FINAL 2020 RELEASE INVESTIGATION WORK PLAN

FEDERAL AVIATION ADMINISTRATION STATION
BUILDINGS 300, 100, AND 103
FORT YUKON, ALASKA

July 2020

Prepared for:

Federal Aviation Administration

Prepared by:

SUSITNA
ENVIRONMENTAL, LLC
8361 Petersburg Street
Anchorage, AK 99507

Prepared by:

Date: July 7, 2020

Ryan Burich,
Project Geologist
Susitna Environmental, LLC

Reviewed by:

Date: July 7, 2020

Melissa Mayer
Project Manager
Susitna Environmental, LLC

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TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

ACRONYMS AND ABBREVIATIONS

%	percent
°C	degrees Celsius
°F	degrees Fahrenheit
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADS	Arctic Data Services
AOC	Area of Concern
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene and total xylenes
COC	contaminant of concern
CoC	Chain of Custody
CS	crawlspace
CS-LAP	Contaminated Sites Laboratory Approval Program
CSM	Conceptual Site Model
CY	cubic yard
DL	detection limit
DQI	data quality indicator
DQO	Data Quality Objective
DRO	diesel range organics
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
ft	feet/foot
GC-MS	gas chromatography/mass spectroscopy
GPS	Global Positioning System
GRO	gasoline range organics
HCL	hydrochloric acid
HLA	Harding Lawson Associates
IA	indoor air
ID	identification number
IDW	investigation derived waste
in	inch
L	liter
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantitation
mg/kg	milligrams per kilogram
mg/l	milligrams per liter
mL	milliliters
mL/min	milliliters per minute
mS/cm	millisiemens/centimeter

MS/MSD	matrix spike/matrix spike duplicate
mV	millivolts
MW	monitoring well
ND	non-detect
OA	outdoor air
ORP	Oxidation-Reduction Potential
oz	ounce
PAH	polycyclic aromatic hydrocarbons
PID	photo-ionization detector
POL	Petroleum, Oil, and Lubricant
PPE	personal protective equipment
ppm	parts per million
PVC	polyvinyl chloride
QA	Quality Assurance
QC	Quality Control
RPD	relative percent difference
RRO	residual range organics
RSD	relative standard deviation
SB	soil boring
SDG	sample delivery group
SG	soil gas
sq ft	square feet
SOW	Scope of Work
Susitna	Susitna Environmental, LLC
TPH	total petroleum hydrocarbons
UN	United Nations
USGS	Unites States Geologic Survey
UST	underground storage tank
VOC	volatile organic compounds
YSI	YSI 556 Multiparameter Instrument

1. INTRODUCTION

Susitna Environmental, LLC (Susitna) has developed this work plan on behalf of the Federal Aviation Administration (FAA) for the performance of environmental investigation activities at three Areas of Concern (AOCs) at the FAA Station in Fort Yukon, Alaska. The release investigations, to be conducted in 2020, will consist of the advancement of soil borings to delineate the extent of subsurface contamination, the installation of groundwater monitoring wells to assess for groundwater contamination, and the collection of soil gas, indoor air, and outdoor air samples to assess for vapor intrusion. The data collected from this investigation effort will be compared to relevant cleanup criteria and target levels, and recommendations will be made concerning remedial options and/or additional monitoring, if needed.

The methodologies and activities detailed in this work plan will be performed in accordance with the requirements listed in Alaska Department of Environmental Conservation (ADEC) 18 Alaska Administrative Code (AAC) 75 Oil and Other Hazardous Substances Pollution Control, dated October 2018, the ADEC Field Sampling Guidance dated October 2019, and the ADEC Vapor Intrusion Guidance for Contaminated Sites dated November 2017. This work plan describes the sampling, handling, and analytical procedures that will be used during the execution of this project.

1.1. Background

The Fort Yukon Airport, and associated air navigational facilities, were constructed in 1943. The FAA began operating the Fort Yukon FAA Station at that time. The station initially consisted of approximately 127 acres but has reduced in size through historical land and facility transactions (E&E 1992). The Quarters/Shop facility has been operated by the FAA since construction of the buildings in 1962. The United States Public Health Service and the Alaska Area Native Health Service began leasing portions of the Quarters/Shop facility in 1978. The FAA conveyed the Quarters/Shop facility (except Building 300) to the City of Fort Yukon in 1994 (United States Geologic Survey [USGS] 1994).

Ten underground storage tanks (USTs) were identified at the Quarters/Shop facility during an environmental compliance investigation performed by Ecology and Environmental, Inc in 1991. Additionally, an area of Petroleum, Oil, and Lubricant (POL) contaminated surface soil was identified at a former drum storage area at the southeast corner of Shop Building 300 (E&E 1992). The USTs were decommissioned and removed by Hardin Lawson Associates in 1995. Petroleum hydrocarbon contaminated soil was identified at multiple former UST locations at that time (HLA 1995). Based on this information, three AOCs requiring further investigation were identified, as follows.

- Shop Building 300 Former Drum Storage Area (RTH AOC 2) (see Figures 2 and 3),
- Former Quarters Building 100 UST 9-C-07 (RTH AOC 3) (see Figures 2 and 4), and
- Former Flight Service Station Building 103 UST 9-C-08 (RTH AOC 4) (see Figures 2 and 5).

1.1.1. Contaminants of Potential Concern

Based on Appendix F of the ADEC Field Sampling Guidance (ADEC 2019a), as well as historical documents pertaining to the site, contaminants of potential concern (COPCs) include gasoline-range organics (GRO), diesel-range organics (DRO), residual-range organics (RRO), volatile organic compounds (VOC) and polynuclear aromatic hydrocarbons (PAHs).

1.1.2. Areas of Concern and Historical Environmental Activities Performed

This section contains descriptions of the three AOCs (located at the Quarters/Shop facility) and historical environmental activities conducted at each.

- ***Shop Building 300 Former Drum Storage Area (RTH AOC 2)***

  Shop Building 300 is a steel-frame structure on a concrete slab. Three USTs (two containing gasoline [9-C-1 and 9-C-2) and one containing heating oil [9-C-4]) were historically located proximal to the building (all were decommissioned in 1995). Additionally, a former drum storage area was associated with the building (at the southeast corner). One site investigation was previously conducted at the site in 1991. A composite soil sample was collected from the former drum storage area and contained 820 milligrams per kilogram (mg/kg) total recoverable petroleum hydrocarbons, 55 mg/kg volatile petroleum hydrocarbons, and 680 mg/kg extractable petroleum hydrocarbons. The decommissioned UST 9-C-4 was replaced by UST 9-C-104.

- ***Former Quarters Building 100 UST 9-C-07 (RTH AOC 3)***

  The former Quarters Building 100 is a wood-frame building (with a crawlspace) and was historically used as FAA housing (currently owned by the City of Fort Yukon). A heating oil UST (UST 9-C-07) was historically located near the south side of the building (decommissioned in 1995 and replaced by UST 9-C-107). Approximately 20 cubic yards (CYs) of potentially-contaminated soil were excavated during the decommissioning event. Confirmation soil samples contained concentrations of ethylbenzene at 9.9 mg/kg, total xylenes at 71 mg/kg, and diesel range organics (DRO) ranging from 3,800 mg/kg to 22,000 mg/kg. Excavation activities were limited to the north by the building foundation. Soil samples were collected from the historical UST 9-C-07 location (in 2013) from the 8 feet (ft) – 9 ft depth interval below ground surface (bgs). One of the samples contained DRO at a concentration of 3,450 mg/kg. Groundwater samples were also collected, and one of the samples contained DRO at a concentration of 3.88 milligrams per liter (mg/l). The ADEC requested vapor intrusion modeling in the crawlspace of the building on 2017.

- ***Former Flight Service Station Building 103 UST 9-C-08 (RTH AOC 4)***

  The former Flight Service Station Building 103 is a wood-frame building (with a crawlspace) and was historically used as both a Flight Service Station and as a housing facility (currently owned by the City of Fort Yukon). A heating oil UST (UST 9-C-08) was historically located at the southeast corner of the building (decommissioned in 1995). Approximately 15 CYs of potentially contaminated soil were excavated during the decommissioning event. Confirmation soil samples contained concentrations of ethylbenzene at 6.5 mg/kg, total xylenes at 5.7 mg/kg, and DRO at 3,000 mg/kg.

Excavation activities were limited by the building foundation. Remaining petroleum contaminated soil at the site was estimated to be less than 1 CY. The decommissioned UST was replaced by UST 9-C-108. The new tank footprint is located southeast of and slightly overlapping the former tank footprint. A release investigation was conducted in 1996 and identified contamination from the 7ft - 8.5ft depth interval bgs (total petroleum hydrocarbons [TPH] greater than 2,500 mg/kg). DRO was not detected in a soil sample collected from the 9ft - 10.5ft depth interval bgs. The ADEC granted a “no-further action” status in 1995. The building is used as a residence by Yukon Flats Health Clinic employees. Consequently, the ADEC requested vapor intrusion modeling in the crawlspace of the building in 2005.

1.2. Physical Setting

The Fort Yukon FAA Station is located approximately 145 miles northeast of Fairbanks, Alaska (see Figure 1). The station is positioned on the northwest boundary of the City of Fort Yukon which is situated at the confluence of the Porcupine and Yukon Rivers. The airport is located adjacent to, and north of, the station. This entire location is surrounded by relatively flat, vegetated terrain and underlain by discontinuous permafrost that may reach depths of over 300 feet. The town (and FAA station) can only be accessed by aircraft or boat. The station is located in Township 20 North, Range 12 East, Section 16, Fairbanks Meridian, and the latitude and longitude of the airport are 66° 34'10" N and 145° 14'52" W, respectively.

The FAA facilities were constructed on fill material above the native alluvium. The fill material consists of medium to coarse grained gravel with varying amounts of silt and sand. The native soil consists of layers of sand, sandy silt, and sandy gravel (Ahtna 2013).

During the release investigations conducted by Harding Lawson Associates (HLA) in 1995, groundwater was measured between 10 and 12 feet bgs; however, it was previously measured at depths of 20 to 30 feet bgs (HLA 1996). Groundwater levels at this location generally are low between March and April and high between August and October. Groundwater flows north toward the Yukon River and then northwest toward the confluence of the Yukon and Porcupine rivers (USGS, 1994).

1.3. Conceptual Site Model

AOC 2 – Shop Building 300

Conceptual Site Model

A conceptual site model (CSM) evaluation was completed upon review of historical soil analytical results to assess the potential exposure pathways and to guide the focus of additional investigation efforts, if necessary. Following analysis of the results from a 1995 release investigation (HLA 1996), Susitna generated a CSM to reflect the possible environmental exposure concerns for the site. The CSM was completed in accordance with the ADEC’s Guidance on Developing CSMs, updated in January 2017 (ADEC 2017b). The ADEC CSM graphic and scoping forms are presented in Appendix E.

Current and Future Receptor Profile

The Area of Concern (AOC) 2 – Shop Building 300 site is included in the Quarters/Shop facility at the FAA Station in Fort Yukon, Alaska.

There is open access to the site. As a result, the current and future receptors include the following:

- Residents;
- Site visitors;
- Construction, commercial, and industrial workers (excavation activities);
- Subsistence harvesters (wild plants); and
- Subsistence consumers (wild plants).

Contaminant Source Areas

Three USTs (two containing gasoline [9-C-1 and 9-C-2) and one containing heating oil [9-C-4]) were historically located proximal to the building (all were decommissioned in 1995). Additionally, a former drum storage area was associated with the building (at the southeast corner). A site investigation was previously conducted at the site in 1991. A surface soil sample soil sample was collected from the former drum storage area and contained 12,000 mg/kg total recoverable petroleum hydrocarbons and 43,000 mg/kg extractable petroleum hydrocarbons. The decommissioned UST 9-C-4 was replaced by UST 9-C-104.

Exposure Pathways

The complete exposure pathways for current and future receptors at the site include incidental soil ingestion, dermal absorption of contaminants in soil, ingestion of groundwater, dermal absorption of contaminants in groundwater, and inhalation of outdoor air. Exposure pathways are considered complete when contaminants are present in media at concentrations greater than 1/10th of their respective ADEC human health cleanup levels.

- The incidental soil ingestion pathway is considered complete for current and future receptors involved in subsurface excavation (and surface) activities at the site where the removal or disturbance of remaining contaminated soil (at depths ranging from 0 to 15 feet bgs) is expected. Hand-to-mouth activities (e.g., eating without washing hands) could inadvertently result in contaminant ingestion.
- The dermal absorption of contaminants from soil pathway may be complete for current and future receptors involved in excavation activities at the site where the removal or disturbance of contaminated soil (at the surface and subsurface) is expected. A surface soil sample collected in 1991 contained multiple contaminants; however, Benzo(a)pyrene was the only contaminant (in Appendix B - Soil Contaminants Evaluated for Dermal Exposure) detected at a concentration that exceeded 1/10th it's respective ADEC Table B1 human health cleanup level for the Under-40-Inch zone.
- The ingestion of groundwater pathway is considered complete for future receptors, as groundwater in the area cannot be ruled out as a reasonably expected future source of drinking water.
- The inhalation of outdoor air pathway is considered complete for current and future receptors involved in excavation activities at the site where the removal or disturbance

of contaminated soil is expected. The pathway is complete due to the possible presence of Volatile Compounds of Potential Concern in surface and subsurface soil.

- The dermal absorption of contaminants in groundwater pathway is considered complete for current and future receptors involved in excavation activities at the site where excavation depths reach groundwater, and dermal contact with groundwater is likely.

AOC 3 – Former Quarters Building 100

A Conceptual Site Model was generated previously for AOC 3, by Ahtna Engineering Services, LLC., in 2013. The primary release mechanisms for petroleum hydrocarbon contamination are from spills and leaks associated with a former heating oil UST. Impacted media include surface and subsurface soils, as well as groundwater. Potential receptors include residents, site workers, site visitors, or trespassers.

The CSM can be reviewed in the document titled *Final Report, Federal Aviation Administration, Decommissioning and Investigation, FAA Station Fort Yukon, Alaska*. (Ahtna 2013).

AOC 4 – Former Flight Service Station 103

A CSM evaluation was completed upon review of historical soil analytical results to assess the potential exposure pathways and to guide the focus of additional investigation efforts, if necessary. Following analysis of the results from a 1995 release investigation (HLA 1996), Susitna generated a CSM to reflect the possible environmental exposure concerns for the site. The CSM was completed in accordance with the ADEC's Guidance on Developing CSMs, updated in January 2017 (ADEC 2017b). The ADEC CSM graphic and scoping forms are presented in Appendix E.

Current and Future Receptor Profile

The Area of Concern (AOC) 4 – Former Flight Service Station Building 103 site is included in the Quarters/Shop facility at the FAA Station in Fort Yukon, Alaska. The Building 103 is currently occupied, and there is open access to the site. As a result, the current and future receptors include the following:

- Residents (local, as well as those living in the residential unit onsite);
- Site visitors; and
- Construction, commercial, and industrial workers (excavation activities).

Contaminant Source Areas

A heating oil UST (UST 9-C-08) was historically located at the southeast corner of the building (decommissioned in 1995). Approximately 15 CYs of potentially contaminated soil were excavated during the decommissioning event. Confirmation soil samples contained concentrations of ethylbenzene at 6.5 mg/kg, total xylenes at 5.7 mg/kg, and DRO at 3,000 mg/kg. Excavation activities were limited by the building foundation. Remaining petroleum contaminated soil at the site was estimated to be less than 1 CY. The decommissioned UST was replaced by UST 9-C-108. The new tank footprint is located southeast of and slightly overlapping the former tank footprint. A release investigation was conducted in 1996 and identified contamination from the 7ft - 8.5ft depth interval bgs (total petroleum hydrocarbons greater than 2,500 mg/kg). DRO was not detected in a soil sample collected from the 9ft - 10.5ft depth interval bgs. The ADEC granted a "no-further action" status in 1995. The building is used as a residence by Yukon Flats Health Clinic employees. Consequently, the ADEC requested vapor intrusion modeling in the crawlspace of the building in 2005.

Exposure Pathways

The complete exposure pathways for current and future receptors at the site include incidental soil ingestion, dermal absorption of contaminants from soil, ingestion of groundwater, dermal absorption of contaminants in groundwater, and the inhalation of indoor and outdoor air. Exposure pathways are considered complete when contaminants are present in media at concentrations greater than 1/10th of their respective ADEC human health cleanup levels.

- The incidental soil ingestion pathway is considered complete for future receptors involved in excavation activities at the site where the removal or disturbance of remaining contaminated soil (at depth greater than 7 feet bgs) is expected. Hand-to-mouth activities (e.g., eating without washing hands) could inadvertently result in contaminant ingestion.
- The dermal absorption of contaminants from soil pathway may be complete for future receptors involved in excavation activities at the site where the removal or disturbance of remaining contaminated soil (at depth greater than 7 feet bgs) is expected. Soil samples collected from the UST-removal excavation in 1995 were not submitted for PAH analysis, which is currently recommended in Appendix F – Determination of Sampling and Lab Analysis for Petroleum in Soil and Groundwater, and Recommended Sampling Materials of the ADEC's Field Sampling Guidance. Soil Contaminants Evaluated for Dermal Exposure (in Appendix B of the Guidance on Developing Conceptual Site Models), include PAHs.
- The ingestion of groundwater pathway is considered complete for future receptors. Building 103 is likely serviced by the local water utility. However, the groundwater in the area cannot be ruled out as a reasonably expected future source of drinking water.
- The inhalation of outdoor air pathway is considered complete for current and future receptors involved in excavation activities at the site where the removal or disturbance of remaining contaminated soil (at depths greater than 7 feet bgs) is expected. The pathway is complete due to the possible presence of Volatile Compounds of Potential Concern in subsurface soil at depths less than 15 feet bgs.
- The inhalation of indoor pathway is considered complete for current and future receptors in the Building 103 due to the possible presence of Volatile Compounds of Potential Concern in soil within 30 feet of the building.

- The dermal absorption of contaminants in groundwater pathway is considered complete for future receptors involved in excavation activities at the site where excavation depths greater than approximately 11 feet bgs (groundwater depth) are expected and dermal contact with groundwater is likely.

1.4. Scope of Work

Investigation activities will be conducted in summer 2020 to meet the following project objectives.

1. Delineate the extent of subsurface contamination at AOCs 2 and 3.
2. Assess for groundwater contamination at AOCs 2 and 3.
3. Assess for vapor intrusion in AOCs 3 and 4.

The scope-of-work to meet the project objectives associated with each AOC (2, 3, and 4) is as follows:

- ***AOC 2 – Shop Building 300 Former Drum Storage Area***
    - Advance soil borings around, and within, the former drum storage area footprint, and collect a minimum of eight soil samples for DRO/residual range organics (RRO), gasoline range organics (GRO)/benzene, toluene, ethylbenzene and total xylenes (BTEX), and polycyclic aromatic hydrocarbons (PAH) analyses to assess the horizontal and vertical extent of contamination.
    - Install one groundwater monitoring well in the former drum storage area footprint, and collect one groundwater sample for DRO/RRO, GRO/BTEX, and PAH analyses to assess for possible groundwater contamination.
- ***AOC 3 – Former Quarters Building 100 – UST 9-C-07 Footprint***
    - Advance soil borings around, and within, the UST 9-C-07 footprint, and collect a minimum of eight soil samples for DRO/RRO, GRO/BTEX, and PAH analyses to assess the horizontal and vertical extent of contamination.
    - Install three groundwater monitoring wells around, and within, the UST 9-C-07 footprint, and collect groundwater samples for DRO/RRO, GRO/BTEX, and PAH analyses to assess for possible groundwater contamination.
    - Conduct a vapor intrusion assessment of Building 100, and include the following:
        - Two soil-gas samples for volatile organic compounds (VOCs),
        - Three indoor air samples (two from the living area and one from the crawlspace) for VOC analysis (two sampling events - summer and winter), and
        - One ambient air sample (outdoor) for VOC analysis (two sampling events - summer and winter).
- ***AOC 4 Former Flight Service Station Building 103 – UST 9-C-08 Footprint***
    - Conduct a vapor intrusion assessment of Building 103, and include the following:
        - Two soil gas samples for VOC analysis,
        - Two indoor air samples (one living area and one crawlspace) for VOC analysis (two sampling events - summer and winter), and
        - One ambient air sample (outdoor) for VOC analysis (two sampling events - summer and winter).
- Generate a report presenting field observations, findings, analytical results, figures, conclusions, and recommendations for each AOC.

1.4.1. Regulatory Framework

A regulatory framework for this project has been developed in consideration of the following regulations and guidance documents.

- 18 AAC 75, ADEC Oil and Other Hazardous Substances Pollution Control, dated October 2018 (ADEC 2018).
- The ADEC Vapor Intrusion Guidance for Contaminated Sites (ADEC 2017a)
- 18 AAC 78, ADEC Underground Storage Tank Regulations, dated September 2019 (ADEC 2019b).
- The ADEC Field Sampling Guidance, dated October 2019 (ADEC 2019a).
- The ADEC Site Characterization Work Plan and Reporting Guidance for Investigation of Contaminated Sites, dated March 2017 (ADEC 2017c).

Groundwater sample analytical data will be compared to the Groundwater Cleanup Levels in Table C of ADEC’s 18 AAC 75.345. Soil sample analytical results will be compared to Migration to Groundwater Cleanup Levels in Table B1. Method Two – Soil Cleanup Levels of ADEC’s 18 AAC 75.341. Soil gas and indoor air analytical results will be compared to Residential Target Levels for Exterior Soil Gas and Residential Target Levels for Indoor Air, respectively, found in Appendix D and E, respectively, of ADEC’s Vapor Intrusion Guidance for Contaminated Sites.

1.5. Schedule

The project schedule for 2020 work at the Fort Yukon FAA Station site is presented below in Table 1. Susitna will advise the FAA if circumstances arise that require schedule adjustment.

TABLE 1: PROJECT SCHEDULE

Event	Anticipated Completion
Notification of Award	March 13, 2020
Draft Work Plan to FAA	April 24, 2020
FAA Review of Draft Work Plan	May 22, 2020
Final Work Plan to FAA/ADEC	June 5, 2020
Fieldwork	July/August 2020 and February 2021
Draft Report to FAA	March 19, 2021
FAA Review of Draft Work Plan	April 30, 2021
Final Report to FAA/ADEC	May 28, 2021

2. PROGRAM ORGANIZATION AND RESPONSIBILITIES

2.1. Project Client

- Mike Austin, Contracting Officer (FAA)
  mike.austin@faa.gov
- Lance Raymore, Contracting Officer Representative, (FAA)
  907-271-1321 Office / 907-440-1284 Cell

2.2. Contractor Personnel

This project will be managed by Melissa Mayer, and fieldwork will be executed by Ryan Burich and Nelson Crone. The project team will consist of the Susitna staff, or alternate qualified staff, and subcontractor personnel listed below.

- Melissa Mayer, Project Manager (Susitna)
  907-350-7952 Cell
- Ryan Burich, Geologist, Field Team Lead (Susitna)
  907-677-7423 Office
  907-341-9305 Cell
- Nelson Crone, GIS Specialist, Field Team Member (Susitna)
  907-310-0940 Cell

2.3. Subcontractors

- Chuck Homestead - SGS North America (Anchorage, AK)
  SGS will provide analytical services for soil and groundwater samples.
  907-562-2343 Office / 907-550-3206 Direct
- Kate Kaneko - ALS Environmental (Simi Valley, CA)
  ALS will provide analytical services for air samples.
  805-526-7162 Office / 805-577-2089 Cell
- Rodney Guritz – Arctic Data Services (ADS) (Fairbanks, AK)
  ADS will provide analytical data review and ADEC Data Review Checklists
  907-457-3147 Office
- Scott Vojta – GeoTek Alaska, Inc. (Anchorage, AK)
  GeoTek will provide soil boring, monitoring well installation, and soil probe placement services.
  907-569-5900 Office

3. FIELD ACTIVITIES – RELEASE INVESTIGATION

Field activities for this project will be conducted in early August 2020 and early February 2021. Susitna will mobilize the project team and all equipment from Anchorage, Alaska. The project team will consist of two Susitna environmental scientists or geologists who meet the ADEC requirements for qualified environmental professionals as defined in ADEC's 18 AAC 75.333, and two Geotek environmental drillers. Site field activities will include a combination of subsurface soil investigations, groundwater monitoring, and vapor intrusion assessments.

3.1. Investigative Approach

Susitna will perform all activities in compliance with all FAA Policies, and adhere to all applicable state and federal regulations. Subsurface soil investigation and groundwater monitoring tasks will be conducted in accordance with the ADEC's Field Sampling Guidance (ADEC 2019a), while the vapor intrusion assessments will be performed in accordance with the ADEC's Vapor Intrusion Guidance for Contaminated Sites (ADEC 2017a). The project team will work closely with the FAA Project Manager to ensure this work plan can be safely executed to accomplish all project objectives.

The field activities will occur in the following order.

1. Coordinate with the FAA project manager 15 days prior to project execution to ensure site access, and associated variables, are addressed prior to the arrival of the field team.
2. Coordinate with applicable property owners for access to Buildings 100 and 103.
3. Submit a utility locate request to Alaska 811 Digline, Inc. a minimum of 10 working days prior to initiation of field activities.
4. Mobilize field crew and equipment to project site.
5. Conduct daily tailgate safety meetings with crew, and discuss Job Hazard Analyses associated with each project task.
6. Stake out all proposed soil boring, groundwater monitoring well, and vapor probe locations with respect to located subsurface utilities and active USTs.
7. Advance soil borings and collect soil samples at AOCs 2 and 3.
8. Install groundwater monitoring wells at AOCs 2 and 3.
9. Install vapor probes at AOCs 3 and 4.
10. Collect groundwater samples from monitoring wells at AOCs 2 and 3.
11. Perform building surveys at AOCs 3 and 4.
12. Collect soil gas, outdoor/ambient air, and indoor air (crawlspace and living area) from AOCs 3 and 4 (two events – summer [August 2020] and winter [February 2021]).
13. Survey all soil boring, groundwater monitoring well, and vapor probe locations and other pertinent site features
14. Appropriately containerize and manage investigation-derived waste (soil cuttings and purge water).

15. Process and package analytical samples for transport to Anchorage and delivery to the laboratory.
16. De-mobilize crew and field equipment from project site.

3.2. Field Activities to be Performed at Each AOC

3.2.1. Subsurface Soil Investigation – AOCs 2 and 3

Prior to commencing any subsurface soil boring activities, Susitna will submit a utility locate request to Alaska 811 Digline, Inc. (minimum 10 working days prior for remote locations) and coordinate with local utilities representatives to confirm all subsurface utility lines in the area have been identified and appropriately marked. Additionally, Susitna will use a Fisher TW-7700 Digital Line Tracer and a Schonstedt Magnetic Locator to further locate subsurface utilities, as needed. Soil boring locations will be placed in the areas of known contamination (based on historical analytical results and in consideration of subsurface utilities).

Borings will be advanced by Geotek using a track-mounted Geoprobe™ direct-push hydraulic percussion drill rig with the Macro-core® soil sampling system. The Geoprobe™ drill rig uses a 5-ft long, 2.5-inch diameter sample barrel for each drive with a disposable polyvinyl chloride (PVC) Macro-core sleeve to contain the sample core. The soil borings will be advanced to groundwater depths. The core barrel will be removed from the drill rig and transported to the decontamination station following each 5-foot drive of the boring. The Macro-core sample sleeve will be removed from the core barrel. Following removal from the core barrel, the Macro-core sleeves will be capped on each end and labeled with the collection information. The soil core will be clearly labeled to identify the boring name, depth interval, date, and time of collection. Red (top) and black (bottom) caps will be placed on the ends of the core to identify the top and bottom and to prevent the loss of any material from the sleeves.

If the recovery volume of the core sample is poor (i.e. less soil is recovered than the length the core was driven), the excess PVC will be cut from the top end of the sleeve before the end cap is secured. This will reduce the amount of space in which the recovered material may un-consolidate during transfer to the processing station, which could impair the sample depth determination. The soil cores will be logged and sampled immediately after extraction in order to minimize loss of organic volatiles and/or contaminant bias.

GeoTek will decontaminate the sample barrels and Macro-core cutting shoes using a brush to remove excess soil and then scrubbing with an Alconox and hot water solution. A new PVC Macro-core liner will then be placed in the sample barrel. This process will be repeated for each sample barrel and cutting shoe prior to being transported back to the drill rig for reuse. Following the completion of each boring, the boreholes will be backfilled with bentonite to prevent the potential migration of surface and subsurface contaminants

Susitna will continuously log the soil borings (to groundwater depths) to assess the soil for evidence of impact. Visual and olfactory observations, as well as field screening results, will be used to identify the contamination. Once subsurface contamination is located, additional soil borings will be “stepped out” approximately 10 feet laterally in all directions until “clean” soil is evident based on screening results. Soil samples will then be collected for laboratory analysis from impacted, as well as “clean”, soil to delineate the vertical and horizontal extents of contamination.

The initial soil boring locations proposed for AOCs 2 and 3 are displayed on Figures 3 and 4, respectively, and are discussed below.

AOC 2 – Shop Building 300 (Figure 3)

The initial boring, soil boring (SB) 01, will be advanced approximately in the center of the Former Drum Storage Area located at the southeast corner of Building 300. Subsequent borings (SB02 through SB06) will be advanced outward in 10-foot increments, from the assumed area of contamination, until field screening results indicate “clean” soil is encountered.

AOC 3 – Former Quarters Building 100 (Figure 4)

The initial boring, SB01, will be advanced approximately 5 feet west of the current UST / former UST footprint located on the south side of Building 100. Subsequent borings (SB02 through SB06) will be advanced outward in 10-foot increments, from the assumed area of contamination, until field screening results indicate “clean” soil is encountered.

3.2.1.1. Field Screening

Due to the low sampling volume of the Macro-core® samplers, the cores will initially be field-screened with a photo-ionization detector (PID) using an expedited screening method. Immediately after cutting open the Macro-core® sleeve, fresh soil will be exposed by making a small divot every 6 inches along the length of the boring. The PID probe will be placed in the freshly exposed divot (taking care not to touch the soil with the probe), and the reading will be recorded. This method will be used to determine the relatively highest area of contamination (within each boring) in order to choose a soil sampling depth interval.

In addition to the expedited screenings, the field team will collect at least one heated-headspace screening sample from the relatively highest area of contamination in each soil boring to provide further information to be used for determining depth intervals to be sampled. The screening samples will be collected, heated and agitated to promote volatilization in accordance with the procedures outlined in the ADEC’s Field Sampling Guidance. Quart-sized Ziploc® bags with double lock seals will be used for the headspace containers. The Ziploc® bags will be partially filled with soil and immediately sealed to trap the volatile vapors. The headspace samples will then be warmed to at least 40 degrees Fahrenheit (°F) for a period of 10 minutes, but not longer than one hour, to permit headspace vapors to develop in the bag. The screening samples will be agitated for 15 seconds at the beginning and end of the headspace development to promote volatilization prior to screening with the PID. After sufficient time has passed for the development of vapors, the PID sampling probe will be inserted into the bag to measure the volatile organics. The results of the heated headspace screenings will be used to determine which depth intervals likely (or not) contain concentrations of petroleum hydrocarbon constituents that exceed target cleanup levels. A heated-headspace, field-screening target level of 20 (parts per million) ppm will be utilized for this purpose.

3.2.1.2. Soil Sampling

Soil samples will be collected, in consideration of the field screening results, from both the relatively highest areas (depth intervals) of contamination, as well as from depth intervals suspected to be “clean”. This approach will be used in determining the vertical and horizontal extent of contamination.

The field team will collect the soil samples in accordance with the collection and preservation requirements outlined in the ADEC Field Sampling Guidance to ensure all chemistry data-quality objectives are met and that all data is defensible and usable for the project. Samples will be collected using clean, disposable, stainless steel or dedicated disposable equipment. Nitrile gloves will be worn by the sampler and changed between sampling locations to prevent cross-contamination. Susitna will collect soil samples for volatile analyses (GRO and BTEX) first, from depth intervals with the highest PID results, to minimize the loss of volatile compounds. For volatile samples, a minimum of 50 grams of soil will be placed directly into tared 4-ounce (oz) jars with a Teflon®-lined septum fused to the lid. Immediately following collection, 25 milliliters (mL) of methanol preservative will be added to the container to completely submerge (and preserve) the volatile soil sample. A trip blank sample will be included with the volatile samples to detect and identify any volatile contamination of the samples while travelling to and from the lab. Soil will then be collected for DRO/RRO and PAH analyses and placed into laboratory-provided sample jars without preservative. Field duplicates will be collected at a frequency of 10 percent (%) for each analysis per each day of sampling. Immediately following collection, the sample containers will be placed into a cooler with sufficient gel ice to maintain a sample temperature of 0 to 6 degrees Celsius (°C) during transport to the analytical laboratory under proper chain of custody procedures. Analytical results from the soil samples will be compared to the ADEC Table B2. Method Two – Petroleum Hydrocarbon Soil Cleanup Levels for Migration to Groundwater in the Under 40 Inch Zone as listed in the ADEC 18 AAC 75 Oil and Other Hazardous Substances Pollution Control (ADEC 2018).

A minimum of 8 soil samples will be collected from each of the AOCs (AOC 2 and AOC 3, for a total of 16 samples), as shown below in Table 2.

TABLE 2: SOIL SAMPLING

Sample ID	Type	# of Samples	Matrix	Analytical Group	Analytical Method
AOC 2 – Shop Building 300					
FYU20SB##-Depth Interval-300	Primary	8	Soil	GRO/BTEX; DRO/RRO/PAH	AK101/SW8021B; AK102/AK103; SW 8270D-SIM
FYU20SB99-Depth Interval-300	Field Duplicate	1			
AOC 3 – Former Quarters Building 100					
FYU20SB##-Depth Interval-100	Primary	8	Soil	GRO/BTEX; DRO/RRO/PAH	AK101/SW8021B; AK102/AK103; SW 8270D-SIM
FYU20SB99-Depth Interval-100	Field Duplicate	1			

3.2.2. Groundwater Monitoring - AOCs 2 and 3

3.2.2.1. Monitoring Well Installation

Susitna will install a total of four groundwater monitoring wells (one well at AOC 3 and three wells at AOC 4) to help characterize and define the extent of contaminant impact in the groundwater in each area, as well as to enable a calculation of the groundwater flow direction and hydraulic gradient. Geotek will install wells with the Geoprobe drill rig using direct push technology. Each monitoring well will be constructed with a 1.5-inch (in) inner diameter x 10-foot-long, prepacked well screen with 0.010-in slot size, and 20/40 silica sand. The well screen will be connected to the surface via 10-foot sections of 1.5-in inner diameter schedule 40 PVC and completed at the surface in a steel flush mount monument. The sand pack will be placed to two feet above the well screen. The remainder of the annular seal will be hydrated bentonite chips to the ground surface. The well screens will be placed at depths that allow groundwater to flow into the wells, based on soil boring observations of saturated soil conditions (indicating groundwater). The monitoring well locations proposed for AOCs 2 and 3 are displayed on Figures 3 and 4, respectively, and are discussed below.

AOC 2 – Shop Building 300 (Figure 3)

One monitoring well (MW) 01 will be placed in the soil boring SB01 location, which will be positioned approximately in the center of the Former Drum Storage Area at the southeast corner of Building 300.

