 | < 39 | < 20 | NA | NA | NA | < 7.8 |
| | 52-54 | SB-10/52-54 | 10/22/2014 | NA | NA | < 66 | < 20 | < 20 | < 39 | < 66 | **27** | < 39 | < 20 | NA | NA | NA | < 7.9 |
| SB-11 | 50-52 | SB-11/50-52 | 10/21/2014 | NA | NA | < 60 | < 20 | < 20 | < 40 | < 60 | < 20 | < 40 | < 20 | NA | NA | NA | < 8.0 |
| SBE-01 | 6 | SBE-1 6FT | 1/11/2016 | < 37.7 | < 37.7 | NA | < 37.7 | < 37.7 | < 37.7 | < 188 | < 188 | NA | NA | < 113 | **37.3** | < 0.377 | **0.0865 J** |
| | 20 | SBE-1 20FT | 1/13/2016 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | 40 | SBE-1 40FT | 1/13/2016 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| SBE-02 | 6 | SBE-2 6FT | 1/11/2016 | < 1.41 | < 1.41 | NA | **17.5** | **9.31** | < 1.41 | **21.8** | **72.7** | NA | NA | **288** | **28.9** | **0.00190 J** | **2.45** |
| | 45 | SBE-2 45FT | 1/12/2016 | < 1.15 | < 1.15 | NA | **0.598 J** | < 1.15 | < 1.15 | < 5.74 | **0.657 J** | NA | NA | < 3.45 | **4.71** | **0.00307 J** | **0.0422 J** |
| SBE-03 | 6 | SBE-3 6FT | 1/12/2016 | < 31.5 | < 31.5 | NA | < 31.5 | < 31.5 | < 31.5 | < 157 | < 157 | NA | NA | < 94.4 | **57.4** | < 0.315 | **0.0475 J** |
| SBE-04 | 5 | SBE-4 5FT | 1/11/2016 | < 1.17 | < 1.17 | NA | **0.728 J** | < 1.17 | < 1.17 | < 5.86 | < 5.86 | NA | NA | **4.34** | **17.4** | < 0.0117 | **0.0653 J** |
| SBE-05 | 6 | SBE-5 6FT | 1/11/2016 | < 1.12 | < 1.12 | NA | **0.971 J** | < 1.12 | < 1.12 | < 5.59 | < 5.59 | NA | NA | **2.82 J** | **9.05** | < 0.0112 | **0.0785 J** |
| SBE-06 | 6 | SBE-6 6FT | 1/12/2016 | < 1.32 | < 1.32 | NA | **1.7** | < 1.32 | < 1.32 | < 6.61 | < 6.61 | NA | NA | < 3.97 | **15.4** | < 0.0132 | **0.0636 J** |
| | 25 | SBE-6 25FT | 1/14/2016 | < 1.15 | < 1.15 | NA | **0.438 J** | < 1.15 | < 1.15 | < 5.73 | **0.717 J** | NA | NA | **0.905 J** | **7.41** | < 0.0115 | **0.0520 J** |
| | 35 | SBE-6 35FT | 1/14/2016 | < 503 | < 503 | NA | **2190** | **25500** | < 503 | **5370** | **61600** | NA | NA | **151000** | **2.47** | **2.56 J** | **1370** |
| | 55 | SBE-6 55FT | 1/14/2016 | < 1.23 | < 1.23 | NA | **75.7** | **19.7** | < 1.23 | **2.37 J** | **105** | NA | NA | **64.4** | **2.76** | **0.00264 J** | **1.60 J** |
| SBE-08 | 10 | SBE-8 10FT | 1/18/2016 | < 1.25 | < 1.25 | NA | **0.559 J** | < 1.25 | < 1.25 | < 6.24 | < 6.24 | NA | NA | < 3.74 | **15.2** | < 0.0125 | < 0.125 |
| | 30 | SBE-8 30FT | 1/18/2016 | < 1.14 | < 1.14 | NA | < 1.14 | < 1.14 | < 1.14 | < 5.72 | < 5.72 | NA | NA | < 3.43 | **5.32** | < 0.0114 | < 0.118 |
| SBE-09 | 25 | SBE-9 25FT | 1/18/2016 | < 107 | < 107 | NA | **90.3 J** | **387** | < 107 | **1430** | **1730** | NA | NA | **16400** | **3.63** | **0.422 J** | **93.1** |
| | 40 | SBE-9 40FT | 1/18/2016 | < 1.14 | < 1.14 | NA | **111** | **25.6** | < 1.14 | **23.3** | **170** | NA | NA | **153** | **3.93** | **0.000460 J** | **1.08** |

