SUBMITTED TO:
Alaska Department of Transportation & Public Facilities
2301 Peger Road
Fairbanks, Alaska 99709

BY:
Shannon & Wilson, Inc.
2355 Hill Road
Fairbanks, AK 99709

(907) 479-0600
www.shannonwilson.com

REVISION 1

WORK PLAN

Bethel Airport AFFF Release Site Characterization

BETHEL, ALASKA

SHANNON & WILSON

April 2020

Shannon & Wilson No: 104507-001

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Submitted To: Alaska Department of Transportation & Public Facilities
2301 Peger Road
Fairbanks, Alaska 99709
Attn: Ms. Samantha Cummings

Subject: REVISION 1 WORK PLAN, BETHEL AIRPORT AFFF RELEASE SITE CHARACTERIZATION, BETHEL, ALASKA

The services proposed in this Work Plan will be conducted on behalf of the Alaska Department of Transportation & Public Facilities (DOT&PF). Our scope of services was specified in our proposal dated November 27, 2019 and authorized on December 30, 2019 by DOT&PF under our Professional Services Agreement Number 25-19-1-013 Per- and Polyfluoroalkyl Substance (PFAS) Related Environmental & Engineering Services. Additional funding to implement this Work Plan and prepare a final report will be requested following Alaska Department of Environmental Conservation (DEC) approval.

This Work Plan was prepared and reviewed by:

Ashley Jaramillo
Chemist, Project Manager

Kristen Freiburger
Senior Chemist, Associate

Christopher Darrah, CPG, CPESC
Vice President, Contract Manager

AMJ:KRF:CBD/amj

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ACRONYMS

AAC	Alaska Administrative Code
AFFF	aqueous film-forming foam
ARFF	aircraft rescue fire fighting
BET	Bethel Airport
°C	degrees Celsius
COC	chain-of-custody
COPC	contaminant of potential concern
DEC	Alaska Department of Environmental Conservation
DOT&PF	Alaska Department of Transportation and Public Facilities
DRO	diesel range organics
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
eV	electron volt
°F	degrees Fahrenheit
GAC	granular activated carbon
GPS	Global Positioning System
GRO	gasoline range organics
HDPE	high density polyethylene
MS	matrix spike
MSD	matrix spike duplicate
µg/kg	micrograms per kilograms
mg/kg	milligrams per kilograms
mL	milliliter
oz	ounce
PAH	polycyclic aromatic hydrocarbons
PFAS	per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PID	photoionization detector
ppm	part per million
RPD	relative percent difference
RRO	residual range organics
SSHP	Site Safety and Health Plan
QA	quality assurance
QC	quality control
VOA	volatile organic analysis
VOC	volatile organic compound

1 INTRODUCTION

This Work Plan describes the proposed approach for site characterization activities at the Bethel Airport (BET) aqueous film-forming foam (AFFF) release site in Bethel, Alaska (Figure 1). This site is an active Alaska Department of Environmental Conservation (DEC)-listed contaminated site due to the release of AFFF, presumed to contain per- and polyfluoroalkyl substances (PFAS), following a Grant Aviation plane crash on July 8, 2019 (File Number 2407.38.030, Hazard ID 27139).

This Work Plan has been prepared in general accordance with DEC's *March 2017 Site Characterization Work Plan and Reporting Guidance for Investigation of Contaminated Sites*. Field activities will be conducted in general accordance with DEC's October 2019 *Field Sampling Guidance*, and our Site Safety and Health Plan (SSHP) presented in Appendix A.

1.1 Data Quality Objectives

The data quality objectives (DQOs) for this project are based on the six-part DQO process presented in DEC's March 2017 *Data Quality Objectives, Checklists, Quality Assurance Requirements for Laboratory Data, and Sample Handling* technical memorandum. The results of sampling will support an informed evaluation of the extent of contamination at the AFFF release site on the BET. Findings from site characterization activities will guide recommendations for additional site investigations or corrective action, as necessary.

1.1.1 Project Objective and Goal

The objective of this project is to sample surface and subsurface soil and surface water (if present) at the AFFF release site to determine the presence or absence of and the degree of contamination related to the contaminants of potential concern (COPCs) resulting from the Grant Aviation plane crash and subsequent AFFF release on July 8, 2019. The goals of this project are to identify the AFFF release site and location of where the plane came to rest in the field and to delineate, to the extent practicable, contamination in surface and subsurface soil and surface water samples collected within the AFFF release site boundaries (Section 1.1.3).

1.1.2 Information Inputs

During the site visit, Shannon & Wilson field staff will conduct field screening activities and collect surface soil, subsurface soil, and surface water (if present) samples from the site boundary for analysis by the following methods:

- 18 PFAS by U.S Environmental Protection Agency (EPA) method 537M,
- Gasoline range organics (GRO) by method AK101,
- Diesel range organics (DRO) by method AK102,
- Residual range organics (RRO) by method AK103,
- Volatile organic compounds (VOCs)by EPA method 8260D, and
- Polycyclic aromatic hydrocarbons (PAHs) by EPA method 8260D.

The details of these samples are described in Section 5.0.

1.1.3 Study Boundaries

Based on the current information regarding the July 8, 2019 Grant Aviation plane crash at the BET and resulting AFFF release, the boundary for the proposed services is an approximately 105 feet by 105 feet grassy area located between runways 1L/19R and 1R/19L and southeast of runway 12/30 (Figure 2). Shannon & Wilson field staff will coordinate with BET Alaska Department of Transportation and Public Facilities (DOT&PF) staff to identify the crash location and resulting AFFF release area prior to the start of field activities.

Historical releases of AFFF are presumed to have occurred at the BET. However, at the time this Work Plan was prepared, information was not available regarding other AFFF releases at the BET. Based on the results of this sampling effort at the AFFF release site, the site boundaries may be revised and/or recommendations may be made for further site characterization work at the BET for areas outside of the site boundaries established in this Work Plan.

1.1.4 Proposed Analytical Approach

Contaminants of potential concern (COPCs) and proposed cleanup levels are outlined in Section 3.0. Analytical methods are presented in Section 6.0.

1.1.5 Acceptance Criteria

For measurement data, the DQO is to verify environmental data are of known and acceptable quality. For analytical data, the DQO is to meet acceptable quality assurance (QA) standards of precision, accuracy, representativeness, comparability, and completeness.

Laboratory and field quality control (QC) measures are outlined in Section 6.0. QA objectives for analytical data and data review procedures are presented in Section 7.0.

1.1.6 Data Collection Methods and Procedures

Sample collection and handling procedures are outlined in Section 5.0.

1.2 Project Schedule and Submittals

Once DEC approval is received for the proposed scope of services outlined in this Work Plan, we will coordinate with DOT&PF staff to collect samples of soil and surface water (if present). Field activities are anticipated to occur during one site visit in summer 2020. Laboratory analysis will be requested on a standard 14-day turn-around time.

After field work is complete, we will prepare a summary report documenting the results of the sampling event. The report will include summarized field observations, Global Positioning System (GPS) points for the plane crash location, analytical results and discussion of data quality, photo documentation, figures showing sample locations, description of deviations from the approved Work Plan, if any, and conclusions and recommendations. The report will also include an updated conceptual site model.

The following is the anticipated schedule:

- Work Plan Implementation (field activities) - summer 2020
- Draft Report Submittal - within 60 days of receipt of analytical results
- Final Report Submittal - within 30 days of receiving DEC comments on the Draft Report

1.3 Project Team

Chris Darrah will be Shannon & Wilson's Principal-in-Charge and Ashley Jaramillo will serve as the Project Manager. Shannon & Wilson's project team also includes other State of Alaska Qualified Environmental Professionals to support the various field and reporting tasks required to achieve the project objectives. The project team and their associated responsibilities are summarized in Exhibit 1-1 below.

Exhibit 1-1: Project Team

Member	Responsibility	Representative	Contact Number
DOT&PF	Client	Sam Cummings, Statewide PFAS Coordinator	(907) 888-5671
DEC	Regulator	Erin Gleason, Project Manager	(907) 269-7556
Shannon & Wilson, Inc.	Principal-in-Charge	Chris Darrah, Principal-in-Charge	(907) 458-3143
	Project Manager	Ashley Jaramillo, Project Manager	(907) 458-3118
Eurofins TestAmerica Laboratories, Inc.	Analytical laboratory services	David Alltucker, Project Manager	(916) 374-4383

2 SITE AND PROJECT DESCRIPTION

2.1 Background

On July 8, 2019, a Grant Aviation aircraft caught fire after a crash landing at the BET in Bethel, Alaska. The plane came to rest in a grassy area located between runways 1L/19R and 1R/19L and southeast of runway 12/30 (Figure 2). BET DOT&PF aircraft rescue and fire fighting (ARFF) staff responded and released approximately 80 gallons of 3% Ansulite brand AFFF to extinguish the fire. The approximate geographic coordinates of the crash site are latitude: 60.7759, longitude: -160.8374.

AFFF is known to contain PFAS, a category of persistent organic compounds considered emerging contaminants. Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) are two PFAS commonly found at sites where AFFF was used. Due to their persistence, toxicity, and bioaccumulative potential, these compounds are of increasing concern to environmental and health agencies.