AOC 3 – Former Quarters Building 100 (Figure 4)

Three monitoring wells (MW01, MW02, and MW03) will be installed in AOC 3. MW01 will be placed in the soil boring SB01 location, which will be positioned approximately 5 feet west of the former UST footprint, located on the south side of Building 100. MW02 will be placed approximately 30 feet south east (and upgradient) of the former UST footprint. MW03 will be placed approximately 75 feet northwest (and downgradient) of the former UST footprint.

3.2.2.2. Monitoring Well Development

Following installation, Susitna will develop the monitoring wells in accordance with the ADEC Monitoring Well Guidance dated September 2013. The development activities may include hand bailing, pumping with a submersible pump, and/or surging with a surge block to create a proper hydraulic connection to the surrounding aquifer. Before and after development, the crew will use a water quality meter to measure and document water temperature, pH, conductivity, redox potential, dissolved oxygen, and turbidity. Groundwater will be pumped from each well at the end of redevelopment until water quality parameters stabilize. Groundwater parameters will be documented on a field form for each monitoring well. The crew will also note the visual appearance (color and turbidity) of the groundwater and assess the recharge rate in each well following development. The team will document all techniques used and observations made in logbooks and on field forms.

3.2.2.3. Monitoring Well Purging and Groundwater Sampling

Following the completion of well development activities, the project team will purge and sample the four newly-installed monitoring wells. Initially, the depth to groundwater will be measured from the top of the well casing and documented on field forms. All depth measurements will be taken from the north side of the well casing, unless a visible reference mark is present on the casing in a different position.

The field team will then purge the monitoring wells in accordance with low-flow techniques outlined in the U.S. Environmental Protection Agency (EPA) Low Stress (low flow) Purging and Sampling Procedures for the Collection of Ground Water Samples from Monitoring Wells published in 2017 and the ADEC Field Sampling Guidance published in October 2019. The wells will be purged using an ADEC-approved submersible-style pump and dedicated tubing. The groundwater will be pumped through a flow-through cell connected to a YSI 556 Multiparameter Instrument (YSI) for measuring the water quality parameters. In accordance with low-flow sampling requirements, water quality parameters are considered stable when three successive readings, collected 3 to 5 minutes apart, are within:

- ± 3 percent (%) for temperature (minimum of ± 0.2°C),
- ± 0.1 for pH,
- ± 3% for conductivity,
- ± 10 mv for redox potential, and
- ± 10% for dissolved oxygen.

A minimum of three (or four if temperature is monitored as an indicator) successive parameter readings within the above listed criteria are required to meet water quality stabilization requirements prior to sampling. All groundwater quality measurements and field observations will be recorded on field forms. While purging, the field team will monitor the depth to water to avoid water level drawdown greater than 0.3 feet, if possible. Additionally, if a low yield well is purged dry before stabilization can be achieved, the well will be allowed to recover to approximately 80% of the initial well volume before groundwater samples are collected.

The project team will sample the groundwater for the following compounds: GRO/BTEX, DRO/RRO, and PAH. Samples submitted for GRO/BTEX will be collected into laboratory-provided, 40-mL VOA vials preserved with hydrochloric acid (HCL). The vials will be filled completely to prevent volatilization. The containers will be capped, turned over and tapped to verify no air bubbles are present. Samples submitted for DRO/RRO will be collected into laboratory-provided 250-mL containers preserved with HCL preservative. Samples submitted for PAH analysis will be collected into laboratory-provided 1-liter containers with no preservative. Susitna will collect the analytical samples in order of the most volatile to least volatile analytes to ensure a minimal loss of volatile concentrations. A trip blank sample will be included with the volatile samples to detect and identify any volatile contamination of the samples while travelling to and from the lab.

Field duplicates will be collected at a frequency of 10% for each analysis per each day of sampling. Immediately following collection, the sample containers will be placed into a cooler with sufficient gel ice to maintain a sample temperature of 0°C to 6°C during transport to the analytical laboratory under proper chain of custody procedures. Analytical results from the groundwater samples will be compared to the ADEC Table C Groundwater Cleanup Levels as listed in the ADEC 18 AAC 75 Oil and Other Hazardous Substances Pollution Control.

One groundwater sample will be collected from each monitoring well, in the top 0.5 feet of the water column, as shown below in Table 3.

TABLE 3: GROUNDWATER SAMPLING

Sample ID	Type	# of Samples	Matrix	Analytical Group	Analytical Method
AOC 2 – Shop Building 300					
FYU20MW##-300	Primary	1	Groundwater	GRO/BTEX; DRO/RRO/PAH	AK101/SW8021B; AK102/AK103; SW 8270D-SIM
AOC 3 – Former Quarters Building 100					
FYU20MW##-100	Primary	3	Groundwater	GRO/BTEX; DRO/RRO/PAH	AK101/SW8021B; AK102/AK103; SW 8270D-SIM
FYU20MW99-100	Field Duplicate	1			

Dedicated disposable sample tubing will be used at each monitoring well location. Nitrile gloves will be worn by the sampler and changed between sampling locations to prevent cross-contamination. Some of the sampling equipment will be non-dedicated and will require decontamination between uses. Equipment anticipated for field decontamination includes, but is not limited to the following:

- Water level indicator
- Submersible pump
- Well development surge block

The decontamination procedures for the sampling equipment ad surge block will consist of the following activities:

- Scrub with brushes using an Alconox solution,
- Rinse with potable water,
- Rinse with distilled water, and
- Dry with paper towel.

3.2.3. Vapor Intrusion Assessments - AOCs 3 and 4

The release investigation activities will include the performance of a vapor intrusion assessment of the residences associated with AOCs 3 and 4 (Buildings 100 and 103, respectively). Susitna will obtain permission and any permits required to access Buildings 100 and 103. If permits are required, they will be attached as Appendix C. The assessment will be conducted to evaluate the volatile exposure concerns for the residential properties. The vapor intrusion assessment will be conducted in accordance with the methods and procedures detailed in the ADEC Vapor Intrusion Guidance published in November 2017, which are described below.

3.2.3.1. Building Surveys

The building survey will consist of completing an ADEC Building Inventory and Indoor Air Sampling Questionnaire and performing a pre-sampling inspection with the current resident, tenant, or other designated representative. The building survey will consist of a walk-through of the entire structure, documenting the building construction, the number of occupants, and occupied spaces, any active HVAC or ventilation systems, any penetrations through the structural floor, and potential sources of background contaminants. The inspection will evaluate the type of structure, the floor layout of each space, the physical conditions and airflows in the structures to identify any conditions that may affect or interfere with the collection of indoor air samples.

The field scientist will investigate the residence for the presence or use of any consumer products known to contain petroleum or volatile organic compounds. The product names and manufacturers of all potential background sources observed during the survey will be documented on the ADEC Building Inventory form. Susitna will work with the residents or property owners to minimize any releases of volatile chemicals from products or activities during the 24 hours leading up to sampling to prevent interference during the sample collection period. Removing the confounding sources from the indoor environment prior to testing is the most effective means of reducing the interference. In particular, the field scientist will attempt to ensure that the following activities are avoided 24 hours before sampling:

- opening any windows, fireplace dampers, openings or vents,
- operating ventilation fans unless special arrangements are made,
- indoor smoking,
- painting,
- using wood stoves, fireplaces or other auxiliary heating equipment (e.g., kerosene heaters),
- operating or storing vehicles in an attached garage,
- storing containers of gasoline or oil in the building, except for fuel oil tanks,

- cleaning, waxing or polishing furniture and floors with petroleum or oil-based products,
- using air fresheners, or odor eliminators, or
- applying building repair products such as caulk or roofing tar.

3.2.3.2. Multiple Lines of Evidence Sampling

Susitna will perform the vapor intrusion assessment by employing a multiple-lines-of evidence-based approach on the collection of vapor data. This approach will consist of the collection of indoor air (including living areas and crawlspaces), ambient air (i.e. outdoor) and near-building soil gas samples (within 10 feet of the structure and at least 4 feet bgs). The data collected from the three forms of vapor media enables a comprehensive evaluation of the vapor intrusion exposure to the property by isolating background chemical interferences, assessing the vapor source strength in the subsurface, identifying the exposure pathways and approximating the risk to current and future receptors.

3.2.3.3. Indoor and Outdoor Air Monitoring

The ADEC Vapor Intrusion Guidance recommends collecting at least one indoor air (IA) sample per 1,000 square feet of floor space. The approximate square footage of the residences are 1,150 square feet (sq ft) for Building 100 and 900 sq ft for Building 103, based on calculations provided by the Google Earth Pro Polygon application. Susitna will collect two 24-hour, indoor air samples from within the living area (and one from the crawlspace [CS]) of Building 100, as well as one 24-hour, indoor air sample from within the living area (and one from the crawlspace) of Building 103, to analyze the indoor air for the presence of volatile contaminants. One 24-hour, ambient, outdoor air (OA) sample will be collected proximal to both Building 100 and 103 (see Figures 4 and 5, as well as Table 4 below).

The precise locations of the sample canister placement will be determined based on the highest potential for vapor intrusion exposure as identified during the building survey. The field scientist will seek to place the samples away from ventilation or moisture sources, which could affect the results, and in secure or protected locations to avoid disturbance during the monitoring period. The field scientist will also attempt to position the canisters so that the intakes are in the same approximate breathing zone as building occupants (i.e. approximately 3 to 6 feet above the floor level).

The samples will be collected into 100 percent-certified, 6-liter stainless steel Summa canisters after performing a leak detection test on the canister and flow controller connections. ALS will provide the sampling hardware and analyze the samples by EPA Method TO-15. The sample canisters will be fitted with flow controllers to provide a 24-hour time-weighted average concentration to ensure they are representative of daily conditions inside the crawlspace.

After recovering the samples, the canisters will be packaged and shipped to the analytical laboratory in accordance with proper chain of custody procedures. Analytical results from the crawlspace air samples will be compared to the ADEC Target Levels for Indoor Air (Residential) as listed in Appendix D of the ADEC Vapor Intrusion Guidance for Contaminated Sites.

3.2.3.4. Soil Vapor Probe Installations

Geotek will install the vapor probes to approximately 48 inches bgs (and within 10 feet of the building foundation) with a Geoprobe drill rig using direct push technology. The probes will be constructed out of 6-inch stainless steel vapor implants connected to 0.25-inch diameter Teflon® tubing. The vapor implant, attached to the Teflon® tubing will be deployed through the drill rod casing upon reaching the desired probe depth. The field scientist will pour 20/40 silica sand into the annulus surrounding the implant, followed by 6 inches of dry, granular bentonite and then hydrated bentonite to the ground surface to make a seal. In accordance with the ADEC Vapor Intrusion Guidance the field team will allow a minimum of 30 minutes for the bentonite seal to cure following installation before beginning sampling activities. The probe tubing will be coiled into a flush-mount monument and marked with a stake so it can be easily located for the second sampling event. The end of the tubing will be capped to prevent air exchange between sampling events.

The vapor probe installation locations proposed for AOCs 3 and 4 are displayed on Figures 4 and 5, respectively, and are discussed below.

AOC 3 – Former Quarters Building 100 (Figure 4)

Two soil gas (SG) vapor probes will be placed within 10 feet of the building foundation, on the south side of the building. The probes will be installed proximal to the former UST footprint (one on the west side and one on the east side of the footprint).

AOC 4 – Former Flight Services Building 103 (Figure 5)

Two SG vapor probes will be placed within 10 feet of the building foundation, near the southeast corner of the building. The probes will be installed proximal to the former UST footprint (one on the north side of the footprint and one approximately 10 feet west of the footprint).

3.2.3.5. Vapor Probe Sampling

Susitna will purge and sample the vapor monitoring probes in accordance with the procedures outlined in the ADEC Vapor Intrusion Guidance. Integrity of the sampling train and vapor probes will be verified in the field through the performance of shut-in and leak tests. The vapor probes will be purged at a rate of 200 milliliters per minute (mL/min). The analytical samples will be collected into 100 percent-certified 1-liter stainless steel Summa canisters.

A flow controller will be attached to the canisters to regulate the flow at a rate of 200 mL/min (for approximately 5 minutes of sample collection). The sample identification number (ID), the initial canister vacuum, the regulator serial number, and the canister ID will be documented in the field notes and the canister tag for tracking purposes.

After recovering the samples, the canisters will be packaged and shipped to the analytical laboratory in accordance with proper chain of custody procedures. Analytical results from the soil gas samples will be compared to the ADEC Target Levels for Exterior or Subslab Soil Gas (Residential) as listed in Appendix E of the ADEC Vapor Intrusion Guidance for Contaminated Sites.

The quantity of each vapor intrusion air sample planned for the assessment is shown below in Table 4.

TABLE 4: AIR SAMPLING

Sample ID	Type	# of Samples Summer	# of Samples Winter	Matrix	Analytical Group	Analytical Method
AOC 3 – Former Quarters Building 100						
FYU20IA##-100 (Indoor Air)	Primary (6L Canister)	2	2	Air	VOCs	EPA Method TO-15
FYU20CS##-100 (Crawlspace)		1	1			
FYU20OA##-100 (Outdoor Air)		1	1			
FYU20IA99-100 (Indoor Air)	Field Duplicate (6L Canister)	1	NA			
FYU20SG##-100 (Soil Gas)	Primary (1L Canister)	2	2			
FYU20SG99-100 (Soil Gas)	Field Duplicate (1L Canister)	1	NA			
AOC 4 – Former Quarters Building 103						
FYU20IA##-103 (Indoor Air)	Primary (6L Canister)	1	1	Air	VOCs	EPA Method TO-15
FYU20CS##-103 (Crawlspace)		1	1			
FYU20OA##-103 (Outdoor Air)		1	1			
FYU20IA99-103 (Indoor Air)	Field Duplicate (6L Canister)	NA	1			
FYU20SG##-103 (Soil Gas)	Primary (1L Canister)	2	2			
FYU20SG99-103 (Soil Gas)	Field Duplicate (1L Canister)	NA	1			

3.2.4. Surveying

Upon completion of all field activities, the field team will survey all soil boring, groundwater monitoring well, and vapor probe locations (and other pertinent site features) utilizing a Leica real-time kinematic Global Positioning System (GPS) that is capable of achieving third order accuracy. Additionally, the field team will survey the elevations of the new monitoring well casings. The elevations of monitoring well casings shall be measured with an accuracy of 0.01 ft. The GPS data will be used to accurately plot soil boring, groundwater monitoring well, and vapor probe locations (and objects of interest) on scaled document drawings and figures.

3.2.5. Waste Management

Field activities will generate investigation derived waste (IDW). IDW will include soil cuttings (from soil borings), purge water (from groundwater sampling activities), as well as personal protective equipment (PPE) and used sampling materials, including disposable nitrile gloves, sample spoons, Ziploc® bags, paper towels, and used Macro-core® sampler sleeves.

Soil cuttings will be stored onsite in a 55-gallon, open-top, United Nations (UN) rated drum. Soil boring sample results from contaminated subsurface soils will be used to characterize the soil cutting waste for proper disposal. Upon receipt of the waste characterization results, the containerized soil cuttings will be labeled, manifested and transported to NRC Alaska (a US Ecology Company) in Fairbanks, Alaska.

Purge water will be treated onsite through a portable granular activated carbon system into a 55-gallon, open-top, UN rated drum. A characterization sample will be collected from the treated purge water and submitted for laboratory analysis. Per waste characterization results, the containerized purge water will either be properly labeled, manifested and transported to NRC Alaska in Fairbanks, Alaska or discharged onsite.

The PPE and used sampling materials will be disposed in the Fort Yukon landfill. Susitna assumes that no hazardous waste streams will be generated during the execution of this project. The treatment and/or disposal methods will be included in the work plan for ADEC approval.

4. SAMPLE CUSTODY, PACKAGING, AND SHIPMENT

Samples will be tracked by use of chain-of-custody (CoC) laboratory forms. Each sample will be individually identified on a chain-of-custody form. These forms will include sample identification number, sample date, sample time, requested analysis, type and number of sample containers, sample preservatives, quality control information, and requested analytical turnaround time. The chain of custody record must accompany the coolers in which the samples are packed. When transferring samples, the individuals relinquishing and receiving the coolers must sign, date, and note the time on the chain of custody record. This record documents sample custody transfer.

Samples will be packaged for shipment according to Department of Transportation regulations. Bubble wrap will be used to prevent breakage, and containers will be enclosed in plastic zip closure bags. Samples will be placed on gel ice (inside hard plastic coolers), maintaining the samples at a temperature within the method's required range of 4°C (±2°C) until delivery to an ADEC-approved laboratory. CoC documentation, temperature blanks, and trip blanks (as required) will accompany the samples in each cooler. Coolers will be taped shut and secured with custody seals to prevent accidental opening. The project crew will escort the sample coolers from the project site to the laboratory.

5. CALIBRATION PROCEDURES AND FREQUENCY

The PID and YSI will be calibrated daily, prior to initiating field activities, as follows.

5.1. PID Calibration

Calibrate the PID daily, onsite and verify that all calibration standards used meet the minimum requirements for source and purity recommended by the instrument manufacturer. The PID will be calibrated with 100 ppm isobutylene, and in accordance with the manufacturer's instructions. The following will be documented in the field notebook:

- Calibration date and time
- Instrument type, name, serial number, and owner
- Calibration gas type, canister lot number, and expiration date
- Zero gas calibration reading
- Calibration gas (span gas) reading
- Ambient weather condition (for example, temperature and wind direction)
- Operators initials
- Other notes and comments

5.2. YSI Calibration

Calibrate the YSI daily, onsite and verify that all calibration standards used meet the minimum requirements for source and purity recommended by the instrument manufacturer. The YSI will be calibrated with pH 4, 7, and 10 buffer solutions, 1.413 millisiemens/centimeter (mS/cm) conductivity standard, and the 240 millivolts (mV) Oxidation-Reduction Potential (ORP) standard, and in accordance with the manufacturer's instructions. The following will be documented in the field notebook:

- Calibration date and time
- Instrument type, name, serial number, and owner
- Calibration standard, lot number, and expiration date
- Initial, stabilized reading
- Accepted calibration reading
- Note if accepted calibration reading is out of range
- Confidence solution reading
- Ambient weather condition (for example, temperature and wind direction)
- Operators initials
- Other notes and comments

The YSI sensor array will be stored in pH 4 solution when not in use.

6. ANALYTICAL PROCEDURES

Soil and groundwater samples will be submitted to SGS North America, Inc. located in Anchorage, Alaska, while air samples will be submitted to ALS Environmental in Simi Valley, California. Both labs are ADEC Contaminated Sites Laboratory Approval Program (CS-LAP)-approved laboratories.

6.1. Analytical Program

Analytical methods to be used for soil, groundwater, and air samples during this project are presented below in Table 5.

Table 5: Sample Analytical Methods

Media	Parameter	Analytical Method	Sample Container	Preservation	Holding Time
Soil	GRO/BTEX	AK101/SW8021B	1 X tared, 4-oz amber w/septa	MeOH; 0-6°C	14 days
	DRO/RRO; PAH	AK102/AK103; SW 8270D-SIM	1 X 4-oz amber	0-6°C	14 days
Water	GRO/BTEX	AK101/SW8021B	3 X 40 ml amber VOA vials w/septa	HCl; 0-6°C	14 days
	DRO/RRO	AK102/AK103	2 X 250 ml amber	HCl; 0-6°C	14 days
	PAH	SW 8270D-SIM	2 X 250 ml amber	0-6°C	7 days
Air	VOCs	EPA Method TO-15	1 X 1L Summa (soil gas)	None	30 days
			1 X 6L Summa (indoor, crawlspace, and outdoor air)		

Key:

HCl	hydrochloric acid
L	liter
MeOH	methanol
ml	milliliter
oz	ounce
VOA	volatile organic analysis
°C	degrees Celsius

6.2. Field Quality Control

Field quality control samples will be collected to assess potential errors introduced during sample collection and handling. The field quality control samples are identified below in Table 6.

Table 6: Field Quality Control Samples

Sample Type	Media	Analytical Methods	Frequency
Field Duplicate	Soil	AK101/SW8021B; AK102/AK103; SW8270D-SIM	1 per 10 samples (10%) [or 1 per day for multi-day event] for each analytical method
	Water	AK101/SW8021B; AK102/AK103; SW8270D-SIM	1 per 10 samples (10%) [or 1 per day for multi-day event] for each analytical method
	Air-1L Summa (soil gas)	EPA Method TO-15	1 per 10 samples (10%) [or 1 per day for multi-day event] for each analytical method
	Air-6L Summa (indoor, crawlspace, and outdoor)	EPA Method TO-15	1 per 10 samples (10%) [or 1 per day for multi-day event] for each analytical method
Trip Blank	Soil	AK101/SW8021B	1 per sample cooler containing GRO/BTEX samples
	Water	AK101/SW8021B	1 per sample cooler containing GRO/BTEX samples
Temperature Blank	250 ml container of tap water	Not Applicable	1 per sample cooler

Key:

ml	milliliter

7. QUALITY ASSURANCE

7.1. Quality Assurance Objectives

Quality assurance (QA) objectives are included in this work plan to address potential concerns from field sample collection through laboratory analysis. The QA objectives for this project are to ensure the following:

- Appropriate analytical methods and sampling equipment are utilized for each media (soil, groundwater, and air) and respective COCs;
- Analytical data are usable for the purposes of this project;
- Daily calibration and maintenance of field instruments (PID and YSI) in accordance with manufacturer's instructions;
- There is no cross-contamination between sample locations (soil borings and groundwater monitoring wells); and
- Consistency in sample collection processes between sampling locations.

7.1.1. Data Quality Objectives

Project Data Quality Objectives (DQOs) were developed using the DQO process outlined in the EPA's Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA 2006).

7.1.1.1. State the Problem

Each of the three AOCs (2, 3, and 4) is contaminated with petroleum hydrocarbons and related VOCs and/or PAHs in varying degrees and extents. The AOCs have documented soil and groundwater contamination with various petroleum-hydrocarbon-related COCs Conceptual site models for each site have been developed and include site-specific details regarding exposure risks, receptors, and pathways to site COPCs (see Section 1.3). For a list of COPCs, refer to Section 1.1.1.

7.1.1.2. Identify the Goals of the Investigation

The primary goal of the project is to fulfill the requirements of the Scope of Work (SOW) (Contract Number 697DCK-20-C-00120) for AOCs 2, 3, and 4 of the Fort Yukon FAA Station. Specific project objectives include the following:

- Delineate the vertical and horizontal extents of petroleum hydrocarbon contamination in soil at AOCs 2 and 3,
- Characterize petroleum hydrocarbon contamination in groundwater at AOCs 2 and 3, and
- Assess vapor intrusion in buildings in AOCs 3 and 4.

7.1.1.3. Identify the Information Inputs

Information inputs include the following:

- Site background and historical results from previous investigations,
- Field observations, and

- Analytical results from samples collected from potentially impacted media, including soil, groundwater, and air samples.

7.1.1.4. Spatial Boundaries of the Project

The spatial boundaries of the investigations proposed for each AOC (2, 3, and 4) are presented on Figures 2 – 5 of this work plan. Spatial boundaries of each AOC are also defined in the following documents:

- *Release Investigation Report, Federal Aviation Administration Facilities, Fort Yukon, Alaska* (HLA 1996a).
- *Site Cleanup and Investigation Report, Hazardous Materials Removal Program, Fort Yukon, Alaska* (HLA 1996b).

7.1.1.5. Develop the Analytic Approach

AOC 2 – Shop Building 300

Subsurface petroleum-hydrocarbon release investigation: Soil borings will be advanced to groundwater depth, on a 10-foot by 10-foot grid, within, and around, the Former Drum Storage Area on the southeast corner of the Building 300 (see Figure 3). A minimum of eight samples will be collected and analyzed for GRO/BTEX by AK101/SW8021B, DRO/RRO by AK102/AK103, and PAH by SW 8270D-SIM. The analytical results for these samples will be used to evaluate the horizontal and vertical extent of soil with contaminant concentrations exceeding the ADEC Table B2. Method Two – Petroleum Hydrocarbon Soil Cleanup Levels for Migration to Groundwater in the Under 40 Inch Zone. In addition, one monitoring well will be installed in the footprint of the Former Drum Storage Area. A groundwater sample will be collected and analyzed for GRO/BTEX by AK101/SW8021B, DRO/RRO by AK102/AK103, and PAH by SW 8270D-SIM. The analytical results for this sample will be used to assess for groundwater contamination that exceeds ADEC Table C Groundwater Cleanup Levels.

AOC 3 – Former Quarters Building 100

Subsurface petroleum-hydrocarbon release investigation: Soil borings will be advanced to groundwater depth, on a 10-foot by 10-foot grid, within, and around, the Former UST footprint on the south side of Building 103 (see Figure 4). A minimum of eight samples will be collected and analyzed for GRO/BTEX by AK101/SW8021B, DRO/RRO by AK102/AK103, and PAH by SW 8270D-SIM. The analytical results for these samples will be used to evaluate the horizontal and vertical extent of soil with contaminant concentrations exceeding the ADEC Table B2. Method Two – Petroleum Hydrocarbon Soil Cleanup Levels for Migration to Groundwater in the Under 40 Inch Zone. In addition, three monitoring wells will be installed (one near the footprint of the former UST footprint, one upgradient of the footprint, and one downgradient of the footprint). A groundwater sample will be collected from each well and analyzed for GRO/BTEX by AK101/SW8021B, DRO/RRO by AK102/AK103, and PAH by SW 8270D-SIM. The analytical results for this sample will be used to assess for groundwater contamination that exceeds ADEC Table C Groundwater Cleanup Levels.

Vapor Intrusion Assessment: A vapor intrusion assessment will be conducted in consideration of subsurface petroleum-hydrocarbon contamination adjacent to the occupied Building 103.Two vapor probes will be installed to 4 feet below ground surface (and within 10 feet of the building foundation) to the west and east of the former UST footprint. Soil gas samples will be collected from these two locations. Additionally, air samples will be collected from one outdoor, one crawlspace, and two indoor/living area locations. All samples will be analyzed for VOCs by EPA Method TO-15. The soil gas results will be compared to Residential Target Levels for Exterior or Subslab Soil Gas. The outdoor, crawlspace, and indoor air results will be compared to Residential Target Levels for Indoor Air.

AOC 4 – Former Flight Service Station Building 103

Vapor Intrusion Assessment: A vapor intrusion assessment will be conducted in consideration of historical subsurface petroleum-hydrocarbon contamination adjacent to the occupied Building 103 (see Figure 5). Two vapor probes will be installed to 4 feet below ground surface (and within 10 feet of the building foundation) to the north and southwest of the former UST footprint. Soil gas samples will be collected from these two locations. Additionally, air samples will be collected from one outdoor, one crawlspace, and one indoor/living area location. All samples will be analyzed for VOCs by EPA Method TO-15. The soil gas results will be compared to ADEC's Appendix E. Residential Target Levels for Exterior or Subslab Soil Gas. The outdoor, crawlspace, and indoor air results will be compared to ADEC's Appendix D. Residential Target Levels for Indoor Air.

7.1.1.6. Specify Performance or Acceptance Criteria

Definitive-quality data will be used to characterize site conditions. Data from the planned investigations will be generated by using standard analytical methods (e.g., AK102, SW8260B). The usability of these data are not restricted unless a quality issue is identified. Analytical data will meet quality expectations for precision, accuracy, representativeness, completeness, comparability, and sensitivity, as described below in Section 7.4 *Calculation of Data Quality Indicators*.

7.1.1.7. Develop the Detailed Plan for Obtaining Data

Sample location and collection is based primarily on site history and will be biased toward areas of historical results indicating the presence of contamination.

Proposed locations for soil borings, groundwater monitoring wells, and air sampling are presented in Figures 3 - 5. Placement of borings and wells is subject to change based on field observations and actual site conditions.

7.2. Data Reduction, Validation, and Reporting

7.2.1. Data Reduction

Raw analytical data will be generated by the project laboratory (SGS) in PDF format. Data will be reviewed as they are generated to verify that the instruments are performing within specifications. This review will include calibration checks, surrogate recoveries, blank checks, retention time reproducibility, and other QC checks as specified in the laboratory's Standard Operating Procedures.

7.2.2. Data Validation

ADS will perform data validation for all analytical data packages. Data validation procedures are detailed in the ADS *Standard Operating Procedure for Stage 2A Data Validation* (2018), provided in Appendix F of this work plan. All data validation findings will be documented in the data quality review report and ADEC laboratory data review checklists, which will be appended to the project report.

7.2.3. Data Reporting

A group of samples submitted to the laboratory at the same time and included on the same CoC will be considered a sample delivery group (SDG). The results for each SDG will be reported as one analytical data package. The analytical data package will contain adequate information and be presented in a clear and concise manner. The laboratories will provide Level II data packages that meet the minimum requirements included in the ADEC Minimum Quality Assurance Requirements for Sample Handling, Reports, and Laboratory Data (ADEC 2019c) which include, but are not limited to, the following:

- Laboratory name, address, telephone number, CS Lab Approval Number, and the name of the person authorizing release of laboratory data,
- Report date,
- Case narrative summary report documenting all discrepancies with the data contained in the report, including but not limited to sample receipt, holding time(s), documentation and discussion of all quality control (QC) discrepancies and resulting corrective action, a discussion of all matrix interferences including low surrogate recoveries, analyte identifications as appropriate, etc,
- Product type (e.g. gasoline, diesel, etc),
- Preparation and analytical method used and method number,
- Type of matrix,
- Field sample number,
- Laboratory sample number,
- Date sampled,
- Date received,
- Date sample prepared,
- Data analyzed,
- Site or project name (from the Chain of Custody),
- Concentrations of analytes and limits of detection,
- Dilution factor,
- Analyst's name, signature or initials, and date signed,

- Definitions of any characters used to qualify data,
- Method blank results per matrix, method, and analytical batch,
- Precision and accuracy values for each sample set, with at least one precision and accuracy evaluation per each set of 20 samples,
- Sample receipt form documenting the condition of the samples and the ambient temperature of the interior of the shipping container adjacent to the sample container (or temperature blank) at the time it was received by the laboratory,
- Copy of the Chain of Custody for each sample or group of samples.

7.3. Internal Quality Control Checks

Field quality control samples will be collected at the frequencies specified in the Minimum Quality Assurance Requirements for Sample Handling, Reports, and Laboratory Data (ADEC 2019c) and ADEC Field Sampling Guidance (ADEC 2019a).

The following field QC samples will be collected and/or submitted for this project:

- One field duplicate sample will be collected at a minimum rate of 10% per matrix per analysis, for each day of sampling activities.
- Trip blanks will be submitted with every cooler for every shipment containing volatile samples.
- Temperature blanks will be submitted with every cooler containing analytical samples.

7.4. Calculation of Data Quality Indicators

The quality of the data to be collected for this project will be verified through appropriate measurement performance criteria established for both sampling procedures and analytical methods. The criteria should relate to data quality indicators (DQIs) consisting of precision, accuracy, representativeness, comparability, completeness, and sensitivity, commonly referred to as PARCCS parameters. The quality of the sampling procedures and laboratory results will be evaluated for compliance with project DQOs through a review of overall PARCCS. The DQIs are defined in the following sections:

Precision

Precision refers to the reproducibility of measurements. Precision is usually expressed as standard deviation, variance, percent difference, or range, in either absolute or relative terms. Precision data are used to evaluate consistency and reproducibility of field sampling and/or analytical procedures. Precision will be evaluated by comparing the following:

- LCS/LCSD (if prepared and analyzed) to determine the precision of the laboratory procedures and verify matrix interference
- MS/MSD samples to determine the effect of the sample matrix on the precision of the results generated using the selected analytical method
- Primary and field duplicate sample results

The required level of precision for field duplicates is relative percent difference (RPD) of 50% for soils and 30% for waters. Field duplicate precision is evaluated by calculating RPD using the following equation:

$$RPD = \frac{2|(D_1 - D_2)|}{D_1 + D_2} x\,100$$

$$RPD = \frac{2|(D_1 - D_2)|}{D_1 + D_2} x\,100$$

Where:

D1 = first sample value

D2 = second sample value (replicate)

RPD = relative percent difference

Accuracy

Accuracy is the degree of agreement between an observed value (such as sample results) and an accepted reference value. A measurement is considered accurate when the reported value agrees with the true value or known concentration of the spike or standard within acceptable limits. Accuracy is evaluated by reviewing:

- Calibrations – initial and continuing; acceptance, and frequency (deviations will be documented in laboratory report case narratives)
- Surrogates – recovery and frequency
- LCS and LCSD recoveries
- MS and MSD recoveries
- Relative response factors and relative standard deviation (RSD) (appropriate calibration procedures improve accuracy of measurement results; deviations will be documented in laboratory report case narratives)
- Method blanks (detections in the method blank may indicate potential high bias in associated samples)
- Gas chromatography second-column confirmation (if required)
- Tune criteria (gas chromatography/mass spectroscopy [GC-MS]) – acceptability and frequency (to ensure accuracy of mass and ion-abundance measurements; deviations will be documented in laboratory report case narratives)
- Internal standards (GC-MS) – acceptability and frequency (deviations will be documented in laboratory report case narratives)

For measurements where matrix spikes are used:

$$\%\,Recovery = \frac{(S - U)}{C_{sa}} x\,100$$

Where:

S = measured concentration in spiked aliquot

U = measured concentration in unspiked aliquot

C_{sa} = actual concentration of spike added

Representativeness

Representativeness is a qualitative term that refers to the degree that data accurately and precisely depict the characteristics of a population, whether referring to the distribution of a contaminant within a sample, a sample within a matrix, or a contaminant at a site. Representativeness is determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, operations process locations, and sampling locations.

Objectives for representativeness, which are defined for each sampling and analysis task, are a function of the investigative objectives. Assessment of representativeness shall be achieved through use of the standard field, sampling, and analytical procedures.

Representativeness will be evaluated by reviewing the following:

- Sample quantities and locations
- Sampling procedures and equipment
- Sample CoC forms and field logbooks
- Holding times and preservation

Comparability

Comparability addresses the degree to which different methods or data agree or can be represented as similar. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by the following:

- Using standard methods for sampling and analysis
- Reporting data in standard units
- Normalizing results to standard conditions
- Operating instruments within their calibrated range according to established procedures based on approved methodology
- Using standard and comprehensive reporting formats

Completeness

Completeness is a measure of the amount of valid data obtained compared with the amount that was expected to be obtained under correct, normal conditions. Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples (such as by site) as set out in the DQOs.

The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the dataset. For completeness requirements, valid results are all results not qualified with an R-flag after a usability assessment has been performed. Completeness should not be determined only on the basis of laboratory data qualifiers. The goal for completeness is 90 percent. Completeness is calculated and reported for each method, matrix, and analyte combination using the formula below:

$$\% \; Completeness = 100 \; x \left(\frac{V}{n} \right)$$

Where:

V = number of measurements judged valid

n = total number of measurements

Sensitivity

Sensitivity is the ability of a method or instrument to detect the target analytes at the level of interest. The capability of analytical laboratory methods and instrumentation to provide data with the sensitivity to meet the DQOs will be evaluated during the planning phase. The laboratory reference limits (including DLs, LODs, and LOQs) will be evaluated against the project action limits in order to determine whether the analytical methods and/or laboratory meet the project DQOs.

If a result is greater than the DL and less than the LOQ, the result will be reported as a detected concentration and flagged “J.” If no detected concentration is determined down to the DL, the result will be reported to the LOD concentration (with the added variables of sample dilution, final volume, and sample mass included), reported as a non-detect (ND) result, and U-flagged. A detected result greater than or equal to the LOQ will be reported without a qualifying flag unless otherwise required by quality control exceedance. No results below the DL will be reported.