**Table 1. Summary Analytical Table - Soil**

| Constituent of Concern | | | | 1,2-Dibromoethane | 1,2-Dichloroethane | 2-Methylnaphthalene | Benzene | Ethylbenzene | MTBE | Naphthalene | Toluene | Xylenes, m & p | Xylene, o | Xylenes, total | Lead | n-Hexane | TPH Gx |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method A Soil Cleanup Levels for Unrestricted Land Use | | | | NA | NA | NA | 0.03 | 6 | 0.1 | 5 | 7 | NA | NA | 9 | 250 | NA | 30 |
| Unit | | | | µg/kg | | | | | | | | | | | mg/kg | | |
| Location | Depth (ft bgs) | Sample ID | Date | | | | | | | | | | | | | | |
| SBE-10 | 6 | SBE-10 6FT | 1/18/2016 | < 1.45 | < 1.45 | NA | < 1.45 | 1.< 45 | < 1.45 | < 7.25 | < 7.25 | NA | NA | < 4.35 | **8** | < 0.0145 | < 0.149 |
| | 10 | SBE-10 (10FT) | 1/19/2016 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | 25 | SBE-10 (25FT) | 1/19/2016 | < 1.18 | < 1.18 | NA | < 1.18 | < 1.18 | < 1.18 | < 5.89 | < 5.89 | NA | NA | < 3.53 | **4.33** | < 0.0118 | **0.179** |
| | 30 | SBE-10 (30FT) | 1/19/2016 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | 35 | SBE-10 (35FT) | 1/19/2016 | < 1.16 | < 1.16 | NA | **1.55** | **2.28** | < 1.16 | < 5.8 | **0.765 J** | NA | NA | **5.61** | **3.75** | **0.00806 J** | **0.867** |
| | 50 | SBE-10 (50FT) | 1/19/2016 | < 1.13 UJ | < 1.13 UJ | NA | **2.03** | **0.471 J** | < 1.13 UJ | < 5.66 UJ | < 5.66 | NA | NA | < 3.39 | **3.33** | < 0.0113 | **0.0468 J** |
| SBE-11 | 6 | SBE-11 6FT | 1/15/2016 | < 1.08 | < 1.08 | NA | < 26 | **1.53** | < 1.08 | **1.18 J** | **0.601 J** | NA | NA | **13.4** | **6.34** | < 0.0108 | **3.64** |
| | 30 | SBE-11 30FT | 1/15/2016 | < 1.13 | < 1.13 | NA | < 1.13 | < 1.13 | < 1.13 | < 5.65 | < 5.65 | NA | NA | < 3.39 | **2.41** | < 0.0113 | < 0.113 |
| SVE-09 | 25 | SVE-9 25 FT | 4/8/2016 | NA | NA | NA | < 5.84 | < 5.84 | NA | NA | < 29.2 | NA | NA | < 17.5 | NA | NA | < 0.584 |
| | 35 | SVE-9 35 FT | 4/8/2016 | NA | NA | NA | < 5.51 | < 5.51 | NA | NA | < 27.6 | NA | NA | < 16.5 | NA | NA | < 0.551 |
| | 41 | SVE-9 41 FT | 4/8/2016 | NA | NA | NA | < 5.47 | < 5.47 | NA | NA | < 27.3 | NA | NA | < 16.4 | NA | NA | < 0.547 |

*Notes:*

*– = not applicable or not available.*

*< = Constituent not detected above the associated detection limit.*

*µg/kg = micrograms per kilogram.*

*ft bgs = feet below ground surface.*

*J = result is considered an estimate.*

*mg/kg = milligrams per kilogram.*

*MTBE = methyl tert butyl ether.*

*TPH = Total Petroleum Hydrocarbons.*

*Values presented in bold have a detection.*

***Bold** = detection*

## 1.3 Project/Task Description

This SAP/QAPP has been prepared by BC on behalf of KAG. The proposed soil sampling activities include:

- Installation of 10 SBs ranging from 40 feet below ground surface (bgs) to 70 feet bgs using sonic drilling methods (see Figure 3)
- Sampling and chemical analyses of soil samples collected from the SBs at targeted depths based on past contamination or evidence of contamination

If soil sample results from this investigation confirm that remediation at the site is complete the SVE system will be decommissioned.