On September 20, 2019, DEC issued DOT&PF two letters regarding the release of AFFF following the Grant Aviation plane crash at the BET. The first letter, a notification of hazardous substance liability, assigned the crash site a DEC contaminated sites file number of 2407.38.030. The second letter requested, at a minimum, characterization of the site to determine if any unacceptable risks to human health or the environment exist from PFAS assumed to be present in the AFFF used at the site.

The field activities proposed in this Work Plan revolve around DEC's request for site characterization of the AFFF release site. Historical releases of AFFF are presumed to have occurred at the BET; however, the work proposed in this Work Plan does not address other releases of AFFF at the BET.

2.2 Site Characterization Field Activities

Site characterization activities will be performed in general accordance with the conditions of the *DOT&PF Professional Services Agreement Number 25-19-1-013 Per- and Polyfluoroalkyl Substance (PFAS) Related Environmental & Engineering Services, 18 Alaska Administrative Code (AAC) 75, and the DEC Field Sampling Guidance*. Sample locations were selected based on publicly available information and documentation provided by DOT&PF regarding the July 8, 2019 Grant Aviation plane crash and the resulting AFFF release.

This Work Plan will guide the following:

- field screening;

- surface and subsurface soil sample collection;
- surface water (if present) sample collection;
- laboratory analysis; and
- evaluation and reporting of the analytical data.

The details of these tasks are described in Section 5.0. Analytical laboratories and methods are described in Section 6.0.

3 CONTAMINANTS OF POTENTIAL CONCERN AND REGULATROY LEVELS

The primary COPCs are PFAS, specifically PFOS and PFOA. However, Appendix F of DEC's *Field Sampling Guidance* identifies the following additional COPCs for sites associated with fire training facilities, fires, and facilities where AFFF was used: GRO, DRO, RRO, VOCs, and PAHs. We will request 18 PFAS analytes be analyzed; however, only PFOS and PFOA are currently regulated with established cleanup levels. To evaluate analytical data, results be will compared to Alaska's 18 AAC 75.341 *Tables B1 Method Two – Migration to Groundwater and B2, Method Two – Under 40-Inch Zone Migration to Groundwater*. The current soil cleanup levels for the site COPCs are summarized below in Exhibit 3-1.

Exhibit 3-1: Applicable Regulatory and Action Levels

Agency	Media	Compound	Level
DEC	Soil	GRO	300 mg/kg[1]
DEC	Soil	DRO	250 mg/kg[1]
DEC	Soil	RRO	11,000 mg/kg[1]
DEC	Soil	VOCs	Analyte dependent[2]
DEC	Soil	PAHs	Analyte dependent[2]
DEC	Soil	PFOS	3.0 µg/kg[2]
DEC	Soil	PFOA	1.7 µg/kg[2]

NOTES:

1 DEC migration-to-groundwater soil-cleanup levels are reported in 18 AAC 75.341, Table B2.

2 DEC migration-to-groundwater soil-cleanup levels are reported in 18 AAC 75.341, Table B1.

µg/kg = micrograms per kilogram, mg/kg = milligrams per kilogram

4 PRELIMINARY CONCEPTUAL SITE MODEL

A CSM describes potential pathways between a contaminant source and possible receptors (i.e., people, animals, and plants) and is used to determine who may be at risk of exposure

to those contaminants. This information is summarized on the *Human Health Conceptual Site Model Graphic Form* in Appendix B; both the scoping and graphic forms are provided.

Based on the current understanding of the AFFF release site conditions potentially contaminated media include soil (both surface and subsurface), groundwater, surface water, outdoor air, sediment, and biota.

Potential receptors include construction workers, commercial or industrial workers, site visitors, and trespassers. Potential exposure routes include incidental soil ingestion, dermal absorption of contaminants from soil, ingestion of groundwater, dermal absorption of contaminants in groundwater, inhalation of outdoor air, and dermal absorption of contaminants in surface water.

5 SAMPLING AND ANALYSIS PLAN

This section describes the analytical sampling approach to investigate the presence of PFAS and petroleum contamination at the AFFF release site. A DEC-qualified sampler will collect and handle the samples for this project and collect required QC samples in accordance with *18 AAC 75* and the DEC's *Field Sampling Guidance*. Field personnel will document field activities with field notes and photographs, in accordance with Section 6.3 of this Work Plan. Analytical samples collected as a part of this site assessment will be submitted to Eurofins TestAmerica West Sacramento, a DEC-approved analytical laboratory, for analysis, as outlined in Section 5.3.

5.1 Site Preparation

Shannon & Wilson field staff will coordinate with BET DOT&PF staff to identify the crash location and resulting AFFF release area prior to the start field activities. The approximate 105 feet by 105 feet site boundary will be marked in the field. The site will then be divided into 49 grid units of 15 feet by 15 feet. Additionally, the plane crash location (where the plane came to rest) will be marked in the field, if possible and for the purposes of this work plan is assumed to encompass three grid units.

5.2 Field Screening

Table 2B, Surface/Excavation Base and Excavation Sidewall Soil Sample Collection Guide in the DEC *Field Sampling Guidance* was reviewed to determine the frequency of field screening. Three field screening samples will be collected from each of the 49 grid units for a total of 147 field screening samples across the site.

Field-screening samples will be collected using the methods outlined in the following section.

5.2.1 PID Field-Screening

Surface soil samples will be screened using a photoionization detector (PID) equipped with a 10.6 electron-Volt (eV) lamp to estimate the relative concentration of volatile organic compounds (VOCs). The PID will be a hand-held MiniRae 2000 Portable VOC Monitor manufactured by Rae Systems, Inc. The PID measures total volatile compounds present as vapors as a semi-quantitative indication of hydrocarbons present. The MiniRae provides a three second response time up to 10,000 parts per million (ppm). The PID will be calibrated daily, or more often as needed, to a 100-ppm isobutylene-in-air standard in accordance with the manufacturer's instructions. Field-screening samples will be collected from within the site boundary from freshly uncovered material at approximately 2-6 inches below the soil surface for volatile samples. Field-screening samples will be collected from freshly uncovered soil using a clean, stainless-steel spoon and place the soil in a clean, sealable plastic bag, filling it one-third to one-half full, quickly sealing it closed.

Potential vapors will be allowed to develop in the headspace (unfilled portion of the bag) by warming it up to at least 40 degrees Fahrenheit (°F) for 10 minutes to one hour, shaking for 15 seconds at the beginning and end of the period to assist volatilization. The bag will be opened just enough to allow insertion of the PID probe about one-half the headspace depth, taking care to avoid uptake of water droplets and soil particles. The maximum PID reading obtained will be recorded, noting any erratic meter response at high-organic vapor concentrations or conditions of elevated headspace moisture. Samples with a PID reading above 20 ppm will be considered contaminated.

Following screening, the soil samples will be emptied from the bags onto the ground surface. Field observations (i.e., location of permanent features), PID results, and the approximate locations of field-screening samples will be recorded in the field notebook. A table and associated map of field-screening results and locations will be prepared and included with the field report.

5.3 Analytical Sampling

We reviewed Table 2B, Surface/Excavation Base and Excavation Sidewall Soil Sample Collection Guide in the DEC *Field Sampling Guidance* to determine the frequency of analytical sample collection and are proposing an alternative sampling frequency described in the following sections.

We will ship the analytical samples Eurofins TestAmerica in West Sacramento, California to be analyzed as presented in Exhibit 5-1 below.

Exhibit 5-1: Analytical Sample Summary

	Matrix	PFAS (EPA 537.1)	GRO (AK101)	DRO (AK102)	RRO (AK103)	VOC (EPA 8260D)	PAH (EPA 8270D)
Number of Samples[4,5,6]	Surface Water[1]	2 + 1 QC	2 + 1 QC	2 + 1 QC	2 + 1 QC	2 + 1 QC	2 + 1 QC
	Surface Soil[2]	49 + 7 QC	49 + 5 QC	49 + 5 QC	49 + 5 QC	49 + 5 QC	49 + 5 QC
	Subsurface Soil[3]	3 + 3 QC	3 + 1 QC	3 + 1 QC	3 + 1 QC	3 + 1 QC	3 + 1 QC

NOTES:

1 Surface water samples will only be collected if surface water is present within the project boundary at the time of the sampling event. A maximum of two surface water samples will be collected, if present.

2 Surface soil samples for petroleum parameters (GRO, DRO, RRO, VOCs, and PAHs) will be collected where field screening results are greater than 20 ppm. Where applicable, a maximum of one petroleum sample will be collected per grid unit. If field screening results are not greater than 20 ppm, a single surface soil sample and field duplicate will be collected for petroleum parameters from the highest initial PID reading.