Sample dilution due to target and or non-target compound concentrations or matrix interference could prevent achievement of DLs. Samples must be analyzed initially while undiluted, when reasonable. If dilution is necessary, both the original and the diluted results must be reported. A process for the handling of samples that require dilution must be set up prior to the start of sampling. Any samples that are not analyzed undiluted must be supported by matrix interference documentation, such as sample viscosity, color, odor, or results from other analyses of the same sample, to show that undiluted analysis is not possible. Appropriate cleanup procedures must be followed to minimize matrix effects on DLs, LODs, and LOQs. The analytical laboratory must notify the Project Chemist for review and approval of diluted samples and/or non-cleanup samples.

The laboratory DLs, LODs, and LOQs were evaluated against project-specific action limits and screening criteria to determine whether the sensitivity of the analysis is sufficient for project decision-making.

7.5. Preventive Maintenance

Equipment will be stored in accordance with its operation manual. While in storage, each piece of measuring and test equipment shall contain a unique number or marking that is readily legible and traceable to calibration and maintenance records.

Upon receipt and prior to the acceptance of leased or rented equipment, a designated field crewmember shall perform an initial instrument inspection consisting of a maintenance document review and a functional or operational check to ensure that the equipment is in proper working order. Field personnel will review maintenance records to verify that periodic maintenance activities are current and equipment-specific QC procedures are included with the instrument. In addition, field personnel will complete an inspection of measuring equipment to verify that it is working consistently and appears to be in satisfactory condition for its intended use, as specified in its operation manual or vendor supplied QC procedures.

Personnel shall maintain records of all field maintenance performed. Such records will be entered directly into the field logbook. The appointed field QA/QC officer or Field Manager will periodically review calibration logs and logbooks to confirm that equipment calibration procedures and equipment performance is within operation standards, as specified in the equipment's operation manual.

7.6. Corrective Action

All equipment deficiencies will be noted, addressed, and resolved during initial instrument inspection and prior to equipment acceptance. Equipment replacement or an equivalent substitution will be required in cases where equipment deficiencies are not resolved during the initial inspection.

An item discovered to be out of calibration or in need of maintenance will not be used until the required service is completed. If equipment does not to conform to its operation criteria as specified in its operation manual, then the non-conformance shall be documented in the project field logbook and the equipment returned to its source. Data generated from field instruments with calibrations outside manufacturer's or project-specified calibration criteria will not be used.

Upon returning measuring and test equipment to the vendor, personnel shall provide written documentation of any and all maintenance or calibration problems encountered in using the item.

7.7. Performance and System Audits

Field Performance Audit

Performance audits of field sampling activities will be conducted by reviewing laboratory sample receipts, and will include the following:

- *Sample volume and preservation*

  Ensure the appropriate sample volume was collected (and preserved, as required) for the analytical method requested.

- *Air bubbles*

  Ensure water sample containers for VOC analysis are filled so that air bubbles are not present.

- *Sample temperature*

  Ensure the samples arrived to the laboratory within the analytical-method-specified temperature range.

- *Custody seals*

  Ensure the sample coolers arrive to the laboratory with unbroken custody seals.

Analytical results will be reviewed by the project manager to assess the performance and adequacy of sample collection procedures. The project manager will review the field log book, soil boring log sheets, and groundwater sample data sheets and discuss findings with the field manager.

Field Systems Audits

Informal field systems audits will be periodically performed on-site. The audits will focus on the proper field-collection of soil, groundwater, and air samples and ensure the work plan is utilized as a reference. Audit activities will include a review of sample collection methods, decontamination practices, equipment calibration, sample processing and packaging, and chain-of-custody procedures.

7.8. Quality Assurance Reports to Management

Records will be maintained by the project team to provide evidence of quality assurance activities. These records will include the following:

- Results of performance and systems audits (in field notebooks and final report).
- Data quality assessment and ADEC laboratory data review checklist.
- Quality assurance observations and proposed corrective action(s).
- Daily field equipment calibration (and maintenance, as required) in field notebook.

8. REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2019a. *Field Sampling Guidance*. October 2019.

ADEC 2019b. 18 Alaska Administrative Code (AAC) Chapter 78 – *Underground Storage Tanks*. September 2019.

ADEC 2019c. Technical Memorandum Minimum Quality Assurance Requirements for Sample Handling, Reports, and Laboratory Data. October.

ADEC. 2018. 18 AAC 75 – *Oil and hazardous Substances Pollution Control*. October 2018.

ADEC 2017a. *Vapor Intrusion Guidance for Contaminated Sites*. November 2017.

ADEC 2017b. *Guidance on Developing Conceptual Site Models*. January.

ADEC 2017c. *Site Characterization Work Plan and Reporting Guidance for Investigation of Contaminated Sites*. March.

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Ecology and Environment, Inc. (E&E). 1992. *Environmental Compliance Investigation Report, Fort Yukon FAA Station*, *Fort Yukon, Alaska*. May.

Harding Lawson Associates (HLA). 1995. UST Decommissioning Assessment. October.

HLA 1996a. *Release Investigation Report, Federal Aviation Administration Facilities, Fort Yukon, Alaska*. March.

HLA 1996b. *Site Cleanup and Investigation Report Hazardous Materials Removal Program, Fort Yukon, Alaska*. June.

U.S. Geological Survey (USGS). 1994. *Overview of environmental and hydrogeologic conditions at Fort Yukon, Alaska*.

FIGURES

Legend

- ● Project Location
- 🟥 Project Extent

Notes:
1. Aerial imagery - ESRI basemaps, acquired April 2020

1 inch = 0 miles
NAD 1983 StatePlane Alaska 4 FIPS 5004 Feet

SITE LOCATION MAP
2020 RELEASE INVESTIGATION WORK PLAN
FAA STATION
FORT YUKON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
17 APR 2020	M. MAYER	1

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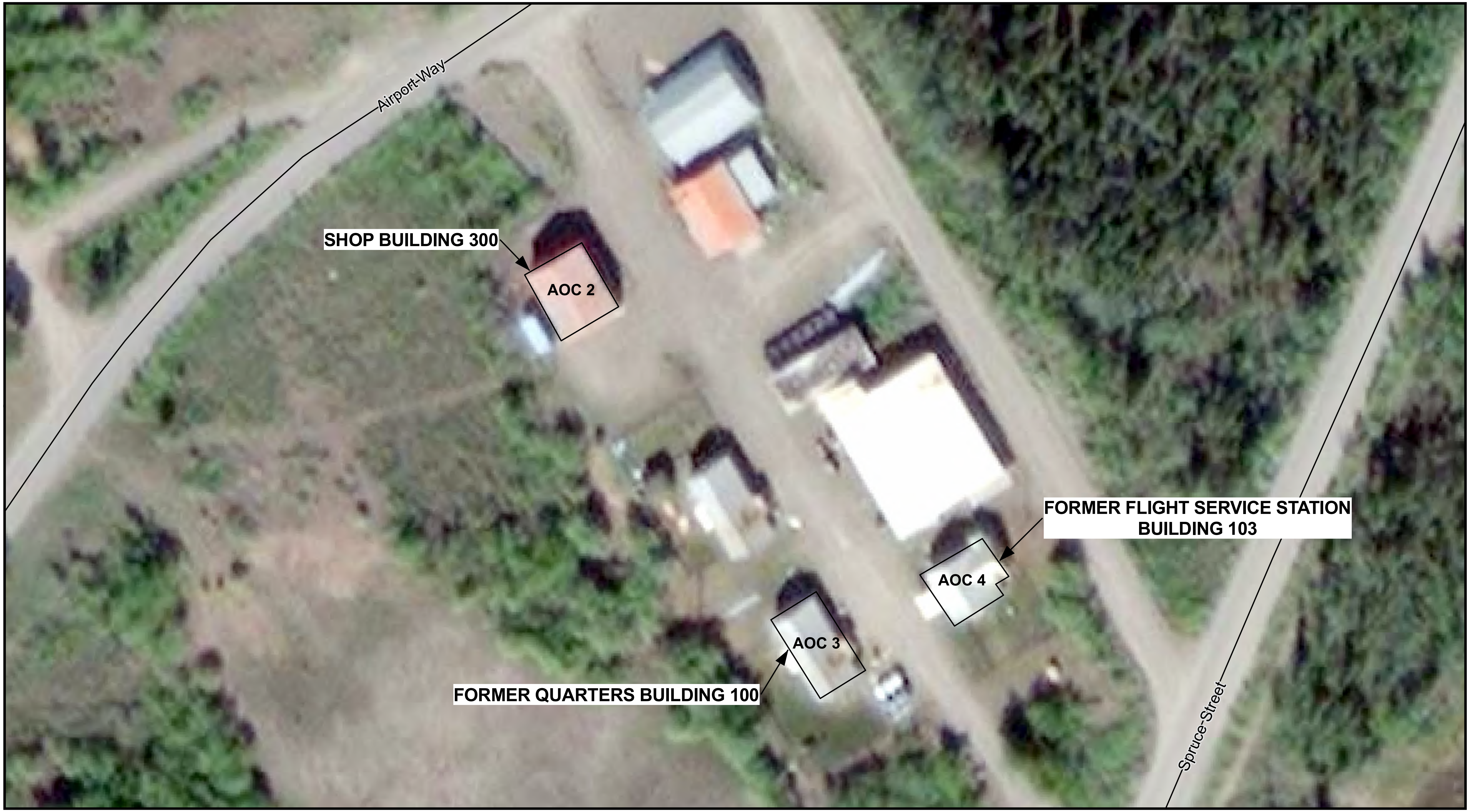

Legend

— Road

▭ Building

Notes:
1. Aerial imagery - ESRI basemaps, acquired April 2020
2. Road infrastructure data from Alaska DNR April 2020

1 inch = 50 feet
NAD 1983 StatePlane Alaska 3 FIPS 5003 Feet

SITE OVERVIEW- AOC 2, 3, AND 4
2020 RELEASE INVESTIGATION WORK PLAN
FAA STATION
FORT YUKON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
17 APR 2020	M. MAYER	2

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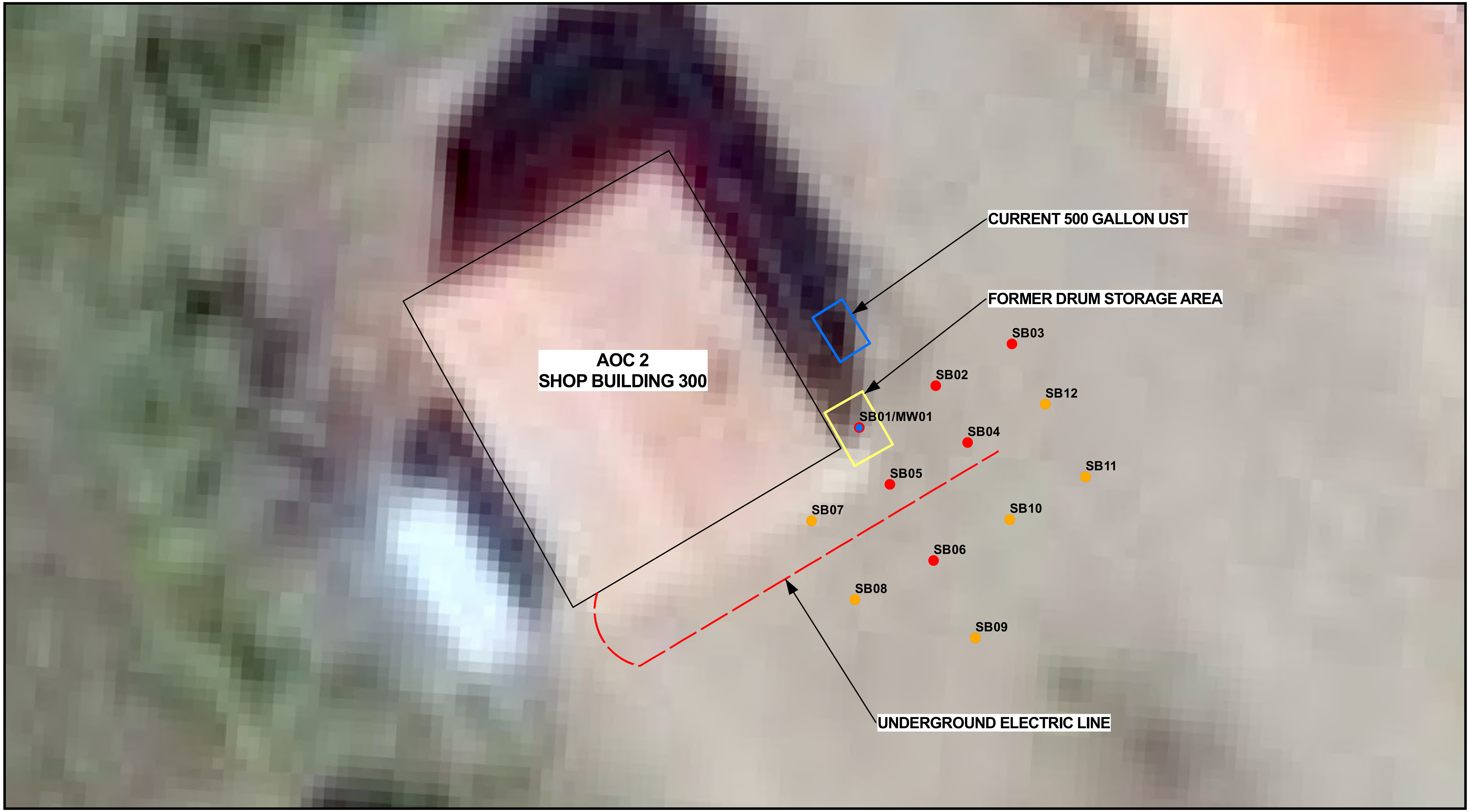

Legend

- ☐ Building
- — Underground Electric Line
- 🟨 Former Drum Stroage Area
- 🟦 Underground Storage Tank
- ● Proposed Soil Boring and Monitoring Well Location
- ● Proposed Soil Boring Location
- ● Additional Step Out Soil Boring Location (As needed)

Notes:
1. Aerial imagery - ESRI basemaps, acquired April 2020
2. Road infrastructure data from Alaska DNR April 2020

N

0 5 10 15 20
Feet

1 inch = 11 feet
NAD 1983 StatePlane Alaska 3 FIPS 5003 Feet

SOIL BORING AND MONITORING WELL LOCATIONS
AOC 2 - SHOP BUILDING 300
2020 RELEASE INVESTIGATION WORK PLAN
FAA STATION
FORT YUKON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
17 APR 2020	M. MAYER	3

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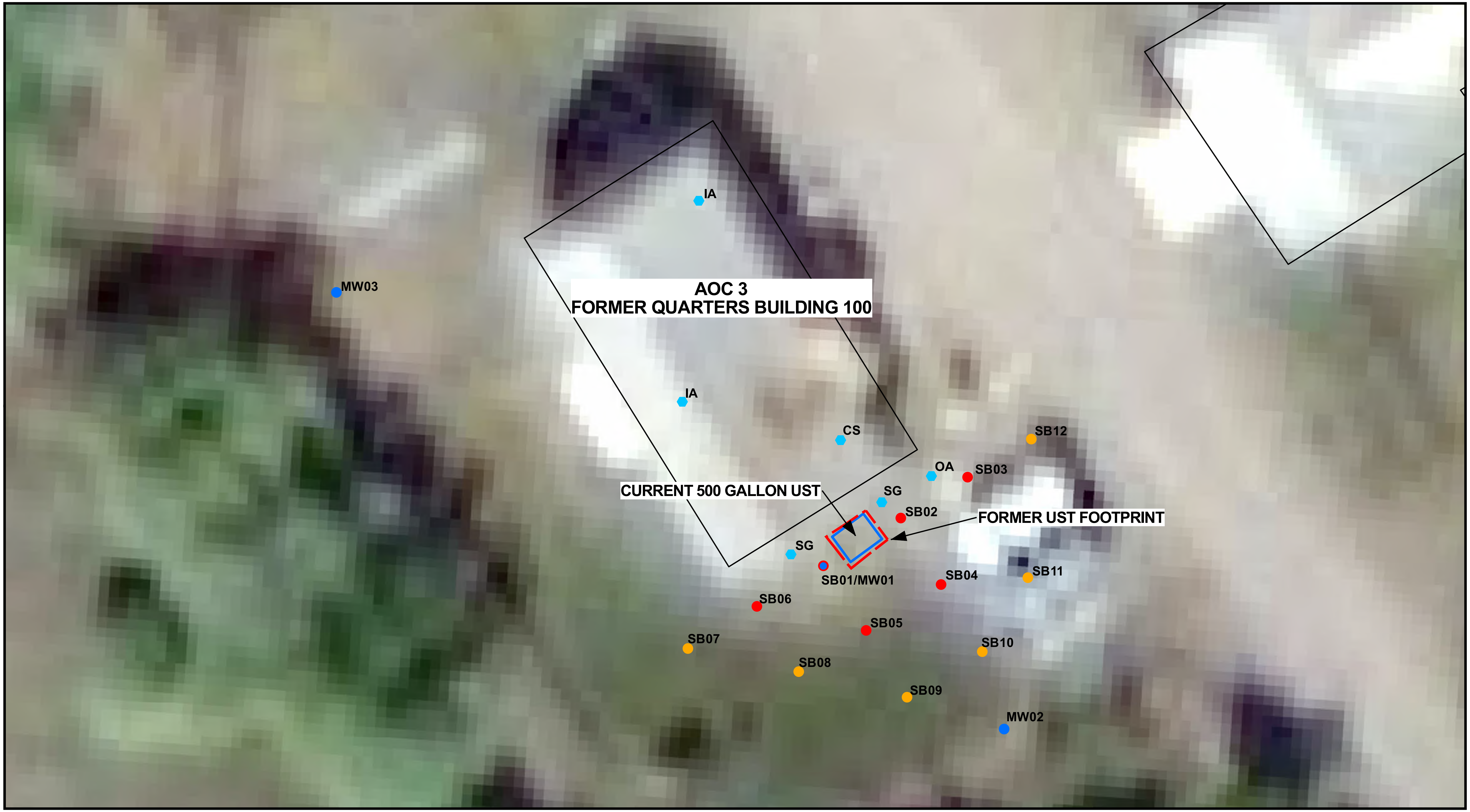

Legend

- ▭ Building
- 🟦 Current 500 Gal Underground Storage Tank
- 🟥 Former Underground Storage Tank Footprint
- ⬢ Proposed Air Sample
- ● Proposed Monitoring Well Location
- ● Proposed Soil Boring and Monitoring Well Location
- ● Proposed Soil Boring Location
- ● Additonal Step out Soil Boring Location (As Needed)

Notes:
1. Aerial imagery - ESRI basemaps, acquired April 2020
2. Air Sample types:
OA - Outdoor Air Sample
SG - Soil Gas Sample
IA - Indoor Air Sample
CS- Crawlspace Air Sample

N

0 5 10 15 20
Feet

1 inch = 12 feet
NAD 1983 StatePlane Alaska 3 FIPS 5003 Feet

SOIL BORING, MONITORING WELL
AND AIR SAMPLING LOCATIONS
AOC 3 - FORMER QUARTERS BUILDING 300
2020 RELEASE INVESTIGATION WORK PLAN
FAA STATION
FORT YUKON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
17 APR 2020	M. MAYER	4

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Legend
- ☐ Building
- 🟦 Current 500 Gallon Underground Storage Tank Footprint
- 🟥 Former Underground Storage Tank Footprint
- ● Air Sample

Notes:
1. Aerial imagery - ESRI basemaps, acquired April 2020
2. Air Sample types:
OA - Outdoor Air Sample
SG - Soil Gas Sample
IA - Indoor Air Sample
CS- Crawlspace Air Sample

N

0 5 10 15 20
Feet

1 inch = 12 feet
NAD 1983 StatePlane Alaska 3 FIPS 5003 Feet

AIR SAMPLING LOCATIONS
AOC 4 - FORMER FLIGHT SERVICE STATION BUILDING 103
2020 RELEASE INVESTIGATION WORK PLAN
FAA STATION
FORT YUKON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
17 APR 2020	M. MAYER	5

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APPENDIX A

ADEC WORK PLAN APPROVAL LETTER

THE STATE
of ALASKA
GOVERNOR MIKE DUNLEAVY

Department of Environmental Conservation
SPILL PREVENTION & RESPONSE
Contaminated Sites Program

610 University Avenue
Fairbanks, AK 99709-3643
Main: 907.451-2360
Fax: 907.451.2155
www.dec.alaska.gov

File: 740.38.011

June 26, 2020.

Electronic delivery only

Lance Raymore
Federal Aviation Administration
Alaska Region Technical Operations
222 W. 7th Ave, #14
Anchorage, AK 99513

RE: ADEC Approval, *Draft 2020 Release Investigation Work Plan, Federal Aviation Administration Station Buildings 300, 100, and 103, Fort Yukon, Alaska.*

Dear Mr. Raymore

The Alaska Department of Environmental Conservation (ADEC) has completed review of the aforementioned work plan detailing soil and groundwater sampling and vapor intrusion investigation to occur at the Building 300, 100, and 103 contaminated sites at the Federal Aviation Administration (FAA) station located in Fort Yukon, Alaska. The work plan is approved as written, please submit a final draft to ADEC for our records.

Thank you for your assistance in protecting human health and the environment, If you have any questions do not hesitate to contact me at (907) 451-5174 or via email at michael.hooper@alaska.gov.

Sincerely,

Michael Hooper
Environmental Program Specialist

APPENDIX B

HEALTH AND SAFETY PLAN

HEALTH, SAFETY AND ENVIRONMENT PLAN

FAA Station – Fort Yukon, Alaska
Release Investigation

Prepared by

SUSITNA
ENVIRONMENTAL, LLC

8361 Petersburg Street
Anchorage, Alaska 99507

TABLE OF CONTENTS

1. SIGNATURES

1.1 Preparers and Reviewers

This Health, Safety and Environment (HSE) plan, which must be maintained on site when field work is being performed, addresses the health and safety hazards of each phase of site operation, including the procedures and equipment required for worker protection. Only the Site Health and Safety Officer (SHSO) can change or amend this document, in agreement with the Project Manager. The SHSO must initial any change made to the HSE at the relevant section. Major amendments (e.g., changes in personal protective equipment, addition of tasks, etc.) must be documented in Section 3 and in Appendix A. This HSE must be reviewed and amended on an annual basis for projects lasting more than one year.

Prepared by: ____
SHSO Date

Approved by: ____
Project Manager Date

This HSE has been given to the following subcontractor(s) in accordance with the Occupational Safety and Health Administration (OSHA) HAZWOPER Standard, per Chapter 29 of Code of Federal Regulations (CFR), Subsection 1910.120.

Subcontractor: ____Date: __________

Subcontractor: ____Date: __________

Subcontractor: ____Date: __________

Instructions for Injury Response

If SERIOUS and/or LIFE THREATENING:

- **Seek immediate medical attention at the hospital/facility that provides emergency care shown on Figure 1.**
- **Once the emergency situation has stabilized, complete the Incident Reporting Form included in this HSE.**

If Non-Life Threatening:

- **Manager/Supervisor calls the Project Manager at (907) 350-7952 (Melissa Mayer) to discuss appropriate medical attention (even if he/she thinks medical attention is not required). If professional care is needed, seek medical attention at the nearest URGENT CARE facility.**
- **Complete the Incident Reporting Form included in this HSE.**

FIGURE 1

ROUTE TO HOSPITAL

Yukon Flats Health Center
907.662.2460
101 Spruce Street
Ft Yukon, AK 99740

Directions to Hospital from Site:

- Exit site to the south on Ramstad Road
- Take first right onto Spruce Street
- Follow this road for approximately 1000ft
- First building on the right is the Yukon Flats Health Center

NSE PROCEDURES

- The Site Health and Safety Officer (SHSO), or designated alternate, should be immediately notified via the on-site communication system. The SHSO assumes control of the emergency response.

- If applicable, the SHSO must immediately notify off-site emergency responders (i.e., fire department, hospital, police department, etc.) and must inform the response team of the nature and location of the emergency on site.

- If applicable, the SHSO calls for evacuation of the site. Site workers should move to their respective refuge stations using the established evacuation routes.

- For small fires, flames should be extinguished using the fire extinguisher. Large fires should be handled by the local fire department.

- If a worker is injured, the procedures presented in Instructions for Injury Response, located in the front of this HSE, must be implemented immediately.

- After an incident has stabilized, complete the Incident Reporting Form.

EMERGENCY RESPONSE CONTACT INFORMATION

Contact	***Telephone Numbers***	
	Office	***Alternate (Type)***
Fire Department	**911**	907-662-2379
Police Department	**911**	907-662-2311
Hospital - Yukon Flats Health Center	**911**	907-662-2460
Project Manager - Melissa Mayer	907.350.7952	NA
Site Health and Safety Officer – Ryan Burich	907.341.9305	NA
Utility Emergencies	811	NA
FAA Contracting Officer – Mike Austin	TBD	TBD

Dear Medical Provider:

On behalf of Susitna Environmental, LLC., you are authorized to evaluate and treat the below-listed Susitna Environmental employee today for an alleged work-related injury or illness.

Employee Name: ________________________________

Injury: ______________________________

Date of Injury: ____________________________

Date of Medical Evaluation: ________________________

Susitna Environmental strives to reduce OSHA recordables; therefore, ***please do not prescribe or dispense prescription medications if OTC medications or non-prescription strength can be used*. It is our primary interest to ensure this employee returns to work full duty. If a full duty release is not possible, Susitna Environmental may be able to find light duty for the **employee**; ***unless it is unavoidable, please do not prescribe lost time.*** We would appreciate it if you would complete the attached form "Physical Status for Return to Work", or a similar form, to assist us in evaluating this employee's work capabilities.

Thank you for your assistance.

Melissa Mayer,
Managing Member, Susitna Environmental, LLC

PHYSICAL STATUS FOR RETURN TO WORK

Employee Name ____________________________ Date of Injury/Illness _______________

TO BE COMPLETED BY TREATING PHYSICIAN

Diagnosis

____

I saw and treated this patient on (date) _______________ and:

__ Release the patient to full duty with no limitations on (date) _______________

__ Patient may return to work with the following limitation on (date) _______________ and may work an 8 hr. shift unless specified otherwise.

LIFTING CAPACITY

__ Occasional lifting (10 lbs. max.) and lifting and carrying occasionally. Walking and standing occasionally.

__ Occasional lifting (20 lbs. max.). Significant walking, standing; or sitting with pushing and pulling with arms or legs.

__ Occasional lifting (50 lbs. max.) with frequent lifting and/or carrying up to 25 pounds.

OTHER ACTIVITIES

		SINGLE DURATION					IN AN 8 HOUR DAY PATIENT MAY DO				
LIMITATION	NO LIMITATION	< 1/2 hr	1/2-1 hr	1-2 hr	2-4 hr	4-6 hr	1/2-1 hr	1-2 hr	2-4 hr	4-6 hr	6-8 hr
SIT											
STAND											
WALK											
USE RIGHT HAND											
USE LEFT HAND											

	NO LIMITATION	FREQUENTLY (31%-60%)	OCCASIONALLY (1%.-30%)	NEVER
BEND				
SQUAT				
CLIMB				
REACH OVERHEAD		WEIGHT LIMIT	WEIGHT LIMIT	
REACH SHOULDER		WEIGHT LIMIT	WEIGHT LIMIT	
PUSHING/PULLING		WEIGHT LIMIT	WEIGHT LIMIT	

Other instructions or limitations:

____

____

____

Estimated length of time of modified duty: ____

__ These restrictions are in effect until (date) ______________ or until patient is reevaluated on (date) _______________

__ Patient is totally incapacitated at this time. Patient will be reevaluated on (date) ________________

Physician Signature ____ Date _____________

ADDITIONAL NOTES:

Incident Reporting Form

EMPLOYEE INFORMATION

Name: ______________________ Position: ______________________________

Department #: __________________ Employee #: ______________ Phone #:________________

Supervisor Name: ______________

FACTS OF INCIDENT

☐Injury ☐Illness ☐General Liability ☐Near Miss Date and Time of Incident: ____________

Date and Time Accident Reported: __________________ To Whom: ___________________________

Where did the incident occur (location name and street address)? ______________________________

City: ________________ State/Province______________ Zip/Postal Code: ________________

County __________________ Country: _____________________________

What was the employee doing when the incident occurred? Name the tools, equipment or material the employee was handling and what he was doing with them. ____

____

____

Explain how the incident occurred. List events leading up to incident, what happened, how it happened and name objects and how they were involved (use a separate sheet if necessary). __________________________________

____

____

NATURE OF INCIDENT

Describe incident and indicate body part affected if injury (e.g. cut on middle left finger). ____________________

____

____

Name object or substance that injured the employee.____________________________________

____

Has any prior, related injury to affected area of body occurred while employed at Geosyntec/MMI? ☐ Yes ☐No

MEDICAL ATTENTION GIVEN (check all that apply)

☐First Aid given by ________________ Date/Time ______________________ Phone ____________________

☐Doctor's Name ___________________ Date/Time ______________________ Phone ____________________

Address ____

☐Hospital Name ___________________ Date/Time ______________________ Phone ____________________

Address ____

☐Released ☐Admitted Length of Stay: ______________________

Did the employee go to an Emergency Room? ☐ Yes ☐No

Incident Reporting Form (continued)

EMPLOYEE'S DESCRIPTION OF THE INCIDENT (IN OWN WORDS)

Describe incident and indicate body part affected (e.g. cut on middle left finger) and what you were doing when the incident occurred (be specific) ____________________

____

____

____

Explain how the incident occurred. List events leading up to incident, what happened, how it happened and name objects and how they were involved (use a separate sheet if necessary). ____________________

____

____

____

Employee's Signature ____________________ **Date**____________________

ADDITIONAL INFORMATION (TO BE COMPLETED BY THE MANAGER)

Witnesses

Name: ____________________ Phone: ____________________

Name: ____________________ Phone: ____________________

What do you believe could be done to help prevent incidents of this type (be specific)? ____________________

____

____

____

Any additional Comments ____________________

____

____

____

Manager's Signature ____________________ **Date**____________________ **Phone #:** ____________________

HR/EHS

OSHA Recordable?☐ Yes ☐ No ☐ Pending WC?☐ Yes ☐ No

Days away from work: ____________ Days of restricted work activity: ____________ Date returned to work ____________

HR Manager's Signature ____________________ **Date**____________________

Comments: ____________________

EHS Manager's Signature ____________________ **Date**____________________

Comments: ____________________

1.2 Site Workers

A pre-entry briefing conducted by the SHSO must be held prior to initiating the field work of this project. All sections of this HSE must be reviewed during this briefing. Any worker not in attendance at the initial meeting must be trained by the SHSO on the information covered in the pre-entry briefing. Tailgate meetings will be held at the beginning of each day by the SHSO to discuss important health and safety issues concerning tasks to be performed during that shift. Topics discussed in the tailgate meetings will be documented in a daily field log. Weekly site health and safety audits will be performed and documented by the SHSO for projects lasting more than one week. After reading the HSE and attending a pre-entry briefing, Susitna Environmental employees must sign the following acknowledgment statement.

"I have read, understand, and agree with the information set forth in this HSE. I have also attended a pre-entry briefing. I agree to perform my work in accordance with this HSE."

Signature	**Printed Name**	**Date**

2. DISCLAIMER

This HSE was prepared in accordance with Susitna Environmental’s Health and Safety Procedures for use by Susitna Environmental project staff. This plan complies with Susitna Environmental’s internal review procedures. Susitna Environmental does not endorse the use of this HSE by others. This document and its contents should not be used by firms other than Susitna Environmental or by persons other than Susitna Environmental employees without a thorough peer review by their health and safety managers. Should the work outlined in this HSE be executed by contractors other than Susitna Environmental the HSE should be modified and reviewed to comply with such company’s corporate health and safety procedures. In the event that a contractor other than Susitna Environmental executes this work, the contractor should complete independent analyses of hazards and mitigation measures, and should update all HSE tables, text, figures, and appendices prior to commencing work. Susitna Environmental assumes no responsibility for the accuracy, content, or health and safety of non- Susitna Environmental personnel during the implementation of the work in this HSE by other parties.

3. HSE AMENDMENTS

Over the course of this project, it is possible that the project-specific details and working conditions will change. This HSE shall be reviewed and amended as necessary to effectively describe the changing working conditions and to mitigate the potential health and safety issues that may arise during the project. Amendments to the HSE should be briefly described in the following spaces provided. The full text of the amendments should be provided in Appendix A.

AMENDMENT 1:

Date: __________ Project Manager: ____________ EHSC: ___________________
Brief description of amendment:
____
____

AMENDMENT 2:

Date: __________ Project Manager: ____________ EHSC: ___________________
Brief description of amendment:
____
____

4. SITE/TASK DESCRIPTION

The following is a brief description of the site, including information as to the location, approximate size, previous usage, and current usage. A description of the tasks to be performed is also presented.

- Site Location: FAA Station – Fort Yukon, Alaska
- Approximate Size of Site: TBD
- Previous Site Usage: FAA Storage / residence
- Current Site Usage: FAA Storage / residence
- Description of Surrounding Property/Population:

North	Fort Yukon Airport	East	Residential Properties
South	Residential Properties	West	Fort Yukon Airport / Residential Properties

Summary of previous site investigations (if available/applicable):

<u>BLDG 300</u>: A composite soil sample was collected from a former drum storage area and contained 820 mg/kg total recoverable petroleum hydrocarbons, 55 mg/kg volatile petroleum hydrocarbons, and 680 mg/kg extractable petroleum hydrocarbons.

<u>BLDG 100:</u> Decommissined UST. Excavation confirmation soil samples contained concentrations of ethylbenzene at 9.9 mg/kg, total xylenes at 71 mg/kg, and DRO ranging from 3,800 mg/kg to 22,000 mg/kg.

<u>BLDG 103:</u> Decommissined UST. Confirmation soil samples contained concentrations of ethylbenzene at 6.5 mg/kg, total xylenes at 5.7 mg/kg, and DRO at 3,000 mg/kg.

Task Descriptions:

Task 1: Soil Boring Advancement, Monitroring Well Installation, and Soil Gas Point Emplacement

Oversee subcontractors (GeoTek Alaska) as they use a Geoprobe to advance multiple soil borings, install four groundwater monitoring wells, and emplace four soil gas probes.

Hazards / Mitigation:

1. Site traffic / High visibility PPE, Safety cones, buddy system, hearing protection
2. Slips, trips and falls / Ensure area is clear of trip hazards. Follow safe load carrying practices
3. Pinch points and puncture hazards / Don appropriate safety gloves
4. Heavy equipment operation / Ensure all equipment is in proper working order. Await for operator acknowledgement prior to approaching equipment.
5. Loud noise / Don hearing protection.
6. Subsurface utility strikes / Ensure utility locate is performed prior to initiating work.

Task 2: Soil and Groundwater Sampling

Collect soil and groundwater samples.

Hazards / Mitigation:

1. Slips, trips and falls / Ensure area is clear of trip hazards. Follow safe load carrying practices
2. Cuts when opening soil cores / Don appropriate work gloves when using utility knife to open soil cores. Use retractable utility knife.
3. Chemical sample-preservative exposure / Wear appropriate eye and hand protection (safety glasses and nitrile gloves) when handling samples and preservatives (MeOH and HCl). For dermal contact, immediately wash skin with soap and water. For eye contact, rinse eyes with onsite saline eyewash.