**Figure 1. Mission Hills Apartment Complex Site Map**

Vancouver, Washington
The Kenan Advantage Group

Figure 1. Spill location Site map

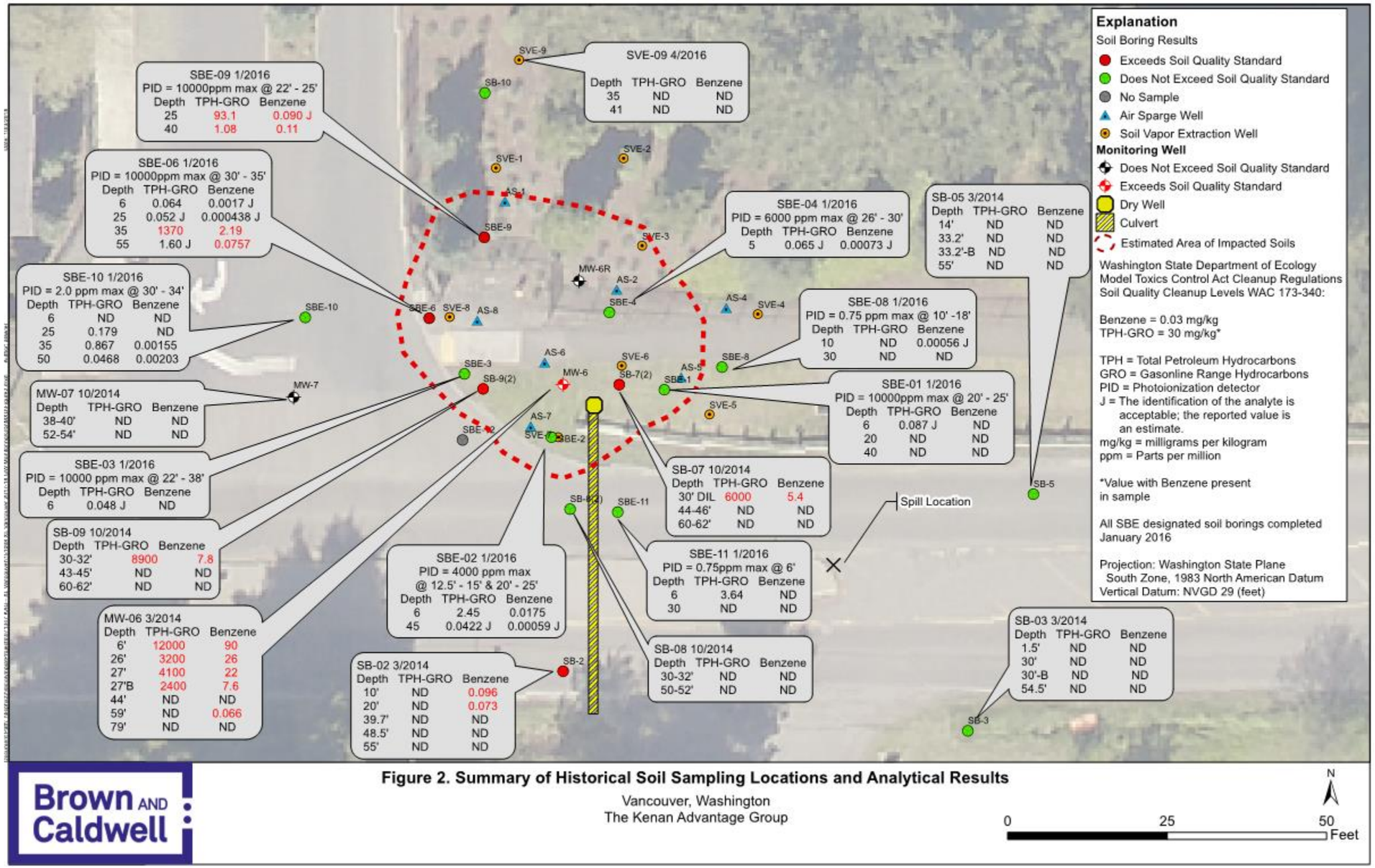



Figure 2. Summary of historical soil sampling locations and analytical results

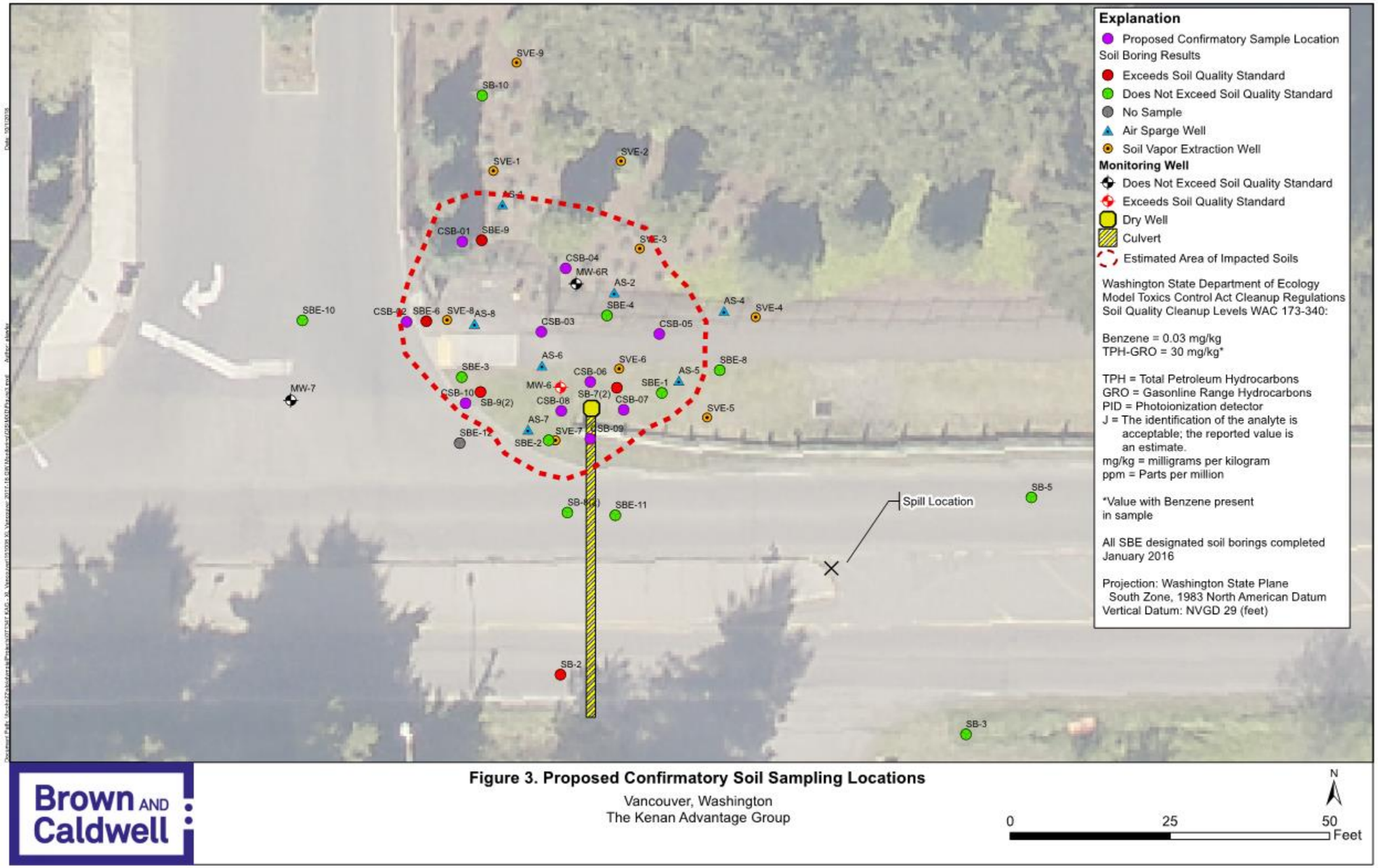



Figure 3. Proposed confirmatory soil sampling locations

# Section 2: Project Organization and Responsibilities

Upon KAG's authorization, BC will perform field activities for soil hydrocarbon characterization. Pace Analytical Services, Inc. (Pace) will be the primary analytical laboratory, performing all chemical analyses on samples collected and submitted during the investigation.

## 2.1 Project/Task Organization: Management Responsibilities

This section defined the various QA field and management responsibilities of key project personnel. This SAP/QAPP will be distributed to all key project personnel, as described below.

### 2.1.1 Carolyn Roth: BC Project Manager

Carolyn Roth will have the overall responsibility of implementing the soil investigation. As project manager, Carolyn will be responsible for overall QA on this project to ensure that it meets technical and contractual requirements. The BC project manager is responsible for technical QC and project oversight, and will perform the following:

- Monitor project activity and quality
- Review results of the hydrocarbon characterization and reporting
- Provide technical representation of project activities to stakeholders

### 2.1.2 Matt Grzegorzewski: BC Field Manager

Matt Grzegorzewski will have overall responsibility for project implementation. As field manager, he will be responsible for overall QA on this project to ensure that it meets technical and contractual requirements. The field manager will report directly to the BC project manager and is responsible for technical QA/QC and project oversight.

The BC field manager will be responsible for leading or coordinating the day-to-day field activities including:

- Coordinating with the BC project manager daily
- Developing and implementing a work plan and setting the field schedule
- Reviewing technical data provided by the field staff, including field measurement data
- Adhering to the work schedule
- Coordinating and overseeing subcontractors
- Coordinating laboratory testing
- Identifying problems, resolving difficulties in consultation with the BC project manager, implementing and documenting corrective action procedures, and communicating between team and upper management
