DATA GAP INVESTIGATION WORK PLAN

NORTH CASCADE FORD PROPERTY
SEDRO-WOOLLEY, WASHINGTON

Prepared for

VSF PROPERTIES, LLC

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Prepared by

Maul Foster & Alongi, Inc.

1329 N State Street, Suite 301, Bellingham WA 98225

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ALONGI

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The material and data in this work plan were prepared under the supervision and direction of the undersigned.

MAUL FOSTER & ALONGI, INC.

Carolyn Wise, GIT
Staff Geologist

Heather Good, LHG
Project Hydrogeologist

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TABLES AND ILLUSTRATIONS

FOLLOWING WORK PLAN:

ACRONYMS AND ABBREVIATIONS

AOC	area of concern
AST	aboveground storage tank
bgs	below ground surface
BNSF	Burlington Northern Santa Fe Railway Company
COC	chemical of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSM	conceptual site model
CUL	cleanup level
Ecology	Washington State Department of Ecology
ESA	environmental site assessment
GPR	ground penetrating radar
MFA	Maul Foster & Alongi, Inc.
MTCA	Model Toxics Control Act
NAPL	nonaqueous-phase liquid
NFA	No Further Action
PAH	polycyclic aromatic hydrocarbon
Property	VSF-owned North Cascade Ford property at 116 West Ferry Street, Sedro-Woolley, Washington
RI/FS	remedial investigation and feasibility study
Site	North Cascade Ford site
TPH	total petroleum hydrocarbons
UST	underground storage tank
VCP	Voluntary Cleanup Program
VOC	volatile organic compound
VSF	VSF Properties, LLC

1 INTRODUCTION

On behalf of VSF Properties, LLC (VSF), Maul Foster & Alongi, Inc. (MFA) has prepared this work plan for supplemental environmental investigation to address data gaps at the North Cascade Ford site (the Site) (Washington State Department of Ecology [Ecology] facility site identification number 58313566, cleanup site identification number 12075) (Figure 1-1). The Site includes the North Cascade Ford property located at 116 West Ferry Street in Sedro-Woolley, Washington (the Property), which is owned by VSF, as well as portions of adjacent properties, including a property owned by Burlington Northern Santa Fe Railway Company (BNSF) to the north of the Property (Figure 1-2). This work plan will be submitted to Ecology for review, along with a Voluntary Cleanup Program (VCP) application and a preliminary remedial investigation and feasibility study (RI/FS), as requested by Ecology. This work is being conducted in support of property-specific No Further Action (NFA) determinations under Ecology's VCP for each parcel included in the Property.

BNSF has allowed access to its property for limited investigation activities, including temporary borings for soil and groundwater sample collection and analysis for only those chemicals of concern (COCs) that were detected above cleanup levels (CULs) on the Property during the preliminary RI/FS (MFA, 2015). Sample collection and analysis for COCs detected above CULs on only the BNSF property portion of the Site are not allowed under the work plan approved by BNSF as part of the access negotiations. Therefore, under the current access agreement, the nature and extent of all COCs associated with the Site might not be adequately characterized. Based on this limitation, the RI/FS is being conducted in support of property-specific NFA determinations for each parcel of the Property. This work plan addresses data gaps and recommended additional data collection in support of the preliminary cleanup options developed in the preliminary RI/FS (MFA, 2015). MFA anticipates that, following completion of the supplemental investigation activities proposed in this work plan, BNSF will allow access to its property for focused cleanup activities under the access agreement executed with MFA.

1.1 Regulatory Framework

The RI/FS conclusions will be used to support cleanup of the Property with the goal of obtaining property-specific NFA determinations under Ecology's VCP for each parcel included in the Property. The supplemental investigation activities proposed in this work plan will provide the information needed to complete the RI/FS consistent with guidance put forth in the Model Toxics Control Act (MTCA) (Washington Administrative Code 173-340).

1.2 Purpose and Objectives

As discussed above, BNSF has granted MFA limited access to its property located to the immediate north of the Property. Investigation activities on the BNSF property are restricted to the sample locations and analyses included in the work plan approved by BNSF during access negotiations

(MFA, 2014). In this work plan, MFA proposes to conduct supplemental RI activities on the Property, on the BNSF property (in accordance with the BNSF-approved work plan), and at selected locations on other adjoining properties not owned by VSF or BNSF (access permitting). The supplemental investigation activities proposed in this work plan will be conducted in support of the selection and implementation of cleanup activities on the Property and the BNSF property in pursuit of property-specific NFA determinations for each parcel included in the Property.

The purpose of this work plan is to provide a scope of work and methodology for conducting supplemental RI activities, as recommended in the preliminary RI/FS (MFA, 2015), needed to finalize the RI/FS for the purposes of pursuing property-specific NFA determinations and as needed to select and design remedial actions on the Property and the BNSF property. The activities outlined in this work plan are also designed to meet the following specific project objectives:

- Develop data quality objectives for field investigation as well as sample collection and laboratory analytical activities
- Generate sufficient data to address data gaps and adequately characterize the nature and extent of environmental contamination on the Property for the following purposes:
  - Further developing the preliminary conceptual site model (CSM)
  - In support of property-specific NFA determinations, evaluating potential risk to current and reasonably likely future human and ecological receptors from COCs originating on the Property
  - Further defining the subsurface geochemical conditions on the Property to evaluate potential cleanup options

2 BACKGROUND

The following discussion is a summary of information provided in the preliminary RI/FS (MFA, 2015).

2.1 Property Overview

The physical address for the Property is 116 West Ferry Street in Sedro-Woolley, Washington (see Figure 1-1). The Property comprises nine tax parcels and is bisected by West Ferry Street (see Figure 1-2); two of the parcels share the same parcel identification number (P109239), but are separate parcels that are divided by the West Ferry Street right-of-way. The Property is bordered by an inactive rail line, Eastern Avenue, and commercial properties to the east. The parcels north of West Ferry Street are bordered by an active BNSF-owned rail line and an industrial property to the north and a gasoline station and automobile parts store to the west. The parcels south of West Ferry Street are bordered by Rita Street to the west, Woodworth Street to the south, and an electrical substation and residential properties to the west and south. The Property is zoned for retail trade (automotive, marine craft, aircraft, and accessories) and is bordered by single- and multi-family housing, retail, and industrial land uses.

The Property is located in section 24 of township 35 north and range 4 east of the Willamette Meridian. The Property parcels cover approximately 3.5 acres. An automobile sales and service building ("auto repair shop") is located on the northern half of the Property and a small loan services building is located on the southern half of the Property.

Details concerning the Property, including history, physical conditions, previous investigations, and the CSM, are included in the preliminary RI/FS (MFA, 2015).

2.2 Previous Environmental Investigations

Phase I environmental site assessments (ESAs) were conducted at the Property by GeoEngineers, Inc. (GeoEngineers, 2001) and Whatcom Environmental Services (Whatcom Environmental, 2011a). Following on the Phase I ESA findings, a Phase II ESA (Whatcom Environmental, 2011b) and subsurface investigations and groundwater monitoring (completed by MFA; MFA, 2015) have been conducted at the Property to assess potential environmental impacts associated with recognized environmental conditions identified during the Phase I ESAs, as well as additional features of concern identified by MFA, and to characterize the nature and extent of confirmed environmental impacts. Previous environmental investigations, as well as soil and groundwater samples collected by MFA, are discussed in the preliminary RI/FS (MFA, 2015). The following sections of this work plan summarize investigation results presented in the preliminary RI/FS.

2.3 Geology and Hydrogeology

Soil beneath the Property was identified as primarily fill material (composed of gravelly sand) to approximately 1.5 feet below ground surface (bgs), underlain by native soils consisting of well to poorly sorted sand and cohesive silty clayey sand and clayey silt. The composition of the native soils varied across the Property. Groundwater was typically encountered between approximately 5 and 10 feet bgs and is generally present in an unconfined water-bearing zone. Groundwater flow at the Property is primarily toward the southeast; however, flow toward the northeast was observed during the groundwater monitoring event conducted in October 2012.

Groundwater elevations were approximately 1 to 2 feet lower in all three monitoring wells during the October 2012 event than during any of the seven other monitoring events conducted since May 2012. Given the variation in soil type observed across the Property and the cohesive nature of the native soils, it is possible that groundwater infiltration was variable between the monitoring well locations during this low-water event and that the groundwater elevations measured during the event were not in hydrostatic equilibrium and therefore were not representative of a continuous water table surface.

2.4 Areas of Concern

Analytical results from the Phase II ESA (Whatcom Environmental, 2011b) and the MFA investigation work (MFA, 2015) were compared to MTCA Method A CULs, and preliminary indicator hazardous substances were selected. CUL exceedances were detected in soil and groundwater in four distinct and separate areas on the Property and the adjoining BNSF property. Therefore, the Site (i.e., the full extent of contamination) was divided into four areas of concern (AOCs) based on detected CUL exceedances and associated source areas (see Figure 2-1). AOCs are discussed below.

AOCs are based on the current understanding of Site conditions, but as discussed in the preliminary RI/FS (MFA, 2015), the extent of CUL exceedances in the AOCs has not been fully delineated and data gaps remain. Data gaps are discussed in Section 2.6 of this work plan.

AOC 1: Auto Repair Shop—Soil and groundwater contamination, including petroleum-related compounds, nonaqueous-phase liquid (NAPL), volatile organic compounds (VOCs), noncarcinogenic polycyclic aromatic hydrocarbons (PAHs), and carcinogenic polycyclic aromatic hydrocarbons (cPAHs), is present at the north end of the Property and is potentially associated with a waste oil spill from drums formerly stored on the BNSF right-of-way and potential releases from a former oil-containing aboveground storage tank (AST) and an active 500-gallon waste oil AST located at the north end of the auto repair shop. In addition, a closed-in-place unleaded gasoline underground storage tank (UST) may also be present in this AOC and may have associated soil and/or groundwater impacts. Groundwater contamination has been confirmed on the BNSF property, and groundwater consistently flows toward the southeast, from the BNSF property toward the Property; therefore, there is the potential for contamination on the BNSF property to migrate onto the Property in this AOC.

AOC 2: Former USTs—Heavy oils (i.e., the sum of the diesel-range and motor-oil-range [i.e., lube-oil-range] total petroleum hydrocarbon [TPH] concentrations) contamination is present in groundwater in an area of the Property to the southeast of the auto repair shop and is associated with a former heating oil UST. Groundwater contamination in this AOC may extend onto the West Ferry Street right-of-way to the south. Groundwater samples were collected from monitoring well MW02 (see Figure 2-1) during quarterly monitoring events conducted in 2014. During those events, heavy-oil concentrations were detected above the MTCA Method A CUL, but concentrations may be decreasing with time (MFA, 2015). Contaminant concentrations in soil in this AOC do not exceed MTCA Method A CULs.

AOC 3: Former Coal Storage Sheds—Coal and coal-related contamination are present in soil along the eastern perimeter of the Property associated with former coal storage sheds. An approximately 2-foot-thick layer of coal with associated cPAH, PAH, and metals (arsenic, cadmium, and lead) concentrations above MTCA Method A CULs is present in subsurface, shallow, unsaturated soil along the eastern Property boundary and likely extends onto the adjoining BNSF property to the north as well as the adjoining properties to the east and south and the West Ferry Street right-of-way (see Figure 2-1). Concentrations of contaminants leaching out of the coal into groundwater do not exceed MTCA Method A CULs and CUL exceedances were detected only in coal-containing soil.

AOC 4: Former Gasoline Station—Heavy-oil contamination is present in groundwater in the western portion of the Property and is associated with a former gasoline station. Groundwater contamination in this AOC may extend onto the West Ferry Street right-of-way to the south. Groundwater samples were collected from monitoring well MW03 (see Figure 2-1) during quarterly monitoring events conducted in 2014. Heavy-oil concentrations were detected above the MTCA Method A CUL during two of those events, and concentrations appear to be relatively stable with time (MFA, 2015). Contaminant concentrations in soil in this AOC do not exceed MTCA Method A CULs.

2.5 Preliminary Cleanup Option Selection

MFA completed a preliminary FS and evaluation of cleanup options for each AOC (MFA, 2015). Additional site characterization, as discussed in the next sections of this work plan, and further evaluation and analysis of cleanup options are recommended before selection of a final remedy. However, based on the current understanding of site conditions, MFA recommended preliminary cleanup options for each AOC, as summarized below:

AOC 1: Auto Repair Shop—Soil excavation and off-site disposal with in situ bioremediation-amended backfill and quarterly groundwater monitoring in the vicinity to verify the effectiveness of the treatment.

AOC 2: Former USTs—In situ bioremediation with groundwater monitoring in the vicinity to verify the effectiveness of the treatment.

AOC 3: Former Coal Storage Sheds—Excavation and off-site disposal of coal-impacted soil on the Property.

AOC 4: Former Gasoline Station—In situ bioremediation with groundwater monitoring in the vicinity to verify the effectiveness of the treatment.