3 Subsurface soil samples will be collected if groundwater is not encountered at the time of sampling. Subsurface soil samples will be collected from the three grid units identified as where the crashed plane came to rest, unless PID readings indicate otherwise. Petroleum samples will be collected if initial field screening results showed readings above 20 ppm. Where applicable, a maximum of one petroleum sample will be collected from each of the three grid units for a total of three. If field screening results are not greater than 20 ppm, a single subsurface soil sample and field duplicate will be collected for petroleum parameters from the highest initial PID reading. We understand if elevated PID readings are observed in the initial subsurface sample that deeper samples will need to be collected until clean soil is documented, or the zone of saturation is reached. We will collect samples to the extent practicable and within the limitations of the field sampling equipment brought to the site. Additional sampling events may be required to reach clean limits or establish that contamination has reached the zone of saturation.

4 QC samples included in this table are field duplicates and MS/MSD samples (PFAS). Other QC samples to be collected as a part of this project include trip blanks (if applicable), field blanks, and equipment blanks.

5 Number of samples presented in this table represent the maximum number of samples that could be collected. The actual number of samples to be collected for each parameter will be dictated by field conditions and field screening results.

5.3.1 Surface Soil

Surface soil samples will be collected between 0 and 2 feet below ground surface. One PFAS surface soil sample will be collected from each of the 49 grid units. Petroleum samples (GRO, DRO, RRO, VOC, and PAH parameters) will be limited to grid units where field screening results are greater than 20 ppm, with a maximum of one petroleum sample per grid unit. Where applicable, the petroleum sample will be collected from the location with the highest PID result above 20 ppm. If field screening results are not greater than 20 ppm, a single surface soil sample will be collected for petroleum parameters from the location with the highest overall surface soil PID reading.

5.3.2 Subsurface Soil

Subsurface soil samples will be collected between 2 and 6 feet below ground surface from the grid units where the crashed plane came to rest, which is presumed to equal

approximately three grid units. The location the crashed plane came to rest will be based on conversations with local DOT&PF staff, unless surface-soil field screening indicates otherwise. One PFAS subsurface soil sample will be collected from each of the three grid units. One petroleum subsurface soil sample will be collected from each of the three grid units from where the plane came to rest if PID results above 20 ppm were observed during initial field screening. Where applicable, the petroleum sample will be collected from the location with the highest initial field screening PID result (above 20 ppm). If field screening results are not greater than 20 ppm, a single subsurface soil sample will be collected for petroleum parameters from the location with the highest PID reading. Subsurface soil samples will be collected unless groundwater is encountered in the subsurface; we do not have reliable information on the potential for groundwater contamination at the BET not related to the AFFF release site.

We understand that if elevated PID readings are observed in the initial subsurface sample, deeper samples will need to be collected until clean soil is documented, or the zone of saturation is reached. We will collect samples to the extent practicable and within the limitations of the field sampling equipment brought to the site (hand tools and augers). Additional sampling events may be required to reach clean limits or establish contamination has reached the zone of saturation.

5.3.3 Surface Water

One PFAS and petroleum sample will be collected from surface water bodies located within the project area, where present, with a maximum of two total samples collected.

5.4 Soil Sample Collection Procedures

New, clean, stainless-steel spoons will be used for the collection of each sample. Surface soil samples will be collected just below vegetation and the subsurface soil samples will be collected at least 2 feet below ground surface, using a hand auger. The samples will be placed in an appropriate laboratory-supplied container. Field personnel will change nitrile gloves before collecting each sample to prevent cross-contamination and exposure.

5.5 Surface Water Sampling Collection Procedures

The proposed water-sampling activities include collecting two surface water samples from the AFFF release site, if surface water is present. Surface water samples will be collected at least 72 hours after a rain event, if possible, to prevent potential dilution effects from the rain event. Samples will be collected using hand-held laboratory provided bottle. Samples will be collected as close to the center of water body cross section as possible. Our samplers may enter shallow water bodies to collect the samples. Prior to entering a water body, our

samplers will verify they are not wearing PFAS-containing clothing or gear. Care will be taken to prevent disturbance of the sediment below; samples will be collected once disturbed solids have settled to the bottom or have moved down stream. Sample containers will be labeled with a unique identifier, date, and time, and placed immediately in a cooler with ice-substitute.

5.6 Special Considerations for PFAS Sampling

Because PFOS and PFOA are found in numerous everyday items, the following special precautions will be taken during sampling activities:

- No use of Teflon®-containing materials (e.g., Teflon® tubing, bailers, tape, sample container lid liners, or plumbing paste).
- No Tyvek® clothing will be worn on-site.
- Clothes treated with stain-, flame-, or rain-resistant coatings will be avoided or go through several washings prior to use on-site.
- No Post-It® notes will be brought on-site.
- No fast food wrappers, disposable cups, or microwave popcorn will be brought on-site.
- After handling the above items, field personnel will wash their hands thoroughly with soap and water prior to sampling activities.
- No use of foil.
- No use of chemical (blue) ice packs.
- Change nitrile gloves between each sample location.
- No preservative, other than chilling is required for PFAS analysis.
- Label jars using permanent, waterproof ink.

5.7 Investigation-Derived Waste

We do not anticipate there will be excess soil generated during sampling. We will return soils collected for field-screening purposes back to the location they originated. Decontamination fluids will be treated through granular activated carbon (GAC) and disposed of to the ground surface on-site. An effluent sample will be collected following the completion of the project. Other investigation-derived waste will include non-reusable equipment such as nitrile gloves and sample tubing and will be disposed of in the Bethel landfill.

6 ANALYTICAL LABORATORIES AND METHODS

Samples will be shipped for analysis via air courier to Eurofins TestAmerica in West Sacramento, California. Upon receipt of the samples, authorized laboratory personnel will store and prepare the samples for analysis, taking into consideration sample holding times for each analysis. A summary of laboratory methods, preservation methods, and holding times is presented in Exhibit 6-1. Analytical deliverables will be provided as described in Section 7.4.

Exhibit 6-1: Sample Containers, Preservation, and Holding Time Requirements

Analyte	Method	Media	Container and Sample Volume	Preservation	Holding Time
PFAS	EPA 537M	Water	2 x 250-mL HDPE bottles	0 °C to 6 °C	14 days to extraction, analyzed within 40 days of extraction
		Soil	4-ounce amber glass jar filled to near capacity		
GRO	AK101	Water	3 x 40-mL VOA vials (no headspace)	HCl to <4 0 °C to 6 °C	14 days to extraction, analyzed within 40 days of extraction
		Soil	Pre-weighed 4-oz amber glass jar with septa	25mL MeOH 0 °C to 6 °C	
DRO	AK102	Water	2 x 250-mL amber glass	HCl to <4 0 °C to 6 °C	7 days to extraction, analyzed within 40 days of extraction
		Soil	4-oz amber glass jar	0 °C to 6 °C	14 days to extraction, analyzed within 40 days of extraction
RRO	AK103	Water	2 x 250-mL amber glass	HCl to <4 0 °C to 6 °C	7 days to extraction, analyzed within 40 days of extraction
		Soil	4-oz amber glass jar	0 °C to 6 °C	14 days to extraction, analyzed within 40 days of extraction
VOCs	EPA 8260D	Water	3 x 40-mL VOA vials (no headspace)	HCl to <4 0 °C to 6 °C	14 days
		Soil	Pre-weighed 4-oz amber glass jar with septa	25mL MeOH 0 °C to 6 °C	
PAHs	EPA 8270D	Water	2 x 250-mL amber glass	0 °C to 6 °C	7 days to extraction, analyzed within 40 days of extraction
		Soil	4-oz amber glass jar		14 days to extraction, analyzed within 40 days of extraction

°C = degrees Celsius, HDPE = high density polyethylene, mL = milliliter, oz = ounce, VOA = volatile organic analysis

6.1 Sample Custody, Storage, and Shipping

Prior to the delivery to the laboratory, the samples will be in the custody of Shannon & Wilson personnel. During field activities, samples will be stored in a cooler with adequate quantities of ice substitute to maintain samples between 0° C to 6° C.

The field representative will complete chain-of-custody (COC) records to document sample possession from the point of collection to the time of receipt by the laboratory's sample-control center. Shannon & Wilson personnel will keep a copy of the COC record to document sample accountability between field and laboratory.

We will ship the samples to the analytical laboratory with sufficient time to allow for the laboratory to extract the sample within the applicable holding time requirements. The field representative will pack the samples in a hard-plastic cooler with bubble wrap and enough ice substitute to maintain samples between 0° C to 6° C during travel. They will pack a "temperature blank" with the samples in each cooler, carefully tape the cooler shut, and affix dated and signed custody seals across the front of the hinged cooler lid.

6.2 Equipment Decontamination

All reusable equipment introduced into sample collection must be decontaminated prior to use and reuse. Decontamination procedures will be as follows:

- non-phosphate detergent wash;
- tap water rinse;
- distilled-water rinse; and
- PFAS-free water rinse.

6.3 Field Notebook

Shannon & Wilson will maintain a bound field notebook throughout the project to document our field activities, procedures, and observations. The field notebook will have consecutively numbered pages. The field representative will sign and date each page on the day he or she makes entries. Entries in the notebook will be in waterproof ink, and include the following:

- Name of field screening and sampling personnel;
- Names and affiliations of pertinent field contacts;
- Date and time(s) of sampling along with sample locations;
- A summary of field measurements and observations;

- GPS points for the plan crash location;
- Unusual/unexpected problems, including observations of leaks, releases, signs of soil contamination, or other unusual items;
- Photographic data (contact number, date/time, location, photographer, photograph number, description, and direction of view);
- Calibration records, if applicable; and
- Weather conditions.
- We will also utilize sampling forms to document our activities. These forms are located in Appendix C.