- Preparing an internal data report summarizing chemical analytical results and hydrocarbon characterization

### 2.1.3 Jaclyn Lauer: BC QA Manager

The BC QA manager, Jaclyn Lauer, reports to the BC project manager and field managers and will be responsible for the analytical data QA/QC review on data generated from laboratory analyses. The QA manager will also be responsible for confirming sample result data validation with the analytical laboratory. Additional responsibilities include:

- Review laboratory data reports including laboratory QA/QC procedures
- Advise on data corrective action procedures
- Review analytical results for field duplicates, field blanks, equipment blanks, and trip blanks

## 2.2 Training Considerations

Hazardous Waste Operations and Emergency Response (HAZWOPER) 40-hour training is required for all field personnel.

## 2.3 Documentation and Records

A current copy of all project documents will be provided to all project personnel in a timely manner. Any modifications to a document will be supplied in advance to the field event so that all documents are always up to date. A copy of the SAP/QAPP, health and safety plan (HASP), and work plan will be kept in the field at all times.

BC will keep all project documents in a secure archive for a five-year period.

# Section 3: Soil Sampling

Soil samples will be collected from SBs that are advanced using sonic drilling technology. Sonic technology allows soil intervals to be collected continuously and will be placed in 2-foot sample bags for logging and soil sample collection. All borings will be monitored and logged by a field technician on either SB log forms or in a field notebook. Soil intervals will be continuously logged, described, and classified per the Unified Soil Classification System (USCS).

Photographs will be taken of representative lithologies and soil sample collection intervals. Soil field screening procedures will be implemented, as described below, before collecting soil samples. Photoionization detector (PID) readings will be logged for each sample before samples are containerized and shipped to the laboratory for analysis.

## 3.1 Soil Field Screening Procedures

Field screening for visual (e.g., presence of product, discolored soil, etc.) and olfactory signs of contamination will be conducted to identify areas of potential contamination.