2.6 Data Gaps

Additional information is needed to further characterize the nature and extent of contamination and to better understand potential exposure risks associated with contamination originating on the Property in order to select and design remedial actions in support of property-specific NFA determinations. Data gaps were identified in the preliminary RI/FS (MFA, 2015) and are summarized by AOC below. In addition to those data gaps identified in the preliminary RI/FS, additional data needs to inform remedy selection and design are listed below. A proposed scope of work to address these data gaps is discussed in Section 3 of this work plan.

AOC 1: Auto Repair Shop

- Estimation of the chemical mass in saturated soil for possible in situ treatment

- Additional characterization of the nature and distribution of subsurface NAPL
- Additional characterization of the subsurface geochemical environment, which influences chemical fate and transport and the effectiveness of in situ bioremediation
- Potential presence of a closed-in-place, former unleaded gasoline UST to the northeast of the auto repair shop and associated, localized soil and/or groundwater impacts
- Further delineation of the extent of CUL exceedances in soil and groundwater, including:
  - Horizontal and vertical extent of cPAHs, gasoline-range TPH, and heavy oils in soil; and heavy oils in groundwater on the VSF and BNSF properties
  - Horizontal and extent of gasoline-range TPH in groundwater on the Property
  - Potential presence of VOCs in soil and groundwater on the Property downgradient of GP01

AOC 2: Former USTs

- Estimation of the chemical mass in saturated soil for possible in situ treatment
- Horizontal extent of heavy oils in groundwater southeast of MW02 on the Property and in the city right-of-way
- Additional characterization of the subsurface geochemical environment, which influences chemical fate and transport and the effectiveness of in situ bioremediation
- Potential presence of closed-in-place, former gasoline and heating oil USTs and associated, localized soil and/or groundwater impacts

AOC 3: Former Coal Storage Sheds

- CUL exceedances in this AOC were determined to be associated with coal material in soil; therefore, further delineation of the extent of coal material in soil is needed in the following areas:
  - For the purposes of property-specific NFA determinations:
    * Horizontal extent to the west of former borings GP30, GP31, and GP32 on the portion of the Property south of West Ferry Street
    * Horizontal extent to the west of former borings GP24 and GP25 on the portion of the Property north of West Ferry Street
  - For the purposes of further characterizing selected portions of the Site outside the boundaries of the Property (access permitting):
    * Horizontal extent to the west and east of former borings GP26 and B-9 on the portion of the Property south of West Ferry Street

* Horizontal extent to the east of former borings GP05 and GP22 on the portion of the Property north of West Ferry Street

AOC 4: Former Gasoline Station

- Estimation of the chemical mass in saturated soil for possible in situ treatment
- Further delineation of the horizontal extent of heavy-oil CUL exceedances in groundwater southeast of monitoring well MW03
- Additional characterization of the subsurface geochemical environment, which influences chemical fate and transport and the effectiveness of in situ bioremediation
- Potential presence of an abandoned UST and associated, localized soil and/or groundwater impacts

3 SCOPE OF WORK

MFA will conduct a subsurface investigation at the Property to address the data gaps identified in the previous section. Investigation activities will be completed in accordance with the Sampling and Analysis Plan included as an appendix to this work plan.

MFA's proposed data gap investigation includes collection and laboratory analysis of environmental samples, measurement of groundwater levels, and measurement of water quality parameters. Soil and groundwater samples will be collected from 36 temporary boreholes and 12 monitoring wells (including the three existing wells) (see Figure 3-1). Borings will be advanced using a direct-push drilling rig. During drilling, a description of soil conditions and visual and olfactory observations will be recorded on boring logs by a project geologist or engineer. Boring locations will be determined using a handheld global positioning system device with sub-meter accuracy. Monitoring well locations and elevations will be surveyed by a licensed surveyor.

Reconnaissance groundwater samples will be collected using temporary well screens set in the boreholes. Five-foot-long well screens will be used and the screen intervals will be selected in the field to span the water table surface in order to collect groundwater from the top of the water table. Proposed monitoring wells will be installed and developed for collection of representative groundwater samples and water level measurements and to allow for additional future monitoring. Ten-foot-long well screens will be installed in order to collect groundwater samples from the water table surface during fluctuating water table conditions.

Soil and groundwater samples will be analyzed for COCs associated with each AOC, as outlined in the attached table. Analytical data and field observations will be used to further characterize the nature and extent of contamination in order to refine the CSM, risk screening, and remedial design.

Samples will be submitted to Analytical Resources, Inc., of Tukwila, Washington, or another Washington State-accredited environmental laboratory, for analysis under standard chain-of-custody procedures. Specific chemical analyses to be performed on each sample are summarized in the attached table. Followup analyses may be requested for some samples, based on the initial analytical results. Prior to sample collection, measurements of field water quality parameters, including dissolved oxygen, pH, redox potential, specific conductance, temperature, and turbidity, will be collected.

The proposed scope of work for each AOC is described below and summarized in the attached table.

3.1 AOC 1: Auto Repair Shop

MFA proposes advancing five temporary borings (proposed borings 1 through 5) and installing four monitoring wells (proposed monitoring wells A through D) on the Property in and near the auto repair shop AOC (see Figure 3-1 and the table). MFA also proposes advancing nine temporary borings (proposed borings 6 through 14) in the portion of this AOC that is located on the adjacent BNSF property, as permitted in the BNSF-approved work plan (MFA, 2014) (see Figure 3-1 and the table).

Borings included in this AOC will be advanced up to a minimum of 15 feet bgs to confirm the presence of a low-permeability layer as well as to collect soil samples from the unsaturated zone (above the water table surface), the capillary zone (the zone immediately above and at the water table surface), and the saturated zone (below the water table surface); and to collect reconnaissance groundwater samples. Soil samples will also be collected from borings to be completed as monitoring wells. During drilling, any NAPL observations and the presence of coal-like material will be recorded on boring logs. Groundwater samples will also be collected from the existing monitoring well (MW01).

In accordance with the BNSF-approved work plan (MFA, 2014), samples collected from borings on the BNSF property will be analyzed only for those COCs that were detected on the Property, which include PAHs and diesel- and gasoline-range TPH in soil and diesel-range TPH in groundwater. Samples collected from borings on the Property will be analyzed for COCs detected on both the Property and the BNSF property, as applicable; these include gasoline- and diesel-range TPH, VOCs, lead, PAHs, and polychlorinated biphenyls (see the table). In addition, selected samples collected on the Property will be analyzed for conventionals (including chloride, nitrate/nitrite, phosphate, sulfate, methane, and total organic carbon) and for total metals (including manganese and dissolved iron) to provide additional information for evaluating the feasibility of an in situ bioremediation treatment. Field water quality measurements may also be used to inform the in situ treatment design.

3.2 AOC 2: Former Underground Storage Tanks

MFA proposes installing three borings (proposed borings 15 through 17) and two monitoring wells (proposed monitoring wells E and F) in and around the former UST AOC (see Figure 3-1). Borings will be advanced up to 15 feet bgs in order to collect soil samples from the unsaturated zone, the capillary zone, and the saturated zone; and to collect reconnaissance groundwater samples. During drilling, any NAPL observations will be recorded on boring logs. Groundwater samples will also be collected from the existing monitoring well (MW02).

Soil samples will be analyzed for gasoline- and diesel-range TPH and VOCs, and groundwater samples will be analyzed for diesel-range TPH. Selected groundwater samples will also be analyzed for conventionals and total metals, and water quality parameters will be measured in the field, similar to AOC 1, for evaluating the feasibility of in situ bioremediation treatment.

3.3 AOC 3: Former Coal Storage Sheds

MFA proposes installing 16 borings (proposed borings 18 through 33) in and around the former coal storage sheds AOC (see Figure 3-1). Borings will be advanced up to 10 feet bgs for the purpose of delineating the vertical and horizontal extent of coal-related contamination. Soil samples will be collected approximately every 5 feet bgs. During drilling, the presence of coal-like material will be recorded on boring logs.

Soil samples will be analyzed for PAHs and metals (arsenic, cadmium, and lead). Given that COCs in this AOC have previously been detected only in samples with visible coal material, samples will be selected for analysis in the field, based on visual observations of coal. Samples not chosen for analysis will be collected but might not be analyzed.

3.4 AOC 4: Former Gasoline Station

MFA will conduct a search of local agencies' records to identify any information related to the former gasoline station located in this AOC as shown in historical Sanborn reports. MFA proposes installing three borings (proposed borings 34 through 36) and three monitoring wells (proposed monitoring wells G through I) in and around the former gasoline station AOC (see Figure 3-1). Borings will be advanced up to 15 feet bgs in order to collect soil samples from the unsaturated zone, the capillary zone, and the saturated zone; and to collect reconnaissance groundwater samples. Soil samples will also be collected from the boring to be completed as a monitoring well located immediately east of existing well MW03. During drilling, any NAPL observations will be recorded on boring logs. Groundwater samples will also be collected from the existing monitoring well (MW03).

Soil samples will be analyzed for gasoline- and diesel-range TPH and VOCs, and groundwater samples will be analyzed for diesel-range TPH. Selected groundwater samples will also be analyzed for conventionals and total metals, and water quality parameters will be measured in the field, similar to AOC 1, for evaluating the feasibility of in situ bioremediation treatment.

3.5 Ground Penetrating Radar Survey

MFA proposes conducting a ground penetrating radar (GPR) survey in the vicinity of AOCs 1, 2, and 4 in order to identify any unknown closed-in-place or abandoned USTs that may have resulted in impacts to the subsurface at the Site. A survey of the northern portion of AOC 3 may be conducted to confirm the presence/absence of a UST associated with a nearby listed site, the Lentz Supply Company site. Boring locations and samples may be added if any USTs are identified during the GPR survey.

4 PROJECT MANAGEMENT PLAN

The following is a description of the roles of key personnel on the project.

Jim Darling will be the project director for MFA and VSF. Mr. Darling will be kept informed of the status of the project and of project activities. He will be provided with data, reports, and other project-related documents prepared by MFA before their submittal to Ecology. He will be responsible for communicating with the property owner, participate in discussions with Ecology, and coordinate on-site activities with the property owner and MFA.

Heather Good will be the project manager for MFA and VSF. Ms. Good will coordinate with project task leaders and will communicate with Mr. Darling. She will be responsible for allocating the resources necessary to ensure that the objectives of the site assessment are met. Ms. Good will also be responsible for technical assistance to assigned staff, as appropriate; assistance with resolution of technical or logistical challenges that may be encountered during the investigation; and assistance with field activities and report writing and review, and will participate in discussions with Ecology at the request of VSF.

Justin Clary will be the principal engineer and will be responsible for managing the overall completion of the RI/FS and for communication of project status to the project manager. Mr. Clary will review data, reports, and other project-related documents prepared by MFA before their submittal to VSF or to Ecology. Mr. Clary will also assist project staff with technical issues.

Andrew Kaparos will be the project engineer and will be responsible for preparing the FS and for communication of project status to the project manager and project director. Mr. Kaparos will assist with field activities, write and review reports, and participate in discussions with Ecology at the request of VSF.

Carolyn Wise will assist with field activities and will write and review reports.

Madi Novak will review the baseline human health and ecological risk screening and will be involved with overall data management. Ms. Novak will participate in discussions with Ecology at the request of VSF.

5 SCHEDULE

The following is the anticipated RI/FS schedule:

Task	Estimated Start Date	Estimated Completion Date
Ecology review of preliminary RI/FS and work plan	December 4, 2015	January 4, 2016
Conduct data gap investigation and data analysis	January 15, 2016	Mid-February 2016
Prepare final RI/FS report	Mid-February 2016	Late February 2016
Ecology review of final RI/FS report	Late February 2016	Late March 2016

The anticipated timeframe for work to be performed is subject to change, based on revisions to the scope of work, potential Property access issues, subcontractor availability, and Ecology review and approval.

LIMITATIONS

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

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

REFERENCES

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Whatcom Environmental. 2011a. Phase I environmental site assessment, North Cascade Ford. Whatcom Environmental Services, Bellingham, Washington. July 15.