Task 3: Performance of Building Surveys and Air Sampling

Perform building survey and household chemical inventory of Buildings 100 and 103.

Collect two outdoor air, three indoor air, two crawlspace air, and four soil gas samples.

Hazards / Mitigation:

1. Slips, trips and falls / Ensure walkway is clear. Always utilize three points of contact on stairs and ladders.
2. Overhead hazards / Don hard hats for low clearance areas
3. Disruptive or threatening tenants or property owners / Ensure approval for access is confirmed prior to arriving on-site. Use the buddy system..

5. KEY PERSONNEL AND HEALTH AND SAFETY RESPONSIBILITIES

Table 1 lists project personnel and their responsibilities in regard to health and safety concerns on this project.

6. WORKER TRAINING

All project personnel will have received the necessary health and safety training in accordance with the company Environmental, Health, and Safety (EH&S) Training Program. At least one person on site will hold a current certification in First Aid and CPR by the American Red Cross or equivalent agency. Pre-entry briefings and daily tailgate meetings shall also be conducted to facilitate site-specific training.

7. MAPS AND SITE CONTROL

7.1 Routes to Hospital and Urgent Care Facility

A medical clinic near the site has been identified. Figure 1 presents the route to the hospital, for emergency care. The figure also includes the facility name, phone number, and written directions from the site. The figure is included at the front of this HSE.

7.2 Site Map

A site map is presented on Figure 2 of the work plan. The site map is intended to show the location of the work zone(s), to provide on-site orientation, and to delineate evacuation routes. Changes may be made to the site map by the SHSO based on changing site conditions. The site map should be accessible in the work area.

7.3 Buddy System

The buddy system is required for all tasks. The buddy system includes maintaining regular contact with onsite Susitna Environmental personnel, clients, and/or contractors to periodically check on the condition of site workers. In situations when only one employee is performing field work, on-site personnel must have appropriate communication devices on his/her persons at all times and shall maintain contact with off-site personnel. The field worker must communicate with off-site personnel, at a minimum, of three times daily: (1) upon arriving at the site; (2) midway through the work day; and (3) upon departing from site.

7.4 Controlled Work Zones

APPLIES TO TASK: ☒① ☐② ☐③ ☐④ ☐⑤ ☐⑥ ☐⑦ ☐⑧ ☐ Not Applicable

Three controlled work zones, including an Exclusion Zone, a Contaminant Reduction Zone (CRZ), and a Support Zone, are required for the task(s) indicated above. The Exclusion Zone is defined as the area on site where contamination is suspected and tasks are to be performed. The CRZ is defined as the area where equipment and workers are to be decontaminated as they leave the Exclusion Zone. The Support Zone is defined as the command area and may serve as a staging and storage area for supplies. The location and extent of the work zones may be modified as necessary as site investigation information becomes available. For sites that do not require the three controlled work zones, the area(s) where work is to be performed shall be called the Work Zone.

The boundaries of the Exclusion Zone, CRZ, and Support Zone or the Work Zone shall be marked using the following methods:

☐ Warning tape
☐ Signs
☐ Other: ______________________
☒ Traffic cones
☐ Fence

7.5 Site Access

Access to the site must be controlled using the following method:

☐ Sign in/Sign out log
☐ Identification badges
☒ Other: <u>No access restrictions exist at the site</u>
☐ Guard
☐ Check in with SHSO

7.6 Visitors

Visitors to the site may need to be continually escorted for safety purposes. Susitna Environmental employees must not be allowed into the CRZ or Exclusion Zone or the Work Zone until they have received the proper personal protective equipment (PPE) and they have read, understand, and meet the requirements outlined in this HSE. Other visitors under Susitna Environmental's direction (subcontractors, etc.) may review this HSE for site familiarity, but they are ultimately responsible for their own health and safety (see disclaimer in Section 1).

7.7 Safe Work Practices

General Safe Work Practices that must be implemented during work activities at this site are listed in Table 2.

7.8 Inspections

For projects with field components lasting longer than one week, the SHSO must conduct periodic health and safety inspections. The inspections must be documented using the Health & Safety Inspection Checklist, presented in Appendix B. The Health & Safety Inspection Checklist records should be kept on file at the project site.

The requirement for periodic inspections is:

☒ Not Applicable
☐ Applicable, and the frequency shall be:
  ☐ Weekly
  ☐ Bi-Weekly
  ☐ Monthly

8. HAZARD ANALYSIS AND MITIGATORS

Site specific hazards have been identified through a hazard analysis. Hazard analysis included a review of chemical, physical, and biological hazards. The analysis also identified health and safety hazard mitigators needed to protect workers, which are presented in Appendix C.

8.1 Chemical Hazards

Potential exposure pathways to chemical health hazard agents include incidental soil ingestion, dermal absorption, and inhalation.. To effectively manage risk to exposure, constituents of concern (COCs) have been identified. Potential exposure to these COCs will be mitigated through engineering, administrative, and/or PPE controls. The COCs are documented and/or suspected materials present based on previous operations/activities. The identified COCs for this project are listed in Appendix D. Hazard Mitigators, which include control measures and methods to minimize exposure, are presented in Appendix C. Also, airborne levels of COCs may be estimated or measured to evaluate levels of PPE that will be required for individual tasks. The type(s) of air monitoring to be performed are discussed in Section 9.

8.2 Physical Hazards

Physical hazards due to the tasks to be performed (e.g., electrocution due to drilling, etc.) and due to the site setting and condition (e.g., slips, trips, or falls due to rocky terrain, etc.) were analyzed. Hazard mitigators for each physical hazard identified are presented in Appendix C. These hazard mitigators must be implemented for each task in which they are applicable, as summarized in the table in Appendix C.

8.3 Biological Hazards

Biological hazards (e.g., allergic reactions to poisonous plants or insects indigenous to the area, etc.) associated with tasks to be performed were analyzed. Hazard mitigators for each biological hazard identified are presented in Appendix C. These hazard mitigators must be implemented for each task in which they are applicable, as summarized in the table in Appendix C.

9. AIR MONITORING

APPLIES TO TASK: ☐① ☐② ☐③ ☐④ ☐⑤ ☐⑥ ☐⑦ ☐⑧ ☒ Not Applicable

Air monitoring will be performed to evaluate airborne exposure levels associated with the COCs on site within the breathing zone of site workers. Hazardous conditions may include concentrations that may cause acute or chronic illness, potential oxygen deficient environments, or potential explosive environments. Air monitoring may also be performed to evaluate the adequacy of engineering, administrative, and/or PPE controls. Air monitoring may be "real-time" (e.g., the instrument provides immediate results at the project), using multi-gas meters, photoionization detectors (PIDs), or colorimetric tubes. "Non-real-time" monitoring may also be performed by collecting samples and forwarding to a laboratory for analysis and quantification.

The type(s) of air monitoring equipment required to evaluate COCs is outlined in Appendix E. Monitoring equipment must be calibrated based on the manufacturer's requirements. Calibration results and air monitoring measurements must be documented. Based on the results noted and site activities or scope of work changes, the frequency of air monitoring may be adjusted on site by the SHSO with the consent of the Project Manager and communication with the EHSC.

10. PERSONAL PROTECTIVE EQUIPMENT

The levels of PPE required for each task are presented in Appendix F. Required equipment and types of protective clothing materials, as well as an indication of the initial level of protection to be utilized, are listed. The level of protection may be upgraded or downgraded by the SHSO according to mitigation measures required in Appendix C or according to action guidelines provided in Appendix E. The PPE levels that are implemented must be documented in a daily field log.

If respirators are worn, workers must abide by the company's Respiratory Protection Program in accordance with 29 CFR §1910.134. Fit tests are valid for a period of one year. Persons with facial hair that may interfere with the respirator seal may not wear respirators.

11. DECONTAMINATION

The SHSO and Project Manager will determine the type and level of decontamination procedures for both personnel and equipment based on evaluation of specific work activities in the controlled work zones. In an emergency, the primary concern is to prevent the loss of life or serious injury to personnel. Medical treatment will take precedence over decontamination in the event of a life threatening and/or serious injury/illness. Personnel will perform decontamination in designated and identified areas upon leaving "hot zones" where the potential exists for exposure to hazardous chemical, biological, or environmental conditions.

Decontamination of personnel in Level D (modified) will consist of closure and disposal of coveralls, disposable boots, and gloves, (if applicable).

Decontamination of personnel in Level C, if applicable, will consist, at a minimum, of:

- Removal and cleaning/disposal of boot covers, coveralls, and outer gloves;
- Removal, cleaning, and storage of respiratory protection;
- Washing of boots or other non-disposable PPE (e.g., hard hat, safety glasses/goggles, etc.) suspected of being contaminated using a soap solution followed by a water rinse; and
- Removal and disposal of inner gloves.

Wash solutions and PPE may require disposal at a licensed waste facility. Hand tools and sampling equipment shall be decontaminated as needed by washing in decontamination basins with appropriate solutions, or, if possible, by dry decontamination.

12. EMERGENCY PREPAREDNESS AND RESPONSE

A table presenting a list of contacts and telephone numbers for the applicable local off-site emergency responders is provided inside the front cover of this HSE (after figures). If the nature of the site work and COCs requires that off-site responders be notified before work begins on this project, the date that the pre-notification was made is presented in the table.

The following emergency response equipment is required for this project:

☒ First Aid Kit
☒ Fire Extinguisher (Type ABC)
☒ Eyewash bottle
☐ Other: ______________________________

In the event of an injury to an employee, the Instructions for Injury Response, located in the front of this HSE, must be implemented immediately. 'Tear-out' forms are located after the Instructions for Injury Response. If professional medical attention is required, these forms must be provided to the medical provider at the time the medical attention is administered. Injury reporting is required on the Incident Reporting Form.

In the event that an emergency develops, the procedures delineated in the Emergency Response Procedures, located in the front of this HSE, are to be followed immediately. (Note that an emergency does not necessarily include an injury.) After the emergency is resolved, post-incident reporting is required.

13. CONFINED SPACE ENTRY

☐ APPLICABLE ☒ NOT APPLICABLE

The task(s) for this project involve confined-space entry. Workers must abide by the company's Confined Space Entry Program [29 CFR §1910.120(j)].

14. SPILL CONTAINMENT

☒ APPLICABLE ☐ NOT APPLICABLE

The task(s) for this project involve handling of drums and/or containers that contain stored chemicals and/or wastes associated with sampling, excavation, transportation, etc. Workers must implement the hazard mitigating procedures for drum/container handling presented in Appendix C.

15. CHEMICAL HAZARD COMMUNICATION LABELING

☒ APPLICABLE ☐ NOT APPLICABLE

The following procedures must be followed for chemicals brought onto the site by Susitna Environmental personnel (i.e., decontamination solution, sampling preservatives, KB-1 solution, sodium permanganate, etc.) while performing the tasks of this project:

- Labels on primary chemical containers must not be defaced.
- Chemical containers must be stored in appropriate storage containers.
- Secondary containers and storage cabinets must be correctly and clearly labeled using the Hazardous Materials Identification System (HMIS).
- Chemicals incompatible with each other must not be stored together.
- Workers must receive training on the chemical hazards.
- Material Safety Data Sheets (MSDSs) for the chemical must be added to Appendix G.

When chemicals are used on site, workers must abide by Susitna Environmenta's Hazard Communication Program.

Table 1: Key Personnel and Health & Safety Responsibilities

Principal-in-Charge or Associate-in-Charge Melissa Mayer	***Project Manager (PM)*** Melissa Mayer	***Site Health & Safety Officer (SHSO)*** Ryan Burich	***Project Personnel*** Ryan Burich and Nelson Crone	***Environmental, Health & Safety Coordinator (EHSC)*** Ryan Burich
• Approve this HSE and amendments, if any. • Verify that elements of this HSE are implemented.	• Approve this HSE and amendments, if any. • Monitor the field logbooks for health and safety work practices employed. • Coordinate with SHSO so that emergency response procedures are implemented. • Verify that corrective actions are implemented. • Verify and document that personnel receive this plan and are aware of its provisions and potential hazards associated with site operations, and that they are instructed in safe work practices and familiar with emergency response procedures. • Provide for appropriate monitoring, personal protective equipment, and decontamination materials.	• Prepare and implement project HSE and amendments, if any, and report to the Project Manager for action if any deviations from the anticipated conditions exist and authorize the cessation of work if necessary. • Verify that site personnel meet the training and medical requirements. • Conduct pre-entry briefing and daily tailgate safety meetings. • Verify that all monitoring equipment and personal protective equipment is operating correctly according to manufacturer's instructions and such equipment is utilized by on-site personnel. Calibrate or verify calibration of all monitoring equipment and record results. • Verify that decontamination procedures are being implemented. • Implement site emergency response and follow-up procedures. • Notify the EHSC in the event an emergency occurs. • Perform weekly inspections.	• Provide verification of required health and safety training and medical surveillance prior to arriving at the site. • Notify the SHSO of any special medical conditions (e.g., allergies). • Attend pre-entry briefings and daily tailgate safety meetings. • Immediately report any accidents and/or unsafe conditions to the SHSO. • Be familiar with and abide by the HSE. • Be ultimately responsible for his or her own safety.	• Review and audit HSE and amendments. • Maintain a copy of the cover sheet of each completed HSE. • Notify Director of Environment, Health & Safety in the event an emergency occurs. • Assist with the implementation of the corporate health and safety program. • Consult on health and safety issues.

Table 2: General Safe Work Practices

- Minimize contact with impacted materials. Do not place equipment on the ground. Do not sit or kneel on potentially contaminated surfaces.
- Smoking, eating, or drinking after entering the work zone and before decontamination is not allowed. Employees who are suspected of being under the influence of illegal drugs or alcohol will be removed from the site. Workers taking prescribed medication that may cause drowsiness shall not operate heavy equipment and are prohibited from performing tasks where Level C or B personal protective equipment is required.
- Practice good housekeeping. Keep everything orderly and out of potentially harmful situations.
- Use of contact lenses may not be allowed under certain hazardous working conditions.
- The following conditions must be observed when operating a motor vehicle.
    - Wearing of seat belts is mandatory
    - The use of headlights is mandatory during periods of rain, fog, or other adverse weather conditions
    - A backup warning system or use of vehicle horn is mandatory when the vehicle is engaged in a backward motion
    - All posted traffic signs and directions from flagmen must be observed
    - Equipment and/or samples transported in vehicles must be secured from movement
    - The use of vehicles acquired by Susitna Environmental by non- Susitna Environmental personnel is prohibited
- In an unknown situation, always assume the worst reasonable conditions
- Be observant of your immediate surroundings and the surroundings of others. It is a team effort to notice and warn of dangerous situations. Withdrawal from a hazardous situation to reassess procedures is the preferred course of action.
- Conflicting situations may arise concerning safety requirements and working conditions. These must be addressed and resolved rapidly by the SHSO and PM to relieve any motivations or pressures to circumvent established safety policies.
- Unauthorized breaches of specified safety protocol must not be allowed. Workers unwilling or unable to comply with the established procedures must be discharged.

Appendix A: HSE Amendments

Discuss details of amendments to this HSE here. Include amendment number, date, and details of amendments.

Appendix B: Health & Safety Inspection Checklist

Project: ______________________________ Date: ________________

Inspected by: ____

Category	***Observations/Corrective Actions (N/A, if Not Applicable)***
Pre-entry briefing records are current	
Tailgate meeting records are current	
Training/medical surveillance/respiratory protection records are current	
Site map is posted	
Buddy system is implemented	
Work zones are identified	
Site access is controlled	
Visitors are being escorted	
On-site/off-site communications are in working order	
Safe work practices are being implemented	
Any additional hazards incurred?	
Air monitoring equipment is in working condition	
Air monitoring records are being recorded in field logbook	
Air monitoring calibration records are being recorded in field logbook	
PPE storage area is neat and organized	
Standard operating procedures are being implemented	
Housekeeping at decontamination zone is appropriate	
Decontamination procedures are being implemented	
Emergency response equipment is in working condition	
Route to hospital is posted	
Confined space entry program is being implemented	
Spill containment equipment is available	
Chemical inventory is up to date	
Material safety data sheets are available	
Primary and secondary containers are properly labeled	
Housekeeping at the chemical storage area is appropriate	

Appendix C: Hazard Analysis and Hazard Mitigators

TASKS	
① Soil boring advancement, monitoring well installation, and soil gas point emplacement.	⑤
②Collection of soil and groundwater samples	⑥
③Performance of building surveys and collection of air samples.	⑦
④	⑧

TASK #	①	②	③	④	⑤	⑥	⑦	⑧
I. Chemical Hazards								
Fire								
Permanganate Handling								
Reactivity								
Skin absorption	**X**	**X**						
II. Physical Hazards								
Bioaugmentation Culture Handling								
Boating								
Chainsaw								
Cold Stress								
Compressed Gas Cylinder			**X**					
Downhole Logging								
Drilling (including Indoor)								
Drum and Container Handling								
Electrocution								
Excavation/Trenching								
Eye Injury	**X**	**X**						
Fall Protection								
Flash Flood								
Hand/Foot Injury	**X**	**X**						
Heat Stress								

TASK #	①	②	③	④	⑤	⑥	⑦	⑧
Heavy Equipment	**X**							
Helicopter								
Knives / Blades	**X**	**X**						
Lifting Heavy Loads	**X**	**X**	**X**					
Lockout/Tagout								
Loud Noise								
Nuclear Gauge Radiation Exposure								
Portable Power/Hand Tool								
Slips, Trips, and Falls	**X**	**X**	**X**					
Thoroughfares	**X**	**X**						
Truck Crane								
Urban Environments	**X**	**X**	**X**					
Utility Protection	**X**							
Welding and Cutting								
Other:								
III. Biological Hazards								
Allergic Reaction to Poisonous Plant								
Alligators								
Dogs								
Stinging Insects / Vermin / Snakes								
Medical Waste								
Mountain Lions								
Other:								

An X in a box indicates that the listed hazard is applicable to the respective task. The appropriate Hazard Mitigators are presented in this Appendix.

SKIN ABSORPTION (MEOH AND HCI PRESERVATIVE)

- Wear nitrile gloves while safely filling groundwater and soil sample containers.

COMPRESSED GAS CYLINDER

- Keep cylinder valve caps screwed on at all times when regulators and gauges are not attached to the cylinder and when the cylinder is being moved.
- Do not use force to remove valve cap if stuck.
- Protect cylinders from cuts and abrasions.
- Use extreme care not to drop cylinders.
- Secure cylinders in an upright position using chains or other approved restraints.
- Do not use cylinders for rollers or support.
- Do not tamper with cylinder valves or safety devices.
- Do not lift cylinders using the protective valve caps.
- Do not substitute oxygen for compressed air.
- Store all oxygen cylinders at least 20 feet from all fuel gas cylinders and gasoline or diesel storage tanks.
- Keep cylinders away from exposure to open flame.
- Do not use oil or grease on oxygen cylinders or regulator connections to avoid an explosion.
- All cylinders must be labeled and indicate when they have been emptied.
- Check all valves and fittings on a cylinder for leaks with each use. If leakage is found, place a tag on the cylinder indicting the defect, and report it to the SHSO.
- Leak test all connections using soap solution where possible.
- Be certain that the second stage of the regulator is closed, after attaching the regulator to the cylinder, but before opening the cylinder valve.
- Stand to one side of the regulator gauge while you slowly open the cylinder valve 1/4 of a turn.
- Keep wrench on the valve stem of an acetylene cylinder when in use.
- Close the cylinder valve and bleed the pressure off hoses on cylinders when not in use.
- Use a cylinder cart to transport cylinders distances greater than 2 feet.

EYE INJURY

- Wear appropriate eye protection according to the task at hand.

HAZARD	TYPE OF PROTECTION
Impact	Safety glasses with side shield or vented safety goggles
Heat (Sparks)	Vented safety goggles or safety glasses with a face shield
Chemical	Hooded vented safety goggles or full-face respirator (if mild chemicals then safety glasses with side shield is acceptable)
Light Radiation	Tinted/reflective safety glasses or tinted/reflective face shield
Dust	Hooded vented safety goggles

- Apply anti-fog product to lens not previously treated.
- Minimize the amount of vapor or particulate matter generated, if possible.
- Avoid touching the face and eyes.
- Flush eyes with water for at least 15 minutes if chemicals do get into the eyes. If condition persists, seek medical attention.
- If dust or foreign objects are in your eyes, do not rub your eyes.
- If an object becomes embedded in the eye, do not attempt to remove. Lightly bandage your eyes, or both eyes, if possible and immediately seek medical attention.
- Do not wear contact lenses if chemical or dust hazard is present (e.g. decontamination or preservation chemicals used during sampling).
- Provide on-site training to workers before tasks at hand.
- If visitors enter area, stop work until they are properly protected.

HAND/FOOT INJURY

- Wear protective gloves as required in the Health and Safety Plan. Gloves should be chosen to suit the work being performed (e.g., chemical resistant gloves will be worn when handling chemicals or sampling for suspected chemicals).
- Steel-toed/steel-shanked safety boots must be worn whenever working around heavy objects (or as required by the HSE). Insulated and/or waterproof boots may also be warranted depending on weather conditions. Boots should be inspected periodically for signs of wear (e.g., cracks in rubber or along soles) and replaced as required.
- Durable footwear which provides adequate ankle support should be worn when working in rugged terrain.
- Use proper lifting techniques to avoid dropping heavy loads on hands and feet (refer to lifting heavy loads hazard mitigator)
- Be aware of moving machinery and heavy equipment in the work area and tuck away any loose clothing.

WORKING AROUND GEOPROBE (HEAVY EQUIPMENT)

HAZARD	TYPE OF PROTECTION
Injury to personnel	Barricade work area to ensure safe work radius. Ensure site workers know to obtain eye contact with operator prior to approaching equipment. Move slowly and methodically in tight or high traffic areas.
Damage to buried utilities or overhead structures Tipping equipment Pinch points	Perform a subsurface utility clearance prior to conducting work. Ensure overhead clearance is sufficient before raising the drill mast. Lower the mast prior to moving the rig. Ensure tracks are on a level / solid base prior to drilling. Do not side hill equipment over uneven terrain.

HAZARD	TYPE OF PROTECTION
	Keep hands free from drill rods during operation.
Spills	Have spill kit on site at all times. Use funnel or fill spout during fueling operations. Inspect Equipment Prior to operation for leaks, damage, or wear marks on hydraulic lines.
Hand lacerations when opening Macrocores	Take care when opening MacroCores. Don protective gloves when working with core cutting tool.
Loud noise while drilling	Don hearing protection while crew is drilling.

KNIVES / BLADES

- Always wear proper protective equipment. This should include:
  - heavy-duty leather gloves,
  - steel-toed boots with non-slip soles, and
  - hardhat and eye protection.
- Check the work area and make sure that:
  - the ground is free of obstacles such as rocks, stumps, holes, and wet or otherwise slippery conditions.
  - you can get a firm footing on the ground.
- Route cords, hoses, and cables supplying power to portable power tools to prevent tripping hazards.
- Protect tools from corrosion damage.
- Keep tools free of accumulated dirt and unnecessary oil or grease.
- Worn, damaged or dull blades should be sharpened or replaced as necessary.

LIFTING HEAVY LOADS

- Proper lifting techniques include:
  - *Feet* - Feet should be parted, with one foot alongside the object being lifted and one behind. Feet should be comfortably spread to give greater stability. The rear foot should be in position for the upward thrust of the lift.
  - *Back* - Use the sit-down position and keep the back straight, but remember that “straight” does not mean “vertical”. A straight back keeps the spine, back muscles, and organs of the body in correct alignment. It minimizes the compression of the abdomen that can cause a hernia.
  - *Arms and Elbows* - The load should be drawn close to the body, and the arms and elbows should be tucked in. When the arms are held away from the body, they lose much of their strength and power. Keeping the arms tucked in also helps keep body weight centered.
  - *Palm* - The palm grip is one of the most important elements of lifting. The fingers and the hand are extended around the object to be lifted. Use the full palm; fingers alone have very little power.
  - *Chin* - Tuck in the chin so the neck and head continue the straight back line. Keep the spine straight and firm.
  - *Body Weight* - Position the body so its weight is centered over the feet. This provides a more powerful line of thrust and assures better balance. Start the lift with a thrust of the rear foot. Shift hand positions so the object can be boosted after knees are bent. Straighten knees as object is lifted or shifted to the shoulders. To change direction, lift the object to a carrying position, and turn the entire body, including the feet. Do not twist your body. In repetitive work, both the person and the material should be positioned so that the worker will not have to twist his body when moving the material. If the object is too heavy to be handled by one person, get help.

- Limit continuous lifting of weights to 50 pounds or the maximum allowed by the client whichever is less. Lifts of heavier weights are permitted on an interim basis. Help shall be obtained for lifting of loads greater than 50 pounds or the maximum allowed by the client whichever is less. Mechanical equipment should be used on heavy materials when possible. If mechanical assistance is not available, adequate manpower to maintain the 50-pound limit per employee will be required.
- Do not lift more weight than can be handled comfortably, regardless of load weight. If necessary, help should be requested to lift a load so that the lifting is comfortable.

- Use drum dollies when moving drums or barrels.
- Inspect objects for grease or slippery substances before they are lifted to ensure that the object will not slip.
- Do not carry long, bulky or heavy objects without first verifying that the way is clear and that vision is unobstructed. This ensures that other persons or objects will not be struck by the load.
- Do not carry loads that cannot be seen over or around.
- Exercise caution when lifting above the chest level.
- Make sure workers are physically suited for the job before assigning jobs requiring heavy and/or frequent lifting. A person’s lifting ability is not necessarily indicated by his height or weight.
- Before lifting an object, consideration should be given to how the object will be set down without pinching or crushing hands or fingers. For example, to place an object on a bench or table, the object should be set on the edge and pushed far enough onto the support so it will not fall. The object can then be released gradually as it is set down, and pushed in place with the hands and body from in front of the object.
- When two or more people are handling the same object, one should “call the signals”. All the persons on the lift should know who this person is and should warn him if anyone in the crew is about to relax his grip.

SLIPS, TRIPS, AND FALLS

- Wear the proper foot wear and clothing for the task at hand.
- Pay attention to the work environment and become aware of all equipment and vehicles active onsite and use caution when moving about.
- Use caution when walking on sloped areas (especially geosynthetics), particularly when moisture is present. Use caution when walking on soft or uneven surfaces; e.g., marsh areas. Watch for icy conditions in cold weather.
- Follow the established designated safe paths for travel and keep these areas free from debris. Avoid steep or slippery slopes and paths near operation vehicles and equipment.
- Follow good housekeeping procedures. Never assume that someone else will clean up a spill or put away an object.
- Remove or clearly mark objects that pose tripping hazards.
- Prevent water accumulation where practicable.

- Cables and/or wiring should be taped down, when possible. Locate cables and/or wiring out of the commonly used areas.
- Mark or repair any opening or hole in the floor.
- Carry objects in a manner that allows you to see in the area you are moving in. Do not carry objects that are too large or bulky. Do not carry more weight than you can balance and keep stable. Understand that PPE can reduce or limit your field of vision and mobility.
- Use the proper ladder for the task at hand and do not exceed the recommended height. Do not use the top two rungs of a ladder. Ensure a flat and stable footing for the placement of a ladder. Utilize the buddy system to help secure the ladder. When working over 6 ft., utilize fall prevention measures. Obey height and weight guidelines and/or rules.
- Use the handrail when using stairs. Be aware of stairway blockages.
- If conditions even slightly resemble an unsafe environment, do not make any assumptions that the integrity of a workplace is intact.
- Never jump over or into a trench or excavation.
- Walk, do not run.
- Maintain proper lighting so obstacles are clearly visible

THOROUGHFARES

- Obtain necessary permits to use/block public thoroughfares.
- All care should be taken to ensure the integrity of walking and working surfaces, including the use of barriers, toe-kicks, etc. to warn personnel and the public of the potential fall and tripping hazards. Guardrails or barrier walls should be constructed surrounding open pits and trenches as appropriate.
- Traffic control plans will be produced and followed when required by the permitting agency or when working on or adjacent to a highway or a busy street. The traffic control plan shall be brought to the site and shall delineate the locations of applicable signs, signals and barricades; describe the necessity for flaggers; and provide other traffic control information..
- Signaling equipment and directions by flaggers shall conform to the latest edition of the U.S. Department of Transportation – Federal Highway Administration, Manual on Uniform Traffic Control Devices for Streets and Highways (http://mutcd.fhwa.dot.gov).
- Flaggers shall be provided with and shall wear fluorescent orange-red or fluorescent yellow-green garments while flagging. Warning garments worn at night shall be made of reflective material. The garments should meet the requirements of ISEA, American National Standard for High-Visibility Apparel.

- Barricades for protection of employees shall conform to the portions of the latest edition of the U.S. Department of Transportation – Federal Highway Administration,, Manual on Uniform Traffic Control Devices for Street and Highways (http://mutcd.fhwa.dot.gov), relating to barricades.

URBAN ENVIRONMENTS

- Always lock your vehicle when you step away from it, even if only temporarily.
- Ensure that the site is properly and sufficiently lighted before performing work.
- Do not perform any work at the site after dusk, or in the case of an active site, during hours when the site is closed.
- If security is a concern at an abandoned or uninhabited site, consider hiring a security guard or investing in other measures to ensure safety.
- When working at an active site, be conscious of on-site client operations. Do not interfere with client operations without consulting the local point of contact for the client.
- Be courteous when interacting with people encountered during activities at the site, including site personnel, passers-by, homeless people, trespassers, etc. Report all unauthorized people to the client point of contact or to another authority as designated by the client.
- If trash and debris are present at the site prior to site work, do not attempt to remove them unless directed to do so by the client. Be particularly alert for broken glass, needles, and other sharp and/or potentially harmful materials.
- Beware of and do not approach wild or stray animals

BURIED UTILITY STRIKES

- The SSHO will ensure buried utilities have been located prior to drilling. Drilling will not be conducted within 5 feet of utilities. If contact with underground utility occurs, halt excavation and contact the Project Manager. Ground disturbance will not be conducted until all utilities are located and appropriate authorizations are received .

Appendix D: Constituents of Concern (COCs)

Constituent[1]	***Medium[2]***	***Maximum Concentration[3]***
GRO	Soil and Groundwater	Unknown at all Buildings
BTEX	Soil, Groundwater, Air	Soil - Ethylbenzene: 6.5 mg/kg (BLDG 103) Soil - Ethylbenzene: 9.9 mg/kg (BLDG 100) Soil - Total xylenes: 5.7 mg/kg (BLDG 103) Soil - Total xylenes: 71 mg/kg (BLDG 100)
DRO	Soil and Groundwater	Soil - 3000 mg/kg (BLDG 103) Soil -3,800 mg/kg – 22,000 mg/kg (BLDG 100) Soil. 820 mg/kg (BLDG 300) GW - 3.88 mg/l (BLDG 100)
RRO	Soil and Groundwater	Unknown
PAH	Soil, Groundwater, Air	Unknown

Footnotes:

1 Constituents that are included on this list have either been detected at the site at concentrations that may cause potential dermal, ingestion, or inhalation hazards, or the constituent is suspected to potentially be present at elevated concentrations but no analytical data are available.

2 Type of medium (i.e. soil, water, sludge, etc.).

3 Maximum concentration previously detected for the constituent based on historic data (if available). Liquid concentrations are presented in micrograms of constituent per liter of solution (ug/L). Solids concentrations are presented in milligrams of constituent per kilogram of soil (mg/kg). Soil gas and/or vapor concentrations are reported in milligrams of constituent per cubic meter of gas/vapor (mg/m^3).

Appendix E: Air Monitoring Equipment, Frequency of Readings, and Action Guidelines per Task

Applies to Task: ☐ ① ☐ ② ☐ ③ ☐ ④ ☐ ⑤ ☐ ⑥ ☐ ⑦ ☐ ⑧

☐ ***Explosimeter***

Brand/Model No.: _______
____
Monitoring Frequency:____
____

Source Reading (% LEL)	Action
1 to 10	Continue with caution.
Greater than 10	Stop work. Evacuate the area. If upon return, if concentration still exceeds 10% LEL, ventilate until concentration is back to <10% LEL.

Note: _______

☐ ***Oxygen Meter***

Brand/Model No.: _______
____
Monitoring Frequency:____
____

Reading (%)	Action
Less than 19.5	Stop work. Evacuate the area.
19.5 to 23.5	Continue to work with caution.
Greater than 23.5	Stop work. Evacuate the area.

Note: _______

☐ ***Photoionization Detector***

Brand/Model No.:_______
____
Monitoring Frequency:____
____

Breathing Zone Reading (ppm)	Action
_____ to _____	Level D PPE
_____ to _____	Level C PPE
Greater than __ ___________	Stop work. Evacuate the area. If upon return, levels still exceed ___, stop work and implement engineering controls.

Note:_______

☐ ***Flame Ionization Detector***

Brand/Model No.: _______
____
Monitoring Frequency: ___
____

Breathing Zone Reading (ppm)	Action
_____ to _____	Level D PPE
_____ to _____	Level C PPE
Greater than __ ___________	Stop work. Evacuate the area. If upon return, levels still exceed ___, stop work and implement engineering controls.

Note: _______

☐ ***Chemical Detector Tube***

Brand/Model No.: _______
____
Monitoring Frequency: ___
____

Breathing Zone Reading (ppm)	Action
_____ to _____	Level D PPE
_____ to _____	Level C PPE
Greater than __ ___________	Stop work. Evacuate the area. If upon return, levels still exceed ___, stop work and implement engineering controls.

Note: _______

☐ ***Other***

Brand/Model No.:_______
____
Monitoring Frequency: ___
____

Breathing Zone Reading	Action
_____ to _____	Level D PPE
_____ to _____	Level C PPE
Greater than __ ___________	Stop work. Evacuate the area. If upon return, levels still exceed ___, stop work and implement engineering controls.

Note: _______________

Appendix F: Personal Protective Equipment per Task

	Task ①	Task ②	Task ③	Task ④	Task ⑤	Task ⑥	Task ⑦	Task ⑧
Potential PPE Level per Task:	☒ D ☐ C	☒ D ☐ C	☒ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C

Modified Level D*		***Level C****	
Equipment	***Material/Type***	***Equipment***	***Material/Type***
☒ Protective clothing		☐ Full-face air-purifying respirator	Cartridge Type:
☒ Outer gloves		☐ Half-mask air-purifying respirator	Cartridge Type:
☐ Outer boots		☐ Protective clothing	
☒ Hard hat**		☐ Outer gloves	
☒ Safety glasses**		☐ Inner gloves	
☒ Hard-toed boots**		☐ Outer boots	
☒ Hearing protection**		☐ Hard hat**	
☐ Other:		☐ Safety glasses**	
		☐ Hard-toed boots**	
		☐ Hearing protection**	
		☐ Other:	

* If checked, indicates initial level of PPE. Other completed columns indicate information to upgrade/downgrade.
** Optional as applicable

Appendix G: Safety Data Sheets

Included in HSE	***Chemical***
☐	Acetone
☒	Alconox
☐	Ammonia
☒	Bentonite
☒	Diesel Fuel Oil No. 2-D
☐	Gasoline
☒	Helium
☐	*n*-Hexane
☒	Hydrochloric Acid
☐	Hydrogen
☒	Isobutylene Calibration Gas
☐	Isopropyl Alcohol
☐	KB-1
☐	Methane Calibration Gas
☒	Methanol
☐	Nitric Acid
☐	Permanganate
☐	Portland Cement
☐	Sulfuric Acid
☐	Other: _____

SAFETY DATA SHEETS

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

1 Identification of the substance/mixture and of the supplier

1.1 Product identifier

Trade Name: Alconox
Synonyms:
Product number: Alconox

1.2 Application of the substance / the mixture : Cleaning material/Detergent

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer	**Supplier**
Alconox, Inc. 30 Glenn Street White Plains, NY 10603 1-914-948-4040	Not Applicable

Emergency telephone number:
ChemTel Inc
North America: 1-800-255-3924
International: 01-813-248-0585

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments.