Sheen will be noted by placing a small quantity (e.g., 1 tablespoon) of sample material in a decontaminated pan or bowl and pouring water onto the sample to see if a sheen forms on the water surface. Photographs of sheen produced by soil will also be taken where heavily impacted by petroleum hydrocarbons. Sheen will be categorized qualitatively as follows (Ecology 2011):

- **No sheen (NS)**: no visible sheen on water surface
- **Slight sheen (SS)**: light, colorless, dull sheen; spread is irregular, not rapid
- **Moderate sheen (MS)**: pronounced sheen over a limited area; exhibits some color/iridescence; spread is irregular and may be rapid
- **Heavy sheen (HS)**: sheen with pronounced color/iridescence; spread is rapid; entire water surface is covered with sheen

Field screening will also be based on PID volatile organic compound (VOC) measurements. Before daily field activities, the PID will be calibrated using isobutylene gas at the standard 100 parts per million (ppm). Approximately 1 or 2 cups of soil will be placed into a plastic bag and then sealed. The plastic bag will be shaken to allow contaminants in the soil to volatilize, and then the PID will be inserted into the plastic bag to take a PID reading (Ecology 2011). These methods will be applied to all SB samples.

## 3.2 Soil Sample Collection

Soil samples will be collected from SBs proposed in Figure 3 using the procedures outlined below. Soil sample collection will proceed based upon the following criteria:

- Locations and depths where historical soil samples indicated soil contamination (see Figure 2)
- Field screening (see Section 3.1) indicates the presence of contaminated soil

The following information will be recorded on the soil sample collection form or within the field notebook:

- Date, time, and name of person logging the sample
- Sample location number
- Soil sample depth and soil description
- Sample recovery
- Presence of sheen or any other indications of contamination (e.g., odor)

After field screening soil samples, petroleum hydrocarbon-impacted soil will be removed from the section identified as likely to exhibit the greatest concentrations of petroleum hydrocarbon within the sample interval of interest (e.g., 15 to 17 feet bgs). Soil **will not** be homogenized over the entire bagged interval recovered from drilling activities—sampling areas within the 2-foot interval will be targeted for the interval most affected by petroleum hydrocarbons.

## 3.3 Soil Sample Collection Decontamination Procedures

Field sampling equipment used to collect SB soil samples (e.g., stainless-steel bowl and spoons, etc.) will be decontaminated by washing with a deionized (DI) water/Alconox/DI water rinse. All field sampling equipment will be decontaminated before initiating sampling activities, between sampling locations, and following sampling activity completion. Drilling equipment that directly contacts soil samples will be decontaminated after each exploration. Decontamination equipment needed for drilling equipment will be provided by the drilling subcontractor and will be determined before field mobilization.

# Section 4: Sample Handling and Custody Documentation

Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analyses, to the time sample results are reported. Field logbook entries will be completed for each location and each sample collected.

## 4.1 Sample Handling

To control sample integrity during transit to the laboratory and before analysis, established preservation and storage measures will be taken. Sample containers will be labeled with the client name, project number, sample number, sampling date and time, required analyses, and initials of the individual who collected the sample. Samples will be placed into laboratory-supplied and labeled sample containers, with the lid tightly sealed, and placed in a cooler on ice. All samples, field duplicate samples, and equipment blank samples will be immediately placed into a cooler with ice and kept at or below 4 degrees Celsius (°C) until custody is transferred to Pace. A fresh set of nitrile gloves will be donned before collecting each sample.

The field manager will check all container labels, COC form entries, and field notebook entries for completeness and accuracy at the end of each sampling day.

## 4.2 Sample Nomenclature and QA/QC Sampling

The sample number format will be "sample location number-sample depth-month/day/year of collection." For example, a sample collected from SB-07 at 20.8 feet bgs on April 6, 2016, will be labeled **SB-07-20.8-040616**. Other information that will be included on the bottle label include date, time, analyses, and initials of the sampler. In this way, every soil and QC sample have a unique identifier (ID), and the collection date is apparent from the sample number.

### 4.2.1 Field Duplicate Samples

One field duplicate soil sample will be collected for every 10 soil samples collected; 1 duplicate sample will be collected for every 5 groundwater samples collected. Samples will be collected immediately following collecting the primary sample. The location of each field duplicate will be recorded in the field and sampling logs. Field duplicates (soil and groundwater) will be analyzed for the same constituents as the primary samples.

A duplicate soil sample collected from the example SB-07 location discussed above will be labeled DUP-040616.

### 4.2.2 Equipment Blank Samples

Equipment rinsate blanks will be collected to assess the decontamination procedures for any non-disposable sampling equipment. Samples will be collected at the end of the day. Following equipment decontamination procedures, equipment blank samples will be collected by pouring distilled water over and/or through the decontaminated equipment directly into the sample container. Equipment blanks will be analyzed for the same constituents as the primary samples.

An equipment rinsate sample that is collected following the examples above will be named **EB-040616**. The **EB** at the beginning of the name signifies that it is an equipment blank sample.

### 4.2.3 Field Blank Samples

Groundwater field blanks will be collected when performing groundwater sampling to assess potential VOC introduction. One field blank will be collected per day; field blanks will be collected at the location of one of the primary samples by pouring distilled water directly into the sampling container.