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TABLE

Table
Sampling and Analysis Summary
North Cascade Ford Property
VSF Properties, LLC
Sedro-Woolley, Washington

AOC	Location Type	Total No. of Locations	Location ID[1]	Sample Matrix	No. of Locations Sampled for Soil/GW	Total Boring Depth (ft bgs)[2]	Sample Depth(s) (feet bgs)[3]	No. of Soil/GW Samples per Location[4]	No. of Locations for Specified Analytical Suite	Location IDs for Specified Analytical Suite[1]	Total No. of Samples[4]	Analytical Suite: NWTPH-HCID	NWTPH-Gx	NWTPH-Dx	As, Cd, Pb	Pb	VOCs	PAHs	PCBs	Conventionals[5]
AOC 1: Auto Repair Shop	Proposed Boring	5	1 through 5	Soil	5	15	unsaturated zone capillary zone saturated zone	3	5	1 through 5	15	X	X	X	--	X	X	X	X	--
				GW	5		5 to 10	1	2	4, 5	2	--	--	X	--	--	--	--	--	--
									3	1, 2, 3	3	--	X	X	--	--	X	--	--	--
	Proposed Monitoring Well	4	A through D	Soil	4	15	unsaturated zone capillary zone saturated zone	3	1	D	3	--	--	--	X	--	--	X	--	--
									3	A, B, C	9	X	X	X	--	X	X	X	X	--
				GW	4		5 to 15	1	2	C, D	2	--	--	X	--	--	--	--	--	--
									1	B	1	--	X	X	--	--	X	--	--	X
									1	A	1	--	X	X	--	--	X	--	--	--
	Existing Monitoring Well	1	MW01	GW	1	NA	3.5 to 13.5	1	1	MW01	1	--	--	X	--	--	--	--	--	X
	Proposed Boring (BNSF property)	9	6 through 14	Soil	4	15	unsaturated zone capillary zone saturated zone	3	4	6, 8, 9, 11	12	X	X	X	--	--	--	X	--	--
				GW	9		5 to 10	1	9	6 through 14	9	--	--	X	--	--	--	--	--	--
AOC 2: Former USTs	Proposed Boring	3	15, 16, 17	Soil	3	15	unsaturated zone capillary zone saturated zone	3	3	15, 16, 17	9	X	X	X	--	--	X	--	--	--
				GW	3		5 to 10	1	3	15, 16, 17	3	--	--	X	--	--	--	--	--	--
	Proposed Monitoring Well	2	E, F	GW	2	15	5 to 15	1	2	E, F	2	--	--	X	--	--	--	--	--	--
	Existing Monitoring Well	1	MW02	GW	1	NA	4 to 14	1	1	MW02	1	--	--	X	--	--	--	--	--	X
AOC 3: Former Coal Storage Sheds[6]	Proposed Boring	16	18 through 33	Soil	16	10	2 7	2	16	18 through 33	32	--	--	--	X	--	--	X	--	--
AOC 4: Former Gasoline Station	Proposed Boring	3	34, 35, 36	Soil	1	15	unsaturated zone capillary zone saturated zone	3	1	34	3	X	X	X	--	--	X	--	--	--
				GW	3		5 to 10	1	3	34, 35, 36	3	--	--	X	--	--	--	--	--	--
	Proposed Monitoring Well	3	G, H, I	Soil	1	15	unsaturated zone capillary zone saturated zone	3	1	H	3	X	X	X	--	--	X	--	--	--
				GW	3		5 to 15	1	3	G, H, I	3	--	--	X	--	--	--	--	--	--
	Existing Monitoring Well	1	MW03	GW	1	NA	4 to 14	1	1	MW03	1	--	--	X	--	--	--	--	--	X

NOTES:
-- = do not analyze.
X = analyze.
AOC = area of concern.
As = arsenic; analysis by USEPA Method 6020 or 200.8.
bgs = below ground surface.
BNSF = Burlington Northern Santa Fe Railway Company.
Cd = cadmium; analysis by USEPA Method 6020 or 200.8.
GW = groundwater.
NA = not applicable.
No. = number.
NWTPH-Dx = Northwest Total Petroleum Hydrocarbons—Diesel- and Heavy-Oil-Range Organics Method.
NWTPH-Gx = Northwest Total Petroleum Hydrocarbons—Gasoline-Range Organics Method.
NWTPH-HCID = Northwest Total Petroleum Hydrocarbons—Hydrocarbon Identification Method.
PAHs = polycyclic aromatic hydrocarbons; analysis by USEPA Method 8270 selective ion monitoring.
Pb = lead; analysis by USEPA Method 6020 or 200.8.
PCBs = polychlorinated biphenyls; analysis by USEPA Method 8082.
USEPA = U.S. Environmental Protection Agency.
UST = underground storage tank.
VOCs = volatile organic compounds—full list; analyzed by USEPA Method SW8260C

[1]Location IDs designated for proposed borings and monitoring wells are temporary; final location IDs will be assigned in the field.

[2]Some borings may be advanced to greater depths in order to confirm the presence of a low-permeability layer below the unconfined water table surface.

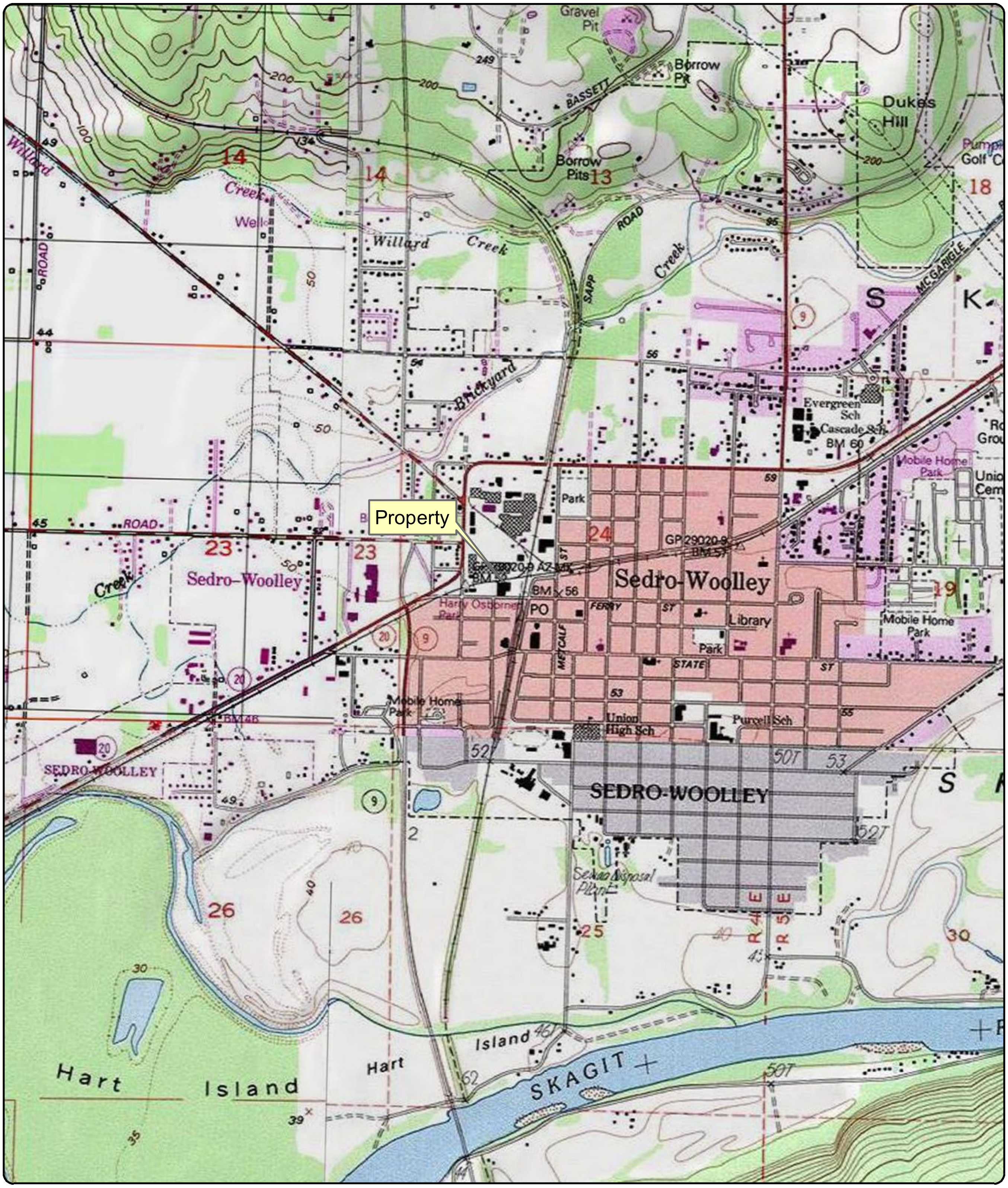
[3]For groundwater samples, the sample depth is the screened interval. For collection of reconnaissance groundwater samples from temporary boreholes, 5-foot-long well screens will be set at the top of the water table, which is expected at approximately 5 feet bgs during the wetter months. However, 10-foot-long well screens will be installed in the new monitoring wells from approximately 5 to 15 feet bgs in order to capture the fluctuating groundwater table. Soil sample depths may change based on observed field conditions.

[4]Field duplicate groundwater samples will also be collected at a frequency of one duplicate sample for every 20 groundwater samples collected per day or a minimum of one sample per day, whichever is greater, and additional soil samples may be collected based on observed field conditions. Other field quality control samples may also be collected and analyzed in accordance with the sampling and analysis plan.

[5]Conventionals include: chloride and nitrate/nitrite by USEPA Method 325.2, total phosphate by USEPA 365.2, orthophosphorus by USEPA Method 4500-P E, sulfate by USEPA Method 375.2, methane by USEPA Method RSK-175, total organic carbon by USEPA Method 9060, total magnesium by USEPA Method 200.8, and dissolved iron by USEPA Method 200.8.

[6]Soil samples will be collected from each boring, but samples will be selected for analysis in the field, based on the visual presence of coal-like material. If coal-like material is not observed, samples may not be analyzed.

FIGURES



Site Address: 116 W Ferry Street, Sedro-Woolley, Washington
Source: US Geological Survey (1990) 7.5-minute topographic quadrangle: Sedro-Woolley North
Section 24, Township 35 North, Range 4 East

Figure 1-1
Property Location

North Cascade Ford Property
Sedro-Woolley, Washington

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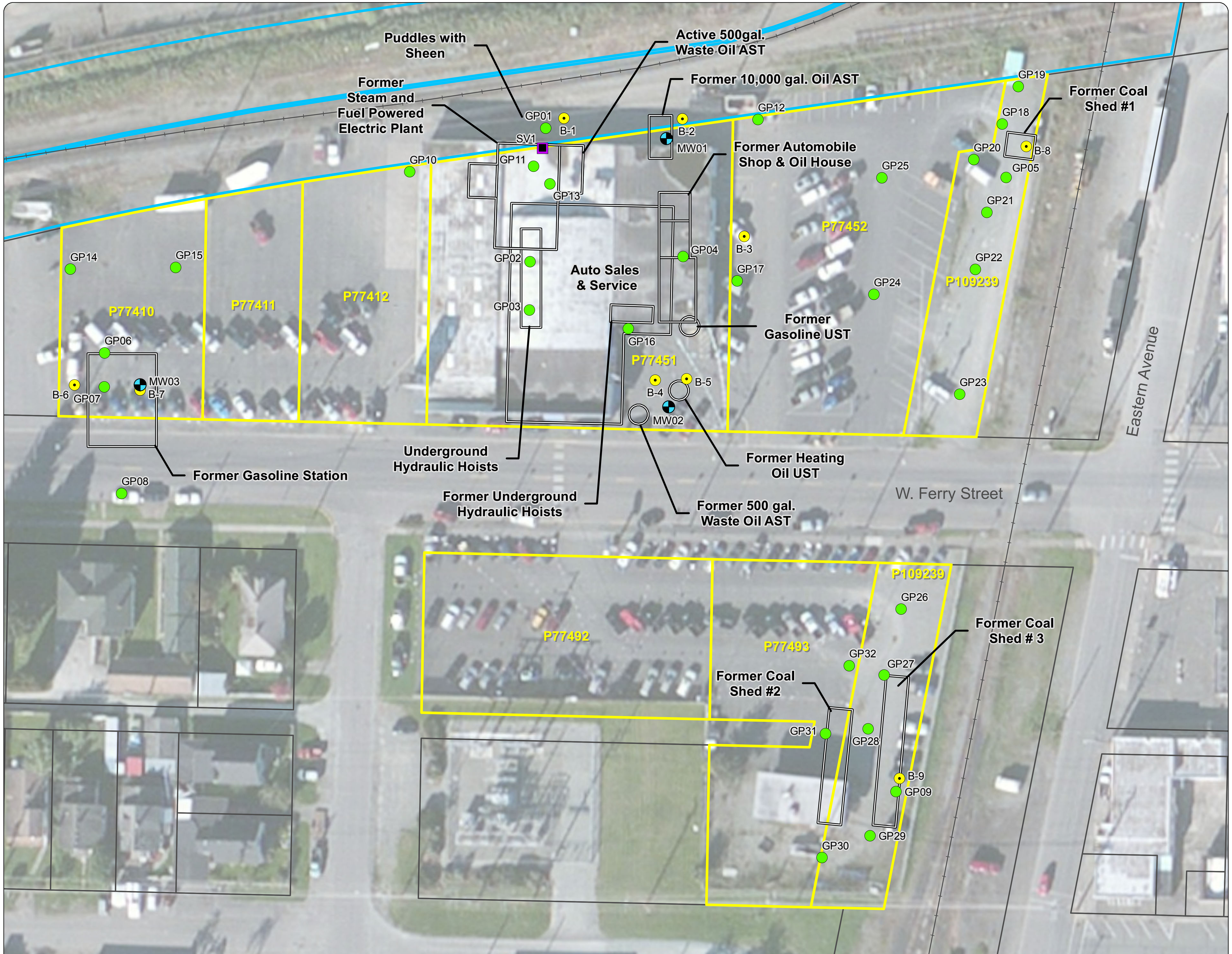
0 750 1,500
Feet

Figure 1-2
Site Features and Sample Locations

North Cascade Ford Property
Sedro-Woolley, Washington



Legend

- Boring Location
- Sub-slab Soil Vapor Probe
- Monitoring Well
- Phase II ESA Boring Location
- Railroad (Approximate)
- Property Parcels and Parcel Number
- BNSF-owned Parcels
- Skagit County Parcels

Notes:
1. All historical feature locations are approximate and shown for relative location reference only.
2. Boring and monitoring well locations were surveyed by Wilson Engineering, LLC on May 15, 2012 using a hand-held global positioning system device.
3. AST = aboveground storage tank.
4. BNSF = Burlington Northern Santa Fe Railway Company.
5. ESA = environmental site assessment.
6. UST = underground storage tank.