6.4 Deviations and Modifications to Work Plan

Deviations from the procedures discussed in this document may be required due to circumstances that may arise during a given sampling event. Deviations from the specified program and the purpose for the deviation will be clearly documented in field logs and reported to the project manager.

The project report will include a separate section discussing deviations from the procedures outlined in this Work Plan. Modifications to this Work Plan may be made in the form of an addenda.

7 QUALITY ASSURANCE PROJECT PLAN

QA and QC are important components of an environmental site investigation. QA is the integrated program for measuring the reliability of data. QC is the routine use of specific procedures set forth to meet defined standards for sampling and analysis. This QA/QC plan describes specific procedures to be followed so the sampling, documentation, and laboratory data are effective and do not detract from the quality and reliability of the results. Services performed on this project will be in general accordance with the DEC Field Sampling Guidance. This section of the Work Plan describes our project-specific details.

7.1 QC Samples

QA and QC are important components of an environmental site investigation. QA is the integrated program for measuring the reliability of data. QC is the routine use of specific procedures set forth to meet defined standards for sampling and analysis.

7.1.1 Temperature Blanks

Each sample cooler will contain a temperature blank. We will add artificial ice as necessary to maintain an interior cooler temperature within the range of 0 °C to 6 °C. Temperature blanks will consist of a jar filled with water and packed with the samples in each cooler. The water temperature in the blank will be measured at the laboratory. The laboratory will document sample and cooler conditions, including temperature.

7.1.2 Field Duplicates

We will collect duplicate samples at a minimum of 10 percent of the overall project samples for each sample matrix. We will collect field-duplicate samples by filling an additional, complete set of sample containers. Duplicates will be analyzed using the same analytical method used for the primary sample. If possible, we will collect duplicate samples from locations suspected to be contaminated, as calculation of duplicate precision is not possible for samples with contaminants below detection limits. We will assign a separate sample number to duplicates and submit them "blind" to the laboratory. We will use duplicate-sample results to test the comparability of analytical data.

7.1.3 MS/MSD

We will collect matrix spike/matrix spike duplicate (MS/MSD) samples for laboratory analysis at a minimum of 5 percent for soil samples for PFAS analysis only.

7.1.4 Equipment Blanks

An equipment blank will be collected daily from reusable soil-sampling equipment. Following decontamination of the hand trowel used for the soil samples, the equipment blank will be collected by pouring certified PFAS-free water down the length of the trowel and collecting the rinsate in a sample jar.

7.1.5 Field Blanks

Field blanks are used to assess whether airborne, particulate PFAS may be contaminating samples during collection. We will collect a field blank daily. We will collect the field blank after collecting a soil sample, without changing gloves, by pouring PFAS-free water into a sample jar.

7.1.6 Trip Blanks

We will use trip blanks to detect and quantify potential volatile analyte cross-contamination between samples or contamination originating from an outside source. The laboratory will create one trip-blank set for each matrix (soil and surface water) and sample cooler

containing volatile samples. Field personnel will transport trip blanks to the sampling location and return them to the laboratory in the same cooler as their associated project samples. The laboratory will analyze the trip blank for volatile parameters using the same analytical method as the project samples. The concentration of any volatile artifacts found in the trip blank will be noted and compared to the project-sample results.

7.2 Data Quality Objectives

The laboratory supervisor or other responsible party will validate the laboratory tests and include evaluation for precision and accuracy of the data set. The laboratory QC officer or other responsible party will review and sign analytical data before release. Data reporting will be included in the laboratory reports submitted to Shannon & Wilson. Individual laboratory reports and completed DEC laboratory data review checklists (Appendix D) will be included with our final report.

The QA objective for measurement data is to verify environmental monitoring data are of known and acceptable quality. Due to the heterogeneous nature of soils, exact duplication of soil samples is often not possible. In addition, matrix interference in soil samples can adversely affect comparability of duplicate laboratory results. For analytical data, the objective is to meet acceptable QA standards of precision, accuracy, representativeness, comparability, and completeness. These terms are defined below. Analytical data may be rejected due to gross QA/QC failures that bring into question the reliability of the results. In these extreme cases, the analytical results are considered unusable and are qualified with an 'R'-flag. These data will not be used in statistical data evaluations.

- Precision: is a measure of agreement among replicate or duplicate results of the same analyte. The laboratory objective for precision is to equal or exceed the precision demonstrated for similar samples and shall be within the established control limits for the methods as published by the EPA. Precision will be measured as the relative percent difference (RPD) between project and duplicate samples. Our goal is not to exceed the DEC precision limits of ±30 percent for water samples and ±50 percent for soil samples.
- Accuracy: is a measure of bias in a measurement system. Accuracy will be expressed as the percent recovery of an analyte from a surrogate or MS sample, or a standard reference material. The laboratory objective for accuracy is to equal or exceed accuracy demonstrated for these analytical methods on similar samples and shall be within the established control limits for the methods as published by the EPA.
- Representativeness: is a quality characteristic attributable to the type and number of samples to be taken to be representative of the medium/environment (e.g., soil or water). Sample locations will be selected in the field to be representative of the soils or water at that location, within the constraints of sample-location guidelines in the regulations.

- Comparability: is a qualitative parameter expressing the confidence with which one data set can be compared to another. The sampling method employed, methods used for the transfer of samples to the analytical laboratory, and analytical techniques implemented at the laboratory shall be performed in a uniform manner.
- Completeness: is a measure of the number of valid measurements obtained in relation to the total number of measurements planned. Results qualified as rejected negatively influence completeness. The objective of completeness is to generate an adequate database to successfully achieve the goals of the investigation. Our goal is to exceed the DEC completeness limit of 85 percent for project samples.

DQOs will meet DEC limits and are presented in Exhibit 7-1 below; reporting limit goals for this project will be below DEC cleanup levels. The laboratory will be asked to flag analytes detected below the reporting limit but above the method detection limit as estimated values (J-flags).

Exhibit 7-1: Quality Assurance Objectives for Analytical Samples

Analyte	Method	Matrix	Precision	Accuracy	Completeness
PFOS & PFOA	EPA 537M	Water	±30%	(analyte dependent)	85%
		Soil	±50%	(analyte dependent)	85%
GRO	AK101	Water	±30%	60-120%	85%
		Soil	±50%	60-120%	85%
DRO	AK102	Water	±30%	60-120%	85%
		Soil	±50%	60-120%	85%
RRO	AK103	Water	±30%	60-120%	85%
		Soil	±50%	60-120%	85%
VOCs	8260D	Water	±30%	(analyte dependent)	85%
		Soil	±50%	(analyte dependent)	85%
PAHs	8270D	Water	±30%	(analyte dependent)	85%
		Soil	±50%	(analyte dependent)	85%

Analytical data will be evaluated against the QA/QC objectives outlined above. Data is accepted when it meets project QA/QC objectives. Analytical data may be rejected due to gross QA/QC failures that bring into question the reliability of the results. In these extreme cases, the analytical results are considered unusable and are qualified with an 'R'-flag. These data will not be used in statistical data evaluations.

7.3 Field-Instrument Use and Calibration

Equipment and instrument calibration allows for accurate and reliable measurements to be obtained.

7.3.1 PID

Calibration checks will be completed once per day, or more often as necessary. The calibration results, as well as any instrument maintenance and error messages, will be recorded in a designated logbook kept with the instrument. The PID battery will be charged prior to use, the detector lamp will be cleaned; the inlet filter will be replaced regularly, in accordance with the manufacturer's instructions.

According to the manufacturer's information, the measurement accuracy of the MiniRae 2000 PID is ±10 percent of a reading or ±2 ppm, whichever is greater, between 0 and 2,000 ppm. The accuracy is ±20 percent of a reading above 2,000 ppm. The precision is 1 percent of calibration (calibrated with 100 ppm isobutylene).

7.4 Laboratory Data Deliverables

Shannon & Wilson will request standard DEC-Level II Data Deliverables from the analytical laboratory for transmittal with the summary report. An internal QA assessment will be included, and a copy of the completed DEC laboratory data review checklist will be submitted (Appendix D).

8 REFERENCES

Alaska Department of Environmental Conservation (DEC), 2019, 18 AAC 75: Oil and other hazardous substances pollution control: Juneau, Alaska, July, available: http://dec.alaska.gov/commish/regulations/.

Alaska Department of Environmental Conservation (DEC), 2019, 18 AAC 75.341 Table B1, Method Two – Migration to Groundwater.

Alaska Department of Environmental Conservation (DEC), 2019, 18 AAC 75.341 Table B2, Method Two – Under 40-inch Zone Migration to Groundwater.

Alaska Department of Environmental Conservation (DEC), 2017, Data Quality Objectives, Checklists, Quality Assurance Requirements for Laboratory Data, and Sample Handling: Juneau, Alaska, DEC Division of Spill Prevention and Response, Contaminated Sites Program, March.