Hazard-determining components of labeling:
Tetrasodium Pyrophosphate
Sodium tripolyphosphate
Sodium Alkylbenzene Sulfonate

2.2 Label elements:

Skin irritation, category 2.
Eye irritation, category 2A.

Hazard pictograms:

Signal word: Warning

Hazard statements:
H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Additional information: None.

Hazard description
Hazards Not Otherwise Classified (HNOC): None

Information concerning particular hazards for humans and environment:
The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

Classification system:
The classification is according to EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments, and extended by company and literature data. The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

3 Composition/information on ingredients

3.1 Chemical characterization : None

3.2 Description : None

3.3 Hazardous components (percentages by weight)

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	12-28
CAS number: 68081-81-2	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	8-22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	2-16

3.4 Additional Information : None.

4 First aid measures

4.1 Description of first aid measures

General information: None.

After inhalation:
Maintain an unobstructed airway.
Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:
Wash affected area with soap and water.
Seek medical attention if symptoms develop or persist.

After eye contact:
Rinse/flush exposed eye(s) gently using water for 15-20 minutes.
Remove contact lens(es) if able to do so during rinsing.
Seek medical attention if irritation persists or if concerned.

After swallowing:
Rinse mouth thoroughly.
Seek medical attention if irritation, discomfort, or vomiting persists.

4.2 Most important symptoms and effects, both acute and delayed

None

4.3 Indication of any immediate medical attention and special treatment needed:

No additional information.

5 Firefighting measures

5.1 Extinguishing media

Suitable extinguishing agents:

Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition.

For safety reasons unsuitable extinguishing agents : None

5.2 Special hazards arising from the substance or mixture :

Thermal decomposition can lead to release of irritating gases and vapors.

5.3 Advice for firefighters

Protective equipment:

Wear protective eye wear, gloves and clothing.
Refer to Section 8.

5.4 Additional information :

Avoid inhaling gases, fumes, dust, mist, vapor and aerosols.
Avoid contact with skin, eyes and clothing.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures :

Ensure adequate ventilation.
Ensure air handling systems are operational.

6.2 Environmental precautions :

Should not be released into the environment.
Prevent from reaching drains, sewer or waterway.

6.3 Methods and material for containment and cleaning up :

Wear protective eye wear, gloves and clothing.

6.4 Reference to other sections : None

7 Handling and storage

7.1 Precautions for safe handling :

Avoid breathing mist or vapor.
Do not eat, drink, smoke or use personal products when handling chemical substances.

7.2 Conditions for safe storage, including any incompatibilities :

Store in a cool, well-ventilated area.

7.3 Specific end use(s):

No additional information.

8 Exposure controls/personal protection

8.1 Control parameters :

7722-88-5, Tetrasodium Pyrophosphate, OSHA TWA 5 mg/m3.

8.2 Exposure controls

Appropriate engineering controls:

Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.

Respiratory protection:

Not needed under normal conditions.

Protection of skin:

Select glove material impermeable and resistant to the substance.

Eye protection:

Safety goggles or glasses, or appropriate eye protection.

General hygienic measures:

Wash hands before breaks and at the end of work.
Avoid contact with skin, eyes and clothing.

9 Physical and chemical properties

Appearance (physical state, color):	White and cream colored flakes - powder	**Explosion limit lower**: **Explosion limit upper**:	Not determined or not available. Not determined or not available.
Odor:	Not determined or not available.	**Vapor pressure at 20°C**:	Not determined or not available.
Odor threshold:	Not determined or not available.	**Vapor density**:	Not determined or not available.
pH-value:	9.5 (aqueous solution)	**Relative density**:	Not determined or not available.
Melting/Freezing point:	Not determined or not available.	**Solubilities**:	Not determined or not available.
Boiling point/Boiling range:	Not determined or not available.	**Partition coefficient (n-octanol/water)**:	Not determined or not available.
Flash point (closed cup):	Not determined or not available.	**Auto/Self-ignition temperature**:	Not determined or not available.
Evaporation rate:	Not determined or not available.	**Decomposition temperature**:	Not determined or not available.

Flammability (solid, gaseous):	Not determined or not available.	**Viscosity**:	a. Kinematic: Not determined or not available. b. Dynamic: Not determined or not available.
Density at 20°C:	Not determined or not available.		

10 Stability and reactivity

10.1 Reactivity : None

10.2 Chemical stability : None

10.3 Possibility hazardous reactions : None

10.4 Conditions to avoid : None

10.5 Incompatible materials : None

10.6 Hazardous decomposition products : None

11 Toxicological information

11.1 Information on toxicological effects :

Acute Toxicity:

Oral:

: LD50 > 5000 mg/kg oral rat - Product .

Chronic Toxicity: No additional information.

Skin corrosion/irritation:

Sodium Alkylbenzene Sulfonate: Causes skin irritation. .

Serious eye damage/irritation:

Sodium Alkylbenzene Sulfonate: Causes serious eye irritation .

Tetrasodium Pyrophosphate: Rabbit - Risk of serious damage to eyes .

Respiratory or skin sensitization: No additional information.

Carcinogenicity: No additional information.

IARC (International Agency for Research on Cancer): None of the ingredients are listed.

NTP (National Toxicology Program): None of the ingredients are listed.

Germ cell mutagenicity: No additional information.

Reproductive toxicity: No additional information.

STOT-single and repeated exposure: No additional information.

Additional toxicological information: No additional information.

12 Ecological information

12.1 Toxicity:

Sodium Alkylbenzene Sulfonate: Fish, LC50 1.67 mg/l, 96 hours.
Sodium Alkylbenzene Sulfonate: Aquatic invertebrates, EC50 Daphnia 2.4 mg/l, 48 hours.
Sodium Alkylbenzene Sulfonate: Aquatic Plants, EC50 Algae 29 mg/l, 96 hours.
Tetrasodium Pyrophosphate: Fish, LC50 - other fish - 1,380 mg/l - 96 h.
Tetrasodium Pyrophosphate: Aquatic invertebrates, EC50 - Daphnia magna (Water flea) - 391 mg/l - 48 h.

12.2 Persistence and degradability: No additional information.

12.3 Bioaccumulative potential: No additional information.

12.4 Mobility in soil: No additional information.

General notes: No additional information.

12.5 Results of PBT and vPvB assessment:

PBT: No additional information.

vPvB: No additional information.

12.6 Other adverse effects: No additional information.

13 Disposal considerations

13.1 Waste treatment methods (consult local, regional and national authorities for proper disposal)

Relevant Information:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities. (US 40CFR262.11).

14 Transport information

14.1 UN Number: None
ADR, ADN, DOT, IMDG, IATA

14.2 UN Proper shipping name: None
ADR, ADN, DOT, IMDG, IATA

14.3 Transport hazard classes:
ADR, ADN, DOT, IMDG, IATA

Class: None
Label: None
LTD. QTY: None

US DOT
Limited Quantity Exception: None

Bulk:	**Non Bulk:**
RQ (if applicable): None	**RQ (if applicable):** None
Proper shipping Name: None	**Proper shipping Name:** None
Hazard Class: None	**Hazard Class:** None
Packing Group: None	**Packing Group:** None
Marine Pollutant (if applicable): No additional information.	**Marine Pollutant (if applicable):** No additional information.

Comments: None **Comments:** None

14.4 Packing group: None
ADR, ADN, DOT, IMDG, IATA

14.5 Environmental hazards : None

14.6 Special precautions for user: None

Danger code (Kemler):	None
EMS number:	None
Segregation groups:	None

14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code: Not applicable.

14.8 Transport/Additional information:

Transport category:	None
Tunnel restriction code:	None
UN "Model Regulation":	None

15 Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture.

North American

SARA

Section 313 (specific toxic chemical listings): None of the ingredients are listed.
Section 302 (extremely hazardous substances): None of the ingredients are listed.

CERCLA (Comprehensive Environmental Response, Clean up and Liability Act) Reportable

Spill Quantity: None of the ingredients are listed.

TSCA (Toxic Substances Control Act):

Inventory: All ingredients are listed.
Rules and Orders: Not applicable.

Proposition 65 (California):

Chemicals known to cause cancer: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for females: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for males: None of the ingredients are listed.

Chemicals known to cause developmental toxicity: None of the ingredients are listed.

Canadian

Canadian Domestic Substances List (DSL):
All ingredients are listed.

EU

REACH Article 57 (SVHC): None of the ingredients are listed.

Germany MAK: Not classified.

Asia Pacific

Australia

Australian Inventory of Chemical Substances (AICS): All ingredients are listed.

China

Inventory of Existing Chemical Substances in China (IECSC): All ingredients are listed.

Japan

Inventory of Existing and New Chemical Substances (ENCS): All ingredients are listed.

Korea

Existing Chemicals List (ECL): All ingredients are listed.

New Zealand

New Zealand Inventory of Chemicals (NZOIC): All ingredients are listed.

Philippines

Philippine Inventory of Chemicals and Chemical Substances (PICCS): All ingredients are listed.

Taiwan

Taiwan Chemical Substance Inventory (TSCI): All ingredients are listed.

16 Other information

Abbreviations and Acronyms: None

Summary of Phrases

Hazard statements:

H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:

P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Manufacturer Statement:

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

NFPA: 1-0-0

HMIS: 1-0-0

SAFETY DATA SHEET

1. Identification

Product identifier CETCO® CRUMBLES

Other means of identification

CAS number 1302-78-9

Synonyms SMECTITE CLAY * BENTONITE

Recommended use Not available.

Recommended restrictions Workers (and your customers or users in the case of resale) should be informed of the potential presence of respirable dust and respirable crystalline silica as well as their potential hazards. Appropriate training in the proper use and handling of this material should be provided as required under applicable regulations.

Manufacturer/Importer/Supplier/Distributor information

Manufacturer

Company name CETCO, an MTI Company

Address
2870 Forbs Avenue
Hoffman Estates, IL 60192
United States

Telephone General Information 800 527-9948

Website http://www.cetco.com/

E-mail safetydata@mineralstech.com

Emergency phone number Emergency 1.866.519.4752/1 760 476 3962

Americas 1.866.519.4752 (US, Canada, Mexico) 1 760 476 3962

2. Hazard(s) identification

Physical hazards Not classified.

Health hazards

Health hazards	Carcinogenicity	Category 1A
	Specific target organ toxicity, repeated exposure	Category 1

Environmental hazards Not classified.

OSHA defined hazards Not classified.

Label elements

Signal word Danger

Hazard statement May cause cancer. Causes damage to organs through prolonged or repeated exposure.

Precautionary statement

Prevention Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not breathe dust/fume/gas/mist/vapors/spray. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Wear protective gloves/protective clothing/eye protection/face protection.

Response If exposed or concerned: Get medical advice/attention.

Storage Store locked up.

Disposal Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC) None known.

Supplemental information 8% of the mixture consists of component(s) of unknown acute dermal toxicity. 8% of the mixture consists of component(s) of unknown acute hazards to the aquatic environment.

3. Composition/information on ingredients

Mixtures

Chemical name	Common name and synonyms	CAS number	%
QUARTZ (SIO2)		14808-60-7	5 - < 10
CRISTOBALITE		14464-46-1	1 - < 3
Other components below reportable levels			90 - 100

Constituents

Chemical name	Common name and synonyms	CAS number	%
INERT OR NUISANCE DUSTS	PARTICLES NOT OTHERWISE REGULATED	SEQ250	

*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret.

Composition comments	Occupational Exposure Limits for constituents are listed in Section 8.

4. First-aid measures

Inhalation	Move to fresh air. Call a physician if symptoms develop or persist.
Skin contact	Wash off with soap and water. Get medical attention if irritation develops and persists.
Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. Get medical attention if symptoms occur.
Most important symptoms/effects, acute and delayed	Prolonged exposure may cause chronic effects.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Keep victim under observation. Symptoms may be delayed.
General information	IF exposed or concerned: Get medical advice/attention. If you feel unwell, seek medical advice (show the label where possible). Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media	Water fog. Foam. Dry chemical powder. Carbon dioxide (CO2).
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	Move containers from fire area if you can do so without risk.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials.
General fire hazards	No unusual fire or explosion hazards noted.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	Put material in suitable, covered, labeled containers. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling	Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep formation of airborne dusts to a minimum. Do not breathe dust. Avoid prolonged exposure. When using, do not eat, drink or smoke. Should be handled in closed systems, if possible. Provide adequate ventilation. Wear appropriate personal protective equipment. Wash hands thoroughly after handling. Observe good industrial hygiene practices.
Conditions for safe storage, including any incompatibilities	Store locked up. Store in original tightly closed container. Keep out of the reach of children. Store away from incompatible materials (see Section 10 of the SDS).

8. Exposure controls/personal protection

Occupational exposure limits

The following constituents are the only constituents of the product which have a PEL, TLV or other recommended exposure limit. At this time, the other constituents have no known exposure limits.

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
QUARTZ (SIO2) (CAS 14808-60-7)	PEL	0.05 mg/m3	Respirable dust.

US. OSHA Table Z-3 (29 CFR 1910.1000)

Components	Type	Value	Form
QUARTZ (SIO2) (CAS 14808-60-7)	TWA	0.1 mg/m3	Respirable.
		2.4 mppcf	Respirable.

Constituents	Type	Value	Form
INERT OR NUISANCE DUSTS	TWA	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.
		50 mppcf	Total dust.
		15 mppcf	Respirable fraction.

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
QUARTZ (SIO2) (CAS 14808-60-7)	TWA	0.025 mg/m3	Respirable fraction.

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value	Form
QUARTZ (SIO2) (CAS 14808-60-7)	TWA	0.05 mg/m3	Respirable dust.

Biological limit values	No biological exposure limits noted for the ingredient(s).
Exposure guidelines	Occupational exposure to nuisance dust (total and respirable) and respirable crystalline silica should be monitored and controlled.
Appropriate engineering controls	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level.

Individual protection measures, such as personal protective equipment

Eye/face protection	Wear safety glasses with side shields (or goggles).
Skin protection	
Hand protection	Wear appropriate chemical resistant gloves.
Other	Use of an impervious apron is recommended.
Respiratory protection	Use a particulate filter respirator for particulate concentrations exceeding the Occupational Exposure Limit.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Observe any medical surveillance requirements.

9. Physical and chemical properties

Appearance	
Physical state	Solid.
Form	Solid.
Color	Not available.
Odor	Not available.
Odor threshold	Not applicable.

pH	8.5 - 11
Melting point/freezing point	> 842 °F (> 450 °C) / Not applicable.
Initial boiling point and boiling range	Not applicable.
Flash point	Not applicable.
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not applicable.
Flammability limit - upper (%)	Not applicable.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not applicable.
Vapor density	Not applicable.
Relative density	2.6 g/cm³
Solubility(ies)	
Solubility (water)	< 0.9 mg/l
Partition coefficient (n-octanol/water)	Not applicable.
Auto-ignition temperature	Not applicable.
Decomposition temperature	> 932 °F (> 500 °C)
Viscosity	Not applicable.
Viscosity temperature	Not applicable.
Other information	
Bulk density	0.9 - 1.4 g/cm³
Explosive limit	Not applicable.
Explosive properties	Not explosive.
Explosivity	Not applicable.
Flame extension	Not applicable.
Flammability	Not applicable.
Flammability (flash back)	Not applicable.
Flammability (Heat of combustion)	Not applicable.
Flammability (Train fire)	Not applicable.
Flammability class	Not applicable.
Flash point class	Not flammable
Molecular formula	UVCB Substance
Molecular weight	Not applicable.
Oxidizing properties	Not oxidizing.
Percent volatile	0 %
pH in aqueous solution	8.5 - 11
Specific gravity	Not applicable.
VOC	CARB 0 %

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.

Conditions to avoid	Avoid temperatures exceeding the decomposition temperature. Contact with incompatible materials.
Incompatible materials	Powerful oxidizers. Chlorine.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Inhalation	Prolonged inhalation may be harmful.
Skin contact	No adverse effects due to skin contact are expected.
Eye contact	Direct contact with eyes may cause temporary irritation.
Ingestion	Expected to be a low ingestion hazard.
Symptoms related to the physical, chemical and toxicological characteristics	Direct contact with eyes may cause temporary irritation.

Information on toxicological effects

Acute toxicity	Not known.

Product	Species	Test Results
Bentonite (CAS 1302-78-9)		
Acute		
Inhalation		
Dust		
LC50	Rat	> 5.27 mg/l, 4 hr OECD 436
Oral		
Dust		
LD50	Rat	> 2000 mg/kg OECD 425

Skin corrosion/irritation	Prolonged skin contact may cause temporary irritation.
Serious eye damage/eye irritation	Direct contact with eyes may cause temporary irritation.
Respiratory or skin sensitization	
Respiratory sensitization	Not a respiratory sensitizer.
Skin sensitization	This product is not expected to cause skin sensitization.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	In 1997, IARC (the International Agency for Research on Cancer) concluded that crystalline silica inhaled from occupational sources can cause lung cancer in humans. However in making the overall evaluation, IARC noted that "carcinogenicity was not detected in all industrial circumstances studied. Carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs." (IARC Monographs on the evaluation of the carcinogenic risks of chemicals to humans, Silica, silicates dust and organic fibres, 1997, Vol. 68, IARC, Lyon, France.) In June 2003, SCOEL (the EU Scientific Committee on Occupational Exposure Limits) concluded that the main effect in humans of the inhalation of respirable crystalline silica dust is silicosis. "There is sufficient information to conclude that the relative risk of lung cancer is increased in persons with silicosis (and, apparently, not in employees without silicosis exposed to silica dust in quarries and in the ceramic industry). Therefore, preventing the onset of silicosis will also reduce the cancer risk..." (SCOEL SUM Doc 94-final, June 2003) According to the current state of the art, worker protection against silicosis can be consistently assured by respecting the existing regulatory occupational exposure limits. May cause cancer. Occupational exposure to respirable dust and respirable crystalline silica should be monitored and controlled.

IARC Monographs. Overall Evaluation of Carcinogenicity

QUARTZ (SIO2) (CAS 14808-60-7)	1 Carcinogenic to humans.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1052)

QUARTZ (SIO2) (CAS 14808-60-7)	Cancer

US. National Toxicology Program (NTP) Report on Carcinogens

QUARTZ (SIO2) (CAS 14808-60-7)	Known To Be Human Carcinogen.

Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.

Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Causes damage to organs through prolonged or repeated exposure.
Aspiration hazard	Not an aspiration hazard.
Chronic effects	Causes damage to organs through prolonged or repeated exposure. Prolonged inhalation may be harmful. Prolonged exposure may cause chronic effects.

12. Ecological information

Ecotoxicity The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Product		**Species**	**Test Results**
Bentonite (CAS 1302-78-9)			
Aquatic			
Algae	EC50	Freshwater algae	> 100 mg/l, 72 hours
Crustacea	EC50	Coon stripe shrimp (Pandalus danae)	24.8 mg/l, 96 hours
		Daphnia	> 100 mg/l, 48 hours
		Dungeness or edible crab (Cancer magister)	81.6 mg/l, 96 hours
Fish	LC50	Freshwater fish	16000 mg/l, 96 hours
		Marine water fish	2800 - 3200 mg/l, 24 hours

Persistence and degradability	No data is available on the degradability of any ingredients in the mixture.
Bioaccumulative potential	No data available.
Mobility in soil	No data available.
Other adverse effects	No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Dispose of contents/container in accordance with local/regional/national/international regulations.
Local disposal regulations	Dispose in accordance with all applicable regulations.
Hazardous waste code	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.
Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1052)

QUARTZ (SIO2) (CAS 14808-60-7)	Cancer lung effects immune system effects kidney effects

Superfund Amendments and Reauthorization Act of 1986 (SARA)

SARA 302 Extremely hazardous substance

Not listed.

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA)	Not regulated.
Food and Drug Administration (FDA)	Total food additive Direct food additive GRAS food additive

US state regulations

California Proposition 65

⚠ **WARNING:** This product can expose you to QUARTZ (SIO2), which is known to the State of California to cause cancer. For more information go to www.P65Warnings.ca.gov.

California Proposition 65 - CRT: Listed date/Carcinogenic substance

QUARTZ (SIO2) (CAS 14808-60-7)	Listed: October 1, 1988

US. California. Candidate Chemicals List. Safer Consumer Products Regulations (Cal. Code Regs, tit. 22, 69502.3, subd. (a))

QUARTZ (SIO2) (CAS 14808-60-7)

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	No
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	No
New Zealand	New Zealand Inventory	No
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	No
Taiwan	Taiwan Chemical Substance Inventory (TCSI)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 05-December-2013

Revision date	23-July-2018
Version #	09
HMIS® ratings	Health: 3* Flammability: 0 Physical hazard: 0
NFPA ratings	Health: 2 Flammability: 0 Instability: 0
Disclaimer	CETCO, an MTI Company cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user’s responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.
Revision information	This document has undergone significant changes and should be reviewed in its entirety.

MSDS SUMMARY SHEET

Manufacturer:
Name: PHILLIPS PETROLEUM COMPANY
Address 1:
Address 2:
Address 3:
CSZ: BARTLESVILLE **State:** OK **Zipcode:** 74004
Emergency phone: (800) 424-9300
Business phone: 800-762-0942

Product:

Ferndale MSDS#: 1354 **Version # :** 6
Manufacturer MSDS#: 0041
Current? : 2002
Name:

NO. 2 DIESEL FUEL

Synonyms:

- CARB **Diesel** TF3
- CARB **Diesel**
- CARB **Diesel** 10%
- **Diesel** Fuel Oil
- EPA Low Sulfur **Diesel** Fuel
- EPA Low Sulfur **Diesel** Fuel – Dyed
- EPA Off Road High Sulfur **Diesel –** Dyed
- Fuel Oil No. 2 – CAS # 68476-30-2
- No. 2 **Diesel** Fuel Oil
- No. 2 Fuel Oil – Non Hiway – Dyed
- No. 2 High Sulfur **Diesel** – Dyed
- No. 2 Low Sulfur **Diesel** - Dyed
- No. 2 Low Sulfur **Diesel** - Undyed
- Crude column 3rd IR
- Crude column 3rd side cut
- Atmospheric tower 3rd side cut
- Ultra Low Sulfur **Diesel** No. 2
- Finished **Diesel**
- DHT Reactor Feed
- Straight Run **Diesel**
- **Diesel**
- Middle Distillate

Product/Catalog Numbers:
MSDS Date: 01/01/2002 **(received:** 01/14/2002**)**

NFPA codes:
Health: 0 **Flammability:** 2 **Reactivity:** 0

MATERIAL SAFETY DATA SHEET
No. 2 Diesel Fuel

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name:	No. 2 Diesel Fuel
Product Code:	Multiple
SAP Code:	
Synonyms:	1354 CARB Diesel TF3 CARB Diesel CARB Diesel 10% Diesel Fuel Oil EPA Low Sulfur Diesel Fuel EPA Low Sulfur Diesel Fuel – Dyed EPA Off Road High Sulfur Diesel – Dyed Fuel Oil No. 2 – CAS # 68476-30-2 No. 2 Diesel Fuel Oil No. 2 Fuel Oil – Non Hiway – Dyed No. 2 High Sulfur Diesel – Dyed No. 2 Low Sulfur Diesel - Dyed No. 2 Low Sulfur Diesel – Undyed No. 2 Ultra Low Sulfur Diesel – Dyed No. 2 Ultra Low Sulfur Diesel - Undyed
Intended Use:	Fuel
Chemical Family:	
Responsible Party:	Phillip's Petroleum Company Bartlesville, Oklahoma 74004
For Additional MSDSs:	800-762-0942
Technical Information:	

The intended use of this product is indicated above. If any additional use is known, please contact us at the Technical Information number listed.

EMERGENCY OVERVIEW

24 Hour Emergency Telephone Numbers:

Spill, Leak, Fire or Accident
Call CHEMTREC
North America: (800) 424-9300
Others: (703) 527-3887 (collect)

California Poison Control System: 800-356-3120

Health Hazards/Precautionary Measures: Causes severe skin irritation. Aspiration hazard if swallowed. Can enter lungs and cause damage. Use with adequate ventilation. Avoid contact with eyes, skin and clothing. Do not taste or swallow. Wash thoroughly after handling.

Physical Hazards/Precautionary Measures: Flammable liquid and vapor. Keep away from heat, sparks, flames, static electricity or other sources of ignition.

Appearance:	Straw-colored to dyed red
Physical Form:	Liquid
Odor:	Characteristic petroleum

HFPA Hazard Class:		**HMIS Hazard Class**
Health:	0 (Least)	Not Evaluated
Flammability:	2 (Moderate)	
Reactivity:	0 (Least)	

2. COMPOSITION/INFORMATION ON INGREDIENTS

HAZARDOUS COMPONENTS	% VOLUME		EXPOSURE GUIDELINE	
		Limits	Agency	Type
Diesel Fuel No. 2 CAS# 68476-34-6	100	100* mg/m3	ACGIH	TWA-SKIN
Naphthalene CAS# 91-20-3	<1	10ppm	ACGIH	TWA
		15ppm	ACGIH	STEL
		10ppm	OSHA	TWA
		250ppm	NIOSH	IDLH

All components are listed on the TSCA inventory

Tosco Low Sulfur No. 2 Diesel meets the specifications of 40 CFR 60.41 for low sulfur diesel fuel.

Note: State, local or other agencies or advisory groups may have established more stringent limits.
Consult an industrial hygienist or similar professional, or your local agencies, for further information.

*Proposed ACGIH (1999)

3. HAZARDS IDENTIFICATION

Potential Health Effects:

Eye: Contact may cause mild eye irritation including stinging, watering, and redness.

Skin: Severe skin irritant. Contact may cause redness, itching, burning, and severe skin damage. Prolonged or repeated contact can worsen irritation by causing drying and cracking of the skin, leading to dermatitis (inflammation). Not actually toxic by skin absorption, but prolonged or repeated skin contact may be harmful (see Section 11).

Inhalation (Breathing): No information available. Studies by other exposure routes suggest a low degree of toxicity by inhalation.

Ingestion (Swallowing): Low degree of toxicity by ingestion. ASPIRATION HAZARD – This material can enter lungs during swallowing or vomiting and cause lung inflammation and damage.

Signs and Symptoms: Effects of overexposure may include irritation of the nose and throat, irritation of the digestive tract, nausea, diarrhea and transient excitation followed by signs of nervous system depression (e.g., headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue).

Cancer: Possible skin cancer hazard (see Sections 11 and 14).

Target Organs: There is limited evidence from animal studies that overexposure may cause injury to the kidney (see Section 11).

Developmental: Inadequate data available for this material.

Pre-Existing Medical Conditions: Conditions aggravated by exposure may include skin disorders and kidney disorders.

4. FIRST AID MEASURES

Eye: If irritation or redness develops, move victim away from exposure and into fresh air. Flush eyes with clean water. If symptoms persist, seek medical attention.

Skin: Immediately remove contaminated shoes, clothing, and constrictive jewelry and flush affected area(s) with large amounts of water. If skin surface is damaged, apply a clean dressing and seek immediate medical attention. If skin surface is not damaged, cleanse affected area(s) thoroughly by washing with mild soap and water. If irritation or redness develops, seek immediate medical attention.

Inhalation (Breathing): If respiratory symptoms develop, move victim away from source of exposure and into fresh air. If symptoms persist, seek medical attention. If victim is not breathing, clear airway and immediately begin artificial respiration. If breathing difficulties develop, oxygen should be administered by qualified personnel. Seek immediate medical attention.

Ingestion (Swallowing): Aspiration hazard; Do not induce vomiting or give anything by mouth because this material can enter the lungs and cause severe lung damage. If victim is drowsy or unconscious and vomiting, place on the left side with the head down. If possible, do not leave victim unattended and observe closely for adequacy of breathing. Seek medical attention.

5. FIRE FIGHTING MEASURES

Flammable Properties:	Flash Point: >125°F/>52° OSHA Flammability Class: Combustible liquid LEL %: 0.3 / UEL %; 10.0 Autoignition Temperature: 500°F/260°C

Unusual Fire & Explosion Hazards: This material is flammable and can be ignited by heat, sparks, flames, or other sources of ignition (e.g., static electricity, pilot lights, or mechanical/electrical equipment, and electronic devices such as cell phones, computers, calculators, and pagers which have not been certified as intrinsically safe). Vapors may travel considerable distances to a source of ignition where they can ignite, flash back, or explode. May create vapor/air explosion hazard indoors, in confined spaces, outdoors, or in sewers. Vapors are heavier than air and can accumulate in low areas. If container is not properly cooled, it can rupture in the heat of a fire.

Extinguishing Media: Dry chemical, carbon dioxide, or foam is recommended. Water spray is recommended to cool or protect exposed materials or structures. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces. Water may be ineffective for extinguishment, unless used under favorable conditions by experienced fire fighters.

Fire Fighting Instructions: For fires beyond the incipient stage, emergency responders in the immediate hazard area should wear bunker gear. When the potential chemical hazard is unknown, in enclosed or confined spaces, or when explicitly required by DOT, a self contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant (see Section 8).

Isolate immediate hazard area, keep unauthorized personnel out. Stop spill/release if it can be done with minimal risk. Move undamaged containers from immediate hazard area if it can be done with minimal risk.

Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Cool equipment exposed to fire with water, if it can be done with minimal risk. Avoid spreading burning liquid with water used for cooling purposes.

6. ACCIDENTAL RELEASE MEASURES

Flammable. Keep all sources of ignition and hot metal surfaces away from spill/release. The use of explosion-proof equipment is recommended.

Stay upwind and away from spill/release. Notify persons down wind of the spill/release, isolate immediate hazard area and keep unauthorized personnel out. Stop spill/release if it can be done with minimal risk. Wear appropriate protective equipment including respiratory protection as conditions warrant (see Section 8).

Prevent spilled material from entering sewers, storm drains, other unauthorized drainage systems, and natural waterways. Dike far ahead of spill for later recovery or disposal. Use foam on spills to minimize vapors (see Section 5). Spilled material may be absorbed into an appropriate material.

Notify fire authorities and appropriate federal, state, and local agencies. Immediate cleanup of any spill is recommended. If spill of any amount is made into or upon navigable waters, the contiguous zone, or adjoining shorelines, notify the National Response Center (phone number 800-424-8802).

7. HANDLING AND STORAGE

Handling: Open container slowly to relieve any pressure. Bond and ground all equipment when transferring from one vessel to another. Can accumulate static charge by flow or agitation. Can be ignited by static discharged. The use of explosion-proof equipment is recommended and may be required (see appropriate fire codes). Refer to NFPA-704 and/or API RP 2003 for specific bonding/grounding requirements.

Do not enter confined spaces such as tanks or pits without following proper entry procedures such ASTM D-4276 and 29CFR 1910.146. The use of appropriate respiratory protection is advised when concentrations exceed any established exposure limits (see Sections 2 and 8).

Do not wear contaminated clothing or shoes. Keep contaminated clothing away from sources of ignition such as sparks or open flames. Use good personal hygiene practices.

High pressure injection of hydrocarbon fuels, hydraulic oils or greases under the skin may have serious consequences even though no symptoms or injury may be apparent. This can happen accidentally when using high pressure equipment such as high pressure grease guns, fuel injection apparatus or from pinhole leaks in tubing or high pressure hydraulic oil equipment.

“Empty” containers retain residue and may be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, or other sources of ignition. They may explode and cause injury or death. “Empty” drums should be completely drained, properly bunged, and promptly shipped to the supplier or a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations.

Before working on or in tanks which contain or have contained this material, refer to OSHA regulations, ANSIZ49.1 and other references pertaining to cleaning, repairing, welding, or other contemplated operations.

Storage: Keep container(s) tightly closed. Use and store this material in cool, dry, well-ventilated areas away from heat, direct sunlight, hot metal surfaces, and all sources of ignition. Post area “No Smoking or Open Flame.” Store only in approved containers. Keep away from incompatible material (see Section 10). Protect container(s) against physical damage. Outdoor or detached storage is preferred. Indoor storage should meet OSHA standards and appropriate fire codes.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering controls: If current ventilation practices are not adequate to maintain airborne concentration below the established exposure limits (see Section 2), additional ventilation or exhaust systems may be required. Where explosive mixtures may be present, electrical systems safe for such locations must be used (see appropriate electrical codes).

Personal Protective Equipment (PPE):

Respiratory: A NIOSH certified air purifying respirator with an organic vapor cartridge maybe used under conditions where airborne concentrations are expected to exceed exposure limits (see Section 2).

Protection provided by air purifying respirators is limited (see manufacturer's respirator selection guide). Use a positive pressure air supplied respirator if there is a potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air purifying respirators may not provide adequate protection.

A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrants a respirator's use.

Skin: The use of gloves impervious to the specific material handled is advised to prevent skin contact, possible irritation and skin damage (see glove manufacturer literature for information on permeability). Depending on conditions of use, apron and/or arm covers may be necessary.

Eyes/Face: Approved eye protection to safeguard against potential eye contact, irritation, or injury is recommended. Depending on conditions of use, a face shield may be necessary.

Other Protective Equipment: Eye wash and quick-drench shower facilities should be available in the work area. Thoroughly clean shoes and wash contaminated clothing before reuse. It is recommended that impervious clothing be worn when skin contact is possible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Note: Unless otherwise stated, values are determined at 20°C (68°F) and 760 mm Hg (1atm).

Appearance: Straw-colored to dyed red
Physical State: Liquid
Odor: Characteristic petroleum
pH: unavailable
Vapor Pressure (mm Hg): 0.40
Vapor Densisty (air=1):>3
Boiling Point/Range: 320-700°F /160-371°C
Freezing/Melting Point: No Data
Solubility in Water: Negligible
Specific Gravity: 0.81-0.88 @ 60°F
Percent Volatile: Negligible
Evaporation Rate (nBuAc=1): <1
Viscosity: 32.6-40.0 SUS @ 100°F
Bulk Density: 7.08 lbs/gal
Flash Point: >125°F / >52°C
Flammable/Expolsive Limits (%): LEL: 0.3 / UEL: 10.0

10. STABILITY AND REACTIVITY

Stability: Stable under normal ambient and anticipated storage and handling conditions of temperature and pressure. Flammable liquid and vapor. Vapor can cause flash fire.

Conditions To Avoid: Avoid all possible sources of ignition (see Sections 5 and 7).

Materials to Avoid (Incompatible Materials): Avoid contact with strong oxidants such as liquid chlorine, concentrated oxygen, sodium hypochlorite, calcium hypochlorite, etc.

Hazardous Decomposition Products: The use of hydrocarbon fuels in an area without adequate ventilation may result in hazardous levels of combustion products (e.g., oxides of carbon, sulfur and nitrogen, benzene and other hydrocarbons) and/or dangerously low oxygen levels. ACGIH has included a TLV of 0.05 mg/m3 TWA for diesel exhaust particulate on its 1999 Notice of Intended Changes. See Section 11 for additional information on hazards of engine exhaust.

Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Diesel Fuel No. 2 (CAS# 68476-34-6)

Carcinogenicity: Chronic dermal application of certain middle distillate streams contained in diesel fuel No. 2 resulted in an increased incidence of skin tumors in mice. This material has not been identified as carcinogen by NTP, IARC, or OSHA. Diesel exhaust is a probable cancer hazard based on tests with laboratory animals.

Target Organ(s): Limited evidence of renal impairment has been noted from a few case reports involving excessive exposure to diesel fuel No. 2.

Naphthalene (CAS# 91-20-3)

Carcinogenicity: Naphthalene has been evaluated in two year inhalation studies in both rats and mice. The National Toxicology Program (NTP) concluded that there is clear evidence of carcinogenicity in male and female rats based on increased incidences of respiratory epithelial adenomas and olfactory epithelial neuroblastomas of the nose. NTP found some evidence of carcinogenicity in female mice (alveolar adenomas) and no evidence of carcinogenicity in male mice. Naphthalene has not been identified as a carcinogen by IARC or OSHA.

12. ECOLOGICAL INFORMATION

Not evaluated at this time

13. DISPOSAL CONSIDERATIONS

This material, if discarded as produced, would be a RCRA “characteristic” hazardous waste due to the characteristic(s) of ignitability (D001) and benzene (D018). If the material is spilled to soil or water, characteristic testing of the contaminated materials is recommended. Further, this material, once it becomes a waste, is subject to the land disposal restrictions in 40 CFR 268.40 and may require treatment prior to disposal to meet specific standards. Consult state and local regulations to determine whether they are more stringent then the federal requirements.

Container contents should be completely used and containers should be emptied prior to discard. Container ?insate? could be considered a RCRA hazardous waste and must be disposed of with care and in compliance with federal, state and local regulations. Large empty containers, such as drums, should be returned to the distributor or to a drum reconditioner. To assure proper disposal of smaller containers, consult with state and local regulations and disposal authorities.

14. TRANSPORT INFORMATION

DOT Shipping Description:	Diesel Fuel, NA1983
Non-Bulk Package Marking:	Diesel Fuel, 3, NA 1993, III

15. REGULATORY INFORMATION

EPA SARA 311/312 (Title III Hazard Categories):

Acute Health:	Yes
Chronic Health:	Yes
Fire Hazard:	Yes
Pressure Hazard:	No
Reactive Hazard:	No

SARA 313 and 40 CFR 372:
This material contains the following chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372:

Component	CAS Number	Weight %
-- None known --		

California Proposition 65:
Warning: This material contains the following chemicals which are known to the state of California to cause cancer, birth defects or other reproductive harm, and are subject to the requirements of California Proposition 65 (CA Health & Safety Code Section 25249.5):

Component	Effect
Benzene	Cancer, Developmental and Reproductive Toxicant
Toluene	Developmental Toxicant

Diesel engine exhaust, while not a component of this material, is on the Proposition 65 list of chemicals known to the State of California to cause cancer.

Carcinogen Identification:
This material has not been identified as a carcinogen by NTP, IARC, or OSHA. See Section 11 for carcinogenicity information of individual components, if any. Diesel exhaust is a probable cancer hazard based on tests in laboratory animals. It has been identified as carcinogen by IARC.

EPA (CERCLA Reportable Quantity: **None**

16. OTHER INFORMATION

Issue Date: 01/01/02
Previous Issue Date: 05/15/01
Product Code: Multiple
Revised Sections: None
Previous Product Code: Multiple
MSDS Number: 0041

Disclaimer of Expressed and Implied Warranties:

The information presented in this Material Data Safety Sheet is based on data believed to be accurate as of the date this Material Data Sheet was prepared. HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THE INFORMATION PROVIDED ABOVE, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THE PRODUCT, OR THE HAZARDS RELATED TO ITS USE. No responsibility is assumed for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices. The information provided above, and the product, are furnished on the condition that the person receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use. In addition, no authorization is given nor implied to practice any patented invention without a license.

UltraLow Sulfur Diesel Product Specification

Ferndale Product Code:34380xx (5) Product Code: ULSD2

(COMETS)

Specification	Unit	Limit	Test Procedure	Typical
Appearance				
Water & Sediment	Vol %	0.05 Max	D 2709	
Color	Number	3.0 Max	D 1500	
Haze Rating	Rating	2 Max	D 4176	
Composition				
Carbon Residue (Ramsbottom)	Wt %	0.35 Max	D 524, D 189	
Volatility				
90% Recovered	Deg; F	540 Min	D 86	
	Deg; F	640 Min	D 86	
Flash Point	Deg; F	125 Min (1)	D 93	130 F
Gravity	API	30 Min	D 287, D4052	
Fluidity				
Pour Point	Deg; F	See Season Table (6)	D 97	
Cloud Point	Deg; F	See Season Table (6)	D 2500	10 F
Viscosity @ 104F	cSt	1.9 Min	D 445	
	cSt	4.1 Max	D 445	
Lubricity, SLBOCLE	grams	3100 Min	D 6078	3300gm
Lubricity, HFRR	mm	.45	D 6079	
Combustion				
Cetane Index or Cetane Number (3,4)	Number	40.0 Min	D 976, D613	47.0
Corrosion				
Copper Strip, 3hr @ 50 deg C	Number	3 Max (2)	D 130	
Aromatics (4)	Vol %	35 Max	D 1319	25 %
Contaminants				
Total Sulfur	PPM	30 Max	D 2622, D4294	15-20ppm
Water & Sediment	Vol %	0.05 Max	D 1796	
Ash	Wt %	0.01 Max	D 482	
Additives				
Cetane Improver	Lb/MBbl	675 Max		
Dye		Undyed		

1. Minimum release specification is 125 deg. F. The refinery should target 135 deg. F.
2. Test result reported as a number and letter (e.g. 1a). Any letter is allowable as long as the number meets the spec shown.
3. Either specification must be met.
4. Either cetane index minimum or aromatics maximum must be met.
5. Winter cloud and pour specifications may be relaxed to the summer specifications by agreement with the customer.
6. Season Table

Month	Product Code	Pour Point	Cloud Point
Jan, Feb, Nov, Dec	WI	0 max (5)	14 max (5)
Mar - Oct	SU	15 max	24 max

ACC# 89989

Print Date: 1/25/07
Revision Date: 1/25/2007
Version: 5

Material Safety Data Sheet

Hydrochloric Acid 18%

Section 1 - Chemical Product and Company Identification

MSDS Name:

Hydrochloric Acid 18% Solution

Catalog Numbers:

ACH-.5-1; ACH-1-1; ACH-2-1; ACH-5-1; PP112-01A5HA; PP113-500A3HA; PP140-40C.2HA PP140-40CDB.2HA; PP140-40CEP.2HA; PP141-40A.2HA; PP141-40ADB.2HA; PP141-40AEP.2HA SVCH-.5-1; SVCH-1-1; SVCH-2-1; SVCH-5-1

Synonyms:

Muriatic acid; Chlorohydric acid; Hydrogen chloride; Spirits of salt

Company Identification:

EP Scientific Products, LLC - Thermo Fisher Scientific
520 North Main Street
Miami, OK 74354

Company Phone Number:

1-800-331-7425

Emergency Phone Number:

CHEMTREC Phone Number, US: (800) 424-9300
CHEMTREC Phone Number, Europe: (202) 483-7616

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name:	Percent	EINECS/ ELINCS	Hazard Symbols	Risk Phrases
7647-01-0	Hydrogen chloride	18.0	231-595-7	C	34 37
7732-18-5	Water	82	231-791-2		

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: Colorless to slight yellow clear liquid
Warning! Causes irritation and possible burns by all routes of exposure. May be harmful if swallowed or inhaled. Repeated or prolonged exposure may cause erosion of exposed teeth. Corrosive to metal.
Target Organs: Respiratory system, Teeth, Eyes, Skin

Potential Health Effects

Eye:

Vapor or mist may cause irritation and severe burns. May cause painful sensitization to light. Causes eye irritation and possible burns.

Skin:

Causes skin irritation and possible burns.

Ingestion:

May cause corrosion and permanent tissue destruction of the esophagus and digestive tract. Causes digestive tract irritation with possible burns.

Inhalation:

Exposure to the mist and vapor may erode exposed teeth. Causes respiratory tract irritation with possible burns.

Chronic:

Repeated exposure may cause erosion of teeth. Prolonged exposure may cause conjunctivitis, photosensitization, and possible blindness. Repeated exposure to low concentrations of HCl vapor or mist may cause bleeding of nose and gums. Chronic bronchitis and gastritis have also been reported.

Section 4 - First Aid Measures

Eyes:

Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately.

Skin:

Get medical aid immediately. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.

Ingestion:

Do not induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Get medical aid immediately.

Inhalation:

Get medical aid immediately. Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

Notes to Physician:

Do NOT use sodium bicarbonate in an attempt to neutralize the acid.

Antidote:

Do NOT use oils or ointments in eye.

Section 5 - Fire Fighting Measures

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Water runoff can cause environmental damage. Dike and collect water used to fight fire. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Not flammable, but reacts with most metals to form flammable hydrogen gas. Use water spray to keep fire-exposed containers cool. Vapors may be heavier than air. They can spread along the ground and collect in low or confined areas. Containers may explode when heated.

Extinguishing Media:

Substance is nonflammable; use agent most appropriate to extinguish surrounding fire.

Autoignition Temperature:

Not applicable.

Explosion Limits:

Lower: Not available Upper: Not available

Flash Point:

Not applicable.

NFPA Rating:

(estimated) Health: 3; Flammability: 0; Instability: 0

Section 6 - Accidental Release Measures

General Information:

Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Large spills may be neutralized with dilute alkaline solutions of soda ash (sodium carbonate, Na_2CO_3), or lime (calcium oxide, CaO). Avoid runoff into storm sewers and ditches which lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Remove all sources of ignition. Provide ventilation. Do not get water inside containers. A vapor suppressing foam may be used to reduce vapors. Cover with dry earth, dry sand, or other non-combustible material followed with plastic sheet to minimize spreading and contact with water.

Section 7 - Handling and Storage

Handling:

Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well-ventilated area. Contents may develop pressure upon prolonged storage. Do not breathe dust, mist, or vapor. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Do not ingest or inhale. Discard contaminated shoes. Use caution when opening.

Storage:

Store in a cool, dry, well-ventilated area away from incompatible substances. Corrosives area. Do not store in metal containers. Store away from alkalies.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls:

Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name:	ACGIH	NIOSH	OSHA
Hydrogen chloride	2 ppm Ceiling	50 ppm IDLH 5 ppm Ceiling; 7 mg/m3 Ceiling	5 ppm Ceiling; 7 mg/m3 Ceiling;
Water	None listed	None listed	None listed

OSHA Vacated PELs

Personal Protective Equipment

Eyes:

Wear chemical splash goggles and face shield.

Skin:

Wear neoprene or polyvinyl chloride gloves to prevent exposure.

Clothing:

Wear appropriate protective clothing to prevent skin exposure.

Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIC or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State:	Clear liquid
Color:	Colorless to slight yellow
Odor:	Strong, pungent
pH:	0.01
Vapor Pressure:	5.7 mm Hg @ 0°C
Vapor Density:	1.26
Evaporation Rate:	> 1.00 (N-butyl acetate)
Viscosity:	No information found
Boiling Point:	81.5-110°C @ 760 mmHg
Freezing/Melting Point:	-74°C
Decomposition Temperature:	No information found
Solubility in water:	Miscible.
Specific Gravity/Density:	1.0-1.2
Molecular Formula:	HCl.H2O
Molecular Weight:	36.46

Section 10 - Stability and Reactivity

Chemical Stability:

Stable under normal temperatures and pressures.

Conditions to Avoid:

Incompatible materials, excess heat

Incompatibilities with Other Materials

Bases, acetic anhydride, alkali metals, aluminum, amines, copper, copper alloys, fluorine, iron, sodium hydroxide, steel, sulfuric acid, vinyl acetate, zinc, potassium permanganate, cesium acetylene carbide, rubidium acetylene carbide, rubidium carbide, sodium, chlorosulfonic acid, oleum, carbonates, perchloric acid, calcium phosphide, metal oxides, acetates, cesium carbide, beta-propiolactone, ethyleneimine, propylene oxide, lithium silicides, alcohols + hydrogen cyanide, 2-aminoethanol, ammonium hydroxide, calcium carbide, 1,1-difluoroethylene, ethylene diamine, magnesium boride, mercuric sulfate, uranium phosphide

Hazardous Decomposition Products

Hydrogen chloride, chlorine, carbon monoxide, carbon dioxide, hydrogen gas

Hazardous Polymerization

Will not occur.

Section 11 - Toxicological Information

RTECS:

CAS# 7647-01-0: MW4025000; MW4031000
CAS# 7732-18-5: ZC0110000

LD50/LC50:

CAS# 7647-01-0:
  Inhalation, mouse: LC50 = 1108 ppm/1H
  Inhalation, mouse: LC50 = 20487 mg/m3/5M
  Inhalation, mouse: LC50 = 3940 mg/m3/30M
  Inhalation, mouse: LC50 = 8300 mg/m3/30M
  Inhalation, rat: LC50 = 3124 ppm/1H
  Inhalation, rat: LC50 = 60938 mg/m3/5M
  Inhalation, rat: LC50 = 7004 mg/m3/30M
  Inhalation, rat: LC50 = 45000 mg/m3/5M
  Inhalation, rat: LC50 = 8300 mg/m3/30M
  Oral, rabbit: LD50 = 900 mg/kg.
CAS# 7732-18-5:
  Oral, rat: LD50 = >90 mL/kg.

Carcinogenicity:

CAS# 7647-01-0: Not listed as a carcinogen by ACGIH, IARC, NTP, or CA Prop 65.
CAS# 7732-18-5: Not listed as a carcinogen by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology:

Experimental reproductive effects have been reported.

Teratogenicity:

Female rats were exposed to 450 mg/m3 of HCl for 1 hour either prior to mating or on day 9 of pregnancy. Developmental effects were observed in the offspring. However, this exposure caused toxic effects, including mortality, in the mothers.

Reproductive:

No information available.

Mutagenicity:

Cytogenetic analysis: Hamster, lung = 30 mmol/L.; Cytogenetic analysis: Hamster, ovary = 8 mmol/L.

Neurotoxicity:

No information available.

Other:

See actual entry in RTECS for complete information.

Section 12 - Ecological Information

Ecotoxicity:

Fish: Bluegill/Sunfish: 3.6 mg/L; 48Hr; Lethal (unspecified)
Fish: Bluegill/Sunfish: LC50; 96 Hr; pH 3.0-3.5

Environmental:

Rapidly hydrolyzes when exposed to water. Will exhibit extensive evaporation from soil surfaces. Upon transport through the soil, hydrochloric acid will dissolve some of the soil materials (especially those with carbonate bases) and the acid will neutralize to some degree.

Physical:

No information found

Other:

No information found

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Part 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.

RCRA P Series Wastes

None of the components are on this list.

RCRA U Series Wastes

None of the components are on this list.

Section 14 - Transport Information

	US DOT	Canadian TDG
Proper Shipping Name:	HYDROCHLORIC ACID, SOLUTION	HYDROCHLORIC ACID, SOLUTION
Hazard Class:	8	8
UN Number:	UN1789	UN89
Packing Group:	II	II

USA RQ: CAS# 7647-01-0: 5000 lb final RQ; 2270 kg final RQ

Section 15 - Regulatory Information

US Federal

TSCA

CAS# 7647-01-0 is listed on the TSCA Inventory.
CAS# 7732-18-5 is listed on the TSCA Inventory.

Health and Safety Reporting List

None of the components are on this list.

Chemical Test Rules

None of the components are on this list.

TSCA Section 12b

None of the components are on this list.

TSCA Significant New Use Rule (SNUR)

None of the components are on this list.

CERCLA Hazardous Substances and corresponding RQs

CAS# 7647-01-0: 5000 lb final RQ; 2270 kg final RQ

SARA Section 302 Extremely Hazardous Substances

CAS# 7647-01-0: 500 lb TPQ (gas only)

SARA Hazard Categories

CAS# 7647-01-0: immediate.

SARA Section 313

This material contains Hydrogen chloride (CAS# 7647-01-0, < 20.0%), which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 372.

Clean Air Act - Hazardous Air Pollutants (HAPs)

CAS# 7647-01-0 is listed as a hazardous air pollutant (HAP).

Clean Air Act - Class 1 Ozone Depletors

None of the components are on this list.

Clean Air Act - Class 2 Ozone Depletors

None of the components are on this list.

Clean Water Act - Hazardous Substances

CAS# 7647-01-0 is listed as a Hazardous Substance under the CWA.

Clean Water Act - Priority Pollutants

None of the components are on this list.

Clean Water Act - Toxic Pollutants

None of the components are on this list.

OSHA - Highly Hazardous

CAS# 7647-01-0 is considered highly hazardous by OSHA.

OSHA - Specifically Regulated Chemicals

None of the components are on this list.

US State

State Right to Know

Hydrogen chloride can be found on the following state Right-to-Know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.
No information found

California Prop 65

None of the components are on this list.

California No Significant Risk Level

None of the components are on this list.
None of the components are on this list.

European/International Regulations

European Labelling in Accordance with EC Directives:

Hazard Symbols: XI

Risk Phrases: R 36/37/38 Irritating to eyes, respiratory system and skin.
Safety Phrases: S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

WGK (Water Danger/Protection)

No information found

United Kingdom Occupational Exposure Limits

No information found

United Kingdom Maximum Exposure Limits

No information found

Canadian DSL/NDSL

CAS# 7647-01-0 is listed on Canada's DSL List.
CAS# 7732-18-5 is listed on Canada's DSL List.

Canadian WHMIS Classifications

This product has a WHMIS classification of E, D2A.
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 7647-01-0 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Other Information

No information found
MSDS Creation Date: July 6, 1999
Revision Date: January 25, 2007

Revisions were made in Sections:

2, 3, 11, 14, 15

This MSDS is intended for review and guidance in the receipt, storage, handling, use and disposal of product purchased from us, and for no other purpose. Use this product only as directed and in accordance with applicable instructions and warnings provided with the product. Please consult your institution's policies regarding use of this product. If you have obtained this MSDS other than in connection with the supply of this product from us, this MSDS should be consulted for general information only, and should not be relied upon for any purpose. As with the use of all hazardous materials, you should in all instances follow the guidance of the MSDS provided or available with the specific product purchased.

SAFETY DATA SHEET

Helium

Section 1. Identification

GHS product identifier : Helium

Chemical name : Helium

Other means of identification : helium (dot); Helium-4; He; o-Helium; UN 1046,Helium USP

Product type : Gas.

Product use : Synthetic/Analytical chemistry.

Synonym : helium (dot); Helium-4; He; o-Helium; UN 1046,Helium USP

SDS # : 001025

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : GASES UNDER PRESSURE - Compressed gas

GHS label elements

Hazard pictograms :

Signal word : Warning

Hazard statements : Contains gas under pressure; may explode if heated.
May displace oxygen and cause rapid suffocation.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction.

Prevention : Not applicable.

Response : Not applicable.

Storage : Protect from sunlight. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise classified : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture	: Substance
Chemical name	: Helium
Other means of identification	: helium (dot); Helium-4; He; o-Helium; UN 1046,Helium USP
Product code	: 001025

CAS number/other identifiers

CAS number : 7440-59-7

Ingredient name	%	CAS number
Helium	100	7440-59-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact	: Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.
Inhalation	: Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.
Skin contact	: Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.
Ingestion	: As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact	: Contact with rapidly expanding gas may cause burns or frostbite.
Inhalation	: No known significant effects or critical hazards.
Skin contact	: Contact with rapidly expanding gas may cause burns or frostbite.
Frostbite	: Try to warm up the frozen tissues and seek medical attention.
Ingestion	: As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact	: No specific data.
Inhalation	: No specific data.
Skin contact	: No specific data.
Ingestion	: No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician	: Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
Specific treatments	: No specific treatment.

Section 4. First aid measures

Protection of first-aiders	: No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media	: Use an extinguishing agent suitable for the surrounding fire.
Unsuitable extinguishing media	: None known.
Specific hazards arising from the chemical	: Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.
Hazardous thermal decomposition products	: No specific data.
Special protective actions for fire-fighters	: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.
Special protective equipment for fire-fighters	: Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	: No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.
For emergency responders	: If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".
Environmental precautions	: Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill	: Immediately contact emergency personnel. Stop leak if without risk.
Large spill	: Immediately contact emergency personnel. Stop leak if without risk. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures	: Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid breathing gas. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement. Avoid contact with eyes, skin and clothing. Empty containers retain product residue and can be hazardous.

Section 7. Handling and storage

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Helium	**ACGIH TLV (United States, 3/2017). Oxygen Depletion [Asphyxiant].**

Appropriate engineering controls : Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Section 8. Exposure controls/personal protection

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [Compressed gas.]
Color : Colorless.
Odor : Odorless.
Odor threshold : Not available.
pH : Not available.
Melting point : -272.2°C (-458°F)
Boiling point : -268.9°C (-452°F)
Critical temperature : -267.9°C (-450.2°F)
Flash point : [Product does not sustain combustion.]
Evaporation rate : Not available.
Flammability (solid, gas) : Not available.
Lower and upper explosive (flammable) limits : Not available.
Vapor pressure : Not available.
Vapor density : 0.14 (Air = 1) Liquid Density@BP: 7.8 lb/ft3 (125 kg/m3)
Specific Volume (ft ^{3}/lb) : 96.1538
Gas Density (lb/ft ^{3}) : 0.0104
Relative density : Not applicable.
Solubility : Not available.
Solubility in water : Not available.
Partition coefficient: n-octanol/water : 0.28
Auto-ignition temperature : Not available.
Decomposition temperature : Not available.
Viscosity : Not applicable.
Flow time (ISO 2431) : Not available.
Molecular weight : 4 g/mole

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : No specific data.

Incompatible materials : No specific data.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 10. Stability and reactivity

Hazardous polymerization	Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure	Not available.

Potential acute health effects

Eye contact	Contact with rapidly expanding gas may cause burns or frostbite.
Inhalation	No known significant effects or critical hazards.
Skin contact	Contact with rapidly expanding gas may cause burns or frostbite.
Ingestion	As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact	No specific data.
Inhalation	No specific data.
Skin contact	No specific data.
Ingestion	No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects	Not available.
Potential delayed effects	Not available.

Long term exposure

Section 11. Toxicological information

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$\log P_{ow}$	BCF	Potential
Helium	0.28	-	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	**TDG**	**Mexico**	**IMDG**	**IATA**
UN number	UN1046	UN1046	UN1046	UN1046	UN1046
UN proper shipping name	HELIUM, COMPRESSED	HELIUM, COMPRESSED	HELIUM, COMPRESSED	HELIUM, COMPRESSED	HELIUM, COMPRESSED
Transport hazard class(es)	2.2 	2.2 	2.2 	2.2 	2.2 
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Additional information

DOT Classification : **Limited quantity** Yes.
Quantity limitation Passenger aircraft/rail: 75 kg. Cargo aircraft: 150 kg.

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2).
Explosive Limit and Limited Quantity Index 0.125
Passenger Carrying Road or Rail Index 75

IATA : **Quantity limitation** Passenger and Cargo Aircraft: 75 kg. Cargo Aircraft Only: 150 kg.

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

Section 15. Regulatory information

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

State regulations

Massachusetts : This material is listed.
New York : This material is not listed.
New Jersey : This material is listed.
Pennsylvania : This material is listed.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Inventory list

Australia : This material is listed or exempted.
Canada : This material is listed or exempted.
China : This material is listed or exempted.
Europe : This material is listed or exempted.
Japan : **Japan inventory (ENCS)**: Not determined.
Japan inventory (ISHL): Not determined.
Malaysia : Not determined.
New Zealand : This material is listed or exempted.
Philippines : This material is listed or exempted.
Republic of Korea : This material is listed or exempted.
Taiwan : This material is listed or exempted.
Thailand : Not determined.
Turkey : Not determined.
United States : This material is listed or exempted.
Viet Nam : Not determined.

Section 16. Other information

Hazardous Material Information System (U.S.A.)

Health	/	1
Flammability		0
Physical hazards		3

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

Section 16. Other information

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)

Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
GASES UNDER PRESSURE - Compressed gas	Expert judgment

History

Date of printing : 4/23/2018

Date of issue/Date of revision : 4/23/2018

Date of previous issue : 1/29/2018

Version : 1.01

Key to abbreviations :
ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

SCOTT SPECIALTY GASES -- ISOBUTYLENE IN AIR, (SEE SUPPL.) -- 6665-01-449-8454

```
=====================  Product Identification  =====================

Product ID:ISOBUTYLENE IN AIR, (SEE SUPPL.)
MSDS Date:11/20/1997
FSC:6665
NIIN:01-449-8454
Status Code:A
Kit Part:Y
MSDS Number: CLFCR
=== Responsible Party ===
Company Name:SCOTT SPECIALTY GASES
Address:2330 HAMILTON BLVD
City:SOUTH PLAINFIELD
State:NJ
ZIP:07080
Country:US
Info Phone Num:908-754-7700
Emergency Phone Num:908-754-7700
Resp. Party Other MSDS Num.:M-704/E-1
CAGE:54262
=== Contractor Identification ===
Company Name:PHOTOVAC INTL INC/DBA PHOTOVAC MONITORING INSTRUMENTS
Address:UNK
Box:UNK
City:DEER PARK
State:NY
ZIP:11729
Country:US
Phone:000-000-0000
CAGE:70123
Company Name:PINE ENVIRONMENTAL SERVICES INC
Address:379 PRINCETON-HIGHTSTOWN RD
Box:City:CRANBURY
State:NJ
ZIP:08512
Country:US
Phone:609-371-9663
Contract Num:SP0200-99-M-T071
CAGE:1JSC4
Company Name:SCOTT SPECIALTY GASES
Address:2330 HAMILTON BLVD
Box:City:SOUTH PLAINFIELD
State:NJ
ZIP:07080
Country:US
Phone:908-754-7700
CAGE:54262

=============  Composition/Information on Ingredients  =============

Ingred Name:ISOBUTYLENE
CAS:115-11-7
RTECS #:UD0890000
Fraction by Wt: 1-1500% PPM

Ingred Name:AIR
CAS:132259-10-0
```

Fraction by Wt: BALANCE

Hazards Identification

Reports of Carcinogenicity:NTP:NO   IARC:NO   OSHA:NO

Health Hazards Acute and Chronic:ACUTE EFFECTS: NONE. CHRONIC EFFECTS: NONE KNOWN.

Explanation of Carcinogenicity:CARCINOGENICITY (U.S. ONLY): NTP - NO; IARC MONOGRAPHS - NO; OSHA REGULATED - NO.

Effects of Overexposure:NONE.

Medical Cond Aggravated by Exposure:NONE KNOWN.

First Aid Measures

First Aid:IN EVENT OF EXPOSURE, CONSULT A PHYSICIAN. INHALATION: IMMEDIATELY REMOVE VICTIM TO FRESH AIR. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN. EYE CONTAC T: NONE. SKIN CONTACT: NONE. INGESTION: NONE.

Fire Fighting Measures

Flash Point:NONFLAMMABLE

Extinguishing Media:USE WHAT IS APPROPRIATE FOR SURROUNDING FIRE.

Fire Fighting Procedures:WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECIVE CLOTHING. KEEP FIRE EXPOSED CYLINDERS COOL WITH WATER SPRAY. IF POSSIBLE, STOP THE PRODUCT FLOW.

Unusual Fire/Explosion Hazard:CYLINDER RUPTURE MAY OCCUR UNDER FIRE CONDITIONS. COMPRESSED AIR AT HIGH PRESSURE WILL ACCELERATE THE COMBUSTION OF FLAMMABLE MATERIALS.

Accidental Release Measures

Spill Release Procedures:EVACUATE AND VENTILATE AREA. REMOVE LEAKING CYLINDER TO EXHAUST HOOD OR SAFE OUTDOOR AREA. SHUT OFF SOURCE IF POSSIBLE AND REMOVE SOURCE OF HEAT.

Handling and Storage

Handling and Storage Precautions:HANDLING: SECURE CYLINDER WHEN USING TO PROTECT FROM FALLING. USE SUITABLE HAND TRUCK TO MOVE CYLINDERS. STORAGE: STORE IN WELL VENTILATED AREAS. KEEP VALVE PROTECTION CAP ON CYLINDERS WHEN NOT IN USE .

Other Precautions:PROTECT CONTAINERS FROM PHYSICAL DAMAGE. DO NOT DEFACE CYLINDERS OR LABELS. CYLINDERS SHOULD BE REFILLED BY QUALIFIED PRODUCERS OF COMPRESSED GAS. SHIPMENT OF A COMPRESSED GAS CYLINDER WHICH HAS NOT B EEN FILLED BY THE OWNER OR WITH HIS WRITTEN CONSENT IS A VIOLATION OF FEDERAL LAW (49 CFR)

Exposure Controls/Personal Protection

Respiratory Protection:IN CASE OF LEAKAGE, USE SELF-CONTAINED BREATHING APPARATUS.

Ventilation:PROVIDE ADEQUATE GENERAL AND LOCAL EXHAUST VENTILATION.

Protective Gloves:NONE

Eye Protection:SAFETY GLASSES.

Other Protective Equipment:SAFETY SHOES WHEN HANDLING CYLINDERS.

Supplemental Safety and Health

VENDOR (CAGE 70123) PART NUMBER: 350005. THIS ENTRY DESCRIBES ONE PART, SERIAL NUMBER XXXXX, ISOBUTYLENE IN AIR, OF A FIELD KIT. SEE THIS SAME NSN, SERIAL NUMBER XXXXX, A 10 HOUR RECHARGEABLE BATTERY

PACK, FOR DATA ON SECOND PART OF KIT.

================== Physical/Chemical Properties ==================

HCC:G3
Vapor Density:.991(AIR=1
Spec Gravity:GAS
Evaporation Rate & Reference:GAS
Solubility in Water:18.68CM3/1@20C
Appearance and Odor:COLORLESS, ODORLESS GAS

================= Stability and Reactivity Data =================

Stability Indicator/Materials to Avoid:YES
OXIDIZING AGENTS.
Stability Condition to Avoid:STABLE UNDER NORMAL STORAGE CONDITIONS. AVOID STORAGE IN POORLY VENTILATED AREAS AND STORAGE NEAR A HEAT SOURCE.
Hazardous Decomposition Products:NONE.
Conditions to Avoid Polymerization:WILL NOT OCCUR.

=================== Toxicological Information ===================

Toxicological Information:LETHAL CONCENTRATION (LC50): NONE ESTABLISHED. LETHAL DOSE 50 (LD50): NOT APPLICABLE. TERATOGENICITY : N/A. REPRODUCTIVE EFFECTS:N/A. MUTGENICITY: N/AP.

===================== Ecological Information =====================

Ecological:NO ADVERSE ECOLOGICAL EFFECTS ARE EXPECTED.

==================== Disposal Considerations ====================

Waste Disposal Methods:DISPOSE OF NON-REFILLABLE CYLINDERS IN ACCORDANCE WITH FEDERAL, STATE, AND LOCAL REGULATIONS. ALLOW GAS TO VENT SLOWLY TO ATMOSPHERE IN AN UNCONFINED AREA OR EXHAUST HOOD. IF THE CYLINDERS ARE THE REF ILLABLE TYPE, RETURN CYLINDERS TO SUPPLIER WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAPS IN PLACE.

=================== MSDS Transport Information ===================

Transport Information:CONCENTRATION: 1 - 1500 PPM. DOT DESCRIPTION (US ONLY): PROPER SHIPPING NAME: COMPRESSED GASSES, N.O.S.; HAZARD CLASS: 2.2 (NONFLAMMABLE); UN 1956; REPORTABLE QUANTITIES: NONE. LABELING: NONFLAMMABLE GAS. ADR/RID (EU ONLY): CLASS 2, 1A. SPECIAL PRECAUTIONS: CYLINDERS SHOULD BE TRANSPORTED IN A SECURE UPRIGHT POSITION IN A WELL VENTILATED TRUCK.

===================== Regulatory Information =====================

SARA Title III Information:THE THRESHOLD PLANNING QUANTIRY FOR THES MIXTURE IS 10,000 LBS.
Federal Regulatory Information:OSHA: PROCESS SAFETY MANAGEMENT: MINOR COMPONENT IS NOT LISTED IN APPENDIX A OF 29 CFR 1910.119 AS A HIGHLY HAZARDOUS CHEMICAL. TSCA: MIXTURE IS NOT LISTED IN TSCA INVENTORY. EU NUMBER: N/A. NUMBER IN ANNES 1 OF DIR 67/548: MIXTURE IS NOT LISTED IN ANNES 1. EU CLASSIFICATION: N/AP. R: 20; S: 9.

SAFETY DATA SHEET

Creation Date 27-Apr-2009 **Revision Date** 18-Jan-2018 **Revision Number** 6

1. Identification

Product Name	**Methanol**
Cat No. :	**A453-1; A453-1LC; A453-500**
CAS-No	67-56-1
Synonyms	Methyl alcohol
Recommended Use	Laboratory chemicals.
Uses advised against	Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Acute oral toxicity	Category 3
Acute dermal toxicity	Category 3
Acute Inhalation Toxicity - Vapors	Category 3
Specific target organ toxicity (single exposure)	Category 1
Target Organs - Optic nerve.	
Specific target organ toxicity - (repeated exposure)	Category 1
Target Organs - Kidney, Liver, spleen, Blood.	

Label Elements

Signal Word
Danger

Hazard Statements
Highly flammable liquid and vapor
Toxic if swallowed
Toxic in contact with skin
Toxic if inhaled
Causes damage to organs
Causes damage to organs through prolonged or repeated exposure

Precautionary Statements
Prevention
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Do not breathe dust/fume/gas/mist/vapors/spray
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Keep cool
Response
IF exposed: Call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor/physician
Skin
Call a POISON CENTER or doctor/physician if you feel unwell
Wash contaminated clothing before reuse
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Ingestion
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician
Rinse mouth
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)

Other hazards
Poison, may be fatal or cause blindness if swallowed. Vapor harmful. Cannot be made non-poisonous.
WARNING. Reproductive Harm - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Methyl alcohol	67-56-1	>95

4. First-aid measures

General Advice	Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.
Inhalation	Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required.
Ingestion	Do not induce vomiting. Call a physician or Poison Control Center immediately.
Most important symptoms and effects	Breathing difficulties. May cause blindness: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Cool closed containers exposed to fire with water spray.
Unsuitable Extinguishing Media	Water may be ineffective
Flash Point	12 °C / 53.6 °F
Method -	No information available
Autoignition Temperature	455 °C / 851 °F
Explosion Limits	
Upper	31.00 vol %
Lower	6.0 vol %
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical

Flammable. Risk of ignition. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Containers may explode when heated. Vapors may form explosive mixtures with air.