0 30 60
Feet

Source: Aerial photograph obtained from ESRI, Inc. ArcGIS Online/Bing Maps; Parcels obtained from Skagit County GIS Department.

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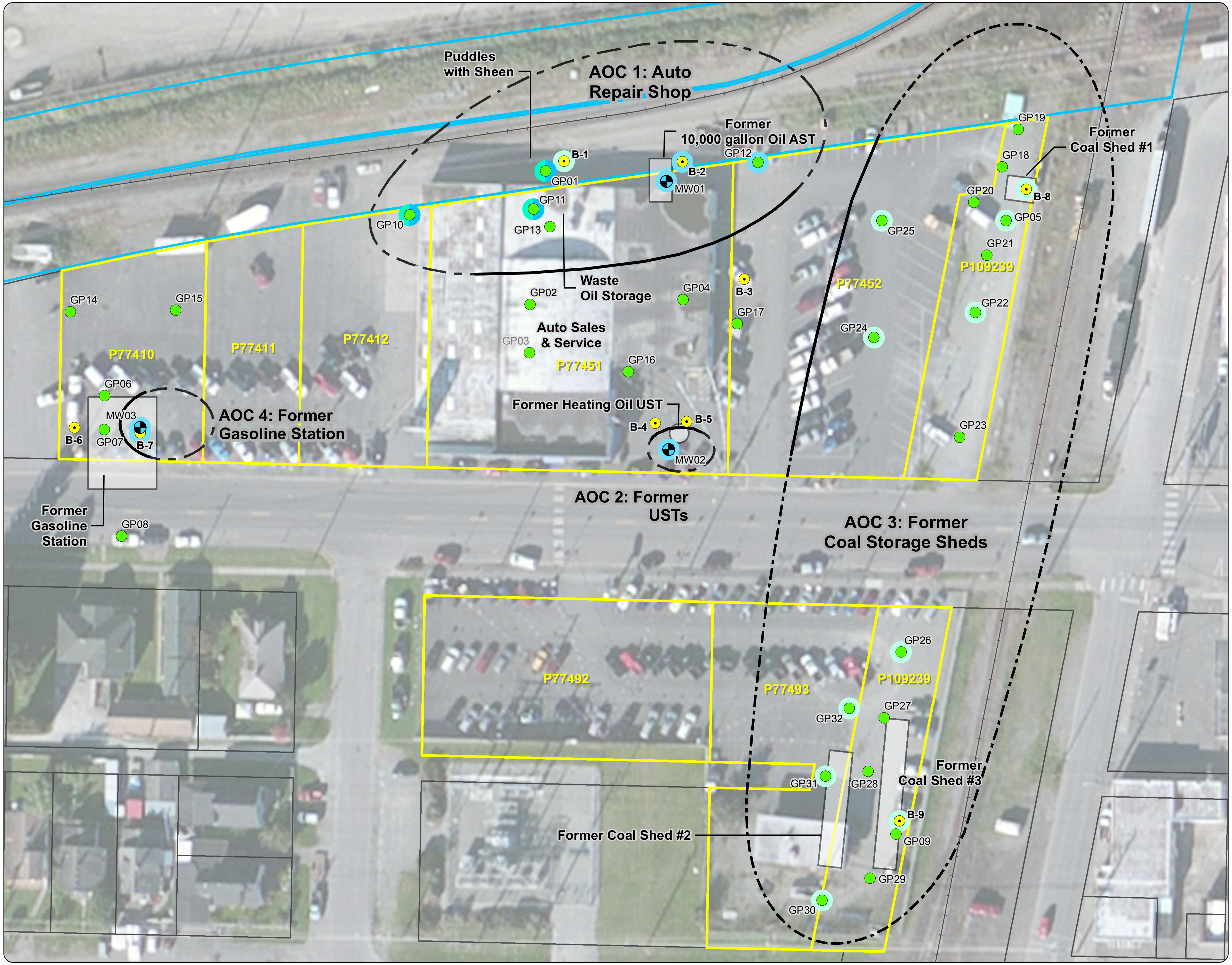
Print Date: 12/4/2015
Approved By: H. Good
Produced By: cwise
Project: 0747.01.05

Figure 2-1
Areas of Concern

North Cascade Ford Property
Sedro-Woolley, Washington



Legend

- Boring Location
- Monitoring Well
- Phase II ESA Boring Location
- Soil Exceedance*
- Groundwater Exceedance*
- Soil and Groundwater Exceedance*
- AOC Boundary (dashed where inferred)
- Property Parcel and Parcel Number
- BNSF-owned Parcels
- Skagit County Parcels

Notes:
1. All historical feature locations are approximate and shown for relative location reference only.
2. Chemical detections in soil samples that were collected below the water table during the 2011 Phase II ESA were not compared to soil cleanup levels.
3. AOC = area of concern
4. AST = aboveground storage tank
5. BNSF = Burlington Northern Santa Fe Railway Company
6. ESA = environmental site assessment
7. UST = underground storage tank

*Model Toxics Control Act Method A cleanup level exceedance detected.

0 30 60
Feet

Source: Aerial photograph obtained from Esri, ArcGIS Online; parcels obtained from Skagit County GIS Department.

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Path: X:\0747.01\Projects\05\Data Gap Work Plan\Fig2-1_Areas of Concern.mxd
Print Date: 11/18/2015
Approved By: H. Good
Produced By: cwise
Project: 0747.01.05

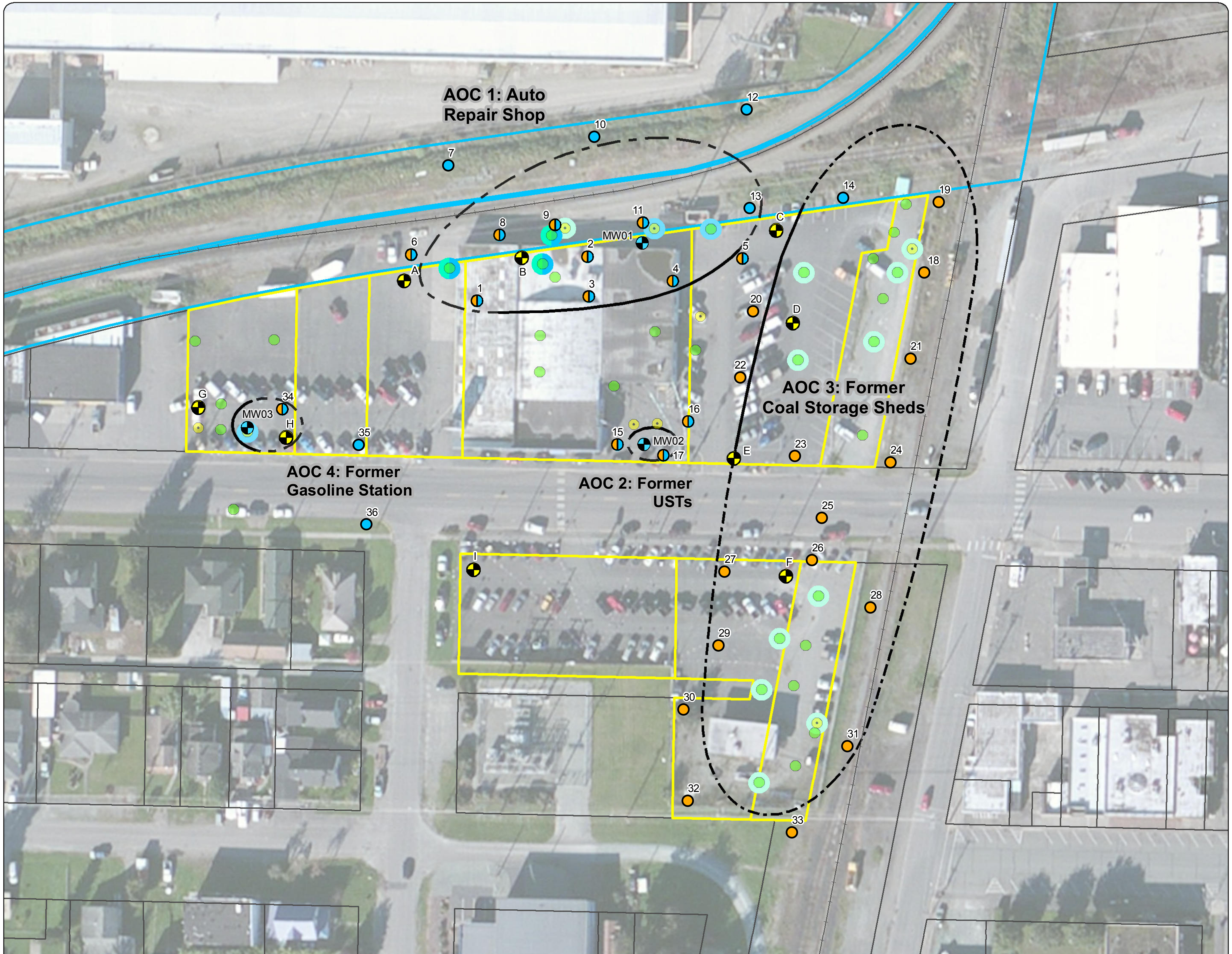

Figure 3-1
Proposed Sample Locations

North Cascade Ford Property
Sedro-Woolley, Washington

Legend

- Proposed Boring (Groundwater)
- Proposed Boring (Soil)
- Proposed Boring (Soil and Groundwater)
- Proposed Monitoring Well
- Existing Monitoring Well
- Phase II ESA Boring Location
- Former Boring Location
- Soil Exceedance*
- Groundwater Exceedance*
- Soil and Groundwater Exceedance*
- AOC Boundary (dashed where inferred)
- Property Parcel and Parcel Number
- BNSF-owned Parcels
- Skagit County Parcels

Notes:
1. All historical feature locations are approximate and shown for relative location reference only.
2. Chemical detections in soil samples that were collected below the water table during the 2011 Phase II ESA were not compared to soil cleanup levels.
3. AOC = area of concern
4. BNSF = Burlington Northern Santa Fe Railway Company
5. ESA = environmental site assessment
6. UST = underground storage tank

*Model Toxics Control Act Method A cleanup level exceedance detected.

0 40 80
Feet

Source: Aerial photograph obtained from Esri, ArcGIS Online; parcels obtained from Skagit County GIS Department.

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Path: X:\0747.01\Projects\05\Data Gap Work Plan\Fig3-1_Proposed Sample Locations.mxd
Print Date: 11/30/2015
Approved By: H. Good
Produced By: jmiller
Project: 0747.01.02-01

APPENDIX

SAMPLING AND ANALYSIS PLAN

SAMPLING AND ANALYSIS PLAN

NORTH CASCADE FORD PROPERTY
SEDRO-WOOLLEY, WASHINGTON

Prepared for

VSF PROPERTIES, LLC

SEDRO-WOOLLEY, WASHINGTON

December 9, 2015

Project No. 0747.01.05

Prepared by

Maul Foster & Alongi, Inc.

1329 N State Street, Suite 301, Bellingham WA 98225

MAUL
FOSTER
ALONGI

SAMPLING AND ANALYSIS PLAN

NORTH CASCADE FORD PROPERTY

SEDRO-WOOLLEY, WASHINGTON

The material and data in this plan were prepared under the supervision and direction of the undersigned.

MAUL FOSTER & ALONGI, INC.

Carolyn Wise, GIT

Staff Geologist

Heather Good, LHG

Project Hydrogeologist

CONTENTS

FOLLOWING PLAN:

TABLES

ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
BNSF	Burlington Northern Santa Fe Railway Company
COC	chain of custody
DROs	diesel-range organics
Ecology	Washington State Department of Ecology
FSDS	field sampling data sheet
GROs	gasoline-range organics
IDW	investigation-derived waste
LCS	laboratory control sample
LDS	laboratory duplicate sample
MFA	Maul Foster & Alongi, Inc.
MS/MSD	matrix spike/matrix spike duplicate
NWTPH	Northwest Total Petroleum Hydrocarbons
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PID	photoionization detector
Property	VSF-owned North Cascade Ford property at 116 West Ferry Street, Sedro-Woolley, Washington
PRT	post run tubing
QA	quality assurance
QC	quality control
RI/FS	remedial investigation and feasibility study
SAP	sampling and analysis plan
SIM	selective ion monitoring
Site	the North Cascade Ford site
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
VSF	VSF Properties, LLC
WAC	Washington Administrative Code

1 INTRODUCTION

Maul Foster & Alongi, Inc. (MFA) has prepared this sampling and analysis plan (SAP), consistent with the requirements of Washington Administrative Code (WAC) 173-340-820, for its client, VSF Properties, LLC (VSF), to guide the collection of samples supporting development of a remedial investigation and feasibility study (RI/FS) at the North Cascade Ford site (the Site). The Site includes the VSF-owned property located at 116 West Ferry Street in Sedro-Woolley, Washington (the Property), and portions of adjacent properties, including a property owned by the Burlington Northern Santa Fe Railway Company (BNSF) located to the north of the Property (see Figures 1-1 and 1-2 of the data gap investigation work plan [MFA, 2015a]).