Alaska Department of Environmental Conservation (DEC), 2017, Guidance on Developing Conceptual Site Models.

Alaska Department of Environmental Conservation (DEC), 2017, Site Characterization Work Plan and Reporting Guidance for Investigation of Contaminated Sites: Juneau, Alaska, DEC Division of Spill Prevention and Response, Contaminated Sites Program, March, available: http://dec.alaska.gov/spar/csp/guidance_forms/csguidance.htm.

Alaska Department of Environmental Conservation (DEC), 2019, Field Sampling Guidance: Juneau, Alaska, DEC Division of Spill Prevention and Response, Contaminated Sites Program, October, available: http://dec.alaska.gov/spar/csp/guidance_forms/csguidance.htm.

APPENDIX A: SITE SAFETY AND HEALTH PLAN

Appendix A

Site Safety and Health Plan

1.0 SITE SAFETY AND HEALTH PLAN

1.1 Applicability and Purpose

Shannon & Wilson prepared this Site Safety and Health Plan (SSHP) for site characterization activities at the Bethel Airport, in the vicinity of an aqueous film forming foam (AFFF) release site. The purpose of this SSHP is to protect the health and safety of field personnel from physical and chemical hazards associated with work at this site.

The provisions of this plan apply to Shannon & Wilson personnel who will potentially be exposed to safety and/or health hazards during this investigation. Shannon & Wilson employees are covered under our Corporate Safety and Health Program. General safety and health requirements described in that program will be met. Each Shannon & Wilson employee on the site will complete the personal acknowledgement form documenting they have read and understand this SSHP and agree to abide by its requirements. A copy of this SSHP will be kept on-site throughout the duration of sampling operations.

1.2 Site Hazard Analysis

There are two categories of hazards that may occur during the field work: potential chemical exposure hazards and physical hazards associated with site characterization activities. These hazards are discussed below.

1.2.1 Chemical-Exposure Hazards

Contaminated soil and water may be encountered during site exploration activities. Perfluoroalkyl-substances (PFAS), gasoline range organics (GRO, diesel range organics (DRO), residual range organics (RRO), benzene, toluene, ethylbenzene, and xylenes (BTEX), and polycyclic aromatic hydrocarbons (PAHs) are believed to be the primary contaminants of potential concern and may be encountered in soils and water at unknown concentrations.

Shannon & Wilson personnel will implement skin protection when they are to contact potentially contaminated soil or water. Field personnel will wear work gloves or nitrile gloves as needed, and Level D personal protective equipment. Field personnel will not require respiratory protection based on our current understanding of site conditions and scope of services.

1.2.2 Physical Hazards

Primary physical hazards associated with site characterization activities include: drilling equipment; temperature stress; lifting, slipping, tripping, falling; and risk of eye injuries. In addition, wildlife may be a hazard in areas around the airport and the area of concern is an active runway. The best means of protection against accidents related to physical hazards are careful

control of equipment activities in the planned work area and use of experienced and safety- and health-trained field personnel.

Field personnel will not enter confined spaces for site characterization activities, nor will they enter trenches or excavations greater than four feet in depth.

1.2.2.1 Slips, Trips, and Falls

The most common hazards on a job site are typically slips, trips, and falls. These hazards will be reduced through the following practices:

- Personnel will stay alert.
- All access-ways will be kept free of materials, supplies, and obstructions at all times.
- Tools and other materials will be located so as not to cause tripping or other hazards.
- Personnel should be aware of potential tripping hazards associated with vegetation, debris, and uneven ground.
- Personnel should be aware of limitations imposed by work clothing and PPE.

The project site may be inherently hazardous due to the potential presence of rain, snow, and ice, which can alter the character of the ground surface. The risk for slips, trips, and falls by site workers is increased due to wet or icy surfaces; therefore, workers will use caution when walking at the site.

1.2.2.2 Insects and Animals

During the summer months in Interior Alaska, mosquitoes and other insects are common in areas predominantly covered with vegetation. Wearing PPE should be sufficient to protect site workers. Animals such as moose and bears are also commonly seen in coastal Alaska. If a large animal approaches the site, workers should keep their distance or seek shelter in their vehicles.

1.2.2.3 Temperature Stress

Wearing PPE may put a worker at risk of developing heat stress; however, since the field screening activities will be conducted in Level D PPE the risk of heat stress is considered low. Cold stress or injury due to hypothermia will be guarded against by wearing appropriate clothing, having warm shelter available, scheduling rest periods, adequate hydration, and self-monitoring physical and mental conditions.

1.2.2.4 Lifting Hazards

Moving coolers of samples or other heavy objects presents a lifting hazard. Personnel will use proper lifting techniques and obtain assistance when lifting objects weighing more than 40 pounds.

1.2.2.5 Congested Area

The site investigation may at times require field personnel to work adjacent to or in the runway, taxiways, and airport roads. Field personnel will observe the speed and frequency of traffic proximal to the work site. We will use appropriate cones, barricades, or signs to secure the work area as required by airport security. We will work with airport operations to alert aircraft pilots to our presence, inform us of safe times to work on or near the runway, and provide an escort to secured areas as necessary.

1.2.3 Other Hazards

Underground utilities are present at the site. We will request utility locates prior to conducting any ground penetrating work.

Biological or ionizing radiation hazards are not expected to be present.

1.3 Personnel Responsibilities, Training, and Medical Surveillance

1.3.1 Assignment of Responsibilities

We are responsible for understanding and complying with the requirements of this SSHP. Following is a list of responsibilities of all Shannon & Wilson personnel working on the site:

- Review and follow this SSHP.
- Attend and participate in safety meetings.
- Take appropriate action as described in this SSHP regarding accidents, fires, or other emergency situations.
- Take all reasonable precautions to prevent injury to themselves and their fellow workers.
- Perform only those tasks they believe they can do safely, and immediately report any accidents or unsafe conditions to Shannon & Wilson's Project Manager or Office Health and Safety Manager.
- Halt work, by themselves or by others, when they observe an unsafe act or potentially unsafe working condition.

- Report accidents, illnesses, and near-misses to the local contact and to Shannon & Wilson's Fairbanks office Health and Safety Manager.

1.3.2 Personnel Training

Shannon & Wilson personnel performing activities on this site and under this plan have completed the appropriate training requirements specified in 29 CFR 1910.120(e). Each individual has completed an annual eight-hour refresher-training course and/or initial 40-hour training course within the last year.

A personal acknowledgement form will be completed by field personnel prior to commencing field activities. This acknowledgment form will document that they have read and understand this SSHP.

1.3.3 Medical Surveillance Program

All field personnel performing activities on this site covered by this SSHP have undergone baseline and annual physical/medical examinations as part of Shannon & Wilson's Corporate Health and Safety Program. All field personnel are active participants in Shannon & Wilson's Medical Monitoring Program or in a similar program, which complies with 29 CFR 1910.120(f).

1.4 Personal Protective Equipment

PPE will be required during the course of the field work. PPE selection will be based primarily on work-task requirements and potential exposure. Field personnel will use Level D protective equipment during normal work activities. Personnel are trained in the use of PPE that is, or may be, required. All personnel shall wear Level D PPE as a minimum:

- standard work clothes or cotton overalls;
- reflective, high-visibility safety vest;
- safety-toe boots;
- safety glasses;
- hearing protection;
- gloves; and,
- hard hat.

Disposable nitrile gloves will be worn during any activity that may require dermal contact with potentially contaminated media.

1.5 Decontamination Procedures

Equipment decontamination procedures are necessary for any reusable equipment that comes into contact with contaminated soil and/or water. Decontamination procedures will consist of a rinse with non-phosphate-based detergent, a second rinse with plain tap water, and a final rinse with certified PFAS-free water. Sampling equipment and PPE that is expendable will be disposed of at the site or in a landfill off-site.

Shannon & Wilson will conduct all site characterization activities in Level D PPE. For this reason, personnel will not be decontaminated when leaving the work site unless gross visual contamination of protective clothing is present.

When decontamination is necessary, it will consist of the following:

- A decontamination station, just outside the work site, will be placed where personnel routinely enter/exit the work site. When exiting the work site, personnel will remove over boots, chemical resistant boots, coveralls, and outer gloves at the specified decontamination area.
- Personnel shall be instructed in proper decontamination technique. This entails removal of protective equipment in an "inside-out" manner. Removal of contaminants from protective clothing or equipment by blowing, shaking, or other means that may disperse material into the air is prohibited.
- Personnel protective clothing that has been removed shall remain at the decontamination station pending personnel re-donning the clothing. At the conclusion of site work each day, PPE will be placed in trash bags for off-site disposal.
- Personnel will not exit the work site until contaminated clothing and equipment have been removed and employees have washed their hands and face with soap and water. A washtub with soap and water will be available to personnel as they exit the work site.
- Employees will wash their hands and face with soap and water before eating, drinking, smoking, or applying cosmetics. These activities will be restricted to designated rest area(s).
- Decontaminated items will be visually inspected for residual contamination to determine if decontamination procedures are effective.