Hazardous Combustion Products

Carbon monoxide (CO) Formaldehyde

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	**Flammability**	**Instability**	**Physical hazards**
1	3	0	N/A

6. Accidental release measures

Personal Precautions	Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Use personal protective equipment. Ensure adequate ventilation. Remove all sources of ignition. Take precautionary measures against static discharges.
Environmental Precautions	Should not be released into the environment. See Section 12 for additional ecological information.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling	Wear personal protective equipment. Do not breathe vapors or spray mist. Do not get in eyes, on skin, or on clothing. Use only under a chemical fume hood. Do not ingest. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded. Take precautionary measures against static discharges.
Storage	Keep container tightly closed in a dry and well-ventilated place. Keep away from open flames, hot surfaces and sources of ignition. Flammables area.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Methyl alcohol	TWA: 200 ppm STEL: 250 ppm Skin	(Vacated) TWA: 200 ppm (Vacated) TWA: 260 mg/m^3 (Vacated) STEL: 250 ppm (Vacated) STEL: 325 mg/m^3 Skin TWA: 200 ppm TWA: 260 mg/m^3	IDLH: 6000 ppm TWA: 200 ppm TWA: 260 mg/m^3 STEL: 250 ppm STEL: 325 mg/m^3	TWA: 200 ppm TWA: 260 mg/m^3 STEL: 250 ppm STEL: 310 mg/m^3

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures	Use only under a chemical fume hood. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	When using, do not eat, drink or smoke. Provide regular cleaning of equipment, work area and clothing.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Alcohol-like
Odor Threshold	No information available
pH	Not applicable
Melting Point/Range	-98 °C / -144.4 °F
Boiling Point/Range	64.7 °C / 148.5 °F @ 760 mmHg
Flash Point	12 °C / 53.6 °F
Evaporation Rate	5.2 (ether = 1)
Flammability (solid,gas)	Not applicable

Flammability or explosive limits	
Upper	31.00 vol %
Lower	6.0 vol %
Vapor Pressure	128 hPa @ 20 °C
Vapor Density	1.11
Specific Gravity	0.791
Solubility	Miscible with water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	455 °C / 851 °F
Decomposition Temperature	No information available
Viscosity	0.55 cP at 20 °C
Molecular Formula	C H4 O
Molecular Weight	32.04
VOC Content(%)	100
Surface tension	0.02255 N/m @ 20°C

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Heat, flames and sparks. Keep away from open flames, hot surfaces and sources of ignition.
Incompatible Materials	Strong oxidizing agents, Strong acids, Acid anhydrides, Acid chlorides, Strong bases, Metals, Peroxides
Hazardous Decomposition Products	Carbon monoxide (CO), Formaldehyde
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information
Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Methyl alcohol	**Calc. ATE 60 mg/kg** LD50 > 1187 – 2769 mg/kg (Rat)	**Calc. ATE 60 mg/kg** LD50 = 17100 mg/kg (Rabbit)	**Calc. ATE 0.6 mg/L (vapours) or 0.5 mg/L (mists)** LC50 = 128.2 mg/L (Rat) 4 h

Toxicologically Synergistic Products Carbon tetrachloride

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation	May cause skin and eye irritation
Sensitization	No information available
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Methyl alcohol	67-56-1	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects	No information available
Reproductive Effects	No information available.
Developmental Effects	Component substance is listed on California Proposition 65 as a developmental hazard.

Teratogenicity	No information available.
STOT - single exposure	Optic nerve
STOT - repeated exposure	Kidney Liver spleen Blood
Aspiration hazard	No information available
Symptoms / effects,both acute and delayed	May cause blindness: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
Endocrine Disruptor Information	No information available
Other Adverse Effects	The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

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Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Methyl alcohol	Not listed	Pimephales promelas: LC50 > 10000 mg/L 96h	EC50 = 39000 mg/L 25 min EC50 = 40000 mg/L 15 min EC50 = 43000 mg/L 5 min	EC50 > 10000 mg/L 24h

Persistence and Degradability	Persistence is unlikely based on information available.
Bioaccumulation/ Accumulation	No information available.
Mobility	Will likely be mobile in the environment due to its volatility.

Component	log Pow
Methyl alcohol	-0.74

13. Disposal considerations

Waste Disposal Methods	Should not be released into the environment.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Methyl alcohol - 67-56-1	U154	-

14. Transport information

DOT

UN-No	UN1230
Proper Shipping Name	METHANOL
Hazard Class	3
Packing Group	II

TDG

UN-No	UN1230
Proper Shipping Name	METHANOL
Hazard Class	3
Subsidiary Hazard Class	6.1
Packing Group	II

IATA

UN-No	UN1230
Proper Shipping Name	METHANOL
Hazard Class	3
Subsidiary Hazard Class	6.1
Packing Group	II

IMDG/IMO

UN-No	UN1230
Proper Shipping Name	METHANOL

Hazard Class	3
Subsidiary Hazard Class	6.1
Packing Group	II

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Methyl alcohol	X	X	-	200-659-6	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Methyl alcohol	67-56-1	>95	1.0

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act) Not applicable

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Methyl alcohol	X		-

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Methyl alcohol	5000 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Methyl alcohol	67-56-1	Developmental	-	Developmental

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Methyl alcohol	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ):	Y
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade	Serious risk, Grade 3

16. Other information

Prepared By	Regulatory Affairs Thermo Fisher Scientific Email: EMSDS.RA@thermofisher.com
Creation Date	27-Apr-2009
Revision Date	18-Jan-2018
Print Date	18-Jan-2018
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

APPENDIX C

PERMITS (IF REQUIRED)

APPENDIX D

FIELD FORMS

Daily Activity Report

SUSITNA
ENVIRONMENTAL, LLC

Contract No.:	Task:	Date:
Weather/Temperature:		
Work Location:		
Susitna Personnel:	Equipment:	Visitors (Representing):

Subcontractor:	Trade/Service

Agreements Made/Phone Conversations:
Materials Delivered (Amount, Condition, Purpose):
Inspections:
Test Data:
Work Completed:
Problems/Resolutions:
Other:

Prepared By:	Signature:

Boring Log

SUSITNA
ENVIRONMENTAL, LLC

Project Name:
Project/Contract Number:
Date:
Logged By:
Company:
Driller:
Company:

Boring Location ID

Boring Start Time:
Boring Completion Time:
Total Depth:

Depth Below Ground Surface (Feet)	Insitu PID Reading (ppm)	Lithology Notes

Analytical Samples			
Sample ID	Time	Depth Interval (feet bgs)	Analyses

SUSITNA
ENVIRONMENTAL, LLC

Groundwater Sampling Record

Project Name: ______________________________ Well ID: ______________________________

Project Location: ______________________________ Sample No.: ______________________________

Project Number: ______________________________ Sampler(s): ______________________________

Date/Time: ______________________________ Weather: ______________________________

Water Level Measurements and Purge Data

Time	Depth of Well (TOC)	Depth to Water (TOC)	Feet of Water in Well	Gallons per Well Volume (2" dia. = 0.163 gal/ft, 4" dia.=0.653 gal/ft)
__________	__________ ☐ Meas. ☐ Hist.	__________ Initial	__________	______________________

Water Level Measurement Method: ☐ Electric Tape ☐ Other: ______________________________

Well Evacuation Method: ☐ Peristaltic Pump ☐ Submersible Pump ☐ Bailer ☐ Other: ______________

Purge Rate: ________________

Begin Purge: Time: __________ Total Volume Purged: ________________

End Purge: Time: __________ Well Volumes Purged: ________________

Purge Water Disposed: ☐ 55-gal Drum ☐ Storage Tank ☐ Ground ☐ Liquabin ☐ Other: ________

Sample Collection Method & Analysis

Sample Type: ☐ Groundwater ☐ Surface Water ☐ Other: ______________________________

Sample Time: ______________

Sample Collection Method: ☐ Pump Type: __________ Dedicated ☐ Y ☐ N ☐ Bailer ☐ Other: __________

Decon Procedure: ☐ N/A ☐ Alconox Wash ☐ Tap Rinse ☐ DI Water ☐ Other:

Sample Description (color, turbidity, odor, sheen, etc.): ______________________________

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
________	________	☐ Glass ☐ Plastic	______________________________
________	________	☐ Glass ☐ Plastic	______________________________
________	________	☐ Glass ☐ Plastic	______________________________
________	________	☐ Glass ☐ Plastic	______________________________
________	________	☐ Glass ☐ Plastic	______________________________
________	________	☐ Glass ☐ Plastic	______________________________

Notes:

APPENDIX E

CONCEPTUAL SITE MODELS

Print Form

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

Site Name: FAA Fort Yukon Quarters Facility Bldg 300 USTs 9-C-1, 9-C-2, 9-C-4

File Number: 740.38.011

Completed by: Ryan Burich / Susitna Environmental

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:

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:

A Former Drum Storage Area was historically identified at the southeast corner of Building 300. Multiple contaminants were identified in one surface soil sample collected in 1991. Benzo(a)pyrene and extractable petroleum hydrocarbons (DRO equivalent) were detected at a concentrations that exceeded 1/10th their respective ADEC Table B1 human health cleanup levels for the Under-40-Inch

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:

Multiple contaminants were identified in one surface soil sample collected in 1991; however, Benzo(a) pyrene was the only contaminant (in Appendix B - Soil Contaminants Evaluated for Dermal Exposure) detected at a concentration that exceeded 1/10th it's respective ADEC Table B1 human health cleanup level for the Under-40-Inch zone.

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 groundwater 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:

A groundwater sample has not been collected. However, multiple contaminants were identified in one surface soil sample collected in 1991. Extractable petroleum hydrocarbons (DRO equivalent) were detected at a concentrations that exceeded the Table B2 Migration to Groundwater Soil Cleanup Level for the Under 40-Inch Zone. Consequently, contaminant migration to groundwater may be possible.

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:

The nearest surface water body is located approximately 1,200 feet north of the site. Contaminants, if present, are not expected to be detected in surface water at this distance from the site.

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: Complete

Comments:

Review of analytical results indicates Bioaccumulative Compounds of Potential Concern (in Appendix C of the Guidance on Developing Conceptual Site Models) were detected in a surface soil sample collected at the site in 1991. These contaminants include phenanthrene, fluoranthene, Benzo[b] fluoranthene, Benzo[a]pyrene, Indeno[1,2,3-cd]pyrene, Benzo[g,h,i]perylene and DDT.

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:

It is not known if volatile contaminants are present in the soil between 0 - 15 feet, as the surface soil sample collected in 1991 was not submitted for a full list VOCs analysis, which is currently recommended in Appendix F – Determination of Sampling and Lab Analysis for Petroleum in Soil and Groundwater, and Recommended Sampling Materials of the ADEC's Field Sampling Guidance

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:

Building 300 is currently not occupied.

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:

- o Climate permits recreational use of waters for swimming.
- o Climate permits exposure to groundwater during activities, such as construction.
- o 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:

Groundwater samples have not been collected at this location.

Inhalation of Volatile Compounds in Tap Water

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

- o The contaminated water is used for indoor household purposes such as showering, laundering, and dish washing.
- o 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:

Groundwater samples have not been collected at this location. However, it is assumed that drinking water is provided by the Fort Yukon Water Treatment and Distribution System. Additionally, review of the Alaska DNR WELTS database indicates there are no drinking water wells near the site.

Inhalation of Fugitive Dust

Inhalation of fugitive dust may be a complete pathway if:

- o 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.
- o 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:

Drums historically stored onsite likely contained volatile and semi-volatile compounds. Consequently, an analysis is not suggested for non-volatile compounds in ADEC's 18 AAC 75 Appendix F – (Determination of Sampling and Lab Analysis for Petroleum in Soil and Groundwater, and Recommended Sampling Materials). Considering the contaminants at the site are likely limited to volatile and semi-volatile compounds, exposure to non-volatile compounds via the Inhalation-of-Fugitive-Dust pathway is considered incomplete.

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:

- o Climate permits recreational activities around sediment.
- o 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:

The closest water body (and sediment) is located approximately 1,200 feet north of the site. Sediment contamination is not expected, due to this distance from the site.

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

Print Form

HUMAN HEALTH CONCEPTUAL SITE MODEL GRAPHIC FORM

Site: FAA Fort Yukon Quarters Facility Bldg 300 USTs 9-C-1, 9-C-2, 9-C-4

Completed By: Ryan Burich / Susitna Environmental

Date Completed: 14 April 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.

Media	Transport Mechanisms	
☑ Surface Soil (0-2 ft bgs)	Direct release to surface soil	check soil
	☑ *Migration to subsurface*	*check soil*
	☑ *Migration to groundwater*	*check groundwater*
	☑ *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
	☐ *Migration to groundwater*	*check groundwater*
	☐ *Volatilization*	*check air*
	☐ *Uptake by plants or animals*	*check biota*
	☐ *Other (list):*	
☐ Ground-water	Direct release to groundwater	check groundwater
	☐ *Volatilization*	*check air*
	☐ *Flow to surface water body*	*check surface water*
	☐ *Flow to sediment*	*check sediment*
	☐ *Uptake by plants or animals*	*check biota*
	☐ *Other (list):*	
☐ Surface Water	Direct release to surface water	check surface water
	☐ *Volatilization*	*check air*
	☐ *Sedimentation*	*check sediment*
	☐ *Uptake by plants or animals*	*check biota*
	☐ *Other (list):*	
☐ Sediment	Direct release to sediment	check sediment
	☐ *Resuspension, runoff, or erosion*	*check surface water*
	☐ *Uptake by plants or animals*	*check biota*
	☐ *Other (list):*	

(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.

Current & Future Receptors

Exposure Media	Exposure Pathway/Route	Residents (adults or children)	Commercial or industrial workers	Site visitors, trespassers, or recreational users	Construction workers	Farmers or subsistence harvesters	Subsistence consumers	Other
☑ soil	☑ Incidental Soil Ingestion	C/F	C/F	C/F	C/F			
	☑ Dermal Absorption of Contaminants from Soil	C/F	C/F	C/F	C/F			
	☐ Inhalation of Fugitive Dust							
☑ groundwater	☑ Ingestion of Groundwater		F		F			
	☑ Dermal Absorption of Contaminants in Groundwater		F		F			
	☐ Inhalation of Volatile Compounds in Tap Water							
☑ air	☑ Inhalation of Outdoor Air		C/F		C/F			
	☐ Inhalation of Indoor Air							
	☐ Inhalation of Fugitive Dust							
☐ surface water	☐ Ingestion of Surface Water							
	☐ Dermal Absorption of Contaminants in Surface Water							
	☐ Inhalation of Volatile Compounds in Tap Water							
☐ sediment	☐ Direct Contact with Sediment							
☑ biota	☑ Ingestion of Wild or Farmed Foods					C/F	C/F	

Revised, 10/01/2010

Print Form

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

Site Name: FAA Fort Yukon Quarters Facility Bldg 103 UST 9-C-8

File Number: 740.38.011

Completed by: Ryan Burich / Susitna Environmental

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. <u>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.</u>

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:

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:

Contaminants are present between 0 and 15 feet below ground surface. Review of analytical results from soil samples collected from the UST-removal excavation floor indicates DRO and ethylbenzene were present at concentrations greater than 1/10th of their respective ADEC Tables B1 and B2 human health cleanup levels for the Under-40-Inch zone.

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:

Soil samples collected from the UST-removal excavation floor and sidewalls in 1995 were not submitted for polynuclear aromatic hydrocarbon analysis, which is currently recommended in Appendix F – Determination of Sampling and Lab Analysis for Petroleum in Soil and Groundwater, and Recommended Sampling Materials of the ADEC's Field Sampling Guidance.

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 groundwater 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:

The concentration of DRO detected in a soil sample collected from the UST-removal excavation floor in 1995 exceeded the Migration-to-Groundwater Soil Cleanup Level. Review of the UST excavation cross-section indicates the sample was collected from approximately 7 feet bgs. Review of soil boring log B-4, indicates groundwater was present at approximately 11 feet bgs. Groundwater samples have

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:

The nearest surface water body is located approximately 1,400 feet north of the site. Contaminants are not expected to be detected in surface water at this distance from the site.

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:

Contaminants were detected approximately 7 feet bgs, which is below the root zone depth for plants (approx 5ft). Additionally, it is not known if site contaminants are present that have the potential to bioaccumulate, as samples were not submitted for polynuclear aromatic hydrocarbon analysis, which is

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:

It is not known if volatile contaminants are present in the soil between 0 - 15 feet, as samples were not submitted for full list VOCs and polynuclear aromatic hydrocarbon analyses, which is currently recommended in Appendix F – Determination of Sampling and Lab Analysis for Petroleum in Soil and Groundwater, and Recommended Sampling Materials of the ADEC's Field Sampling Guidance

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: Complete

Comments:

It is not known if volatile contaminants are present in the soil between 0 - 15 feet, as samples were not submitted for full list VOCs and polynuclear aromatic hydrocarbon analyses, which is currently recommended in Appendix F – Determination of Sampling and Lab Analysis for Petroleum in Soil and Groundwater, and Recommended Sampling Materials of the ADEC's Field Sampling Guidance.

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:

- o Climate permits recreational use of waters for swimming.
- o Climate permits exposure to groundwater during activities, such as construction.
- o 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:

Groundwater samples have not been collected at this location.

Inhalation of Volatile Compounds in Tap Water

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

- o The contaminated water is used for indoor household purposes such as showering, laundering, and dish washing.
- o 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:

Groundwater samples have not been collected at this location. However, it is assumed that drinking water is provided by the Fort Yukon Water Treatment and Distribution System. Additionally, review of the Alaska DNR WELTS database indicates there are no drinking water wells near the site.

Inhalation of Fugitive Dust

Inhalation of fugitive dust may be a complete pathway if:

- o 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.
- o 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:

Contamination remaining at the site is at 7 feet bgs, based on review of historical documents.

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:

- o Climate permits recreational activities around sediment.
- o 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:

The closest water body (and sediment) is located approximately 1,400 feet north of the site. Sediment contamination is not expected, due to this distance from the site.

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

Print Form

HUMAN HEALTH CONCEPTUAL SITE MODEL GRAPHIC FORM

Site: FAA Fort Yukon Quarters Facility Bldg 103 UST 9-C-8

Completed By: Ryan Burich / Susitna Environmental

Date Completed: 14 April 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.

Media / Transport Mechanisms

Media	Transport Mechanisms	
☐ Surface Soil (0-2 ft bgs)	Direct release to surface soil	check soil
	☐ *Migration to subsurface*	*check soil*
	☐ *Migration to groundwater*	*check groundwater*
	☐ *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
	☑ *Migration to groundwater*	*check groundwater*
	☑ *Volatilization*	*check air*
	☐ *Uptake by plants or animals*	*check biota*
	☐ *Other (list):*	
☑ Ground-water	Direct release to groundwater	check groundwater
	☑ *Volatilization*	*check air*
	☐ *Flow to surface water body*	*check surface water*
	☐ *Flow to sediment*	*check sediment*
	☐ *Uptake by plants or animals*	*check biota*
	☐ *Other (list):*	
☐ Surface Water	Direct release to surface water	check surface water
	☐ *Volatilization*	*check air*
	☐ *Sedimentation*	*check sediment*
	☐ *Uptake by plants or animals*	*check biota*
	☐ *Other (list):*	
☐ Sediment	Direct release to sediment	check sediment
	☐ *Resuspension, runoff, or erosion*	*check surface water*
	☐ *Uptake by plants or animals*	*check biota*
	☐ *Other (list):*	

(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.

Exposure Media / Exposure Pathway/Route / Current & Future Receptors

Exposure Media	Exposure Pathway/Route	Residents (adults or children)	Commercial or industrial workers	Site visitors, trespassers, or recreational users	Construction workers	Farmers or subsistence harvesters	Subsistence consumers	Other
☑ soil	☑ Incidental Soil Ingestion		F		F			
	☑ Dermal Absorption of Contaminants from Soil		F		F			
	☐ Inhalation of Fugitive Dust							
☑ groundwater	☑ Ingestion of Groundwater	F	F	F	F			
	☑ Dermal Absorption of Contaminants in Groundwater	F	F	F	F			
	☐ Inhalation of Volatile Compounds in Tap Water							
☑ air	☑ Inhalation of Outdoor Air		C/F		C/F			
	☑ Inhalation of Indoor Air	C/F	C/F	C/F	C/F			
	☐ Inhalation of Fugitive Dust							
☐ surface water	☐ Ingestion of Surface Water							
	☐ Dermal Absorption of Contaminants in Surface Water							
	☐ Inhalation of Volatile Compounds in Tap Water							
☐ sediment	☐ Direct Contact with Sediment							
☐ biota	☐ Ingestion of Wild or Farmed Foods							

APPENDIX F

ARCTIC DATA SERVICES
STAGE 2A DATA VALIDATION SOP

STANDARD OPERATING PROCEDURES FOR STAGE 2A DATA VALIDATION

Revision 1.1

December 27, 2018

Arctic Data Services

Arctic Data Services, LLC
302 Cushman Street, Suite 203
Fairbanks, AK 99701

Table of Contents

Tables

Attachments

Attachment 1 – Table A-1. Combined Data Qualification Criteria

List of Acronyms

%R	percent recovery
°C	Degrees Celsius
ADEC	Alaska Department of Environmental Conservation
ADS	Arctic Data Services, LLC
CADR	Computer-Assisted Data Review
CDQR	Chemical Data Quality Review
COC	Chain of Custody
CRQL	Contract Required Quantitation Limit
DL	Detection Limit
DoD	Department of Defense
DQA	Data Quality Assessment
DQI	Data Quality Indicator
DQO	Data Quality Objective
EB	Equipment Blank
ELAP	Environmental Laboratory Accreditation Program
EM	Engineering Manual
EPA	U.S. Environmental Protection Agency
FD	Field Duplicate
FSP	Field Sampling Plan
IB	Instrument Blank
ISM	Incremental Sampling Methodology
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOD	Limit of Detection
LOQ	Limit of Quantitation
MB	Method Blank
MeOH	methanol
mm	millimeters
MQO	Measurement Quality Objectives
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PAL	Project Action Levels
PARCCS	Precision, Accuracy, Representativeness, Comparability, Completeness, Sensitivity
PDS	Post-Digestion Spike
PS	Project Sample
QAPP	Quality Assurance Project Plan
QC	Quality Control
QSM	Quality Systems Manual
RPD	Relative Percent Difference
SAP	Sample and Analysis Plan
SDG	Sample Delivery Group
SRF	Sample Receipt Form

SEDD	Staged Electronic Data Deliverable
SOP	Standard Operating Procedure
TB	Trip Blanks
TCLP	toxicity characteristic leaching procedure
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
VOC	Volatile Organic Compound
WP	Work Plan

STANDARD OPERATING PROCEDURES FOR STAGE 2A DATA VALIDATION

1.0 Introduction

Before data is used to make procedural decisions, implement corrective actions, inform policy, or guide a project toward successful attainment of project goals and objectives, it is important to make sure the data actually can and should be used in such a manner. In other words, data must not be assumed to be scientifically sound and of known and documented quality before it is reviewed in the context of the goals, objectives, and regulatory framework of the project for which it was generated.

Such review is achieved by subjecting the data to a rigorous process involving methods of data verification, data validation, and usability assessment. The purpose of this standard operating procedure (SOP) is to describe in detail the means by which Arctic Data Services, LLC (ADS) accomplishes data validation. Data usability assessment takes into account data verification and data validation, but involves the entire decision-making team for the project, and is beyond the scope of this SOP. We demonstrate ADS's data validation procedures are logical, scientifically defensible, and comply with relevant regulations, contract specifications, and governmental guidance documents.

1.1 Data Review Process Summary

There are three basic steps to the process of evaluating data quality and usability, each of which will be defined and briefly discussed in this summary.

1.1.1 Data Verification

Data verification is the first step in data review. Data verification is a process for evaluating the completeness, correctness, consistency, and compliance of field records, sample handling and receipt forms, chain of custody forms, laboratory reports, and analytical data against standards, regulations, or project-specific requirements. Data verification procedures are described in Standard Operating Procedures for Environmental Data Verification (ADS, 2017).

1.1.2 Data Validation

Data validation is the process of comparing quality control (QC) sample results, whose true values are known, to fixed criteria of analytical performance for data precision, accuracy, and sensitivity. If these performance criteria are not met for samples whose true values are known, it is assumed they have not been met for samples whose values are not known, and these sample results are qualified with data flags to indicate the impact to data quality. Performance criteria may include regulatory criteria (e.g. cleanup levels), published standards (e.g. method criteria), laboratory control limits (internal laboratory performance criteria), or project-specific criteria designed to ensure the data meets specific project objectives. For Department of Defense (DoD) projects, performance criteria for analytical accuracy and precision are defined in the DoD Quality Systems Manual (QSM). The performance criteria used for any given project are termed measurement quality objectives (MQOs).

1.1.3 Data Usability Assessment

Data usability assessment is the process of determining whether the data can be used to support project decision making. It is the final step in the data review process, and involves both a detailed knowledge of the implications of data verification and validation failures, as well as broad knowledge of a project's objectives. The assessment involves evaluating data verification and validation findings in the context of broader project data quality objectives (DQOs), and determining whether the data is usable for purposes of project decision-making.

1.2 Data Quality Indicator Summary

Precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) are the six data quality indicators (DQIs) that are generally used as a framework for defining project data quality and usability. Precision, accuracy, and sensitivity can be evaluated quantitatively through data verification and validation. Representativeness and comparability are evaluated qualitatively in the context of project objectives during the data quality assessment, though elements of data validation inform the evaluation of representativeness and comparability. Completeness is a quantitative measure, but must be defined through the data usability assessment. These DQIs are defined below, and further discussed where relevant in subsequent sections of this SOP.

- **Precision** measures the reproducibility of repetitive measurements. It is typically evaluated by calculating the relative percent difference (RPD) between duplicate samples and comparing calculated RPDs to project MQOs.
- **Accuracy** measures the correctness, or the closeness, between the true value and the quantity detected. It is evaluated by calculating the percent recovery of known concentrations of spiked compounds introduced into the appropriate sample matrix and comparing calculated recovery to project MQOs.
- **Representativeness** describes the degree to which data accurately and precisely represent site characteristics. Representativeness is affected by factors such as sample frequency and matrix or contaminant heterogeneity, and is evaluated by checking that sample collection methodology was appropriate, samples were collected in accordance with this methodology, and that sampling methods and frequencies were sufficient to adequately represent site conditions. This is largely quantitative, but evaluation of field duplicate RPDs may help inform the reviewer as to the impact of matrix heterogeneity on representativeness of the data.
- **Comparability** describes whether two data sets can be considered equivalent with respect to project goals. Comparability is affected by factors such as sampling methodology and analytical performance (including sensitivity, accuracy, and precision). Comparability is evaluated by checking for consistency in sampling methodology and analytical performance between sampling events, as well as conformance to standards and broader method or QC program requirements.
- **Completeness** describes the amount of valid data obtained from the sampling event(s). It is calculated as the percentage of valid measurements compared to the total number of measurements. A project completeness goal is commonly defined in the project work plan (WP) or quality assurance project plan (QAPP). In terms of data verification, completeness also refers to the completeness of documentation

supporting the generation of valid data, though a completeness score for this more qualitative measure is not calculated.

- **Sensitivity** describes the ability of the sampling and analytical methodology to differentiate analyte signal from background noise. In the context of a project, sensitivity is evaluated by checking that detection limits, reporting limits, and/or quantitation limits meet detection, reporting, and/or quantitation limit objectives.

1.3 Project Background Review

Data verification, validation, and usability assessment all require knowledge of project-specific requirements; thus, review of project planning documents is the first step in data review. Planning documents often include project WPs, field sampling plans (FSPs), and QAPPs. The FSP and QAPP are sometimes combined in a sampling and analysis plan (SAP). For many federal projects, a Uniform Federal Policy (UFP) QAPP will be the primary planning document governing analytical data quality. Since this SOP focuses only on the data validation step, planning documents relevant to data validation are discussed below.

Regardless of what planning documents were prepared, the reviewer should identify and familiarize themselves with the following elements that will provide the context for data validation:

- analytical methods and method-specific sample handling and preservation requirements;
- MQOs;
- project action levels (PALs), including cleanup levels and/or screening levels; and
- data validation procedures (check for consistency with this SOP; if not consistent, the project-specific requirements govern).

This project background review is conducted solely to provide the data validator the needed understanding with which to conduct the data validation. It is not intended to scrutinize the planning documents, except to the extent that deficiencies or discrepancies in the planning documents may preclude effective data validation.

2.0 Data Validation Procedures

The goals of data validation are to evaluate whether or not MQOs have been met, to determine the impact to data quality for those data where MQOs were not met and document that impact by applying data qualifiers to the reported results, and to document the findings of data validation in a summary report that can be used during data usability assessment.

ADS data validation guidelines have been developed in accordance with requirements of the Alaska Department of Environmental Conservation (ADEC) and draw from a variety of U.S. DoD, U.S. Environmental Protection Agency (EPA) and U.S. Army Corps of Engineers (USACE) guidance documents. For a complete list of references, see Section 4.0.

All project data will go through a minimum of a Stage 2A validation, as defined in the EPA Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (2009). Stage 2A validation involves review and compliance checks on analytical parameters at the preparatory batch level, such as method blanks, laboratory control samples, matrix spikes, and surrogate spikes, and field QC samples, such as field duplicates and trip blanks. This level of validation is deemed appropriate as a default for most projects undertaken, and is consistent with ADEC guidance and general requirements for most USACE projects. If further validation is required, additional validation requirements will be further defined in a project-specific QAPP. A more thorough validation will also be considered when significant systematic issues are observed during Stage 2A validation.

ADS utilizes ChemData, an internally developed and proprietary computer-assisted data review (CADR) software to assist in the data validation process. ChemData allows the reviewer to quickly and efficiently make all quantitative comparisons from staged electronic data deliverables (SEDDs). ChemData outputs are checked for consistency with the laboratory report before being used, and professional judgement is always applied when using CADR to assist in data validation.

Data validation findings will be summarized in a data quality assessment (DQA) or chemical data quality report (CDQR), which will be appended to each associated project report. Where required (including all projects regulated by the ADEC contaminated sites program), the chemist/data reviewer will complete an ADEC Laboratory Data Review Checklist for each sample delivery group (SDG).

Data validation involves applying data qualifiers (flags) to data affected by QC failures and anomalies identified during the course of the review. Table 1 presents and defines the data qualifiers to be used for data validation, unless other qualifiers are specified in the project QAPP. It is important to note that there is no flag for rejecting data as part of data validation. Data rejection must occur at the data usability step, taking into account broader project data quality objectives (DQOs).

Table 1. Data Validation Qualifier Definitions

Qualifier	Definition
U	The analyte was not detected and is reported as less than the LOD.
J	Estimated concentration; analyte was detected between the DL and the LOQ or was affected by QC failures or sample handling and preservation anomalies with an unknown bias.
J+	Estimated concentration (high bias); analyte was detected and was affected by QC failures or sample handling and preservation anomalies indicative of a potential high bias.
J-	Estimated concentration (low bias); analyte was detected and was affected by QC failures or sample handling and preservation anomalies indicative of indicative of a potential high bias.
UJ	The analyte was not detected and is reported as less than the LOD; however, the associated numerical value is an estimate, and there is uncertainty whether the absence of detected analyte is valid at the listed value due to QC failures or sample handling and preservation anomalies.
B	The analyte was detected above the LOQ but may be affected by blank-associated sample contamination (biased high).
NJ	Tentative detection, estimated concentration; there is significant uncertainty in the identity and quantity of the detected analyte.
N	Tentative detection; there is significant uncertainty in the identity of the detected analyte.
Q	The sample result was affected by serious deficiencies in the ability to meet published method or project QC criteria. The presence or absence of the analyte cannot be verified. Acceptance or rejection of the data should be decided by the project team, but exclusion of the data is recommended.

Notes:

DL	detection limit
LOD	limit of detection
LOQ	limit of quantitation (also used to report non-detect results if an LOD is not reported)
QC	quality control
PAL	project action level

The following describe the QC elements that will be reviewed in the course of data validation. Tables presenting data qualification criteria are included in each relevant section. A comprehensive table for all data qualification criteria is included as Attachment A. Data qualification criteria are derived from guidance documents, published methods, and standards, and refined based on ADS professional judgement. If a project QAPP specifies different criteria, the project-specific criteria govern.

2.1 Sample Custody, Sample Handling and Preservation, and Holding Times

The following sections describe the process of validating data for sample custody, sample handling and preservation, and holding time anomalies or failures. Such anomalies and failures can affect the overall accuracy of the data, as well as the effective sensitivity and representativeness of the data.

2.1.1 Sample Custody

Sample custody anomalies identified during the data verification process include: absence of required signatures, dates, and times on the chain of custody (COC) form; absence of custody seals; incorrect or inconsistent sample information (including sample IDs, dates, and times); incorrect analyses requested; or failure to list relevant QC samples or additional volume. In general, these anomalies will not affect data quality if corrected shortly after receipt at the laboratory. However, the reviewer should use professional judgement to determine whether custody may have been breached, or if anomalies resulted in real impacts to data quality or usability. If there is evidence that custody was breached and samples have been tampered with, the entire dataset should be flagged '**Q**' for possible rejection. Rejection of data in response to serious custody issues should be conducted carefully following thorough communication with the laboratory, project manager, and field sampling team.

2.1.2 Sample Handling and Preservation

Sample preservation requirements vary for different analytical methods, and are generally published in the method or in the parent document under which the method is published. For instance, Chapters 3 and 4 of the EPA Test Methods for Evaluating Solid Waste: Physical/Chemical Methods (SW-846; 2014) outline sample handling and preservation requirements for inorganic and organic SW-846 methods, respectively. Sample preservation requirements typically involve chilling the samples to below 6°C and for some analyses, adding a chemical preservative to slow the process of analyte degradation in the sample. Exceedance of sample handling and preservation requirements generally imparts a low bias, though this may vary by analysis and even by analyte (see Table 2 exceptions, below).

Sample condition also affects data quality. Samples received in compromised condition (e.g. broken bottles, cracked lids, leaking bottles, vials with headspace) warrant data qualification. Professional judgement should be used to determine which qualifier is most relevant; compromised sample condition does not always warrant imparting a low bias.

First, review the sample receipt form (SRF) for any sample handling and preservation anomalies, as well as general sample condition and errors noted by the laboratory during sample log-in. For sample preservation and condition anomalies, review the sample container information provided with the SRF to check whether the laboratory used the compromised container for analysis. If multiple containers were shipped per sample, the laboratory should use containers with adequate preservation and in good condition before any compromised containers.

Table 2 presents general data qualification criteria that will be used to validate data for sample handling and preservation failures.

Table 2. Data Qualification Criteria – Sample Handling and Preservation

Performance Criteria	Criteria Variance	Qualifier (detected results)	Qualifier (non-detect results)	Applied To:
Sample Temperature	Sample temperature ≤ 6°C	None	None	Not applicable
	Sample temperature ≤ 0°C and ice present (water samples only)	**J**	**UJ**	All samples with ice present
	Sample temperature > 6°C	**J-**	**UJ**	All samples in cooler with elevated temperature
	Sample temperature > 10°C (volatile analytes only)	**J-**	**Q**	All samples in cooler with elevated temperature
Sample Preservation	Sample adequately preserved	None	None	Not applicable
	Sample pH outside required limits	**J-**	**UJ**	All samples with pH outside limits (review bottle list)
Sample Condition	Samples received in good condition	None	None	Not applicable
	Headspace: bubbles > 2 mm in vials used for VOC analysis	**J-**	**UJ**	All analytes if bottle with headspace is used in analysis (review bottle list)
	Sample received in compromised condition (broken lid, leaking container, soil samples with insufficient MeOH, etc.)	Use professional judgement	Use professional judgement	Use professional judgement

Notes:

°C	degrees Celcius
mm	millimeters
MeOH	methanol
VOC	volatile organic compound

Exceptions:

1) Metals analysis: if samples are received with inadequate preservation (pH > 2), no qualification is necessary if the laboratory adjusted the pH to ≤ 2 at the time of receipt (EPA, 2017).