Completion of the data gap investigation will allow MFA to further assess environmental conditions at the Site by further characterizing contaminated soil and groundwater. The procedures described in this SAP will be used for all sample collection and analysis proposed in the data gap investigation work plan (MFA, 2015a). The goal of the sampling is to obtain data about physical, environmental, and chemical conditions at the Property that will support the goals and objectives of the preliminary remedial investigation and the data gap investigation work plan (MFA, 2015a,b).

This SAP has been prepared consistent with the requirements of the Washington State Department of Ecology's (Ecology) Guidance on Sampling and Data Analysis Methods (Ecology, 1995), Guidance for Preparing Quality Assurance Project Plans for Environmental Studies (Ecology, 2004), and the 1993 Model Toxics Control Act (WAC Chapter 173-340).

1.1 Sampling and Analysis Plan Objectives

The primary objective of this SAP is to establish procedures for the collection of data of sufficient quality to further evaluate the nature and extent of impacted soil and groundwater at the Site. The work plan references the relevant procedures and protocols from this SAP and identifies specific media to be sampled, as well as the locations, frequency, and types of field or laboratory analyses that will be conducted. This SAP is meant to ensure that reliable data are obtained in support of the development of remedial actions at the Site if such actions are necessary for the protection of human health and the environment. It provides a consistent set of procedures that will be used throughout the various work phases identified in the work plan (MFA, 2015a).

During the preliminary RI/FS, impacts to soil and groundwater were identified at the Site (MFA, 2015b). The preliminary RI/FS will aid in the understanding of the nature and extent of confirmed soil and groundwater impacts and will attempt to resolve data gaps associated with exposure pathways.

If a phase of work or an otherwise unforeseen change in methodology requires modification to this SAP, an addendum may be prepared that describes the specific revision(s), or the alternative procedures used will be documented in the preliminary RI/FS report. Procedures are provided that will be used to direct the investigation process so that the following conditions are met:

- Data collected are of high quality, representative, and verifiable.
- Use of resources is cost effective.
- Data can be used by VSF and Ecology to support selection and implementation of remedial actions, if necessary.

This SAP describes methods that will be used for sampling environmental media, decontaminating equipment, and managing investigation-derived waste (IDW). It also includes procedures for collecting, analyzing, evaluating, and reporting useful data. This SAP includes quality assurance (QA) procedures for field activities, quality control (QC) procedures, and data validation.

2 ACCESS AND SITE PREPARATION

2.1 Access

Signed agreements have been obtained from the current Property owner and lessee, granting access for MFA to conduct the subsurface investigation. MFA will coordinate activities directly with VSF, Ecology, and the Property lessee and will notify VSF and the Ecology project manager before beginning work at the Property.

MFA is executing an access agreement with BNSF for environmental investigation activities on the BNSF property. MFA will conduct work on the BNSF property in accordance with the terms of the access agreement.

MFA will request access and any needed permits to conduct subsurface investigation activities on other adjacent properties, as needed.

2.2 Site Preparation and Coordination

Before subsurface field sampling programs begin at the Site, public and private utility-locating services will be used to check for underground utilities and pipelines near the proposed sampling locations.

3 SOIL AND GROUNDWATER ASSESSMENT

The proposed locations of soil and reconnaissance groundwater borings are shown on Figure 3-1 of the work plan (MFA, 2015a). Subsurface soil and reconnaissance groundwater samples will be collected using a direct-push drill rig (i.e., Geoprobe™). All boring and monitoring well installation and decommissioning will be conducted by a driller licensed in the State of Washington.

A photoionization detector (PID) or an organic vapor monitor may be used to screen soil samples in the field before samples for laboratory analysis are selected. Visual and olfactory observations will be noted and may also be used to select samples for analysis. Soil and groundwater samples will be analyzed following the program outlined in the work plan table (MFA, 2015a). If there is evidence of impacts in the field, the sample depths may be adjusted in order to collect samples in and/or beneath the impacted areas. Additional analyses may be recommended based on field observations.

3.1 Borings

The borings will be advanced with the direct-push drill rig and industry-standard sampling techniques. In the event that refusal is met before the desired boring depth is reached (i.e., significant debris, cobbles, or bedrock are encountered), a different drilling technology may be considered.

Reconnaissance groundwater samples may be collected using a stainless steel water sampler (e.g., Geoprobe). The water sampler will be advanced to the desired depth. The casing around the water sampler will be pulled back, exposing the screen. If water does not flow into the screen within 15 minutes, the sampler will be removed and a temporary well will be installed. This will consist of placing 0.010-inch machine slot screen with polyvinyl chloride riser into the boring and allowing the system to rest for a maximum of 12 hours. If no water is in the well after the rest period, the well will be abandoned.

If practicable, at least one casing volume of groundwater will be purged before sample collection, using new polyethylene tubing or a disposable bailer and following procedures summarized in Section 5.1.

New, disposable tubing will be used at each location to collect water samples. Nondisposable equipment used for water sample collection will be decontaminated both before its use at the Site and after each sample is collected, in accordance with the procedures outlined in Section 3.7 of this plan.

Samples will be labeled, preserved, and shipped to the analytical laboratory under standard chain-of-custody (COC) procedures.

3.2 Documentation

Soil and other observations at each boring location will be documented on a boring log and in field notes by a geologist or hydrogeologist licensed by the State of Washington or by a person working under the direct supervision of a Washington State-licensed geologist or hydrogeologist. Boring logs will include information such as the project name and location, the name of the drilling contractor, the drilling method, the sampling method, sample depths, blow counts (if applicable), a description of soil encountered, and screened intervals. Soils will be described using American Society for Testing and Materials designation D2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedures). The information will be recorded on the MFA boring log form provided in Appendix A or in field notes.

3.3 Boring Decommissioning

When a boring is no longer needed, it will be decommissioned with bentonite chips or with bentonite grout in accordance with the WAC for Minimum Standards for Construction and Maintenance of Wells (WAC 173-160, 1998).

3.4 Monitoring Wells

Monitoring wells (if installed) will be constructed according to the Washington State well construction standards (Chapter 173-160 WAC) and as described below:

- Monitoring wells will be constructed with 2-inch-diameter polyvinyl chloride or stainless steel riser pipe and screened sections. The well screens will consist of 0.010-inch machine slots. The monitoring wells may be constructed with prepacked well screen with 10 x 20 washed silica sand or by placing materials downhole, following the WAC regulation listed above.
- Additional filter pack may be placed around the prepacked screen (if used). The additional filter pack will consist of graded 10 x 20 washed silica sand and will extend a maximum of 1 foot below the bottom of the screen and 3 feet above the top of the screen. A weighted line will be used to monitor the level of the filter pack during installation. The filter pack may be surged during installation.
- Bentonite grout or hydrated chips (e.g., 0.75-inch minus) will be used to seal the annulus above the filter pack. A weighted line will be used to measure the top of the bentonite chips as they are poured into place. Potable water will be used to prepare the bentonite grout (if used) or hydrate the bentonite chips after they are poured into place.
- At least 24 hours after installation of a well, the well will be developed by surging, bailing, or pumping to remove sediment that may have accumulated during installation and to improve the hydraulic connection with the water-bearing zone.
- Water quality field parameters such as specific conductance, pH, temperature, and turbidity will be measured during well development, as deemed appropriate. The wells will be developed until the turbidity measurements are 10 nephelometric turbidity units or less, or until there is no noticeable decrease in turbidity. To the extent practical, water quality field parameters will be considered stable when the specific conductance is within 10 percent of the previous reading, pH is within 0.1 standard unit of the previous reading, and temperature is within 0.1 degree Celsius of the previous reading.

3.5 Groundwater Elevations

Water level measurements to the nearest 0.01 foot will be taken, using an electronic water level indicator. If it is not known, the depth of the boring or the monitoring well will also be measured. The depth to water will be measured from the top of the casing (typically the polyvinyl chloride riser pipe) at the surveyed elevation point. This reference point will be marked so that readings are taken from the same reference point in future measurements. In addition, the well condition (including the condition of the lock, monument integrity, and legibility of well labels) will be recorded for each location. Gauging equipment will be decontaminated between wells in accordance with the procedures outlined in Section 3.7.

3.6 Surveying

The location of the borings, surface samples, and other features of interest will be surveyed using a global positioning unit (e.g., Trimble™) capable of sub-meter accuracy. If monitoring wells are installed, they will be surveyed by a licensed surveyor.

3.7 Equipment Cleaning and Decontamination

3.7.1 Drilling Equipment

The working area of the drill rig and downhole drilling equipment will be steam-cleaned or pressure-washed after arrival on the Site and after use in each borehole or monitoring well. Decontamination fluids will be transferred to drums approved by the Washington State Department of Transportation, and will be managed according to the procedures outlined in Section 3.8.

3.7.2 Sampling Equipment

Nondisposable sampling equipment and reusable materials that contact the soil or water will be decontaminated on site before and after use at each sampling location. Decontamination will consist of the following:

- Tap-water rinse (may consist of an equivalent high-pressure or hot-water rinse). Visible soil to be removed by scrubbing.
- Non-phosphate detergent wash, consisting of a dilute mixture of Liqui-Nox® (or equivalent) and tap water.
- Distilled-water rinse.
- Methanol solution rinse (1:1 solution of methanol with distilled water).
- Distilled-water rinse.

Decontamination fluids will be transferred to drums for management.

3.8 Management of Investigation-Derived Waste

IDW may include items such as soil cuttings, purged groundwater, decontamination fluids, sampling debris, and personal protective equipment. The IDW will be segregated into solids, liquids, and sampling debris (e.g., personal protective equipment, tubing, bailers). IDW will be stored in a designated area on the Property in drums approved by the Washington State Department of Transportation.

Drums will be labeled with their contents, the approximate volume of material, the date of collection, and the origin of the material. Pending characterization, the drums will be sealed, secured, and transferred to a designated area on the Property. Analytical data from the soil- and groundwater-sampling activities previously described may be used to characterize the soil cuttings, drilling fluids, purge water, and decontamination fluids generated during drilling and monitoring well sampling.

4 SOIL SAMPLING

Soil samples will be collected for lithologic description, field screening, and chemical analyses, as described below. The sampling intervals, depths, and initial sample analysis schedule are specified in the work plan table (MFA, 2015a).

4.1 Procedure

Samples will be prepared, handled, and documented as follows:

- Soil-sampling equipment will be decontaminated before it is used at each sampling location (see Section 3.7).
- Samples will be obtained by hand, using a new, uncontaminated glove; or with a decontaminated stainless steel spoon, trowel, or knife.
- Soil that will be analyzed for volatile organic compounds (VOCs) and gasoline-range organics (GROs) will be transferred directly from freshly exposed soil into laboratory-supplied containers, using the appropriate U.S. Environmental Protection Agency (USEPA) 5035A sampling procedures. The samples will be placed in 40-milliliter vials. Depending on the soil type, 5 milligrams of soil will be added to the prepared vials preserved with sodium bisulfate monohydrate or methanol. A soil sample will also be collected in an unpreserved glass jar to be analyzed for petroleum hydrocarbons, heavy metals, and other analytes specified in the work plan table (MFA, 2015a).
- Large particles (i.e., larger than 0.25 inch) may be removed before the sample is placed in a laboratory-supplied container.
- Soil samples will be transferred directly from the sampling device into laboratory-supplied glass jars by hand, using a new, uncontaminated glove; or with a decontaminated stainless steel spoon, trowel, or knife.
- Sample containers will be labeled, packed in iced shipping containers with COC documentation, and delivered or shipped to the laboratory (see Sections 9.5 and 9.6).
- Sampling information will be recorded in a field notebook, on a field sampling data sheet (FSDS), and on the COC form.
- Generally, one duplicate soil sample should be collected for every 20 samples collected.

4.2 Nomenclature

Soil samples will be labeled with a prefix to describe the location identification number, an "S" to indicate a soil sample matrix, and the sample depth in feet. The depth interval should be specified as the middle of the sampling interval. For example, a soil sample collected from a boring at location 12 and at a depth interval from 18 to 22 feet below ground surface (bgs) will have the sample nomenclature of GP12-S-20.0.

Duplicate soil samples will replace the location number with "DUP," and the sample will have the same sample time as the primary sample. A duplicate sample of the abovementioned sample would appear as GPDUP-S-20.0. To avoid confusion, duplicate samples should not be collected from multiple locations at the same depth on the same day and at the same time.

Relevant sample information will be documented on the boring log (see Appendix A) or an FSDS (see Appendix B).