A field blank sample will be assigned a sample ID with a monitoring well ID that field staff **know** does not exist, **but the laboratory does not**. For example, if only six monitoring wells will be installed, a viable field blank name for a sample collected on April 6, 2016, will be **MW-7-040616**. The name of field blank samples will be recorded in the field notebook.

### 4.2.4 Trip Blanks

Pace will provide trip blanks to evaluate the potential for contamination resulting from laboratory-prepared sample containers and sample transport. Trip blanks will be analyzed at a frequency of one per sample shipment.

A trip blank sample associated with the examples above will be named **TB-040616**. The **TB** at the beginning of the name signifies that it is a trip blank sample.

## 4.3 Sample Chain of Custody

COC procedures will be strictly followed to provide an accurate written record of sample possession from the time it is collected in the field through laboratory analyses. Adequate sample custody will be achieved by means of approved field and analytical documentation, including the COC record, which is first completed by the sampler and then signed by individuals who accept custody. A sample will be considered in custody if it meets one or more of the following criteria:

- In someone's physical possession
- In someone's view
- Locked up or secured in a locked container/vehicle or otherwise sealed with a custody seal so that any tampering is evident
- Kept in a secure area, restricted to authorized personnel only

The laboratory will provide sufficient copies of blank COC forms. All sample information (e.g., sample date/time, sample matrix, number of containers, etc.) including all required analyses, will be logged onto a COC form before formal sample container transfer to the analytical laboratory. For any instance when sample possession is transferred, individuals relinquishing/receiving the samples will respectively sign, date, and note the time of transfer on the COC form. This form documents the transfer of custody from the sampler to the laboratory.

The person responsible for transferring/transporting the samples to the laboratory will complete and sign the COC form, keeping a copy for future reference. The sampler will place the original form in a clear plastic bag inside the sample cooler with the samples. One COC form will be completed and placed inside each individual cooler.

## 4.4 Sample Preservation

Samples that require field preservation will be placed into laboratory-supplied pre-preserved sample jars. Immediately after filling the sample jars, they will be placed in the appropriate cooler with a sufficient number of ice packs (or crushed ice) to keep cool through transport to the laboratory. All samples will be preserved by cooling to 4°C and following analyses.

## 4.5 Sample Transport and Shipment

Table 1 summarizes sample size requirements, container type, preservation method, and holding times for soil analytes. Technical field staff will be responsible for all sample tracking and custody procedures in the field. The field manager will be responsible for final sample inventory and will maintain sample custody documentation. At the end of each day, and before transfer, COC form entries will be made for all samples. Each sample cooler will be accompanied by COC forms; copies of all forms will be retained and included as appendices to QA/QC reports to management.

Before transporting and/or shipping, field staff will wrap and securely pack the cooler with ice packs (or crushed ice). The original, signed COC forms will be transferred with the cooler. Samples will be delivered daily to the laboratory under custody following sampling activity completion, or at maximum every other day.

| Table 2. Sample Analysis Methods | | | | |
|---|---|---|---|---|
| Medium | Method | Sample Container | Number of Containers | Preservative |
| Soil | NWTPH-Gx | TBD | TBD | TBD |
| Soil | BTEX, N-Hexane, MTBE, Ethylene Dibromide, Ethylene Dichloride, and Ethanol (EPA Method 8260) | TBD | TBD | TBD |
| Soil | Naphthalene, 1-Methyl Naphthalene, and 2 Methyl Naphthalene (EPA Method 8270) | TBD | TBD | TBD |
| Soil | Lead (EPA Method 6010) | TBD | TBD | TBD |

*TBD = to be determined (by Pace before shipping bottle order).*

## 4.6 Sample Receipt

The laboratory's designated sample custodian will accept sample custody and verify that the COC matches the sample received. Pace staff will properly sign the COC form upon receipt and note questions or observations concerning sample integrity on the COC forms. Any notification provided by Pace that discrepancies exist between COC forms and the sample shipment upon receipt will be immediately relayed to the BC project manager. Pace representatives will specifically note any coolers that do not contain ice packs or are not sufficiently cold upon receipt.

# Section 5: Additional Field Documentation

Field documentation will consist of logbook entries that include the following information:

- Date and time of activities
- Location of activities
- Site and weather conditions
- Personnel present
- Subcontractors present
- Regulatory agency representatives present
- Level of health and safety protection
- Sampling methodology and information
- Sample locations
- Chronological description of field activities
- Manufacturer, model, serial number, and most recent calibration date and time of any field instruments used
- Description of any conditions that may potentially affect sample results
- Records of any deviation from the work plan (including a clear description of the reason for the deviation)
- Records of telephone conversations
- Records of decontamination procedures

Sampling logs will include a record of the source of samples, sample IDs, sample date and time, sample container types and preservatives, and lot numbers for bottles and preservatives.

Sample containers will be labeled with a unique sample ID, date and time of sample collection, Site name, and the BC job number.

COC forms will be completed on site and will include the sample ID, sample date and time, sample matrix, number of containers, and requested analyses. COC forms will be signed and dated by the individuals who are relinquishing and receiving samples.