2) For low stability analytes or analytes that may be oxidized or reduced to different states, the above criteria may not be appropriate. Carefully consider the need for more conservative flags (e.g. '**Q**' for non-detects) and the direction of bias for target analytes and degradation byproducts.

2.1.3 Holding Times

Method specific holding times (technical holding times) are generally published alongside sample handling and preservation requirements. Holding times for inorganic analytes may be analyte-specific, and vary for different analytes under the same method. Sample handling and preservation work hand-in-hand with holding times to ensure that samples are prepared and analyzed before significant analyte degradation has occurred in the samples. Thus, if there are sample handling or preservation issues in addition to holding time failures, professional judgement should be used and more conservative flags applied.

The way that holding-times are evaluated varies based on the sample matrix and method. Certain methods list a collection-to-analysis holding time (e.g. VOC analysis of soil, where extraction occurs at the time of collection) while others list separate holding times for collection to extraction and for extraction to analysis.

Technical holding times that are listed in days are evaluated in days (i.e. exceeding a 14-day holding time by 1 hour does not warrant data qualification; exceeding a 14-day holding time by 1 day does). Technical holding times listed in hours are evaluated in hours.

Table 3. Data Qualification Criteria – Holding Times

Performance Criteria	Criteria Variance	Qualifier (detected results)	Qualifier (non-detect results)	Applied To:
Holding Time	Sample HT ≤ technical HT	None	None	NA
	Sample HT > technical HT	**J-**	**UJ**	All results reported from analysis with HT exceedance
	Sample HT > 2x technical HT (gross holding time exceedance)	**J-**	**Q**	All results reported from analysis with HT exceedance

Notes:

HT holding time

2.2 Detection, Reporting, and Quantitation Limits (Sensitivity)

Comparing reporting limits and quantitation limits to PALs is a critical step in evaluating analytical sensitivity. The following defines detection limits (DLs), limits of detection (LODs; reporting limits), and limits of quantitation (LOQs) as used in this SOP. Note that the methods used to determine DLs, LODs, and LOQs vary from laboratory to laboratory; the laboratory demonstrates their determination is adequate as part of laboratory accreditation.

The DL is the lowest concentration that a laboratory can reliably discern from background (blank concentration). If a substance is detected at or above the DL, it can be reliably stated (with 99% confidence) that the analyte is present (there is a 1% chance that the detection is a false positive). The false negative rate at the DL is 50%, so the absence of an analyte at the DL does not reliably indicate the absence of the analyte in the sample.

The LOD is the lowest concentration that must be present in a sample to reliably detect that analyte (with 99% confidence). In other words, at the LOD, there is a 1% chance that a detection is a false negative. The LOD is the preferable limit to compare to PALs to determine whether analytical sensitivity is adequate for project decision making. Results where an analyte was not detected should be reported as less than the LOD (< LOD or LOD U).

The LOQ is the lowest concentration that the laboratory can reliably quantitate. The LOQ must be equal to or greater than the LOD, and should be within the linear calibration range of the analysis. In the absence of a LOD, the LOQ is used to represent non-detect results (< LOQ or LOQ U) and to compare to PALs.

For results where an analyte is not detected and the LOD (or LOQ) exceeds the PAL, results are of limited usefulness. These results should be clearly identified during reporting, and results with insufficient analytical sensitivity should be discussed as part of the data usability assessment. However, the simple fact that an LOD exceeds a PAL is not grounds for applying a data qualifier. Data quality has not been compromised; rather, it simply does not meet current sensitivity goals. There is the chance that PALs for the site may change in the future, thus rendering qualifiers, if applied, no longer applicable. Therefore, instead of applying qualifiers, ADS generates an analytical sensitivity summary table presenting DLs, LODs, and LOQs alongside PALs for non-detect results where one or more of these limits exceed the PAL. Limits exceeding the PAL are clearly identified. If ADS is charged with producing project reporting tables, then ADS will identify LODs that exceed the PAL with shading and/or footnotes on these tables as well. The analytical sensitivity summary report will be included with the data validation report for use by the project team during data usability assessment.

Note that if the LOD is below the PAL but the LOQ exceeds the PAL and the analyte was detected below the LOQ (LOD < result < PAL < LOQ), the project team should exercise caution when relying on the result. Given that the analyte is present (with 99% confidence) and that the PAL falls below the level that can be reliably quantitated, it is possible the analyte is present above the PAL.

2.3 Blanks

To check for possible contributions to the analytical results from cross-contamination between samples or sample-contamination from an outside source, blank samples are analyzed. A blank sample is a clean sample of a known matrix that is carried through part or all of the analytical process. The following blank samples may be analyzed and reported:

- instrument blanks (IBs);
- method blanks (MBs);
- trip blanks (TBs); and
- equipment blanks (EBs).

In addition to those listed above, additional method-specific blank samples may be analyzed; additional blanks should be evaluated on a case-by-case basis (Section 2.3.4). Each of these blanks checks for sample-contamination issues at various steps between sample collection and analysis. Detections in blanks higher up on this list indicate issues that can cause related detections in blanks lower on this list; one can think of this list as a hierarchy of blanks. For example, a detection in an instrument blank (contamination at the analysis step) indicates an issue that may cause detections in corresponding method blanks, trip blanks, or equipment blanks. Likewise, a detection in a method blank (contamination at the extraction step) can result in a detection in a trip blank or equipment blank. Therefore, it is important to investigate blank detections to determine at what stage sample-contamination was first introduced; data qualification should proceed beginning at this level. However, instrument blank review is beyond the scope of a Stage 2A data validation; if instrument blank detections are documented by the laboratory in the case narrative, a further level of validation may be required.

Sample contamination identified in blanks can impact accuracy of associated field-sample results (by imparting a high bias) and representativeness of the data (by potentially causing false-positive results). General data qualification criteria for blanks are presented in Table 4. Sample results detected within 10 times the blank concentration are qualified with a '**B**' flag to indicate a potential contribution to the analytical result (high bias) due to sample contamination. Additional considerations are discussed in individual blank sections.

Table 4. Data Qualification Criteria – Blanks

Performance Criteria	**Criteria Variance**	**Qualifier (detected results)**	**Qualifier (non-detect results)**	**Applied To[1]:**
Method Blanks, Trip Blanks, and Equipment Blanks	Blank < DL	None	None	NA
	Blank > DL *and* DL < Sample < 10xBlank	**B**	None	Individual results for associated samples – see below

Notes:

[1] Refer to individual blank sections (below) for discussion of which samples to qualify

DL	detection limit
LOD	limit of detection
LOQ	limit of quantitation
NA	not applicable

2.3.1 Method Blanks

MBs are prepared by the laboratory with every preparatory batch (extraction batch), at a minimum rate of one MB per 20 samples for most analyses. MBs are samples of clean media (soil, water, etc.) that are subjected to the same extraction and analysis procedures as project samples. MBs are evaluated to determine if the method of extraction, cleanup, or analysis introduces any contamination during the process.

The reviewer will check that MBs were prepared and analyzed by the laboratory at the required frequency, and that no analytes were detected in the MBs. If an analyte is detected in a MB, all samples in the corresponding preparatory batch should be reviewed for the detected analyte. Data qualifiers should be applied according to Table 4.

2.3.2 Trip Blanks

TBs are prepared by the laboratory and included in each shipment of samples for volatile organic analysis. Trip blanks are prepared in the same way as method blanks, but packaged for shipment in sample containers consistent with field samples. TB contamination is indicative of cross-contamination of samples or contamination from an outside source during sample handling, shipping, or storage. Theoretically, TBs check for the potential for volatile analytes to absorb through sample septa or otherwise make their way into samples prior to analysis. In reality, TBs may be more of a secondary check for laboratory-based contamination, as they are subjected to the same process as method blanks, and detections are often consistent between the two, suggesting TB detections are often attributable to laboratory-based contamination.

The reviewer should check that TBs were prepared, transported, and analyzed with samples for volatile organic analysis. The procedure for evaluating TB detections is the same as for MBs, except that data qualifiers are applied to detections in project samples from the same sample cooler as the affected TB. The COC should document which sample bottles traveled with which TBs; this is not always done, and so in the absence of cooler-sample associations, all samples in the SDG should be considered potentially affected.

If a TB detection is attributable to a MB detection (TB result would have been flagged '**B**'), then the TB detection will not be used to qualify sample results.

2.3.3 Equipment Blanks

EBs are collected in the field by the sampling personnel, generally by transferring clean media (e.g. water) to sample bottles using the same equipment as was used to collect field samples. The EB is used to determine if sufficient decontamination of reusable sampling equipment is performed between sampling locations.

The procedure for evaluating EB detections is the same as for MBs, except that significant professional judgement must be used to determine which samples to qualify. For instance, an EB collected immediately following sample collection at a highly contaminated location may indicate inadequate decontamination following that sample, and may affect subsequent samples collected following the EB. However, an EB detection after several relatively clean locations were sampled may indicate a more pervasive equipment-based contamination source, and may affect all samples collected with that equipment during that sampling event. The reviewer should look at sample results and sample chronology and use best judgement when applying flags.

A rinsate blank is a form of EB, prepared by running clean water over sampling equipment that was used for soil sampling, and collecting it in a bottle for analysis of target analytes. Since rinsate blank results are in water units, and cannot be readily translated to soil units (for the 10x comparison), if an analyte is detected in a rinsate blank all corresponding detections in associated soil samples should be conservatively qualified with a '**B**' flag, regardless of their concentration.

If a EB detection may be attributable to a MB or TB detection, use professional judgement when qualifying project-sample data based on the suspect EB detection.

2.3.4 Other Blanks

Other blanks may be used to check for sample contamination for specific analytical methods or sampling procedures. These include leachate blanks for toxic characteristic leaching procedure (TCLP) analyses and field blanks to check for sample contamination from airborne contaminants at the sampling site. Professional judgement should be used to qualify data based on detections in other blanks; the criteria in Table 4 may be a useful starting point.

2.4 Sample Spike Recovery (Accuracy)

Accuracy is evaluated at multiple levels throughout the analytical process, using a variety of techniques. At the preparatory-batch level, accuracy is assessed using recovery information from laboratory control samples (LCS) and laboratory control sample duplicates (LCSD), matrix spike samples (MS) and matrix spike duplicates (MSD), and analyte surrogates. MS/MSD and surrogate recovery information is also used to determine whether interference from the sample matrix affects the accuracy of the reported results.

Percent recovery is calculated for LCS, LCSD, and surrogates as follows:

$$\%R = (Q_d / Q_a) \times 100\%$$

Where: $\%R$ = Percent recovery
Q_d = Quantity detected by analysis
Q_a = True or accepted reference quantity or value

Percent recovery is calculated for MS and MSDs as follows:

$$\%R = ((Q_i - Q_c)/Q_t) \times 100\%$$

Where: $\%R$ = Percent recovery
Q_i = Quantity detected initially for spiked sample
Q_c = Quantity detected initially for unspiked sample
Q_t = True value of spike added

Accuracy MQOs should be specified for each method and analyte in the QAPP. In the absence of project-specific MQOs, laboratory control chart accuracy limits (laboratory control limits) will be used. For DoD projects, MQOs are specified in the DoD QSM.

When the percent recovery falls below lower control limits, the resulting data has a low bias. When the percent recovery falls above upper control limits, the resulting data has a high bias. In the case of conflicting recovery information, the direction of bias is not clear.

2.4.1 Laboratory Control Samples

Laboratory control samples (sometimes referred to as blank spikes) are prepared by the laboratory with every preparatory batch, at a minimum of one LCS per 20 samples. In some cases, the laboratory also analyzes a LCSD to check analytical precision (see Section 3.5.1); recovery information from the LCSD is also used to assess accuracy. LCSs and LCSDs are blank samples that are spiked with a known concentration of analyte(s) and subjected to the same preparation/extraction methods as field samples. The laboratory reports a percent recovery of the spiked amount for each analyte added to the blank sample.

The reviewer will check that an LCS was reported for each preparatory batch of no more than 20 samples; absence of an LCS for a preparatory batch may warrant rejection of all data from that batch, and all associated data should be qualified '**Q**.' The reviewer will check that LCS/LCSD recoveries meet accuracy MQOs. An LCS or LCSD recovery failure affects all corresponding samples in the same preparatory batch for the affected analyte(s). Data qualification criteria for LCS/LCSD recovery are listed in Table 5.

Table 5. Data Qualification Criteria – Laboratory Control Samples

Performance Criteria	Criteria Variance	Qualifier (detected results)	Qualifier (non-detect results)	Applied To[1]:
LCS or LCSD	LCL ≤ %R ≤ UCL	None	None	NA
	%R > UCL	**J+**	None	Specific analyte in associated preparatory batch
	%R < LCL	**J-**	**UJ**	Specific analyte in associated preparatory batch
	%R < LCL *and* %R < 60% (inorganics) *or* %R < 40% (purge-and-trap organics) *or* %R < 20% (extractable organics)	**J-**	**Q**	Specific analyte in associated preparatory batch

Notes:

LCL	lower control limit
UCL	upper control limit
%R	percent recovery

Exceptions:

1) If the LCS is recovered below the LCL and the LCSD is recovered above the UCL (or vice versa), then the direction of bias is not well defined, and associated detected results should be qualified '**J**.' In these cases the LCS/LCSD RPD is also likely to exceed control limits (see Section 3.5.1).

2) If LCS or LCSD recovery is grossly below the lower control limit (Table 5), detections below the PAL may be flagged '**Q**' to identify the results for possible rejection during data usability assessment. The results should not be used as evidence that the PAL was not exceeded.

2.4.2 Matrix Spikes (Organic Analyses)

An MS is a field sample that is spiked with a known concentration of analyte(s) and subjected to the same preparation/extraction methods as field samples. The laboratory reports a percent recovery of the spiked amount for each analyte added to the MS. MS recovery is used to evaluate whether interference from the sample matrix affects data accuracy. An MSD is a duplicate MS and is also used to evaluate analytical precision. This section addresses MS/MSD recovery for organic analyses only; inorganic analysis MS/MSD recovery is addressed separately in Section 2.4.3 due to the requirement for additional QC following an MS/MSD recovery failure for inorganic analyses.

The project QAPP should specify whether MS/MSDs are required. If required, additional sample volume must be collected and submitted to the laboratory for preparing the MS/MSDs, and the laboratory should prepare and analyze at least one MS/MSD per preparatory batch of no more than 20 samples. Only those MS/MSDs prepared from field samples from the project are reviewed for purposes of data validation for that project.

Table 6 presents data qualification criteria for MS/MSD recovery. When LCS/LCSD recovery is acceptable and there is an MS/MSD recovery failure, this is generally indicative of matrix interference. The reviewer should use professional judgement to determine which samples are affected by MS/MSD recovery failures. In general, failures are only considered to affect the parent sample (the sample spiked for the MS/MSD). However, if samples were collected from an environment of uniform and relatively homogenous matrix (i.e. the same surface water body or groundwater aquifer), qualification of all field samples of similar matrix may be warranted, particularly if multiple MS/MSDs from that matrix exhibit similar matrix interference.

Table 6. Data Qualification Criteria – Matrix Spikes

Performance Criteria	**Criteria Variance**	**Qualifier (detected results)**	**Qualifier (non-detect results)**	**Applied To:**
MS/MSD	LCL ≤ %R ≤ UCL	None	None	NA
	%R > UCL	**J+**	None	Specific analyte in associated parent sample
	%R < LCL	**J-**	**UJ**	Specific analyte in associated parent sample
	%R < 10%	**J-**[1]	**Q**	Specific analyte in associated parent sample

Notes:

MS	matrix spike	MSD	matrix spike duplicate
LCL	lower control limit	UCL	upper control limit
%R	percent recovery		

Exceptions:

1) When the MS/MSD spiking concentration is less than the native analyte concentration in the parent sample, MS/MSD recovery failures are not used to qualify data. Because of the way that MS/MSD recovery is calculated, the laboratory cannot reliably recovery a relatively low spiking concentration on top of a relatively high native analyte concentration.

2) Similar to surrogate spikes (Section 3.4.3), recovery information may not be relevant if a sample is excessively diluted. If an MS/MSD was diluted greater than 10-fold following spiking, MS/MSD recovery failures are not considered to affect data quality.

2.4.3 Matrix and Post-Digestion Spikes (Inorganics)

MS/MSDs are typically required for inorganic analyses. Where required, additional sample volume must be collected and submitted to the laboratory for preparing the MS/MSDs, and the laboratory should prepare and analyze at least one MS/MSD per preparatory batch of no more than 20 samples. Only those MS/MSDs prepared from field samples from the project are reviewed for purposes of data validation for that project.

A post-digestion spike (PDS), also referred to as a bench spike, is the addition of a known concentration and volume of an analyte standard to a processed sample (one which has already undergone digestion and other preparatory procedures), by this time usually in the form of a highly acidic solution (or digestate), in order to test the measured recovery against the known true value. This is done as a way of checking and trouble-shooting MS recovery results which fell outside applicable control limits. The PDS is used to investigate the reason for the failed MS (or MSD) recovery, which may have been due to a matrix effect, an error during analysis, an interference by another analyte in the digestate, or other cause. MS and PDS recovery is always evaluated together.

When an MS (or MSD) recovery falls outside of control limits and the sample native analyte concentration is less than 4 times the MS spiking concentration, a PDS must be performed (if the native concentration was equal to or greater than four times the MS spiking concentration, a post digestion spike is not required). The reviewer will confirm the concentration of the PDS is at least twice the concentration of analyte in the sample or twice the contract required quantitation limit (CRQL), whichever is greater. The reviewer will then compare MS/MSD and PDS recovery to accuracy MQOs to evaluate for potential matrix interference. Table 7 presents data qualification criteria for MS/MSD and PDS recovery for inorganic analyses.

The reviewer should use professional judgement to determine which samples are affected by MS/MSD recovery failures. In general, failures are only considered to affect the parent sample (the sample spiked for the MS/MSD). However, if samples were collected from an environment of uniform and relatively homogenous matrix (i.e. the same surface water body or groundwater aquifer), qualification of all field samples of similar matrix may be warranted, particularly if multiple MS/MSDs from that matrix exhibit similar matrix interference.

Table 7. Data Qualification Criteria – Matrix and Post-Digestion Spikes (Inorganics)

Performance Criteria	Criteria Variance	Qualifier (detected results)	Qualifier (non-detect results)	Applied To:
Post-Digestion Spike[1] (Bench Spikes)	LCL ≤ MS/MSD %R ≤ UCL	None	None	NA
	MS/MSD %R < 30% *and* PDS %R < LCL	**J-**	**Q**	Use sample associations of MS/MSD parent sample
	MS/MSD %R < 30% *and* PDS %R > LCL	**J**	**UJ**	Use sample associations of MS/MSD parent sample
	MS/MSD %R < LCL *and* PDS %R < LCL	**J-**	**UJ**	Use sample associations of MS/MSD parent sample
	MS/MSD %R ≤ LCL *and* PDS %R > LCL	**J**	**UJ**	Use sample associations of MS/MSD parent sample
	MS/MSD %R > UCL *and* PDS %R > UCL	**J+**	NA	Use sample associations of MS/MSD parent sample
	MS/MSD %R > UCL *and* PDS %R < UCL	**J**	NA	Use sample associations of MS/MSD parent sample

Notes:

[1] The post-digestion criteria listed in the above table assume the native analyte concentration was less than 4 times the MS spiking concentration.

MS	matrix spike
MSD	matrix spike duplicate
PDS	post-digestion spike
LCL	lower control limit
UCL	upper control limit
%R	percent recovery

2.4.4 Surrogate Spikes

Surrogates are organic compounds chemically similar to the analytes being determined by a given method. The surrogates are introduced (spiked) into a field or laboratory QC sample prior to sample preparation and analysis. They are used to identify matrix interference and/or inefficiencies during sample extraction for organic analyses. Accuracy is expressed as a percent recovery of the spiked amount added to the sample.

The reviewer will check that surrogates were reported for each sample for organic analyses. Surrogate recovery will be compared to MQOs. In the absence of project-specific MQOs, laboratory control chart limits will be used to evaluate surrogate recovery.

Table 8 presents data qualification criteria for surrogate recovery. Surrogate recovery failures affect data for those analytes most closely associated with the surrogate. Laboratories maintain lists of which analytes most closely associate with a given surrogate – these lists should be obtained and used to determine which results to qualify.

If multiple surrogates grossly exceed recovery criteria, then a spiking error may be suspected, and more severe data qualification may be necessary.

Table 8. Data Qualification Criteria – Surrogate Spikes

Performance Criteria	**Criteria Variance**	**Qualifier (detected results)**	**Qualifier (non-detect results)**	**Applied To[1]:**
Surrogate Spikes	LCL ≤ %R ≤ UCL	None	None	NA
	%R > UCL	**J+**	None	All analytes associated with the surrogate (see above)
	%R < LCL	**J-**	**UJ**	All analytes associated with the surrogate (see above)
	%R < LCL *and* %R < 40% (purge-and-trap organics) *or* %R < 20% (extractable organics)	**J-[1]**	**Q**	All analytes associated with the surrogate (see above)

Notes:
[1] See exception 1, below

LCL	lower control limit
UCL	upper control limit
%R	percent recovery

Exceptions:

- 1) Surrogate recoveries are not considered to affect data quality when the sample or extract was excessively diluted. In general, do not qualify data for surrogate recovery failures when the dilution factor was greater than 10.

2.5 Duplicate Sample RPD (Precision)

Analytical precision is typically evaluated by calculating the relative percent difference (RPD) between duplicate results for laboratory QC sample duplicates. RPDs are calculated for LCS/LCSDs, MS/MSDs, or for some inorganic analyses, a field sample and a laboratory duplicate. At least one laboratory QC sample duplicate must be reported per preparatory batch of no more than 20 samples.

Overall precision is typically evaluated by calculating the RPD between field duplicate sample results. However, precision can also be evaluated using a relative standard deviation for triplicate sample results, such as in the case of samples collected using incremental sampling methodology (ISM). Such alternate approaches are beyond the scope of this SOP, and should be addressed in the project QAPP.

RPDs are calculated as follows:

RPD = ABS($D_1 - D_2$)/{($D_1 + D_2$)/2} x 100

Where: RPD = Relative percent difference
ABS() = Absolute value
D_1 = First duplicate value
D_2 = Second duplicate value

MQOs for precision should be defined in the project QAPP for laboratory QC samples and field duplicates. In the absence of project-specific MQOs, evaluate RPD against laboratory control chart limits for laboratory QC samples, and regulatory requirements or relevant standards for field duplicates. The ADEC specifies field-duplicate MQOs of 25% for air samples, 30% for water samples, and 50% for soil samples.

2.5.1 Laboratory Control Sample Duplicates

LCSDs may be used to evaluate analytical precision of a sample batch. For Alaska Methods AK101, AK102, and AK103, LCSDs are required per the method. LCS/LCSD RPD failures affect all corresponding results detected in the preparatory batch. Table 9 presents data qualification criteria for LCS/LCSD RPD.

Table 9. Data Qualification Criteria – Laboratory Control Sample Duplicates

Performance Criteria	Criteria Variance	Qualifier (detected results)	Qualifier (non-detect results)	Applied To:
LCS/LCSD	RPD ≤ CL	None	None	NA
	RPD > CL	**J**	None	Specific analyte in associated preparatory batch

Notes:

CL	control limit
RPD	relative percent difference

2.5.2 Matrix Spike Duplicates

MSDs are often used to evaluate analytical precision of a sample batch. For many DoD projects, MS/MSDs are collected at a frequency of one per 20 field samples, and analyzed and reported with each preparatory batch. For organic analyses where an LCSD was not reported, the MS/MSD RPD is the primary measure of analytical precision. MS/MSD RPD failures may be caused by issues of reproducibility in the analytical procedure, or by significant matrix interference. The reviewer should use professional judgement to determine which sample results are qualified based on MS/MSD RPD failures. In general, failures are only considered to affect the parent sample (the sample spiked for the MS/MSD). However, if samples were collected from an environment of uniform and relatively homogenous matrix (i.e. the same surface water body or groundwater aquifer), qualification of all field samples of similar matrix may be warranted, particularly if multiple MS/MSDs from that matrix exhibit similar matrix interference. Further, if the MS/MSD RPD is the only measure of batch precision (no LCSD was reported) and there is no other evidence of matrix interference, qualification of all samples in the preparatory batch may be warranted. Table 10 presents data qualification criteria for LCS/LCSD RPD.

Table 10. Data Qualification Criteria – Matrix Spike Duplicates

Performance Criteria	Criteria Variance	Qualifier (detected results)	Qualifier (non-detect results)	Applied To[1]:
MS/MSD	RPD ≤ CL	None	None	NA
	RPD > CL	**J**	None	Specific analyte in associated parent sample

Notes:
[1]See discussion, above
CL control limit
RPD relative percent difference

Note that while MS/MSD recovery failures are not used to flag data when the spiking concentration is low compared to the native analyte concentration, this is not the case for MS/MSD RPD failures. The ratio of the native analyte concentration to the spiking concentration should have no impact on MS/MSD precision, since the RPD is calculated based on the effective sum of the two (the final analyte concentration for the MS and the MSD).

2.5.3 Field Duplicates

Field duplicates are duplicate samples collected from the same location at the same time as the primary field sample. The duplicate sample will have a “dummy” sample number and time, and is submitted to the lab as a regular field sample (i.e. the duplicate is submitted “blind”). Field duplicate RPDs are used to evaluate the reproducibility of the sampling technique, as well as precision the subsequent laboratory analysis. Heterogeneity in the sample matrix may drive field duplicate RPD failures; thus, RPD failures are not necessarily indicative of analytical imprecision.

The reviewer will calculate a field duplicate RPD using the detected concentration of the primary and duplicate sample, and compare it to project MQOs. Field duplicate RPD failures are generally considered to only affect data quality for the primary sample and the field duplicate. However, professional judgement should be used, and if repeated field duplicate RPD failures are exhibited for a given sample matrix and sampling method, this may indicate a systematic issue with sampling reproducibility or a heterogenous sample matrix. In this case, qualification of additional sample results may be warranted.

Field duplicate results will also be compared for agreement between the primary and duplicate samples where one of the duplicate results is not detected. In these cases, if one result is above the LOQ and one is not detected, the detected result will be qualified ‘**J**’ and the non-detect result will be qualified ‘**UJ**’ to indicate the results are lacking precision due to disagreement between primary and duplicate sample results. Table 11 presents data qualification criteria for field duplicates.

Table 11. Data Qualification Criteria – Field Duplicates

Performance Criteria	Criteria Variance	Qualifier (detected results)	Qualifier (non-detect results)	Applied To[1]:
Field Duplicates	RPD ≤ CL	None	None	NA
	PS < DL *and* FD > LOQ *or* FD < DL *and* PS > LOQ	**J**	**UJ**	Specific analyte in associated primary sample and field duplicate
	RPD > CL	**J**	None	Specific analyte in associated primary sample and field duplicate

Notes:

[1] See discussion, above

CL	control limit
RPD	relative percent difference
PS	primary sample
FD	field duplicate

3.0 Data Validation Reports

Data validation findings will be presented in either a brief DQA or a detailed CDQR, depending on project requirements and complexity. Data verification findings may also be included in the DQA or CDQR, and recommendations are made to guide the reader in considering data verification and validation findings as part of the subsequent data usability assessment. However, the DQA does not constitute an assessment of data usability in and of itself.

The data validation report describes the dataset that was validated, describes the level of data validation, and notes any deviations from the QAPP relevant to data validation. Data validation findings are discussed for each relevant QC category listed in Section 2.0, and qualifications made to the data based on QC failures are described and justified. The analytical sensitivity summary table (Section 2.2) and a detailed table summarizing all qualified data are presented as attachments to the report. The report summarizes the impact to data quality in the context of the six DQIs (Section 1.2). Lastly, the report makes conclusions and recommendations for considering data validation findings as part of the data usability assessment. Note that the data validation report will not make conclusions regarding data usability, as this process is conducted by the project team in the context of broader project DQOs. No data will be rejected through data validation, and thus a completeness score will not be calculated. Rather, the data validation report summarizes impacts to data quality and potential impacts to data usability so that the data user can make an informed decision on the usability of data of compromised quality during project decision-making.

The following is an example outline of a DQA. A CDQR contains the same elements, but documents the process of data validation to a greater level of detail.

Data Quality Assessment – Example Outline

Header includes:

- Date
- Project Name
- Laboratory(s)
- Sample Delivery Groups (laboratory work orders)
- Name and title of reviewer
- Name and title of approver (generally the project chemist)
- Name and address of client

1. Introduction
    a. Sample Analysis Summary
2. Data Verification Findings
3. Data Validation Findings
    a. Sample Custody, Handling and Preservation, and Holding Times
    b. Analytical Sensitivity
    c. Method Blanks
    d. Trip Blanks
    e. Laboratory Control Samples
    f. Matrix Spikes and Duplicates
    g. Surrogate Recovery
    h. Field Duplicates
    i. Other QC Anomalies (e.g. Stage 2B anomalies reported in the case narrative, or other anomalies not falling into the above categories)
    j. Resolution of Multiple Flags
4. Summary of Data Quality (includes recommendations for data usability, in the context of the six DQIs)
    a. Precision
    b. Accuracy
    c. Representativeness
    d. Sensitivity
    e. Comparability
    f. Completeness
5. Conclusions and Limitations

Table 1 – Summary of Qualified Results
Table 2 – Analytical Sensitivity Summary

4.0 References

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Attachment 1

Table A-1. Combined Data Qualification Criteria

Performance Criteria	**Criteria Variance**	**Qualifier (detected results)**	**Qualifier (non-detect results)**	**Applied To:**
Sample Temperature	Sample temperature ≤ 6°C	None	None	Not applicable (NA)
	Sample temperature ≤ 0°C and ice present (water samples only)	**J**	**UJ**	All samples with ice present
	Sample temperature > 6°C	**J-**	**UJ**	All samples in cooler with elevated temperature
	Sample temperature > 10°C (volatile analytes only)	**J-**	**Q**	All samples in cooler with elevated temperature
Sample Preservation	Sample adequately preserved	None	None	NA
	Sample pH outside required limits	**J-**	**UJ**	All samples with pH outside limits (review bottle list)
Sample Condition	Samples received in good condition	None	None	NA
	Headspace: bubbles > 2 mm in vials used for VOC analysis	**J-**	**UJ**	All analytes if bottle with headspace is used in analysis (review bottle list)
	Sample received in compromised condition (broken lid, leaking container, soil samples with insufficient MeOH, etc.)	Use professional judgement	Use professional judgement	Use professional judgement
Holding Time	Sample HT ≤ technical HT	None	None	NA
	Sample HT > technical HT	**J-**	**UJ**	All results reported from analysis with HT exceedance
	Sample HT > 2x technical HT (gross holding time exceedance)	**J-**	**Q**	All results reported from analysis with HT exceedance
Method Blanks, Trip Blanks, and Equipment Blanks	Blank < DL	None	None	NA
	Blank > DL *and* DL < Sample < 10xBlank	**B**	None	Individual results for associated samples[1]

Performance Criteria	**Criteria Variance**	**Qualifier (detected results)**	**Qualifier (non-detect results)**	**Applied To:**
LCS/LCSD Accuracy	LCL ≤ %R ≤ UCL	None	None	NA
	%R > UCL	**J+**	None	Specific analyte in associated preparatory batch
	%R < LCL	**J-**	**UJ**	Specific analyte in associated preparatory batch
	%R < LCL *and* %R < 60% (inorganics) *or* %R < 40% (purge-and-trap org.) *or* %R < 20% (extractable organics)	**J-**	**Q**	Specific analyte in associated preparatory batch
MS/MSD Accuracy	LCL ≤ %R ≤ UCL	None	None	NA
	%R > UCL	**J+**	None	Specific analyte in associated parent sample[3]
	%R < LCL	**J-**	**UJ**	Specific analyte in associated parent sample[3]
	%R < 10%	**J-**[1]	**Q**	Specific analyte in associated parent sample[3]
Post-Digestion Spike[2] (Bench Spikes) Accuracy (Inorganics only)	LCL ≤ MS/MSD %R ≤ UCL	None	None	NA
	MS/MSD %R < 30% *and* PDS %R < LCL	**J-**	**Q**	Specific analyte in associated parent sample[3]
	MS/MSD %R < 30% *and* PDS %R > LCL	**J**	**UJ**	Specific analyte in associated parent sample[3]
	MS/MSD %R < LCL *and* PDS %R < LCL	**J-**	**UJ**	Specific analyte in associated parent sample[3]
	MS/MSD %R ≤ LCL *and* PDS %R > LCL	**J**	**UJ**	Specific analyte in associated parent sample[3]
	MS/MSD %R > UCL *and* PDS %R > UCL	**J+**	NA	Specific analyte in associated parent sample[3]
	MS/MSD %R > UCL *and* PDS %R < UCL	**J**	NA	Specific analyte in associated parent sample[3]

Performance Criteria	Criteria Variance	Qualifier (detected results)	Qualifier (non-detect results)	Applied To:
Surrogate Spike[4] Accuracy	LCL ≤ %R ≤ UCL	None	None	NA
	%R > UCL	**J+**	None	All analytes associated with the surrogate (see above)
	%R < LCL	**J-**	**UJ**	All analytes associated with the surrogate (see above)
	%R < LCL *and* %R < 40% (purge-and-trap organics) *or* %R < 20% (extractable organics)	**J-**[1]	**Q**	All analytes associated with the surrogate (see above)
LCS/LCSD Precision	RPD ≤ CL	None	None	NA
	RPD > CL	**J**	None	Specific analyte in associated preparatory batch
MS/MSD Precision	RPD ≤ CL	None	None	NA
	RPD > CL	**J**	None	Specific analyte in associated parent sample[4]
Field Duplicate Precision	RPD ≤ CL	None	None	NA
	PS < DL *and* FD > LOQ *or* FD < DL *and* PS > LOQ	**J**	**UJ**	Specific analyte in primary sample and field duplicate[5]
	RPD > CL	**J**	None	Specific analyte in primary sample and field duplicate[5]

[1] Refer to individual blank sections (below) for discussion of which samples to qualify

[2] The post-digestion criteria listed in the above table assume the native analyte concentration was less than 4 times the MS spiking concentration.

MS matrix spike

[3] MS/MSD recovery and RPD failures typically only affect data quality for the MS/MSD parent sample. However, if samples were collected from an environment of uniform and relatively homogenous matrix (i.e. the same surface water body or groundwater aquifer), qualification of all field samples of similar matrix may be warranted, particularly if multiple MS/MSDs from that matrix exhibit similar matrix interference.

[4] Surrogate recoveries are not considered to affect data quality when the sample or extract was diluted beyond a dilution factor of 10.

[5] Field duplicate RPD failures are generally considered to only affect data quality for the primary sample and the field duplicate. However, professional judgement should be used, and if repeated field duplicate RPD failures are exhibited for a given sample matrix and sampling method, this may indicate a systematic issue with sampling reproducibility or a heterogenous sample matrix. In this case, qualification of additional sample results may be warranted.

°C	degrees Celcius
%R	percent recovery
CL	control limit
LCL	lower control limit
DL	detection limit
HT	holding time
LOD	limit of detection
LOQ	limit of quantitation
MeOH	methanol
MS	matrix spike
MSD	matrix spike duplicate
PDS	post-digestion spike
NA	not applicable
Notes:	
mm	millimeters
RPD	relative percent difference
VOC	volatile organic compound