4.3 Composite Soil Sampling

Should soil stockpiles be created on site in the future, each stockpile will be characterized through collection of representative composite soil samples. A clean shovel or hand auger will be used to dig up to 1.5 feet into the pile from at least three subsample locations. Each of the subsamples will be collected by hand with clean, disposable gloves. Subsample locations will be selected to obtain representative material, based on visual inspection and best professional judgment. To the extent possible, subsamples should consist of fine-particle-sized material, with larger rocks and debris removed. Subsamples will be combined and homogenized. The composite sample of the material source will be transferred to a laboratory-supplied glass container(s).

5 GROUNDWATER SAMPLING

During drilling, reconnaissance groundwater samples may be collected for chemical analyses, as described below. Should monitoring wells be installed, groundwater samples may be collected following the procedure outlined below.

5.1 Reconnaissance Groundwater Sampling

Reconnaissance groundwater samples will be collected using conventional methods associated with the drilling method (e.g., inertia or peristaltic pump). Before groundwater sampling, the borehole will be purged to minimize solids and ensure that a representative sample is collected.

Groundwater will be transferred directly into laboratory-supplied containers specific to the analysis required, as outlined in Section 9.5. If there is enough water, water quality field parameters (e.g., temperature, specific conductance, pH, turbidity) will be measured.

5.2 Monitoring Well Groundwater Sampling

If monitoring wells are installed, a peristaltic pump will be used to collect groundwater samples, using standard low-flow sampling techniques. If possible, groundwater samples should be collected from the middle of the screened interval or, if the water level is below the top of the screen, from the middle of the water column. New, disposable tubing will be used at each monitoring location.

Before collection of groundwater samples, the water level will be measured and the well will be purged. If a peristaltic pump is used, the well should be purged at a low flow rate (e.g., 0.1 to 0.5 liter per minute). A minimum of one well volume will be purged before sample collection, or purging will continue until selected water quality field parameters (e.g., temperature, specific conductance, pH, turbidity) have stabilized. If the well goes dry during purging, a sample can be collected once the well recharges enough water. During purging, the flow rates, water levels, and water quality parameters will be recorded on an appropriate field form or in the field notes. Groundwater will be transferred directly into laboratory-supplied containers specific to the analysis required.

5.3 Nomenclature

Groundwater samples will be labeled with a prefix to describe the sampling location identification number, a "W" to indicate a water sample matrix, and the midpoint of the screened or open area sample depth in feet. For example, a reconnaissance groundwater sample collected from a boring at location 4 and with a screen from 30 feet to 35 feet bgs will have the sample nomenclature of GP4-W-32.5.

Duplicate reconnaissance groundwater samples will replace the location number with "DUP," and the sample will have the same sample time as the primary sample. To avoid confusion, avoid collecting more than one duplicate sample from the same depth on the same date and at the same time. A duplicate sample of the abovementioned sample would appear as GPDUP-W-32.5.

Relevant sample information will be documented on the boring log (see Appendix A) or an FSDS (see Appendix B); documentation may include items such as the screened interval or open space, equipment used, water quality field parameters, and the amount of water purged before sampling. The screened interval or open borehole will be recorded on the boring log.

6 SOIL VAPOR

In the event that soil or groundwater chemical concentrations indicate that chemical concentrations in soil vapor may be contributing impacts to indoor or outdoor air quality, soil vapor sampling may be conducted as described below.

6.1 Procedure

Soil vapor samples will be collected from temporary boreholes advanced using a Geoprobe. A post run tubing (PRT) system will be used to eliminate problems that may occur with sampling directly through the steel rods. The PRT system uses an adapter and tubing to isolate the soil gas sample from the drill rods, thereby eliminating possible leaks of ambient air from the rod joints into the sample. A PRT point holder and expendable point are attached to the leading end of a sampling screen, and the drill rods will be advanced to the desired soil depth above the water table, making sure to target relatively permeable zones such as sands. The PRT adapter attached to the sample tubing is threaded into the reverse thread fitting in the top of the point holder. The rods are then retracted to release the expendable point, exposing the screen and creating an opening where soil gas can enter the PRT. The upper end of the tubing will be connected to the purging/sampling system. A flow controller will be attached to the sample setup to regulate the flow of soil vapor into the sample container. The line will be purged for at least one minute or a period of time sufficient to achieve a purge volume that equals at least three pore volumes, and then the sample will be collected. Helium, used as a leak-check compound, will be contained in a small, tent-like structure set up around the sampling apparatus and sampling location. The helium test will verify the integrity of the sampling system before the sample is collected.

6.2 Nomenclature

Soil vapor samples will be labeled with a prefix to describe the type of sampling, a location identification number, "SV" to indicate the soil vapor sample matrix, and the midpoint of the screened or open area sample depth. For example, a soil vapor sample collected from a Geoprobe boring at location 4 and with an open screen from 5 feet to 7 feet bgs will have the sample number B4-SV-6.

Duplicate soil vapor samples will replace the location number with "DUP," and the sample will have the same sample time as the primary sample. A duplicate sample of the abovementioned sample would appear as GPDUP-SV-6.

Samples will be documented on an FSDS (see Appendix B) and a boring log (see Appendix A); documentation will include the screened interval or open space, equipment used, and PID readings. The boring log will include the screened interval or open borehole.

7 SUBSLAB SOIL VAPOR

7.1 Procedure

Subslab soil vapor sampling may be performed to evaluate vapors that collect under a building's foundation. The following procedures may be followed to install subslab soil vapor sampling points.

Subslab utilities, such as water, sewer, and electrical, should be located and marked on the slab prior to drilling or cutting. If a building is determined to have a moisture barrier and/or a tension slab, special care should be taken when drilling or cutting through the concrete slab. Subslab samples will not be collected if the slab is in contact with, or potentially could come into contact with, groundwater.

After removal of the floor covering, a 1.0- to 1.25-inch-diameter hole will be drilled through the concrete slab. A hammer drill can be used to drill the holes. The holes should be advanced 3 to 4 inches into the engineering fill below the slab. Drill cuttings should be removed from the borehole, using a vacuum.

Vapor probes will be constructed of 1/8-inch- or 1/4-inch-diameter stainless steel tubing (e.g., Swagelok®) with a permeable probe tip. A Teflon™ sealing disk should be placed, as needed, between the probe tip and the blank riser pipe to prevent the downward migration of materials into the sand pack.

Dry granular bentonite should be used to fill the borehole annular space to above the base of the concrete foundation. Hydrated bentonite should then be placed above the dry granular bentonite. The bentonite for this portion of probe construction should be hydrated to ensure proper sealing. Care should be used in placement of the bentonite to prevent post-emplacement expansion, which might compromise both the probe and the cement seal. The remainder of the hole should be filled with bentonite grout if the probe installation is permanent. Before the introduction of the bentonite grout or cement, the existing concrete surfaces in the borehole should be cleaned with a damp towel to increase the likelihood of obtaining a good seal. The vapor probe tip should be surrounded by a sand filter pack to ensure proper airflow to the probe tip.

Water used in the construction of the probe should be deionized, the bentonite grout should be contaminant-free and quick-drying, and the metal probe components should be stainless steel and should be cleaned to remove manufacturer-applied cutting oils.

Before sampling, at least two hours of time should elapse following installation of a probe to allow the construction materials to cure and the subsurface to equilibrate (USEPA, 2006).

The upper end of the tubing will be connected to the purging/sampling system. A flow controller will be attached to the sample setup to regulate the flow of soil vapor into the sample container. Before sampling, the line will be purged for one minute or a period of time sufficient to achieve a purge volume that equals at least three presampling volumes of the purging/sampling system. Relevant sampling information should be recorded, including items such as the sampling start and stop times, the initial and final canister vacuum readings, and weather conditions. A sample collected with a stainless steel canister should be rejected or the data qualified if the initial canister pressure is not at least -28 inch of mercury or if the final canister pressure is greater than -5 inch of mercury.

Upon completion of the sampling events, the foundation probes will be decommissioned by overdrilling the probe tip, probe tubing, bentonite, and grout. The borehole will be filled with grout and concrete patch material.

7.2 Nomenclature

Subslab soil vapor samples will be labeled with a prefix to describe the sampling location identification number, "BV" to indicate the subslab soil vapor sample matrix, and the midpoint of the screened or open area sample depth. For example, a subslab soil vapor sample collected from boring location 4 and with an open screen from 5 feet to 7 feet bgs will have the sample number GP4-BV-6.0.

Duplicate soil vapor samples will replace the location number with "DUP," and the sample will have the same sample time as the primary sample. A duplicate sample of the abovementioned sample would appear as GPDUP-BV.

Samples will be documented in field notes and will include the equipment used and the screened interval or open space.

8 INDOOR/OUTDOOR AIR SAMPLING

If indoor or outdoor air sampling is performed, it should be conducted as described below.

8.1 Procedure

Indoor air samples should be collected from each level, if applicable, of each building included in the assessment. Indoor air samples will be collected approximately 3 to 5 feet above the floor. If outdoor ambient air samples are collected, they should be taken from locations upwind of the building around the same time as the indoor air sample collection.

A flow controller should be attached to the sample setup to regulate the flow of air into the sample container. If a 6-liter stainless steel canister is used, the valve will be opened to collect the sample over a 24-hour period. Field data will be recorded, including items such as a description of the sample location, sampling start and stop times, the initial and final canister vacuum readings, and weather conditions. The sample should be rejected or the data qualified if the initial canister pressure is not at least -28 inch of mercury or if the final canister pressure is greater than -5 inch of mercury.

8.2 Nomenclature

Indoor air samples will be labeled with a prefix to describe the sampling location identification number prefixed by L, "IA" to indicate the indoor air sample matrix, and a height above ground, in feet. Background air samples will be labeled with a prefix to describe the sampling location identification number prefixed by L, "BA" to indicate the background air sample matrix, and a height above ground, in feet. For example, an indoor air sample collected at location 4, 3 feet off the ground, will have the sample number L04-IA-3.0.

Duplicate air samples will replace the location number with "DUP," and the sample will have the same sample time as the primary sample. A duplicate sample of the abovementioned sample would appear as LDUP-IA-3.0.

Relevant sample information may be documented on an FSDS (see Attachment B) and should include items such as a description of the sample location, the screened interval or open space, and equipment used. Field data will be recorded before and after the sampling, including items such as the sampling start and stop times, the initial and final canister vacuum readings, temperature, relative humidity, and observations of conditions that may influence sampling results (e.g., presence or use of products that may contain chemicals of interest; open windows/doors; ventilation systems).

9 ANALYTICAL METHODS

9.1 Chemicals of Interest

The following chemicals were identified in soil and/or groundwater at the Site during previous subsurface investigations (MFA, 2015b):

- Heavy oils (residual-range organics and diesel-range organics [DROs])
- GROs
- Polychlorinated biphenyls (PCBs)
- VOCs
- Metals (total; specifically arsenic, lead, and cadmium))
- Polycyclic aromatic hydrocarbons (PAHs)

Soil and groundwater samples will be collected to address the four areas of concern as outlined in the work plan table (MFA, 2015a).

9.2 Laboratory Test Methods and Reporting Limits

9.2.1 Soil

In accordance with the QA/QC requirements set forth in this SAP, an accredited laboratory may perform the following analyses. Laboratory methods are summarized in Table 9-1.

- Petroleum hydrocarbons by Northwest Total Petroleum Hydrocarbons (NWTPH) hydrocarbon identification method (NWTPH-HCID)
- Total metals (arsenic, lead, and cadmium) by USEPA Method 6020 or 200.8
- PAHs by USEPA Method 8270 selective ion monitoring (SIM)
- VOCs by USEPA Method 8260B

- PCBs by USEPA Method 8082
- GROs by NWTPH-Gx
- Heavy oils by NWTPH-Dx

9.2.2 Groundwater

In accordance with the QA/QC requirements set forth in this SAP, an accredited laboratory may perform the following analyses. Laboratory methods are summarized in Table 9-2.

- DROs by NWTPH-Dx
- GROs by NWTPH-Gx
- VOCs by USEPA Method 8260B

Selected groundwater samples may also be analyzed for the following geochemical parameters to prescreen conditions for potential in situ bioremediation:

- Total organic carbon by USEPA Method 9060
- Nitrate/nitrite by USEPA Method 325.2
- Chloride by USEPA Method 325.2
- Sulfate by USEPA Method 375.2
- Total phosphorus by USEPA Method 365.2
- Orthophosphorus by USEPA Method 4500-P E
- Methane by USEPA Method RSK-175
- Total magnesium and dissolved iron by USEPA Method 200.8

9.2.3 Soil Vapor

In the event that soil vapor sampling at the Site is recommended, chemical analyses will be determined based on chemical impacts observed in soil and/or groundwater. For example, samples may be analyzed for selected compounds by Modified USEPA Method TO-15 SIM or TO-17 SIM. An accredited laboratory will provide a 6-liter, stainless steel canister (e.g., Summa canister) or sorbent tube for each sample to be analyzed for VOCs.

9.2.4 Subslab Vapor Sampling

In the event that subslab soil vapor sampling at the Property is recommended, chemical analyses will be determined based on chemical impacts observed in soil and/or groundwater. For example, samples may be analyzed for selected compounds by Modified USEPA Method TO-15 SIM or TO-17 SIM. An accredited laboratory will provide a 6-liter, stainless steel canister (e.g., Summa canister) or sorbent tube for each sample to be analyzed for VOCs.

9.2.5 Indoor/Outdoor Air Sampling

In the event that indoor air/outdoor air sampling at the Property is recommended, chemical analyses will be determined based on chemical impacts observed in soil, groundwater, and/or vapor sampling. For example, samples may be analyzed for selected VOC compounds by Modified USEPA Method TO-15 SIM to achieve low reporting limits. An accredited laboratory may provide a 6-liter, stainless steel canister (e.g., Summa canister) or sorbent tube for each sample.

9.3 Quality Assurance and Quality Control Samples Generated in Field

To ensure that field samples and quantitative field measurements are representative of the media collected and conditions being measured, sample collection and measurement methods will follow procedures documented in Sections 4 through 7. QC samples collected in the field include field equipment rinsate blanks, trip blanks, and field duplicates. Field QC samples will be identified on the FSDSs. Field and trip blank results may indicate possible contamination introduced by field or laboratory procedures; field duplicates indicate the degree of precision in both field and laboratory procedures.

9.4 Laboratory Operations

In the laboratory, QC samples may include matrix spike/matrix spike duplicate (MS/MSD) samples, laboratory control samples (LCSs), surrogate spike samples, and method blanks, as well as other QC samples and procedures required by the individual methods.

9.5 Sample Containers, Preservations, and Handling

9.5.1 Preservation

Soil, water, and, if collected, soil vapor, subslab soil vapor, and/or air samples, will be collected in laboratory-supplied containers, as generally specified; soil and groundwater sample containers, preservatives, and hold times are summarized in Tables 9-1 and 9-2, respectively.

Soil samples for GRO and VOC analyses will be collected in 40-milliliter glass vials, using the USEPA 5035A sample collection method. Other soil samples will be collected in glass jars. The soil and groundwater samples will be stored in iced coolers at approximately 4 degrees Celsius. Sample containers will be supplied by the laboratory.

9.5.2 Sample Packaging and Shipping

Soil and groundwater samples will be stored in iced shipping containers or a refrigerator designated for samples, and then transported to the analytical laboratory in containers. Vapor samples will be transported to the analytical laboratory in shipping containers or boxes and are not to be stored in iced shipping containers or refrigerators.

9.6 Sample Custody

Sample custody will be tracked from point of origin through analysis and disposal, using a COC form, which will be filled out with the appropriate sample and analytical information after samples are collected.

The following items will be recorded on the COC form:

- Project name
- Project number
- MFA project manager
- Sampler name(s)
- Sample number, date and time collected, media, number of bottles submitted
- Requested analyses for each sample
- Type of data package required
- Turnaround requirements
- Signature, printed name, and organization name of persons having custody of samples, and date and time of transfer
- Additional instructions or considerations that would affect analysis (nonaqueous layers, archiving, field filtering, etc.)

Persons in possession of the samples will be required to sign and date the COC form whenever samples are transferred between individuals or organizations. The COC will be included in the shipping containers. The laboratory will implement its in-house custody procedures, which begin when sample custody is transferred to laboratory personnel.

If samples are shipped via air or ground transportation (by a third party), the following custody procedures will be followed. The COC will be signed and custody will be relinquished to the carrier. The signed COC(s) will be packed in shipping containers with the samples, and a custody seal will be placed on the container. The shipping documentation will be used by the carrier to document custody of the package while it is in transit to the laboratory.

At the analytical laboratory, a designated sample custodian will accept custody of the samples and will verify that the COC form matches the samples received. The shipping container or set of containers is given a laboratory identification number, and each sample is assigned a unique sequential identification number.

9.7 Instrumentation

9.7.1 Field Instrumentation

Field instruments will be used during the investigations. The following field equipment may require calibration before use and periodically during sampling activities:

- pH meter
- Conductivity meter
- Dissolved-oxygen meter
- Oxygen reduction potential meter
- Turbidity meter
- Thermometer
- PID
- Electronic water-level probe

Field-instrument calibration and preventive maintenance will follow the manufacturers' guidelines, and deviations from the established guidelines will be documented.

9.7.1.1 Field Calibration

Generally, field instruments should be calibrated daily before work begins. Field personnel may decide to calibrate more than once a day if inconsistent or unusual readings occur, or if conditions warrant more frequent calibration. Calibration activities should be recorded in logbooks or field notebooks. To ensure that field instruments are properly calibrated and remain operational, the following procedures will be followed, at a minimum:

- Operation, maintenance, and calibration will be performed in accordance with the instrument manufacturers' specifications.
- Standards used to calibrate field instruments will meet the minimum requirements for source and purity recommended in the equipment operation manual. Standards will be checked for expiration dates that may be printed on the bottle. Standards that are expired should not be used.
- Acceptable criteria for calibration will be based on the limits set in the operations manual.
- Users of the equipment should be trained in the proper calibration and operation of the instrument.
- Operation and maintenance manuals for each field instrument should be available to persons using the equipment.
- Field instruments will be inspected before they are taken to the Site.

- Field instruments will be calibrated at the start of each workday. Meters will be recalibrated, as necessary, during the work period.
- Calibration procedures (including items such as time, standards used, and calibration results) should be recorded in a field notebook. The information should be available if problems are encountered.

9.7.1.2 Preventive Maintenance

Preventive maintenance of field instruments and equipment will follow the operations manuals. A schedule of preventive-maintenance activities should be followed to minimize downtime and ensure the accuracy of measurement systems. Maintenance will be documented in the field notebook.

9.7.2 Laboratory Instrumentation

Specific laboratory instrument calibration procedures, frequency of calibration, and preparation of calibration standards will be according to the method requirements as developed by the USEPA, following procedures presented in SW-846 (USEPA, 1986).

9.7.2.1 Laboratory Calibration and Preventive Maintenance

The laboratory calibration ranges specified in SW-846 (USEPA, 1986) will be followed.

Preventive maintenance of laboratory equipment will be the responsibility of the laboratory personnel and analysts. This maintenance includes routine care and cleaning of instruments and inspection and monitoring of carrier gases, solvents, and glassware used in analyses. The preventive-maintenance approach for specific equipment should follow the manufacturers' specifications, good laboratory practices, and industry standard techniques.

Precision and accuracy data will be examined for trends and excursions beyond control limits to determine evidence of instrument malfunction. Maintenance should be performed when an instrument begins to change, as indicated by the degradation of peak resolution, shift in calibration curves, decrease in sensitivity, or failure to meet any of the QC criteria.

9.8 Laboratory Quality Assurance and Quality Control Samples

The laboratory QC samples will be used to assess the accuracy and precision of the laboratory analysis. Each category of laboratory QA/QC will be performed by the laboratory as required by method-specific guidelines. The acceptance criteria presented in the guidelines will be adhered to and samples that do not meet the criteria will be reanalyzed or qualified, as appropriate.

9.8.1 Calibration Verification

Instruments will initially be calibrated at the start of the project or sample run, as required, and when any ongoing calibration does not meet control criteria. The number of points used in the initial calibration is defined in the analytical method. Calibration will be continued as specified in the analytical method to track instrument performance. If a continuing calibration does not meet control limits, analysis of project samples will be suspended until the source of the control failure is either eliminated or reduced to within control specifications.

9.8.2 Matrix Spike/Matrix Spike Duplicate

MS samples are analyzed to assess the matrix effects on the accuracy of analytical measurements. MS/MSD samples will be prepared by spiking investigative samples with known amounts of analytes before extraction and preparation and analysis. The recoveries for the MS/MSD samples will be used to assess the accuracy and precision in the analytical method by measuring how well the analytical method recovers the target compounds in the investigative matrices. For each matrix type, at least one set of MS/MSD samples will be analyzed for each batch of samples (consisting of 20 or fewer samples) received.

9.8.3 Method Blanks

Method blanks are prepared using analyte-free (reagent) water and are processed with the same methodology (e.g., extraction, digestion) as the associated investigative samples. Method blanks are used to document contamination resulting in the laboratory from the analytical process. A method blank shall be prepared and analyzed in every analytical batch. The method blank results are used to verify that reagents and preparation do not impart unacceptable bias to the investigative sample results. The presence of analytes in the method blank sample will be evaluated against method-specific thresholds. If analytes are present in the method blank above the method-specific threshold, corrective action will be taken to eliminate the source of contamination before proceeding with analysis. Investigative samples of an analytical batch associated with method blank results outside acceptance limits will be qualified, as appropriate, by the data validation contractor.

9.8.4 Laboratory Control Samples

LCSs are prepared by spiking laboratory-certified, reagent-grade water with the analytes of interest or a certified reference material that has been prepared and analyzed. The result for percent recovery of the LCS is a data quality indicator of the accuracy of the analytical method and laboratory performance.

9.8.5 Laboratory Duplicate Samples

Laboratory duplicate samples (LDSs) are prepared in the laboratory by splitting an investigative sample into two separate aliquots and performing separate sample preparation and analysis on each aliquot. The results for relative percent difference of the primary investigative sample and the respective LDSs are used to measure precision in the analytical method and laboratory performance. For nonaqueous matrices, sample heterogeneity may affect the measured precision for the LDSs.

9.9 Field Quality Control

The following samples will be prepared by the sampling personnel in the field and submitted to the laboratory:

- **Equipment Rinsate Blanks—**To ensure that decontamination procedures are sufficient, an equipment rinsate blank will be collected when nondedicated, nondisposable equipment is used. At least one equipment rinsate blank will be collected for every 20 samples collected. If more than 20 samples are collected with the same equipment, or if high concentrations of contaminants are encountered, additional equipment rinsate blanks may be collected. Equipment rinsate blanks will be collected by passing laboratory deionized/distilled water through or over nondisposable sampling equipment.
- **Trip Blanks—**A trip blank monitors the potential for sample contamination during sample collection and transport. A trip blank consists of reagent-grade water in a new sample container, which is prepared at the same time as the sample containers. The trip blank will accompany the samples throughout collection, shipment, and storage. At least one trip blank should be included with each cooler in which samples for VOC analyses are stored.
- **Field Duplicates—**Field duplicates are collected to measure sampling and laboratory precision. At least one duplicate sample will be collected for every 20 samples.

9.10 Data Reduction, Validation, and Reporting

The analytical laboratory will submit analytical data packages that include laboratory QA/QC results to permit independent and conclusive determination of data quality. MFA will determine the data quality, using the data evaluation procedures described in this section. The results of the MFA evaluation will be used to determine if the project data quality objectives are met.

9.10.1 Field Data Reduction

Daily internal QC checks will be performed for field activities. Checks will consist of reviewing field notes and field activity memoranda to confirm that the specified measurements and calibrations are attained and that specified procedures are being followed. The need for corrective action will be assessed on an ongoing basis, in consultation with the project manager.

9.10.2 Laboratory Evaluation

Initial data reduction, evaluation, and reporting at the analytical laboratory will be carried out as described in USEPA SW-846 manuals for analyses (USEPA, 1986), as appropriate. Additional laboratory data qualifiers may be defined and reported to further explain the laboratory's QC concerns about a particular sample result. Additional data qualifiers will be defined in the laboratory's case narrative reports.

9.10.3 Data Deliverables

Laboratory data deliverables are listed below. Electronic deliverables will contain the same data that are presented in the hard-copy report.

- Transmittal cover letter
- Case narrative
- Analytical results
- COC
- Surrogate recoveries
- Method blank results
- MS/MSD results
- Laboratory duplicate results

9.10.4 MFA Evaluation

9.10.4.1 Data QA/QC Review

MFA will evaluate the laboratory data for precision, completeness, accuracy, and compliance with the analytical method. MFA will review data according to applicable sections of USEPA organics and inorganic procedures (USEPA, 2008, 2010), as well as appropriate laboratory method-specific guidelines (USEPA, 1986).

Data qualifiers, as defined by the USEPA, are used to classify sample data according to their conformance to QC requirements. Common qualifiers are listed below:

- J—Estimate, qualitatively correct but quantitatively suspect.
- R—Reject, data not suitable for any purpose.
- U—Not detected at a specified reporting limit.

Poor surrogate recovery, blank contamination, or calibration problems, among other things, can require qualification of the sample data. When sample data are qualified, the reasons for the qualification should be stated in the data evaluation report.

QC criteria not defined in the guidelines for evaluating analytical data are adopted, where appropriate, from the analytical method.

The following information will be reviewed during data evaluation, as applicable:

- Sampling locations and blind sample numbers
- Sampling dates
- Requested analysis
- COC documentation
- Sample preservation

- Holding times
- Method blanks
- Surrogate recoveries
- MS/MSD results
- Laboratory duplicates (if analyzed)
- Field duplicates
- Field blanks
- LCSs
- Method reporting limits above requested levels
- Additional comments or difficulties reported by the laboratory
- Overall assessment

The results of the data evaluation review will be summarized for each data package. Data qualifiers will be assigned to sample results on the basis of USEPA guidelines, as applicable.

9.10.4.2 Data Management and Reduction

MFA uses a database (e.g., EQuIS™) to manage laboratory data. The laboratory will provide the analytical results in electronic, EQuIS-compatible format. Following data evaluation, data qualifiers will be entered into the database.

Data may be reduced to summarize particular data sets and to aid interpretation of the results. Statistical analyses may also be applied to results. Data reduction QC checks will be performed on hand-entered data, calculations, and data graphically displayed. Data may be further reduced and managed using one or more of the following computer software applications:

- Microsoft® Excel® (spreadsheet)
- EQuIS (database)
- Microsoft Access® (database)
- AutoCad and/or Arc GIS (graphics)
- USEPA ProUCL (statistical software)

10 REPORTING

After the data are received, MFA will generate a data report, which will summarize and screen the data against the applicable criteria.

LIMITATIONS

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

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

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TABLES

Table 9-1
Soil Sample Handling Summary
North Cascade Ford Property
VSF Properties, LLC
Sedro-Woolley, Washington

Analyte	Method	Suggested Volume	Container	Number of Containers	Preservative	Storage Temperature	Holding Time from Collection
Total Petroleum Hydrocarbons—Hydrocarbon Identification	NWTPH-HCID	4 ounces	Glass Jar	1	none	4 degrees C	14 days
Total Petroleum Hydrocarbons—Diesel	NWTPH-Dx	4 ounces	Glass Jar	1	none	4 degrees C	14 days
Total Petroleum Hydrocarbons—Gasoline	NWTPH-Gx	5035 Sample Kit	VOA/Glass Jar	5	5035 Sample Kit	4 degrees C	14 days
Arsenic, Cadmium, and Lead	USEPA 6020 or 200.8	4 ounces	Glass Jar	1	none	4 degrees C	six months
PAHs	USEPA 8270 SIM	4 ounces	Glass Jar	1	none	4 degrees C	14 days
PCBs	USEPA 8082A	4 ounces	Glass Jar	1	none	4 degrees C	14 days

NOTES:

5035 Sample Kit consists of two prepared 40-milliliter VOAs with 5 milliliters of sodium bisulfate, two prepared 40-milliliter VOAs with 5 milliliters of methanol, and one 2-ounce jar for moisture content determination.

C = Celsius.

NWTPH = Northwest Total Petroleum Hydrocarbons.

PAH = polycyclic aromatic hydrocarbon.

PCB = polychlorinated biphenyl.

SIM = selective ion monitoring.

USEPA = U.S. Environmental Protection Agency.

VOA = volatile organic analysis vial.

Table 9-2
Groundwater Sample Handling Summary
North Cascade Ford Property
VSF Properties, LLC
Sedro-Woolley, Washington

Analyte	Method	Suggested Volume	Container	Number of Containers	Preservative	Storage Temperature	Holding Time from Collection
Gasoline-range organics	NWTPH-Gx	40 milliliter	VOA	3	HCL pH < 2	4 degrees C	14 days
Diesel- and residual-range organics	NWTPH-Dx	1 liter	Amber Glass	1	HCL pH < 2	4 degrees C	14 days
Total organic carbon	USEPA Method 9060	250 milliliter	Amber Glass	1	H_2SO_4 pH<2	4 degrees C	28 days
Methane	USEPA Method RSK-175	40 milliliter	VOA	3	none	4 degrees C	14 days
Nitrate/nitrite and chloride	USEPA Method 325.2	500 milliliter	Polyethylene	1	5 milliliter 1:1 HNO_3	4 degrees C	28 days
Sulfate	USEPA Method 375.2	500 milliliter	Polyethylene	1	none	4 degrees C	28 days
Total phosphorus	USEPA Method 365.2	500 milliliter	Polyethylene	1	H_2SO_4 pH<2	4 degrees C	28 days
Orthophosphorus	USEPA Method 4500-P E	500 milliliter	Amber Glass	1	Filter	4 degrees C	48 hours
Total magnesium and dissolved iron	USEPA Method 200.8	500 milliliter	Polyethylene	1	HNO_3 pH < 2	4 degrees C	six months
VOCs	USEPA 8260B/8021B	40 milliliter	VOA	3	HCL pH < 2	4 degrees C	14 days

NOTES:
C = Celsius.
H_2SO_4 = sulfuric acid.
HCL = hydrochloric acid.
HNO_3 = nitric acid.
NWTPH = Northwest Total Petroleum Hydrocarbons.
USEPA = U.S. Environmental Protection Agency.
VOA = volatile organic analysis vial.
VOC = volatile organic compound.

APPENDIX A
BORING LOG FORM

MAUL FOSTER ALONGI

Boring Log Form

Boring/Well No.: ____________

Site: ____________

Location: ____________

Project #: ____________

Drill Rig		MFA Staff:		Hole Dia:		Total Depth:	
Drilling Co.:				Water Level:		WLE Note:	
Start Date:		End Date:		Water Level:		WLE Note:	
Notes:							

Completion	Sample				Soil Type:				Color:	
	Top:		Time:	Depth:	Top:		Fines:		Moisture:	
	Length:				Bottom:		Sand:		PID:	
	Type:		Sample ID		Soil Class:		Gravel:		Line Type:	
	% Recov:				Trace:				Impacts:	
					Notes:					
	Top:		Time:	Depth:	Soil Type:				Color:	
	Length:				Top:		Fines:		Moisture:	
	Type:		Sample ID		Bottom:		Sand:		PID:	
	% Recov:				Soil Class:		Gravel:		Line Type:	
					Trace:				Impacts:	
					Notes:					
	Top:		Time:	Depth:	Soil Type:				Color:	
	Length:				Top:		Fines:		Moisture:	
	Type:		Sample ID		Bottom:		Sand:		PID:	
	% Recov:				Soil Class:		Gravel:		Line Type:	
					Trace:				Impacts:	
					Notes:					
	Top:		Time:	Depth:	Soil Type:				Color:	
	Length:				Top:		Fines:		Moisture:	
	Type:		Sample ID		Bottom:		Sand:		PID:	
	% Recov:				Soil Class:		Gravel:		Line Type:	
					Trace:				Impacts:	
					Notes:					
	Top:		Time:	Depth:	Soil Type:				Color:	
	Length:				Top:		Fines:		Moisture:	
	Type:		Sample ID		Bottom:		Sand:		PID:	
	% Recov:				Soil Class:		Gravel:		Line Type:	
					Trace:				Impacts:	
					Notes:					
	Top:		Time:	Depth:	Soil Type:				Color:	
	Length:				Top:		Fines:		Moisture:	
	Type:		Sample ID		Bottom:		Sand:		PID:	
	% Recov:				Soil Class:		Gravel:		Line Type:	
					Trace:				Impacts:	
					Notes:					
	Top:		Time:	Depth:	Soil Type:				Color:	
	Length:				Top:		Fines:		Moisture:	
	Type:		Sample ID		Bottom:		Sand:		PID:	
	% Recov:				Soil Class:		Gravel:		Line Type:	
					Trace:				Impacts:	
					Notes:					
Borehole Notes:										

MAUL FOSTER ALONGI

Boring/Well Completion Form

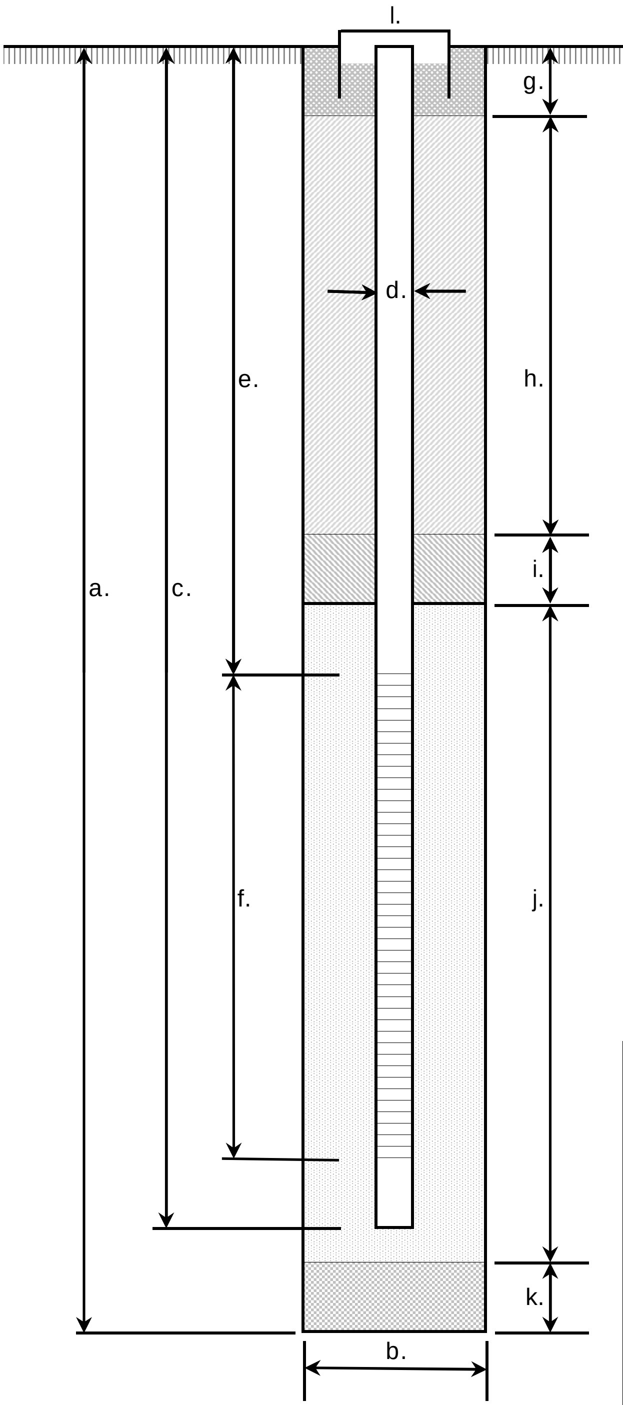
Boring/Well No.: ____________

Site: ____________

Location: ____________

Project #: ____________

Drilling Co.:		MFA Staff:		Start Date:		End Date:	
Drill Rig/ Method:				Well ID No.:		Start Card No.:	



Completion Details

a. Total Depth: ______ ft. bgs

b. Borehole diameter: ______ in.

c. Total Casing Length: ______ ft.

Material: ____________

d. Well diameter: ______ in.

e. Depth to top of screen: ______ ft. bgs

f Screen length: ______ ft.

screened interval: ______ ft. to ______ ft. bgs

Perforation type: ____________

Perforation size: ____________

g. Surface completion: ______ ft. bgs

completion material: ____________

Amount: ____________

h. Surface Seal: ______ ft. to ______ ft. bgs

Seal material: ____________

Amount: ____________

i. Secondary seal/pack: ______ ft. to ______ ft. bgs

Material: ____________

Amount: ____________

j. Filter Pack: ______ ft. to ______ ft. bgs

Material: ____________

Amount: ____________

Prepacked screen used: ____________ (Yes/No)

k. Seal or Slough: ______ ft. to ______ ft. bgs

Material: ____________

Amount: ____________

l. Type of well monument: ____________

Well height above/below ground surface: ______ ft. bgs

gINT Data

Top	Bottom	gINT Graphic

gINT Graphic Options*

Surface Completion
- CMNT11

Borehole Seal
- BENT11

Filter Pack
- FILT11, FILT11-A

Screen
- SLOT11

Sump
- PCAP11, PCAPBENT11

Backfill
- BENTBOTT, FILTBOTT, SLUFFBOTT

*more graphics available

Note:

APPENDIX B

FIELD SAMPLING DATA SHEET

Maul Foster & Alongi, Inc.

7223 NE Hazel Dell Avenue, Suite B, Vancouver, WA 98665 (360) 694-2691 Fax. (360) 906-1958

Water Field Sampling Data Sheet

Client Name		**Sample Location**	
Project #		**Sampler**	
Project Name		**Sampling Date**	
Sampling Event		**Sample Name**	
Sub Area		**Sample Depth**	
FSDS QA:		**Easting** ____ **Northing** ____ **TOC** ____	

Hydrology/Level Measurements

Date	Time	DT-Bottom	DT-Product	DT-Water	(Product Thickness) DTP-DTW	(Water Column) DTB-DTW	(Gallons/ft x Water Column) Pore Volume

(0.75" = 0.023 gal/ft) (1" = 0.041 gal/ft) (1.5" = 0.092 gal/ft) (2" = 0.163 gal/ft) (3" = 0.367 gal/ft) (4" = 0.653 gal/ft) (6" = 1.469 gal/ft) (8" = 2.611 gal/ft)

Water Quality Data

Purge Method	Time	Purge Vol (gal)	Flowrate l/min	pH	Temp (C)	E Cond (uS/cm)	DO (mg/L)	EH	Turbidity
Final Field Parameters									

Methods: (1) Submersible Pump (2) Peristaltic Pump (3) Disposable Bailer (4) Vacuum Pump (5) Dedicated Bailer (6) Inertia Pump (7) Other (specify)

Water Quality Observations:

Sample Information

Sampling Method	Sample Type	Sampling Time	Container Code/Preservative	#	Filtered
	Groundwater		VOA-Glass		
			Amber Glass		
			White Poly		
			Yellow Poly		
			Green Poly		
			Red Total Poly		
			Red Dissolved Poly		
			Total Bottles	0	

General Sampling Comments

Signature ______________________________