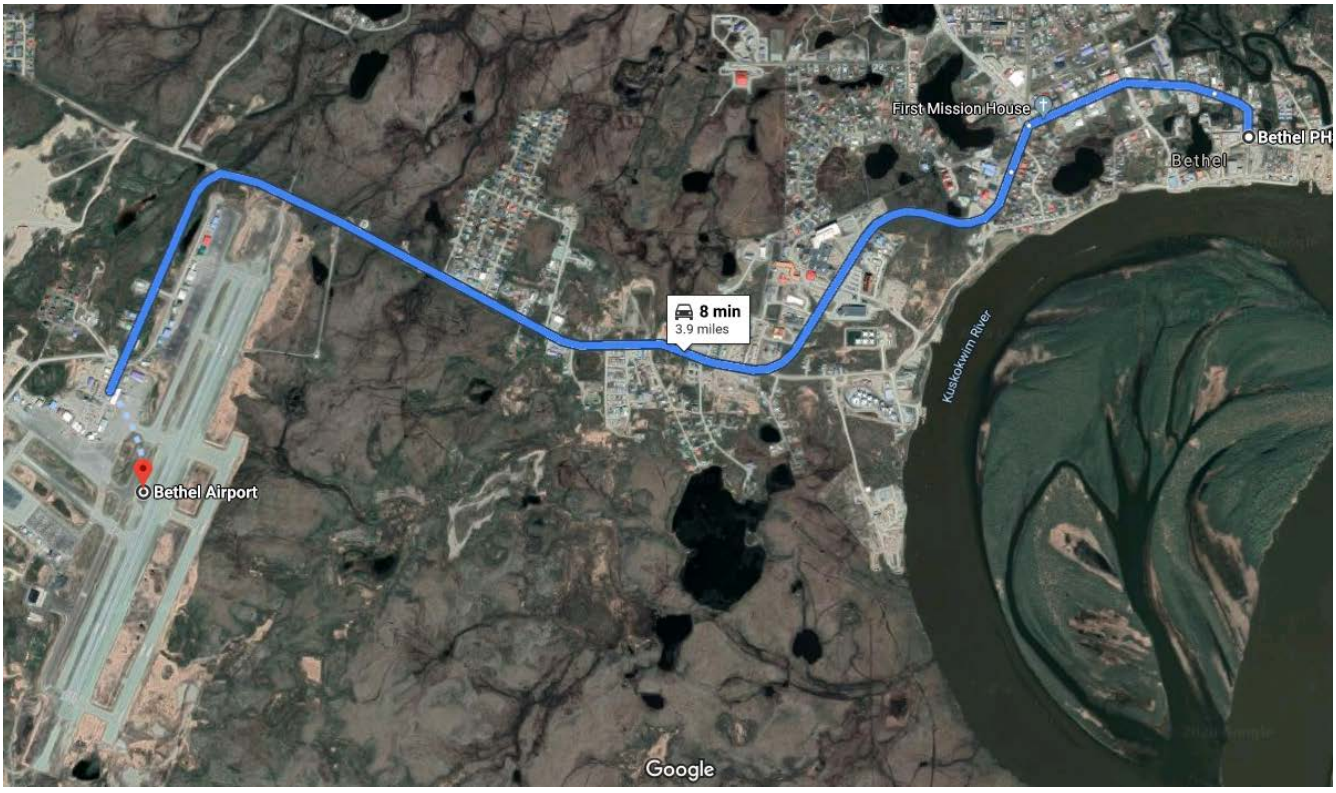
1.6 Accidents and Emergencies

Shannon & Wilson field personnel are current in first aid and cardiopulmonary resuscitation (CPR) training. At a minimum, the following site safety equipment and first aid supplies shall be available in the field:

- PPE and clothing specialized for known site hazards;
- first aid kit, including first aid booklet;
- portable eye wash;
- clean water in portable containers; and
- other decontamination supplies.

The primary emphasis of any health and safety plan is accident prevention. If an injury or illness occurs during the course of field work, the severity of the problem will dictate the level of response. Minor injuries or illness will be addressed with basic first aid measures as recommended by a registered nurse through our corporate Medcor service (1-800-775-5866). More serious injuries will require assistance from the medical staff at Bethel PHS Hospital, 700 Eddie Hoffman Hwy, Bethel, AK 99559. The telephone number for the clinic is (907) 543-6300. We will keep field phones easily accessible in the case of an emergency.

Exhibit 1-1: Directions to Bethel PHS Hospital



Shannon & Wilson's Corporate Health and Safety Program requires accident reporting when there is a site-related accident, near-miss incident, or medical emergency. If an employee is treated by medical personnel, the medical attendant will complete an Incident Medical Treatment Documentation form. Completion of an Alaska Department of Labor Report of Occupational Injury or Illness is also required within 10 days for any work-related injury or illness.

1.7 General Site Safety Requirements

The following measures are designed to augment the specific health and safety guidelines provided in this plan:

- Field personnel will refrain from smoking, eating, drinking, or chewing tobacco while in work zones or a potentially contaminated area.
- Field personnel should avoid contact with potentially contaminated surfaces such as: walking through puddles or pools of liquid; kneeling on the ground; or leaning, sitting, or placing equipment on contaminated soil or containers.
- Field personnel will be familiar with procedures for initiating an emergency response.
- Hazard assessment is a continual process; personnel must be aware of their surroundings and any chemical/physical hazards present.
- Personnel in the exclusion area shall be the minimum number necessary to perform work tasks in a safe and efficient manner.
- The use of contact lenses is prohibited; soft lenses may absorb irritants, and all lenses concentrate irritants.
- Equipment contacting potentially contaminated soil or water must be decontaminated or properly discarded before leaving the site.

Field personnel will be familiar with the physical characteristics of the work site including wind direction, site access, and location of communication devices and safety equipment.

SITE SAFETY AND HEALTH PLAN
PERSONAL ACKNOWLEDGMENT FORM

BETHEL AIRPORT PFAS SITE CHARACTERIZATION
BETHEL, AK

I have reviewed this document and understand its contents and requirements. A copy of the above-referenced document has been made available to me. I agree to abide by the requirements of this Site Safety and Health Plan.

_____	_____
Signature	Name (printed)
_____	_____
Date	Representing

APPENDIX B: PRELIMINARY CONCEPTUAL SITE MODEL

Appendix B

Preliminary Conceptual Site Model

CONTENTS

Print Form

Appendix A - Human Health Conceptual Site Model Scoping Form and Standardized Graphic

Site Name: Bethel Airport PFAS Site Characterization

File Number: 2407.38.030

Completed by: Amber Masters; Shannon & Wilson, Inc.

Introduction

The form should be used to reach agreement with the Alaska Department of Environmental Conservation (DEC) about which exposure pathways should be further investigated during site characterization. From this information, summary text about the CSM and a graphic depicting exposure pathways should be submitted with the site characterization work plan and updated as needed in later reports.

General Instructions: Follow the italicized instructions in each section below.

1. General Information:

Sources *(check potential sources at the site)*

- ☐ USTs
- ☐ ASTs
- ☐ Dispensers/fuel loading racks
- ☐ Drums
- ☐ Vehicles
- ☐ Landfills
- ☐ Transformers
- ☒ Other: Aqueous Film Forming Foam (AFFF) release

Release Mechanisms *(check potential release mechanisms at the site)*

- ☐ Spills
- ☐ Leaks
- ☒ Direct discharge
- ☐ Burning
- ☐ Other:

Impacted Media *(check potentially-impacted media at the site)*

- ☒ Surface soil (0-2 feet bgs*)
- ☒ Subsurface soil (>2 feet bgs)
- ☐ Air
- ☒ Sediment
- ☒ Groundwater
- ☒ Surface water
- ☒ Biota
- ☐ Other:

Receptors *(check receptors that could be affected by contamination at the site)*

- ☐ Residents (adult or child)
- ☒ Commercial or industrial worker
- ☒ Construction worker
- ☐ Subsistence harvester (i.e. gathers wild foods)
- ☐ Subsistence consumer (i.e. eats wild foods)
- ☒ Site visitor
- ☒ Trespasser
- ☐ Recreational user
- ☐ Farmer
- ☐ Other:

* bgs - below ground surface

2. Exposure Pathways: *(The answers to the following questions will identify complete exposure pathways at the site. Check each box where the answer to the question is "yes".)*

a) Direct Contact -

1. Incidental Soil Ingestion

Are contaminants present or potentially present in surface soil between 0 and 15 feet below the ground surface? (Contamination at deeper depths may require evaluation on a site-specific basis.) ☒

If the box is checked, label this pathway complete: Complete

Comments:

2. Dermal Absorption of Contaminants from Soil

Are contaminants present or potentially present in surface soil between 0 and 15 feet below the ground surface? (Contamination at deeper depths may require evaluation on a site specific basis.) ☒

Can the soil contaminants permeate the skin (see Appendix B in the guidance document)? ☒

If both boxes are checked, label this pathway complete: Complete

Comments:

b) Ingestion -

1. Ingestion of Groundwater

Have contaminants been detected or are they expected to be detected in the groundwater, or are contaminants expected to migrate to groundwater in the future? ☒