# Section 6: QA Objective of Laboratory Analysis Program

Collected soil samples will be analyzed for the following constituent groups using the methods presented below (see Section 7.2). Chemical analyses will be performed by Pace.

## 6.1 Contract Laboratory Requirements

The contract laboratory is expected to meet the following minimum requirements to complete chemical analyses:

- Adhere to the methods outlined in this QAPP, including those referenced for each analytical procedure
- Deliver fax, hard-copy, and electronic data as specified
- Meet reporting requirements for deliverables
- Meet turnaround times for deliverables
- Implement QA/QC procedures, including QAPP data quality requirements, laboratory QA requirements, and performance evaluation testing requirements
- Allow laboratory and data audits to be performed, if deemed necessary

## 6.2 Chemical Analyses

Collected soil samples will be analyzed for petroleum hydrocarbons soil contamination by analyzing for the following constituents using the methods indicated below:

- Gasoline-range petroleum hydrocarbons by NWTPH-Gx
- BTEX by EPA Method 8260B

### 6.2.1 Reporting Limits

The analytical methods identified in this SAP/QAPP result in the lowest analytically achievable method detection limits and reporting limits, or practical quantitation limits (PQLs). Reporting limits are goals only, insofar as instances may arise when high sample concentrations, sample non-homogeneity, or matrix interferences preclude achieving the desired reporting limit and associated QC criteria. In such instances, the laboratory will report the reason for any deviation from these reporting limits.

### 6.2.2 Sample Archival

Remaining soil sample volumes will be archived in a laboratory freezer if additional analysis is needed.

# Section 7: Data Reduction, Validation, and Management

Initial data reduction, evaluation, and reporting at the laboratory will be carried out as described in the appropriate analytical protocols and the laboratory's QA manual. QC data resulting from methods and procedures described in this document will also be reported.

## 7.1 Data Reduction and Laboratory Reporting

The laboratory will be responsible for internal checks on data reporting and will correct errors identified during the QA review. Close contact will be maintained with the laboratories to resolve any QC problems in a timely manner. The analytical laboratories will be required, where applicable, to report the following:

- **Project/case narrative:** This summary (in the form of a cover letter) will any discuss problems encountered during any aspect of analysis. This summary should discuss, but not be limited to, QC, sample transport/shipment, sample storage, and analytical difficulties. Any problems encountered (actual or perceived) and their resolutions will be documented in as much detail as necessary.
- **Sample IDs:** Records will be produced that clearly match all blind duplicate QA samples with laboratory sample IDs.
- **COC records:** Legible copies of the COC forms will be provided as part of the data package. This documentation will include the time of receipt and condition of each sample received by the laboratory. Additional internal sample custody tracking by the laboratory will also be documented.
- **Sample results:** The data package will summarize the results for each sample analyzed. The summary will include the following information when applicable:
  - Field sample ID code and the corresponding laboratory ID code:
    - Sample matrix
    - Date of sample extraction
    - Date and time of analysis
    - Weight and/or volume used for analysis
    - Final dilution volumes or concentration factor for the sample
    - Percent moisture in solid samples
    - Identification of the instrument used for analysis
  - Method reporting and quantitation limits:
    - Analytical results reported with reporting units identified
    - All data qualifiers and definitions
    - Electronic data deliverables (EDDs)
- **QA/QC summaries:** This section will summarize all QA/QC procedure results. Each QA/QC sample analysis will be documented with the same information required for the sample results (see above). No recovery or blank corrections will be made by the laboratory. The required summaries are listed below; additional information may be requested.
- **Method blank analysis:** The method blank analyses associated with each sample and the concentration of all compounds of interest identified in these blanks will be reported.
- **Surrogate spike recovery:** All surrogate spike recovery data for organic compounds will be reported. The name and concentration of all compounds added, percent recoveries, and range of recoveries will be listed.

- **Matrix spike recovery:** All matrix spike recovery data for metals and organic compounds will be reported. The name and concentration of all compounds added, percent recoveries, and range of recoveries will be listed. The relative percent difference (RPD) for all duplicate analyses will be reported.
- **Matrix duplicate:** The RPD for all matrix duplicate analyses will be reported.
- **Blind duplicates:** Blind duplicates will be reported in the same format as any other sample. RPDs will be calculated for duplicate samples and evaluated as part of the data quality review.

## 7.2 Data Validation

BC will review laboratory reports for internal consistency, transmittal errors, laboratory protocols, and adherence to the quality requirements specified in this SAP/QAPP. BC will validate all analytical data. A Level II Data Quality Review (Summary Validation) will be performed on all the analytical data.

A Level II Data Quality Review (Summary Validation) includes the following:

- Evaluate package completeness
- Verify that sample numbers and analyses match those requested on the COC form
- Review method-specified preservation and sample holding times
- Verify that the required detection and reporting limits have been achieved
- Verify that the field duplicates, matrix spikes/matrix spike duplicates, and laboratory control samples were analyzed at the proper frequency
- Verify analytical precision and accuracy via replicate analysis and analyte recoveries
- Verify that the surrogate compound analyses were performed and meet QC criteria
- Verify that the laboratory method blanks are free of contaminants
- Data validation, which will be based on the QC criteria as recommended in the methods identified in this SAP/QAPP

Data usability, conformance with the quality requirements, and any deviations that may have affected data quality, as well as the basis of application of qualifiers, will be included in final data reporting. Any required corrective actions based on evaluating the analytical data will be determined by the TestAmerica project manager and data validator in consultation with the BC QA manager, and may include data qualification or rejection.

## 7.3 Data Management

BC will maintain a custom database to store and query environmental chemistry results. This database will be used during the hydrocarbon characterization activities and data can be queried as needed. Analytical laboratory data will be received in an EDD format suitable for import into the database. Both laboratory data qualifiers and external data validation qualifiers are stored in the database.

Data will be mapped in ArcGIS™ as needed. Specialized queries may be written to assist data analyses. Queried data will be tabulated in Excel spreadsheet format. Excel spreadsheets will be formatted to be compatible with data export to comma-separated values (CSV) format. All numerical data (e.g., coordinates, concentration values, distances, and depths) will be entered into the Excel spreadsheet as numbers.

# Section 8: Laboratory Audits and Corrective Actions

This section describes laboratory and field performance audits and corrective action procedures.

## 8.1 Laboratory and Field Performance Audits

Laboratory and field performance audits comprise onsite reviews of QA systems and equipment for sampling, calibration, and measurement. Laboratory audits will not be conducted as part of this study; however, all laboratory audit reports will be made available to the project QA coordinator upon request. The laboratory is required to have written procedures addressing internal QA/QC and must ensure that personnel engaged in all sample logging and analyses tasks have appropriate training.

The laboratory will provide written details of all method modifications planned for BC's review as part of the audit process.

## 8.2 Corrective Actions for Field Sampling

The BC field QA officer will be responsible for correcting sampling field errors or documenting equipment malfunctions during the field sampling effort. The BC QA officer will be responsible for resolving situations in the field that may result in noncompliance with this SAP/QAPP. All corrective measures will be immediately documented in the field logbook.

## 8.3 Corrective Actions for Laboratory Analyses

The laboratory is required to comply with its standard operating procedures and EPA's analytical method requirements as specified in this SAP/QAPP. The Pace project manager will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this SAP/QAPP. All laboratory personnel will be responsible for reporting problems that may compromise data quality.

If any QC sample exceeds the project-specified control limits, the analyst will identify and correct the anomaly before continuing with the sample analysis. The analyst will document the corrective action taken in a memorandum submitted to the BC QA manager. A narrative describing the anomaly, steps taken to identify and correct the anomaly, and relevant sample batch treatment (i.e., recalculation, reanalysis, and/or re-extraction) will be submitted with the data package.

# Section 9: Waste Management

Except for waste personal protective equipment (PPE), all investigation-derived waste (IDW) generated during this investigation will be containerized, sealed, labeled, and retained on site in Washington State Department of Transportation (WSDOT)-approved 55-gallon drums. The drums will be labeled as non-hazardous waste until waste characterization is conducted, confirming the waste material classification. All waste derived during hydrocarbon characterization will be disposed of per appropriate state and federal regulations. Soils will be transported in the 55-gallon drums to a licensed disposal facility for direct land disposal by a licensed waste hauler.

As drums containing soil drill cuttings and decontamination water are generated, they will be placed in a secure area, owned by the CoV. The drums will then be stored until waste characterization is complete, then manifested and transported by NRC to an appropriate disposal facility depending on results of the hydrocarbon characterization analytical data.

IDW drum labels will include the following information:

- Drum contents and source (e.g., drill cuttings SB-1, decontamination water)
- Date generated
- Generator contact information and telephone number
- Waste classification (e.g., non-hazardous)

# Section 10: Data Reporting

A future hydrocarbon characterization data report will document activities associated with collecting, transporting and performing chemical analysis on soil samples for transmittal to Ecology. The report will include the following:

- Summary of the purpose and goals of the investigation.
- Summary of the field sampling and laboratory analytical procedures.
- A general vicinity map showing the Site location, and a sampling location map. Coordinates (e.g., latitude and longitude and state plane coordinates) for the sampling locations will be reported in an accompanying table.
- Data tables for all media summarizing the chemical and conventional analytical results, forensic results, and pertinent QA/QC data. The tables will include sample location numbers, sample IDs, dates of sample collection, depth of sample collection, and whether the sample was a duplicate or other QC sample. The data will be compared to MTCA-A cleanup levels.
- QA reports and laboratory data reports as appendices or attachments.
- Copies of field logs and COC forms as appendices or attachments.

The report will also include a cover letter describing the submittal and specifying the requested department action or response. The report will be stamped and signed by a Professional Geologist and licensed Hydrogeologist registered in the state of Washington. KAG understands that all sampling data must be submitted to Ecology in both written and electronic formats, per Washington Administrative Code 173-340-840 and Ecology policy 840.

# References

Brown and Caldwell. 2018. *Summary for May 2018 Tanker Spill Third Phase Remedial Investigation (Sampling) and Remedial Action Implementation (Construction) at NE 18th Street, Vancouver, Washington*. Correspondence to Marlin Zechman, XL Insurance Company, Ltd plc. July 30.

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