Could the potentially affected groundwater be used as a current or future drinking water source? Please note, only leave the box unchecked if DEC has determined the ground-water is not a currently or reasonably expected future source of drinking water according to 18 AAC 75.350. ☒

If both boxes are checked, label this pathway complete: Complete

Comments:

2. Ingestion of Surface Water

Have contaminants been detected or are they expected to be detected in surface water, or are contaminants expected to migrate to surface water in the future? ☒

Could potentially affected surface water bodies be used, currently or in the future, as a drinking water source? Consider both public water systems and private use (i.e., during residential, recreational or subsistence activities). ☐

If both boxes are checked, label this pathway complete: Incomplete

Comments:

3. Ingestion of Wild and Farmed Foods

Is the site in an area that is used or reasonably could be used for hunting, fishing, or harvesting of wild or farmed foods? ☐

Do the site contaminants have the potential to bioaccumulate (see Appendix C in the guidance document)? ☒

Are site contaminants located where they would have the potential to be taken up into biota? (i.e. soil within the root zone for plants or burrowing depth for animals, in groundwater that could be connected to surface water, etc.) ☒

If all of the boxes are checked, label this pathway complete: Incomplete

Comments:

c) Inhalation-

1. Inhalation of Outdoor Air

Are contaminants present or potentially present in surface soil between 0 and 15 feet below the ground surface? (Contamination at deeper depths may require evaluation on a site specific basis.) ☒

Are the contaminants in soil volatile (see Appendix D in the guidance document)? ☒

If both boxes are checked, label this pathway complete: Complete

Comments:

2. Inhalation of Indoor Air

Are occupied buildings on the site or reasonably expected to be occupied or placed on the site in an area that could be affected by contaminant vapors? (within 30 horizontal or vertical feet of petroleum contaminated soil or groundwater; within 100 feet of non-petroleum contaminted soil or groundwater; or subject to "preferential pathways," which promote easy airflow like utility conduits or rock fractures) ☐

Are volatile compounds present in soil or groundwater (see Appendix D in the guidance document)? ☒

If both boxes are checked, label this pathway complete: Incomplete

Comments:

Several Appendix D analytes are contaminants of potential concern, however, at this time, no analytical results are available to indicate if volatile compounds are present in the soil or groundwater. Additionally, no buildings are located in this area and are not anticipated to in the future given the proximity to the runways.

3. **Additional Exposure Pathways:** *(Although there are no definitive questions provided in this section, these exposure pathways should also be considered at each site. Use the guidelines provided below to determine if further evaluation of each pathway is warranted.)*

Dermal Exposure to Contaminants in Groundwater and Surface Water

Dermal exposure to contaminants in groundwater and surface water may be a complete pathway if:

- Climate permits recreational use of waters for swimming.
- Climate permits exposure to groundwater during activities, such as construction.
- Groundwater or surface water is used for household purposes, such as bathing or cleaning.

Generally, DEC groundwater cleanup levels in 18 AAC 75, Table C, are deemed protective of this pathway because dermal absorption is incorporated into the groundwater exposure equation for residential uses.

Check the box if further evaluation of this pathway is needed: ☒

Comments:

Inhalation of Volatile Compounds in Tap Water

Inhalation of volatile compounds in tap water may be a complete pathway if:

- The contaminated water is used for indoor household purposes such as showering, laundering, and dish washing.
- The contaminants of concern are volatile (common volatile contaminants are listed in Appendix D in the guidance document.)

DEC groundwater cleanup levels in 18 AAC 75, Table C are protective of this pathway because the inhalation of vapors during normal household activities is incorporated into the groundwater exposure equation.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Due to the lack of current groundwater sample analytical results, the box was not checked. However, it may change following the collection of groundwater samples during site characterization activities.

Inhalation of Fugitive Dust

Inhalation of fugitive dust may be a complete pathway if:

- Nonvolatile compounds are found in the top 2 centimeters of soil. The top 2 centimeters of soil are likely to be dispersed in the wind as dust particles.
- Dust particles are less than 10 micrometers (Particulate Matter - PM_{10}). Particles of this size are called respirable particles and can reach the pulmonary parts of the lungs when inhaled.

DEC human health soil cleanup levels in Table B1 of 18 AAC 75 are protective of this pathway because the inhalation of particulates is incorporated into the soil exposure equation.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Due to the lack of current soil sample analytical results, the box was not checked. However, it may change following the collection of surface soil samples during site characterization activities.

Direct Contact with Sediment

This pathway involves people's hands being exposed to sediment, such as during some recreational, subsistence, or industrial activity. People then incidentally ingest sediment from normal hand-to-mouth activities. In addition, dermal absorption of contaminants may be of concern if the the contaminants are able to permeate the skin (see Appendix B in the guidance document). This type of exposure should be investigated if:

- Climate permits recreational activities around sediment.
- The community has identified subsistence or recreational activities that would result in exposure to the sediment, such as clam digging.

Generally, DEC direct contact soil cleanup levels in 18 AAC 75, Table B1, are assumed to be protective of direct contact with sediment.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

4. Other Comments *(Provide other comments as necessary to support the information provided in this form.)*

HUMAN HEALTH CONCEPTUAL SITE MODEL GRAPHIC FORM

Site: Bethel Airport

Completed By: Amber Masters; Shannon & Wilson, Inc.

Date Completed: 01/16/2020

***Instructions*: Follow the numbered directions below. Do not consider contaminant concentrations or engineering/land use controls when describing pathways.**

(1) *Check the media that could be directly affected by the release.*

(2) *For each medium identified in (1), follow the top arrow and check possible transport mechanisms. Check additional media under (1) if the media acts as a secondary source.*

(3) *Check all exposure media identified in (2).*

(4) *Check all pathways that could be complete. The pathways identified in this column **must** agree with Sections 2 and 3 of the Human Health CSM Scoping Form.*

(5) *Identify the receptors potentially affected by each exposure pathway: Enter "C" for current receptors, "F" for future receptors, "C/F" for both current and future receptors, or "I" for insignificant exposure.*

Media	Transport Mechanisms	Exposure Media	Exposure Pathway/Route	Current & Future Receptors: Residents (adults or children)	Commercial or industrial workers	Site visitors, trespassers, or recreational users	Construction workers	Farmers or subsistence harvesters	Subsistence consumers	Other
☑ Surface Soil (0-2 ft bgs)	☑ Direct release to surface soil — check soil	☑ soil	☑ Incidental Soil Ingestion		C/F	I	C/F			
	☑ Migration to subsurface — check soil		☑ Dermal Absorption of Contaminants from Soil		C/F	I	C/F			
	☑ Migration to groundwater — check groundwater		☐ Inhalation of Fugitive Dust							
	☐ Volatilization — check air									
	☑ Runoff or erosion — check surface water									
	☑ Uptake by plants or animals — check biota									
	☐ Other (list):									
☑ Subsurface Soil (2-15 ft bgs)	☑ Direct release to subsurface soil — check soil	☑ groundwater	☑ Ingestion of Groundwater	C/F	C/F	I	C/F			
	☑ Migration to groundwater — check groundwater		☑ Dermal Absorption of Contaminants in Groundwater		C/F	I	C/F			
	☐ Volatilization — check air		☐ Inhalation of Volatile Compounds in Tap Water							
	☑ Uptake by plants or animals — check biota									
	☐ Other (list):									
☑ Ground-water	☑ Direct release to groundwater — check groundwater	☑ air	☑ Inhalation of Outdoor Air		C/F	I	C/F			
	☐ Volatilization — check air		☐ Inhalation of Indoor Air							
	☑ Flow to surface water body — check surface water		☐ Inhalation of Fugitive Dust							
	☐ Flow to sediment — check sediment									
	☑ Uptake by plants or animals — check biota									
	☐ Other (list):									
☑ Surface Water	☑ Direct release to surface water — check surface water	☑ surface water	☐ Ingestion of Surface Water							
	☐ Volatilization — check air		☑ Dermal Absorption of Contaminants in Surface Water		C/F	I	C/F			
	☐ Sedimentation — check sediment		☐ Inhalation of Volatile Compounds in Tap Water							
	☐ Uptake by plants or animals — check biota									
	☐ Other (list):									
☐ Sediment	☐ Direct release to sediment — check sediment	☐ sediment	☐ Direct Contact with Sediment							
	☐ Resuspension, runoff, or erosion — check surface water									
	☐ Uptake by plants or animals — check biota									
	☐ Other (list):									
		☑ biota	☐ Ingestion of Wild or Farmed Foods							

Revised, 10/01/2010

APPENDIX C: FIELD FORMS

Appendix C

Field Forms

CONTENTS

FIELD ACTIVITIES DAILY LOG

Date _____
Sheet ____ of ____
Project No. _____

Project Name: _____
Field activity subject: _____
Description of daily activities and events: _____

Visitors on site: _____

Changes from plans/specifications and other special orders and important decisions:

Weather conditions: _____

Important telephone calls: _____

Personnel on site: _____
Signature: Date:

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

DAILY SAFETY MEETING LOG

JOB NAME: _____ JOB NO: _____ BORING NO: _____

LOCATION: _____ DATE: / / TIME: :

SUBCONTRACTOR: _____ S&W REP: _____ S&W PM: _____

WORK DESCRIPTION: _____

CHECK APPLICABLE HAZARDS: Heavy Equipment ☐, Vehicles ☐, Overhead ☐, Tools ☐, Temperature ☐, Lifting ☐ (Use Mechanical Means Instead), Site Housekeeping ☐ (Clear Walkways to Prevent Slips, Trips, Falls), Awkward Work Area ☐, Public ☐, Security ☐, Plants ☐, Animals ☐, Noise ☐, Vibration ☐, Dust ☐, Radiation ☐, UV exposure ☐, Repetitive Motion ☐, Suspected Contamination ☐, Chemical Exposure ☐, Flammable/Explosive ☐

OTHER HAZARDS: _____

EQUIPMENT ON SITE: _____

DOCUMENTATION:	Present	PPE:	Present
SSHSP On Site?	☐	Boots - Safety Toe / Other	☐
Hospital Map On Site?	☐	Safety Glasses	☐
Fall Protection Plan On Site?	☐	Vest - Class II / Class III	☐
Respiratory Protection Plan On Site?	☐	Hard Hat	☐
Confined Space Entry Plan On Site?	☐	Ear - Plugs / Muffs / Both	☐
Traffic Control Plan?	☐	Gloves - Type: _____	☐
Other Plan? _____	☐	Face Shield	☐
Current Fit Test?	☐	Respirator	☐

Cards/Certs Required? *List Below*

_____

_____

Other PPE? *List Below*

_____

_____

Hazards & Controls Discussed? ☐ Need to Update SSHSP? ☐

My signature below confirms that the above hazards, controls and plans have been discussed and that I understand them.

PRINT NAME	SIGNATURE	COMPANY	HAS ALL CARDS	PPE On?
			☐	☐
			☐	☐
			☐	☐
			☐	☐
			☐	☐
			☐	☐
			☐	☐

FIELD SCREENING LOG (soil samples)

Project Number: Project Name:

Date:

Sampler: Calibration time, result: PID number:

FS Sample Number	Sample Time	PID Reading	Depth (ft)	FS Sample Location	Soil Description/Notes

SAMPLE COLLECTION LOG

Project Number: Location: Page of

Date:

Sampler:

Sample Number	Location	Sample Time	Depth Interval (ft) top	Depth Interval (ft) bottom	Matrix Type	Sampling Method	Sample Type	PID Reading	Analyses

Matrix Type		Sampling Method		Sample Type	
AR	Air	B	Bailer/Coliwasa	ES	Environmental sample
GW	Groundwater	D	Drill cuttings	ER	Equipment rinsate
PR	Product	G	Grab sampling	FB	Field blank
SB	Subsurf. soil	H	Hand auger	FD	Field duplicate
SE	Sediment	L	Tube liner	FM	Field measurement
SG	Sludge	P	Pump (liquid)	FR	Field replicate
SS	Surface soil	SS	Split spoon	MD	Matrix spike duplicate
SW	Surface water	T	Shelby tube	MS	Matrix spike duplicate
WR	Water	V	Vacuum (gas)	TB	Trip blank
		W	Wipe sampling		

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CHAIN-OF-CUSTODY RECORD

Page_____ of_____

Laboratory_____

Attn:_____

400 N. 34th Street, Suite 100
Seattle, WA 98103
(206) 632-8020

2043 Westport Center Drive
St. Louis, MO 63146-3564
(314) 699-9660

303 Wellsian Way
Richland, WA 99352
(509) 946-6309

2355 Hill Road
Fairbanks, AK 99709
(907) 479-0600

5430 Fairbanks Street, Suite 3
Anchorage, AK 99518
(907) 561-2120

2255 S.W. Canyon Road
Portland, OR 97201-2498
(503) 223-6147

1200 17th Street, Suite 1024
Denver, Co 80202
(303) 825-3800

Analysis Parameters/Sample Container Description
(include preservative if used)

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab							Total Number of Containers	Remarks/Matrix

Project Information	Sample Receipt	
Project Number:	Total Number of Containers	
Project Name:	COC Seals/Intact? Y/N/NA	
Contact:	Received Good Cond./Cold	
Ongoing Project? Yes ☐ No ☐	Delivery Method:	
Sampler:	(attach shipping bill, if any)	

Instructions
Requested Turnaround Time:
Special Instructions:

Relinquished By: 1.	Relinquished By: 2.	Relinquished By: 3.
Signature: Time:	Signature: Time:	Signature: Time:
Printed Name: Date:	Printed Name: Date:	Printed Name: Date:
Company:	Company:	Company:

Received By: 1.	Received By: 2.	Received By: 3.
Signature: Time:	Signature: Time:	Signature: Time:
Printed Name: Date:	Printed Name: Date:	Printed Name: Date:
Company:	Company:	Company:

Distribution: White - w/shipment - returned to Shannon & Wilson w/ laboratory report
Yellow - w/shipment - for consignee files
Pink - Shannon & Wilson - Job File

F-19-91/UR

No. 30000

APPENDIX D: DEC LABORATORY DATA REVIEW CHECKLIST

Appendix D

DEC Laboratory Data Review Checklist

Laboratory Data Review Checklist

Completed By:

Title:

Date:

Consultant Firm:

Laboratory Name:

Laboratory Report Number:

Laboratory Report Date:

CS Site Name:

ADEC File Number:

Hazard Identification Number:

Laboratory Report Date:

CS Site Name:

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

   a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

      Yes☐ No☐ N/A☐ Comments:

   b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

      Yes☐ No☐ N/A☐ Comments:

2. Chain of Custody (CoC)

   a. CoC information completed, signed, and dated (including released/received by)?

      Yes☐ No☐ N/A☐ Comments:

   b. Correct analyses requested?

      Yes☐ No☐ N/A☐ Comments:

3. Laboratory Sample Receipt Documentation

   a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

      Yes☐ No☐ N/A☐ Comments:

   b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

      Yes☐ No☐ N/A☐ Comments:

Laboratory Report Date:

CS Site Name:

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes☐ No☐ N/A☐ Comments:

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes☐ No☐ N/A☐ Comments:

e. Data quality or usability affected?

Comments:

4. Case Narrative

a. Present and understandable?

Yes☐ No☐ N/A☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes☐ No☐ N/A☐ Comments:

c. Were all corrective actions documented?

Yes☐ No☐ N/A☐ Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Laboratory Report Date:

CS Site Name:

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes☐ No☐ N/A☐ Comments:

b. All applicable holding times met?

Yes☐ No☐ N/A☐ Comments:

c. All soils reported on a dry weight basis?

Yes☐ No☐ N/A☐ Comments:

d. Are the reported LOQs less than the Cleanup Level or the minimum required detection level for the project?

Yes☐ No☐ N/A☐ Comments:

e. Data quality or usability affected?

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☐ Comments:

ii. All method blank results less than limit of quantitation (LOQ) or project specified objectives?

Yes☐ No☐ N/A☐ Comments:

Laboratory Report Date:

CS Site Name:

iii. If above LOQ or project specified objectives, what samples are affected?

Comments:

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☐ Comments:

v. Data quality or usability affected?

Comments:

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

Yes☐ No☐ N/A☐ Comments:

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☐ Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

Yes☐ No☐ N/A☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

Yes☐ No☐ N/A☐ Comments:

Laboratory Report Date:

CS Site Name:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☐ Comments:

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Note: Leave blank if not required for project

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☐ Comments:

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☐ Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

Yes☐ No☐ N/A☐ Comments:

Laboratory Report Date:

CS Site Name:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

Yes☐ No☐ N/A☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☐ Comments:

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes☐ No☐ N/A☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

Yes☐ No☐ N/A☐ Comments:

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☐ Comments:

Laboratory Report Date:

CS Site Name:

iv. Data quality or usability affected?

Comments:

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes☐ No☐ N/A☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

Yes☐ No☐ N/A☐ Comments:

iii. All results less than LOQ and project specified objectives?

Yes☐ No☐ N/A☐ Comments:

iv. If above LOQ or project specified objectives, what samples are affected?

Comments:

v. Data quality or usability affected?

Comments:

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

Yes☐ No☐ N/A☐ Comments:

Laboratory Report Date:

CS Site Name:

ii. Submitted blind to lab?

Yes☐ No☐ N/A☐ Comments:

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

RPD (%) = Absolute value of: $\frac{(R_1-R_2)}{((R_1+R_2)/2)} \times 100$

Where R_1 = Sample Concentration
R_2 = Field Duplicate Concentration

Yes☐ No☐ N/A☐ Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)
Comments:

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes☐ No☐ N/A☐ Comments:

i. All results less than LOQ and project specified objectives?

Yes☐ No☐ N/A☐ Comments:

ii. If above LOQ or project specified objectives, what samples are affected?
Comments:

iii. Data quality or usability affected?
Comments:

Laboratory Report Date:

CS Site Name:

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

   a. Defined and appropriate?

      Yes☐ No☐ N/A☐ Comments:

IMPORTANT INFORMATION

Important Information

About Your Environmental Report

IMPORTANT INFORMATION

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors which were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

IMPORTANT INFORMATION

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGEMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

IMPORTANT INFORMATION

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland