## REMEDIAL INVESTIGATION WORK PLAN Helping Hands Food Bank, Hardin, Montana PHASE II ENVIRONMENTAL SITE ASSESSMENT

Beartooth Resource Conservation and Development Brownfields Assessment

> MT DEQ Facility ID # 02-13259 TREADS ID # 17849 Release ID # 2031 Work Plan ID # 34889



Revision 1

May 2025

### **TABLE OF CONTENTS**

1.0 PROJECT PURPOSE	1
1.1 SITE LOCATION AND CURRENT CONDITIONS	2
1.2 BACKGROUND	2
1.2.1 PROBLEM DEFINITION	4
1.2.2 SAMPLING APPROACH	5
1.3 PROJECT/TASK DESCRIPTION	7
1.4 RESOURCE AND TIME CONSTRAINTS	8
1.5 PERSONNEL RESPONSIBILITIES AND TRAINING REQUIREMENTS	8
2.0 PROJECT/TASK ORGANIZATION AND CONTACTS	8
3.0 DATA GENERATION/ACQUISITION	10
3.1 SOIL BORING AND SAMPLING	10
3.2 GROUNDWATER MONITORING WELL INSTALLATION	11
3.3 GROUNDWATER MONITORING AND SAMPLING	11
3.4 SOIL GAS SAMPLING	12
3.5 TROUBLESHOOTING	14
3.6 CRITICAL INFORMATION	14
3.7 SOURCES OF VARIABILITY	14
4.0 ANALYTICAL METHODS	14
4.1 FIELD EQUIPMENT, CALIBRATION, AND FREQUENCY	23
4.2 STANDARD OPERATING PROCEDURES FOR DATA COLLECTION	23
4.3 STANDARD OPERATING PROCEDURES FOR NON-STANDARD METHODS	23
4.4 FIELD SUPPLIES AND CONSUMABLES	23
4.5 PROJECT QUALITY CONTROL SAMPLES	23
4.6 INVESTIGATION-DERIVED WASTE	23
4.7 DATA MANAGEMENT	24
4.8 PROJECT REPORTING	24
5.0 REFERENCES	24

### TABLES

TABLE 1: FIELD PERSONNEL AND SUBCONTRACTOR TRAINING REQUIREMENTS	26
TABLE 2: ANALYTICAL SOP REQUIREMENTS	27
TABLE 3: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION	28
TABLE 4: PROJECT SAMPLING SOPS	29
TABLE 5: FIELD SUPPLIES AND CONSUMABLES CHECKLIST	30
TABLE 6: FIELD QUALITY CONTROL SAMPLE SUMMARY	31
TABLE 7: INVESTIGATION-DERIVED WASTE	32
TABLE 8: SOFTWARE AND FORMS	33

### **FIGURES**

FIGURE 1: VICINITY MAP	.35
FIGURE 2: SITE MAP	.36
FIGURE 3: PREVIOUS SAMPLING LOCATIONS (2023)	.37
FIGURE 4: PROPOSED SAMPLING LOCATIONS	.38

### **EXHIBITS**

EXHIBIT 1: USE OF EXISTING DOCUMENTATION AND DATA	3
EXHIBIT 2: MEDIA, SAMPLING STRATEGY, AND SAMPLING RATIONALE	6
EXHIBIT 3: PROJECT ACTIVITIES AND TIMELINE	7
EXHIBIT 4: DISTRIBUTION/CONTACT LIST	9
EXHIBIT 5: SAMPLING LOCATION AND METHODS AND SOPS1	6
EXHIBIT 6A: ANALYTICAL GROUPS, REPORTING LIMITS, AND SCREENING LEVELS FOR SOIL.1	7
EXHIBIT 6B: ANALYTICAL GROUPS, REPORTING LIMITS, AND SCREENING LEVELS FOR GROUNDWATER	9
EXHIBIT 6C: ANALYTICAL GROUPS, REPORTING LIMITS, AND SCREENING LEVELS FOR SOIL VAPOR	0

### **APPENDICES**

APPENDIX A: EPA REGION 8 QC CROSSWALK APPENDIX B: SITE-SPECIFIC STANDARD OPERATING PROCEDURES

### ACRONYMS/ABBREVIATIONS

°C	Degrees Celsius
µg/dL	Micrograms per deciliter
µg/L	Micrograms per liter
$\mu g/m^3$	Micrograms per cubic meter
ACRES	Assessment, Cleanup, and Redevelopment Exchange System
APH	Air phase hydrocarbons
ASTM	ASTM International
bgs	Below ground surface
CFR	Code of Federal Regulations
СО	Carbon monoxide
COC	Contaminant of concern
COPC	Contaminant of potential concern
DEQ	Montana Department of Environmental Quality
DQO	Data quality objective
DUP	Duplicate
EPA	U.S. Environmental Protection Agency
EPH	Extractable petroleum hydrocarbons
ESA	Environmental Site Assessment
FB	Field blank
GNSS	Global navigation satellite system
GPS	Global positioning system
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response Standard
HHS	Human Health Standard
$H_2SO_4$	Sulfuric acid
IDW	Investigation-derived waste
LBP	Lead-based paint
LEL	Lower explosive limit

MCL	Maximum Contaminant Level
mg/kg	Milligrams per kilogram
mL	Milliliter
mL/min	Milliliters per minute
MS/MSD	Matrix spike/matrix spike duplicate
MTBE	Methyl-tert butyl ether
NA	Not applicable
NIST	National Institute of Standards and Technology
02	Oxvgen
ORP	Oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
OZ	Ounce
PAH	Polycyclic aromatic hydrocarbon
PID	Photoionization detector
ppm	Parts per million
PQL	Practical Quantitation Limit
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
DDCI	Dick Decad Screening Level
	Risk-Dased Scieening Level
REC	Recognized Environmental Condition
DI	Recognized Environmental Condition
KL DSI	Reporting Limit
KSL	Regional Screening Level
SAP	Sampling and Analysis Plan
SIM	Selective Ion Monitoring
SiO <sub>2</sub>	Silicon dioxide
SOP	Standard Operating Procedure
SVOC	Semivolatile organic compound
TBA	Targeted Brownfields Assessment
TBD	To be determined
TCLP	Toxicity Characteristic Leaching Procedure
Tetra Tech	Tetra Tech Inc
1000 1000	10114 10011, 1110.

THQ	Target Hazard Quotient
ТО	Toxic Organics
TPH	Total petroleum hydrocarbons
USCS	Unified Soil Classification System
UST	Underground storage tank
VOC	Volatile organic compound
VPH	Volatile petroleum hydrocarbons

## Sampling and Analysis Plan Approval Sheet

Sampling and Analysis Plan (SAP) for Beartooth RC&D Brownfields Assessment, Phase II Environmental Site Assessment Remedial Investigation Work Plan – Helping Hands Hardin, Tetra Tech, Inc. Work Order Number: 2025-1

#### **Document Title**

Brandon Kingsbury – Tetra Tech, Inc.

Preparer's Name and Organizational Affiliation

825 W Custer Avenue, Helena, MT 59602 Tetra Tech, Inc. Email: Brandon.Kingsbury@tetratech.com Telephone: 406.437.9869

Preparer's Address, Telephone Number, and E-mail Address

Brandon Kingsbury

Tetra Tech, Inc. Project Manager

#### EPA Approval Signature:

Stephanie Shen

**EPA Region 8 Brownfields Project Manager** 

Beartooth RC&D Approval Signature:

Nan Knight

**Beartooth RC&D Finance Director** 

Signature of this page constitutes EPA approval of the SAP, but not the Health and Safety Plan (HASP). Tetra Tech HASPs are prepared and approved internally by Tetra Tech, Inc.

Signature/Date

Signature/Date

Signature/Date

#### **1.0 PROJECT PURPOSE**

Beartooth RC&D, on behalf of the property owner Helping Hands Food Bank, is providing assistance through Beartooth's Brownfields Assessment Program to complete a Brownfields Phase II Environmental Site Assessment (ESA) Remedial Investigation at the Helping Hands Food Bank (the Site, Figure 2). Tetra Tech, Inc. has prepared this Sampling and Analysis Plan (SAP) for Beartooth RC&D, the property owner Helping Hands Food Bank, and the Montana Department of Environmental Quality (DEQ) Petroleum Tank Cleanup Section, to guide environmental data collection and analysis during the Phase II Environmental Site Assessment (ESA). Preparation of this SAP proceeded under Contract Number 2025-1 and a DEQ work plan request. The Site is the Helping Hands Food Bank property located at 825, 815, 811, 807, and 805 3<sup>rd</sup> Street, West, in Hardin, Big Horn County, Montana (Figure 1). For regulatory purposes, the former gas station and petroleum Release associated with the property has been issued DEQ Facility ID 02-13259 (TREADS ID 17849), Release ID # 2031.

The owner, Helping Hands Food Bank, is interested in redeveloping the Site and is required by DEQ to investigate release 2031 for eventual cleanup. Per DEQ's work plan request (Work Plan ID 34889), the remedial investigation will include the following scope of work:

- 1. Investigate the extent and magnitude of contamination associated with the southern dispenser island. This will include the installation of five soil borings. One soil boring will be installed west of previously installed temporary monitoring well MW-02 near the western end of the former dispenser island. One soil boring will be installed to the southwest of former monitoring well MW-02. One soil boring will be installed in the same area as MW-02. One soil boring will be installed southeast of monitoring well MW-02, and one soil boring will be installed NE of monitoring well MW-02.
- 2. Based on observations of contamination during soil boring activities, four of the five soil borings will be completed as permanent 2" monitoring wells with flush mount covers to allow for vehicle traffic. Soil borings chosen as monitoring wells will include a source well, cross gradient well(s), and downgradient well(s).
- 3. Soils will be field screened with a Photoionization Detector (PID) and discrete soil samples will be collected from the interval with highest impacts based on field observations and the soil-groundwater interface. If impacted soil is observed from 0'-2' a surface soil discrete sample will also be collected.
- 4. Soil samples will be submitted to the selected analytical laboratory for EPH Screen with potential fractionation, and VPH.
- 5. Once wells are installed and developed, Tetra Tech will allow for at least 24 hours of equilibration before sampling. Groundwater samples will be collected semi-annually during high and low groundwater for one year.
- 6. Groundwater samples will be submitted for EPH and VPH.
- 7. Static water level measurements will be obtained in all new wells and existing monitoring well MW-05 during both monitoring events.
- 8. DEQ will determine whether additional soil vapor and indoor air investigation will be required as part of this scope of work to address vapor intrusion concerns discovered during the 2023 Phase II ESA.
- 9. Tetra Tech will complete project reporting to include a Remedial Investigation report to cover the soil investigation and first round of groundwater monitoring and a follow up Groundwater monitoring report to detail the findings of the second groundwater monitoring event.

Preparation of this SAP accorded with Beartooth RC&Ds Brownfields Assessment Quality Assurance Project Plan (QAPP) (Tetra Tech 2024). Exhibits detailing site-specific and general procedures can be found

within the text portion of this SAP and tables and figures follow the references in section 5.

### **1.1 SITE LOCATION AND CURRENT CONDITIONS**

The Site is an approximately 1.13-acre area comprised of six parcels in a commercial corridor in Hardin, Big Horn County, Montana. The geographic coordinates at the approximate center of the Site are 45.731605 degrees north latitude and -107.620171 degrees west longitude. The Site is on the west side of Hardin in a corridor of light commercial zoning surrounded by residences. The Site is currently developed as a food bank but was formerly a gas station that was built in 1958. The former gas station operated for an unknown amount of time and discontinued operation prior to the inception of underground storage tank rules in 1988. The food bank expanded the original 1,400 square foot gas station building with remodels between 2006 and 2015 and the expansion has increased the footprint of the building to the north by an additional 3,000 square feet. The Site consists primarily of unpaved, compacted gravel and a community garden with raised beds on the east of the property, a concrete pad directly south of the building, and compacted gravel on the west of the property. The Site contains evidence of former dispensers and underground tanks (i.e., concrete cut-outs of two dispenser islands and three cut and filled concrete circles indicative of former tank fill ports).

### **1.2 BACKGROUND**

The Facility was developed originally as a Bair's Service Station that operated from 1954 until 1965, when fueling operations ceased. Two USTs were reportedly removed in the 1960's. A third UST and underground piping were removed in December 1993. Underground piping left in place after the UST removal in December 1993 was removed in September 1995. The property was acquired by Pepsi-Cola Bottling Company in 1970. The property was sold in the late 1990's or early 2000's and is currently owned by Helping Hands of Hardin. The Site operated as a former gas station prior to state regulations governing permitting and compliance of underground storage tanks (UST). Based on a reconnaissance of the former gas station building and surface features, which included observations of concrete cut-outs of two dispenser islands and three cut and filled concrete circles indicative of UST fill ports, evidence indicates the presence of at least three large USTs and two dispenser islands, which agrees with historical knowledge of the site.

The former Pepsi Co. facility associated with the onsite historical gas station and eastern portion of the Site is a registered Leaking Underground Storage Tank (LUST) site with the DEQ Petroleum Tank Cleanup Section (PTCS). The historical fuel system and Release has been listed as TREADS ID 17849, Facility ID # 02-13259, and Release ID # 2031. The release was confirmed in January 1994 after removal of one UST and associated piping used for diesel storage resulted in the discovery of diesel contamination in December of 1993. Petroleum-stained soil was reported in the UST basin. Concentrations of petroleum hydrocarbons detected in soil samples collected during over excavation of the UST basin exceeded DEQ risk-based screening levels. Investigative excavations of the former UST basin and the diesel dispenser island were completed in 1994 that indicated the need for further cleanup in these areas. In July of 1994, eight soil borings were advanced to investigate the former UST basin and diesel dispenser island and three borings (BSH-1, BSH-2, and BSH-3) were converted to monitoring wells. All three monitoring wells were sampled in January and July of 1995 and did not exceed RBSLs or Human Health Standards.

In September of 1995, approximately 1,230 cubic yards of petroleum impacted soil was excavated to approximately 9 feet below ground surface (bgs) at the former diesel island and to approximately 13 feet bgs in the former UST basin, test pits TP-1 and TP-2 were completed, and underground piping that remained in place after December 1993 was removed. The soil was transported to a permitted one-time land farm for treatment. Confirmation soil samples collected at depths ranging from approximately 4 to 13 feet bgs were analyzed for GRO and DRO. Soil RBSLs were not exceeded. TP-1 was used to delineate the eastern edge of the former UST basin prior to excavation and TP-2 was used to assess for petroleum impacted soil that may have been in contact with the sanitary sewer, located downgradient of the UST basin. Petroleum impacted soil was not observed in TP-2. (DEQ 2020)

Based on the successful excavation of the UST basin and diesel dispenser island, and three rounds of groundwater monitoring indicating concentrations below regulatory standards, Release 2031 was closed by DEQ and issued a No Further Corrective Action letter in 2020.

In 2022 Helping Hands Food Bank approached EPA Region 8 for a Target Brownfields Assessment in order to redevelop the onsite structure and convert a large portion of the property into a community garden. In response a Phase II ESA was completed that included a geophysical survey to locate any subsurface features associated with historical fueling systems and subsequent soil sampling and groundwater sampling. During the investigation six soil borings were advanced with three soil borings (MW-01, SB-01, and SB-02) advanced to 20 feet bgs and three soil borings (MW-02, MW-03, and MW-04) advanced to 25 feet bgs. Four of the six soil borings were converted to temporary groundwater monitoring wells (MW-01, MW-02, MW-03, and MW-04). Existing well BSH-2 was also sampled and given the name MW-05 as part of the assessment. Soils and groundwater were sampled for Volatile Petroleum Hydrocarbons (VPH), Extractable Petroleum Hydrocarbons (EPH), EPA method 8260b shortlist for VOCs, EPA method 8151 for Chlorinated Herbicides, and EPA method 8081 for chlorinated pesticides. Samples were also submitted for EPA SW-846 Method 8011 for EDB, and for RCRA 8 metals via SW-846 Method 6020b. (Tetra Tech 2023)

Visual and olfactory observations of gasoline contamination in soil core samples and analytical results from the soil and groundwater sampling indicated that there was a gasoline release associated with the southern dispenser island (soil boring MW-02 and groundwater sample HH-GW-02) with exceedances of C5-C8 aliphatics and benzene in soil, and C5-C8 aliphatics, C9-C12 aliphatics, and benzene in groundwater. Based on the initial observations a 24-hour release report was called into DEQ's PTCS and the release was confirmed upon receipt of lab analytical data. As the Release was discovered during investigation of the former PepsiCo Release # 2031, the Release was reopened in accordance with DEQ's release numbering rules.

In response to the newly discovered contamination associated with release # 2031, on June 13, 2024, Jonathan Love of DEQ's PTCS requested a remedial investigation of the southern dispenser island and surrounding soils and groundwater to define the extent and magnitude of soil and groundwater impacts.

Helping Hands Food Bank has reached out to Beartooth RC&Ds Brownfields Assessment Program for assistance in completing this investigation and this Phase II ESA SAP (WPID 34889) is provided to guide the remedial investigation per DEQ's request.

Exhibit 1 summarizes existing data pertaining to the Site, and applicability and use of these data within the current project scope.

Reference for Data Source	Date Published	Summary of Scope	Data Type	Data Meets Current Quality Objectives (Yes/No)	Data Use (Qualitative/ Quantitative)
Phase II ESA	December 2023	Soil, groundwater, soil gas, and hazardous building materials assessment	Soil, soil gas, groundwater, asbestos, lead, and metals analytical data.	Yes	Qualitative and Quantitative

#### EXHIBIT 1: USE OF EXISTING DOCUMENTATION AND DATA

Reference for Data Source	Date Published	Summary of Scope	Data Type	Data Meets Current Quality Objectives (Yes/No)	Data Use (Qualitative/ Quantitative)
Phase II ESA Geophysical Survey	November 2022	Geophysical survey results from surveying event	Ground penetrating radar data and electromagnetic induction data	Yes	Quantitative
DEQ TREADS Database	Inquiry- March, 2022, Ongoing	Release status and location	Administrative Record	Yes	Qualitative
DEQ Petroleum Tank Cleanup Section – Closure Report for Petroleum Release	May 19, 2020	Concise presentation of remedial actions to support closure of Release 2031.	Technical report summary for corrective actions related to release 2031	Yes	Qualitative and Quantitative

Notes:

DEQ Montana Department of Environmental Quality

ESA Environmental Site Assessment

#### **1.2.1 PROBLEM DEFINITION**

The property owner Helping Hands Food Bank has requested Beartooth RC&D and Petrofund (PTRCB) assistance to conduct a Phase II ESA remedial investigation for reuse of the Site for commercial use associated with the food bank operations and residential use associated with the proposed community garden. DEQ tasked Tetra Tech with determining the nature and extent of contaminants of potential concern associated with:

- 1. Surface soil gasoline direct contact impacts associated with the southern dispenser island
- 2. Subsurface soil gasoline direct contact and leaching impacts associated with the southern dispenser island and surrounding soils
- 3. Groundwater impacts associated with historical southern dispenser island leaks.
- 4. Sub-slab soil gas and indoor air impacts associated with previously detected concentrations of perchloroethylene.

Based on past uses of the Site, the recently completed Phase II ESA, and a review of DEQ databases associated with ongoing release regulation, Tetra Tech has identified contaminants of potential concern (COPC) and potential media affected by COPCs to include surface soil, subsurface soil, groundwater, soil gas, and indoor air. Surface soil, subsurface soil, groundwater, soil gas, and indoor air sampling will provide information to the property owner, Beartooth RC&D, and DEQ to better understand risks to receptors and determine appropriate cleanup alternatives.

Objectives of the Phase II ESA are to: (1) install soil borings to investigate the extent of known contamination associated with the former southern dispenser island and surrounding soils; (2) investigate the extent and magnitude of groundwater contamination associated with the former onsite fuel system, and historical

releases; and (3) investigate sub-slab impacts from soil gas and indoor air due to potential vapor intrusion into the food bank structure.

Soil samples will be tested for the possibility of COPCs leaching to groundwater, ingestion or dermal contact with soils, and inhalation of dust or vapors. Groundwater samples will be analyzed for VPH and EPH associated with former petroleum storage and dispensing activities.

Environmental samples will be collected and analyzed against appropriate screening levels as follows:

#### Soils:

Soil samples will be compared initially to Tier 1 DEQ Risk -Based Screening Levels (RBSLs) to assess potential risks to human health and the environment (DEQ 2024). The following exposure pathways will be evaluated:

- 1. Residential and Commercial Direct Contact via discrete samples collected at 0 inches to 24 inches bgs based on visual, olfactory, and PID observations.
- 2. Industrial/Commercial Direct Contact via discrete samples collected at 0 inches to 24 inches bgs based on visual, olfactory, and PID observations.
- 3. Construction scenario direct contact via discrete samples collected from 2 feet to 10 feet bgs from soil borings based on visual, olfactory, and PID observations.
- 4. Leaching to Groundwater via discrete subsurface sampling from soil borings at the interval with highest apparent impacts based visual, olfactory, and PID readings, and the soil-groundwater interface.

#### Groundwater:

Groundwater samples will be collected, and associated data will be compared to DEQ RBSLs, and DEQ-7 Numeric Water Quality Human Health Standards (HHS) (DEQ 2019, 2024).

#### **Soil Gas Sampling:**

Soil gas samples will be compared to EPA commercial Regional Screening Levels (RSLs) and VISLs based on a Target Risk of 1 x  $10^{-6}$  and a Target Hazard Quotient of 0.1 and DEQ RSLs (EPA 2022; DEQ 2021). Concentrations will be compared to standards effective when sampling results are received.

The decision goal of this study is to provide current site data that will support decisions by the regulators and the property owner regarding environmental risk, and what estimated cleanup costs would be to use the property for commercial and residential purposes.

Data of sufficient quantity and quality must be acquired that will lead to determinations of the nature and extent of contamination vertically and horizontally. Numbers of samples of each medium are listed in Table 6 of this SAP. Duplicate samples also will be collected to evaluate method accuracy and precision.

Validation methods will be applied to verify laboratory method controls. Data results will appear in the final remedial investigation report.

#### **1.2.2 SAMPLING APPROACH**

To determine concentrations of COPCs in sub slab soil gas the media listed in Exhibit 2 will be sampled and analyzed for COPCs at an accredited laboratory. Exhibit 2 details the media to be sampled, reasons for collecting the samples, sampling strategy, and COPC groups to be analyzed.

#### EXHIBIT 2: MEDIA, SAMPLING STRATEGY, AND SAMPLING RATIONALE

Media	Sampling Rationale	Sampling Strategy	COPCs
Soil (surface) Southern Dispenser Island Area	Evaluate residential and commercial/industrial direct contact risks associated with petroleum hydrocarbons detected within 0-2 feet bgs in soil borings based on field observations.	For hydrocarbons, field screening with a PID and with visual and olfactory investigations to determine sample locations. Discrete sampling for gas and diesel- range hydrocarbons will occur within the 0-to 2-foot bgs interval.	EPH (Diesel Range Hydrocarbons) and VPH (Gas Range Hydrocarbons)
Soil (subsurface) Southern Dispenser Island Area and surrounding soils	Evaluate potential direct contact construction exposure risk and leaching risk in soil borings within the 2- to 10-feet bgs interval, at the soil groundwater interface, and at apparent worst-case intervals. Soil borings will be advanced to a maximum depth of 25 feet to accommodate deeper sampling and wells, if necessary. Waste characterization sampling.	Field screening with a PID and with visual and olfactory investigations to determine sample locations. Discrete soil sampling.	VPH (Gas Range Hydrocarbons), EPH (Diesel Range Hydrocarbons)
Air	Evaluate soil gas concentrations based on previously observed exceedances of RSLS associated with the former sub slab soil gas sample.	Employ summa cannisters and collect a grab sample from a sub-slab vapor point. Install sub-slab vapor point and allow to equilibrate for at least 24-hours prior to sampling.	Massachusetts APH (Air Phase Hydrocarbons) and TO- 15 SIM (Toxic Organics, VOCs).
Groundwater	Evaluate groundwater concentrations of petroleum hydrocarbons and potential exposure risk associated with contaminated soil originating from the former southern dispenser island. Groundwater likely at approximately 8' bgs and soil borings advanced to a maximum depth of 25' to accommodate monitoring well installation.	Groundwater sampling of existing and newly installed monitoring wells.	Massachusetts method VPH and EPH
Notes: bgs COPC	below ground surface Contaminant of potential concern		

- DEQ Montana Department of Environmental Quality
- EPH Extractable petroleum hydrocarbons
- PID Photoionization Detector
- SIM Selective Ion Monitoring
- VPH Volatile petroleum hydrocarbons

### **1.3 PROJECT/TASK DESCRIPTION**

Exhibit 3 outlines activities to occur during this project, the schedule of those activities, and roles and contact information pertaining to any participating subcontractors.

The following activities will occur to complete soil boring and sampling, groundwater sampling, soil gas, and indoor/outdoor ambient air sampling.

Activity	Specific Task	Anticipated Start Date	Anticipated Completion Date
Phase II SAP Work	Prepare Phase II ESA HASP/SAP	1/27/2025	2/14/2025
Plan Development	Phase II ESA HASP/SAP Submittal	2/14/2025	2/21/2025
Stakeholder and	Beartooth RC&D and EPA Approval	2/14/2025	2/28/2025
Regulatory Review	Helping Hands Approval	2/14/2025	2/21/2025
and Approval	DEQ and PTRCB Approval	2/28/2025	4/25/2025
	Procurement of field equipment	2/21/2025	3/15/2025
Preparation for	Procurement of utility locate	TBD	TBD
Fieldwork	Procurement of soil boring/well install contractor	1/27/2025	2/14/2025
Fieldwork	Soil boring/well installation and collection of field samples	April 28 to May 2	Initial: TBD Groundwater Monitoring: TBD
Receive Laboratory Results	Prepare Draft Phase II ESA Report	After completion of field work and receipt of analytical data	Within four weeks of receipt of analytical data from the lab.
Reporting	eporting EPA and DEQ provides comments on Draft Phase II ESA Report		Within one week of receipt of EPA and DEQ comments
Document Quality Review	Tetra Tech addresses client and stakeholder comments and finalizes Phase II ESA Report	Upon receipt of comments	Within one week of receipt of comments
Notes: DEQ Mo EPA U.S ESA Env	ntana Department of Environmental Quality 5. Environmental Protection Agency vironmental Site Assessment		

#### **EXHIBIT 3: PROJECT ACTIVITIES AND TIMELINE**

HASP Health and Safety Plan

- SAP Sampling and Analysis Plan
- TBD To be determined

### **1.4 RESOURCE AND TIME CONSTRAINTS**

Possible resource constraints for this project include:

Tetra Tech will subcontract a Montana-licensed well installation contractor for all soil boring and well installation activities on the sampling dates. Due to high local demand for contractors, field activities may depend on availability of local labor and equipment. Tetra Tech has secured the services of a licensed well installation contractor for the dates specified in this SAP.

Possible time constraints for this project include:

The Site will be in use two days a week, between the hours of 10:00 am and 5:00 pm. During this time, sampling cannot be conducted, due to high traffic on Site.

### **1.5 PERSONNEL RESPONSIBILITIES AND TRAINING REQUIREMENTS**

Table 1 summarizes personnel responsibilities and training requirements. The primary training requirements for Tetra Tech personnel engaged in field activities are the emergency response and hazardous waste operations training requirements defined in Title 29 *Code of Federal Regulations* (CFR) 1910.120. Tetra Tech personnel serving as Environmental Professionals are trained and experienced in ASTM E1527-21 and E1903-19 ESA standards. In addition, Tetra Tech personnel are trained on operation and use of sampling equipment. Additional specialized trainings or certifications related to environmental data collection are listed in Table 1. The Beartooth RC&D Brownfields Assessment programmatic QAPP lists general training requirements for personnel and the QAPP indicates responsibility for assuring training requirements are met (Tetra Tech 2024).

#### 2.0 PROJECT/TASK ORGANIZATION AND CONTACTS

Tetra Tech has prepared this SAP for Beartooth RC&Ds Brownfields Assessment program for EPA Region 8. This SAP was prepared under Contract No. 2025-1 and DEQ WPID 34889 to guide environmental data collection for the Helping Hands Food Bank (Release # 2031) Phase II Remedial Investigation in Hardin, Montana. Preparation of the SAP accorded with the programmatic Beartooth Brownfields Assessment Program QAPP (Tetra Tech 2024). Personnel listed in Exhibit 4 will be involved in planning or technical activities pertaining to the Site. The EPA Project Manager and each field team member will receive a copy of the SAP, and a copy will be retained on the Site and in the Site file.

Personnel	Title	Organization	Telephone Number	E-mail Address
Stephanie Shen*	Brownfields Project Manager	EPA Region 8	720-371-7925	Stephanie.Shen@tetratech.com
Jason Seyler	Brownfields Coordinator	DEQ	406-444-6447	jseyler@mt.gov
Jonathan Love*	Environmental Project Officer	DEQ	406-247-4450	jonathan.love@mt.gov
Brandon Kingsbury	Project Manager/Field Team Lead	Tetra Tech	406-437-9869	Brandon.Kingsbury@tetratech.com
Nan Knight	Financial Director	Beartooth RC&D	406-962-3914	nknight@beartooth.org
Sloane Realbird	Helping Hands Food Bank Executive Director	Helping Hands Food Bank	406-665-2997	Sloane.realbird@bighornvalley.org
Andrea Berry	Big Horn County - MSU Extension Services Administrator	MSU Extension Services/Helping Hands Food Bank	406-665-9774	Andrea.berry2@montana.edu
Denny Cox	Health and Safety Officer	Tetra Tech	816-412-1747	denny.cox@tetratech.com
Private Locate Subcontractor	TBD	TBD	TBD	TBD
Ethan Perro	Environmental Division Manager	Olympus Technical Services, Inc	406-430-1784	eperro@olytech.com

#### **EXHIBIT 4: DISTRIBUTION/CONTACT LIST**

#### Notes:

\*Indicates an individual whose approval of the site-specific Sampling and Analysis Plan is required. EPA U.S. Environmental Protection Agency DEQ Montana Department of Environmental Quality

TBD To be determined (on a site-specific basis)

### 3.0 DATA GENERATION/ACQUISITION

To meet the objectives of the Phase II ESA remedial investigation, media will be sampled and analyzed as described in the following sections. Sampling locations, methods, and standard operating procedures (SOP) are detailed in Exhibit 5.

### 3.1 SOIL BORING AND SAMPLING

Five soil borings will be advanced on the Site to approximately 25 feet below ground surface (bgs) to accommodate maximum vertical extent of potential petroleum contamination and groundwater monitoring well construction.

- One soil boring will be installed west of previously installed temporary monitoring well MW-02 near the western end of the former dispenser island. The location will be chosen to investigate impacts to soil and groundwater associated with former dispensing activities, and possible smear zone contamination from the groundwater plume.
- One soil boring will be installed to the southwest of monitoring well MW-02 to provide information on the upgradient to cross gradient extent of soil and groundwater contamination.
- One soil boring will be installed in the same area as MW-02 to provide soil and groundwater data from the source area. This boring will be completed as a permanent groundwater monitoring well as the previous groundwater sample from this location was obtained from a temporary well.
- One soil boring will be installed southeast of monitoring well MW-02 to capture soil and groundwater data from the downgradient extent of suspected petroleum contamination.
- One soil boring will be installed northeast of monitoring well MW-02 to provide soil and groundwater data from the downgradient or cross gradient extent of suspected petroleum contamination.
- Tetra Tech will determine which soil borings will be completed as groundwater monitoring wells based on groundwater and lithologic characteristics, visual, olfactory, and PID observations of apparent contamination.

Proposed soil boring and groundwater monitoring well locations are depicted on Figure 4, however, locations are subject to change and will be determined in the field based on site conditions, field observations, and discussion with the EPA and DEQ project manager to achieve the objectives of the investigation.

Soil borings will be evaluated and logged using the Unified Soil Classification System (USCS). Organic vapors will be monitored during boring advancement to identify impacted intervals using a photoionization detector (PID) and application of the heated headspace method. Soil samples will be split, with half of the samples placed in a heated headspace bag for field evaluation, and the other half immediately chilled for eventual sample analysis.

Within the five borings installed to 25 feet, to assess impacts on surface soil at the Site, discrete samples will be collected within the 0- to 2-foot bgs interval. Surface soil boring samples will be collected to assess:

- 1. Residential and commercial direct contact risk associated with petroleum hydrocarbons, which includes ingestion, inhalation, and dermal contact with surface soils.
- 2. Leaching to groundwater

Sampling will be biased toward worst-case surface soil sample locations, which will be determined based on visual and olfactory observations of apparent impacts and PID readings.

Subsurface soil boring sampling will be collected to assess the following risks to human health and the environment with the following protocols:

- 1. Direct contact construction risk: One discrete sample will be collected within the 2- to 10-feet bgs interval in each boring biased to intervals with highest apparent impacts to determine risk associated with ingestion, inhalation, and dermal contact with subsurface soils.
- 2. Leaching risk: As DEQ is a non-degradation state, a discrete sample will be collected at either the soil-groundwater interface and/or within the zone of apparent worst-case contamination based on visual and olfactory detections of impacts and PID readings.
- 3. For extractable petroleum hydrocarbon (EPH) composite samples, which are required by DEQ to investigate petroleum releases, Tetra Tech will collect five aliquots of equal volumes of soil and homogenize the aliquots in a mixing bowl. The homogenizing process will be considered complete when texture and color of the sample appear uniform throughout. The homogenized soil then will be transferred into sample jars, and any stones, grass, or roots from the sample will be removed. Discrete samples may also be obtained if only a select interval(s) are impacted.
- 4. Volatile petroleum hydrocarbons (VPH) aliquots will be individually jarred to reduce volatilization, preserved, and submitted to the laboratory within applicable holding times for composition and analysis. Discrete VPH samples if applicable will be immediately jarred, preserved, and submitted to the laboratory within applicable holding times for analysis.
- 5. Soil sample depth(s) and associated PID readings will be noted on the associated boring log.

Soil sample results will be evaluated in the release area by comparing to DEQ 2024 Tier I Risk-Based Screening Levels (RBSLs) for surface soil for leaching less than 10 feet to groundwater (DEQ 2024). Soil sample results will also be compared to DEQ 2024 Tier I RBSLs for subsurface soil leaching 0 to 10 feet to groundwater (DEQ 2024) based on the anticipated distance to groundwater. Direct contact risk will be evaluated by comparing surface soil samples to DEQ Tier 1 commercial RBSLs and subsurface samples to DEQ Tier 1 direct Contact Construction RBSLs (DEQ 2024).

Exhibit 6A presents the targeted analytes, analytical groups, reporting limits, and screening levels for soil.

### **3.2 GROUNDWATER MONITORING WELL INSTALLATION**

Four groundwater monitoring wells will be completed to 25 feet bgs using select soil borings. Based on a review of well logs from the existing on-site well, water level notes and lithology from the 2023 Phase II ESA, and Groundwater Information System Records (GWIC, 2024), wells will be screened between 5 and 20 feet bgs with a 15-foot screen to accommodate water levels anticipated to fluctuate between 7 and 15 feet bgs. Permanent monitoring wells will be completed by installing 2-inch diameter wells, polyvinyl chloride (PVC) blank casing and manufactured PVC screen (10-slot) in each borehole. A bentonite well seal will be extended to approximately 1-foot bgs. The wells will be developed and allowed to equilibrate with the aquifer for at least 24 hours prior to sampling. A licensed monitoring well contractor will install the monitoring wells. Installations of all wells will conform to Montana Board of Water Well Contractor Standards. Copies of the monitoring well logs will be provided as an appendix to the Phase II ESA Remedial Investigation Report.

### **3.3 GROUNDWATER MONITORING AND SAMPLING**

Based on relatively impermeable soils and to allow for sufficient recharge and equilibration with the aquifer, Tetra Tech will allow at least 24 hours following well development before attempting to sample wells. The existing monitoring well, if it can be located, will be named MW-01 and newly installed permanent wells

will be named MW-02, MW-03, MW-04, and MW-05. All viable wells will be sampled. Monitoring wells will be placed accordingly:

- 1. To investigate impacts from the previously identified source area, one monitoring well will be placed at the eastern end of the southern dispenser island. (one monitoring well)
- 2. To investigate the upgradient to cross-gradient extent of groundwater contamination one well will be placed in each boring located to the northeast and southwest of the southern dispenser island. (up to two monitoring wells)
- 3. To investigate impacts associated with the downgradient extent of contamination one to two monitoring wells will be placed to the east, northeast or southeast of the source area depending on field observations. (up to two monitoring wells)

Proposed monitoring well locations are depicted in figure 4.

Prior to sampling, Tetra Tech will obtain static water level measurements from all on-site wells to determine groundwater gradient and flow direction. Low-flow sampling will be employed to purge and sample all wells by use of a bladder pump or peristaltic pump. Well purge water flow rates will be regulated not to exceed 500 milliliters per minute (mL/min), and the tube or pump intake will be placed in the upper third of the water column. During purging, water levels will be recorded at each field parameter reading to assess drawdown. Field parameters dissolved oxygen, oxidation-reduction potential (ORP), pH, temperature, specific conductance, and turbidity will be recorded periodically by use of a flow- through cell. Purging will continue until the indicator parameters temperature, conductivity, dissolved oxygen, ORP, and pH have stabilized. Parameters are considered stabilized when three or more sequential measurements are either within  $\pm 0.2$  degrees Celsius (°C) for temperature,  $\pm 3$  percent for conductivity,  $\pm 10$  percent for dissolved oxygen, and  $\pm 0.1$  unit for pH. Groundwater samples for laboratory analysis will be collected by disconnecting the down-hole tubing from the flow-through cell and collecting the sample. If the stabilization parameters do not fall within the specified ranges after approximately three well volumes have been purged, field personnel will note on the data sheet that sample collection began after purge of three well casing volumes. If the well runs dry before the specified amount of purge water has been withdrawn, the well will be allowed to recharge for no more than 24 hours. After the well has recharged, one set of stabilization parameters will be measured, and the well will be sampled.

Groundwater samples will be submitted to the analytical laboratory for VPH and EPH screen. If the EPH screen concentration exceeds 1,000 micrograms per liter ( $\mu$ g/L), the sample will be fractionated without polycyclic aromatic hydrocarbons (PAHs). Groundwater sample results will be compared to DEQ RBSLs and HHSs (DEQ 7 Numeric Water Quality Standards).

Exhibit 6B presents the targeted analytes, analytical groups, reporting limits, and screening levels for groundwater.

### 3.4 SOIL GAS SAMPLING

Per DEQ's Montana Vapor Intrusion Guide (DEQ 2021), Tetra Tech will collect a soil gas sample to assess the vapor migration pathway at the Site. Based on previous sampling data and consultation with DEQ, DEQ will collect a sub-slab soil gas sample in the same area as the previous sample collected in 2023. Sample collection will include installation of one sub-slab soil-gas sampling point to assess accumulation of soil-gas vapors originating from the historical tank system, contaminated soil, and groundwater. A vapor point will be drilled through the sub slab to a depth of 6 inches where samples will be taken. Prior to sampling, a sterile syringe will be used to evacuate the sample train to ensure formation gas is retrieved by the sample cannister. Soil-gas grab samples will be collected at least 24-hours after sample point installation using up to a 60minute flow controller and 6-liter summa canisters. Soil-gas samples will be analyzed for Toxic Organics (TO)-15 Selective Ion Monitoring (SIM) and Massachusetts Method Air Phase Hydrocarbons (APH). A second summa cannister will be employed at the soil vapor sampling point and attached to the sampling train using a duplicate sampling "T" to obtain a duplicate soil gas sample.

Soil-gas sample results will be compared to DEQ and EPA residential and industrial RSLs using DEQ's APH Vapor Intrusion Screening Level Calculator and EPA VISLs using EPA's VISL calculator. General screening levels for initial comparison are provided in this SAP. Following sampling and analysis, DEQ and EPA VISL screening level calculators will be used to provide further screening using site-specific parameters. Results will be reported in micrograms per cubic meter ( $\mu g/m^3$ ).

Exhibit 6C presents the targeted analytes, analytical groups, reporting limits, and screening levels for air.



### **3.5 TROUBLESHOOTING**

If planned sampling areas are inaccessible because of the location of materials stored on the Site or other site features, the Field Team Leader will determine an acceptable alternate location for sample collection. If shallow refusal of sampling points is encountered, Tetra Tech will work with the subcontractor to access sampling points before contacting the DEQ or the EPA project officer to determine whether to continue at the specific location, relocate the sample location, or take another action.

Areas of the property deemed unsafe will not be entered, investigated, or sampled. Should Tetra Tech encounter such an area, the Field Team Leader will contact DEQ and the EPA project officer. Locations and conditions of any areas deemed unsafe will be recorded in the field notes and logbook.

### **3.6 CRITICAL INFORMATION**

The following information is critical to this sampling event:

- 1. Concentrations of petroleum in surface soil in borings.
- 2. Concentrations of petroleum in surface and subsurface soil and groundwater (if applicable).
- 3. Concentrations of COPCs in sub slab soil vapor.
- 4. Locations of samples to inform the conceptual site model.

### **3.7 SOURCES OF VARIABILITY**

Weather and access to targeted materials may create variability. This variability will be reconciled by the following procedures:

- 1. Unsafe areas will not be entered, investigated, or sampled. Should Tetra Tech encounter such an area, the Field Team Leader will contact the project officer, and these locations and conditions will be recorded in the field notes and logbook.
- 2. Power tools may be necessary to access surface and subsurface soil and the sub-slab space. Should access to the sub-slab space be impeded by building materials or refusal from sub-surface materials, the lack of access will be noted and a new location may be chosen to achieve the desired sampling area.
- 3. Variability will be reconciled by using project information to conduct a data usability assessment, which will identify the data quality based on validation qualifiers and metrics such as precision and accuracy. Guidance for data usability assessments is in Beartooth's Programmatic QAPP (Tetra Tech 2024). Moreover, Tetra Tech will discuss possible reasons for variability of results obtained from different areas of the Site in the Phase II ESA report.

### 4.0 ANALYTICAL METHODS

Exhibit 6 outlines the analysis methodology for 12 aqueous samples, 16 soil samples, and 2 air samples collected for the soil, soil gas, and water investigation. Samples will be analyzed for VPH, EPH Screen, and EPH fractionation without PAHs if the screening threshold (1,000  $\mu$ g/L for water; 200 mg/kg for soil) is exceeded. Soil gas samples will be analyzed for Massachusetts method APH and TO-15 SIM. In addition to the above- mentioned samples, one 5-point composite toxicity characteristic leaching procedure (TCLP) metals waste characterization sample will be collected for characterization of investigative-derived soil waste. If soil waste is generated as part of the petroleum assessment, two waste-stream characterization samples will be analyzed for TCLP RCRA 8 metals—one from any additional investigative-derived waste

(IDW) and one from a homogenized bulk materials sample. The laboratories Energy Labs, Inc of Billings, MT and ALS labs of Simi Valley, CA will be used. The laboratory contact information is 406-252-6325 for Energy Labs, and 805-526-7161 for ALS labs. Analytical SOPs and associated requirements are summarized in Table 2.

Matrix	Sampling Location/ ID Number	Location (Figure #)	Depth (If applicable)	Sampling Methods (SOP#)	Analytical Group(s)
Air	SGS-01-25 (Soil Gas) (DUP)	Figure 3 for soil gas,	Soil Gas – TBD ~6" below slab based on soil Screening criteria	SOP 074-4 SOP #1704	Mass APH TO-15 SIM
Groundwater	HH-GW-01 through HH-GW-06	Figure 3	8' - 12' bgs	Tetra Tech SOP #010	VPH EPH
Soil (surface)	HH-SB-01-0-2 through HH-SB-05-0-2 (Soil Borings)	Figure 3	0' - 2'	Tetra Tech SOP #005	VPH EPH
Soil (subsurface)	Soil (subsurface) HH-SB-01-(depth) through HH-SB- 05-(Depth) (Soil Borings)		TBD based on visual/olfactory/ PID readings.	Tetra Tech SOP #005	VPH EPH
Waste	WM-001	NA	IDW	Tetra Tech SOP #005	VPH, EPH, TCLP (RCRA 8)
QC Samples (Soil and Groundwater)	(DUP/FB)	See above	See above	See above	VPH, EPH

#### EXHIBIT 5: SAMPLING LOCATION AND METHODS AND SOPS

#### Notes:

APH	Air Phase Hydrocarbons	TCLP
DUP	Duplicate	VPH
EPH	Extractible Petroleum Hydrocarbons	WM
FB	Field Blank	
HH	Helping Hands Foodbank	
ID	Identification	
IDW	Investigative Derived Waste	
NA	Not applicable	
QC	Quality Control	
RCRA	Resource Conservation and Recovery Act	
SGS	Soil Gas Sample	
SIM	Selective Ion Monitoring	
SOP	Standard Operating Procedure	
TBD	To Be Determined	

Toxicity Characteristic Leaching Procedure Volatile petroleum hydrocarbons Waste Management

#### EXHIBIT 6A: ANALYTICAL GROUPS, REPORTING LIMITS, AND SCREENING LEVELS FOR SOIL

Matrix	Analytical Group	Analyte	Method Reporting Limit (mg/kg)	DEQ Default RBSL (mg/kg)	DEQ Tier 1 Leaching 0- 10 ft to GW (mg/kg)	General Leaching RBSLs <sup>6</sup> (mg/kg)	DEQ Direct Contact Construction RBSL (mg/kg)	Direct Contact Resident DEQ <sup>7</sup> /EPA RSL (mg/kg)	DEQ Commercial RBSL (mg/kg)	EPA Industrial RSL (mg/kg) <sup>1</sup>	Project Screening Level (mg/kg)	Is RL Below Project Screening Level?
		Benzene	0.068	0.07	0.07	NA	190	1.7	7.6	5.1	0.07	Yes
		Ethylbenzene	0.068	8.4	26	NA	1,200	8.4	38	25	8.4	Yes
Surface and Subsurface Soil		Methyl tert- Butyl Ether	0.14	0.078	0.078	NA	9,100	67	310	210	0.078	No
		Naphthalene	0.14	2.9	12	NA	120	2.9	13	8.6	25       8.4       Yes         210       0.078       No         8.6       2.9       Yes         4,700       21       Yes         250       75       Yes         450*       90       Yes         800*       160       Yes         300*       60       Yes         1,600*       290       Yes         330,000*       25,000       Yes	
	Volatile Petroleum	Toluene	0.050	21	21	NA	14,000	630	6,300	4,700	21	Yes
	Hydrocarbons	Xylenes	0.068	75	320	NA	1,900	75	330	250	75	Yes
	(VPH)	C5-C8 Aliphatics	2.0	90	220	NA	2,000	90	450	450*	90	Yes
		C9-C12 Aliphatics	2.0	160	11,000	NA	3,000	160	800	800*	160	Yes
		C9-C10 Aromatics	2.0	60	130	NA	4,000	60	300	300*	60	Yes
		EPH Screen	10.0	$200^{2}$	$200^{2}$	$200^{2}$	$200^{2}$	$200^{2}$	$200^{2}$	NA	$200^{2}$	Yes
	Extractable Petroleum	C9-C18 Aliphatics	10.0	290	53,000	NA	6,000	290	1,600	1,600*	290	Yes
	Hydrocarbons (EPH)	C19-C36 Aliphatics	10.0	25,000	Immobile	NA	1,600,000	25,000	330,000	330,000*	25,000	Yes
		C11-C22 Aromatics	10.0	370	370	NA	33,000	540	6,200	6,200*	200 <sup>2</sup> 290 25,000 370 2.9	Yes
		Arsenic	0.1	$22.5^4$	NA	2.9	NA	0.68	NA	3.0	2.9	Yes
		Barium	1.0	4294	NA	421	NA	1,500	NA	22,000	421	Yes
		Cadmium	0.01	3.8	NA	0.7	NA	0.71	NA	10	0.7	Yes
Surface Soil, Subsurface Soil.	TCLP	Chromium	0.1	12,000	NA	19	NA	12,000	NA	6.3	19	Yes
and Waste Soil	RCRA 8 Metals	Lead	0.1	2005	NA	140	NA	400	NA	696	140	Yes
(Soil Cuttings)		Mercury	0.002	1.0	NA	1.0	NA	1.1	NA	1.0	1.0	Yes
		Selenium	0.01	2.6	NA	2.6	NA	39	NA	580	2.6	Yes
		Silver	0.02	8.5	NA	8.5	NA	39	NA	580	8.5	Yes
QC	EPH	Same as above	Same as above					Same as	above			
Samples	VPH	Same as above	Same as above					Same as	above			

**Notes:** \*TPH and EPH Fraction analytical data unavailable from EPA's RSL Table. DEQ's commercial RBSL used.

<sup>1</sup> Screening levels reflect EPA RSL Table, May, 2024, with a Target Hazard Quotient (THQ) of 0.1 with an associated risk of 1.0 x 10<sup>-6</sup>. Tetra Tech will use the most up-to-date screening levels at time of reporting.

 $^2$  200 mg/kg screen result is screening threshold for determining subsequent EPH fractionation.

<sup>3</sup> The laboratory Practical Quantitation Limit (PQL) for the specified method cannot achieve the regulatory screening level.

<sup>4</sup> DEQ Background Threshold Value

<sup>5</sup> Screening level updated to reflect DEQ 2021 RBCA Lead Memorandum and a residential risk for a blood lead concentration of 5 micrograms per deciliter (µg/dL).

<sup>6</sup> Leaching Screening Level determined using DEQ Surface and Subsurface Soil Screening Flow Chart, Part 2

- DEQ Montana Department of Environmental Quality EPA U.S. Environmental Protection Agency EPH Extractable petroleum hydrocarbons GW Groundwater
- mg/kg Milligrams per kilogram (parts per million) MTBE Methyl-tert butyl ether
- Not applicable NA
- Quality Assurance Project Plan QAPP
- Quality control
- QC RBSL Risk-Based Screening Level
- Resource Conservation and Recovery Act RCRA
- Reporting Limit RL
- RSL Regional Screening Level
- TCLP Toxicity Characteristic Leaching Procedure



#### EXHIBIT 6B: ANALYTICAL GROUPS, REPORTING LIMITS, AND SCREENING LEVELS FOR GROUNDWATER

Matrix	Analytical Group	Analyte	Method Reporting Limit (µg/L)	DEQ HHS DEQ-7/ RBSL (µg/L)	Project Screening Level (µg/L)	Is RL Below Project Screening Level?
		Benzene	0.50	5	5	Yes
		Ethylbenzene	0.50	700	700	Yes
		Methyl tert-Butyl Ether	1.0	30	30	Yes
		Naphthalene	1.0	100	100	Yes
	Volatile Petroleum Hydrocarbons	Toluene	0.50	1,000	1,000	Yes
		Xylenes	0.50	10,000	10,000	Yes
Groundwater		C5-C8 Aliphatics	20	700	700	Yes
		C9-C12 Aliphatics	20	3,000	3,000	Yes
		C9-C10 Aromatics	20	980	980	Yes
		EPH Screen	300	1,000 <sup>2</sup>	1,000 <sup>2</sup>	Yes
	Eutropichia Datrolaum Undroporthana	C9-C18 Aliphatics	300	3,000	3,000	Yes
	Extractable Petroleum Hydrocarbons	C19-C36 Aliphatics	300	100,000	100,000	Yes
		C11-C22 Aromatics	300	1,100	1,100	Yes
QC Samples			Same as above for 1 tr	ip blank and 1 field duplicate	sample.	

#### Notes:

\*TPH and EPH Fraction analytical data unavailable from EPA's RSL Table. DEQ's groundwater RBSL used.
 <sup>21</sup>,000 µg/L screen result is screening threshold for determining subsequent EPH fractionation.
 HHS DEQ-7 Human Health Standard per DEQ-7 Circular

- Micrograms per liter
- μg/L MCL Maximum Contaminant Level
- RL Reporting Limit
- NA Not Applicable
- MTBE Methyl-tert butyl ether QC Quality Control

Matrix	Analytical Group	Analyte	Method Reporting Limit (µg/m <sup>3</sup> )	DEQ/EPA Industrial RSL* (µg/m³)	Project Screening Level (µg/m³)	Is RL Below Project Screening Level?
		1,2 Dichloroethane (DCA)	0.01	0.47	0.47	Yes
		1,3 Butadiene	0.01	0.41	0.41	Yes
		Aliphatic (C5-C8)	12	880	880	Yes
		Aliphatic (C9-C12)	12	150	150	Yes
		Aromatic (C9-C10)	10	440	440	Yes
	۸DU	Benzene	0.01	1.6	1.6	Yes
	Агп	Ethylbenzene	0.2	4.9	4.9	Yes
		Ethylene Dibromide (EDB)	0.01	0.02	0.02	Yes
		MTBE	1.0	47	47	Yes
		Naphthalene	0.5	0.36	0.36	Yes
		Toluene	0.2	2,200	2,200	Yes
		Xylenes (mix of m,p, & o)	0.4	44	44	Yes
		Acetone	-	-	-	
		Acrolein	0.3	0.0088	0.0088	Yes - No Yes Yes Yes
		Benzene	0.16	1.6	1.6	Yes
Air		Benzyl Chloride	0.24	0.25	0.25	Yes Yes
All		Bromomethane	0.15	2.2	2.2	Yes
		Bromodichloromethane	0.14	0.33	0.33	Yes
		Bromoform	0.22	11	11	Yes
		1,3-Butadiene	0.18	0.41	0.41	Yes
		2-Butanone	0.22	2,200	2,200	Yes
	TO 15 SIM	Carbon Disulfide	0.32	310	310	Yes
	10-15 SIM	Carbon Tetrachloride	0.15	2.0	2.0	Yes
		Chlorobenzene	0.14	22	22	Yes         Yes         Yes         No         Yes         Ye
		Chloroethane	0.13	1,800	1,800	Yes
		Chloroform	0.14	0.53	0.53	Yes<
		Chloromethane	0.17	39	39	
		Cumene	0.16	180	180	Yes
		Cyclohexane	0.3	2,600	2,600	Yes
		Dibromochloromethane	0.14	-	-	-
		Bromodichloromethane	0.16	0.33	0.33	Yes
		1,2-Dibromoethane (EDB)	0.13	0.02	0.02	No

#### EXHIBIT 6C: ANALYTICAL GROUPS, REPORTING LIMITS, AND SCREENING LEVELS FOR SOIL VAPOR

Matrix	Analytical Group	Analyte	Method Reporting Limit (µg/m <sup>3</sup> )	DEQ/EPA Industrial RSL* (µg/m³)	Project Screening Level (µg/m³)	Is RL Below Project Screening Level?
		1,2-Dibromo-3- chloropropane	0.2	0.0026	0.0026	No
		1,2-Dichlorobenzene	0.16	88	88	Yes
		1,3-Dichlorobenzene	0.16	-	-	-
		1,4-Dichlorobenzene	0.17	1.1	1.1	Yes
		Dichlorodifluoromethane	0.18	44	44	Yes
		1,1-Dichloroethane	0.16	7.7	7.7	Yes
		1,2-Dichloroethane (DCA)	0.12	0.47	0.47	Yes
		1,1-Dichloroethene	0.15	1.7	1.7	Yes
		Cis-1,2-dichloroethene	0.15	18	18	Yes
		Trans-1,2-dichloroethene	0.15	18	18	Yes
		1,2-Dichloro-1,1,2,2- Tetrafluoroethane	0.17	-	-	-
		1,2-dichloropropane	0.13	1.8	1.8	Yes
		Cis-1,3-Dichloropropene	0.17	3.1	3.1	-
		Trans-1,3- Dichloropropene	0.22	3.1	3.1	-
		1,4-Dioxane	0.13	2.5	2.5	Yes
		Ethyl Acetate	0.57	31	31	Yes
Air	TO-15 SIM	Ethylbenzene	0.15	4.9	4.9	Yes
All	10-15 511	4-Ethyltoluene	0.17	-	-	-
		Hexachlorobutadiene	0.22	0.56	0.56	Yes
		2-Hexanone	0.13	13	13	Yes
		Methylene Chloride	0.30	260	260	Yes
		MTBE	0.13	47	47	Yes
		Naphthalene	0.26	0.36	0.36	Yes
		n-Hexane	0.22	310	310	Yes
		n-Heptane	0.17	180	180	Yes
		4-Methyl-2-Pentanone	0.15	1,300	1,300	Yes
		2-Propanol	0.45	88	88	Yes
		Propene	0.26	1,300	1,300	Yes         Y
		Styrene	0.17	440	440	
		1,1,2,2- Tetrachloroethane	0.15	1.7	1.7	Yes
		Tetrachloroethene	0.14	18	18	Yes
		Tetrahydrofuran (THF)	0.14	880	880	Yes
		Toluene	0.13	2,200	2,200	Yes

Matrix	Analytical Group	Analyte	Method Reporting Limit (µg/m³)	DEQ/EPA Industrial RSL* (µg/m³)	Project Screening Level (µg/m³)	Is RL Below Project Screening Level?
		1,2,4-Trichlorobenzene	0.26	0.88	0.88	Yes
		1,1,1-Trichloroethane	0.13	2,200	2,200	Yes
		1,1,2-Trichloroethane	0.11	0.088	0.088	No
		Trichloroethene	0.15	0.88	0.88	Yes
		Trichlorotrifluoroethane	0.16	2,200	2,200	Yes
Air	TO-15 SIM	Trichlorofluoromethane	0.15	-	-	-
		1,3,5-Trimethylbenzene	0.16	26	26	Yes
		1,2,4-Trimethylbenzene	0.15	26	26	Yes
		Vinyl Acetate	2.4	88	88	Yes
		Vinyl Chloride	0.12	2.8	2.8	Yes
		Xylene m, p, o	0.28	44	44	Yes
QC Samples	VOCs		Same as above	ve for 1 field duplicate sample.		

Notes:

\* Screening levels reflect EPA RSL Table and MT DEQ's VI Calculator, with a Target Hazard Quotient (THQ) of 0.1 and an associated risk of 1.0 x 10<sup>^-6</sup> μg/m<sup>3</sup> Micrograms per cubic meter
 RSL Regional Screening Level
 MTBE Methyl-tert butyl ether

Quality Control

QC VOC Volatile Organic Compound



### 4.1 FIELD EQUIPMENT, CALIBRATION, AND FREQUENCY

Table 3 at the end of this document shows the field equipment selected to collect the data needed for the project objectives, as well as field equipment calibration, maintenance, testing, and inspection procedures.

#### 4.2 STANDARD OPERATING PROCEDURES FOR DATA COLLECTION

Sampling equipment selected to meet project objectives is listed in Table 3. Affected media will include air, groundwater, surface, and subsurface soils. To the extent possible, Tetra Tech will rely on DEQ and EPA-approved methods for sample collection, monitoring, and field measurements. EPA-approved sampling SOPs anticipated for this project are listed in Table 4.

# **4.3 STANDARD OPERATING PROCEDURES FOR NON-STANDARD METHODS**

Affected media will include soil gas, soil, and groundwater. To the extent possible, Tetra Tech will rely on DEQ and EPA-approved methods for sample collection, monitoring, and field measurements. EPA-approved sampling SOPs anticipated for this project are listed in Table 4 at the end of the document.

#### 4.4 FIELD SUPPLIES AND CONSUMABLES

Table 5 is a checklist for supplies and consumables needed to accomplish air, surface soil, subsurface soil, and groundwater sampling. The table is to be used as a checklist prior to mobilization. The Field Team Leader will identify critical supplies and consumables prior to mobilization and will bring reasonably sufficient quantities to the field.

### 4.5 PROJECT QUALITY CONTROL SAMPLES

Tetra Tech developed a programmatic QAPP (Tetra Tech 2024) to define project data quality objectives (DQO), and guide data acquisition and data validation activities. Data validation will be Level 2A. Personnel involved with field activities, evaluation of data, and reporting will use the programmatic QAPP as a guide for quality assurance/quality control (QA/QC) during the project.

QC samples will be collected to evaluate field sampling methods and overall reproducibility of laboratory analytical results, as detailed in Table 6 at the end of this document. Laboratory QA/QC standard procedures will be followed to ensure analytical results are of acceptable quality. As applicable, temperature blanks and trip blanks will be submitted with each cooler used for transport of samples to the laboratory.

### 4.6 INVESTIGATION-DERIVED WASTE

IDW will be handled in accordance with the programmatic QAPP (Tetra Tech 2024) and applicable SOPs. Unless otherwise specified here, IDW will be collected in drums that will be left on site until the characterization sampling is complete. A subcontractor will remove the drums after the IDW has been characterized and can be collected for disposal. This is typically two to six weeks after the sampling is complete—two weeks for laboratory analysis and up to four weeks for drum pickup and IDW disposal. Specific wastes will be characterized and disposed of as identified in Table 7 at the end of this document.

### 4.7 DATA MANAGEMENT

Data collected for this project will be managed with field notes, digital spreadsheets, and electronic data deliverables. Table 8 lists software or forms to be used, how they work, and for what they are to be used. The table will also be used as a checklist.

#### **4.8 PROJECT REPORTING**

Following completion of field work and receipt of laboratory analytical results, Tetra Tech will provide a Phase II ESA Report of Findings Remedial Investigation in accordance with ASTM E1903-19 and DEQ PTCS requirements for Remedial Investigation reports. The report will state the objectives of the assessment, describe the work performed, explain sampling rationale and deviations from the sampling plan, and document the information and data acquired. Site-specific information and data will be presented and evaluated against applicable local and federal regulatory standards. The Remedial Investigation report will detail results of the soil boring, groundwater monitoring well installation, soil gas sampling, and first round of groundwater monitoring will be provided following the second semi-annual groundwater monitoring event. Results will be interpreted based on the established DQOs and the conceptual site model for the assessment. Tables, figures, and laboratory analytical data will be appended to the reports.

#### **5.0 REFERENCES**

- Montana Department of Environmental Quality (DEQ). 2019. Circular DEQ-7, Montana Numeric Water Quality Standards. June.
- DEQ. 2020. Petroleum Tank Cleanup Section Closure Report for Petroleum Release. Facility ID 02-13259, Release 2031. May.
- DEQ. 2021. Montana Vapor Intrusion Guide. Final, September
- DEQ. 2024. Montana Risk-Based Corrective Action Guidance for Petroleum Releases. Final, February.
- Tetra Tech. 2022. Geophysical Survey Results for Helping Hands Food Bank, Hardin, Big Horn County. December
- Tetra Tech. 2023. Phase II Environmental Site Assessment for Helping Hands Food Bank, Hardin, Big Horn County. Version 2. November
- Tetra Tech, Inc (Tetra Tech) 2024. Quality Assurance Project Plan (QAPP) for Beartooth Resource Conservation and Development Brownfields Assessment Program. Prepared for Beartooth RC&D. Revision 2. July.
- U.S. Department of Housing and Urban Development (HUD). 2012. *Guidelines for the Evaluation and Control* of Lead-Based Paint Hazards in Housing. Second Edition. July.
- U.S. Environmental Protection Agency (EPA). 1986. Asbestos Hazard Emergency Response Act (AHERA), Public Law 99-519. October 22.
- U.S. EPA. 2024. Regional Screening Levels (RSLs) Generic Tables. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables. May.

### TABLES



Name	Title	Organization/ Affiliation	Responsibilities	Special Training Requirements
Brandon Kingsbury	Site-Specific Project Manager	Site-Specific Project Manager Tetra Tech labora analy cher Pr		Bachelor of Science, 16 years of experience, OSHA 40-hour HAZWOPER
Brandon Kingsbury	Field Team Leader Tetra		Supervises field sampling and coordinates field activities; reports to applicable regulators and stakeholders while conducting field activities.	OSHA 40-hr HAZWOPER
Ryan Kizer	Field Team	Tetra Tech	Performs field sampling, records notes and documents sampling locations and activities, preserves samples, ships samples	OSHA 40-hr HAZWOPER
Misia Zilinski	Field Team	Tetra Tech	Performs field sampling, records notes and documents sampling locations and activities, preserves samples, ships samples	OSHA 40-hr HAZWOPER
Ethan Perro	Ethan Perro Soil Boring/Well Ol Install Subcontractor		Provides construction support	Licensed Well Installer

#### TABLE 1: FIELD PERSONNEL AND SUBCONTRACTOR TRAINING REQUIREMENTS

TBD

HAZWOPER Hazardous Waste Operations and Emergency Response

- OSHA U.S. Occupational Safety and Health Administration
- QAPP Quality assurance project plan

To be determined



Matrix	Estimated # of Samples	Analytical Group	Concentration Level	Analytical Methods	Sample Volume and Containers	Preservation Requirements	Maximum Holding Time <sup>1</sup> (Preparation/ Analysis)	Laboratory Used	Laboratory Turnaround Time	Validation Methods
Soil Gas	3	VOCs	SIM, Low	TO-15 SIM Mass APH	6-liter Summa Canister	NA	14 days to analysis	TBD	Standard	Level 2A
Water	10	EPH	Low	DEQ MA EPH	Two 1-Liter Amber glass bottles.	To pH < 2 with H₂SO₄; store at 4 ℃	14 days to extraction/ 40 days to analysis	TBD	Standard	Level 2A
Water	10	VPH	Trace, Low	MT DEQ MA VPH	Three 40- mL glass vials with Teflon- lined septum. Zero Headspace	To pH < 2 with hydrochloric acid; store at 4 ℃	NA/14 days	TBD	Standard	Level 2A
Soil	15	VPH	Trace, low	Montana Method VPH	One 4-oz glass jar	Store at 4 °C	7 days to extraction/28 days to lab analysis	TBD	Standard	Level 2A
Soil	15	EPH	Trace, low	Montana Method EPH	One 4-oz glass jar	Store at 4 °C	14 days to extraction/ 40 days to lab analysis	TBD	Standard	Level 2A
Soil	One 5-point composite	TCLP Metals	Trace, low	SW-6010 RCRA 8	One 500-gram plastic or glass jar	None	6 months	TBD	Standard	Level 2A

#### TABLE 2: ANALYTICAL SOP REQUIREMENTS

#### Notes:

 1
 Maximum holding time may be extended by regulatory agency for non-mercury metals analysis.

 DEQ
 Montana Department of Environmental Quality

 EPH
 Extractable petroleum hydrocarbons

H2SO4 Sulfuric acid

NA Not applicable

Ounce oz

RCRA Resource Conservation and Recovery Act

SIM Selective Ion Monitoring

- TBD To Be Determined
- TCLP Toxicity Characteristic Leaching Procedure Volatile petroleum hydrocarbon
- VPH



#### TABLE 3: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION

Field Equipment	Calibration Activity	Maintenance Activity	Testing/ Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person (Verification)		
MiniRAE Pro w/Gamma Sensor	Zero unit in ambient air or with zero value calibration gas (99.99% N <sub>2</sub> ). Span calibrate the LEL/O <sub>2</sub> /H <sub>2</sub> S/CO sensors using quad-mix calibration gas. Span calibrate PID sensor with appropriate isobutylene calibration gas. (ppm level)	Change moisture filter when dirty; maintain on charge.	Power on; Bump Test.	Routine: Monthly full calibration. Onsite: Weekly full calibration with daily bump tests, or as indicated by meter	Calibration acceptable within ± 2% of span gas value.	If batteries fail or will not hold a charge, request a replacement If sensors will not pass calibration, recalibrate. If sensors continue to not pass calibration, request a replacement	Tetra Tech Team Personnel		
Trimble R1 GNSS Receiver	None	Check battery and Bluetooth connectivity.	Power on. Ensure connection with tablet via GNSS Status Utility.	Monthly	Ensure GPS accuracy is suitable for DQOs.	If battery will not hold a charge or unit will not connect to satellites or tablets, contact Trimble Tech Support at 1 (800) 874-6253.	Tetra Tech Team Personnel		
Digital Still Camera	None	Charge battery or replace batteries when required.	Ensure the camera is able to take pictures and download them onto another storage device.	Monthly	Pass/Fail	If the camera is unable to take or download pictures, request a replacement, and return to vendor.	Tetra Tech Team Personnel		
Tablet w/ Data Plan	None	Software updates for tablet and applications	Ensure the tablet connects to network as well as to the Trimble R1 Bluetooth GPS unit.	Monthly	Pass/Fail	If the tablet will not connect to the network or to the Trimble R1 Bluetooth unit, obtain replacement	Tetra Tech Team Personnel		
MGD 2002 Helium Leak Detector	Factory calibration oncer per year	Charge battery or replace batteries when required	Power on to ensure battery life is higher than ¼ charge	Prior to use	Pass/Fail	Replace batteries and/or send to factory for inspection and replacement of critical filters, complete software upgrades and calibration.	Tetra Tech Team Personnel		

Notes:

CO Carbon monoxide

DQO Data quality objective

Global navigation satellite system Global positioning system GNSS

GPS

 $H_2S$ 

Hydrogen sulfide Lower explosive limit LEL

Dinitrogen N2

PID Photoionization detector ppm Parts Per Million

NIST National Institute of Standards and Technology  $O_2$ Oxygen

TETRA TECH



Reference Number	SOP Title (Revision Date or Number)	Source	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP 002-4	General Equipment Decontamination (March 2018)	Tetra Tech	Scrub brushes, wash tubs, squirt bottles, water, decontamination solutions	No	
SOP 003-4	Organic Vapor Air Monitoring	Tetra Tech	Photoionization Detector, Flame Ionization Detector, Organic Vapor Analyzer	No	
SOP 005-3	Soil Sampling (February 2017)	Ing     Tetra Tech     Spoons, spatulas, triers, shovels, augers, core samplers, sample		No	
SOP 010-5	Groundwater Sampling (March 2020)	Tetra Tech	Water level indicator, bailers, pumps, sample containers	No	
SOP 024-3	Recording Notes in Field Logbooks (July 2020)	Tetra Tech	Logbook, pen with permanent ink	No	
SOP 019-8	Packaging and Shipping Samples	Tetra Tech	Coolers, ice, packing materials, tape, plastic bags for samples and to line cooler, custody forms and seals	No	
SOP 074-4	Active Subsurface Gas Sampling	Tetra Tech	Sampling train, Summa Canister, filter cartridges vapor pins, helium shrouds.	No	
SOP #1704	Summa Cannister Sampling	Tetra Tech	Summa Canisters	No	
SOP #2006	Sampling Equipment Decontamination (December 2015)	EPA ERT	Scrub brushes, wash tubs, water, decontamination solutions	No	
SOP #2049	Investigation- Derived Waste Management (April 2020)	EPA ERT	Drums, buckets, trash bags, containers, decontamination supplies	TBD	

Notes:

EPA U.S. Environmental Protection Agency

ERT Environmental Response Team

- SOP Standard operating procedure
- TBD To be determined on a site-specific basis
| Supplies / Consumables                | Amount     | Item Present? |
|---------------------------------------|------------|---------------|
| Logbook                               | 2          |               |
| Stainless Steel Trowel                | 2          |               |
| Nitrile Gloves                        | 2 boxes    |               |
| Plastic Bags (gallon)                 | 4 boxes    |               |
| Bucket                                | 2          |               |
| Cooler                                | 8          |               |
| Brush                                 | 2          |               |
| Deionized Water                       | 12 gallons |               |
| Cleaning Solution                     | 3 bottles  |               |
| Paper towels                          | 5 rolls    |               |
| Calibration gas regulators            | 1          |               |
| Isobutylene calibration gas           | 1          |               |
| Air Sample train tubing               | 1 roll     |               |
| Sterile Scoops                        | 12         |               |
| Pump (Low Flow) and Flow-Through Cell | 1          |               |
| Hammer Drill                          | 1          |               |
| Mixing Bowl                           | 3          |               |
| Water Quality Meter                   | 1          |               |
| Vapor Pin                             | 1          |               |
| Concrete Mix                          | 1 bag      |               |
| Water Level Meter                     | 1          |               |
| Trash Bags                            | 1 Roll     |               |
| Photoionization detector              | 1          |               |
| Soil Knife                            | 1          |               |
| Tablet                                | 1          |               |
| GPS                                   | 1          |               |

Matrix	Analytical Group	Analytical SOP Reference	No. of Sampling Locations	No. of Samples	No. of Field Duplicates <sup>2</sup>	No. of MS/MSDs <sup>1</sup>	No. of Equipment Rinsate Blanks <sup>2</sup>	No. of Trip Blanks <sup>1</sup>	Total No. of Samples to Laboratory
Water	VPH	A1, A2	5	10	1 in 10	1 in 20	1	1 per cooler	12
	EPH	A1, A5	5	10	1 in 10	1 in 20	NA	NA	12
Soil	VPH	A1, A2	15	15	1 in 10	1 in 20	1	1 per cooler	16
	EPH	A1, A5	15	15	1 in 10	1 in 20	NA	NA	16
	TCLP (RCRA 8 Metals)	A11, A12, A13	1	1	1 in 10	1 in 20	NA	NA	1
Air	Mass APH	NA	1	2	1 in 10	1 in 20	NA	NA	2
	TO 15 SIM	A4	1	2	1 in 10	1 in 20	NA	NA	2

## TABLE 6: FIELD QUALITY CONTROL SAMPLE SUMMARY

#### Notes:

<sup>1</sup>See discussion of field quality control samples in "Requirements" section below for specific guidelines and frequencies.

EPH Extractable Petroleum Hydrocarbons

- Mass APH Massachusetts Method Air Phase Hydrocarbons
- MS/MSD Matrix spike/matrix spike duplicate
- NA Not applicable
- RCRA Resource Conservation and Recovery Act
- SIM Selective Ion Monitoring
- SOP Standard Operating Procedure
- VPH Volatile Petroleum Hydrocarbons



Investigation-Derived Waste Type	Characterization Method	Disposal Method
Personal protective equipment	None	Municipal waste
Soil boring cuttings	VPH, EPH, and TCLP (RCRA 8) metals sampling	Haul to permitted facility (likely Billings or Hardin Land Fill)
Purge water	ЕРН, VPH,	TBD by subcontractor and DEQ Purge Water Flowchart

## TABLE 7: INVESTIGATION-DERIVED WASTE

#### Notes:

DEQ	Montana Department of Environmental Qu	uality
-----	--	--------

- EPH Extractable petroleum hydrocarbons
- RCRA Resource Conservation and Recovery Act

TBD To be determined

- TCLP Toxicity Characteristic Leaching Procedure
- VPH Volatile petroleum hydrocarbons



## TABLE 8: SOFTWARE AND FORMS

Forms/Software	Purpose	Project Purpose	Software/Forms Present?
MS Excel	A sample/monitoring data management system used for managing samples, locations, monitoring data, COCs, and analytical data.	Store and manage sample locations, analytical data, and screening data	
GPS units	GPS units used to capture locational data for samples and/or monitoring data. GPS units can include high-accuracy units (e.g., centimeter accuracy when differentially corrected) or other GPS units capable of accuracy at 5 meters.	Capture sample locations	
ArcGIS	Capture location data and apply to maps. Used to co-locate field data and GPS data to produce site maps	Capture sample locations, coordinates, elevations, and sample data	

Notes:

COC Contaminant of concern

GPS Global positioning system

MS Microsoft



# FIGURES



FIGURE 1: VICINITY MAP





FIGURE 2: SITE MAP





Path: C:Users\taylor.spiegelberg\OneDrive - Tetra Tech, Inc\Documents\06\_TJS Local ArcGIS\01\_Projects\Helping Hands Food Bank\ArcGIS\_ProjHelping Hands Food Bank.aprx

FIGURE 3: PREVIOUS SAMPLING LOCATIONS (2023)



Path: C:\Users\taylor.spiegelberg\OneDrive - Tetra Tech, Inc\Documents\06\_TJS Local ArcGIS\01\_Projects\Helping Hands Food Bank\ArcGIS\_Pro\Helping Hands Food Bank.aprx

FIGURE 4: PROPOSED SAMPLING LOCATIONS





Path: C:\Users\taylor.spiegelberg\OneDrive - Tetra Tech, Inc\Documents\06\_TJS Local ArcGIS\01\_Projects\Helping Hands Food Bank\ArcGIS\_Pro\Helping Hands Food Bank.arx

## APPENDIX A: SITE-SPECIFIC STANDARD OPERATING PROCEDURES



## SOP APPROVAL FORM

TETRA TECH, INC.

## EMI OPERATING UNIT

## ENVIRONMENTAL STANDARD OPERATING PROCEDURE

## GENERAL EQUIPMENT DECONTAMINATION

#### **SOP NO. 002**

## **REVISION NO. 5**

Last Reviewed: August 2021

Carlo punto

Quality Assurance Approved

August 2021

Date

#### 1.0 BACKGROUND

All nondisposable field equipment must be decontaminated before and after each use at each sampling location to obtain representative samples and to reduce the possibility of cross-contamination.

## 1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for decontaminating equipment in the field.

## 1.2 SCOPE

This SOP applies to decontaminating general nondisposable field equipment. All sampling equipment must be thoroughly cleaned before each use to prevent contamination of samples.

## 1.3 **DEFINITIONS**

Alconox: Phosphate-containing soap, obtained in powder form and dissolved in water

**Deionized (DI) Water:** DI water is water that has been treated to remove all ions – typically, that means all of the dissolved mineral salts and metal ions.

Liquinox: Phosphate-free soap, obtained in liquid form for mixing with water

**Luminox:** Specialized detergent with the capability of removing oils and organic contamination, also phosphate-free and liquid

#### **1.4 REFERENCES**

- U.S. Environmental Protection Agency (EPA). 1992. "RCRA Ground-Water Monitoring: Draft Technical Guidance." Office of Solid Waste. Washington, DC. EPA/530 R 93 001. November.
- EPA. 2020a. "Management of Investigation-Derived Waste." LSASDPROC-202-R4. May 8. https://www.epa.gov/quality/management-investigation-derived-waste
- EPA. 2020b. "Field Equipment Cleaning and Decontamination." LSASDPROC-205-R4. June 22. https://www.epa.gov/sites/production/files/2016-01/documents/field\_equipment\_cleaning\_and\_decontamination205\_af.r3.pdf

## 1.5 REQUIREMENTS AND RESOURCES

The equipment and supplies to conduct decontamination may include the following:

• Scrub brushes

- Large wash tubs or buckets
- Squirt or spray bottles
- Alconox or Liquinox (Note: Alconox contains phosphates, and phosphates have been banned in many household cleaning products based on their adverse effect on the environment.)
- Tap water
- Distilled water
- DI water
- Plastic sheeting
- Aluminum foil
- Isopropanol (laboratory grade) or Luminox

#### 2.0 PROCEDURES

This section describes procedures for decontamination of personal protective equipment (PPE) as well as equipment for drilling and monitoring well installation, borehole soil sampling, general sampling, water level measurement, and groundwater sampling. PPE (as outlined in the site-specific health and safety plan) should be used during decontamination procedures. Special handling of used PPE and wastewater generated from decontamination procedures may be required if the type of contamination is considered hazardous according to the Resource Conservation and Recovery Act (RCRA).

Any special handling should also be outlined in the site-specific health and safety plan or the sampling and analysis plan. At a minimum, no eating, drinking, smoking, or any other hand-to-mouth contact should be allowed during decontamination activities.

Some clients may have additional requirements for decontamination procedures. For example, phosphatefree detergent may be a requirement and, therefore, it would not be appropriate to use Alconox.

Source water for decontamination should be selected based on site-specific conditions and contaminants. In general, laboratory DI water is preferred for decontamination of instruments and sampling devices. Standard distilled water, readily available at grocery stores, may be appropriate at other times. However, distilled water may still contain unacceptable levels of inorganic ions. Decontamination of heavy equipment such as drill rigs will typically use tap water or similar source water, often used in combination with a steam or hot-water cleaning unit. During procurement, Tetra Tech personnel should specify the source of decontamination water to be used by the subcontractors and ensure that it is consistent with investigation goals. Refer to the site-specific sampling and analysis plan for details concerning source water.

In general, conduct field activities to move from cleaner to more contaminated locations to minimize the potential for cross contamination between locations.

## 2.1 PERSONAL PROTECTIVE EQUIPMENT DECONTAMINATION

Personnel working in the field are required to follow specific procedures for decontamination prior to leaving the work area so that contamination is not spread off site or to clean areas. Refer to the site-specific health and safety plan as the first resource for types of PPE; not all types of PPE nor methods for decontamination discussed below will be appropriate for every site. All used disposable protective clothing, such as Tyvek, coveralls, gloves, and booties, will be containerized for later disposal.

Decontamination water will be containerized in 55-gallon drums or similar sealable containers (refer to Section 3.0).

Personnel decontamination procedures will be as follows:

- 1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
- 2. Wash neoprene boots (or neoprene boots with disposable booties) with Liquinox or Alconox solution and rinse with clean water. Remove booties and retain boots for subsequent reuse.
- 3. Remove outer gloves and place into plastic bag for disposal.
- 4. Remove Tyvek or coveralls. Containerize Tyvek for disposal and place coveralls in plastic bag for laundry before reuse.
- 5. Remove air purifying respirator (APR), if used, and place the spent filters in a plastic bag for disposal. Filters should be changed daily or sooner, depending on use and application. Place the respirator into a separate plastic bag after it has been cleaned and disinfected according to the instructions for the respirator.
- 6. Remove disposable gloves and place them in plastic bag for disposal.
- 7. Thoroughly wash hands and face in clean water and soap.

# 2.2 DRILLING AND MONITORING WELL INSTALLATION EQUIPMENT DECONTAMINATION

All drilling equipment should be decontaminated at a designated location on site before drilling operations begin, between borings, and at completion of the project. Decontamination may be conducted on a temporary decontamination pad constructed at a satellite location within the site. The purpose of the decontamination pad is to contain wash waters and potentially contaminated soil generated during decontamination procedures. Decontamination pads may be constructed of concrete, wood, or plastic sheeting, depending on the site-specific needs and plans. Wash waters and contaminated soil generated during decontamination should be considered investigation-derived waste (IDW) and, thus, should be collected and containerized for proper disposal.

Monitoring well casing, screens, and fittings are assumed to be delivered to the site in a clean condition. However, they may be steam cleaned and placed on polyethylene sheeting on site before they are used downhole, if required by the site-specific work plan. The drilling subcontractor will typically furnish the steam cleaner and water. The drilling auger, bits, drill pipe, any portion of drill rig that is over the borehole, temporary casing,

surface casing, and other equipment used in or near the borehole should be decontaminated by the drilling subcontractor as follows:

- 1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
- 2. Remove loose soil using shovels, scrapers, wire brushes, and any related material.
- 3. Steam clean or pressure wash to remove all visible dirt. Use appropriate PPE (for example, a face shield and Tyvek/coveralls) as necessary.
- 4. If equipment has directly or indirectly contacted contaminated media and is known or suspected of being contaminated with oil, grease, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), or other hard-to-remove organic materials, rinse equipment with laboratory-grade isopropanol or Luminox solution.
- 5. To the extent possible, allow components to air dry; drying helps limit the spread of contamination through contact. Equipment should be dried and stored upwind of contaminated areas to minimize potential cross-contamination.
- 6. All wastewater from decontamination procedures should be containerized.

## 2.3 BOREHOLE SOIL SAMPLING DOWNHOLE EQUIPMENT DECONTAMINATION AND GENERAL SOIL SAMPLING EQUIPMENT DECONTAMINATION

All soil sampling equipment should be decontaminated before use and after each sample as follows:

- 1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
- 2. Scrub the split-barrel sampler and sampling tools in a wash bucket or tub using a stiff, longbristle brush with a solution of tap water with Liquinox or Alconox.
- 3. Rinse equipment thoroughly with tap water or distilled water.
- 4. Perform a final rinse with DI or distilled water. Refer to the site-specific sampling and analysis plan for requirements for DI or distilled water.
- 5. Place cleaned equipment in a clean area on plastic sheeting or aluminum foil and allow to air-dry. Clean, dry equipment should be stored in clean equipment cases to minimize potential crosscontamination. If the equipment does not have a case, it should be stored on a clean surface upwind of contaminated areas to minimize potential cross-contamination.
- 6. Containerize all water and rinsate; also, containerize disposable, single-use sampling equipment.

## 2.4 WATER LEVEL MEASUREMENT EQUIPMENT DECONTAMINATION

Field personnel should decontaminate the water-level indicator or interface probe before inserting and

after removing it from each well. The following decontamination procedures should be used:

- 1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
- 2. Wipe the tape and probe with a disposable Alconox- or Liquinox-impregnated cloth or paper towel. Spray the probe with Alconox or Liquinox solution to ensure that all ports on the probe are cleaned.
- 3. If immiscible layers are encountered, the interface probe may require steam cleaning or washing with laboratory-grade isopropanol or Luminox solution.
- 4. Rinse with distilled or deionized water, including spraying the probe with rinse water.
- 5. Store clean, dry equipment in clean equipment cases to minimize potential cross-contamination. If the equipment does not have a case, it should be stored on a clean surface upwind of contaminated areas to minimize potential cross-contamination.
- 6. Containerize all water and rinsate for proper disposal.

#### 2.5 GROUNDWATER SAMPLING EQUIPMENT

The following procedures are to be employed to decontaminate equipment used for groundwater sampling. Decontamination is not necessary when using disposable (single-use) or dedicated (reused but only at a single sample point) pump tubing or bailers. Decontamination procedures for reused equipment are described below.

- 1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
- 2. Remove and containerize any purge water in the pump and tubing and dispose of tubing.
- 3. Dismantle the pump as much as possible and scrub components in a wash bucket or tub using a stiff brushes of appropriate size with a solution of tap water with Liquinox or Alconox.
- 4. Rinse pump components thoroughly with tap water or distilled water.
- 5. If groundwater contains or is suspected to contain oil, grease, PAHs, PCBs, or other hard-toremove organic materials, rinse the pump and tubing with laboratory-grade isopropanol or Luminox solution.
- 6. Perform a final rinse with DI or distilled water.
- 7. Allow components to air dry.
- 8. Wrap pump in aluminum foil or a clean plastic bag for storage.
- 9. Containerize the used tubing and decontamination wash waters for proper disposal.

## 3.0 INVESTIGATION-DERIVED WASTE

IDW can include disposable, single-use PPE and sampling equipment, soil cuttings, purge water, and decontamination wash waters and sediments. Requirements for waste storage may differ from one facility to the next. Facility-specific directions for waste storage will be provided in project-specific documents, or separate direction will be provided by the project manager. Make sure to consult with a qualified professional before making any waste characterization decisions. The following guidelines are provided for general use:

- 1. Assume that all IDW generated from decontamination contains the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. Waste solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.
- 2. Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility.
- 3. Label IDW storage containers with the facility name and address, date, contents, company generating the waste, and an emergency contact name and phone number.
- 4. Temporarily store the IDW in a protected area that provides access to the containers and allows for spill/leak monitoring, sampling of containers, and removal after the disposal method has been identified.

## SOP APPROVAL FORM

TETRA TECH, INC.

## EMI OPERATING UNIT

## ENVIRONMENTAL STANDARD OPERATING PROCEDURE

## ORGANIC VAPOR AIR MONITORING

## **SOP NO. 003**

## **REVISION NO. 4**

Last Reviewed: May 2020

Carlo punts

Quality Assurance Approved

May 2020

Date

#### 1.0 BACKGROUND

Exposure to airborne organic contaminants can present a significant threat to worker health and safety. Identifying and quantifying these contaminants through air monitoring is essential for reconnaissance activities. Reliable measurements of airborne organic contaminants are necessary for selecting or upgrading personal protective equipment (PPE), delineating areas where protection is needed, assessing the potential health effects of exposure, and evaluating the need for specific medical monitoring. Organic vapor air monitoring is also commonly used as a screening tool to identify relatively impacted environmental media and to provide a real-time basis for selecting samples for chemical analysis.

Various types of air monitoring instruments are available to measure organic vapors. Common organic vapor monitoring instruments used by Tetra Tech include photoionization detectors (PID), organic vapor analyzer (OVA), flame ionization detectors (FID), and multigas meters that combine organic and inorganic vapor monitoring. It should be noted that this standard operating procedure (SOP) discusses only some of the air monitoring instruments available to field personnel. The particular type of meter or monitoring system to be used should be identified in the project work plan or field sampling plan and selected on a site-specific basis depending on the data collection needs, the types of organic vapors to be monitored, and the sampling procedures to be used.

#### 1.1 PURPOSE

This SOP establishes the general requirements and procedures for using various instruments to conduct organic vapor air monitoring in the field. It also discusses general factors to consider when conducting organic vapor air monitoring.

#### 1.2 SCOPE

This SOP applies to general procedures for calibrating and operating organic vapor air monitoring instruments in the field. The project work plan or field sampling plan should identify the types of instruments to be used and the actual project-specific field parameters to be measured. The project-specific health and safety plan should identify chemical-specific action levels for health and safety purposes. For each type of air monitoring instrument, the manufacturer's manual should be consulted for specific operating instructions.

#### **1.3 DEFINITIONS**

**Flame ionization:** A process by which a sample gas is ionized with a flame, allowing a count of carbon atoms to measure organic vapor concentration.

**Flame ionization detector (FID):** A portable instrument used to detect, measure, and provide a direct reading of organic vapor concentrations in a gas sample that is ionized with a flame.

**Ionization potential:** The amount of energy needed to strip an electron from the orbit of its resident molecule, expressed in electron volts.

**Organic vapor:** Airborne compounds composed of carbon, hydrogen, and other elements with chain or ring structures.

**Organic vapor analyzer (OVA):** A portable instrument used to detect, measure, and provide a direct reading of the concentration of a variety of trace organic gases in the atmosphere through flame ionization.

**Photoionization:** A process involving the absorption of ultraviolet light by a gaseous molecule, leading to ionization.

**Photoionization detector (PID):** A portable instrument used to detect, measure, and provide a direct reading of the concentrations of a variety of trace organic gases in the atmosphere through photoionization.

**Breathing zone:** The area where field workers would be inhaling potentially impacted air, generally from about 3 to 5 feet above the ground surface. The breathing zone will vary depending on the types of work activities being performed. Air monitoring is conducted in this zone to ensure that it is representative of the air being breathed by field team members.

Head space: The vapor mixture trapped above a solid or liquid in a sealed vessel.

#### 1.4 **REFERENCES**

National Institute for Occupational Safety and Health (NIOSH). 2007. "Pocket Guide to Chemical Hazards." Department of Health and Human Services, Centers for Disease Control and Prevention. Publication 2005-149. September.

## 1.5 REQUIREMENTS AND RESOURCES

The following items are typically required to monitor organic vapors in air using this SOP:

- Organic vapor air monitoring meter
- Manufacturer-supplied calibration gas
- Manufacturer-supplied calibration kits including tubing and regulators

- Resealable plastic bags for conducting soil head space measurements (if applicable)
- Sample jars for conducting water head space measurements (if applicable)
- Sharpie or similar type of permanent marker
- Container to collect soil or water used for head space measurements (if applicable)
- Logbook or field data sheets (may be in an electronic format)

#### 2.0 APPLICATIONS, DETECTION METHODS, AND LIMITATIONS

All direct-reading instruments have inherent constraints in their ability to detect gaseous organic compounds. They usually detect or measure only specific classes of chemicals. Generally, they are not designed to measure or detect airborne concentrations below 1 part per million (ppm). Finally, many direct-reading instruments that have been designed to detect one particular substance also detect other substances, causing interference and possibly resulting in false readings. The following subsections discuss general application, detection methods, and limitations when using a PID and an OVA FID.

#### 2.1 APPLICATION

The PID can be used to detect total concentrations of many organic and some inorganic gases and vapors. It can also be used in conjunction with other detection devices such as colorimetric indicator detector tubes to identify specific compounds (see SOP No. 065, Colorimetric Indicator Detectors [Dräeger Tubes]).

When set in the survey mode, the OVA FID can detect the total concentration of many organic gases and vapors. In the gas chromatography (GC) mode, the OVA FID can identify and measure the concentrations of specific compounds. In the survey mode, all organic compounds are ionized and detected at the same time. In the GC mode, volatile species are ionized and detected separately.

Each type of unit (PID or FID) has some limitations in the detection of various categories of compounds or for specific organic compounds. Examples are described below in Section 2.2. The user manual for the specific instrument should be used to confirm its applicability for measurements of the organic vapors of concern at the site.

#### 2.2 DETECTION METHODS

The PID ionizes molecules using ultraviolet (UV) radiation and can be used with a variety of electron voltage lamps best matched to the compound of concern at a site. The UV radiation strips electrons from the molecules, producing ions that produce a current proportional to the number of ions generated. The PID is more sensitive to aromatic and unsaturated compounds than the OVA FID. The PID is nonspecific for gas and vapor detection for organic and some inorganic compounds. The PID is also sensitive to 0.1 ppm of benzene. Sensitivity is related to the ionization potential of the compound being monitored. PIDs will only detect compounds that have ionization energies similar to the energy of the photons the detector uses. Gases with ionization potential values below the electron volt (eV) output of the lamp will be detected. The most common PID lamp used is the 10.6 eV lamp because it detects most volatile organic compounds; however, 9.5 eV and 11.7 eV lamps are also commonly available. It is recommended that

the ionization potential of the chemicals of concern be known in order to select the most appropriate lamp for a specific project. Ionization potential information can be obtained from the vendor, in the manufacturer's manual, or on line.

Organic gases and vapors are flame-ionized in the OVA FID. The ions produce a current that is proportional to the number of carbon atoms present. The current is interpreted by a deflection on the instrument's meter. In the survey mode, the OVA FID functions as a nonspecific total hydrocarbon analyzer. In the GC mode, the OVA FID can provide a tentative qualitative and quantitative identification of gases and vapors. The OVA FID is most sensitive to saturated hydrocarbons (alkanes), unsaturated hydrocarbons (alkenes), and aromatic hydrocarbons. The OVA FID is not suitable for inorganic gases such as chlorine, hydrogen cyanide, and ammonia. The OVA FID is also less sensitive to aromatics and unsaturated compounds than the PID. However, the OVA FID is less sensitive to high humidity than the PID. Gases and vapors that contain substituted function groups such as hydroxide (OH-) reduce the detector's sensitivity. Finally, if the operator monitors for a specific gas or vapor.

## 2.3 LIMITATIONS

The PID cannot be used to:

- Detect methane
- Detect a compound that has a higher energy level than the ionization potential of the PID light source
- Respond accurately to a mixture of gases or vapors
- Respond accurately in high humidity or very cold weather
- Respond accurately when interference from other sources is present

The OVA FID cannot be used to:

- Detect organic vapors at temperatures below 40°F (4°C)
- Identify specific organic vapors when operated in the survey mode; results must be reported relative to the calibration standard used (for example, as methane equivalents).
- Detect inorganic gases and vapors; the instrument also gives a lower response to oxygencontaining organic compounds (such as alcohols, ethers, and aldehydes) and nitrogen-containing organic compounds (such as amines, amides, and nitriles).
- Detect high organic contaminant concentrations or detect contaminants in oxygen-deficient atmospheres; operation in these conditions requires system modification.

#### 3.0 **PROCEDURES**

The procedures outlined in this SOP are general and typically apply to various types of monitoring instruments used to measure organic vapors in air. General procedures for testing and calibrating the instruments are presented first, followed by procedures for using the instruments and making field measurements, guidelines for recording information accurately, and a discussion of variables that may affect outdoor air monitoring. The particular monitoring instrument should be identified in the project work plan or field sampling plan and should be operated in accordance with the manufacturer's instruction manual.

## 3.1 TESTING AND CALIBRATION PROCEDURES

Each air monitoring instrument should be calibrated according to manufacturer's specifications. General procedures applicable to most equipment are as follows:

- Equipment should be thoroughly cleaned, and then calibrated and tested before the startup of sampling at each site.
- Equipment should be calibrated and tested using manufacturer-provided calibration gas and calibration connector kits.
- Batteries should be charged before startup of field work, and the battery charge level should be checked at the start of each day. The battery charge life will vary depending on the particular monitoring instrument used, the application, and environmental conditions such as temperature. Some instruments are equipped with an adapter that will allow the unit to be plugged into a car charger.
- It is recommended that extra batteries be kept on hand when conducting field work.
- The PID can typically run continuously on a fully charged battery for at least 8 hours. The PID battery should be recharged for 14 hours.
- The OVA FID can typically run continuously on a fully charged battery for 8 hours alone or for 3 hours with a strip chart recorder. The OVA FID battery must be recharged every 8 hours or replaced, as needed.
- Calibration and testing of field equipment should be documented every time it is performed. Calibration and testing information should be recorded in field logbooks (or field data sheets, if applicable).
- If testing and calibration measurements are out of tolerance, the instrument must be serviced or repaired.

## 3.2 FIELD MEASUREMENT PROCEDURES

Each air monitoring instrument should be operated according to manufacturer's specifications. The actual field procedures will vary depending on the type of air monitoring to be conducted. Almost all PIDs and

OVA FIDs have a recommended warm-up period (see the manufacturer's operations manual for the specific type of meter to be used). Similarly, many instruments are affected by moisture, humidity, and dust. The use of an external filter on the probe tip is recommended in these situations. Finally, many instruments include a data logging option that can be used, if desired. A general procedural summary for air monitoring associated with health and safety and field screening applications is presented below.

## 3.2.1 Health and Safety Monitoring

The site-specific health and safety plan will specify the types of contaminants of concern, health and safety related action levels, and the types of PPE necessary. The goal of air monitoring for health and safety purposes is to ensure that field work is conducted in accordance with the health and safety plan and to identify conditions where upgrading the level of PPE may be necessary. General procedures for conducting health and safety air monitoring for organic vapors are as follows:

- Following the instrument manual, calibrate and test air monitoring equipment.
- Approach the sampling location from the upwind direction.
- Monitor organic vapors in the breathing zone (multiple levels of monitoring may be required depending on the work being performed).
- Monitor down-hole vapor concentrations, if drilling.
- Take readings at a frequency appropriate for the types of tasks being conducted, the types of organic vapors expected, and the levels of organic vapors being detected (monitor at a more frequent rate if organic vapors are detected and they are near the site-specific action levels specified in the health and safety plan).
- Record information in a field logbook, on field data sheets, or on an air monitoring log sheet (record site name, date and time, sampling location, PID or FID readings, and pertinent weather information). A negative (non-detect) result should also be recorded to demonstrate that the measurement was taken.
- Upgrade the level of PPE, implement engineering controls, or stop work if organic vapors are sustained in the breathing zone above action levels specified in the site-specific health and safety plan.

## 3.2.2 Field Screening

The site-specific work plan or field sampling plan will specify the media to be sampled, the sampling methods and procedures to be used, and field screening requirements. Typically, the goals of air monitoring for field screening purposes are to identify relatively higher organic vapor concentrations in soil, groundwater, or other media to select subsequent sampling locations, or to select environmental samples to send to a laboratory for chemical analysis. General procedures for conducting field screening air monitoring for organic vapors are as follows:

- Following the instrument manual, calibrate and test air monitoring equipment.
- Work from the upwind direction, when possible.
- If samples are collected at low temperatures, they may require some warming to allow organic compounds to volatilize. Care must be taken for samples not to be overheated, allowing any organic vapors to escape.
- Directly screen soil cores or drill cuttings by running the tip of the meter along the soil surface while taking care not to get soil into the probe.
- Depending on sampling protocol, dig into or freshly "break" the soil and measure vapors at the newly exposed surface.
- When collecting soil samples for head space measurements, place soil in a resealable plastic bag, record the sampling location and depth on the bag with a Sharpie or other type of permanent marker, wait at least 5 minutes for vapors to accumulate (the bag may be placed in direct sunlight or in a warm area while waiting), shake the bag vigorously, and then insert the probe into the bag without placing the tip directly in the soil (while taking care not to let vapors escape).
- Directly screen purged well water (or surface water) by running the tip of the meter along the water surface while taking care not to get water into the probe.
- When collecting water samples for head space measurements, place water in a jar and tightly close the lid, record the sampling location and depth on the jar with a Sharpie or other type of permanent marker, wait at least 5 minutes for vapors to accumulate (the jar may be placed in direct sunlight or in a warm area while waiting), shake the jar vigorously, and then slightly open the lid and insert the probe into the jar without placing the tip directly in the water (while taking care not to let vapors escape).
- Record information in a field logbook, on field data sheets, or on an air monitoring log sheet (record site name, date and time, sampling location, PID or FID readings, and pertinent weather information). A negative (non-detect) result should also be recorded to demonstrate that the measurement was taken.

## 3.3 ACCURATE RECORDING AND INTERPRETATION

Direct-reading instruments must be operated and the data interpreted by individuals who understand the operating principles and limitations of the instruments. At hazardous waste sites, where unknown and multiple contaminants are frequently encountered, instrument readings should be interpreted conservatively.

The following guidelines promote accurate recording and interpretation:

- Calibrate instruments in accordance with the manufacturer's instructions before and after every use.
- Conduct additional monitoring at any location where a positive response occurs.
- Report a reading of zero as nondetectable (ND) rather than as "clean." Quantities of chemicals

may be present but at concentrations that are not detectable by the instrument.

• Repeat the air monitoring survey using other detection devices.

## 3.4 VARIABLES AFFECTING OUTDOOR AIR MONITORING

Complex environments containing many substances, such as those associated with hazardous waste sites, pose significant challenges to accurately and safely assess airborne contaminants. Several independent and uncontrollable variables (most notably temperature and weather conditions) can affect airborne concentrations. These factors must be considered when conducting air monitoring and interpreting data. The following environmental variables must be considered:

- Temperature: An increase in temperature increases the vapor pressure of most chemicals.
- Wind speed: An increase in wind speed can affect vapor concentration near a free-standing liquid surface. Dust and particulate-bound contaminants are also affected.
- **Rainfall:** Water from rainfall can essentially cap or plug vapor emission routes from open or closed containers, saturated soil, or lagoons, thereby reducing airborne emissions of certain substances.
- **Moisture:** Dusts, including finely divided hazardous solids, are highly sensitive to moisture. Moisture can vary significantly with respect to location and time and can also affect the accuracy of many sampling results.
- **Background vapor emissions:** Vapor emission from other activities in the area of the field investigations can also affect readings. Operations such as vehicle maintenance or fueling facilities can affect readings associated with perimeter monitoring. Permanent markers can also influence instrument responses, so pens should be tightly capped and stored away from instruments.
- Work activities: Work activities often require the mechanical disturbance of contaminated materials, which may change the concentration and composition of airborne contaminants and contribute to airborne emissions. Organic air emissions at a work site can also occur from operation of gasoline or diesel engines.

These conditions should be reported with organic vapor readings to provide a more accurate interpretation of monitoring results.

## SOP APPROVAL FORM

TETRA TECH, INC.

## EMI OPERATING UNIT

## ENVIRONMENTAL STANDARD OPERATING PROCEDURE

SOIL SAMPLING

#### **SOP NO. 005**

## **REVISION NO. 4**

Last Reviewed: August 2021

Carlo punto

Quality Assurance Approved

August 2021

Date

#### 1.0 BACKGROUND

Soil is sampled for three main reasons: (1) for chemical analysis in the laboratory, (2) for physical analysis in the laboratory, or (3) for evaluation in the field (for example, visual classification, assessment of staining, and field screening). These three sampling objectives can be achieved separately or in combination. Sampling locations are typically chosen to provide information in both the horizontal and vertical directions. A sampling and analysis plan or a site-specific quality assurance project plan (QAPP) is used to outline sampling methods and to provide a preliminary rationale for sampling locations. Sampling locations may be adjusted in the field based on the screening or sampling methods used and the physical features of the area.

#### 1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for soil sampling. Soil is sampled to evaluate the chemical and physical characteristics of surface and subsurface soils.

#### 1.2 SCOPE

This SOP describes procedures for soil sampling in different areas using various implements. It includes procedures for test pit, surface soil, and subsurface soil sampling and describes a variety of soil sampling devices.

#### **1.3 DEFINITIONS**

**Aliquot**: A portion of a larger whole, especially a sample taken for chemical analysis or other treatment; in particular, the discrete portions of a composite sample.

**Bucket Auger:** A type of auger that consists of a cylindrical bucket 10 to 72 inches in diameter with teeth arranged at the bottom.

**Composite Sample:** A sample that consists of soil combined from more than one discrete location (also called an aliquot). Typically, composite samples consist of soil obtained from several locations and homogenized in a stainless-steel or Teflon bowl, tray, or plastic bag.

**Core Sampler:** A thin-walled cylindrical metal tube with diameter of 0.5 to 3 inches, a tapered nosepiece, a "T" handle to facilitate sampler deployment and retrieval, and a check valve (flutter valve) in the headpiece.

**Direct-push technology (DPT):** Investigation tools that drive or push small-diameter rods and tools (typically not exceeding 4 inches in diameter) into the subsurface by hydraulic or percussive methods. Geoprobe Systems is a manufacturer of DPT equipment, and its brand name is often used interchangeably with "DPT."

**EnCore Sampler:** A disposable volumetric sampling device. It comes in sample sizes of 5 and 25 grams. It is a hermetically sealed, single-use soil sampler made from a high-tech, inert polymer. EnCore samplers are used to collect soil samples with zero headspace, as required for volatile organic compound (VOC) analysis (including purgeable total petroleum hydrocarbons). Each sample is collected using a reusable "T" handle.

Grab Sample: A sample collected from a discrete location or depth.

**Hand Auger:** An instrument attached to the bottom of a length of pipe that has a crossarm or "T" handle at the top. The auger can be closed-spiral or open-spiral.

**Spatulas or Spoons:** Stainless-steel or disposable instruments for collecting loose unconsolidated material.

**Split-Spoon** (or **Split-Barrel**) **Sampler:** A thick-walled steel tube that is split lengthwise. A cutting shoe is attached to the lower end; the upper end contains a check valve and is connected to drill rods.

**Terra Core Sampler:** A disposable volumetric sampling device. It comes in sample sizes of 5 and 10 grams and is part of a sampling kit. It is a single-use sampler used to collect soil samples with zero headspace, as required for VOCs. Each sample is collected with the disposable coring device. However, unlike the EnCore sampler, the sample is placed directly into a 40-milliliter (mL) glass volatile organics analysis (VOA) vial after the soil is collected. The VOA vial is included in the sampling kit.

**Thin-Wall Tube Sampler:** A steel tube (1 to 3 millimeters thick) with a tapered bottom edge for cutting. The upper end is fastened to a check valve that is attached to drill rods.

**Trier:** A tube cut in half lengthwise with a sharpened tip that allows for collecting sticky solids or loosening cohesive soils.

**Trowel:** A metal or disposable tool with a scooped blade 4 to 8 inches long and 2 to 3 inches wide with a handle.

VOA Plunger: A disposable, plastic, single-use soil device to collect samples for analysis of VOCs.

#### **1.4 REFERENCES**

- ASTM International (ASTM). 2016. D1452-16, Standard Practice for Soil Exploration and Sampling by Auger Borings, West Conshohocken, PA.
- ASTM D1586-18. 2018.Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils, ASTM International, West Conshohocken, PA.
- ASTM D1587-15. Standard Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes, ASTM International, West Conshohocken, PA.
- ASTM D2488-17e1. 2015. Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). ASTM International, West Conshohocken, PA. 2017.
- ASTM D4220 / D4220M-14. 2014. Standard Practices for Preserving and Transporting Soil Samples, ASTM International, West Conshohocken, PA.
- ASTM D4700-15. 2015. Standard Guide for Soil Sampling from the Vadose Zone, West Conshohocken, PA.
- ASTM D6151-15. 2015. Standard Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling, ASTM International, West Conshohocken, PA.
- ASTM D6286-20. 2020. Standard Guide for Selection of Drilling Methods for Environmental Site Characterization, ASTM International, West Conshohocken, PA.
- ASTM D6282 / D6282M-14. 2014.Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations, ASTM International, West Conshohocken, PA.
- ASTM D6640-01 (2015). 2015. Standard Practice for Collection and Handling of Soils Obtained in Core Barrel Samplers for Environmental Investigations, ASTM International, West Conshohocken, PA.
- ASTM D6907-05 (2016). 2016. Standard Practice for Sampling Soils and Contaminated Media with Hand-Operated Bucket Augers, ASTM International, West Conshohocken, PA.
- U.S. Environmental Protection Agency (EPA). 1980. Samplers and Sampling Procedures for Hazardous Waste Streams. EPA/600/2-80/018. January.
- EPA. 1989. Soil Sampling Quality Assurance User's Guide; Second Edition. EPA/600/8-89/046. March.
- EPA. 1991. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. EPA/600/4-89/034. March.
- EPA. 1992. Preparation of Soil Sampling Protocol: Techniques and Strategies. EPA/600/SR-92/128.
- EPA. 1996. Method 5035 (SW-846): Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples. December. <u>https://www.epa.gov/hw-sw846/sw-846-test-method-5035-closed-system-purge-and-trap-and-extraction-volatile-organics-soil</u>
- EPA. 2005. A Compendium of Superfund Field Operations Methods, Revised. OSWER Directive 9355.-14 EPA/540/P 87/001.
- EPA. 2020a. "Soil Sampling." LSASDPROC-300-R4. June 11. https://www.epa.gov/quality/soilsampling
- EPA. 2020b. Sampler's Guide, Contract Laboratory Program Guidance for Field Samplers. EPA/540/R 20/005. November. https://www.epa.gov/clp/contract-laboratory-program-guidance-fieldsamplers
- EPA. 2021. Quality System and Technical Procedures for LSASD Field Branches. https://www.epa.gov/quality/quality-system-and-technical-procedures-lsasd-field-branches

#### 1.5 **REQUIREMENTS AND RESOURCES**

Soil sampling requires the use of one or more of the following types of equipment:

- Spoon and spatula •
- Trowel
- Shovel or spade
- Trier
- Core sampler
- EnCore sampler •
- Terra Core sampler
- VOA plunger
- Hand auger
- Bucket auger
- Split-spoon
- Thin-wall tube

In addition, the following equipment may also be needed for various methods:

- Sample containers, labels, and chain-of-custody forms •
- Logbook and field forms
- Stakes or flags for marking sample locations
- Tape for measuring recovery
- Soil classification information, including Munsell Color Chart

- Wax or caps for sealing ends of thin-wall tube
- "T" Handles
- Stainless-steel or Teflon bowls, aluminum pans, or other vessels for composite sampling (made from material that will not interfere with the planned analyses)
- Plastic sheeting
- Decontamination equipment
- Drilling equipment
- Backhoe
- Health and safety equipment

#### 2.0 PROCEDURES

This SOP presents procedures for collecting test pit, surface soil, and subsurface soil samples. The site sampling plan will specify which of the following procedures will be used.

Soil samples for chemical analysis should be collected in order of decreasing volatility, with samples for VOCs collected first. Samples for physical analysis can be containerized after the chemical samples have been containerized. Typical physical analyses conducted include (1) grain size distribution, (2) moisture content, (3) saturated permeability, (4) unsaturated permeability, and (5) Atterberg limits. Additionally, visual descriptions of samples, using the Unified Soil Classification System (USCS, ASTM D2488-17e1), should be recorded. Field tests such as head-space analysis can also be conducted using a photoionization detector or a flame ionization detector before samples are collected for chemical or physical analysis.

Soil samples for chemical analysis can be collected either as grab samples or as composite samples. A grab sample is collected from a discrete location or depth. A composite sample consists of soil combined from more than one discrete location. Typically, composite samples consist of soil obtained from several locations (aliquots) and homogenized in a stainless steel or Teflon bowl, tray, or plastic bag. Refer to the site-specific QAPP for the methodology for composite sample collection, including number and location of aliquots. Samples for VOC analysis should not be composited.

All non-disposable equipment used for soil sampling should be decontaminated between sampling locations in accordance with SOP 002, General Equipment Decontamination.

## 2.1 SOIL SAMPLE COLLECTION PROCEDURES

Soil samples can be collected as discrete samples for VOC analysis using specialized equipment for preservation in the laboratory or in the field. Samples for VOC analysis should not be composited. Soil samples collected for non-VOC analysis can be collected as either grab or composite samples using standard equipment.

## 2.1.1 Procedure for Preserving and Collecting Soil Samples for VOC Analysis

Samples collected for VOC analysis using traditional methods, such as collection in a jar with no preservation, are shown to yield nonrepresentative results based on loss of VOCs. Soil samples collected for analysis for VOCs should be collected so that an undisturbed aliquot can be submitted for analysis. The aliquot should be taken directly from the sampling device and put in the sample container. EPA SW-846 Method 5035 is the preferred method for collecting samples for analysis for VOCs.

There are several options for collecting samples under Method 5035, including a variety of sampling devices, preservatives, and containers (including the potential presence of stir bars in the containers). The sampling team should work with the analytical laboratory to identify the anticipated range of concentrations, the window for sample delivery to the laboratory from the field, and the data quality objectives for the project.

Soil may be collected using any method described in Sections 2.3 or 2.4 that results in an undisturbed soil core. Once the soil is collected, a sampling device such as an EnCore sampler, a Terra Core sampler, syringe, stainless-steel spoon, plunger, or other device may be used to collect the sample into the container. The container may be unpreserved or may be pre-preserved with methanol, sodium bisulfate, or other solvents. Table 1 lists some of the options for Method 5035.

## TABLE 1

Option	Procedure		Advantages		Disadvantages
1	Collect two 40-milliliter (mL) vials with about 5 grams (g) of sample and one 2-ounce (oz) glass jar with a septum lid for screening, percent moisture, and preservative compatibility.	•	Screening conducted by laboratory	•	48-hour holding time for unpreserved samples Sample containers must be tared
2	Collect three EnCore samplers and one 2-oz glass jar with a septum lid for screening and percent solids.	•	Lab conducts all preservation and preparation procedures	•	48-hour holding time for unpreserved samples
3	Collect two 40-mL vials with 5 g of sample and preserve with methanol or sodium bisulfate and one 2-oz glass jar with a septum lid for screening and percent solids.	•	Longer holding time	• •	Hazardous materials used in the field Sample containers must be tared
4	Collect one 2-oz glass jar with septum lid for analysis and percent solids.	•	Lab conducts all preservation and preparation procedures	•	May have significant loss of constituents of concern

## **METHOD 5035 SUMMARY**

Because the EnCore and Terra Core samplers are most commonly used, specific procedures for these devices are included below. For other sampling devices, the laboratory should be consulted to ensure their correct use.

**EnCore Sampler:** Soil samples collected for VOC analysis that are to be preserved at the laboratory may be obtained using a hand-operated, hermetically sealed sample vial such as an EnCore sampler. Each sample is collected using a reusable sampling handle ("T" handle) that can be provided with the EnCore

sampler when it is requested and purchased. Using the EnCore sampler eliminates the need for field preservation and the shipping restrictions associated with preservatives. A complete set of instructions is included with each EnCore sampler.

Collect the soil sample in the following manner for each EnCore sampler. Typically, three EnCore samplers will be collected per sample location.

- The EnCore sampler is loaded into the "T" handle with the plunger fully depressed.
- Press the "T" handle into the soil to be sampled. The plunger will be forced upward as the cavity fills with soil.
- When the sampler is full, rotate the plunger and lock it into place using the "T" handle. If the plunger does not lock, then it is not filled with soil. Soft soil may require several plunges or soil may be forced against a hard surface such as a decontaminated sample trowel to ensure headspace has been eliminated.
- Remove soil from the outside of the sampler so a tight seal can be made between the sample cap and the O-ring.
- With soil slightly piled above the rim of the sampler, force the cap on until the catches hook the side of the sampler.
- Remove any surface soil from outside of the sampler and place the sampler in the foil bag provided with the sampler. Seal the bag and label it with sample location information.
- Decontaminate the "T" handle between sample locations.
- Place samples on ice immediately and deliver them to the laboratory within 48 hours.

**Terra Core Sampler:** Terra Core disposable samplers may be used instead of EnCore samplers. These devices are used when samples will be preserved and have the advantage of a longer holding time. Each Terra Core sampling kit typically comes with one Terra Core sampler that collects either a 5- or a 10- gram aliquot into multiple pre-preserved containers that may also have stir bars. The sample containers will also typically be tared at the laboratory before sampling. Because the vials are pre-weighed, no additional labels should be added. Sampling information should be written directly on the label already on the vial.

Collect the soil sample in the following manner for each Terra Core sampler. Typically, multiple containers with different preservatives will be filled for each sample.

• With the plunger seated in the handle, push the sampler into freshly exposed soil until the sample chamber is filled.

- Wipe any excess soil and debris from the exterior of the sampler and remove any soil that extends beyond the mouth of the sampler.
- Rotate the plunger that was seated in the handler top 90 degrees until it aligns with the slots in the body.
- Place the mouth of the sampler into the desired 40-mL VOA vial and extrude the sample by pushing the plunger down. Quickly place the lid back on the VOA vial.
- After all vials provided have been filled, the sampler is now contaminated and must be disposed of unless additional duplicate or matrix spike sampling will be collected at the same location.
- Place the samples on ice immediately and ensure that samples are delivered to the laboratory within the holding time allowed for the preservation regime.

## 2.1.2 Procedure for Collecting Soil Samples for Non-VOC Analysis

Samples collected for non-VOC analysis may be either grab or composite samples as follows. When collecting a grab sample, transfer a portion of soil to be analyzed to a stainless-steel or Teflon bowl, disposable inert plastic tray, or plastic bag. Avoid or remove vegetation and small stones. When a composite sample is collected, collect four to five discrete soil samples of roughly equal volume, based on the sample design in the QAPP. Remove roots, vegetation, sticks, and stones larger than the size of pea gravel (about <sup>1</sup>/<sub>4</sub>- to <sup>1</sup>/<sub>2</sub>-inch diameter). Thoroughly mix the soil with a stainless-steel spoon to obtain as uniform a texture and color as practicable. Transfer the mixed soil to the appropriate sample containers and close and label the containers. Place the sample containers on ice; ice may not be required for some analytes such as metals, but samples should be iced as a best practice.

#### 2.2 TEST PIT AND TRENCH SOIL SAMPLING

Test pit and trench soil samples are collected when a complete soil profile is required or as a means of locating visually detectable contamination. This type of sampling provides a detailed description of the soil profile and allows for multiple samples to be collected from specific soil horizons. The sampling team should ensure that the sampling area is clear of utility lines, subsurface pipes, and poles before any test pit or trench is excavated with a backhoe.

A test pit or trench is excavated by incrementally removing soil with a backhoe bucket. The excavated soil is placed on plastic sheeting well away from the edge of the test pit. A test pit should not be excavated to depths greater than 4 feet unless its walls are properly sloped or stabilized. No personnel may enter any test pit or trench excavation more than 4 feet deep; such action would constitute confined space entry and must conform with Occupational Safety and Health Administration (OSHA) regulations at Title 29 *Code of Federal Regulations* (29 CFR) § 1910.

Personnel entering the test pit may be exposed to toxic or explosive gases and oxygen deficient environments. Air monitoring is required before they may enter the test pit, and use of appropriate respiratory gear and protective clothing is mandatory. At least two persons must be present at the test pit before sampling personnel may enter the excavation and begin soil sampling. Refer to project-specific health and safety plans for required safety procedures for excavations.

Soil samples can also be obtained directly from the backhoe bucket or from the excavated material after it has been removed and deposited on plastic sheeting. The sampling personnel may direct the backhoe excavator to obtain material from the selected depth and location within the excavation. The backhoe operator will set the backhoe bucket on the ground in a designated location, at a sufficient distance from the excavation to allow the sampler safe access to the bucket. The backhoe operator must disengage the controls and signal to the sampler that it is safe to approach the bucket. Collect the soil sample from the center of the backhoe bucket to reduce the potential for cross-contamination of the sample.

Test pits are not practical for sampling at depths greater than 15 feet. If soil samples are required from depths greater than 15 feet, samples should be obtained using test borings instead of test pits. Test pits are also usually limited to a few feet below the water table. In some cases, a pumping system may be required to control the water level within the pits.

Access to open test pits should be restricted by flagging, tape, or fencing. If a fence is used, it should be erected at least 6 feet from the perimeter of the test pit. The test pit should be backfilled as soon as possible after sampling is completed.

Various equipment may be used to collect soil samples from the walls or bottom of a test pit. A hand auger, bucket auger, or core sampler can be used to obtain samples from various depths. A trier, trowel, EnCore sampler, Terra Core sampler, VOA plunger, or spoon can be used to obtain samples from the walls or pit bottom surface.

## 2.3 SURFACE SOIL SAMPLING

Surface soil samples can be used to investigate contaminants that exist in the near-surface environment. Contaminants detected in the near-surface environment may extend to considerable depths, potentially migrating to groundwater, surface water, the atmosphere, or biological systems. Sampling depths for surface soil are typically those that can be reached without use of a drill rig, DPT, or other mechanized equipment. Surface soil sample depths typically extend up to depths of less than 2 feet below ground surface (bgs). However, the definition of "surface soil" and the resultant sample depths may vary based

on risk assessment or other project requirements. Be aware of these site-specific constraints and follow the requirements of the QAPP to select the depths for surface soil samples.

The surface soil sampling equipment presented in this SOP is best suited for sampling to depths of 0 to 6 feet bgs. The sample depth, analytical suite, soil type, and soil moisture will also dictate the most suitable sampling equipment. The sampling locations should be cleared of any surface debris such as twigs, rocks, and litter before samples are collected. Surface soil samples may be grab samples or composite samples, and samples may be collected for analysis from the sample device following the procedures described in Section 2.1. Samples collected using EPA SW-846 Method 5035 may only be collected from an undisturbed core.

Excess soil remaining after sample containers are filled should be retained for disposal or returned to the borehole as required by the site-specific investigation-derived waste (IDW) plan.

Table 2 presents various surface soil sampling equipment and their effective depth ranges, operating means (manual or power), and sample types collected (disturbed or undisturbed).

## TABLE 2

Sampling Equipment	Effective Depth Range (feet below ground surface)	Operating Means	Sample Type
Hand Auger	0 to 6	Manual	Disturbed
Bucket Auger	0 to 4	Power	Disturbed
Core Sampler	0 to 4	Manual or Power	Undisturbed
Trier	0 to 1	Manual	Undisturbed
Spoon/Spatula	0 to 0.5	Manual	Disturbed
Trowel	0 to 1	Manual	Disturbed

#### SURFACE SOIL SAMPLING EQUIPMENT

The procedures for using these various types of sampling equipment are discussed below.

## 2.3.1 Hand Auger

A hand auger equipped with extensions and a "T" handle is used to obtain samples from depths of up to 6 feet bgs. It is possible to hand auger deeper than 6 feet. However, hand-augering below this depth is uncommon because of the time, effort, and cost effectiveness when sampling to depths greater than 6 feet bgs. If necessary, a shovel may be used to excavate the topsoil to reach the desired subsoil level. If topsoil is removed, its thickness should be recorded. Samples obtained using a hand auger are disturbed in their collection; establishing the exact depth where samples are obtained is difficult.

The hand auger is screwed into the soil at an angle of 45 to 90 degrees from horizontal. When the entire auger blade has penetrated the soil, the auger is removed from the soil by lifting it straight up without turning it, if possible. If the desired sampling depth has not been reached, the soil is removed from the auger and deposited onto plastic sheeting. This procedure is repeated until the desired depth is reached and the soil sample is obtained. The auger is then removed from the boring and the soil sample is collected directly from the auger into an appropriate sample container.

Page 12 of 15

#### 2.3.2 **Bucket Auger**

A bucket auger, similar to the hand auger, is used to obtain disturbed samples from depths of up to 4 feet bgs. A bucket auger should be used when stony or dense soil is sampled that prohibits the use of a handoperated core or screw auger. A bucket auger with closed blades is used in soil that cannot generally be penetrated or retrieved by a core sampler.

The bucket auger is rotated while downward pressure is exerted until the bucket is full. The bucket is then removed from the boring, the soil collected is placed on plastic sheeting, and this procedure is repeated until the appropriate depth is reached and a sample is obtained. The bucket is then removed from the boring and the soil sample is transferred from the bucket to an appropriate sample container.

#### 2.3.3 **Core Sampler**

A hand-operated core sampler (Figure 1), similar to the hand auger, is used to obtain samples from depths of up to 4 feet bgs in uncompacted soil. The core sampler is capable of retrieving undisturbed soil samples and is appropriate when low concentrations of metals or organics are of concern. The core sampler should be constructed of stainless steel. A polypropylene core sampler is generally not suitable for sampling dense soils or sampling at greater depths.

The core sampler is pressed or driven (for example, using a slide hammer) into the soil at an angle of 45 to 90 degrees from horizontal and is rotated when the desired depth is reached. The core is then removed, and the sample is placed into an appropriate sample container.

#### 2.3.4 Trier

A trier (Figure 2) is used to sample soil from depths up to 1 foot bgs. A trier should be made of stainless steel or polypropylene. A chrome-plated steel trier may be suitable when samples are to be analyzed for organics and heavy metal content is not a concern.

Samples are obtained by inserting the trier into soil at an angle of up to 45 degrees from horizontal. The trier is rotated to cut a core and is then pulled from the soil being sampled. The sample is then transferred to an appropriate sample container.

## 2.3.5 Shovel

A shovel or spade may be used to obtain large quantities of soil that are not readily obtained with a trowel. A shovel is used when soil samples from depths of up to 6 feet bgs are to be collected by hand excavation; a tiling spade (sharpshooter) is recommended for excavation and sampling. A standard steel shovel may be used for excavation; either a stainless-steel or polypropylene shovel may be used for sampling. Soil excavated from above the desired sampling depth should be stockpiled on plastic sheeting. Soil samples should be collected from the shovel and placed into the sample container using a stainless-steel scoop, plastic spoon, or other appropriate tool.

#### 2.3.6 Trowel

A trowel is used to obtain surface soil samples that do not require excavation beyond a depth of 1 foot. A trowel may also be used to collect soil subsamples from profiles exposed in test pits. Use of a trowel is practical when sample volumes of approximately 1 pint (0.5 liter) or less are to be obtained. Excess soil should be placed on plastic sheeting until sampling is completed. A trowel should be made of stainless or galvanized steel. It can be purchased from a hardware or garden store. Soil samples to be analyzed for organics should be collected using a stainless-steel trowel. Samples may be placed directly from the trowel into sample containers.

#### 2.4 SUBSURFACE SOIL SAMPLING

Subsurface soil sampling is accomplished in conjunction with borehole drilling for depths greater than approximately 6 feet bgs. Subsurface soil sampling is frequently coupled with exploratory boreholes or monitoring well installation. As described above for surface soil, the definition of "subsurface soil" may vary based on risk assessment or other project requirements. Be aware of site-specific constraints and follow the requirements of the QAPP to select the depths for subsurface soil samples. Surface soil samples may also be collected using these methods as part of a larger sampling event that includes subsurface soil sampling.

Subsurface soil may be sampled using a drilling rig, power auger, or DPT. Selection of sampling equipment depends on geologic conditions and the scope of the sampling program. All sampling tools should be decontaminated before and after each use. All three of the methods described below may be used to collect undisturbed samples from unconsolidated soils. Subsurface soil samples may be grab

samples or composite samples, and samples may be collected for analysis from the sample device following the procedures described in Section 2.1. Samples collected using EPA SW-846 Method 5035 may only be collected from an undisturbed core.

Excess soil remaining after sample containers are filled should be retained for disposal or returned to the borehole as required by the site-specific IDW plan.

## 2.4.1 Split-Spoon Sampler

Split-spoon samplers are available in a variety of types and sizes. Site conditions and project needs, such as large sample volume for multiple analyses, dictate the specific type of split-spoon sampler to be used. Figure 3 shows a generic split-spoon sampler.

The split-spoon sampler is advanced into the undisturbed soil beneath the bottom of the casing or borehole using a weighted hammer and a drill rod. The relationship between hammer weight, hammer drop, and number of blows required to advance the split-spoon sampler in 6-inch increments indicates the density or consistency of the subsurface soil. After the split-spoon sampler has been driven to its intended depth, it should be removed carefully to avoid loss of sample material. A catcher or basket should be used to help retain the sample in noncohesive or saturated soil.

After the split-spoon sampler is removed from the casing, it is detached from the drill rod and opened. If samples for VOC analysis are to be collected, the sample device (for example, the EnCore sampler) should be filled with soil taken directly from the split-spoon sampler. Samples for other specific chemical analyses should be taken as soon as the VOA sample has been collected. The remainder of the soil recovered can then be used for visual classification of the sample and homogenized and containerized for physical analysis.

## 2.4.2 Thin-Wall Tube Sampler

A thin-wall tube sampler, sometimes called the Shelby tube (Figure 4), is used to collect soil samples for geophysical analysis. Tube samplers are best suited for collecting cohesive soils such as clays and silts. The tube sampler may be pressed or driven into soil inside a hollow-stem auger flight, wash bore casing, or uncased borehole. The tube sampler is pressed into the soil, without rotation, to the desired depth or until it meets refusal. If the tube cannot be advanced by pushing, it may be necessary to drive it into the soil without rotation using a hammer and drill rod. The tube sampler is then rotated to collect the sample from the soil and removed from the borehole.

After the tube sampler is removed from the drilling equipment, the tube sampler should be inspected for adequate sample recovery. The sampling procedure should be repeated until an adequate soil core is obtained (if the tube sampler can retain the sample material). The soil core obtained should be documented in the logbook. Any disturbed soil is removed from each end of the tube sampler. If chemical analysis is required, samples for VOC analysis must be collected immediately after the tube sampler is withdrawn. The sample device (for example, the EnCore sampler) should be filled with soil taken directly from the tube sampler. Before use, and during storage and transport, the tube sampler should be capped with a nonreactive material. The tube is sealed using plastic caps for physical sampling parameters. The top and bottom of the tube sampler should be labeled and the tube sampler should be stored accordingly.

## 2.4.3 Direct-Push Technology Methods

In many cases, DPT is less expensive and faster than collecting soil samples with a standard drilling rig. In addition, the use of DPT causes minimal disturbance to the ground surface and generates little to no soil cuttings. DPT drill rigs, as well as traditional drill rigs, often use clear polyvinyl chloride (PVC) sleeves or brass liners inside of split-spoon or thin-wall tube samplers for collecting soil samples.

The sample sleeve is extruded from the sampling rod when the sampling rod is retrieved from the ground. The sleeve is sliced lengthwise twice to open the sleeve. Soil samples can be collected directly from the opened sleeve. If samples for VOC analysis are to be collected, the sample device (for example, the EnCore sampler) should be filled with soil taken directly from the opened DPT sampler. Samples for other specific chemical analysis should be collected after the VOC sample. The remainder of the recovered soil can then be used for visual classification of the sample and homogenized and containerized for physical analysis.

# FIGURE 1

## HAND-OPERATED CORE SAMPLER





# FIGURE 3

## GENERIC SPLIT-SPOON SAMPLER



# FIGURE 4

## THIN-WALL TUBE SAMPLER



## SOP APPROVAL FORM

TETRA TECH, INC.

## EMI OPERATING UNIT

## ENVIRONMENTAL STANDARD OPERATING PROCEDURE

## **GROUNDWATER SAMPLING**

## **SOP NO. 010**

## **REVISION NO. 5**

Last Reviewed: March 2020

Carlo punts

Quality Assurance Approved

March 2020

Date

#### 1.0 BACKGROUND

Groundwater sampling may be required for a variety of reasons, such as to examine potable or industrial water supplies, check for and track contaminant plume movement in the vicinity of a land disposal or spill site, conduct regulatory compliance monitoring, or examine a site where historical information is minimal or nonexistent, but where groundwater may be contaminated.

Groundwater is usually sampled through an in-place well, either temporarily or permanently installed. However, it can also be sampled anywhere groundwater is present, such as in a pit or a dug or drilled hole.

Occasionally, a well will not be in the preferred location to obtain the sample needed (for example, to track a contaminant plume). In such a case, a temporary or permanent well will have to be installed. SOP No. 020 (Monitoring Well Installation) provides guidance for installing new monitoring wells.

An experienced and knowledgeable person (preferably a hydrogeologist) will need to locate the well and supervise its installation so that the samples ultimately collected will be representative of the groundwater. Personnel installing wells should work under the supervision of a registered professional, and the requirements of the state where the work is being performed should be followed as to the specific requirements for the registered professional and there level of involvement and oversight.

## 1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for measuring the quality of groundwater entering, leaving, or affected by site activities through groundwater sampling. The samples are obtained by retrieving water from a well screened in the aquifer or aquifers underlying a site.

## 1.2 SCOPE

This SOP provides general guidance for groundwater sampling activities conducted in the field. SOP No. 015 (Groundwater Sampling Using Low-Flow Methodology) provides additional specific guidance for using low-flow methods to collect groundwater samples. The sampling methods referred to in this SOP are not a comprehensive list of all possible sampling methods. For other sampling methods, such as the use of passive diffusion bags, the manufacturer's instructions or other SOPs should be consulted.

## **1.3 DEFINITIONS**

**Bailer:** A cylindrical sampling device with valves on either end, used to extract water from a well. Bailers are usually constructed of an inert material such as stainless steel or polytetrafluoroethylene (Teflon) or of

easily decontaminated plastic, such as polyvinyl chloride (PVC) or polyethylene. Bailers may be reusable (decontaminated between use), disposable, or dedicated to a single well (and typically stored in the well). The bailer is lowered and raised by means of a cable that may be cleaned and reused, or by disposable rope. Temporary wells, such as those installed with direct-push technology (for example, Geoprobe screen points) are sometimes sampled with tubing to which a check valve has been attached. This tubing is functionally a bailer, and similar precautions should be taken.

**Electrical Water Level Indicator:** An electrical device that has a light or sound alarm connected to an open circuit, used to measure the depth to liquid. The circuit is closed when the probe intersects a conducting liquid. The wire used to raise and lower the probe is usually graduated.

**Immiscible Phase:** A liquid phase that cannot be uniformly mixed or blended with water. Heavy immiscible phases (also known as dense nonaqueous phase liquids, or DNAPLs) sink, and light immiscible phases (also known as light nonaqueous phase liquids, or LNAPLs) float on water.

**Interface Probe:** An electrical probe that measures the distance from the surface to air-water, airimmiscible, or immiscible-water interfaces. Similar in operation to an electrical water level indicator, these instruments are typically used when the thickness of an immiscible layer must be measured.

**Purge Volume:** The volume of water that needs to be removed from the well prior to sampling to ensure that the sample collected is representative of the formation groundwater.

**Riser Pipe:** The length of well casing above the ground surface.

**Total Well Depth:** The distance from the reference measuring point (top of well casing or ground surface) to the bottom of the well.

**Water Level:** The level of water in a well, measured as depth to water or as elevation of water, relative to a reference mark or datum.

## **1.4 REFERENCES**

- U.S. Department of Energy. 1985. "Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells: Second Edition." Edited by N. Korte and P. Kearl. Technical Measurements Center, Grand Junction Projects Office. GJ/TMC-08.
- U.S. Environmental Protection Agency (EPA). 1977. "Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities." EPA-530/SW-611. August.

- EPA. 1986. "Resource Conservation and Recovery Act (RCRA) Ground-Water Monitoring Technical Enforcement Guidance Document." Office of Solid Waste and Emergency Response (OSWER)-9550.1. September. On-line Address: https://www.epa.gov/sites/production/files/documents/rcragwguiddoc-rpt\_0.pdf
- EPA. 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Publication: EPA542-S-02-001. May. <u>http://www.epa.gov/tio/tsp/download/gw\_sampling\_guide.pdf</u>
- EPA Region 4. 2016. Groundwater Level and Well Depth Measurement SOP. Document Number SESDPROC-105-R3. November. On-line Address: <u>https://www.epa.gov/sites/production/files/2017-</u> 07/documents/groundwater level and well depth measurement105 af.r3.pdf
- EPA Region 4. 2017. Groundwater Sampling SOP. Document Number SESDPROC-301-R4. April. Online Address: <u>https://www.epa.gov/sites/production/files/2017-</u>07/documents/groundwater\_sampling301\_af.r4.pdf

## 1.5 REQUIREMENTS AND RESOURCES

There are various options available to obtain groundwater samples. The procedures are outlined in the following section. The equipment needed to accomplish these procedures includes the following:

- 1. Organic vapor detector with a flame ionization detector (FID) or a photoionization detector (PID)
- 2. Pipe wrench and other tools needed to open monitoring wells (socket wrench, screwdriver, mallet, etc.); keys to well locks
- 3. Electrical water level indicator or interface probe
- 4. Purging device (type needed depends on well depth, casing diameter, and type of sample desired; see sampling devices below)
- 5. Graduated cylinder or bucket
- 6. Sampling device (type needed depends upon depth to water, well diameter, and type of sample analysis desired)
  - o Bailer
  - o Bladder pump
  - Stainless steel submersible (non-oil-bearing) pump
  - o Existing dedicated equipment
  - o Peristaltic pump
- 7. Sample containers
- 8. Wastewater containers for purge water

- 9. Field logbook and field forms
- 10. Stopwatch

Additional equipment is required to complete measurement of field parameters (for example, pH, specific conductance, and temperature) of the groundwater in the well. Refer to Tetra Tech SOP 061 (Field Measurement of Groundwater Indicator Parameters) or individual field parameter SOPs as appropriate.

#### 2.0 PROCEDURES

Prior to sampling, a site-specific sampling plan should be developed. The plan should take into consideration the site characteristics and should include:

- 1. Specific, repeatable well measurement techniques and reference points for measuring the depth to water and the depth to the bottom of the well
- 2. Specific method of purging and selection of purging equipment
- 3. Specific methods and equipment for measurements of field parameters
- 4. Specific method of sample collection and the sampling equipment that will be used
- 5. Specific parameters for which samples will be analyzed
- 6. Order in which sample bottles will be filled, based on the analytical parameters

The following sections discuss procedures for approaching the well, establishing a sample preparation area, making preliminary well measurements, purging the well, and collecting samples.

## 2.1 APPROACHING THE WELL

In general, all wells should be assumed to pose a health and safety risk until field measurements indicate otherwise. Approach the well from the upwind side. Record well appearance and the general condition of the protective casing, surface seal, and surrounding area in the logbook.

Once at the well, the lead person should systematically use the organic vapor detector to survey the immediate area around the well (from the breathing zone to the top of the casing to the ground). If elevated FID or PID readings are encountered, retreat to a safe area and instruct the sampling team to either let vapors dissipate and approach the well again or put on the appropriate level of personal protective equipment (PPE), as specified in the site-specific health and safety plan. See SOP No. 003 (Organic Vapor Air Monitoring) for additional air monitoring guidance.

Some monitoring wells have the potential to contain pressurized headspace—for example, through the generation of gases from contaminated groundwater, biological processes, degradation of contaminants, or simply based on location such as near a landfill or in areas that intersect lithological abnormalities; or through intentional artificial means such as those associated with air sparging systems. Injection or extraction wells may be artificially pressurized and may remain so for several days after the system has been turned off. Over-pressuring presents a hazard to people opening these wells. Employ the following practices to minimize these hazards:

- 1. Wear safety glasses to protect the eyes. If site-specific observations and conditions indicate that the wells may be pressurized, wear a full-face shield over the safety eye protection.
- 2. Do not place the face or any other part of the body over the well when opening because this may place you in a strike zone.
- 3. Open the well cover at arm's length, then step away and allow the well to off gas and stabilize.

Upon opening the well casing, the lead person should systematically survey the air inside the well casing, above the well casing in the breathing zone, and in the immediate area around the well. Any positive PID or FID readings should be recorded in the logbook or on field forms. If elevated FID or PID readings in the breathing zone are encountered (see the health and safety plan for action levels), retreat and put on appropriate PPE. It is important to remember that action levels are based on readings in the breathing zone, not within the well casing. Representative organic vapor detector readings should be recorded in the logbook. Also look out for insects or other animals that may nest in well openings, and refer to the health and safety plan for site-specific hazards.

## 2.2 ESTABLISHING A SAMPLE PREPARATION AREA

The sample preparation area is generally located upwind or to either side of the well. If elevated readings are encountered using an organic vapor detector, this area should be taped off and the sample preparation area should be located upwind of the well, where ambient conditions are measured. Plastic sheeting or a tarp should be laid down around the well head and under the sample preparation area to prevent discharge of groundwater to soil and to protect tubing from touching the ground.

## 2.3 MAKING PRELIMINARY WELL MEASUREMENTS

Several preliminary well measurements should be made prior to initiating sampling of the well. These include measuring the water level and total well depth, evaluating the presence of immiscible phases, and calculating purge volumes. All preliminary measurements will be recorded in the logbook or a groundwater sampling data sheet as they are gathered (examples of typical data sheets are included as an exhibit to this SOP). SOP No. 014 (Static Water Level, Total Well Depth, and Immiscible Layer Measurement) provides additional information concerning these preliminary measurements.

## 2.3.1 Water Level and Total Well Depth Measurements

Tetra Tech typically uses an electric water level indicator for water level and total well depth measurements. This device sounds an alarm or triggers a light when the measuring probe touches the water surface, thus closing an electrical circuit. The electric cable supporting the probe is usually graduated to 0.01 foot and can be read at the well site directly. The distance between the static water level

and the marked or notched location at the top of the riser pipe is measured. If the casing is not marked or notched, the measurement should be taken from the north side of the casing. The height of the riser pipe above ground surface, as obtained from well location survey data, is then subtracted from the total reading to calculate the depth to static water. To improve accuracy, three separate readings should be made, and the values averaged. This helps to eliminate any errors caused by kinks or bends in the cable, which may change in length when the water level indicator is raised and lowered, or from water level probes catching on flaws or joints in the sides of the casing.

After sampling is completed, the total well depth can be measured by lowering the probe into the well until resistance is met, indicating that the probe has reached the bottom of the well. The total well depth is then read to the 0.01-foot fraction. The distance between the bottom of the well and the marked or notched location on the riser pipe is calculated. The height of the riser pipe above the ground surface, as obtained from well survey data, is then subtracted from the total reading to calculate the depth to the bottom of the well. To improve accuracy, three separate readings should be made, and the readings averaged. If the bottom of the well feels "soft" (suggesting sediment accumulation in the well), a note should be made in the logbook or on field forms. If a well is known to have a soft bottom, the total well depth measurement should be made after the sample is collected to minimize sediment disturbance and turbid samples.

## 2.3.2 Evaluating Whether Immiscible Nonaqueous-Phases Liquids are Present

If immiscible, nonaqueous-phase liquids (NAPL) are known or are strongly suspected to be present, based on previous or nearby groundwater sampling, the following measurement activities should be undertaken. Organic liquids are measured by lowering an interface probe slowly to the surface of the liquid in the well. When the audible alarm sounds, record the depth. If the alarm is continuous, a floating immiscible layer has been detected. To measure the thickness of this layer, continue lowering the probe slowly until the alarm changes to an oscillating signal. The oscillating signal indicates that the probe has detected an aqueous layer. Record this depth as the depth to water and calculate the thickness and the volume of the immiscible layer.

Continue lowering the probe into the well to evaluate whether dense immiscible phases (sinkers) are present. If the alarm signal changes from oscillating to a continuous sound, a heavier immiscible layer has been detected; record this depth.

Continue lowering the probe to the bottom of the well and record the total depth. Calculate and record the sinker phase volume and total water volume in the well (see equation in Section 2.3.3). If immiscible

phases are present, immediately refer to Section 2.5.3 or 2.5.4 of this SOP for sample collection procedures.

## 2.3.3 Calculation of Standing Water in the Well

If the presence of immiscible phases does not need to be determined, measure the depth to water and the total depth of the well as described in Section 2.3.1. Once these measurements have been made and recorded, calculate the total volume of water in the well. The volume of water in the well is based on the following formula:

$$V = \pi r^2 h \times 7.48$$

where

V	= static volume of water in the well (gallons)
r	= inside radius of the well (feet)
h	= length of water in the well (total well depth minus depth to water) (feet)
7.48	= conversion factor (cubic feet to gallons)

Common well sizes and corresponding volumes are as follows:

- 1-inch well = h x 0.041 gallons per foot (gal/ft)
- 2-inch well =  $h \ge 0.163$  gal/ft
- $3-inch well = h \ge 0.367 \text{ gal/ft}$
- 4-inch well =  $h \ge 0.652$  gal/ft

## 2.4 PURGING THE WELL

Once the water level is measured and the volume of water in the well is known, purging may begin. Wells are purged to eliminate stagnant water residing in the casing and screen that has undergone geochemical changes or loss of volatile chemicals. At the end of purging, the water being drawn from the well should be representative of groundwater in the aquifer.

Turbidity is often elevated during purging by the disturbance of formation materials at the borehole walls. As many contaminants (metals and many organic compounds) will sorb to the formation particles, a sample including these particles will not represent the dissolved concentrations of the contaminants. Thus, a secondary goal of purging is to reduce the turbidity to the point that the sample will represent the dissolved concentration of contaminants. The amount of water to be purged will depend on site-specific program requirements, individual well yield characteristics, or stabilization of field parameters measured during purging. In some cases, a standard volume is purged (for example, three well volumes). Field parameters (for example, pH, specific conductance, and temperature) should be measured prior to purging and at standard intervals (for example, after each well volume or every 3 to 5 minutes). All field parameter data should be recorded in the field logbook, on field forms, or in electronic applications. Refer to specific Tetra Tech SOP 061 as appropriate for more detailed procedures for measuring these field parameters.

The most comment methods for purging wells are:

- 1. Bailers
- 2. Bladder pumps
- 3. Submersible pumps
- 4. Dedicated pumps or other dedicated equipment
- 5. Peristaltic pumps

As previously stated, the minimum purging volume is typically three casing volumes, unless a low-flow sampling strategy has been chosen. SOP No. 015 (Groundwater Sampling Using Low-Flow Methodology) provides additional specific guidance for using low-flow methods (including purging methods) to collect groundwater samples. Exceptions to a three-well-volume purge standard also may be made in the case of low-yield or slow-recharging wells. When purging low-yield wells, purge the well until the water level is equal to the top of screen elevation (if possible). Samples should be collected no sooner than 2 hours after purging and when sufficient groundwater volume is available.

The well should be purged until measured field parameters, such as pH or specific conductance have stabilized. If any field parameter has not stabilized, additional purging should be performed. To be considered stable, field parameters should change by no more than the stabilization criteria listed on Table 1 between each well volume purged or within the purging interval specified in the sampling plan (for example, every 5 minutes). If the above conditions have not been met after a specified period of time, purging will be considered complete and sampling can begin. Refer to the field sampling plan or quality assurance project plan (QAPP) for specified time period. Record the final well stabilization parameters on the Groundwater Sampling Data Sheet, and indicate if the well purging was considered complete based on stabilized parameters or exceeding the specified period of time.

## TABLE 1

Parameter	Stabilization Criterion
pH	± 0.1 unit
Specific Conductance	$\pm 3$ percent
Oxidation-Reduction Potential	± 20 millivolts
Turbidity	$\pm$ 10 percent (when greater than 5 nephelometric turbidity units
	[NTU]); considered stable if less than 5 NTU
Dissolved Oxygen	$\pm$ 10 percent when greater than 0.5 milligram per liter (mg/L);
	considered stable if less than 0.5 mg/L
Temperature	$\pm 3$ percent

## STABILIZATION CRITERIA FOR WATER QUALITY PARAMETERS

At no time should the purging rate be high enough to cause groundwater to cascade back into the well, as this could result in excessive aeration and potential stripping of volatile constituents.

The actual volume of purged water can be measured using several acceptable methods:

- 1. When bailers are used, the actual volume of each bailer's contents can be measured using a calibrated bucket if the volume is not specified on the packaging.
- 2. If a pump is used for purging, the pump rate can be measured by using a container of known volume or with graduated measurements, a stopwatch, and the duration of pumping time necessary to purge the known volume.

## 2.5 SAMPLE COLLECTION

This section first describes general groundwater sample collection procedures. This section also describes procedures for collecting groundwater samples for volatile organic analysis (VOA) and for collecting samples when light or heavy immiscible layers are present in a monitoring well. Samples of light and heavy immiscible layers should be collected before the well is purged. Site-specific sampling plans may indicate that, based on the presence of NAPL, no groundwater sample is to be collected.

## 2.5.1 General Groundwater Sampling Procedures

The technique used to withdraw a groundwater sample from a well should be selected based on the parameters for which the sample will be analyzed. To ensure that the groundwater samples are representative, it is important to avoid physically altering or chemically contaminating the sample during collection, withdrawal, or containerization. If the samples are to be analyzed for volatile organic compounds, it is critical that air does not become entrained in the water column.

In some cases, it may become necessary to use dedicated equipment already in the well to collect samples. This is particularly true of high-volume, deep wells (>150 feet) where bladder pumps are

ineffective and bailing is impractical. If existing equipment must be used, however, identify the make and model of the pump and obtain information on component construction materials from the manufacturer or facility representatives. If an existing pump is to be used for sampling, make sure the flow volume can be reduced so that a reliable VOA sample can be taken. Record the specific port, tap, or valve from which the sample is collected. If nondedicated sampling equipment is used, the least contaminated wells should be purged and sampled first and most contaminated wells should be purged and sampled last (if past sampling data are available to make this determination).

General sampling procedures are as follows:

- 1. Clean sampling equipment should not be placed directly on the ground. Use a plastic drop cloth or feed line from clean reels. Never place contaminated lines back on reels.
- 2. A clean pair of new, non-powdered, disposable gloves will be worn each time a different location is sampled, and the gloves should be donned immediately prior to sampling. The gloves should be changed any time during sample collection when their cleanliness is compromised.
- 3. Sample containers for samples suspected of containing high concentrations of contaminants or NAPLs shall be stored separately to minimize cross-contamination.
- 4. Check the operation of the bailer check valve assemblies to confirm free operation.
- 5. Lower sampling equipment slowly into the well to avoid degassing the water and damaging the equipment.
- 6. Pump flow rates should be adjusted to eliminate intermittent or pulsed flow. The settings should be selected during the purging operations. In general, pumping rates should be set to the lowest rate that allows a smooth flow.
- 7. A separate sample volume should be collected to measure necessary field parameters. If samples are being collected with a pump, a flow-through cell should be used to measure water quality parameters.
- 8. Samples should be collected and containerized following procedures outlined in the projectspecific field sampling plan, QAPP, and in the order of the parameters' volatilization sensitivity. Table 2 lists the preferred collection order for common groundwater parameters.

## TABLE 2

## ORDER OF PREFERRED SAMPLE COLLECTION

1.	Volatile organic analysis (VOA)
2.	Purgeable organic halogens (POX)
3.	Total organic halogens (TOX)
4.	Cyanide
5.	Extractable organics
6.	Purgeable organic carbon (POC)

7.	Total metals
8.	Dissolved metals
9.	Total organic carbon (TOC)
10.	Phenols
11.	Sulfate and chloride
12.	Nitrate and ammonia
13.	Radionuclides

Intermediate containers should never be used to prepare VOA samples and should be avoided for all parameters in general. All VOA containers should be filled at a single sampling point or from a single bailer volume. Also refer to site-specific sampling plan for other sample handling requirements that may be unique to a site or to specific chemical constituents.

## 2.5.2 Collection of Volatile Organics Samples

This section discusses in detail the collection of samples for VOA using either a bailer or bladder pump. Other pumps (such as positive displacement) can be used. The following factors are critical to the collection of representative samples for VOA: ensuring that no air has become entrained in the water column, achieving low pump flow rates (less than 100 milliliters [mL] per minute, if possible), avoiding flow surges, and adjusting sample preservatives if they are found to cause reactions with the sample.

## 2.5.2.1 Collection with Bailers

Samples for VOA should be collected from the first bailer removed from the well after purging is complete. The most effective method requires two people. One person should retrieve the bailer from the well and pour its contents into the appropriate number of 40-mL VOA vials held by the second person. When filling the vials, overflow slightly, so that a convex meniscus forms on the top of the vial. Each vial should be capped, inverted, and gently tapped to check if any air bubbles are present. If a bubble exists, unscrew the cap and add more water, or discard and repeat if vials are not pre-preserved. If bubbling persists in a vial containing acid preservative, the sample may need to be collected without the preservative and the laboratory notified to add preservative upon receipt. The sample should be transferred from the bailer to the sample container in a manner that will limit the amount of agitation to reduce the loss of VOCs from the sample.

Always fill VOA vials from a single bailer volume. If the bailer is refilled, samples cannot be considered duplicates or splits.

## 2.5.2.2 Collection with a Pump

To successfully perform VOA sampling with a pump, the following steps should be completed:

- 1. Following manufacturer's directions, activate the pump. The discharge and recharge settings should be manually set and adjusted to pump at optimum flow rates. Reduce water flow rate for VOA sample collection to the lowest flow rate that allows a smooth flow.
- 2. Disconnect the discharge tubing from the flow-through cell, then collect VOA sample from discharge tubing. VOA vials should be placed beneath the discharge tubing while avoiding direct contact between the vials and the tubing. Never place tubing past the mouth of the VOA vial. The pump control should be adjusted as necessary to maintain a trickle of water to obtain a meniscus in the vial.
- 3. Continue with non-VOA sampling. The pump flow rate can be increased for non-volatile analytes as long as the discharge does not become turbid.

## 2.5.3 Sampling of Light Immiscible Floaters

The approach used when collecting a sample of a floating layer depends on the depth to the floating layer and the thickness of that layer. If the thickness of the floater is 2 feet or greater, a bottom-filling valve bailer should be used. Slowly lower the bailer until contact is made with the floater surface, and lower the bailer to a depth less than that of the floater-water interface depth as measured by preliminary measurements with the interface probe.

When the thickness of the floating layer is less than 2 feet and the depth to the surface of the floating layer is less than 15 feet, a peristaltic pump can be used to extract a sample.

When the thickness of the floating layer is less than 2 feet and the depth to the surface of the floating layer is beyond the effective lift of a peristaltic pump (greater than 20 to 25 feet), a bailer can be modified to allow filling from the top only (an acceptable alternative is to use a top-loading Teflon or stainless-steel bailer). Disassemble the bailer's bottom check valve and insert a piece of 2-inch-diameter Teflon sheet between the ball and ball seat. This will seal off the bottom valve. Remove the ball from the top check valve, thus allowing the sample to enter from the top. To overcome buoyancy when the bailer is lowered into the floater, place a length of 1-inch stainless steel pipe on the retrieval line above the bailer (this pipe may have to be notched to allow sample entry if the pipe remains within the top of the bailer). As an alternative, use a top-loading stainless-steel bailer. Lower the device, carefully measuring the depth to the surface of the floating layer, until the top of the bailer is level with the top of the floating layer. Lower the bailer an additional one-half thickness of the floating layer and collect the sample. This technique is the most effective method of collection if the floating layer is only a few inches thick.

## 2.5.4 Sampling of Heavy Immiscible Sinkers

The best method for collecting a sample of a sinker is the use of a double check valve bailer. The key to sample collection is controlled, slow lowering and raising of the bailer to and from the bottom of the well. Sample collection methods are equivalent to those described in Section 2.5.3 above.

## **EXHIBIT 1**

# EXAMPLE GROUNDWATER SAMPLING DATA SHEETS



# **GROUNDWATER SAMPLING DATA SHEET**

Monitoring Well No.:				Date:					
Project Name:				Project No.	:				
Sampler:									
Depth to Well Bottom:			ft	Well Volum	ne:				
Depth to Water:		ft		1-inch well = water column (ft) x 0.041 gal/ft 2-inch well = water column (ft) x 0.163 gal/ft					
Water Column:			ft	4-inch well	3-inch well = water column (ft) x 0.367 gal/ft 4-inch well = water column (ft) x 0.653 gal/ft				
Well Diameter:		10							
Immiscible Layers (Y/N):			W	Vell Volume:			gal		
							0		
Time Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L	Other		
					<u> </u>				
			. <u> </u>						
Purge start time		Method	of Purging	$\Box$ Pump (specify type	below)	□ Bailer (specify	type below)		
Purge end time		Purged I	Dry (y/n)?						
Total Volume Purged:				How Measured?			<u> </u>		
QA/QC Sample Collected Here?	□ Duplicate		Matrix Spike	□ Equip. Blank   □ N	No QA/QC Samp	le			
Date and Time of Sample Collect	ction:			Sample Number(s):	: <u> </u>				
Comments:									



#### **GROUNDWATER SAMPLING DATA SHEET**

Site Name Well Number Field Personnel Weather Conditions			Project Date	Number			
Well Depth Static Water Level Length of Water Column		ft ft ft	Well Dia	ameter		i	'n
TOC Elevation		ft amsl	Ground	water Ele	vation	1	ft amsl
Standing Well Volume 2-in: Multiply length of colu 4-in: Multiply length of colu 6-in: Multiply length of colu	ımn by 0.163 ımn by 0.653 ımn by 1.47	gal	Immisci	ible Layer	(yes/no)		
Began Purging (time) Volume Purged Purged Dry (yes/no)	gal		Ended	Purging (	(time)		
Well Sampling Method	Bailed (check o	one):	Pumped (check on	e):	Other (desc	ribe):	
	Teflon PVC Stainless		Submersible Bladder Peristaltic				

Groundwater Quality Parameter Measurements for Stabilization								
Parameter	1	2	3	4	5	6	7	
Time (24 hr)								
pH (std. Units)								
Conductivity (uS/cm)								
Temperature (F)								
Turbidity (NTU)								
Other								

Instruments used in measuring groundwater quality parameters:

Note any visual observations relevant to the site, monitoring well, or groundwater quality that may be useful in analyzing the groundwater sampling data:

#### SOP APPROVAL FORM

TETRA TECH, INC.

## EMI OPERATING UNIT

## ENVIRONMENTAL STANDARD OPERATING PROCEDURE

## PACKAGING AND SHIPPING SAMPLES

## **SOP NO. 019**

## **REVISION NO. 8**

Last Reviewed: August 2020

Carlo franks

Quality Assurance Approved

August 11, 2020

Date

## 1.0 BACKGROUND

In any sampling program, the integrity of a sample must be ensured from its point of collection to its final disposition. This standard operating procedure (SOP) describes procedures for packaging and shipping samples. Steps in the procedures should be followed to ensure sample integrity and to protect the welfare of persons involved in shipping and receiving samples.

## 1.1 PURPOSE

This SOP establishes the requirements and procedures for packaging and shipping nonhazardous environmental samples. It has been prepared in accordance with the U.S. Environmental Protection Agency (EPA) "Contract Laboratory Program Guidance for Field Samplers." Procedures described in this SOP should be followed for all routine sample packaging and shipping of nonhazardous samples. If procedures are to be modified for particular contract- or laboratory-specific requirements, modified procedures should be clearly described in site-specific plans such as work plans, field sampling plans (FSP), or quality assurance project plans (QAPP). Deviations from the procedures in this SOP must be documented in a field logbook. This SOP assumes that samples are already in the appropriate sample jars and that the sample jars are labeled.

## This SOP does not cover the packaging and shipment of Dangerous Goods or Hazardous Materials.

The shipment of Dangerous Goods (by air) and Hazardous Materials (by ground) requires specialized training. If you have NOT received this training in the last 2 years, you are NOT qualified to package or ship these materials and may be personally liable for any damages or fines. Contact one of Tetra Tech's shipping experts for assistance. Instructions to access the training course, shipping experts, and health and safety (H&S) contacts, and general information on packaging and shipping hazardous substances and dangerous goods can be obtained by checking the links provided in <u>Section 1.4</u> (References) and communicating with appropriate Tetra Tech H&S contacts listed on the EMI Operating unit internal H&S web site.

## 1.2 SCOPE

This SOP applies to packaging and shipping of environmental and nonhazardous samples. This SOP does not address shipping dangerous goods or hazardous materials.

## **1.3 DEFINITIONS**

**Airbill:** An airbill is a shipping form (such as a FedEx shipping form) acquired from the commercial shipper and is used to document shipment of the samples from the sampler to the designated analytical laboratory (see Figure 1).
**Blank:** A blank is any sample that is used to assess cross-contamination from sampling and sample management procedures. A typical blank sample will consist of distilled or deionized (DI) water (water sampling) or an air filter cartridge (air sampling) that is then analyzed by the laboratory to evaluate whether cross-contamination has been introduced. Each blank is assigned its own unique sample number. Blanks collected in the field include trip blanks, field blanks, and equipment blanks, all intended to assess potential cross-contamination. For example, a trip blank checks for contamination during sample handling, storage, and shipment from the field to the laboratory. Field blanks assess the contamination of water or soil from ambient air. Equipment blanks (also known as rinse blanks) assess contamination from incomplete decontamination procedures.

**Chain-of-Custody form:** A chain-of-custody form is used to document the transfer of custody of samples from the field to the designated analytical laboratory (see Figure 2). The chain-of-custody form is critical to the chain-of-custody process and is used to identify the samples in each shipping container to be shipped or delivered to the laboratory for chemical or physical (geotechnical) analysis. A copy of the chain-of-custody form is shipped with the samples and accompanies them from sampler to laboratory (see Figure 3).

**Custody seal:** A custody seal is a tape-like seal and is used to indicate that samples are intact and have not been disturbed during shipping or transport after the samples have been released from the sampler to the shipper (see Figure 4). The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been packaged for shipping (see Figure 5).

**Environmental samples:** Environmental samples include drinking water, groundwater, surface water, soil, sediment, treated municipal and industrial wastewater effluent, indoor and ambient air, nonhazardous bulk materials, soil gas, dust, asbestos, and biological specimens. Environmental samples typically contain low concentrations of contaminants and, when handled, require only limited precautionary procedures.

**Nonhazardous samples:** Nonhazardous samples are those samples that do not meet the definition of a hazardous sample AND do not need to be packaged and shipped in accordance with the International Air Travel Association's (IATA) "Dangerous Goods Regulations" (DGR) or U.S. Department of Transportation's "Hazardous Materials Regulations" defined in Title 49 *Code of Federal Regulations* (CFR).

The following definitions are provided to further distinguish environmental and nonhazardous samples from dangerous goods and hazardous samples:

**Dangerous goods:** Dangerous goods are articles or substances that can pose a significant risk to health, safety, or property when transported by air; they are classified as defined in Section 3 of the DGR (IATA 2020).

**Hazardous samples:** Hazardous samples include dangerous goods and hazardous substances. Hazardous samples shipped by air should be packaged and labeled in accordance with procedures specified by the DGR; ground shipments should be packaged and labeled in accordance with the Hazardous Material Regulations.

**Hazardous substance:** A hazardous substance is any material, including its mixtures and solutions, that is listed in 49 CFR 172.101 and its quantity, in one package, equals or exceeds the reportable quantity listed in Table 1 to Appendix A of 49 CFR 172.101.

#### 1.4 REFERENCES

- General Awareness, H&S Contacts, and Course Training Information (Tetra Tech, Inc., EMI Operating Unit. Intranet) On-line address: <u>https://int.tetratech.com/sites/EMI/hs/Pages/Dangerous-Goods-Shipping.aspx</u>
- International Air Transport Association (IATA). 2020. "Dangerous Goods Regulations. 2020." For sale at: <u>https://www.iata.org/en/publications/dgr/</u>. Updated annually, with new edition available late in year.
- U.S. Environmental Protection Agency (EPA). 40 CFR, 763 Subpart F, Asbestos Hazards Emergency Response Act (AHERA).
- EPA. 2014. "Contract Laboratory Program Guidance for Field Samplers." EPA 540-R-014-013. October. On-line address: <u>https://www.epa.gov/sites/production/files/2015-03/documents/samplers\_guide.pdf</u>.
- EPA. 2020. "Packing, Marking, Labeling and Shipping of Environmental and Waste Samples." EPA Region 4, LSASDPROC-209-R4. February 23. On-line address: <u>https://www.epa.gov/sites/production/files/2015-06/documents/Shipping-Environmental-and-Waste-Samples.pdf</u>

# 1.5 REQUIREMENTS AND RESOURCES

The procedures for packaging and shipping samples require the following:

- Coolers (insulated ice chest) or other shipping containers appropriate to sample type
- Ice
- Bubble wrap or similar cushioning material
- Chain-of-custody forms and seals
- Airbills

- Resealable plastic bags for sample jars and ice
- Tape (strapping and clear)
- Large plastic garbage bags for lining the cooler
- Temperature blank sample bottle filled with distilled water can be included in the cooler if appropriate to sample type
- Trip blank samples used to check for volatile contamination during sample handling in the field should accompany sample containers during shipment from laboratory to field (empty containers) and from field to laboratory (filled containers). It should remain in the cooler with sample containers during the sampling event. Trip blanks should be requested from the laboratory when containers are initially ordered.

## 2.0 **PROCEDURES**

The following procedures apply to packaging and shipping nonhazardous and environmental samples.

## 2.1 PACKAGING SAMPLES

After they have been appropriately containerized and labeled, environmental samples should be packaged as described in this section. This section covers procedures for packing samples for delivery by commercial carrier (air or ground) and hand delivery of environmental samples (by employee or courier), as well as shipping asbestos and air quality samples. Note that these instructions are general; samplers also should be aware of client-specific requirements concerning the placement of custody seals or other packaging provisions.

#### 2.1.1 Packaging Samples for Delivery by Commercial Carrier (Air or Ground)

Samples shipped by commercial carriers should be packed for shipment using the following procedures and in compliance with all carrier requirements:

#### **Preparing the sample:**

- 1. Allow a small amount of headspace in all bottles, or as instructed by the laboratory (except volatile organic compound [VOC] containers with a septum seal) to compensate for any changes in pressure and temperature during transfer.
- 2. Be sure the lids on all bottles are tight (will not leak). Lids maybe taped or sealed with custody seals as added protection or as required. For any sample containers that are not marked with a tare weight by the laboratory, cover the completed sample label on the container with clear tape to protect the label.
- 3. Place sample containers in resealable plastic bags.

#### **Preparing the cooler:**

- 1. Secure and tape the drain plug of the cooler with fiber or duct tape.
- 2. Line the cooler with a large plastic garbage bag before samples, ice, and absorbent packing material are placed in the cooler.
- 3. Wrap the sample containers in bubble wrap or line the cooler (bottom and sides) with a cushioning material to prevent breakage of bottles or jars during shipment.
- 4. If required by the laboratory for the analytical method, add a sufficient quantity of ice to the cooler to cool samples to 4 °C (± 2 °C). Ice should be double bagged in resealable plastic bags to prevent the melted ice from leaking out. If required, include one temperature blank (a sample bottle filled with distilled water) per cooler.

- 5. For VOC samples only, include one trip blank for VOC analysis per shipment matrix in each cooler.
- 6. Fill all remaining space between the bottles or jars with bubble wrap.
- 7. As each container is placed in the cooler, verify the sample information on the chain-of-custody form. The samples listed on the chain-of-custody form must match exactly with the contents of the cooler.
- 8. Securely fasten the top of the large garbage bag with tape (preferably plastic electrical tape).
- 9. If more than one cooler is being shipped, mark each cooler as "1 of 2," "2 of 2," and so forth.
- 10. Place the chain-of-custody forms (see Figure 2) into a resealable plastic bag, and tape the bag to the inner side of the cooler lid (see Figure 3). If you are shipping more than one cooler, copy the chain-of-custody form so that there is one copy of all forms in each cooler. The samples listed on the chain-of-custody form must match exactly with the contents of the cooler. Tape any instructions for returning the cooler to the inside of the lid.
- 11. Close the lid of the cooler and tape it shut by wrapping strapping tape around both ends and hinges of the cooler at least once.
- 12. Place two signed custody seals (see <u>Figure 4</u>) on opposite sides of the cooler, ensuring that each one covers the cooler lid and side of the cooler (see <u>Figure 5</u>; note that in contrast to the figure, the seals should be placed on the opposite sides of the cooler and offset from each other, rather than directly across from each other as shown in <u>Figure 5</u>). Place clear plastic tape over the custody seals so that the cooler cannot be opened without breaking the seal.
- 13. Shipping containers should be marked "THIS END UP." Arrow labels, which indicate the proper upward position of the container, may also be affixed to the container. As appropriate, the containers should also be labeled for Saturday delivery or other special requirements.
- 14. Ship samples overnight using a commercial carrier such as FedEx. As a best practice, electronic sample shipping labels should be prepared by the shipping agency's employees, at the direction of Tetra Tech employees or sampling personnel. This allows the sampling personnel to confirm special shipping requirements, such as Saturday delivery, and verify that samples will be shipped that day (that is, the last shipment of the day has not already occurred). If this is not possible, the airbill can be prepared by hand (see Figure 1), but samples should still be handed over directly to shipping agency employees and shipping details should be verified. The shipping label should be placed on the outside of the container.
- 15. A copy of the receipt with sample tracking number should be retained by the sampling personnel and delivery should be verified the next day.

#### 2.1.2 Hand Delivery of Environmental Samples (by Employee or Courier)

Samples hand-delivered to the laboratory should be packed for shipment using the following procedures:

#### **Preparing the sample:**

1. Bottles can be filled completely with sample (required for VOC containers with a septum seal).

2. Be sure the lids on all bottles are tight (will not leak).

#### **Preparing the cooler:**

- 1. Secure and tape the drain plug of the cooler with fiber or duct tape.
- 2. Wrap the sample containers in bubble wrap or line the cooler (bottom and sides) with a cushioning material to prevent breakage of bottles or jars during shipment.
- 3. As each container is placed in the cooler, verify the sample information on the chain-of-custody form. The samples listed on the chain-of-custody form must match exactly with the contents of the cooler.
- 4. If required for by the laboratory for the analytical method, add a sufficient quantity of ice to the cooler to cool samples to 4 °C. Ice should be double bagged in resealable plastic bags to prevent the melted ice from leaking out. If required, include one temperature blank (a sample bottle filled with distilled water) per cooler.
- 5. For VOC samples only, include one trip blank for VOC analysis per shipment matrix in each cooler.
- 6. If more than one cooler is being shipped, mark each cooler as "1 of 2," "2 of 2," and so forth.
- 7. Place the chain-of-custody form (see Figure 2) in a resealable plastic bag and tape to the inside of the cooler lid (see Figure 3), close the lid, and seal with custody seals (see Figure 5; note that in contrast to the figure, the seals should be placed on the opposite sides of the cooler and offset from each other, rather than directly across from each other as shown in Figure 5). Place clear plastic tape over the custody seals so that the cooler cannot be opened without breaking the seal. Transfer the cooler to the courier. When samples will be delivered directly to the laboratory, it is sufficient to close the cooler and hand-deliver it with the chain-of-custody form.
- 8. Include any instructions for returning the cooler to the inside of the lid.
- 9. If the cooler is being transferred to a courier, the shipping containers should be marked "THIS END UP," and arrow labels, which indicate the proper upward position of the container should be affixed to the container.

#### 2.1.3 Shipping Asbestos Samples

Asbestos samples shipped by commercial carriers should be packed for shipment using the following procedures and in compliance with all carrier requirements:

- 1. Place each asbestos sample in a small reseatable plastic bag or Whirl-pak seatable bag. Seat the
- bags carefully and place the sample bags in a larger resealable plastic bag.
- 2. Select a rigid shipping container and pack the samples upright in a noncontaminating, nonfibrous medium such as a bubble pack to minimize excessive movement during shipping.
- 3. Avoid using expanded polystyrene because of its static charge potential. Also avoid using particle-based packaging materials because of possible contamination.

- 4. Affix custody seals to the samples or outer sample bag so that the bags cannot be opened without breaking the seal.
- 5. Insert the chain-of-custody form in the box. Include a shipping bill and a detailed listing of samples shipped, their descriptions and all identifying numbers or marks, sampling data, shipper's name, and contact information.
- 6. Ship bulk samples in a separate container from air samples. Bulk samples and air samples delivered to the analytical laboratory in the same container will be rejected.
- 7. For each sample set, designate which are the ambient samples, which are the abatement area samples, which are the field blanks, and which is the sealed blank if sequential analysis is to be performed.
- 8. Hand-carry samples to the laboratory in an upright position if possible; otherwise, choose that mode of transportation least likely to shake the samples in transit.
- 9. Address the package to the laboratory sample coordinator by name when known and alert him or her of the package description, shipment mode, and anticipated arrival as part of the chain-of-custody and sample tracking procedures. This information will also help the laboratory schedule timely analysis for the samples when they are received.

#### 2.1.4 Shipping Air Samples

Packaging and shipping requirements for air samples vary depending on the media used to collect the samples and the analyses required. Sampling media typically include Summa canisters and Tedlar bags for whole air samples, filters for metals and particulate matter, and sorbent tubes for organic contaminants. This section of the SOP provides general guidelines for packaging and shipping air samples collected using these media. The project FSP or QAPP should also be reviewed for any additional project-specific requirements or instructions.

#### **Summa Canister Samples**

- 1. Close the canister valve by tightening the knob clockwise or flipping the toggle switch. Replace the brass cap on the canister inlet.
- 2. If a flow controller was used to collect the air sample over a specified time interval, the flow controller should be removed before replacing the brass cap.
- 3. Fill out the sample tag on the canister with the sample number and the date and time of collection. Include the identification number of the flow controller on the sample tag if one was used. Make sure the information on the sample tag matches the chain-of-custody form.
- 4. Complete the chain-of-custody form. In addition to the information normally included, the form should include the following data: sample start and stop dates and times; initial and final Summa canister vacuum readings; Summa canister identification number; and flow controller identification number.

- 5. Package the Summa canister (and flow controller) in its original shipping box with the original packaging material. Tape the box shut and apply custody seals if required. Note: Summa canisters should never be packaged with ice.
- 6. Summa canister shipments typically include several canisters, and may include more than one shipping box. The chain-of-custody form for the shipment should be sealed within one of the shipping boxes. If more than one box is being shipped, mark each box as "1 of 2," "2 of 2," and so forth.
- 7. Ship the samples by a method that will meet the holding time. Summa canister samples should be analyzed within 30 days of sample collection.

#### **Tedlar Bag Samples**

- 1. Before removing it from the sample port, close the Tedlar bag by tightening the valve clockwise. The bag should only be approximately half-full to allow for pressure changes during shipping and handling of the sample. Keep the Tedlar bag out of direct sunlight to preserve the sample.
- 2. Fill out the label on the bag with the sample number and the date and time of sample collection. Make sure the information on the label matches the chain-of-custody form.
- 3. Complete the chain-of-custody form.
- 4. Package the Tedlar bag in a shipping box with appropriate packing material to prevent the bag from being punctured or damaged. Multiple bags can be packaged in the same box. Tape the box shut and apply custody seals if required. Note: Tedlar bag samples should not be cooled or packaged with ice, although they can be shipped in an ice chest to protect the samples.
- 5. Tedlar bag shipments may include more than one shipping box. The chain-of-custody form for the shipment should be sealed within one of the shipping boxes. If more than one box is being shipped, mark each box as "1 of 2," "2 of 2," and so forth.
- 6. Ship the samples using priority overnight delivery. Tedlar bag samples should be analyzed within 3 days of sample collection.

#### **Filter Cassette Samples**

- 1. Disconnect the filter cassette from the air sampling pump and replace the plastic caps on the inlet and outlet openings.
- 2. Attach a label to the sample that includes the sample number and the date and time of sample collection. Make sure the information on the label matches the chain-of-custody form.
- 3. Complete the chain-of-custody form. In addition to the information normally included, the form should include the following data: sample start and stop dates and times; initial and final air flow rates (or average flow rate); volume of air sampled; and sampling pump identification number.
- 4. Package the filter cassettes in a shipping box (such as a FedEx box). Use an appropriate packing material (such as bubble wrap) to separate the samples and prevent damage.
- 5. Place the chain-of-custody form within the box, seal the box, and apply custody seals if required. Filter cassette samples typically do not need to be cooled, but check the field sampling plan (FSP) or Quality Assurance Project Plan (QAPP) for project-specific requirements.

6. Ship the samples by a method that will meet the holding time.

#### **Sorbent Tube Samples**

- 1. Disconnect the sample tube from the air sampling pump and seal both ends of the tube with plastic caps.
- 2. Complete a sample label that includes the sample number and the date and time of sample collection. Make sure the information on the label matches the chain-of-custody form.
- 3. If the tube is small and the label cannot be attached to the tube, the tube can be placed in a small resealable plastic bag and the label can be attached to the bag or placed inside the bag with the tube.
- 4. Complete the chain-of-custody form. In addition to the information normally included, the form should include the following data: sample start and stop dates and times; initial and final air flow rates (or average flow rate); volume of air sampled; and sampling pump identification number.
- 5. Packaging requirements for the sample tubes will depend on the analysis required, and the sampler should check the FSP or QAPP for project-specific requirements (for example, tubes may need to be wrapped in aluminum foil to prevent exposure to light). Packaging containers and methods include (1) shipping boxes (as described under filter cassette samples), (2) small sample coolers filled with double-bagged ice, and (3) small sample coolers filled with blue (reusable) ice.
- 6. Place the chain-of-custody form within the box or container, seal the box or container, and apply a custody seal if required.
- 7. If coolers are used for shipping, tape instructions for returning the cooler to the inside of the lid.
- 8. Ship the samples by a method that will meet the holding time.

#### **Polyurethane Foam (PUF) Tube Samples**

- 1. Disconnect the PUF tube from the air sampling pump and wrap the tube in aluminum foil.
- 2. Attach a label to the wrapped sample tube that includes the sample number and the date and time of sample collection. Make sure the information on the label matches the chain-of-custody form.
- 3. Wrap the PUF tube in bubble wrap and place the tube in a glass shipping jar.
- 4. Complete the chain-of-custody form. In addition to the information normally included, the form should include the following data: sample start and stop dates and times; initial and final air flow rates (or average flow rate); volume of air sampled; and sampling pump identification number.
- 5. Package the PUF tube jars in a cooler that is filled with double-bagged ice. Use bubble wrap or other cushioning material to separate the samples and prevent breakage.
- 6. Place the chain-of-custody form within the cooler, seal the cooler, and apply a custody seal if required.
- 7. If coolers are used for shipping, tape instructions for returning the cooler to the inside of the lid.
- 8. Ship the samples by a method that will meet the holding time. Samples collected in PUF tubes typically must be extracted within 7 days of collection.

#### 2.2 SHIPPING DOCUMENTATION FOR SAMPLES

Airbills, chain-of-custody forms, and custody seals must be completed for each shipment of nonhazardous environmental samples.

Field staff collecting samples should also review their field work plans to confirm what documentation must be completed during each sampling event, including client-specific requirements. For example, some EPA programs have a specific requirement to use Scribe software, an environmental data management system, to create sample documentation, electronically input information into Traffic Report or chain-of-custody forms, and enter other data.

- The Scribe software can be accessed from the EPA Environmental Response Team (ERT) at the following address: <u>http://www.ertsupport.org/scribe\_home.htm</u>
- The ERT User Manual for Scribe, reference, and training materials can be accessed from the Scribe Support Web site at the following address: <u>http://www.epaosc.org/scribe</u>

Note that some laboratories must routinely return sample shipping coolers within 14 calendar days after the shipment has been received. Therefore, the sampler should also include instructions for returning the cooler with each shipment, when possible. The sampler (not the laboratory) is responsible for paying for return of the cooler and should include shipping airbills bearing the sampler's shipping account number, as well as a return address to allow for return of the cooler. Samplers should use the least expensive option possible for returning coolers.

#### 2.3 SHIPMENT DELIVERY AND NOTIFICATION

A member of the field sampling team must contact the laboratory to confirm it accepts deliveries on any given day, especially Saturdays. In addition, samplers should ensure the laboratory has been notified in advance of the pending shipment and notify any additional parties as required. The sampler needs to know the laboratory's contact name, address, and telephone number and be aware of the laboratory's requirements for receiving samples.

In addition, samplers should be aware of the sample holding times, shipping company's hours of operation, shipping schedule, and pick-up and drop-off requirements to avoid delays in analytical testing.

#### **Priority Overnight Delivery**

Priority overnight delivery is typically the best method for shipment. Delays caused by longer shipment times may cause the sample temperature to rise above the acceptable range of  $4^{\circ}$  C ( $\pm 2^{\circ}$  C) and technical holding time may expire, which in turn may compromise sample integrity and require recollection of

samples. If sample delivery procedures are to be modified for particular contract- or laboratory-specific requirements, the procedures should be clearly described in site-specific plans such as work plans, FSPs, or QAPPs.

# **Saturday Delivery**

If planning to ship samples for Saturday delivery, the laboratory must be contacted in advance to confirm it will accept deliveries on Saturdays or arrange for them to be accepted. In addition, samplers should ensure the laboratory has been notified in advance of the pending shipment and notify any additional parties as required.

# 2.4 HEALTH AND SAFETY CONSIDERATIONS

In addition to the procedures outlined in this SOP, all field staff must be aware of and follow the health and safety practices that result from the Activity Hazard Analyses (AHA) for the project. The AHAs include critical safety procedures, required controls, and minimum personal protective equipment necessary to address potential hazards. The hazards specific to project tasks must be identified and controlled to the extent practicable and communicated to all project personnel via the approved, projectspecific health and safety plan (HASP).

### 3.0 POTENTIAL PROBLEMS

The following potential problems may occur during sample shipment:

- Leaking package. If a package leaks (either from broken sample containers or melting ice), the carrier may open the package and return the package. Special care should be taken during sample packaging to minimize potential leaks.
- Improper labeling and marking of package. If mistakes are made in labeling and marking the package, the carrier will most likely notice the mistakes and return the package to the shipper, thus delaying sample shipment. A good practice is to have labels, forms, and container markings double checked by a member of the field team.
- Bulk samples and air samples delivered to the analytical laboratory in the same container. If samples are combined in this way, they will be rejected. Always ship bulk samples in separate containers from air samples.
- Issues in packing asbestos samples. When asbestos samples are shipped, avoid using expanded polystyrene because of its static charge potential. Also avoid using particle-based packaging materials with asbestos samples because of possible contamination.
- Improper, misspelled, or missing information on the shipper's declaration. The carrier will most likely notice these errors as well and return the package to the shipper. A good practice is to have another field team member double check this information.
- Missed drop off time or wrong location. Missing the drop off time or having the wrong location identified for drop off will delay delivery to the laboratory and may cause technical holding times to expire. Establish the time requirements in advance of completing the field effort and be sure and provide some contingency time for potential delays such as traffic or checking and redoing paperwork.
- Incorrectly packaging samples for analysis at multiple laboratories. For example, inorganic samples may be shipped to one laboratory for analysis, while organic samples may need to be shipped to another laboratory. All field staff should be aware which samples are to be shipped to which laboratory when they package samples for multiple types of analysis.
- Holidays or weather-related delays. Be aware of holidays and weather forecasts that could cause delays in delivery. Delays caused by longer shipping times may cause technical holding times to expire, which in turn may compromise sample integrity or require recollection of samples.
- Not noting field variances in field logbook. Field variances should be noted in the field logbook and the project manager notified. Common field variances include:
  - Less sample volume collected than planned. Notify appropriate staff and the laboratory to ensure there is an adequate amount for analysis.
  - Sample collected into incorrect jar because of broken or missing bottle-ware. Notify appropriate laboratory staff to ensure there is no confusion regarding the analysis of the sample.

#### EXAMPLE OF A FEDEX US AIRBILL FOR LOW-LEVEL ENVIRONMENTAL SAMPLES

0	1	Pankana	•
~	1	Express US Airbill # 1234 5678 901C	m 0200 Sender's Copy
0	1	1 From Please photod group kerk Date: 3/1/20 Sendar's Fodix 9 9 9 9 - 9 9 9 9 - 9	4 Express Package Service "A exemution Packages up to REIts A example of REIts A example
0	ł	Sander's Tyler Hanlon Proves 662 , 555-1812	Start Rusiness Day     2 or 2 first over time       Prefix First Over time     Perfix Start over time       Instrument time     Perfix Start over time       Instrument time     Perfix Start over time       Instrument time     Perfix Start over time
0	g I	Consury	XI     Partial Provide Comparison       Section and the Comparison of th
	463.33	Action 1234 Main Street Instantion	Pack Sandard Densight Sandard Service Street Sandard Service Street Sandard Service Street
0	1800	cry Phoenix Sum AZ zr 85034	5 Packaging Second and Second
~	fedfa	2 Year Internal Billing Reference Int Teleview of agent at each	Den Line Alter
0	18006	3 To Pecipren's Liam Riley Provel 405 ; 555-8300	Special Manifold and Delivery Signature Options: Internet and Internet and Saturity Delivery Saturity Delivery
0	COM	Consury Ridgeway Design	No. Spread res Sectors Spread are Industry Spread res Control Spread r
0	fedex	Address 2020 Vision Street	Been this ability word contain Cargorium gandh?       Interest new locations:       With the new location of the nenviron of the new location o
0		<sub>Dev</sub> Atlanta Sam GA ze 30305	7 Pagnetat. Altric: Construction of the set
0			Notivesta Tourfridges Tourflinker TourbodewetValuer 450
0	1	Ship it. Track it. Pay for it. All coline. Gete ledex.com	

#### Filling Out the FedEx US Airbill

- The sender *must complete* the following fields on the pre-printed airbill:
  - Section 1: Date
  - Section 1: Sender's FedEx Account Number (available from your office administrator)
  - Section 1: Sender's Name, Company, Address, and Phone Number
  - Section 2: Internal Billing Reference (Project Number) (this field may not be present on newer airbills)
  - Section 3: Recipient's Name, Company, Address, and Phone Number
  - Section 4: Express Package or Freight Services (Priority Overnight)
  - Section 5: Packaging (usually "Other," your own packaging)
  - Section 6: Special Handling (Saturday delivery if prearranged with receiving laboratory; "No" dangerous goods contained in shipment)
  - Section 7: Payment ("Bill to Sender")
  - Section 7: Total Number of Packages
  - Section 7: Total Weight (completed by FedEx employee)
  - Section 8: Delivery Signature Options ("No Signature Required")

#### Completing a Sample Chain-of-Custody Form (See Also Section 2.2 on SCRIBE for Forms)

After samples have been collected, they will be maintained under chain-of-custody procedures. These procedures are used to document the transfer of custody of the samples from the field to the designated

analytical laboratory. The same chain-of-custody procedures will be used for the transfer of samples from one laboratory to another, if required.

The field sampling personnel will complete a Chain-of-Custody and Request for Analysis (CC/RA) form for each separate container of samples to be shipped or delivered to the laboratory for chemical or physical (geotechnical) analysis. These forms are often triplicate, carbonless forms. Care should be taken when completing the form that all copies are legible—PRESS FIRMLY WHEN WRITING. Information on the form will include:

- 1. Project identification (ID) (for example, contract and task order number);
- 2. Project Contract Task Order (CTO) number;
- 3. Laboratory Project Order (PO) number;
- 4. Tetra Tech Technical Contact;
- 5. Tetra Tech Project Manager;
- 6. Laboratory name;
- 7. Field sampler names;
- 8. Field sampler signature;
- 9. Sample ID;
- 10. Date and time of sampling;
- 11. Sample matrix type;
- 12. Sample preservation method; note "NONE" if no preservatives;
- 13. Number and types of containers per sample;
- 14. Sample hazards (if any);
- 15. Requested analysis;
- 16. Requested sample turnaround time or any special remarks (for example, possible presence of free product or high screening concentrations);
- 17. Page \_\_ of \_\_;
- 18. Method of shipment;
- 19. Carrier/waybill number (if any);
- 20. Signature, name, and company of the person relinquishing the samples and the person receiving the samples when custody is transferred;

- 21. Date and time of sample custody transfer;
- 22. Condition of samples when they are received by the laboratory.

The sample collector will cross out any blank space on the CC/RA form below the last sample number listed on the part of the form where samples are listed.

The sampling personnel whose signature appears on the CC/RA form is responsible for the custody of a sample from time the sample is collected until the custody of the sample is transferred to a designated laboratory, a courier, or to another Tetra Tech employee for transporting a sample to the designated laboratory. A sample is considered to be in custody when the custodian: (1) has direct possession of it; (2) has plain view of it; or (3) has securely locked it in a restricted access area.

Custody is transferred when both parties to the transfer complete the portion of the CC/RA form under "Relinquished by" and "Received by" or a sample is left at a FedEx facility pending shipment. Signatures, printed names, company names, and date and time of custody transfer are required. When custody is transferred, the Tetra Tech sampling personnel who relinquished the samples will retain the third sheet (pink copy) of the CC/RA form. When the samples are shipped by a common carrier, a Bill of Lading supplied by the carrier will be used to document the sample custody, and its identification number will be entered on the CC/RA form. Receipts of Bills of Lading will be retained as part of the permanent documentation in the Tetra Tech project file.

# EXAMPLE OF A CHAIN-OF-CUSTODY FORM (WHITE COPY)

	Tetra Tech EM Inc. Oakland Office Chain of Custody Record No. 9814									4	13G175 Page of								
	1999 Harrison Street, Suite 500 Oakland, CA 94612 510.302.6300 Phone		Lab: OAKZF EMAX chnical contact: Sandy Sack Pelosuca Jours roject manager: Je Dellitonine Pelosuca Jourson Field samplers' signatures Pelosuca Jourson Field samplers' signatures Pelosuca Jourson Pelosuca Jourson			-	]					New King King King King King King King King							
	510.433.0830 Fax Project name: Concord PAPNI	130AR 2 T THEMI technical contact:				N	o./Cor	ntai	ner 7	ypes			Ana	lysi	s Req	luire	đ		
	Project (CTO) number: 1036 14 590 29	TIEMI project manager: Stave Delltonine				I VOA	r Amber ni Poly	9	al Poly	a	-	2	Purgeables Extractables						
	Sample ID	Point ID/Depth	Date	Time	Matrix 3	40 H	1 lite 500 n	Sleev	Glass 250 n	Enco	VOA SV0/	Pest	HqT	PCB					
123456	0295RE 55Ø1 0295RE 55Ø2 02982C 3D55Ø1 029C3D55Ø2 029C3D55Ø3 020C3D55Ø3		7/22/13 7/22/13 7/24/13	1240 1203 1215 1215 1230 1215 1230 1215	() () ()			Co		ny Na	× × × × ×				Date		Tim		
	Received by: Part of the second secon			Deberga toppoor			Trie	NT-	t	7(7			25	2/3/12		163	20		
	Relinquished by: Received by: Relinquished by:						71)						7/						
	Received by:																		
7002	urnaround time/remarks: Standard TAT Temp-20°C Prioritize: SVOCS, tPH-2 on 029C3D5501 -> BY Thennetals																		
	Fed Ex #: 8612 4667 77	213																	
WHITE-Laboratory Copy YELLOW-Sample Tracker PINK-File Copy																			

#### EXAMPLE OF A SAMPLE COOLER WITH ATTACHED DOCUMENTATION



Source: U.S. Environmental Protection Agency. 2014.

Place the necessary paperwork (chain-of-custody form, cooler return instructions, and associated paperwork) in the shipping cooler or acceptable container. All paperwork must be placed in a plastic bag or pouch and then secured to the underside of the shipping container lid.

EXAMPLE OF A CUSTODY SEAL

# **Custody Seal**

DATE

SIGNATURE



# EXAMPLE OF SHIPPING COOLER WITH CUSTODY SEALS

Source: U.S. Environmental Protection Agency. 2014.

Please note that the two seals typically are affixed to opposite sides of the cooler and offset from each other, although the offset is not depicted on the EPA figure above.

# SOP APPROVAL FORM

TETRA TECH, INC.

# EMI OPERATING UNIT

# ENVIRONMENTAL STANDARD OPERATING PROCEDURE

# **RECORDING NOTES IN FIELD LOGBOOKS**

# **SOP NO. 024**

# **REVISION NO. 3**

Last Reviewed: July 2020

Carlo punts

Quality Assurance Approved

July 2, 2020

Date

#### 1.0 BACKGROUND

Complete and accurate field documentation is critical to a successful project and the field logbook is an important tool to support field documentation needs. The field logbook should include detailed records of all field activities, document interviews with people, and record observations of conditions at a site. Entries should be described in a level of detail to allow personnel to reconstruct, after the fact, activities and events that occurred during their field assignments. Furthermore, entries should be limited to facts. Avoid speculation related to field events and do not record hearsay or unfounded information that may be presented by other parties during field activities. For example, do not record theories regarding the presence or absence of contamination when you are collecting field screening data or speculation regarding the reasons for a property owner's refusal to grant access for sampling.

Field logbooks are considered accountable documents in enforcement proceedings and may be subject to review. Therefore, the entries in the logbook must be accurate and detailed, but should not contain speculative information that could conflict with information presented in subsequent project deliverables and correspondence. Also be aware that the field logbooks for a site may be a primary source of information for depositions and other legal proceedings that may occur months or years after field work is complete and long after our memories have faded. The accuracy, neatness, and completeness of field logbooks are essential for recreating a meaningful account of events.

Field notes may also be recorded digitally, using a variety of software programs. The requirements and use of digital recording programs is not addressed in this standard operating procedure (SOP) because many items are unique to the selected software system. However, many of the principles discussed in this SOP will apply to the digital recording of field notes.

#### 1.1 PURPOSE

The purpose of this SOP is to provide guidance to ensure that field logbook documentation collected during field activities meets all requirements for its later use. Among other things, field logbooks may be used for:

- Identifying, locating, labeling, and tracking samples
- Recording site activities and the whereabouts of field personnel throughout the day
- Documenting any deviations from the project approach, work plans, quality assurance project plans, health and safety plans, sampling plans, and any changes in project personnel
- Recording arrival and departure times for field personnel each morning and evening and weather conditions each day

• Describing photographs taken during the project.

In addition, the data recorded in the field logbook may later assist in the interpretation of analytical results. A complete and accurate logbook also aids in maintaining quality control, because it can verify adherence to project scope and requirements.

# 1.2 SCOPE

This SOP establishes the general requirements and procedures for documenting site activities in the field logbook.

#### 1.3 **DEFINITIONS**

None.

#### 1.4 **REFERENCES**

Compton, R.R. 1985. Geology in the Field. John Wiley and Sons. New York, NY.

#### 1.5 REQUIREMENTS AND RESOURCES

The following items are required for field notation:

- Bound (sewn) notebooks
- Ballpoint pens or Sharpies with permanent waterproof ink
- 6-inch ruler (optional)

Field logbooks should be bound (sewn) with water-resistant and acid-proof covers, and each page should have preprinted lines or grids and numbered pages. They should be approximately  $7^{1}/_{2}$  by  $4^{1}/_{2}$  inches or  $8^{1}/_{2}$  by 11 inches in size. Loose-leaf sheets are not acceptable for use as a field logbook, although logs and field forms used to record field measurements and data are acceptable as loose-leaf sheets maintained in a three-ring binder with numbered pages, as a supplement to the logbook. If notes are written on loose paper, they must be transcribed as soon as possible into a bound field logbook by the same person who recorded the notes originally.

Ideally, distribution of logbooks should be controlled by a designated person in each office. This person assigns a document control number to each logbook, and records the assignment of each logbook distributed (name of person, date distributed, and project number). The purpose of this procedure is to ensure the integrity of the logbook before its use in the field, and to document each logbook assigned to a

project. In the event that more than one logbook is assigned to a project, this process will ensure that all logbooks are accounted for at project closeout.

# 2.0 **PROCEDURES**

The following subsections provide general guidelines and formatting requirements for field logbooks, and detailed procedures for completing field logbooks.

# 2.1 GENERAL GUIDELINES

- A separate field logbook must be maintained for each project. If a site consists of multiple subsites (or operable units), designate a separate field logbook for each subsite. Similarly, if multiple activities are occurring simultaneously requiring more than one task leader (for example, well installation, private well sampling, or geophysical survey), each task leader should maintain a separate field logbook to ensure that each activity is documented in sufficient detail.
- At larger sites, a general field log may be kept at the site trailer or designated field office to track site visitors, document daily safety meetings, and record overall site issues or occurrences.
- Data from multiple subsites may be entered into one logbook that contains only one type of information for special tasks, such as periodic well water-level measurements.
- All logbooks must be bound and contain consecutively numbered pages. If the pages are not prenumbered, the sequential page number should be written at the top of each page.
- No pages can be removed from the logbook for any purpose.
- All information must be entered using permanent, waterproof ink, either a traditional ballpoint pen or a permanent marker. Do not use pens with water-based ink (typically identified as rollerball or gel ink pens) because the ink may wash out if the paper gets wet. Pencils are not permissible for field notes because information can be erased. The entries should be written dark enough so that the logbook can be easily photocopied.
- Be sure that all entries are legible. Use print rather than cursive writing and keep the logbook pages free of dirt and moisture to the extent possible.
- Set apart critical information such as sample numbers by circling or drawing a box around the critical data.
- Do not enter information in the logbook that is not related to the project. The language used in the logbook should be factual and objective. Avoid speculation that could conflict with information presented in subsequent project deliverables and correspondence (see Section 1.0 above).
- Use military time, unless otherwise specified by the client. If a logbook entry is not related to a specific event, set it aside with the identification as a "NOTE."
- Include site sketches, as appropriate.
- Begin a new page for each day's notes.
- Include the date, project number, and location (if the project has multiple locations) at the top of each page.

- At the end of a day, draw a single diagonal line through any unused lines on the page, and sign at the bottom of the page. Note and implement any client-specific requirements (for example, some clients require each logbook page to be signed).
- Write notes on every line of the logbook. Do not skip any pages or parts of pages unless a day's activity ends in the middle of a page.
- If a line is left blank for some reason, cross it out (with a single line) and initial to prevent unauthorized entries.
- Cross out (with a single line) and initial any edits to the logbook entries. Note and implement any client-specific requirements (for example, some clients also require that edits be dated). Edits should only be made if the initial entry is illegible or erroneous. Do not make corrections for grammar or style.

# 2.2 LOGBOOK FORMAT

The layout and organization of each field logbook should be consistent and generally follow the format guidelines presented below. Some clients or contracts may have specific formatting guidelines that differ somewhat from this SOP; review client requirements at the start of the project to help ensure any client-specific guidelines are integrated.

#### 2.2.1 Logbook Cover

Spaces are usually provided on the inside front cover (or the opening page in some logbooks) for the company name, address, contact names, and telephone numbers. If preprinted spaces for this information are not provided in the logbook, write the information on the first available page. Information to be included on the inside front cover or first page includes:

- Logbook document control number (assigned by issuer)
- "Book # of #" (determined by the project manager if there is more than one logbook for the project)
- Contract and task order numbers
- Name of the site and site location (city and state)
- Name of subsite (or operable unit), if applicable
- Type of activity, if the logbook is for a specific activity, such as well installation or indoor air sampling
- Beginning and ending dates of activities entered into the logbook

## 2.2.2 Inside Cover or First Page

Spaces are usually provided on the inside front cover (or the opening page in some logbooks) for the company name, address, contact names, and telephone numbers. If preprinted spaces for this information are not provided in the logbook, write the information on the first available page. Information to be included on the inside front cover or first page includes:

- Tetra Tech project manager and site manager names and telephone numbers
- Tetra Tech office address
- Client contact and telephone number
- Site safety officer and telephone number
- Emergency contact telephone number (911, if applicable, or nearest hospital)
- Subcontractor contacts and telephone numbers
- Site property owner or property manager contact information

Note—some clients prohibit the inclusion of personally identifiable information such as personal mobile telephone numbers on official project records.

# 2.3 ENTERING INFORMATION IN THE LOGBOOK

The following lists provide guidance on the types of information to be included in a typical field logbook. This guidance is general and is not intended to be all-inclusive. Certain projects or clients may specify logbook requirements that are beyond the elements presented in this SOP.

#### 2.3.1 General Daily Entries

- Document what time field personnel depart the Tetra Tech office and arrive at the hotel or site. If permitted by the client to charge travel time for site work, document what time personnel leave and arrive at the hotel each day. (This information may be needed at remote sites where hotel accommodations are not near the site.)
- Indicate when all subcontractors arrive and depart the site.
- Note weather conditions at the time of arrival on site and any changes to the weather that might affect completion of project tasks during the day.
- Include the date and project number at the top of each page.
- Document that a site safety meeting was held and include the basic contents of the meeting.
- List the level of personal protection to be used for health and safety.

- Summarize the day's planned activities.
- Summarize which activities each field team member will be doing.

# 2.3.2 Field Activity Entries

- Refer to field data collection forms for details about field data collection activities (for example time, date, depth of samples, and field measurements). If separate field sampling sheets are not used, see Section 2.3.3 regarding logbook entries for sampling activities.
- Refer to well purge forms, well construction logs, and other activity-specific forms as applicable rather than including this type of information in the field logbook. These other forms allow the information to be more accessible at a later date.
- List any air monitoring instrumentation used, with readings and locations.
- Refer to instrument field logs for equipment calibration information.
- Summarize pertinent conversations with site visitors (agency representatives, property owners, client contacts, and local citizens).
- Summarize any problems or deviations from the quality assurance project plan (QAPP) or field sampling plan.
- Document the activities and whereabouts of each team member. (As indicated in Section 2.1, multiple logbooks may be required to ensure sufficient detail for contemporaneous activities).
- Indicate when utility clearances are completed, including which companies participated.
- Indicate when verbal access to a property is obtained.
- Include names, addresses, and telephone numbers of any pertinent site contacts, property owners, and any other relevant personnel.
- Document when lunch breaks or other work stoppages occur.
- Include approximate scale for all diagrams. If a scale is not available, write "not to scale" on the diagram. Indicate the north direction on all maps and cross-sections, and label features on each diagram.

#### 2.3.3 Sampling Activity Entries

The following information should typically be on a sample collection log and referenced in the logbook. If the project does not use sample sheets as a result of project-specific requirements, this information should be included in the logbook.

- Location description
- Names of samplers
- Collection time

- Designation of sample as a grab or composite sample
- Identification of blind duplicates or split samples
- Type of sample (water, sediment, soil gas, or other medium)
- On-site measurement data (such as pH, temperature, and specific conductivity)
- Field observations (odors, colors, weather)
- Preliminary sample description
- Type of preservative used
- Instrument readings, if applicable

#### 2.3.4 Closing Daily Entries

- Describe decontamination procedures (personnel and equipment).
- Describe handling and disposition of any investigation-derived wastes.
- Summarize which planned activities were completed and which ones were not.
- Note the times that personnel depart the site for the day.
- Summarize any activities conducted after departing the site (paperwork, sample packaging, etc.). This may be required to document billable time incurred after field activities were completed for the day.

#### 2.3.5 Photographic Log Entries

- Before using a digital camera, ensure that the system date and time are correct. Verify whether the timestamp is being recorded on the image, if required.
- Indicate in the text that photographs were taken and the location where the photographs can be found (for example, in the project file) and identify the photographer.
- Begin a new photolog page for each new field day.
- Record the time of photograph so that the image can be generally identified when reviewing the digital files.
- Note the direction in which the photograph was taken, along with any relevant details that might not be understood when looking at the photograph.
- In the event that a film camera is used, the sequential number of the image should also be recorded, and the time from the logbook will be the recorded time for the photograph.

# 2.4 LOGBOOK STORAGE

Custody of logbooks must be maintained at all times. During field activities, field personnel must keep the logbooks in a secure place (locked car, trailer, or field office) when the logbook is not in personal possession. When the field work is over, the logbook should be included in the project file, which should be in a secured file cabinet; in addition, if directed by the project manager, scan logbook pages for electronic file management upon returning to the office. The logbook may be referenced in preparing subsequent reports and scanned logbook pages may be included as an appendix to a report. However, it is advisable to obtain direction directly from the client before including the logbook as a report appendix, because its inclusion may not be appropriate in all cases.

#### 2.5 HEALTH AND SAFETY CONSIDERATIONS

In addition to the procedures outlined in this SOP, all field staff must be aware of and follow the health and safety practices that result from the Activity Hazard Analyses (AHA) for a project. The AHAs include critical safety procedures, required controls, and minimum personal protective equipment necessary to address potential hazards. The hazards specific to project tasks must be identified and controlled to the extent practicable and communicated to all project personnel via the approved, projectspecific health and safety plan.

# SOP APPROVAL FORM

TETRA TECH, INC.

EMI OPERATING UNIT

# ENVIRONMENTAL STANDARD OPERATING PROCEDURE

#### ACTIVE SUBSURFACE GAS SAMPLING

## **SOP NO. 074**

# **REVISION NO. 4**

Last Reviewed:

Carlo punts

Quality Assurance Approved

November 2021

Date

#### 1.0 BACKGROUND

This standard operating procedure (SOP) addresses active subsurface gas sampling. It addresses: (1) installing soil gas and sub-slab gas probes, (2) evaluating the integrity of the probes, (3) collecting environmental samples, and (4) decommissioning the probes. The focus of the SOP is (1) soil gas probe installation using a manual slide hammer, rotary hammer drill, direct-push drill rig, or hollow-stem auger drill rig, (2) sub-slab gas probe installation, and (3) active soil gas and sub-slab gas sampling using Tedlar bags, syringes, stainless-steel SUMMA canisters, filter cartridges, and sorbent tubes. As with all SOPs, users should be aware of any client-, state-, or location-specific requirements related to collecting subsurface gas samples.

#### 1.1 PURPOSE

The purpose of this SOP is to provide guidance for soil gas and sub-slab gas sampling from the installation of the probes through leak detection, purging, sampling, and decommissioning.

#### 1.2 SCOPE

This SOP applies to all personnel collecting soil gas and sub-slab gas samples. Site-specific planning documents (for example, a health and safety plan, a quality assurance project plan [QAPP], and a field sampling plan [FSP] or sampling and analysis plan [SAP]) should be followed during soil gas and sub-slab gas sampling activities.

#### **1.3 DEFINITIONS**

Grout: Hydrated bentonite or bentonite/cement mixture used as a seal.

**Sampling train:** The tubing and all connections from the ground surface to, or including, the sample container or sampling media.

**Soil gas:** The gases or atmosphere filling the void spaces in soil and unconsolidated sediment. The soil gas composition may include components of natural origin with or without detectable quantities of contaminants or byproducts from human activity.

**Sub-slab gas sampling:** The collection of vapor from the zone just beneath the lowest floor slab of a building (that is, the slab that rests directly on the ground, regardless of whether the slab is at the ground surface of the surrounding area or below grade).

SUMMA canister: A stainless-steel canister that is treated to render the interior surface nearly

chemically inert and non-reactive. The SUMMA canister is prepared for sampling by evacuating its

contents to vacuum; the canister uses negative pressure to collect a gas sample.

#### 1.4 **REFERENCES**

This section cites references used to support this SOP. On-line addresses are those active at the time this SOP was prepared.

- ASTM International (ASTM). 2012. ASTM Standard D7663-12, "Standard Practice for Active Soil Gas Sampling in the Vadose Zone for Vapor Intrusion Evaluations." ASTM International, West Conshohocken, PA. Reapproved 2018. DOI: 10.1520/D7663-12R18E01.
- ASTM. 2018. ASTM Standard D7648/D7648M-18, "Standard Practice for Active Soil Gas Sampling for Direct Push or Manual-Driven Hand-Sampling Equipment." ASTM International, West Conshohocken, PA. DOI: 10.1520/D7648 D7648M-18.
- California Environmental Protection Agency, Department of Toxic Substances Control (DTSC). 2012. "Advisory – Active Soil Gas Investigations." April.
- DTSC. 2015. "Advisory Active Soil Gas Investigations." Final. July. On-line address: https://dtsc.ca.gov/wp-content/uploads/sites/31/2018/01/VI\_ActiveSoilGasAdvisory\_FINAL.pdf
- DTSC. 2020. Public Draft. Supplemental Guidance: Screening and Evaluating Vapor Intrusion. February. On-line address: <u>https://dtsc.ca.gov/wp-content/uploads/sites/31/2020/02/Public-Draft-Supplemental-VI-Guidance 2020-02-14.pdf</u>
- Cox Colvin and Associates, Inc. 2013. "Standard Operating Procedure Leak Testing Vapor Pin Via Mechanical Means." December 3.
- Cox Colvin and Associates, Inc. 2016a. "Standard Operating Procedure Leak Testing Vapor Pin Via Mechanical Means." March 29. On-line address: <u>http://vaporpin.coxcolvin.com/wp-content/uploads/2016/09/VP-Leak-Testing-via-mechanical-means.pdf</u>
- Cox Colvin and Associates, Inc. 2016b. "Standard Operating Procedure Installation and Extraction of the Vapor Pin." April 3. September 9. On-line address: <u>http://www.vaporpin.com/wp-content/uploads/2016/09/Vapor-Pin-SOP-09-2016-Web.pdf</u>
- Interstate Technology and Regulatory Council (ITRC). 2007. "Vapor Intrusion Pathway: A Practical Guideline." VI-1. Washington, DC. Interstate Technology and Regulatory Council, Vapor Intrusion Team. January. On-line address: <u>http://www.itrcweb.org/documents/VI-1.pdf</u>
- Ohio Environmental Protection Agency (Ohio EPA). 2020. "Sample Collection and Evaluation of Vapor Intrusion to Indoor Air for Remedial Response and Voluntary Action Programs." Division of Environmental Response and Revitalization. March. On-line address: <u>https://epa.ohio.gov/portals/30/vap/docs/VI%20guidance%20Final%203-6-2020.pdf</u>
- Tetra Tech EMI Operating Unit (Tetra Tech). 2020. "Organic Vapor Air Monitoring." Environmental Standard Operating Procedure (SOP) No. 003. Revision No. 4. May. On-line address: <u>https://int.tetratech.com/sites/EMI/quality/Pages/Standard-Operating-Procedures.aspx</u>.

- Tetra Tech. 2020. "Packaging and Shipping Samples." Environmental SOP No. 019. Revision No. 8. August. On-line address: <u>https://int.tetratech.com/sites/EMI/quality/Pages/Standard-Operating-Procedures.aspx</u>.
- United States Environmental Protection Agency (EPA). 2020. "Sampler's Guide Contract Laboratory Program Guidance for Field Samplers." EPA Office of Superfund Remediation and Technology Innovation (OSRTI). Washington, DC. OLEM 9240.0-51. EPA 540-R-20-005. November. On-line address: <u>https://www.epa.gov/sites/default/files/2021-</u>03/documents/samplers\_guide\_clp\_guidance\_for\_field\_samplers\_november\_2020.pdf.
- EPA. 2015. "OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air." EPA Office of Solid Waste and Emergency Response (OSWER). OSWER Publication 9200.2-154. June. On-line address: <u>http://www.epa.gov/sites/production/files/2015-09/documents/oswer-vapor-intrusion-technicalguide-final.pdf</u>. (Note also Errata for guide at: <u>https://www.epa.gov/sites/default/files/2016-10/documents/errata.pdf</u>).

# 1.5 **REQUIREMENTS AND RESOURCES**

This section describes equipment and resource needs for installing soil gas and sub-slab gas probes,

performing leak tests, purging probes, and collecting samples.

# 1.5.1 General Field Equipment

The following general equipment may be required for field procedures related to soil gas and sub-slab gas sampling:

- Logbook, field data sheets (see Figures 1, 2, and 3 for example field data sheets), or electronic recording devices (tablet, smartphone, computer, etc.)
- Digital camera
- Global Positioning System recording device with sub-meter accuracy
- Gloves
- Photoionization detector (PID), flame ionization detector (FID), or multiple-gas meter (if required by the site-specific FSP, SAP, or QAPP)
- Health and safety equipment indicated in the site-specific health and safety plan

# 1.5.2 Installation of Soil Gas Probes

Soil gas probe locations may be advanced to the proposed depth using a manual slide hammer, rotary hammer drill, direct-push equipment, or hollow-stem auger. Once the borehole is advanced to the proposed depth, additional equipment is used to complete installation of the soil gas probe. The following equipment may be included to accomplish these procedures:

- Manual slide hammer, rotary hammer drill, direct-push equipment, or hollow-stem auger
- Post-run tubing system (probe rod, threaded tubing adapter, expendable drive point holder, and expendable drive point)
- Soil gas implant system (probe rod, vapor sampling implant, expendable drive point holder, and expendable implant anchor)
- Inert tubing for gas sampling (made of nylon, polyether ether ketone [PEEK], Teflon, or other material, depending on the chemical of concern), with dimensions of <sup>1</sup>/<sub>4</sub>-inch outer diameter (OD) by 3/16-inch inner diameter (ID), or smaller; small lengths of silicone (<sup>1</sup>/<sub>4</sub>-inch ID) or other flexible tubing may be used to complete connections to barbed fittings or other non-compression fittings
- Unions, tees, two-way and three-way valves or stopcocks, nuts, ferrules, and caps to connect tubing, as either compression fittings (for example, Swagelok), Luer fittings, quick-connecting fittings, hose barbs, or other means. NOTE: Each laboratory has its own type of fittings and connections.
- Wrenches to accommodate compression fittings, typically in the range <sup>1</sup>/<sub>2</sub>-inch to 9/16-inch
- Sharp blade for cutting tubing
- Tape measure (length depends on potential sampling depths)
- Clean sand or glass beads
- Dry granular bentonite
- High-purity water for bentonite hydration
- Cement or concrete mix (for permanent installations)
- Well protective box or casing (for permanent installations)
- Protective bumpers or bollards surrounding probe (optional)

#### 1.5.3 Installation of Sub-Slab Gas Probes

Two methods may be used when installing sub-slab gas probes: (1) permanent probe or (2) Vapor Pin. Equipment needed for each method is identified in the following subsections.

#### 1.5.3.1 Permanent Sub-Slab Gas Probe

A permanent sub-slab gas probe typically uses a stainless-steel tube connected to stainless-steel or brass compression fittings (for example, Swagelok) (see Figure 4). Push-to-connect fittings (for example, Alpha fittings) can also be used (provided they are constructed of inert materials and do not contain greases or oils that may contact the soil gas sample). As needed, performance testing should be

conducted using equipment blank samples or absorption studies to verify materials do not introduce a positive or negative bias to measured concentrations. The probe is then placed through a vacant hole in the concrete slab and cemented in place. The following equipment may be used to install permanent sub-slab gas probes:

- Hammer drill or rotary hammer drill
- <sup>3</sup>/<sub>8</sub>-inch and 1-inch hammer drill bits
- Portable wet/dry vacuum cleaner with high-efficiency particulate air (HEPA) filter
- Stainless steel vapor implant screen, such as Geoprobe soil vapor implants, or AMS, Inc. gas vapor implants
- Tape measure
- Tube or pipe cutter
- <sup>1</sup>/<sub>4</sub>-inch OD stainless-steel tubing, pre-cleaned, instrument grade
- Two 9/16-inch wrenches or equivalent adjustable wrenches
- <sup>1</sup>/<sub>4</sub>-inch hex wrench
- Teflon thread tape
- Teflon washer ID <sup>1</sup>/<sub>4</sub>-inch, OD <sup>3</sup>/<sub>4</sub>-inch, or modeling clay
- Disposable cup (less than 12-ounce); quick-setting cement; tap water; and mixing implement (that is, plastic fork, popsicle stick, or similar)
- Whenever possible, a valve should be installed on the top of the vapor implant to allow measurement of soil gas pressure with a digital manometer.

# 1.5.3.2 Vapor Pin

An alternative method for sub-slab gas probe installation uses a stainless-steel or brass barbed probe fitted with a silicon sleeve. The most-common of these is the Vapor Pin (<u>https://www.vaporpin.com/</u>). Other acceptable brands of similar sub-slab probes with a similar configuration are available; this SOP, however, will specifically address Vapor Pin installation.

The probe is placed in a vacant hole in the concrete slab and sealed using a silicon sleeve surrounding the probe (see Figure 5). The following equipment may be used to install the Vapor Pin.

• Hammer drill or rotary hammer drill

- <sup>5</sup>/<sub>8</sub>-inch and 1<sup>1</sup>/<sub>2</sub>-inch hammer drill bits
- Portable wet/dry vacuum cleaner with HEPA filter
- Bottle brush
- Assembled Vapor Pin with silicon sleeve
- Vapor Pin protective cap
- Vapor Pin installation/extraction tool
- Dead blow hammer
- Vapor Pin flush-mounted cover (optional)
- Disposable cups (less than 12-ounce); mixing implement (that is, plastic fork, popsicle stick, or similar); quick setting cement; and tap water (for decommissioning)

#### 1.5.4 Leak Tests

Four types of leak detection tests may be performed to evaluate the integrity of the soil gas or sub-slab gas probe: shut-in, shroud, laboratory leak tracer, and water dam (sub-slab gas probes only).

#### 1.5.4.1 Shut-in Leak Detection Test

The following items are needed to conduct a leak detection test on the sampling train before collecting a soil gas sample.

- Desired sampling media (Tedlar bags, syringes, stainless-steel SUMMA canisters, filter cartridges, or sorbent tubes)
- Additional tubing and fittings (compression/Luer/quick-connect/hose barbs/other) (see Section 1.5.2)
- Shut-in test system:
- 3-way stopcock valve with appropriate fitting connections
- 2-way valve with appropriate fitting connections
- Integrated vacuum (negative pressure to -15 inches mercury or -200 inches water) gauge connected to a tee or other appropriate fitting enabling it to be installed in line (see Figure 6)
- Graduated syringe, air sampling pump, or peristaltic pump
- Stopwatch
- Wrenches to connect and tighten fittings, in the range 9/16-inch to  $\frac{1}{2}$ -inch
#### 1.5.4.2 Shroud Leak Detection Test

The following items are needed to conduct a leak detection test on the soil gas or sub-slab gas probe and sampling train prior to collecting a soil gas sample.

- Desired sampling media (Tedlar bags, syringes, stainless-steel SUMMA canisters, filter cartridges, or sorbent tubes)
- 3-way stopcock valve with appropriate fitting connections
- Shroud (hard plastic box with three openings or a plastic bag) (See Figure 7)
- Draft guard with heavy beads (if using a plastic bag as shroud)
- Additional tubing and fittings (compression/Luer/quick-connect/hose barbs/other) (see Section 1.5.2)
- Wrenches to connect and tighten fittings, in the range 9/16-inch to ½-inch
- Tedlar bag in vacuum chamber with pump and calibrator for pump, or graduated syringe.
- Helium gas supply and helium detector

#### 1.5.4.3 Laboratory Leak Tracer Detection Test

A laboratory leak tracer detection test is performed by spraying a cloth or other absorbent material with a volatile liquid leak detection compound (tracer) and sequentially positioning the cloth near each joint or connection in the sampling system while collecting an actual soil gas or sub-slab gas sample. Alternately, one may inject a volatile leak detection compound (liquid or gas tracer) into a shroud covering the entire sampling system while collecting an actual soil gas or sub-slab gas sample. The tracer compound is then analyzed along with other target compounds during laboratory analysis of the sample. A disadvantage of this leak detection procedure is that the presence or absence of a leak (and the degree of leakage, if any) is not determined until samples have already been collected and analyzed. The following items are needed to conduct this leak detection test on the soil gas or sub-slab gas probe and sampling train:

- Desired sampling media (Tedlar bags, syringes, stainless-steel SUMMA canisters, filter cartridges, or sorbent tubes)
- Tubing and fittings (compression/Luer/quick-connect/hose barbs/other) (see Section 1.5.2)
- Liquid leak detection compound (hexane, pentane, difluoroethane, or isopropanol) or gas leak detection compound contained within a supply container (helium or sulfur hexafluoride)
- Cloth or absorbent material for absorbing the liquid leak detection compound

- Shroud (hard plastic box with at least one injection port, or plastic bag)
- Draft guard with heavy beads (if using a plastic bag as shroud)

# 1.5.4.4 Water Dam Leak Detection Test

A water dam leak detection test may be used to evaluate whether a sub-slab gas probe is leaking at the surface seal and possibly at the first connection off the probe. The following items are used to conduct the water dam leak test:

- High-purity water (organic- and inorganic-free)
- Tubing and fittings (compression/Luer/quick-connect/hose barbs/other) (see Section 1.5.2)
- Short length (about 2 inches long) of 2-inch diameter polyvinyl chloride (PVC) pipe
- Water-insoluble modeling clay free of volatile organic compounds (VOC)
- Wet/dry vacuum

# 1.5.5 Soil Gas and Sub-Slab Gas Probe Purging

The following items are involved with purging a soil gas or sub-slab gas probe and sampling train following installation:

- Desired sampling media (Tedlar bags, syringes, stainless-steel SUMMA canisters, filter cartridges, or sorbent tubes)
- Additional tubing and fittings (compression/Luer/quick-connect/hose barbs/other) (see Section 1.5.2)
- A three-way stopcock valve with appropriate fitting connections (if not already installed when leak testing)
- Wrenches to connect and tighten fittings, in the range 9/16-inch to ½-inch
- Graduated syringe or air sampling pump with flow calibrator
- Photoionization detector (PID), flame ionization detector (FID), or multiple gas meter (if required by site-specific FSP, SAP, or QAPP)
- Stopwatch

# 1.5.6 Soil Gas and Sub-Slab Gas Sampling Media

This section covers soil gas and sub-slab gas sampling using Tedlar bags, syringes, SUMMA canisters or, sorbent tubes and filter cartridges.

#### 1.5.6.1 Tedlar Bags

When using Tedlar bags to collect soil gas and sub-slab gas samples, the following items are needed:

- A port in the sampling train to which the Tedlar bag can be connected
- Wrenches to connect and tighten fittings, in the range 9/16-inch to ½-inch
- Additional tubing and fittings (compression/Luer/quick-connect/hose barbs/other) (see Section 1.5.2)
- Tedlar bags or equivalent with appropriate fittings
- Air pump capable of a flow of 200 milliliters per minute (mL/min)
- Flow rate calibrator (for example, Bios DryCal or equivalent)
- Vacuum chamber for collecting samples using Tedlar bags, with a viewing window for observing the Tedlar bag as it fills
- Sampling tee (stainless steel, Teflon, or equivalent) for collecting field duplicate samples. For stainless-steel tees, the following parts may be useful: Swagelok tee (SS-400-3-4TMT) stainless-steel Swagelok tube fitting, male run tee [¼-inch tube OD x ¼-inch male National Pipe Thread (NPT) x ¼-inch tube OD] or SS-400-3 stainless-steel Swagelok tube fitting, union tee [¼-inch tube OD]).
- Stopwatch or watch

#### 1.5.6.2 Syringes

When using syringes to collect soil gas and sub-slab gas samples, the following items are needed:

- A port in the sampling train to which the syringe can be connected
- Wrenches to connect and tighten fittings, in the range 9/16-inch to ½-inch
- Additional tubing and fittings (compression/Luer/quick-connect/hose barbs/other) (see Section 1.5.2)
- Clean, graduated laboratory-prepared syringes
- A two-way stopcock valve with appropriate fitting connections
- Stopwatch or watch
- Aluminum foil

#### 1.5.6.3 SUMMA Canisters

When using SUMMA canisters to collect soil gas and sub-slab gas samples, the following items are needed:

- A port in the sampling train to which the SUMMA canister can be connected
- Wrenches to connect and tighten fittings (in the range 9/16-inch to  $\frac{1}{2}$ -inch)
- Additional tubing and fittings (compression/Luer/quick-connect/hose barbs/other) (see Section 1.5.2)
- A supply of clean, evacuated SUMMA canisters
- For SUMMA canisters, (1) a pressure gauge to verify internal pressure and (2) a flow controller (a combined flow controller/pressure gauge may also be used)
- Sampling tee (stainless steel, Teflon, or equivalent) for collecting field duplicate samples. The laboratory supplying the SUMMA canisters should supply these fittings.
- Stopwatch or watch

# 1.5.6.4 Sorbent Tubes and Filter Cartridges

When using sorbent tubes and filter cartridges to collect soil gas and sub-slab gas samples, the following items are needed:

- A port in the sampling train to which the sorbent tube or filter cartridge can be connected.
- Wrenches to connect and tighten fittings, in the range 9/16-inch to ½-inch
- Additional tubing and fittings (compression/Luer/quick-connect/hose barbs/other) (see Section 1.5.2)
- Sorbent tubes or filter cartridges for the appropriate target compounds
- Air pump capable of a flow of 200 mL/min
- Flow rate calibrator (for example, Bios DryCal or equivalent)
- Sampling tee (stainless steel, Teflon, or equivalent) for collecting field duplicate samples. For stainless-steel tees, the following parts may be useful: Swagelok tee (SS-400-3-4TMT) stainless-steel Swagelok tube fitting, male run tee [¼-inch tube OD x ¼-inch male NPT x ¼-inch tube OD] or SS-400-3 stainless-steel Swagelok tube fitting, union tee [¼-inch tube OD]).
- Stopwatch or watch
- Aluminum foil (for wrapping sorbent tubes or filter cartridges, as required for sample preparation)

#### 2.0 **PROCEDURES**

This section describes selecting soil gas sampling locations, installing soil gas probes and sub-slab gas probes, and preparing the probes for sampling (including probe equilibration, leak testing, and purging). This section also provides procedures for collecting samples using Tedlar bags, syringes, SUMMA canisters, sorbent tubes, and cartridges. Finally, this section discusses additional considerations for soil gas sampling—including collecting field duplicate and field blank samples, decontaminating soil gas sampling equipment, and decommissioning soil gas and sub-slab gas probes.

# 2.1 SAMPLING LOCATION SELECTION

Sampling locations should be selected and prepared for sampling as described in the site-specific QAPP and FSP or SAP. Soil gas samples may be collected from depths as shallow as 3 feet below ground surface (bgs) (although sampling shallower than 5 feet is not recommended because of atmospheric influences) or as deep as 50 feet bgs. The sampling depth depends on the objectives of the project, soil type encountered, depth to groundwater, and the type of drilling or probing equipment used. Soil gas probes should not be installed within or below the capillary fringe. The horizontal spacing of soil gas sampling points (grid size) can range from a few feet to over 500 feet. Again, probe depth and spacing are functions of project-specific objectives and site conditions. Sub-slab gas samples are collected from directly below a building's concrete slab. If possible, the location should be centrally located and at least 5 feet away from obvious cracks in the slab. Some states provide guidance and requirements for the number and spacing of sub-slab gas probes to be installed in residences, so it is important to consult each state's requirements when planning a sampling event. The site-specific QAPP and FSP or SAP should cite the state's guidance and the sub-slab sampling approach should reflect the guidance.

# 2.2 SOIL GAS PROBE INSTALLATION

The following three general sample probe advancement methods are used, depending on probe depth and length of service:

- A hand-driven (powered rotary hammer or manual slide hammer) probe or hand auger, typically good for shallow applications.
- A hydraulic-driven (direct-push) probe, good for shallow to moderately deep temporary and permanent applications.
- A drill rig-driven (hollow-stem auger) probe, typically good for deep, permanent applications including nested, multi-depth probe constructions.

Two methods of soil gas probe installation are described in this section: (1) using a post-run tubing (PRT) system where soil gas samples are collected through the end of a probe rod after it has been retracted from an expendable drive point, or (2) anchoring a permanent or semi-permanent soil gas implant to an expendable drive point, where soil gas is sampled through the implant after the probe rod is retracted partially or completely.

# 2.2.1 Post-Run Tubing System

The post-run tubing system is composed of a hollow probe rod with a threaded PRT adapter, expendable drive point holder, and an expendable drive point on the lead rod (Figure 8). Installation of a PRT system requires the following steps:

- Advance the PRT system to the target sample depth.
- Assemble the soil gas tubing with a threaded tubing adapter (see Section 1.5.2 for approved tubing types).
- Lower the soil gas sampling tubing with a threaded tubing adapter down to, and into, the threaded expendable drive point holder and twist until fully secured.
- Place a cap at the end of the tubing to prevent ambient air from infiltrating the subsurface.
- Retract the probe rod to expose the desired sampling interval.
- Place hydrated bentonite at the surface around the probe rod to create a seal.
- Because this is a temporary method, no sand pack (or glass beads), dry granular bentonite, Portland cement/bentonite grout or other sealant, or permanent casing is required. The top end of the probe rod should be low enough to the ground to perform leak detection testing.

# 2.2.2 Soil Gas Implant

A soil gas probe may be installed using a vapor sampling implant attached to an expendable implant anchor (Figure 9) or by placing a vapor sampling implant into an empty borehole (Figure 10). Implement the following steps:

- Drive the soil gas implant (vapor sampling implant) attached to the expendable implant anchor (that is, expendable drive point) to the proper depth or lower the pre-prepared soil gas implant down the pre-drilled borehole to the proper depth.
- Pour sand or glass beads through the probe rod or the vacant borehole to a depth that sufficiently covers the soil gas implant (typically 3 inches above the implant).
- Pour dry, granular bentonite to a thickness of 12 inches above the sand or glass beads.

- Install hydrated, granular bentonite above the dry granulated bentonite to a thickness of at least 36 inches. If only one soil gas implant will be installed, then this layer can extend to the ground surface (or near the ground surface to allow for a cement cap).
- Implants may be nested vertically in the same borehole, with each implant separated from the one below by 12 inches of dry granular bentonite and at least 36 inches of hydrated granular bentonite, as described in the bullets above. To install a second (or third, etc.) implant, simply repeat the steps in the preceding bullets.
- Depending on the use of the soil gas probe, the surface seal may be completed with cement and casing to further seal the system and protect the tubing.
- Place a sealed cap at the end of the tubing to prevent ambient air from infiltrating the subsurface.

# 2.2.3 Cautions During Installation of Permanent Soil Gas Probes

In all permanent soil gas implant installation scenarios, caution should be taken to avoid bridging (the creation of gaps or pockets within the material as it is poured) while installing the sand pack and bentonite seals. For deeper soil gas implants (greater than 15 feet), a tremie pipe may be used to minimize bridging and to segregate the bentonite from the sand pack. A minimum of 3 feet of bentonite should be placed above the soil gas probe. Cement may be used to complete the seal at the surface and to guide water away from the probe housing. To mitigate accidental damage or vandalism, a locking cover may be used to house the tubing. Guard posts may be installed in areas where accidental damage is likely to occur.

# 2.3 SUB-SLAB GAS PROBE INSTALLATION

Sub-slab probes are installed to investigate the gas composition within the substrate immediately beneath a concrete slab. A hole is drilled through the concrete slab and into the substrate material, and a probe is installed. Two types of probes are typically installed (1) a permanent sub-slab gas probe, or (2) a Vapor Pin. The subsections below provide installation instructions for both types of probes.

# 2.3.1 Permanent Sub-Slab Probe

Installation of a permanent sub-slab gas probe uses cement to seal the probe from aboveground ambient air. The following method was modified from Ohio EPA guidance and is consistent with most state and federal guidance. See Figure 4 for an illustration of the construction details. Implement the following steps:

- Check for buried obstacles and utilities (pipes, electrical lines, etc.) before beginning installation.
- Using a hammer drill or rotary hammer drill, drill a <sup>3</sup>/<sub>8</sub>-inch diameter inner or pilot hole approximately 2 inches in depth, being careful not to puncture through the concrete slab. If the slab is less than 2 inches thick, stop drilling before puncturing the slab.

- Using the <sup>3</sup>/<sub>8</sub>-inch diameter pilot hole as your center, drill a 1-inch diameter outer hole to a depth of approximately 1<sup>3</sup>/<sub>8</sub> inches. If the slab is less than 1<sup>3</sup>/<sub>8</sub> inches thick, stop drilling before puncturing the slab.
- Vacuum or brush any cuttings and concrete dust out of the holes.
- Resume drilling the <sup>3</sup>/<sub>8</sub>-inch diameter pilot hole, completing it through the slab and extending a few inches into the sub-slab substrate material. Vacuum any cuttings and concrete dust from the hole.
- Determine the length of the stainless-steel tubing required to reach from the bottom of the outer hole through the slab and into the open cavity below the slab. Cut a piece of stainless-steel tubing equal to this length.
- Compression-fit one end of the stainless-steel tubing to the Swagelok end of the SS-400-7-4 stainless-steel Swagelok tube fitting. Follow tightening instructions provided with the compression fittings using two 9/16-inch wrenches or adjustable wrenches. If using stainless-steel fittings, wrap one layer of Teflon thread tape around the threads to minimize binding. Brass fittings do not require Teflon tape. Do not overtighten.
- Connect an SS-4-HP Swagelok stainless-steel pipe fitting, hollow hex plug, <sup>1</sup>/<sub>4</sub>-inch male NPT to the NPT end of the SS-400-7-4 stainless-steel Swagelok tube fitting to prevent the interior of the tube fitting from getting contaminated.
- Slide the Teflon washer onto the stainless-steel tube. Alternatively, place rolled modeling clay around the ¼-inch stainless-steel tubing below the Swagelok nut before sub-slab probe installation.
- Place the completed probe into the outer hole, with the tubing extending down into the pilot hole, to check fit and to ensure that the stainless-steel tubing is not in contact with the slab material.
- In the disposable cup, mix a small amount of quick-setting cement with water. The mixture should be stiff and moldable.
- With the probe assembly in place, put the quick-setting cement mixture into the outer hole around the assembly, making sure cement is filling any void space. The Teflon washer (or modeling clay) should prevent cement from entering the pilot hole.
- Allow the cement to cure before conducting any leak test.
- Prepare a sampling train that will connect to this sub-slab gas probe assembly by installing tubing (see Section 1.5.2 for approved tubing types) to the Swagelok SS-400-1-4 stainless-steel Swagelok tube fitting, male connector (¼-inch tube OD to ¼-inch male NPT), using two 9/16-inch wrenches or adjustable wrenches.
- For field duplicate sampling, either (1) replace the Swagelok SS-400-1-4 fitting mentioned in the previous bullet with the SS-400-3-4TMT stainless-steel Swagelok tube fitting, male run tee (¼-inch tube OD x ¼-inch male NPT x ¼-inch tube OD), or (2) use a short stretch of tubing to attach the SS-400-3 stainless-steel Swagelok tube fitting, union tee (¼-inch tube OD) to the Swagelok SS-400-1-4 fitting.

# 2.3.2 Vapor Pin

Installation of the Vapor Pin is done in accordance with the manufacturer's (Cox-Colvin and Associates, Inc. 2016b) SOP as described below:

- Check for buried obstacles and utilities (pipes, electrical lines, etc.) before beginning installation.
- For a flush-mount installation, drill a 1½-inch diameter hole at least 1¾ inches into the slab using a hammer drill or rotary hammer drill. Vacuum any cuttings and concrete dust out of the hole while drilling. Be careful not to puncture the concrete slab with the 1½-inch diameter drill bit.
- Drill a <sup>5</sup>/<sub>8</sub>-inch diameter hole, centered within the larger-diameter hole, through the concrete slab and extending about 1 inch into the sub-slab substrate material to form a void. Vacuum any cuttings and concrete dust out of the hole while drilling.
- Brush the hole with a bottle brush, and carefully vacuum any cuttings and concrete dust from the hole.
- Place the lower end of the Vapor Pin assembly with silicon sleeve, and fitted with the protective cap, into the <sup>5</sup>/<sub>8</sub>-inch drilled hole. Place the installation/extraction tool over the Vapor Pin to protect the barb fitting and tap the Vapor Pin into place using a dead blow hammer. Make sure the installation/extraction tool is centered well and aligned parallel to the Vapor Pin to avoid damaging the barb fitting.
- For flush-mount installations, cover the Vapor Pin with a flush-mount cover using either a plastic cover or the Vapor Pin manufacturer's stainless-steel cover.
- Figure 5 presents a diagram of a completed Vapor Pin installation.

# 2.4 EQUILIBRIUM TIME

Subsurface conditions are disturbed during soil gas probe and sub-slab gas probe installations. The following equilibration times are recommended to allow disturbed subsurface conditions to equilibrate and return to normal conditions. After the appropriate equilibration time, the soil gas probe or sub-slab gas probe should be tested to ensure that there are no leaks between the aboveground atmosphere and the subsurface (through the surface seal), within the subsurface (through subsurface seals), and within the gas sampling train.

#### 2.4.1 Soil Gas Probe

The following general equilibrium times should be allowed based on the soil gas probe installation method (also check for any state regulations for minimum soil gas equilibration time):

• A minimum of 30 minutes for soil gas probes installed by direct-push methods where the probe rod remains in the ground (PRT installation)

- 2 hours for temporary or permanent soil gas implants installed by direct-push methods
- 48 hours for soil gas probes installed by hollow-stem auger drilling methods

#### 2.4.2 Sub-Slab Gas Probe

Approximately 2 hours should be allowed for the quick-setting cement to cure and subsurface conditions to return to equilibrium. However, site access limitations imposed by property owners may limit equilibration to a shorter time. In this case, the equilibrium time used should be noted along with an appropriate explanation on the field data sheet or field logbook.

#### 2.5 LEAK DETECTION PROCEDURES

Leakage during soil gas and sub-slab gas sampling may dilute gas samples with ambient air or air from subsurface zones that are not the target of sampling; leakage may produce results that either underestimate or overestimate the actual contaminant concentrations. Four types of leak detection tests may be performed: (1) a shut-in leak detection test to evaluate whether a leak is occurring in the aboveground sampling train, (2 and 3) a shroud leak detection test or laboratory leak tracer detection test to assess whether a leak is occurring in the sampling train or through surface and subsurface seals, and (4) a water dam leak detection test to evaluate whether a sub-slab gas probe is leaking at the surface seal and possibly at the first connection off the probe. Shut-in and shroud tests are conducted before purging and sampling. A laboratory leak tracer detection test is conducted after purging but during sampling. A water dam test is performed on a sub-slab gas probe port before purging and sampling. Other general leak test considerations include:

- A leak test should always be performed on the sampling train before sampling.
- For soil gas sampling, a leak test should be performed at least once on the sampling train seals before sampling, although some state agencies may not require such testing if the desired soil gas sampling interval is more than 5 feet bgs. Therefore, state regulations should be consulted before sampling.
- Some sampling media may not be suitable for certain leak detection tests. For example, a laboratory may not be able to analyze for a leak check compound (for example, isopropyl alcohol) if samples are collected using mercury sorbent tubes. In these situations, the sampler should note the issue and proceed with the most appropriate leak detection test. Alternatively, the sampler can use a sampling medium to conduct the leak detection test, before switching to the sampling media targeting the contaminant(s) of interest.

Sections 2.5.1 through 2.5.4 provides procedures for each leak detection test.

#### 2.5.1 Shut-In Leak Detection Test

A shut-in test is conducted by creating negative pressure within the aboveground portion of the sampling train to evaluate whether it is adequately sealed. A shut-in test should be performed as a precaution before performing a shroud test or other general leak test of the entire sampling system to prevent unwanted chemicals or gross contamination from entering the sampling system. The following procedures are used to conduct a shut-in test. See Figure 6 for an example of how a shut-in test may be set up. Implement the following steps:

- Ensure that the sampling medium is isolated from the sampling train (for example, sampling container valve is in the closed position or the sorbent tube is intact [not broken]). Some sampling media (for example, a syringe or filter cartridge) may need to be disconnected from the sampling train and the connection may need to be temporarily plugged with an appropriate fitting.
- Connect the soil gas or sub-slab gas tubing from the subsurface port to one port on a three-way stopcock valve.
- Connect one of the two remaining ports on the three-way stopcock valve to the assembled sampling train leading to the sampling media.
- Connect the last port on the three-way stopcock valve to tubing leading to a tee or other appropriate fitting that enables the vacuum gauge to be installed in line. The vacuum gauge then connects through tubing to a two-way valve. The two-way valve connects through additional tubing to a graduated syringe, air sampling pump, or peristaltic pump.
- Turn the three-way stopcock valve to close off the tubing going to the subsurface port, to prevent air from being drawn through the port from the subsurface.
- Use the syringe or pump to evacuate the system to a vacuum of about -200 inches of water or -15 inches of mercury, as measured on the vacuum gauge.
- After reaching the target level of vacuum, close the two-way valve to isolate the syringe or pump from the sampling train.
- Observe the vacuum gauge for at least 3 minutes. A stable gauge reading indicates a leak-free sampling train.
- Identify an acceptable rate of increase in pressure (drop in vacuum) in the sampling train (refer to project-specific data quality objectives). If more than 0.5 to 3 percent (again, depending on data quality objectives) of the vacuum is lost over the 3 or so minutes, check/tighten/replace connections and repeat the test until acceptable test results are achieved.

#### 2.5.2 Shroud Leak Detection Test

The shroud test is used to evaluate whether ambient air is being introduced to the soil gas or sub-slab gas probe system through improper seals at the surface or within the subsurface or through fittings in the sampling train. Figure 7 shows a typical shroud leak detection test set up. A shroud test is performed by placing a shroud (an inverted bag or box) on the ground over the gas probe and the sampling train and sample. Helium is then injected into a shroud. Sulfur hexafluoride may also be used; however, this gas and an appropriate gas detector are not as widely available. Therefore, helium is the preferred gas. A leak detection meter or air pump is then used to draw vapor from the sampling train and gas probe to assess whether a leak is infiltrating the system. The leak check compound (in this case, helium) used during a shroud test should be detected using a portable, on-site helium gas detection meter. If the shroud cannot cover the sampling train and sample, necessitating that the shroud test be applied only to test the surface and subsurface seals of the gas probe, then a shut-in leak detection test should be conducted on the aboveground portion of the sampling train in addition to the shroud test. See Section 2.5.1 and Figure 6 for information regarding the shut-in leak detection test. Implement the following steps:

- Ensure that the sampling medium is isolated from the sampling train (for example, sampling container valve is in the closed position or the sorbent tube is intact [not broken]). Some sampling media (for example, a syringe or filter cartridge) may need to be disconnected from the sampling train and the connection may need to be temporarily plugged with an appropriate fitting.
- Connect the soil gas or sub-slab gas tubing from the subsurface port to one port on a three-way stopcock valve. The three-way stopcock valve should be closed when assembling the shroud leak detection test equipment.
- Connect one of the two remaining ports on the three-way stopcock valve to the assembled sampling train leading to the sampling media.
- Connect to the last port on the three-way stopcock valve a piece of tubing that then passes through a fitting in the shroud, and on to either a Tedlar bag in a vacuum chamber with an air pump, or a graduated syringe. This tube will also connect to the helium detector at the appropriate time.
- Turn the three-way stopcock valve so that all three positions are open and gas flows unimpeded between the soil gas or sub-slab gas probe, the sampling train and sample, and the Tedlar bag in a vacuum chamber with an air pump, or graduated syringe.
- Place the shroud over the soil gas or sub-slab gas probe at its surface-subsurface seal (where the probe's sampling tubing meets the ground surface), sampling train, and sample.
- If using a plastic bag as a shroud, secure the bottom of the bag with a draft guard containing heavy beads.
- Connect a helium gas supply to a pass-through fitting in the shroud that allows the helium to flow into the shroud. Open the gas supply and inject the helium gas into the shroud.
- The shroud should have an additional pass-through fitting that is set in the open position to allow the shroud to be filled with helium, displacing the ambient air within it. Intermittently connect the helium gas detector to this fitting to measure the concentration of helium in the shroud. Fill the shroud with helium so that its concentration is at least 50 percent (indicated by the helium detector).

- After the concentration of helium is measured to be at least 50 percent within the shroud, pump vapor from the sampling system (soil gas or sub-slab gas probe, sampling train, and sample) using either the Tedlar bag in a vacuum chamber with an air pump, or the graduated syringe. The pumping rate should not exceed 200 mL/min. The Tedlar bag (or syringe) will also be used to collect a soil gas or sub-slab gas sample from the sampling system (see below). The helium detector might also be suitable for pumping vapor from the sampling system (possibly with a pump to pull vapor from the sampling system through to the helium leak detector).
- Follow the steps below to analyze the vapor within the sampling system consisting of the soil gas or sub-slab gas probe, the sampling train, and sample:
  - Disconnect the Tedlar bag in a vacuum chamber with an air pump, or the graduated syringe from the tubing that passes through the shroud and connects to the three-way stopcock valve.
  - Depending on the apparatus being used, connect the helium detector to: (1) the Tedlar bag, (2) the syringe, or (3) directly to the tubing that passes through the shroud and connects to the three-way stopcock valve.
  - The helium detector can then measure the concentration of helium within the vapor sample collected in the Tedlar bag or syringe or directly from the sampling system. A concentration of helium in the sample or sampling system that is no greater than 5 percent of the concentration of helium within the shroud, is typically acceptable. However, specific requirements will depend on the state agency and project-specific data quality objectives.
  - If the helium concentration ratio for the sampling system relative to the shroud is greater than 5 percent, an unacceptable leak exists. In this case, portions of the sampling system should be isolated, leak-checked, and tightened/repaired/replaced until the source of the leak(s) is found and eliminated. If a continuous leak is identified at the surfacesubsurface interface or in the subsurface, the gas probe may need to be reinstalled or relocated.

#### 2.5.3 Laboratory Leak Tracer Detection Test

A leak detection test may be performed using a volatile liquid leak detection compound (tracer) applied to a cloth or other absorbent material and sequentially positioning the cloth near each joint or connection in the sampling system while collecting an actual soil gas or sub-slab gas sample. During this procedure, the liquid leak detection compound should be near, but not on, connections in the sampling system; the liquid should never come into contact with, or be placed directly on, tubing or connections in the sampling system. Appropriate liquid leak detection compounds may include hexane, pentane, difluoroethane, and isopropanol (that is, greater than 99 percent isopropyl alcohol). Alternately, the leak detection test may be performed by covering the entire sampling system with a shroud and filling the shroud with the vapor of a leak detection compound (liquid or gas tracer) while collecting an actual soil gas or sub-slab gas sample. Appropriate gas leak detection compounds may include helium or sulfur hexafluoride. Other leak detection compounds may be appropriate if they are not target compounds and do not interfere with the laboratory analysis of target compounds. A laboratory leak tracer detection test is performed after purging and while collecting the actual soil gas or sub-slab gas sample. Implement the following steps:

- Connect the soil gas or sub-slab gas tubing exiting the gas probe to the desired sampling media using appropriate connections, tubing, and fittings.
- Purge the soil gas or sub-slab gas probe (see Section 2.6).
- While collecting the soil gas or sub-slab gas sample from the gas probe, apply the volatile liquid leak detection compound to a cloth or other absorbent material and, in sequential fashion, place the cloth on the ground or hold it near to joints and connections in the sampling system (soil gas or sub-slab gas probe, the sampling train, and sample); do not place the liquid leak detection compound directly on any part of the sampling system.
- A laboratory leak tracer detection test may also be performed by placing a shroud over the entire sampling system (soil gas or sub-slab gas probe, sampling train, and sample). If using a plastic bag as a shroud, secure the bottom of the bag with a draft guard containing heavy beads. Then, while collecting the soil gas or sub-slab gas sample from the gas probe, inject a volatile gas or liquid leak detection compound into the shroud through a port (pass-through fitting) in the shroud. If a liquid leak detection compound is used, it may be introduced to the shroud by pouring a small quantity onto a shallow dish and placing the dish inside the shroud; be careful to prevent the liquid leak detection compound from coming into direct contact with any part of the sampling system.
- Submit the soil gas or sub-slab gas sample for analysis; analysis should include testing for the leak detection compound that was used.

# 2.5.4 Water Dam Leak Detection Test

A water dam leak detection test is performed to evaluate the integrity of the sub-slab probe by placing a water dam (a piece of cut PVC pipe) around the sub-slab probe and filling it with water. A decrease in water while purging and sampling from the probe indicates a leak in the surface seal of the sub-slab probe or possibly at the first connection off the probe (if this connection is submerged in the water). The water dam test can only assess the integrity of these seals; therefore, leak testing must be separately performed on the sampling train. The water dam leak test procedure provided below is based on the procedures provided by the manufacturer of the Vapor Pin sub-slab gas probe with some modifications; however, this procedure may be applied to testing for leaks in most types of sub-slab gas probes. Implement the following steps:

- For a flush-mounted sub-slab gas probe installation (where the probe port is recessed beneath the floor level), the 1- to 1<sup>1</sup>/<sub>2</sub>-inch depression surrounding the probe serves as the water dam.
- For an installation where the probe protrudes from the concrete slab above floor level, prepare a water dam as follows:

- Roll a 1-inch diameter ball of modeling clay between your gloved palms to form a "snake" approximately 7 inches long and press it around the circumference of one end of the 2-inch-long section of 2-inch-diameter PVC pipe.
- Make sure the slab surrounding the probe is clean and free of loose dust and dirt.
- Push the PVC pipe (clay side down) against the slab, centered around the probe, to form a seal between the PVC pipe and the concrete slab. Note that water-soluble clays such as Play-Doh should not be used as they may absorb enough water to interfere with interpreting the results of leak tests lasting for extended periods of time (for example, an hour or more).
- Connect the sampling train to the sub-slab probe's first connection above the floor surface.
- Pour high-purity water into the water dam consisting of the probe's flush-mount depression or the PVC and clay cylinder. Pour enough water to immerse the sub-slab gas probe surface seal and, if possible, the first connection to the sub-slab gas probe.
- Purge and sample the sub-slab gas probe as indicated in Sections 2.6 and 2.7. Note the initial level of the water in the water dam and observe the level as the purging and sampling procedures progress. A drop in the water level within the dam, the appearance of water in the sample tubing connected to the probe, or any other observations of leakage, indicates a failure in one or more seals. Note, however, that the water level might drop slightly because of water absorption into the concrete.
- If there is a leak, remove the water (a wet/dry vacuum may help with this). Check/tighten the first connection to the probe. If the sub-slab gas probe is a Vapor Pin, possibly remove and reinstall the Vapor Pin. Then, repeat the water dam test. Note that water leaks through the probe seal into the sub-slab may require probe decommissioning and reinstallation of the probe at another location.

# 2.6 PURGING THE SOIL GAS OR SUB-SLAB GAS PROBE

The sampling system (soil gas probe subsurface volume or the sub-slab gas probe's disturbed space [that is, pore space of the sand filter pack] and the internal volume of the tubing and other fittings of the sampling train) should be purged of stagnant air to ensure that soil gas samples are representative of subsurface conditions. The probe should be purged after the leak detection test and before sampling (exceptions: the laboratory leak tracer detection test is performed after purging and during sampling; the water dam leak detection test is performed while purging and sampling). Implement the following steps:

- Ensure that the sampling medium is isolated from the sampling train (for example, sampling container valve is in the closed position or the sorbent tube is intact [not broken]). Some sampling media (for example, a syringe or filter cartridge) may need to be disconnected from the sampling train and the connection may need to be temporarily plugged with an appropriate fitting.
- Connect the soil gas or sub-slab gas tubing from the subsurface port to one port on a three-way stopcock valve.

- Connect one of the two remaining ports on the three-way stopcock valve to the assembled sampling train leading to the sampling media.
- Connect the last port on the three-way stopcock valve to tubing leading to a graduated syringe or air sampling pump.
- Set the three-way stopcock valve so that the valve is open.
- Using either a flow-calibrated vacuum pump or graduated syringe, remove a minimum of three volumes from the assembled sampling system (soil gas or sub-slab gas probe and sampling train). Note: site-specific planning documents (FSP, SAP, or QAPP) may specify different volumes. Refer to the table below for the formula used to calculate volumes and for some common reference volumes.
- The pumping rate should not exceed 200 mL/min as measured by the flow-calibrated air pump or syringe and stopwatch.
- If required by the site-specific FSP, SAP, or QAPP, collect PID, FID, and/or multiple-gas meter readings of the purged air using methods described in Tetra Tech SOP No. 003, Organic Vapor Monitoring.
- After the sampling system is purged but before pumping is stopped, close the three-way stopcock valve to isolate the air pump or graduated syringe from the sampling system. After the purged sampling system is sealed, the air pump should be turned off or pulling air into the syringe should be ceased.
- Sample collection can now proceed using the appropriate sampling media.

+ oranies per 1 overler 1 jpreur son ous una sus sins ous 110se constructions						
	Outer Diameter	Inner Diameter	Volume per Foot Length of Tubing			
	<sup>1</sup> / <sub>4</sub> inch	3/16 inch	5.43 mL			
Tubing	<sup>1</sup> / <sub>4</sub> inch	<sup>1</sup> / <sub>8</sub> inch	2.41 mL			
	<sup>1</sup> / <sub>8</sub> inch	0.078 inch	0.94 mL			
Sand Pack (Typical	2.25 inches	NA	391 mL (assumes porosity of 0.30			
direct-push borehole)			for sand)			
1  inch = 2.54  centimeters		Volume = $r$	Volume = $\pi$ (Inner Diameter / 2) <sup>2</sup> × Length			
1 centimeter <sup>3</sup> = 1 millilite	er					

#### Volumes per Foot for Typical Soil Gas and Sub-Slab Gas Probe Constructions

Notes: mL = milliliter NA = not applicable

# 2.7 SAMPLE COLLECTION

Sample collection may proceed following leak detection tests and purging steps (exceptions: the laboratory leak tracer detection test is performed after purging and during sampling; the water dam leak detection test is performed while purging and sampling). This section includes sample collection procedures for the following media: Tedlar bags, syringes, stainless-steel SUMMA canisters, and sorbent tubes or filter cartridges. Syringes should only be used if gas samples will be analyzed on site. Sample

media, sample preservation methods, and holding times vary according to the analytical parameters and associated analytical methods; therefore, consult appropriate guidance documents, including the project-specific QAPP, FSP, and SAP, as well as the laboratory, for further details.

Note that each laboratory supplies its own Summa cannisters and these may have different types of connections and fittings. Several days before the field sampling event, the project team should check the sampling containers and fittings to confirm that compatible fittings and connections are on hand for the sampling effort.

# 2.7.1 Sample Collection using Tedlar Bags

Soil gas or sub-slab gas can be collected for on-site or off-site chemical analysis in a Tedlar bag, which is a specially prepared bag that has an attached sampling port and valve, made for containing gas samples. Sampling using a Tedlar bag is accomplished by placing the evacuated bag in a specially prepared box with ports, within which a vacuum can be induced using an air pump. The bag is connected to tubing that extends through a port in the vacuum chamber to the soil gas or sub-slab gas probe. As a vacuum is induced inside the vacuum chamber, the Tedlar bag expands, pulling sample gas into its interior. The following procedures should be used for collecting Tedlar bag gas samples:

- Install gas sample tubing that connects from a port in the sampling train to the location where the vacuum chamber is situated. Check to make sure that the tubing (for example, 3/16-inch ID tubing) is compatible with the connection on the Tedlar bag. Use as short a length of sampling tubing as possible.
- Insert the tubing through the top of, and into, the vacuum chamber. It may be necessary to connect the tubing to a pass-through port connection on the outside of the vacuum chamber, and then connect another short stretch of tubing to the inner side of the port. Connect the tubing inside the vacuum chamber to the Tedlar bag. Up to this point, the valve on the bag should be closed with the bag evacuated. Open the valve on the Tedlar bag and place the bag into the body of the vacuum chamber.
- Secure the top onto, or otherwise close, the vacuum chamber.
- Using a flow rate calibrator, set the flow of the air pump to near, but not higher than, 200 mL/min.
- Connect the free end of the tubing attached to the vacuum chamber's evacuation port to the air pump.
- If the sampling train has a three-way stopcock valve that was used during leak testing, open it to allow vapor to flow from the soil gas or sub-slab gas probe to the Tedlar bag. Any other port in the three-way stopcock valve should be closed.

- Turn on the air pump. This will create a vacuum in the chamber, and the Tedlar bag should fill at • a rate of approximately 200 mL/min. You can confirm the approximate fill rate of the bag by comparing how the bag is observed to be filling (as seen through the vacuum chamber viewing window) against the time it would take to fully fill it at a flow rate of 200 mL/min. For example, a 500-mL bag would fill up in 2.5 minutes at that flow rate. The rate at which the bag fills will depend on the porosity and permeability of the soil and may be lower than the desired fill rate.
- The minimum amount of soil gas or sub-slab gas needed for analysis is approximately 0.25 liter. • Do not fill the Tedlar bag to more than two-thirds of its maximum capacity.
- After the soil gas sample is collected in the Tedlar bag, turn off the pump, slowly vent the • vacuum chamber to atmospheric pressure, and remove the top of, or otherwise open, the vacuum chamber.
- Close the valve on the Tedlar bag, disconnect the sampling tubing from the bag, and either close off the end of the sample tubing with a cap or close the three-way stopcock valve (or both) to isolate the gas probe from the aboveground sampling train.
- Document the sample collection procedures on a field data sheet or in the field logbook. •
- Fill out the chain-of-custody form and pack and ship samples to the laboratory for analysis using • Tetra Tech SOP No. 019, Packaging and Shipping Samples (other custody, packaging, and shipping requirements may also apply – see the project-specific OAPP, FSP, and SAP).

#### 2.7.2 **Sample Collection Using Syringes**

Soil gas and sub-slab gas samples can also be collected for on-site chemical analysis using a graduated syringe. The sample is collected using the following procedures:

- Connect the opening of the syringe to the two-way stopcock valve (this may be unnecessary because the laboratory that supplies the syringe may provide a syringe with a two-way valve).
- Install gas sample tubing that connects from a port in the sampling train to the syringe through the • syringe's two-way stopcock valve. Check to make sure that the tubing (for example, 3/16-inch ID tubing) is compatible with the connection on the syringe. Use as short a length of sampling tubing as possible. A Luer fitting may be required at the end of the sample tubing to obtain connection with the syringe; regardless of the type of fitting, prepare the tubing so that it can connect to the syringe.
- If the sampling train has a three-way stopcock valve that was used during leak testing, open it to • allow vapor to flow from the soil gas or sub-slab gas probe to the syringe. Any other port in the three-way stopcock valve should be closed.
- Turn the two-way stopcock valve at the opening of the syringe to the open position and collect a gas sample by pulling on the syringe piston to extract the desired volume at a rate of no greater than 200 mL/min.
- Close the two-way stopcock valve, disconnect the sampling tubing from the syringe, cap the • syringe, and either close off the end of the sample tubing with a cap or close the three-way stopcock valve (or both) to isolate the gas probe from the aboveground sampling train.

- Wrap the syringe in aluminum foil to protect the collected sample from photo-degradation.
- Document the sample collection procedures on a field data sheet or in the field logbook.
- Fill out the chain-of-custody form and pack and ship samples to the laboratory for analysis using Tetra Tech SOP No. 019, Packaging and Shipping Samples (other custody, packaging, and shipping requirements may also apply see the project-specific QAPP, FSP, and SAP).

# 2.7.3 Sample Collection Using SUMMA Canisters

Soil gas and sub-slab gas samples can be collected for chemical analysis in an inert evacuated stainlesssteel canister (SUMMA canister). When this method is used, the sampling train is connected directly to the evacuated canister by compression fittings. Both grab and time-integrated sampling can be accomplished with SUMMA canisters. The sampling duration is controlled by one of several flow controllers, including using a mass flow controller or a critical orifice device. To obtain the desired sampling duration, the user must contact the supplier of the canister for the appropriate apparatus.

Below is a general procedure for sampling using a SUMMA canister. Alternatively, procedures provided by the laboratory may be used in place of, or in addition to, the procedure provided below. For example, see the website at: <u>http://www.eurofinsus.com/media/161448/guide-to-air-sampling-analysis-2014-06-27\_revised-logos.pdf</u>. Implement the following procedure:

- Confirm the sampling canister's valve is closed. Remove the compression cap at the opening to the valve.
- If a flow controller (preferably with a built-in pressure gauge) is to be used, attach it to the valve; then attach a compression cap to the open end of the flow controller.
- If the flow controller does not have a built-in pressure gauge, attach a pressure gauge to the open end of the flow controller; then attach a compression cap to the open end of the pressure gauge.
- If a flow controller will not be used, attach a pressure gauge directly to the canister's valve; then attach a compression cap to the open end of the pressure gauge.
- Conduct a leak test of this assembly according to instructions provided by the supplier of the canister. The assembly should pass this leak test before it is used to collect a soil gas or sub-slab gas sample. If leaks are detected, corrective actions should be taken to eliminate them; the leak test should be repeated to confirm that the leaks have been sealed.
- Record the initial vacuum of the canister in a field logbook or field data sheet. The initial canister vacuum should be less than -25 inches of mercury. If the vacuum is less than -25 inches mercury (that is, anywhere from 0 to -25 inches mercury), return the canister to the laboratory unused and use a different canister.
- Make sure the SUMMA canister's valve is closed. Remove any pressure gauge not built in to a flow controller from the canister. If a flow controller (with or without a built-in pressure gauge)

is to be used, leave it attached to the canister. Attach a compression cap either to the open end of the canister's valve (if no flow controller is used) or to the open end of the flow controller if one is attached.

- To collect a sample, remove the compression cap from the open end of the canister's valve (if no flow controller is used) or from the open end of the flow controller. If grab sampling is to be conducted (with no flow controller), you will likely attach a particulate filter to the open end of the canister's valve. Then, install gas sample tubing that connects from a port in the sampling train to either the open end of the particulate filter (if no flow controller is used) or to the open end of the flow controller. Check to make sure that the tubing is compatible with the connection on the SUMMA canister. Use as short a length of sampling tubing as possible.
- If the sampling train has a three-way stopcock valve that was used during leak testing, open it to allow vapor to flow from the soil gas or sub-slab gas probe to the SUMMA canister. Any other port in the three-way stopcock valve should be closed.
- When ready to collect a gas sample, open the SUMMA canister valve. This will allow the evacuated canister to begin drawing in soil gas or sub-slab gas. If a flow controller with a built-in pressure gauge is being used, immediately record the initial canister vacuum reading and time.
- If a grab sample is being collected, the canister will likely fill up within several minutes. After the sample has been collected, close the canister's valve. Record the time and measure the final vacuum reading for the canister; do this by temporarily reattaching a pressure gauge to the canister and repeating the steps used to obtain the initial vacuum reading.
- If an integrated sample is being collected, monitor sampling progress periodically by observing and recording the canister vacuum reading (as read from the flow controller's built-in pressure gauge) at appropriate time intervals. When the target sample collection time has been reached, close the canister's valve. Record the time and final vacuum reading for the canister. The canister vacuum at the end of the sampling period should ideally be near but no closer to atmospheric pressure than -5 inches mercury. If the final vacuum reading is 0 inches mercury, the sampler may not know when the canister reached this pressure and how long the actual sampling interval was; however, the canister will nonetheless contain a valid sample of soil gas or sub-slab gas from the site.
- Disconnect the sampling tubing from the SUMMA canister, and either close off the end of the sample tubing with a cap or close the three-way stopcock valve (or both) to isolate the gas probe from the aboveground sampling train.
- Remove the flow controller, particulate filter, and any other remaining parts from the valve opening on the canister and attach a compression cap to the opening of the valve.
- Document the sample collection procedures on a field data sheet or in the field logbook.
- Fill out the chain-of-custody form and pack and ship samples to the laboratory for analysis using Tetra Tech SOP No. 019, Packaging and Shipping Samples (other custody, packaging, and shipping requirements may also apply see the project-specific QAPP, FSP, and SAP).

# 2.7.4 Sample Collection Using Sorbent Tubes and Filter Cartridges

Sorbent tubes or filter cartridges are typically provided by the laboratory, and selection of the sorbent tube or filter cartridge medium depends on the target compounds to be analyzed. The flow rate of the air pump used to pull soil gas or sub-slab gas through the sorbent tube or filter cartridge should be set before sampling begins to pull gas through the tube or cartridge at less than 200 mL/min; the flow rate should be measured and recorded both before and after actual gas sampling. The flow rate should be measured with the sampling medium installed, so that the flow resistance created by the sampling medium is accounted for. The actual flow rate required may depend on the type of sorbent tube or filter cartridge being used and the target compounds being collected for laboratory analysis; refer to sampling method guidance and the project-specific QAPP, FSP, and SAP. The following procedures are used to collect soil gas or sub-slab gas samples with sorbent tubes or filter cartridges:

- Install gas sample tubing that connects from a port in the sampling train to the sorbent tube or filter cartridge. Check to make sure that the tubing is compatible with the chemicals of concern and connects securely to the tube or cartridge. Use as short a length of sampling tubing as possible.
- Connect the outlet end of the sorbent tube or filter cartridge to the air pump using the appropriate tubing. Using the flow rate calibrator, briefly measure the flow rate through the sorbent tube or filter cartridge. Record this initial flow rate on a field data sheet or in the field logbook.
- Connect the inlet end of the sorbent tube or filter cartridge to the sample tubing on the sampling train.
- If the sampling train has a three-way stopcock valve that was used during leak testing, open it to allow vapor to flow from the soil gas or sub-slab gas probe to the sorbent tube or filter cartridge. Any other port in the three-way stopcock valve should be closed.
- Start the air pump and record the start time on a field data sheet or in the field logbook. After the desired sampling duration, stop the air pump and record the end time on a field data sheet or in the field logbook.
- Disconnect the inlet end of the sorbent tube or filter cartridge from the sample tubing on the sampling train. Using the flow rate calibrator, briefly measure the flow rate through the sorbent tube or filter cartridge. Record this final flow rate on a field data sheet or in the field logbook.
- Either close off the end of the sample tubing with a cap or close the three-way stopcock valve (or both) to isolate the gas probe from the aboveground sampling train.
- Disconnect the outlet end of the sorbent tube or cartridge from the tubing leading to the air pump, and place end plugs on both the inlet and outlet openings of the tube or cartridge.
- Document the sample collection procedures on a field data sheet or in the field logbook. Also, use the initial and final flow rates to calculate an average flow rate for the sampling period. Use this average flow rate with the sampling duration (as determined using the start and end times

recorded earlier) to calculate the total soil gas or sub-slab gas volume collected. Record the calculated average flow rate, sampling duration, and total gas volume collected on a field data sheet or in the field logbook; the gas volume should also be recorded on the chain-of-custody form.

- Many samples collected using sorbent tubes and filter cartridges must be stored and transported to the laboratory in a cooler with ice. Some sorbent tubes and filter cartridges also require that they be wrapped in aluminum foil during, or immediately after, sampling to protect the sample from photo-degradation. Consult with the laboratory, the analytical method, and the site-specific QAPP, FSP, or SAP for specific sample handling, preservation, and shipping requirements.
- Fill out the chain-of-custody form and pack and ship samples to the laboratory for analysis using Tetra Tech SOP No. 019, Packaging and Shipping Samples (other custody, packaging, and shipping requirements may also apply see the project-specific QAPP, FSP, and SAP).

# 2.8 QUALITY CONTROL SAMPLE COLLECTION

This section discusses quality control for sampling, including field duplicates, field blanks, and equipment decontamination. Field duplicate soil gas and sub-slab gas samples and field blanks may be collected during a sampling event at the frequencies required by the laboratory analytical method or the site-specific QAPP, FSP, or SAP.

# 2.8.1 Field Duplicates

Field duplicate samples are collected to check precision in the laboratory and field procedures (and, for some applications, to check for temporal inhomogeneity). Field duplicate samples may be collected in Tedlar bags, syringes, SUMMA canisters, filter cartridges, and sorbent tubes, as described below. Purging and gas sample collection will proceed as described in previous sections. After collection, one sample will be labeled as the environmental sample and the other as the field duplicate sample.

- A Tedlar bag field duplicate sample is collected using a sampling tee, one end of which is connected to the sampling tubing that is inserted through the top of the vacuum chamber. Two Tedlar bags are then attached, one to each of the remaining two ends end of the tee. Both bag samples are collected at the same time inside the vacuum chamber.
- When collecting gas samples using a syringe, field duplicate sampling is conducted as follows. Two gas samples are collected in succession (the second sample [field duplicate] collected immediately after the first).
- SUMMA canister field duplicate samples are also collected using a sampling tee that is installed in the sampling train so that two canisters can collect soil gas or sub-slab gas at the same time. The laboratory may provide the option for either installing a single flow controller/regulator in the sampling train upstream of the tee (between the probe and the tee) or installing separate flow controllers/regulators downstream of the tee (between the tee and each canister).

• Sorbent tube or filter cartridge field duplicate samples are collected using a sampling tee that is connected at the end of the sampling train. Each air pump should be calibrated so the combined flow rate through both tubes/cartridges does not exceed 200 mL/min.

#### 2.8.2 Field Blanks

A field blank sample is collected to evaluate background concentrations of target compounds in the sampling media; to evaluate the potential for cross-contamination during sample collection, preservation, handling, and shipment; and to evaluate the potential for cross-contamination during sample processing and handling in the laboratory. Field blanks samples may be collected when sampling using Tedlar bags, sorbent tubes, and filter cartridges during soil gas and sub-slab gas sampling. Field blank samples are typically not collected when sampling using SUMMA canisters.

- Tedlar bag field blank samples are collected by filling the bag with zero air (contaminant-free calibration gas) at the start of environmental gas sample collection and shipping this sample to the laboratory along with the environmental gas samples.
- Sorbent tube or filter cartridge field blank samples are collected by briefly opening and closing/sealing the sorbent tube or filter cartridge and placing it the same controlled, non-hazardous field environment where the environmental gas samples are stored. No air is drawn through the field blank sample's sorbent tube or filter cartridge. Once environmental sampling is completed, the field blank sample is packaged and shipped to the laboratory with the environmental sample for analysis.

#### 2.8.3 Decontamination

All manual slide hammer, rotary hammer drill, hydraulic-driven, and drill rig-driven equipment that penetrates the subsurface should be decontaminated before the first soil gas probe is installed and between soil gas probe sampling points. Decontamination procedures should follow standard decontamination for such equipment. Applicable regulatory guidance should be consulted to select the correct protocols. Decontamination may include use of a high-pressure steam cleaner. Requirements may also specify that equipment be decontaminated before first use and between uses using a non-phosphate detergent (for example, Liquinox or Luminox) and water; a tap water rinse; and finally, a high-purity, organic-free water rinse.

Both single-use parts used to install permanent sub-slab gas probes and reusable parts used to install Vapor Pin sub-slab gas probes also require decontamination before use. In accordance with manufacturer's instructions, Vapor Pin parts intended for re-use should be decontaminated by soaking in hot water and Liquinox/Luminox, rinsed, and then heated in an oven to a temperature of 265°F for 15 to 30 minutes. This procedure may also be used for single-use parts used to install permanent sub-slab gas probes. A high-purity, organic-free water rinse may also be required before the heating step, depending

on the target compounds involved and requirements provided in the project-specific QAPP, FSP, and SAP.

Aboveground soil gas and sub-slab gas sampling tubing should be used only if new and then disposed of after each sample. Stainless-steel and brass fittings and other parts, however, should be decontaminated before first use and between successive samples. At a minimum, the stainless-steel and brass parts should be visually cleaned of any dirt; flushed with zero air, inert gas, or clean ambient air; and heated until warm to the touch (at least 265°F for 15 to 30 minutes). If grossly contaminated, these parts may require decontamination using a non-phosphate detergent (for example, Liquinox or Luminox) and water; a tap water rinse; a high-purity, organic-free water rinse; before flushing with zero air, inert gas, or clean ambient air, and subsequent heating.

To the extent possible, sampling media (Tedlar bags, syringes, SUMMA canisters, filter cartridges, and sorbent tubes) should be procured pre-cleaned and certified contaminant-free, directly from the laboratory or vendor. If necessary, the media can be tested to document that they are contaminant-free by analyzing them using the appropriate analytical method.

#### 2.9 **DECOMMISSIONING**

The decommissioning process should be completed following final gas sample collection to prevent the probe from becoming a preferential conduit for the migration of contaminants.

#### 2.9.1 Soil Gas Implant

Soil gas implants should be decommissioned as described below.

- Pull the implant tubing to remove as much as possible from the borehole. The tubing usually breaks free from the implant below grade.
- Complete the surface location with native material, topsoil, asphalt, concrete, etc., to restore the probe location to a condition matching the surrounding area.

#### 2.9.2 Sub-Slab Gas Probe

Sub-slab gas probes should be decommissioned as described below.

- Remove a permanent sub-slab gas probe by breaking its concrete seal using a concrete chisel. Then, remove all parts of the probe from the hole in the slab.
- Remove a reusable Vapor Pin sub-slab gas probe from the hole in the slab according to manufacturer's instructions using the appropriate tool included in the kit.

- Clean the vacant sub-slab and inter-slab hole of any larger debris and particles. Lightly spray the hole with water (optional).
- In a disposable cup, mix a small amount of quick-setting cement with water. The mixture should be stiff and moldable.
- Place the quick-setting grout mixture into the vacant sub-slab and inter-slab hole, making sure the cement fills all void spaces by tamping grout down into hole with a rod. For small-diameter holes, polyurethane caulk (such as Sikaflex) may be used instead of grout.
- Smooth the surface of the cement using a trowel or putty knife, to restore the former probe location to grade.

#### 3.0 CAUTIONS AND CONSIDERATIONS

This section discusses several additional factors that should be considered when collecting soil gas and sub-slab gas samples.

#### **3.1 SAMPLE TUBING**

Some tubing materials may interact with certain chemicals entrained in soil gas or sub-slab gas (for example, hexane, pentane, naphthalene, etc.) through sorption or other processes. Therefore, sample tubing should be carefully selected based on the target compounds for the investigation, as well as any other non-target compounds that may be present, to prevent biased sampling results. Currently Teflon, nylon, and polyether ether ketone (PEEK) are acceptable for most types of soil gas and sub-slab gas sampling. Low-density polyethylene (LDPE) tubing should be avoided based on (1) the presence of hydrocarbons in this material and (2) poor recovery of target analytes observed during research. Check any state or local guidance documents for additional recommendations. The same considerations apply to all connections and fittings used in the sampling train.

#### 3.2 LEAK CHECK COMPOUNDS

For the laboratory leak tracer detection test, check with the laboratory to identify whether the leak detection compound can be analyzed using the same method that will be applied to the collected soil gas or sub-slab gas samples. The leak detection compound should be included in the laboratory analyte list for the collected sample. Some leak detection compounds, such as helium, can be found at party supply stores but in grades that may contain traces of volatile organic compounds (VOCs). For this reason, only use high-purity helium or test the helium supply for the presence of VOCs. Some chemicals that have historically been used as leak detection compounds, such as shaving cream, may also contain trace amounts of VOCs. Consult with the laboratory to identify its preferred leak detection compound (for example, helium, sulfur hexafluoride, hexane, pentane, difluoroethane, or isopropanol) before conducting the laboratory leak tracer detection test. Extreme caution should be taken to ensure no gross leaks are present in the system before this leak test is implemented. If there is a significant leak, the tracer compound might produce such a large signal when the laboratory analyzes it that it interferes with detection of actual target compounds of interest. Furthermore, gross leaks may result in contamination of laboratory equipment. These circumstances may result in low-quality or unusable laboratory results for the sample.

#### 3.3 CLIMATE CONDITIONS

Atmospheric pressure typically does not affect soil gas or sub-slab gas sampling from subsurface depths greater than 5 feet bgs. However, a major frontal system causing atmospheric pressure to fluctuate over a short timeframe may force ambient air farther into the subsurface.

Rain events are also unlikely to affect soil gas sampling from subsurface depths greater than 5 feet bgs. However, depending on soil type, rainwater may percolate downward far enough to influence the soil gas and cause biased results. State guidance for sampling following major rain events (typically considered ½ inch or more of rain within 24 hours) varies widely; for example, California requires not sampling for 5 days and Ohio requires not sampling for 1 day after the same intensity rain event. Most state guidance documents agree that soil gas sampling should not occur while it is raining.

# 3.4 LIGHT SENSITIVITY

Tedlar bags, syringes, and some sorbent tubes and filter cartridges are transparent or translucent. Light passing through these units can impact target compounds that are susceptible to photo-degradation from exposure to sunlight or even artificial light. Consequently, any transparent or translucent sample media should be stored in a dark place, such as a cooler, and analyzed as quickly as possible. Sampling media such as syringes, sorbent tubes, and filter cartridges can also be wrapped in aluminum foil after collection to minimize exposure to light.

Tetra Tech, Inc. EMI Operating Unit – Environmental SOP No. 074Page 34 of 43Title:Active Subsurface Gas SamplingLast Reviewed: November 2021

	FIGURE 1						
	SOIL GAS INSTALLATION	FORM					
Site/Facility Name:	ty Name: Date:						
Project No.:							
Sample Location:							
Latitude:Longitude:							
Drilling Method:							
	Surface	Total Depth Int From:	<b>erval of Probe (feet)</b> _To:				
	Gas Tight Fitting	<b>Bentonite Grout</b> Composition:					
	Probe Box (optional)	<b>Depth Interval</b> From:	of Grout (feet) To:				
	Bentonite Grout	<b>Dry Bentonite</b> Type of Materia <b>Depth Interval</b>	l: of Bentonite (feet)				
		From: <b>Tubing</b> Type of Material Total Tubing (fe Outer/Inner Diar	To: l: et): neters (inches):				
	(metal, nylon, PEEK, teflon®)	Filter Pack					
	Dry Granular Bentonite	<b>Depth Interval</b> From:	of Sand (feet) To:				
	Probe Tip	<b>Probe</b> Type:					
	Sand	Depth of Probe From:	Screen (feet) To:				
Note: Above diagram modified from I Installation: Date: Time:	DTSC 2012 Leak Detection Test: _ Date: Time:		Equilibrium Time: Minutes:				
Leak Detection Test: Pass or Fail:							
<b>Purge Volume:</b> Method used to purge probe:	Total v	olume removed:					
Additional Comments: (add a	a location map on the reverse, a	s necessary)					

# FIGURE 2 SUB-SLAB GAS INSTALLATION FORM

Site/Facility Name:		Date:	
Project No.:			
Sample Location:			
Construction Type (for example, perm	nanent or Vapor Pir	h):	
Thickness of Concrete Slab (inches):_		Flush Mount (yes or no)	·
Total probe length (inches):			
Map of Location			
Note: map not to scale			
Installation:	Leak Detection	Test:	Equilibrium Time:
Date: Time:	Date:	Time:	Minutes:
Leak Detection Test:		Daga on Failt	
Type of leak test on port.			
Purge Volume: Method used to purge probe:		Total volume removed:	
Additional Comments:			

Tetra Tech, Inc. EMI Operating Unit – Environmental SOP No. 074 Title: Active Subsurface Gas Sampling Page 36 of 43 Last Reviewed: November 2021

		S	FIG SOIL GAS A FIELD DA	URE 3 ND SU ATA S	3 JB-SLAB HEET	
Site/Facility Name:				Date:		
Project No.: _						
Sample Locat	ion:					
Sampled By: _						
Sample ID:			Field Duplicate :			
Sample Inform Pump Type and	nation: d No			S	ample Media:	
Container ID:			Flow Regulator ID:			
Weather Conditions: Temperature:			Precipitation:			
Atmospheric P	Atmospheric Pressure:			Wind Speed/Direction:		
Leak Test/Pur Leak Test Type	rge/Sample F e:	Readings:		Р	ass or Fail:	
Purge Volume:			FID, PID or multimeter Results:			
Start Time:				End Time:		
Start Pressure/Flow:			End Pressure/Flow:			
Volume Gas I	Extracted:	<u> </u>		<b>I</b>		I
Time	Flow (mL/1	nin)	Pressure		Comments	

**Additional Comments:** 





\* Stainless steel tubing passes through the modeling clay or Teflon washer to create an airtight seal between the outer hole and inner/pilot hole.

# FIGURE 5 VAPOR PIN CONSTRUCTION DETAILS (From COX COLVIN AND ASSOCIATES, INC. 2013)



# FIGURE 6 SHUT-IN LEAK DETECTION TEST



FIGURE 7 SHROUD LEAK DETECTION TEST



#### FIGURE 8









After the implant is secured at the desired depth, driller's sand or glass beads are poured down through rod to surround implant. Bentonite is then added to provide a seal above the implant.
#### FIGURE 10 TYPICAL SINGLE AND NESTED SOIL GAS PROBE DESIGN (From DTSC 2015)



Neat-Cement Grout means a mixture in the proportion of 94 pounds of Portland cement and not more than 6 gallons of water. Bentonite up to 5 percent by weight of cement (4.7 pounds of bentonite per 94 pounds of Portland cement) may be used to reduce shrinkage.

### STANDARD OPERATING PROCEDURE APPROVAL AND CHANGE FORM

Scientific, Engineering, Response and Analytical Services 2890 Woodbridge Avenue Building 209 Annex Edison New Jersey 08837-3679

STANDARD OPERATING PROCEDURE				
Title: SUMMA Canister Sampling				
Approval Date: 11/16/2015				
Effective Date: 11/16/2015	SERAS S	SOP Number 1704, Rev 1.0		
Authors	CAN SHE			
Name David Adams				
Title SERAS Environmental Scientist		3 A		
Signature	Date	11/12/15		
Name		/ /		
Title				
Signature	Date			
Approvals		the state		
Name Philip Solinski				
Title Air Response Chemist		112		
Signature	Date	1/12/15		
Name Deborah Killeen		l -		
Signature	Date	11/12/15		
Name Kevin Taylor		•		
Title Program Manage		1/12/18		
Signature //	Date	11/13/10		

The top row of this table shows the most recent changes to the controlled document. For previous revision history information, archived versions of this document are maintained by the SERAS QA/QC Officer on the SERAS local area network (LAN).

History	Effective Date
Supersedes: SOP #1704, Revision 0.1, 07/27/95	11/16/15
Revised entire document to include both grab and time-weighted sampling	
Added additional test about the UFP-QAPP to 1.0 Scope and Application	
Expanded the data validation section to include data verification	
Removed Figure 1	



 SOP:
 1704

 PAGE:
 1 of 11

 REV:
 1.0

 EFFECTIVE DATE:
 11/16/15

### SUMMA CANISTER SAMPLING

#### CONTENTS

- 1.0 SCOPE AND APPLICATION
- 2.0 METHOD SUMMARY
- 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE
- 4.0 INTERFERENCES AND POTENTIAL PROBLEMS
- 5.0 EQUIPMENT/APPARATUS
- 6.0 REAGENTS
- 7.0 PROCEDURES
  - 7.1 Grab Sample Collection
  - 7.2 Time-Weighted Average Collection
- 8.0 CALCULATIONS
- 9.0 QUALITY ASSURANCE/QUALITY CONTROL
- 10.0 DATA VALIDATION
- 11.0 HEALTH AND SAFETY
- 12.0 REFERENCES
- 13.0 APPENDICES
  - A Typical Reporting Limits for Volatile Organic Compounds
  - B Air Sampling Worksheet SUMMA\*

SUPERSEDES: SOP #1704; Revision 0.1; 07/27/95, US EPA Contract No. 68-C4-0022



 SOP:
 1704

 PAGE:
 2 of 11

 REV:
 1.0

 EFFECTIVE DATE:
 11/16/15

#### SUMMA CANISTER SAMPLING

#### 1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to describe a procedure for sampling of Volatile Organic Compounds (VOCs) in ambient air. The method is based on samples collected as whole air samples in SUMMA or equivalent passivated stainless steel canisters. The VOCs are subsequently separated by gas chromatography (GC) and measured by mass-selective detector or multi-detector techniques. This method presents procedures for sampling into canisters at final pressures below atmospheric pressure referred to as sub-atmospheric pressure sampling.

This method is applicable to specific VOCs and a limited set of other compounds that have been tested and determined to be stable when stored in subatmospheric pressure canisters. The volatile organic compounds that have been successfully collected in canisters by this method along with their reporting limits are listed in Appendix A. These compounds results are reported as parts per billion by volume (ppbv) and micrograms per meter cubed ( $\mu$ g/m<sup>3</sup>).

A Quality Assurance Project Plan (QAPP) in Uniform Federal Policy (UFP) format describing the project objectives must be prepared prior to deploying for a sampling event. The sampler needs to ensure that the methods used are adequate to satisfy the data quality objectives listed in the QAPP for a particular site.

The procedures in this SOP may be varied or changed as required, dependent on site conditions, equipment limitations or other procedural limitations. In all instances, the procedures employed must be documented on a Field Change Form and attached to the QAPP. These changes must be documented in the final deliverable.

#### 2.0 METHOD SUMMARY

Subatmospheric pressure sampling uses an initially evacuated canister and mass flow controller to regulate flow. With this configuration, a sample of air is drawn through a sampling train comprised of components that regulate the rate and duration of sampling into a pre-evacuated SUMMA canister. Alternatively subatmospheric pressure sampling may be performed using a fixed orifice, capillary or adjustable micrometering valve in lieu of the mass flow controller arrangement for taking grab samples or time-integrated samples. Grab samples are typically collected during discrete odor events. For grab sampling, the canister value is opened, and the vacuum inside the canister draws in an air sample in a few seconds. Time-integrated sampling is conducted over a specific period of time to acquire a specific volume of air. The most common use is for the collection of sub-slab soil gas, indoor and ambient air samples associated with vapor intrusion activities.

#### 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

Sample holding times must be determined prior to initiating field activities and are dependent on the compound (s) being analyzed. Canisters and orifices should be stored in a cool dry place and always be placed in their plastic/metal shipping boxes during transport and storage to protect the canisters from dents and/or punctures during transport.

Typically 6-liter (L) passivated canisters are used for vapor intrusion and/or odor events although 1-L canisters may also be used. After the air sample is collected, the canister valve is closed, an identification tag is attached to the canister and the canister is transported to a laboratory for analysis. Upon receipt at the laboratory, the canister tag data are recorded.



1704 SOP: PAGE: 3 of 11 **REV**: 1.0 EFFECTIVE DATE: 11/16/15

#### SUMMA CANISTER SAMPLING

#### 4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Contamination may occur in the sampling system if canisters are not properly cleaned before use. Additionally, all other sampling equipment (e.g. flow controllers) must be thoroughly cleaned. Instructions for cleaning the SUMMA canisters and flow controllers are described in the Scientific, Engineering, Response and Analytical Services (SERAS) SOP #1739, Procedures for SUMMA Canister and Flow Controller Cleaning,

Care must be used with canister valves. Do not overtighten the valves.

Ambient air sampling during rainy weather may result in clogging of the flow controller filter causing reduction or stoppage of flow. Sampling during rainy weather should be avoided.

#### 5.0 EQUIPMENT/APPARATUS

- Sampling inlet line (optional) Teflon tubing to connect the sampler to the environment being sampled (e.g. sub-slab, ambient)
- SUMMA canister, Restek Corporation, PA, Model # 27420 or 27408 or equivalent leak-free stainless steel pressure vessels of desired volume with valve and electropolished interior surfaces, certified clean by the laboratory for the analytes of interest and leak checked
- (Optional) Particulate matter filter, Swagelok, OH, Model SS-2F-K4-2 or equivalent 2-µm sintered stainless steel in-line filter.
- Mass flow controller, fixed orifice, capillary or adjustable micro-metering valve, Valco Instruments. TX, VICI Model 202 or equivalent - for grab samples or time-integrated samples.
- Vacuum gauge, certified annually, to record canister vacuum in inches of mercury
- UNCON Flow meter, accompanied by an annual certificate of analysis, to verify orifice flow rates (ADM3000 or equivalent)
- Wrench, 9/16"

#### 6.0 REAGENTS

This section is not applicable to this SOP.

#### 7.0PROCEDURE

7.1 Grab Sample Collection

> A canister, which is evacuated to one atmosphere below ambient and fitted with a flow restricting device, is opened to the atmosphere containing the VOCs to be sampled. The pressure differential causes the sample to flow into the canister. This technique may be used to collect grab samples (duration of seconds). The typical steps for collecting a grab sample are as follows:



1.

2.

3.

4.

5.

6

2.

3.

4.

6.

7.

8.

9.

7.2

canister sampling port.

1704 SOP: PAGE: 4 of 11 **REV**: 1.0 EFFECTIVE DATE: 11/16/15

#### SUMMA CANISTER SAMPLING

- With a 9/16" wrench, remove the brass fitting from the top of the canister. Attach the vacuum gauge to the canister and open the canister valve. Verify and record the "Initial" reading of the evacuated SUMMA canister. The evacuated canister should read no more than -29.5 inches (") of mercury. Ensure that the canister valve is fully closed before removing the vacuum gauge. Place the SUMMA canister in desired location. If sampling from a vapor stream, connect inert tubing to Open sampling valve by turning knob counter clockwise until the knob moves easily. 7. An audible "hiss" may indicate that sampling has initiated. When the hissing stops, close valve and replace cap. Sample duration should be approximately 10 to 30 seconds. 8. Document sample collection information on the Air Sampling Worksheet (Appendix B) Time-Weighted Average Collection This technique may be used to collect time-integrated samples (duration of 1 to 24 hours). The sampling duration depends on the degree to which the flow is restricted. 1. With a 9/16" wrench, remove the brass fitting from the top of the canister. Attach the vacuum gauge to the canister and open the canister valve. Verify and record the "Initial" reading of the evacuated SUMMA canister. The evacuated canister should read no more than -29.5 "of mercury. Ensure that the canister valve is fully closed before removing the vacuum gauge. 5. Check the flow rate of the orifice using a certified flow meter or a rotameter that has been checked against the primary flow meter. Attach the flow controller to the top of the canister. Start the fitting by hand to avoid cross threading, then tighten firmly with a 9/16" wrench. Open the valve on the canister counter clockwise and record the "start" time. Monitor sampling progress periodically. At the end of the sampling period, close the valve on the canister by turning clockwise until hand tight. Record the "end" time. While the ideal reading on the can gauge should be slightly negative, the actual can pressure will be tested with a calibrated gauge at the laboratory.
- 10. Remove the flow controller and put it into its appropriate shipping container.



 SOP:
 1704

 PAGE:
 5 of 11

 REV:
 1.0

 EFFECTIVE DATE:
 11/16/15

#### SUMMA CANISTER SAMPLING

- 11. Replace the brass fitting on top of the canister.
- 12. Record the final vacuum of the canister and complete the Air Sampling Worksheet SUMMA Canister.

#### 8.0 CALCULATIONS

A flow control device is chosen to maintain a constant flow into the canister over the desired sample period. This flow rate is determined so the canister is filled to about 5-L in a 6-L-canister for sub-atmospheric pressure sampling over the desired sample period. The flow rate can be calculated by:

$$F = \frac{(P)(V)}{(T)(60)}$$

where:

- F = flow rate (cc/min)
- P = final canister pressure, atmospheres absolute (1 for atmospheric, non-pressurized sampling)
- V = volume of the canister (cm<sup>3</sup>)
- T = sample period (hours)

$$F = \frac{(5000)}{(24)(60)} = 3.5 \text{cc} / \text{min}$$

#### 9.0 QUALITY ASSURANCE/QUALITY CONTROL

Specific QA/QC activities that apply to the implementation of these procedures will be listed in the Quality Assurance Project Plan prepared for the applicable sampling event. The following general QA procedures will also apply:

- 1. All SUMMA canister sampling data, including the items listed in Section 10 must be documented in site logbooks or on field data sheets.
- 2. All equipment must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the QAPP. Equipment check-out and calibration is necessary prior to sampling and must be done according to the instruction manuals supplied by the manufacturer. The vacuum inside each canister must be checked prior to use to ensure no leaks have occurred. The pre-set flow rates set by the laboratory are checked prior to use to ensure that the proper volume of sample will be collected.

#### 10.0 DATA VALIDATION

Data verification (completeness checks) must be conducted to ensure that all data inputs are present for ensuring the availability of sufficient information. This may include but is not limited to: Location, Sub-location, SUMMA ID number, orifice ID number, start and end pressures, NIST vacuum gauge ID number, flow rate, flow meter ID number, start and end times. These data are essential to providing an accurate and complete final deliverable. The SERAS Task Leader (TL) is responsible for completing the UFP-QAPP verification checklist for each project.



 SOP:
 1704

 PAGE:
 6 of 11

 REV:
 1.0

 EFFECTIVE DATE:
 11/16/15

#### SUMMA CANISTER SAMPLING

#### 11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, Occupational Safety and Health Administration (OSHA) or ERT/SERAS health and safety guidelines. More specifically, depending upor the site-specific contaminants, various protective programs must be implemented prior to some SUMMA canister sampling activities. The site health and safety plan (HASP) must be reviewed with specific emphasis placed on the protection program planned for the sampling activities. Standard operating procedures should be followed such as minimizing contact with potential contaminants in the vapor phase through the use of respirators and disposable clothing.

#### 12.0 REFERENCES

EPA Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry Analysis (GC/MS), January 1999.

#### 13.0 APPENDICES

A - Typical Reporting Limits for Volatile Organic Compounds B –Air Sampling Worksheet - SUMMA Canister



 SOP:
 1704

 PAGE:
 7 of 11

 REV:
 1.0

 EFFECTIVE DATE:
 11/16/15

### SUMMA CANISTER SAMPLING

APPENDIX A Typical Reporting Limits for Volatile Organic Compounds SOP #1704 November 2015



 SOP:
 1704

 PAGE:
 8 of 11

 REV:
 1.0

 EFFECTIVE DATE:
 11/16/15

#### SUMMA CANISTER SAMPLING

Typical Reporting Limits for Volatile Organic Compounds

Analyta	MW	CAS	Reporting Limits	
Analyte	101 00	Number	ppbv	µg/m <sup>3</sup>
Acetone	58.08	67-64-1	0.200	0.475
Benzene	78.11	71-43-2	0.020	0.064
Bromoform (Tribromomethane)	252.73	75-25-2	0.020	0.207
Bromomethane	94.94	74-83-9	0.020	0.078
2-Butanone (MEK)	72.11	78-93-3	0.020	0.059
1,3-Butadiene	54.09	106-99-0	0.020	0.044
Carbon Tetrachloride	153.82	56-23-5	0.020	0.126
Chlorobenzene	112.56	108-90-7	0.020	0.092
Chloroethane (Ethyl Chloride)	64.51	75-00-3	0.020	0.053
Chloroform	119.38	67-66-3	0.020	0.098
Chloromethane	50.49	74-87-3	0.020	0.041
Cyclohexane	84.16	110-82-7	0.020	0.069
Dibromochloromethane	208.28	124-48-1	0.020	0.170
1,2-Dibromoethane (EDB)	187.86	106-93-4	0.020	0.154
1,2-Dichlorobenzene	147.00	95-50-1	0.020	0.120
1,3-Dichlorobenzene	147.00	541-73-1	0.020	0.120
1,4-Dichlorobenzene	147.00	106-46-7	0.020	0.120
Dichlorodifluoromethane (Freon 12)	120.91	75-71-8	0.020	0.099
1,1-Dichloroethane	98.96	75-34-3	0.020	0.081
1,2-Dichloroethane	98.96	107-06-2	0.020	0.081
1,1-Dichloroethene	96.94	75-35-4	0.020	0.079
cis-1,2-Dichloroethene	96.94	156-59-2	0.020	0.079
trans-1,2-Dichloroethene	96.94	156-60-5	0.020	0.079
Dichloromethane (Methylene chloride)	84.93	75-09-2	0.020	0.069
1,2-Dichloropropane	112.99	78-87-5	0.020	0.092
cis-1,3-Dichloropropene	110.97	10061-01-5	0.020	0.091
trans-1,3-Dichloropropene	110.97	10061-02-6	0.020	0.091
1,4-Dioxane	88.11	123-91-1	0.020	0.072
Ethyl Acetate	88.11	141-78-6	0.020	0.072
Ethylbenzene	106.17	100-41-4	0.020	0.087
4-Ethyltoluene	120.19	622-96-8	0.020	0.098

UNCONTROLLED COP



 SOP:
 1704

 PAGE:
 9 of 11

 REV:
 1.0

 EFFECTIVE DATE:
 11/16/15

#### SUMMA CANISTER SAMPLING

Typical Reporting Limits for Volatile Organic Compounds (cont'd)				
Analyte	MW	CAS	Reporting Limits	
Anaryw		Number	ppbv	μg/m <sup>3</sup>
Freon 113 (Trichlorotrifluoroethane)	187.37	76-13-1	0.020	0.153
Freon 114 (1,2-Dichloro-1,1,2,2-tetrafluoroethane)	170.92	76-14-2	0.020	0.140
n-Heptane	100.20	142-82-5	0.020	0.082
2-Hexanone (MBK)	100.16	591-78-6	0.020	0.082
n-Hexane	86.18	110-54-3	0.020	0.070
Isopropyl Alcohol (2-Propanol)	60.10	67-63-0	0.200	0.492
Methyl Isobutyl Ketone (4-Methyl-2-pentanone)	100.16	108-10-1	0.020	0.082
Methyl Tert-Butyl Ether	88.15	1634-04-4	0.020	0.072
m & p -Xylene	106.17	108-38-3	0.040	0.174
Naphthalene	128.17	91-20-3	0.020	0.105
o-Xylene	106.17	95-47-6	0.020	0.087
Propene (Propylene)	42.08	115-07-1	0.200	0.344
Styrene	104.15	100-42-5	0.020	0.085
1,1,2,2-Tetrachloroethane	167.85	79-34-5	0.020	0.137
Tetrachloroethene	165.83	127-18-4	0.020	0.136
Tetrahydrofuran (THF)	72.11	109-99-9	0.020	0.059
Toluene	92.14	108-88-3	0.020	0.075
1,1,1-Trichloroethane	133.40	71-55-6	0.020	0.109
1,1,2-Trichloroethane	133.40	79-00-5	0.020	0.109
Trichloroethene	131.39	79-01-6	0.020	0.107
Trichlorofluoromethane (Freon 11)	137.37	75-69-4	0.020	0.112
1,2,3-Trichloropropane	147.43	96-18-4	0.020	0.121
1,2,4-Trimethylbenzene	120.19	95-63-6	0.020	0.098
1,3,5-Trimethylbenzene	120.19	108-67-8	0.020	0.098
Vinyl Acetate	86.09	108-05-4	0.020	0.070
Vinyl Chloride	62.50	75-01-4	0.020	0.051

COP UNCONTROLLED



 SOP:
 1704

 PAGE:
 10 of 11

 REV:
 1.0

 EFFECTIVE DATE:
 11/16/15

### SUMMA CANISTER SAMPLING

APPENDIX B Air Sampling Worksheet - SUMMA Canister SOP #1704 November 2015

10 - Stan		EPA/Envi	ronmental Response	- Team	Page	_of
Site:	Scientif	ic, Engineerii Lockheed U.S. EPA ( Air Sampli	ng, Response and A Martin Corp., Edis Contract No. EP-W ing Work Sheet - SI	nalytical Services on, NJ •09-031 JMMA	WA#	
Sampler:				U.S. EPA/ERT W	AM:	_ (
Date:			SERAS Task Leader:		er:	_ \
Sample #						
Location						
Sub-Location						<u> </u>
Summa #						
Orifice ID						
Start Pressure						
NIST Gauge S/N						
Flow Rate (Start)						
Flow meter						
Analysis/Method						
Time/Counter (Start)						
Time/Counter (Stop)						
Total Time						
End Pressure						
NIST Gauge S/N						



SOP: ERT-PROC-2006-20 PAGE: 1 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

#### CONTENTS

#### DISCLAIMERS

- 1.0 SCOPE AND APPLICATION
- 2.0 METHOD SUMMARY
- 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE
- 4.0 INTERFERENCES AND POTENTIAL PROBLEMS
- 5.0 EQUIPMENT/APPARATUS
  - 5.1 Decontamination Tools/Supplies
  - 5.2 Health and Safety Equipment
  - 5.3 Waste Disposal
- 6.0 REAGENTS
- 7.0 PROCEDURES
  - 7.1 Decontamination Methods
    - 7.1.1 Abrasive Cleaning Methods
    - 7.1.2 Non-Abrasive Cleaning Methods
  - 7.2 Field Sampling Equipment Decontamination Procedures
    - 7.2.1 Decontamination Setup
    - 7.2.2 Decontamination Procedures
    - 7.2.3 Post Decontamination Procedures
  - 7.3 Decontamination of Earth Moving Equipment/Drilling Equipment and Accessories
    - 7.3.1 Decontamination Setup
    - 7.3.2 Decontamination Procedures
    - 7.3.3 Post Decontamination Procedures
- 8.0 CALCULATIONS
- 9.0 QUALITY ASSURANCE/QUALITY CONTROL
- 10.0 DATA VALIDATION
- 11.0 HEALTH AND SAFETY



SOP: ERT-PROC-2006-20 PAGE: 2 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

CONTENTS (cont'd)

- 12.0 REFERENCES
- 13.0 APPENDICES

A - Tables

B-Figures



SOP: ERT-PROC-2006-20 PAGE: 3 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

The policies and procedures established in this document are intended solely for the guidance of OLEM employees of the U.S. Environmental Protection Agency (EPA). They are not intended and cannot be relied upon to create any rights, substantive or procedural, enforceable by any party in litigation with the United States. EPA reserves the right to act at variance with these policies and procedures, and to change them at any time without public notice. EPA strongly encourages all readers to verify the validity of the information contained in this document by consulting the most recent Code of Federal Regulations (CFR) and updated guidance documents.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.



SOP: ERT-PROC-2006-20 PAGE: 4 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

#### 1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to describe the methods for preventing or limiting cross-contamination of samples due to inappropriate or inadequate equipment decontamination and to provide general guidelines for developing decontamination procedures for sampling equipment to be used during environmental investigations as per 29 Code of Federal Regulations (CFR) 1910.120. This SOP does not address personnel decontamination.

A Quality Assurance Project Plan (QAPP) in Uniform Federal Policy (UFP) format describing the project objectives must be prepared prior to deploying for a sampling event. The sampler needs to ensure the methods used are adequate to satisfy the data quality objectives (DQOs).

The procedures in this SOP may be varied or changed as required, dependent on site conditions, equipment limitations or other procedural limitations. In all instances, the procedures employed must be documented on a Field Change Form and attached to the QAPP. These changes must be documented in the final deliverable.

#### 2.0 METHOD SUMMARY

Removing or neutralizing contaminants from equipment minimizes the possibility of sample cross contamination, reduces or eliminates transfer of contaminants to clean areas, and prevents the mixing of incompatible substances. Some equipment may have specific decontamination procedures that do not follow this SOP. Refer to the user manual for each piece of equipment before utilizing this SOP.

Gross contamination can be removed by physical decontamination procedures. These abrasive and non-abrasive methods include the use of brushes and high and low pressure water cleaning.

The first step is the physical removal of gross contamination on sampling equipment which may include steam or a high pressure water wash. The second step is a soap and water wash that removes the remainder of visible material and residual oils and grease. The third step involves a potable water rinse to remove any detergent, followed by a distilled/deionized water rinse.

For the removal of metals, an acid rinse with a 10% nitric acid solution is used prior to the final distilled/deionized water rinse. For the removal of organics, pesticide grade acetone, methanol or hexane, depending on the specific contaminant of concern, will be applied prior to the final distilled/deionized rinse. Acetone is typically chosen because it is excellent at removing organics, miscible in water, and not a target analyte on the Priority Pollutant List. If acetone is known to be a contaminant of concern or if Target Compound List analysis (which includes acetone) is to be performed, another solvent such as methanol will need to be substituted.

Hexane should be used when the contaminant of concern is polychlorinated biphenyls (PCBs) or in oily media. The solvent must be allowed to evaporate completely and then a final distilled/deionized water rinse is performed. This rinse removes any residual traces of the solvent.

A generalized decontamination procedure is:

- 1. Physical removal
- 2. Non-phosphate detergent wash with potable water
- 3. Potable water rinse
- 4. Solvent rinse (acetone, hexane, etc.)
- 5. Air dry
- 6. 10% nitric acid solution rinse



SOP: ERT-PROC-2006-20 PAGE: 5 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

- 7. Distilled/deionized water rinse
- 8. Air dry

In instances in which sampling equipment is being used to collect samples for biological pathogens, the acid is replaced with a 10% bleach solution. Modifications to the standard procedure are required to be documented in the site-specific QAPP, field log book and subsequent reports. All decontamination water is replaced daily at a minimum. If at any point throughout the day the water becomes too dirty, then it is no longer suitable for cleaning and is required to be replaced. All sampling equipment must be decontaminated before collecting samples on-site and after use of each piece of sampling equipment.

Waste materials generated from the decontamination processes are referred to as Investigation-Derived Waste (IDW). Management of this waste should be in coordination with Environmental Response Team (ERT) SOP, *Investigation-Derived Waste Management*.

#### 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The amount of sample collected, along with the proper sample container type (i.e. glass, plastic), chemical preservation, and storage requirements are dependent upon the matrix sampled and analysis performed. For further information, refer to ERT SOP, *Sample Storage, Preservation and Handling*.

Sample collection and analysis of decontamination waste generated on-site may be required prior to disposal of decontamination liquids and solids. This should be determined prior to initiation of site activities or as soon as possible thereafter. For more information on handling of IDW, refer to ERT SOP, *Investigation-Derived Waste Management*.

#### 4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Acetone is an excellent solvent since it is miscible with water; however, if volatile organic compounds (VOCs) are to be analyzed, the use of an alternate solvent (methanol, hexane) should be considered since acetone is a compound on the Target Compound List (TCL).

The use of deionized (distilled if only option) water is required for decontamination of sampling equipment. In addition, that water is required to be lab certified, analyte free (specifically for the contaminants of concern). The deionized water must be secured prior to field activities as it is not commonly found local to the site.

The use of solvents and acids on sensitive sampling equipment may cause damage. It is important to avoid damaging the equipment. If acids or solvents are utilized, follow health and safety, and waste disposal guidelines.

When decontaminating equipment when temperatures are below freezing, water will freeze in pump spray hoses lines, tanks and in buckets/pails, etc. Additionally, equipment will require longer drying times. Do not store sampling equipment or reagents used for decontamination near gasoline or any exhaust emissions. Improperly cleaned and prepared sampling equipment can lead to misinterpretation of analytical data due to cross contamination.

Make sure that the decontamination station is set up as not to compromise a clean environment.

#### 5.0 EQUIPMENT/APPARATUS

Decontamination equipment is selected based on the type of equipment to be cleaned and anticipated contaminants to be removed. For example, soft-bristle scrub brushes or long-handled bottle brushes are used



SOP: ERT-PROC-2006-20 PAGE: 6 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

to remove contaminants. Large galvanized wash tubs, stock tanks, buckets, or children's wading pools hold wash and rinse solutions. Large plastic garbage cans or other similar containers lined with plastic bags help segregate contaminated equipment. Drums are used to store liquid and solid site derived waste.

The following standard materials and equipment are recommended for decontamination activities:

- 5.1 Decontamination Tools/Supplies
  - Long and short handled brushes
  - Bottle brushes, composed of nonmetallic material such as nylon
  - Plastic sheeting
  - Paper towels
  - Plastic or galvanized tubs or buckets
  - Pressurized sprayers filled with potable water
  - Spray bottles
  - Aluminum foil
  - Pressure washer
  - Garden hose
  - Electrical cords
  - Work lights (if working in the dark)
  - Generator (if using a submersible pump or lights)
  - Water tank
  - Sump pump
- 5.2 Health and Safety Equipment

The use of personal protective equipment (PPE), (i.e. safety glasses or splash shield, Tyvek<sup>®</sup> suits, nitrile gloves, aprons or coveralls, steel toe boots, etc.), is required. Refer to the site-specific Health and Safety Plan (HASP) for site-specific requirements.

- 5.3 Waste Disposal
  - Trash bags
  - 55-gallon drums (open and closed top types)
  - Metal/plastic buckets/containers for storage and disposal of decontamination solutions

#### 6.0 REAGENTS

Table 1 (Appendix A) lists solvents recommended for the elimination of particular chemicals. In general, solvents typically utilized during the decontamination process are:

- 10% Nitric Acid (HNO<sub>3</sub>), typically used for inorganic compounds such as metals
- Acetone (pesticide grade)
- Hexane (pesticide grade)
- Methanol (pesticide grade)
- Deionized/Distilled Water that meets ASTM Type II specifications
- Non-Phosphate Detergent
- Potable Water



SOP: ERT-PROC-2006-20 PAGE: 7 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

#### 7.0 PROCEDURES

A decontamination area should be set up prior to sampling. Weather conditions (i.e. hot, cold, rain, snow, etc.) play an important role in the decontamination process. In hot, cold, rainy or snowy conditions, a tent or canopy may be erected around and over the decontamination area. In cold environments, the decontamination may need to occur inside a building or portable heaters may be needed to warm the area under the tent or canopy. In addition, in cold environments the potable and deionized water may freeze. Plan accordingly and consider your working conditions prior to field sampling activities

A decontamination plan needs to be implemented and includes:

- The number, location, and layout of decontamination stations
- Decontamination equipment
- Selection of appropriate decontamination methods
- Methods of disposal of all investigative derived waste (i.e. PPE, solid and liquid waste, etc.)
- Work practices that minimize contact with potential contaminants.
- Protection procedures for monitoring and sampling equipment (i.e. covering with plastic, etc.)
- Considerations related to weather conditions
- The use of disposable and dedicated sampling equipment, when possible
- 7.1 Decontamination Methods

All samples and equipment removed from site must be decontaminated, removing all contamination that may have adhered to the equipment. Various decontamination methods remove contaminants by washing with water and another physical cleaning action. In addition, solvents and/or acids may be used to decontaminate the equipment.

Physical decontamination methods are grouped into two categories, abrasive and non-abrasive methods, and are listed below:

7.1.1 Abrasive Cleaning Methods

Abrasive cleaning methods work by rubbing and wearing away the top layer of the surface containing the contaminant. It involves the use of metal or nylon brushes. The amount and type of contaminants removed will vary with the brush type, length of time brushed, degree of brush contact, degree of contamination, nature of the contaminant and surface being cleaned.

7.1.2 Non-Abrasive Cleaning Methods

Non-abrasive cleaning methods work by forcing the contaminant off a surface with water pressure (i.e. sprayer or pressure washer).

#### Low-Pressure Water

This method consists of a pressure sprayer filled with water. The user pumps air into the sprayer tank to create pressure. The water is then discharged through a slender nozzle and hose, cleaning the equipment. Scrubbing with a brush is typically used in conjunction with this method.



SOP: ERT-PROC-2006-20 PAGE: 8 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

#### High-Pressure Water

This method consists of the use of a pressure washer. The operator controls the directional nozzle which is attached to a high-pressure hose. Operating pressure usually ranges from 400 - 600 pounds per square inch (PSI). Scrubbing with large brushes can be used to aid in the decontamination process.

#### Rinsing

Contaminants and any remaining solvents and/or acids are removed by thorough rinsing. The rinsing is done either by the use of a sprayer or a pressure washer depending on the equipment being cleaned.

#### Damp Cloth Removal

In some instances, due to sensitive, non-waterproof equipment or due to the unlikelihood of equipment being contaminated, it is not necessary to conduct an extensive decontamination procedure. For example, air sampling pumps attached to a fence, placed on a drum, or equipment protected by plastic or some other material are not likely to become heavily contaminated.

A damp cloth is used to wipe off any contaminants which may have adhered to equipment through airborne contaminants or from surfaces upon which the equipment was set. The use of a different cleaning cloth for each piece of equipment is required. Upon completion, dispose of all cloths with the site derived waste.

#### 7.2 Field Sampling Equipment Decontamination Procedures

#### 7.2.1 Decontamination Setup

Set up the decontamination area by laying out a section of plastic sheeting large enough for the type and amount of equipment to be decontaminated and for the equipment drop and equipment air drying areas.

Stage brushes, pressure sprayers, spray bottles (w/appropriate solvents, acids and deionized water), 5-gallon buckets, plastic/galvanized wash tubs, pressure washer (if required) and detergent. Figure 1 (Appendix B) shows the decontamination area overall layout. Section 7.2.2 discusses the decontamination procedures depending on the contaminants of concern for a Site.

Stage the appropriate amount and type of sample bottles and a cooler, for the collection of rinsate samples. For specific rinsate sample information, refer to ERT SOP, *Quality Assurance/Quality Control Samples*.

#### 7.2.2 Decontamination Procedures

There are various stations of the cleaning process in which the equipment move through that are designed to remove all visible contamination. Stations 1 and 2 are designed to remove all visible contamination. Additional stations after 1 and 2 remove materials that require dissolution and a final rinse. Once the equipment has passed through all stations, it is laid out to air dry.



SOP: ERT-PROC-2006-20 PAGE: 9 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

Decontamination Process for Metals

<u>Station 1</u> - Place the sampling equipment into the soapy water solution and thoroughly scrub with brushes or pressure washer. When there is no visible residue remaining, transfer to Station 2.

<u>Station 2</u> - Rinse the equipment in the bucket/tub with potable water. Then remove from the bucket/tub and rinse with the pressure sprayer. When satisfied with the cleanliness of the sampling equipment, transfer to Station 3.

<u>Station 3</u> - Apply the acid solution and air dry on the plastic sheeting, behind Station 3. Once equipment has fully dried, transfer to Station 4.

**Station 4** - Rinse the equipment with the pressure sprayer filled with deionized water. When satisfied the rinsing process is complete, transfer to the equipment drying area. After drying, the equipment should be wrapped in aluminum foil to prevent contamination of the equipment.

#### Decontamination Process for Organics

<u>Station 1</u> - Place the sampling equipment into the soapy water solution and thoroughly scrub with brushes. When there is no visible residue remaining, transfer to Station 2

<u>Station 2</u> - Rinse the equipment in the bucket/tub with potable water. Then remove from the bucket/tub and rinse with the pressure sprayer. When satisfied with the cleanliness of the sampling equipment, transfer to Station 3.

<u>Station 3</u> - Apply the appropriate solvent or solvents and air dry on the plastic sheeting, behind Station 3. Once equipment has fully dried, transfer to Station 4.

<u>Station 4</u> - Rinse the equipment with the pressure sprayer filled with deionized water. When satisfied the rinsing process is complete, transfer to the equipment drying area.

Decontamination process for Metals and Organics

<u>Station 1</u> - Place the sampling equipment into the soapy water solution and thoroughly scrub with brushes. When there is no visible residue remaining, transfer to Station 2.

<u>Station 2</u> - Rinse the equipment in the bucket/tub with potable water. Then remove from the bucket/tub and rinse with the pressure sprayer. When satisfied with the cleanliness of the sampling equipment, transfer to Station 3.

Station 3 - Apply the acid solution and transfer to Station 4.

**<u>Station 4</u>** - Rinse the equipment with the pressure sprayer filled with deionized water. When satisfied the rinsing process is complete, transfer to Station 5.

<u>Station 5</u>- Apply the solvent or solvents and air dry on the plastic sheeting behind Station 5. Once equipment has fully dried, transfer to Station 6.



SOP: ERT-PROC-2006-20 PAGE: 10 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

<u>Station 6</u> - Rinse the equipment with the pressure sprayer filled with deionized water. When satisfied the rinsing process is complete, transfer to the equipment drying area. After drying, the equipment should be wrapped in aluminum foil to prevent contamination of the equipment.

- 7.2.3 Post Decontamination Procedures
  - 1. Fill out the appropriate labels for the all the various wastes and affix the labels to the drums and/or containers.
  - 2. Clean up the entire work area. Collect solid waste (i.e. nitrile gloves, plastic sheeting, etc.) and store in an appropriate Department of Transportation (DOT) certified drum.
  - 3. Return any remaining unused solvents or acid solutions to their respective labeled containers and properly store.
  - 4. Transfer potable water rinse waste into an appropriate DOT certified drum or container.
  - 5. Transfer the solvent and acid solution rinse water waste into the appropriately labeled DOT certified drums or containers.
  - 6. Using a pressure sprayer, rinse the basins/buckets.
  - 7. Transfer liquid generated from this process into the potable water rinse waste container.
  - 8. Transfer the decontamination brushes into the solid waste container.
  - 9. Empty the pressure sprayer filled with potable water onto the ground.
  - 10. Return all equipment into their carrying cases or shipping containers.
  - 11. Make arrangements for the pickup of all liquid and solid waste.

For further information on waste disposal, refer to ERT SOP, Investigation-Derived Waste Management.

7.3 Decontamination of Earth Moving Equipment/Drilling Equipment and Accessories

The decontamination of earth moving and/or drilling equipment and their accessories will require the use of a pressure washer. In addition, an on-site water supply will need to be available. If an onsite water supply is not available, a water tank along with a pump, hoses and a generator will be required. Finally, a designated area on-site needs to be designated as a decontamination area. Some sites already have a concrete pad set-up for this very purpose. If this is not the case, work with the ERT Work Assignment Manager (WAM) to assign a location for these activities to take place onsite.

An area for decontamination can be built with 4x4 lumber or hay bales, heavy-duty plastic sheeting and a sump pump. The area will need to extend at least 4 feet beyond the outer dimensions of the equipment being cleaned. Either slope the decontamination area down to one corner or dig a small



SOP: ERT-PROC-2006-20 PAGE: 11 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

hole about 2 feet by 2 feet square and about 2 feet deep to allow for the collection of the decontamination water. Cover the decontamination area with plastic sheeting, wrapping the sides around and under the 4 x 4 lumber or bales of hay. If equipment being decontaminated includes equipment with tracks that might tear through the plastic sheeting, appropriate surfaces need to be included for the equipment to drive on. Finally, place a sump pump into this area and periodically empty the water as necessary, into the appropriately labeled liquid waste drum.

- 7.3.1 Decontamination Set-up Procedures
  - 1. Move the equipment into the decontamination area.
  - 2. Stage all the decontamination equipment and supplies (i.e. Pressure Washer, Hoses, PPE, etc.)
  - 3. Connect all hoses and fill the pressure washer with fuel.
  - 4. Dress out in the appropriate PPE (refer to the site-specific HASP).

At a minimum, Tyvek<sup>®</sup>, safety glasses/goggles, steel toe boots, and nitrile gloves must be worn. If handling any equipment (i.e. drill rods, etc.) work gloves must also be worn to prevent possible injury. For site specific requirements refer to the site-specific HASP.

- 7.3.2 Decontamination Cleaning Procedures
  - 1. Physically remove as much of the visible material as possible from the heavy equipment after use and prior to steam cleaning. If contaminated material is suspected as determined by visual observations, instrument readings, or other means, collect material in an appropriate waste container.
  - 2. Place the heavy equipment on the decontamination pad in the decontamination area. Verify the decontamination pad has no leaks and the sump pump is functioning properly before beginning the decontamination process.
  - 3. Power on the pressure washer and begin cleaning from the top to the bottom. Thoroughly clean parts of the heavy machinery that come into contact with visible material (such as tires, bucket, augers, drill rods, tracks and the back and underneath of the drill rig). Scrub areas with excessive dirt/debris with large bristle brushes. A flat head shovel can be used to aide in the removal of the dirt/debris. Continue cleaning until all visible contamination has been removed. If required, apply solvents and/or acid solutions, rinse with deionized/distilled water and then let air dry.

The use of solvents and/or acid solutions will depend on site specific conditions. Check with the site-specific HASP for further guidance.

- 7.3.3 Post Decontamination Procedures
  - 1. Fill out the appropriate labels for the all the various wastes and affix the labels to the drums and/or containers.



SOP: ERT-PROC-2006-20 PAGE: 12 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

- 2. Transfer potable water rinse waste into an appropriate DOT certified drum or container. Transfer water from the decontamination pad to the liquid waste drums using a sump pump.
- 3. Collect and transfer solid waste (i.e. nitrile gloves, plastic sheeting, etc.) to a DOT-certified drum or container.
- 4. Transfer the solvent and acid solution rinse water waste into the appropriately labeled DOT-certified drums or containers.
- 5. Make arrangements for the pickup of all liquid and solid waste.

For further information on waste disposal, refer to ERT SOP, *Investigation Derived Waste Management*.

#### 8.0 CALCULATIONS

This section is not applicable to this SOP.

#### 9.0 QUALITY ASSURANCE/QUALITY CONTROL

Documentation of the decontamination process including date, time and personnel that conducted the decontamination activities must be recorded in a field logbook. Record manufacturer and lot numbers of the reagents used for the decontamination procedures.

A rinsate blank is a specific type of quality control sample associated with the field decontamination process. This sample will provide information on the effectiveness of the decontamination process employed in the field. Rinsate blanks are samples obtained by pouring analyte free deionized water over previously decontaminated sampling equipment, testing for residual contamination. The blank water is then collected in sample containers, processed, shipped and analyzed. The rinsate blank is used to assess possible cross-contamination caused by improper decontamination procedures. The most common frequency of collection is one rinsate blank per day per type of sampling device, to meet definitive data objectives. For further information for each analysis, refer to ERT SOP, *Quality Assurance/Quality Control Samples*.

For information on sample container types and preservation, refer to ERT SOP, *Sample Storage, Preservation and Handling*.

If sampling equipment requires the use of Teflon<sup>®</sup> or polyethylene tubing, it must be disposed of into the onsite waste container and replaced with clean tubing before additional sampling occurs.

Records must be maintained documenting the training of the operators that use equipment for the collection of environmental information.

#### 10.0 DATA VALIDATION

Data verification (completeness checks) must be conducted to ensure that all data inputs are present for ensuring the availability of sufficient information. These data are essential to providing an accurate and complete final deliverable. Results of quality control samples will be evaluated for possible cross-contamination of improperly or inadequately decontaminated sampling equipment. This data will be utilized to quantify the sample results in accordance with the project's data quality objectives. The ERT contractor's Task Leader (TL) is responsible for completing the UFP-QAPP verification checklist for each project.



SOP: ERT-PROC-2006-20 PAGE: 13 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

#### 11.0 HEALTH AND SAFETY

Based on Occupational Safety and Health Administration (OSHA) requirements, a site-specific health and safety plan (HASP) must be prepared for response operations under the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard, <u>29 CFR 1910.120</u>. Field personnel working for EPA's ERT should consult the Emergency Responder Health and Safety Manual currently located at <u>https://response.epa.gov/\_HealthSafetyManual/manual-index.htm</u> for the development of the HASP, required PPE and respiratory protection.

The decontamination process can pose hazards under certain circumstances. Hazardous substances may be incompatible with decontamination materials. For example, the decontamination solution may react with contaminants to produce heat, explosion, or toxic products. Also, vapors from decontamination solutions may pose a direct health hazard to workers by inhalation, contact, fire, or explosion.

The decontamination solutions must be determined to be acceptable before their use. Decontamination materials may degrade protective clothing or equipment and some solvents can permeate protective clothing. If decontamination materials pose a health hazard, measures are to be taken to protect personnel. Alternatively, substitutions can be made to eliminate the hazard. The choice of respiratory protection based on contaminants of concern from the site may not be appropriate for solvents used in the decontamination process. Material generated from decontamination activities requires proper handling, storage, and disposal. PPE may be required for these activities.

Safety data sheets (SDS) are required for all decontamination solvents or solutions as required by the Hazard Communication Standard (i.e. acetone, alcohol, etc.).

#### 12.0 REFERENCES

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, August 2005.

Compendium of Superfund Field Operations Methods, EPA 540/p-87/001.

The Field Branches Quality System and Technical Procedures – Field Equipment Cleaning and Decontamination, USEPA Region IV Science and Ecosystem Support Division, November 2007.

Guidelines for the Selection of Chemical Protective Clothing, Volume 1, Third Edition, American Conference of Governmental Industrial Hygienists, Inc., February 1987.

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, NIOSH/OSHA/USCG/EPA, October 1985.

#### 13.0 APPENDICES

A – Tables B - Figures



SOP: ERT-PROC-2006-20 PAGE: 14 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

SAMPLING EQUIPMENT DECONTAMINATION

APPENDIX A Tables SOP: ERT-PROC-2006-20 October 2020



SOP: ERT-PROC-2006-20 PAGE: 15 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

TABLE 1. Soluble Contaminants and Recommended Solvent Rinse				
SOLVENT <sup>(1)</sup>	EXAMPLES OF	SOLUBLE		
	SOLVENTS	CONTAMINANTS		
Water	Deionized water Potable water	Low-chain hydrocarbons Inorganic compounds Salts Some organic acids and other polar compounds		
Dilute Acids	Nitric acid Acetic acid Boric acid	Basic (caustic) compounds (e.g., amines and hydrazines) and inorganic compounds.		
Dilute Bases	Sodium bicarbonate	Acidic compounds Phenol Thiols Some nitro and sulfonic compounds		
Organic Solvents <sup>(2)</sup>	Acetone Alcohols Ketones Aromatics Alkanes (e.g., hexane) Common petroleum products (i.e. fuel, oil, kerosene)	Nonpolar compounds (e.g., some organic compounds)		
Organic Solvent <sup>(2)</sup>	Hexane	PCBs		

<sup>(1)</sup> - Safety data sheets are required for all decontamination solvents or solutions as required by the Hazard Communication Standard

<sup>(2)</sup> - WARNING: Some organic solvents can permeate and/or degrade protective clothing



SOP: ERT-PROC-2006-20 PAGE: 16 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

SAMPLING EQUIPMENT DECONTAMINATION

APPENDIX B Figures SOP: ERT-PROC-2006-20 October 2020



SOP: ERT-PROC-2006-20 PAGE: 17 of 17 REV: 1.1 EFFECTIVE DATE: 10/19/20

### SAMPLING EQUIPMENT DECONTAMINATION

FIGURE 1. Sampling Equipment Decontamination Area

#### Configuration for the Removal of Metals



#### Configuration for the Removal of Organics



#### Configuration for the Removal of Metals and Organics





 SOP:
 ERT-PROC-2010-20

 PAGE:
 1 of 24

 REV:
 1.0

 EFFECTIVE DATE:
 06/18/20

### TANK SAMPLING

#### CONTENTS

#### DISCLAIMERS

- 1.0 SCOPE AND APPLICATION
- 2.0 METHOD SUMMARY
- 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE
- 4.0 INTERFERENCES AND POTENTIAL PROBLEMS
- 5.0 EQUIPMENT/APPARATUS
- 6.0 REAGENTS
- 7.0 PROCEDURES
  - 7.1 Preparation
  - 7.2 Preliminary Inspection
  - 7.3 Sampling Procedure
  - 7.4 Before Sampling
  - 7.5 Sampling Devices
    - 7.5.1 Bacon Bomb Sampler
    - 7.5.2 Sludge Judge
    - 7.5.3 Subsurface Grab Sampler
    - 7.5.4 Glass Thief (Drum Thief)
    - 7.5.5 Bailer
    - 7.5.6 COLIWASA
- 8.0 CALCULATIONS
- 9.0 QUALITY ASSURANCE/QUALITY CONTROL
- 10.0 DATA VALIDATION
- 11.0 HEALTH AND SAFETY
- **12.0 REFERENCES**
- 13.0 APPENDICES
  - A Volume Calculations
  - B Figures



 SOP:
 ERT-PROC-2010-20

 PAGE:
 2 of 24

 REV:
 1.0

 EFFECTIVE DATE:
 06/18/20

### TANK SAMPLING

The policies and procedures established in this document are intended solely for the guidance of OLEM employees of the U.S. Environmental Protection Agency (EPA). They are not intended and cannot be relied upon to create any rights, substantive or procedural, enforceable by any party in litigation with the United States. EPA reserves the right to act at variance with these policies and procedures, and to change them at any time without public notice. EPA strongly encourages all readers to verify the validity of the information contained in this document by consulting the most recent Code of Federal Regulations (CFR) and updated guidance documents.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.



SOP: ERT-PROC-2010-20 PAGE: 3 of 24 REV: 1.0 EFFECTIVE DATE: 06/18/20

### **TANK SAMPLING**

#### 1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide technical guidance in choosing appropriate sampling techniques and equipment for the collection of representative samples from tanks. A sample of all or parts of a tank may be collected to determine chemical and physical properties of its contents. Data obtained from the sample may be used to select suitable methods of treatment and disposal or confirm the contents of labeled tanks.

A Quality Assurance Project Plan (QAPP) in Uniform Federal Policy (UFP) format describing the project objectives must be prepared prior to deploying for a sampling event. The sampler needs to ensure that the methods used are adequate to satisfy the data quality objectives (DQOs) listed in the QAPP for a particular site.

The procedures in this SOP may be varied or changed as required, dependent on site conditions, equipment limitations or other procedural limitations. In all instances, the procedures employed must be documented on a Field Change Form and attached to the QAPP. These changes must be documented in the final deliverable.

#### 2.0 METHOD SUMMARY

Safe collection of a representative sample is the premier criterion for selecting sample locations. A representative sample can be collected using techniques or equipment that are designed for obtaining liquids or sludge from various depths. The structure and characteristics of storage tanks may present problems with collection of samples from more than one location; therefore, the selection of sampling devices is an important consideration.

Depending on the type of vessel and characteristics of the material to be sampled, a bacon bomb sampler, sludge judge, subsurface grab sampler, glass thief, bailer, or Composite Liquid Waste Sampler (COLIWASA) may be chosen to collect the sample. A sludge judge, bacon bomb, or COLIWASA can be used to determine if the tank contents are stratified. Various other custom-made samplers may be used depending on the specific application.

All sample locations should be surveyed for air quality prior to sampling. At no time should sampling continue with a lower explosive level (LEL) reading greater than 25 percent (%), oxygen readings below 19.5% or above 23.5%, problematic total volatile organic vapors (TVOCs) levels, or any elevated level of toxic gas on the fourth sensor. The fourth sensor on the MultiRAE should be chosen based on the potential contents of the tank. If necessary, multiple MultiRAE or AreaRAE instruments may be used equipped with several types of sensors.

#### 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Unknown samples collected from tanks are considered waste samples and could consist of highly concentrated chemicals. As such, addition of preservatives are not required due to the potential reaction of the sample with the preservative. Samples should be cooled to less than or equal to ( $\leq 6$ ) degrees Centigrade (°C) with ice and protected from sunlight to minimize any potential reaction due to the potential light sensitivity of the sample. There may be times when cooling of the sample causes an alteration in the chemical and physical characteristics. Selection of preservation techniques and applicable holding times should be based on all available information, including the properties of the analytes of interest for the project, their



 SOP:
 ERT-PROC-2010-20

 PAGE:
 4 of 24

 REV:
 1.0

 EFFECTIVE DATE:
 06/18/20

### TANK SAMPLING

anticipated concentration levels, the composition of the sample matrix itself, and the stated project-specific DQOs.

Sample bottles for collection of waste liquids, sludge, or solids are typically wide-mouth amber jars with Teflon-lined screw caps. Actual volume required for analysis should be determined in conjunction with the laboratories performing the various analyses, and according to the requirements of the UFP-QAPP.

Sample handling procedures must be as follows:

- 1. Label the sample jar per Environmental Response Team (ERT) SOP, Sample Documentation.
- 2. Place sample container into two Ziploc plastic bags, marking the outside bag with the identification number.
- 3. Wrap each double bagged container securely in bubble wrap.
- 4. Place the bubble wrapped samples in a cooler and fill remaining space with absorbent packing material.
- 5. Fill out chain of custody record for each cooler, place in plastic, and affix to inside lid of cooler.
- 6. Secure and custody seal the lid of cooler.
- 7. Arrange for the appropriate transportation mode consistent with the type of hazardous waste involved.

#### 4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Sampling a storage tank requires a great deal of manual dexterity, often requiring climbing to the top of the tank going up a narrow vertical or spiral stairway or ladder while wearing protective clothing and carrying sampling equipment. All platforms or ladders must be appropriately guarded or alternative safety methods for working at heights must be employed.

Before climbing onto the vessel, a structural survey should be performed. This will ensure appropriate consideration of safety and accessibility prior to initiation of any field activities.

As in all opening of containers, extreme caution should be taken to avoid ignition or combustion of volatile contents. All tools used must be constructed of a non-sparking material and all electronic instruments to be used near the sampling points must be intrinsically safe and this includes cell phones.

All sample locations should be surveyed for air quality prior to sampling. At no time should sampling continue with a LEL reading of 25% or more.

#### 5.0 EQUIPMENT/APPARATUS

Materials found in storage tanks may include liquids, sludge, still bottoms, and solids of various types. As previously stated, samplers commonly used for tanks include: a bacon bomb sampler, sludge judge, glass thief, bailer, COLIWASA, and subsurface grab sampler. The type of sampler chosen should be compatible with the waste. The tank sampling equipment checklist includes:

- UFP-QAPP
- Safety equipment
- Tape measure
- Weighted tape line, measuring stick, or equivalent



 SOP:
 ERT-PROC-2010-20

 PAGE:
 5 of 24

 REV:
 1.0

 EFFECTIVE DATE:
 06/18/20

### TANK SAMPLING

- Camera
- Stainless steel bucket or bowl
- Sample containers
- Ziplock plastic bags
- Logbook
- Labels
- Site Logbook
- Chain of Custody (COC) records
- COC seals
- Flashlight (explosion proof)
- Coolers
- Ice
- Decontamination supplies per ERT SOP, Sampling Equipment Decontamination
- Bacon bomb sampler, stainless steel or brass-plated, 2-1/2 inch (") outer diameter (O.D.) x 10" long and holds 500 milliliters (mL) for liquid sampling at a wide variety of sampling depths
- Sludge judge, 3/4" plastic pipe in 5-foot sections, marked at 1-foot increments with screw-type fittings for sampling settled solids
- Glass thieves, 6 millimeter (mm) to 16 mm inner diameter (I.D.) and 48 inches long for sampling drums, transformers and other liquid containers
- Bailers, manual dipping device
- COLIWASA, for sampling hazardous wastes, liquids, slurry-type sludge, and semi-solids from top to bottom of tanks
- Subsurface grab sampler
- Water/oil level indicator
- Combustible Gas Analyzer
- Hand-Held MultiRAE for:
  - o Oxygen
  - o LEL
  - Volatile Organic Compounds (VOCs)
  - $\circ$  ~ Toxic Gas Sensor, e.g., Hydrogen Sulfide or Carbon Monoxide
- Organic vapor analyzer (OVA) (or equivalent)
- High volume intrinsically safe blower

#### 6.0 REAGENTS

Reagents are not typically required for the preservation of waste samples. However, reagents will be utilized for decontamination of equipment. Decontamination solutions required are specified in ERT SOP, *Sampling Equipment Decontamination*.

#### 7.0 PROCEDURE

- 7.1 Preparation
  - 1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.


SOP: ERT-PROC-2010-20 PAGE: 6 of 24 REV: 1.0 EFFECTIVE DATE: 06/18/20

## **TANK SAMPLING**

- 2. Obtain necessary sampling and monitoring equipment.
- 3. Decontaminate or pre-clean equipment and ensure that it is in working order.
- 4. Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.
- 5. Perform a general site survey prior to site entry in accordance with the site-specific Health and Safety Plan.
- 6. Identify and mark all sampling locations.
- 7. Refer to Appendix A regarding calculations utilized in determining tank volumes.
- 7.2 Preliminary Inspection
  - 1. Inspect the external structural characteristics of each tank and record in the site logbook. Potential sampling points should be evaluated for safety, accessibility, and sample quality.
  - 2. Prior to opening a tank for internal inspection, the tank sampling team will:
    - Review safety procedures and emergency contingency plans with the Health and Safety Officer (HSO).
    - Ensure that the tank is properly grounded.
    - Remove all sources of ignition from the immediate area.
  - 3. Each tank should be accessed using appropriate means. Remove manway covers using non-sparking tools.
  - 4. Collect air quality measurements for each potential sample location using a MultiRAE to measure LEL/lower flammability limit (LFL), oxygen, VOCs, and Toxic Gas readings. An additional reading from an OVA for an organic vapor concentration may also be taken. All readings should be taken from the tank headspace, above the sampling port, and in the breathing zone.
  - 5. Prior to commencing sampling, the tank headspace should be cleared of any toxic or explosive vapor concentration using a high-volume explosion proof blower. No work will start if LEL readings exceed 25%; between 10% and 25% LEL, work can continue but with extreme caution. The HSO should be informed if the LEL reading is close to the 25% upper limit.

#### 7.3 Sampling Procedure

- 1. Determine the depth of any and all liquid, solid, and liquid/solid interface, and depth of sludge using a weighted tape measure, probe line, sludge judge, or equivalent.
- 2. Collect liquid samples from one (1) foot below the surface, from mid-depth of liquid, and from one (1) foot above the bottom sludge layer. This can be accomplished with a subsurface grab sampler or bacon bomb. For liquids less than five (5) feet in depth, use a glass thief or COLIWASA to collect the sample.



SOP: ERT-PROC-2010-20 PAGE: 7 of 24 REV: 1.0 EFFECTIVE DATE: 06/18/20

### **TANK SAMPLING**

When sampling storage tanks, vacuum trucks, or process vessels, collect at least one sample from each compartment in the tank. Samples should always be collected through an open hatch at the top of the tank. Valves near the bottom should not be used, because of their questionable or unknown integrity. If such a valve cannot be closed once open, the entire tank contents may be lost to the ground surface. Also, individual strata cannot be sampled separately through a valve near the bottom.

- 3. Compare the three samples for visual phase differences. If phase differences appear, systematic iterative sampling should be performed. By halving the distance between two discrete sampling points, one can determine the depth of the phase change.
- 4. If another sampling port is available, sample as above to verify phase information.
- 5. Since it is difficult and may be dangerous to measure the inside diameter of the tank without confined space entry, measure the outside diameter of the tank only.
- 6. Sludge can be collected using a bacon bomb sampler, glass thief, or sludge judge.
- 7. Record all information on the sample data sheet or site logbook. Label the container with the appropriate sample tag.
- 8. Decontaminate sampling equipment as per ERT SOP, Sampling Equipment Decontamination.
- 7.4 Before Sampling
  - 1. Using the UFP-QAPP for guidance, obtain and prepare all needed sample containers of adequate size and type (glass, amber, clear, polyethylene (PE), etc.) for sample type.
  - 2. Establish a Scribe File for the sampling effort, accounting for all of the sampling required and prepare and print COC Seals from Scribe.
  - 3. If practical, pre-label the sample containers with sample number and location to save time and to ensure that the samples are properly identified and managed. However, if the sampling process carries a significant risk that the label will be impacted by the sample being collected, then do not add the permanent label until after the sample is in the jar and the jar decontaminated.
  - 4. Be sure to bring an excess of each type of sample container to accommodate replacement samples as well as the need to add sampling locations and samples to the original sampling plan in the QAPP.

#### 7.5 Sampling Devices

7.5.1 Bacon Bomb Sampler

The bacon bomb sampler (Figure 1, Appendix B) is designed for the collection of material from various levels within a storage tank. It consists of a cylindrical body, usually made of



SOP: ERT-PROC-2010-20 PAGE: 8 of 24 REV: 1.0 EFFECTIVE DATE: 06/18/20

### **TANK SAMPLING**

chrome-plated brass and bronze with an internal tapered plunger that acts as a valve to admit the sample. A line attached to the top of the plunger opens and closes the valve. A line is attached to the removable top cover which has a locking mechanism to keep the plunger closed after sampling. To collect a sample using the Bacon Bomb sampler, follow the steps below.

- 1. Attach the sample line and the plunger line to the sampler.
- 2. Measure and then mark the sampling line at the desired depth.
- 3. Gradually lower the sampler by the sample line until the desired level is reached.
- 4. When the desired level is reached, pull up on the plunger line and allow the sampler to fill before releasing the plunger line to seal off the sampler.
- 5. Retrieve the sampler by the sample line with care not to pull up on the plunger line and thereby prevent accidental opening of the bottom valve.
- 6. Rinse or wipe off the exterior of the sampler body.
- 7. Position the sampler over the sample container and release its contents by pulling up on the plunger line.
- 8. Cap the sample tightly and transport the sample to the decon pad for careful decontamination of the outside of the container.
- 9. After decontamination, dry the sample container and add the label, and if applicable, affix the COC seals to the sample bottle closure.
- 10. Log all samples in the site logbook or on field data sheets, enter the sample data into Scribe, and check to ensure that all labels are correctly placed.
- 11. Package samples and complete necessary paperwork to ship.
- 12. After completing sampling activities at this location/port, replace the flange or manway or place plastic tightly over the tank opening.

#### 7.5.2 Sludge Judge

A sludge judge (Figure 2, Appendix B) is used for obtaining an accurate reading of settleable solids in any liquid. The sampling depth is dependent upon the length of the sludge judge. The sampler consists of 3/4" plastic pipe in 5 foot sections, marked at 1-foot increments with screw-type fittings. To collect a sample using the sludge judge, follow the steps below.

1. Prepare Scribe, COC seals, sample containers, and sample labels (if practical) for the samples to be collected.



SOP: ERT-PROC-2010-20 PAGE: 9 of 24 REV: 1.0 EFFECTIVE DATE: 06/18/20

### **TANK SAMPLING**

- 2. Lower the sludge judge to the bottom of the tank.
- 3. When the bottom has been reached, the float valve will open allowing the pipe to fill to the surface level. Tugging on the line will seat the float valve, trapping the column of material.
- 4. When the unit has been raised clear of the tank liquid, the amount of sludge in the sample can be read using the one-foot increments marked on the pipe sections.
- 5. By touching the pin extending from the bottom section against a hard surface, the material is released from the unit.
- 6. Cap the sample tightly and transport the sample to the decon pad for careful decontamination of the outside of the container.
- 7. After decontamination is complete, dry the container, add the label, and if applicable, affix the COC seal.
- 8. Log all samples in the site logbook or on field data sheets, enter the sample data into Scribe, and check to ensure that all labels and COC seals are correctly placed.
- 9. Package samples and complete necessary paperwork to ship.
- 10. After completing sampling activities at this location/port, replace the flange or manway. If this is not possible, place plastic tightly over the tank opening.
- 7.5.3 Subsurface Grab Sampler

Subsurface grab samplers (Figure 3, Appendix B) are designed to collect samples of liquids at various depths. The sampler is usually constructed of aluminum or stainless steel tubing with a polypropylene or Teflon head that attaches to a 1-liter sample container. To collect a sample using the subsurface grab sampler, follow the steps below.

- 1. Prepare Scribe, COC seals, sample containers, and sample labels (if practical) for the samples to be collected.
- 2. Screw the sample bottle onto the sampling head.
- 3. Gently lower the sampler to the desired depth to avoid creating turbulence or mixing.
- 4. Pull the ring at the top which opens the spring-loaded plunger in the head assembly.
- 4. After waiting sufficient time to fill the sample bottle, release the ring, lift the sampler, and remove sample bottle.
- 5. Cap the sample tightly and transport the sample to the decontamination pad for careful decontamination of the outside of the container.



SOP: ERT-PROC-2010-20 PAGE: 10 of 24 REV: 1.0 EFFECTIVE DATE: 06/18/20

### **TANK SAMPLING**

- 6. After decontamination, dry the sample container and add the label, and if applicable, affix the COC seal.
- 10. Log all samples in the site logbook on field data sheets, enter the sample data into Scribe, and check to ensure that all labels and COC seals are correctly placed.
- 11. Package samples and complete necessary paperwork to ship.
- 12. After completing sampling activities at this location/port, replace the flange or manway or place plastic tightly over the tank opening.
- 7.5.4 Glass Thief (Drum Thief)

The most widely used implement for sampling is a glass tube commonly referred to as a glass thief or drum thief (Figure 4, Appendix B). This tool is simple, cost effective, quick, and collects a sample without having to decontaminate. Glass thieves are typically 6 mm to 16 mm I.D. and 48 inches long. This method is applicable to drums (30 to 85 gallons) and small, similarly configured tanks. To collect a sample using a glass thief, follow the steps below.

- 1. Remove the cover from the sample container.
- 2. Remove the bung or lid from the drum or small tank.
- 3. Insert the glass tube (thief) almost to the bottom of the tank or until a solid layer is encountered. About one foot of tube should extend above the drum.
- 4. Allow the waste in the tank to reach its natural level in the tube.
- 5. Cap the top of the sampling tube with a tapered stopper or thumb, ensuring liquid does not come into contact with stopper.
- 6. Carefully remove the capped tube from the tank and insert the uncapped end in the sample container. Do not spill liquid on the outside of the sample container.
- 7. Release stopper and allow the glass thief to drain until the container is approximately 2/3 full.
- 8. Remove tube from the sample container. If it is not an issue from an analytical standpoint for possible future sampling to dispose of the thief in the drum, break it (score it first) while still wearing all normal PPE and using kevlar gloves for cut protection. Alternatively, a 4" or larger PVC pipe section can be capped at one end, the used thieves inserted, then after the sample has been collected cap/seal the other end and hold for disposal.
- 9. Cap the sample tightly and transport the sample to the decontamination pad for careful decontamination of the outside of the container.





SOP: ERT-PROC-2010-20 PAGE: 11 of 24 REV: 1.0 EFFECTIVE DATE: 06/18/20

### **TANK SAMPLING**

- 10. After decon, dry the sample container, add the label, and if applicable, affix the COC seal.
- 11. Log all samples in the site logbook or on field data sheets, enter the sample data into Scribe and check to ensure that all labels and COC seals are correctly placed.
- 12. Package samples and complete necessary paperwork to ship.
- 13. After completing sampling activities at this location/port, replace the flange or manway or place plastic tightly over the tank opening.

NOTE: In many instances a tank containing waste material will have a sludge layer on the bottom. Slow insertion of the sample tube down into this layer and then a gradual withdrawal will allow the sludge to act as a bottom plug to maintain the fluid in the tube. The plug can be gently removed and placed into the sample container by the use of a stainless steel lab spoon.

7.5.5 Bailer

The positive-displacement volatile sampling bailer (Figure 5, Appendix B) (manufactured by GPI) is perhaps the most appropriate for collection of water samples for volatile analysis. Other bailer types (messenger, bottom fill, etc.) are less desirable, but may be mandated by cost and site conditions. Generally, bailers can provide an acceptable sample, providing that the sampling personnel use extra care in the collection process. To use the bailer, follow the steps below.

- 1. Make sure clean plastic sheeting surrounds the tank.
- 2. Attach a line to the bailer.
- 3. Lower the bailer slowly and gently into the tank so as not to splash the bailer into the tank contents.
- 4. Allow the bailer to fill completely and retrieve the bailer from the tank.
- 5. Begin slowly pouring from the bailer.
- 6. Cap the sample tightly and transport the sample to the decontamination pad for careful decontamination of the outside of the container.
- 7. After decon, dry the sample container, add the label, and if applicable, affix the COC seal.
- 8. Log all samples in the site logbook or on field data sheets, enter the sample data into Scribe, and check to ensure that all labels and COC seals are correctly placed.
- 9. Package samples and complete necessary paperwork to ship.



SOP: ERT-PROC-2010-20 PAGE: 12 of 24 REV: 1.0 EFFECTIVE DATE: 06/18/20

## **TANK SAMPLING**

10. After completing sampling activities at this location/port, replace the flange or manway or place plastic tightly over the tank opening.

#### 7.5.6 COLIWASA

Sampling devices are available that allow collection of a sample from the full depth of a tank and maintain its integrity in the transfer tube until delivery to the sample bottle. The sampling device is known as a COLIWASA (Figure 6, Appendix B). The COLIWASA is a sampler designed to permit representative sampling of multiphase wastes from tanks and other containerized wastes.

One configuration consists of 152 centimeter (cm) by 4 cm I.D. section of tubing with a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end. Manipulation of the locking mechanism opens and closes the sampler by raising and lowering the neoprene stopper.

Since COLIWASA samplers are expensive and difficult to decontaminate, use disposable units where this type of sampler is indicated, especially in instances where a true representation of a multiphase waste is absolutely necessary. Follow the steps outlined below for use of a COLIWASA sampler.

- 1. Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.
- 2. Slowly lower the sampler into the liquid waste. Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sample tube is lower than that outside the sampler, the sampling rate is too fast and will result in a non-representative sample.
- 3. When the sampler stopper hits the bottom of the waste container, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the closed position by turning the T-handle until it is upright and one end rests tightly on the locking block.
- 4. Slowly withdraw the sample from the waste container with one hand while wiping the sampler tube with a disposable cloth or rag with the other hand.
- 5. Carefully discharge the sample into a suitable sample container by slowly pulling the lower end of the T-handle away from the locking block while the lower end of the sampler is positioned in a sample container.
- 6. Cap the sample tightly and transport the sample to the decontamination pad for careful decontamination of the outside of the container.
- 7. After decontamination, dry the sample container, add the label, and if applicable, affix the COC seal.
- 8. Log all samples in the site logbook or on field data sheets, enter the sample data into



SOP: ERT-PROC-2010-20 PAGE: 13 of 24 REV: 1.0 EFFECTIVE DATE: 06/18/20

## TANK SAMPLING

Scribe, and check to ensure that all labels and COC seals are correctly placed.

- 9. Package samples and complete necessary paperwork to ship.
- 10. After completing sampling activities at this location/port, replace the flange or manway or place plastic tightly over the tank opening.

#### 8.0 CALCULATIONS

There are no specific calculations for these procedures. Some common volume calculations can be found in Appendix A.

#### 9.0 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following general QA procedures apply:

- 1. All data must be documented and must be entered into SCRIBE.
- 2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the QAPP. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented in field data sheets or in site logbook.
- 3. Records must be maintained, documenting the training of the operators that use instrumentation and equipment for the collection of environmental information.

#### 10.0 DATA VALIDATION

Data verification (completeness checks) must be conducted to ensure that all data inputs are present for ensuring the availability of sufficient information. This may include but is not limited to: location information, start and end times, sampling method, and total volume sampled. These data are essential to providing an accurate and complete final deliverable. The contractor's Task Leader (TL) is responsible for completing the UFP-QAPP verification checklist for each project.

#### 11.0 HEALTH AND SAFETY

Based on Occupational Safety and Health Administration (OSHA) requirements, a site-specific health and safety plan (HASP) must be prepared for response operations under the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard, <u>29 CFR 1910.120</u>. Field personnel working for EPA's ERT should consult the Emergency Responder Health and Safety Manual currently located at <u>https://response.epa.gov/\_HealthSafetyManual/manual-index.htm</u> for the development of the HASP, required PPE and respiratory protection.

Hazards specific to tank sampling are:

1. Hazardous atmospheres which are either flammable, toxic, asphyxiating, or corrosive.



SOP: ERT-PROC-2010-20 PAGE: 14 of 24 REV: 1.0 EFFECTIVE DATE: 06/18/20

## **TANK SAMPLING**

- 2. If activation of electrical or mechanical equipment would cause injury, each piece of equipment should be manually isolated using lockout/tag-out procedures to prevent inadvertent activation while workers are occupied.
- 3. Communication with intrinsically safe equipment is of utmost importance between the sampling worker and the standby person to prevent distress or injury going unnoticed.
- 4. Proper procedures to evacuate a tank with forced air and grounding of equipment and tanks should be reviewed.

#### 12.0 REFERENCES

American Society for Testing and Materials (ASTM) D6232-08 Standard Guide for Selection of Sampling Equipment for Waste and Contaminated Media Data Collection Activities.

ASTM D7831-13, Standard Practice for Sampling of Tanks by Field Personnel.

EPA 1985, Guidance Document for Cleanup of Surface Tank and Drum Sites, OSWER Directive 9380.0-3.

EPA 1986, Drum Handling Practices at Hazardous Waste Sites, EPA-600/S2-086-013.

OSHAPPE standards, 29 CFR 1910.132 to 29 CFR 1910.138.



 SOP:
 ERT-PROC-2010-20

 PAGE:
 15 of 24

 REV:
 1.0

 EFFECTIVE DATE:
 06/18/20

# TANK SAMPLING

APPENDIX A Volume Calculations SOP: ERT-PROC-2010-20 June 2020



 SOP:
 ERT-PROC-2010-20

 PAGE:
 16 of 24

 REV:
 1.0

 EFFECTIVE DATE:
 06/18/20

## TANK SAMPLING

Volume Calculations





 SOP:
 ERT-PROC-2010-20

 PAGE:
 17 of 24

 REV:
 1.0

 EFFECTIVE DATE:
 06/18/20

## TANK SAMPLING

Volume Calculations (cont'd)





 SOP:
 ERT-PROC-2010-20

 PAGE:
 18 of 24

 REV:
 1.0

 EFFECTIVE DATE:
 06/18/20

# TANK SAMPLING

APPENDIX B Figures SOP: ERT-PROC-2010-20 June 2020



 SOP:
 ERT-PROC-2010-20

 PAGE:
 19 of 24

 REV:
 1.0

 EFFECTIVE DATE:
 06/18/20

# TANK SAMPLING







 SOP:
 ERT-PROC-2010-20

 PAGE:
 20 of 24

 REV:
 1.0

 EFFECTIVE DATE:
 06/18/20

# TANK SAMPLING

FIGURE 2. Sludge Judge





 SOP:
 ERT-PROC-2010-20

 PAGE:
 21 of 24

 REV:
 1.0

 EFFECTIVE DATE:
 06/18/20

# TANK SAMPLING

FIGURE 3. Subsurface Grab Sampler





 SOP:
 ERT-PROC-2010-20

 PAGE:
 22 of 24

 REV:
 1.0

 EFFECTIVE DATE:
 06/18/20

## TANK SAMPLING







 SOP:
 ERT-PROC-2010-20

 PAGE:
 23 of 24

 REV:
 1.0

 EFFECTIVE DATE:
 06/18/20

## TANK SAMPLING

FIGURE 5. Bailer





 SOP:
 ERT-PROC-2010-20

 PAGE:
 24 of 24

 REV:
 1.0

 EFFECTIVE DATE:
 06/18/20

## TANK SAMPLING

FIGURE 6. COLIWASA





SOP: ERT-PROC-2049-20 PAGE: 1 of 12 REV: 0.1 EFFECTIVE DATE: 04/29/20

## INVESTIGATION-DERIVED WASTE MANAGEMENT

#### CONTENTS

#### DISCLAIMERS

- 1.0 OBJECTIVE
- 2.0 APPLICABILITY
- 3.0 DESCRIPTION
  - 3.1 Regulatory Background and Options for Management of IDW
    - 3.1.1 Regulatory Preferences
    - 3.1.2 IDW Management Options
  - 3.2 Characterization of IDW
    - 3.2.1 Types of IDW
    - 3.2.2 Hazardous Waste IDW
    - 3.2.3 Polychlorinated Biphenyl-Containing Waste
    - 3.2.4 Asbestos-Containing Waste
    - 3.2.5 Non-Hazardous IDW

#### 3.3 Management of IDW

- 3.3.1 Waste Minimization
- 3.3.2 Types, Hazards, and Quantities of IDW
- 3.3.3 On-Site IDW Handling Options
- 3.3.4 Options Available for Off-Site Disposal of IDW
- 3.4 Equipment/Apparatus
  - 3.4.1 Waste Disposal
  - 3.4.2 Decontamination Equipment

#### 4.0 **RESPONSIBILITIES**

- 4.1 ERT Work Assignment Manager
- 4.2 ERT Contractor's Task Leader
- 4.3 ERT Contractor's Health and Safety Officer
- 4.4 ERT Contractor's Hazardous Waste Coordinator
- 5.0 REFERENCES
- 6.0 APPENDICES



SOP: ERT-PROC-2049-20 PAGE: 2 of 12 REV: 0.1 EFFECTIVE DATE: 04/29/20

## INVESTIGATION-DERIVED WASTE MANAGEMENT

The policies and procedures established in this document are intended solely for the guidance of OLEM employees of the U.S. Environmental Protection Agency (EPA). They are not intended and cannot be relied upon to create any rights, substantive or procedural, enforceable by any party in litigation with the United States. EPA reserves the right to act at variance with these policies and procedures, and to change them at any time without public notice. EPA strongly encourages all readers to verify the validity of the information contained in this document by consulting the most recent Code of Federal Regulations (CFR) and updated guidance documents.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.



SOP: ERT-PROC-2049-20 PAGE: 3 of 12 REV: 0.1 EFFECTIVE DATE: 04/29/20

## INVESTIGATION-DERIVED WASTE MANAGEMENT

#### 1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to provide general reference information on the management of investigation-derived waste (IDW) generated during Environmental response Team (ERT) site investigations.

A Quality Assurance Project Plan (QAPP) in Uniform Federal Policy (UFP) format describing the project objectives must be prepared prior to deploying for a sampling event. The anticipated approach and procedures for IDW management will be detailed in the approved QAPP for the site investigation.

The procedures in this SOP may be varied or changed as required, dependent on site conditions, equipment limitations or other procedural limitations. In all instances, the procedures employed must be documented on a Field Change Form and attached to the QAPP. These changes must be documented in the final deliverable.

#### 2.0 APPLICABILITY

This SOP is applicable only if the U.S.EPA On-Scene Coordinator (OSC), Remedial Project Manager (RPM), or other Regional Manager does not have procedures in place for IDW management. Prior to site activities, the ERT contractor's Task Leader (TL) determines if the OSC, RPM, or other Regional Manager has procedures in place for IDW management. This should be done by contacting the ERT Work Assignment Manager (WAM). If it is determined that procedures are not in place, then the contractor's TL should evaluate IDW handling and management options based on:

- Site contaminants and their concentrations, and total projected volume of IDW
- Media potentially affected (e.g., groundwater, soil) by management options
- Location of the nearest population(s) and likelihood and/or degree of site access
- Potential exposure to workers
- Potential environmental impacts

Every effort must be made to ensure the selection of investigation method(s) minimizes the generation of IDW, contact with contaminants, and cost of disposal. It is important that the TL share information about site contaminants and expected IDW with the contractor's Health and Safety Officer (HSO) and Hazardous Waste Coordinator well in advance of site startup. This will better ensure that the upfront work can be done to minimize and dispose of IDW efficiently and in compliance with applicable regulations. Efforts made to characterize IDW will be consistent with the scope and purpose of the site investigation.

#### 3.0 DESCRIPTION

- 3.1 Regulatory Background and Options for Managing IDW
  - 3.1.1 Regulatory References

This SOP provides information that is based on the rules, regulations, and guidance documents summarized in Table 1 of Appendix A.

3.1.2 IDW Management Options

The National Oil and Hazardous Substances Contingency Plan (NCP) requires that management of IDW generated during site investigations complies with all applicable or relevant and appropriate requirements (ARARs) to the extent practicable unless a waiver



SOP: ERT-PROC-2049-20 PAGE: 4 of 12 REV: 0.1 EFFECTIVE DATE: 04/29/20

## **INVESTIGATION-DERIVED WASTE MANAGEMENT**

is granted. Potentially applicable provisions for IDW management at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites are listed in the following ARARs: the Resource Conservation and Recovery Act (RCRA), Safe Drinking Water Act (SDWA), Clean Air Act (CAA), Toxic Substances Control Act (TSCA), Clean Water Act (CWA), and other state laws.

Typical options for handling IDW include immediate disposal or interim management at the end of which the IDW is either: (1) returned to its source or (2) treated, disposed, or stored elsewhere. The contractor's TL in conjunction with the ERT WAM is required to select options for IDW management that are protective of human health and the environment and comply with or waive the ARARs. The most important general elements of managing IDW are as follows:

- Leaving a site in no worse condition than existed prior to the investigation
- Removing those wastes that pose an immediate threat to human health or the environment
- Leaving on site those wastes that do not require off-site disposal or long-term aboveground containerization
- Complying with federal and state ARARs to the extent practicable (OERR, 1991)
- Planning and coordination for IDW management
- Minimizing the quantity of wastes generated

The specific elements of the approach are as follows:

- Characterizing IDW through the use of existing information (manifests, Safety Data Sheets (SDSs), previous test results, knowledge of the waste generation process, and other relevant records) and best professional judgment.
- Delineating an area of concern (AOC) unit for leaving RCRA hazardous soil cuttings within the unit.
- Containerizing RCRA hazardous groundwater, decontamination fluids, personal protective equipment (PPE), and disposable sampling equipment (if generated in excess of 100 kilograms [kg]/month) and disposing of it at RCRA Subtitle C facilities.
- Leaving on site RCRA nonhazardous soil cuttings, groundwater, and decontamination fluids preferably without containerization and testing.

The U.S. EPA does not recommend the removal of wastes from all sites and, in particular, from those sites where IDW does not pose any immediate threat to human health or the environment.

Based on this information and the guidelines included in the following sections, the ERT contractor's TL should include a plan for handling IDW in the QAPP. Any deviations from or modifications to the plan due to unexpected or unforeseen field conditions must be documented using a field change form and noted in the site logbook.



SOP: ERT-PROC-2049-20 PAGE: 5 of 12 REV: 0.1 EFFECTIVE DATE: 04/29/20

## INVESTIGATION-DERIVED WASTE MANAGEMENT

- 3.2 Characterization of IDW
  - 3.2.1 Types of IDW

IDW can be divided into investigation-derived environmental media, debris, and other materials. The U.S. EPA uses the term environmental media to describe soil, sediment, surface water, and groundwater or a mixture of such materials (61 Federal Register 18780, 18783; April 29, 1996). Environmental media are not inherently waste but contaminated environmental media becomes a waste if it cannot be returned to its source. The definition of environmental debris found in 40 Code of Federal Regulations (CFR) 268.2(g) and includes: solid material, particles that exceed 60 millimeters (mm), and materials intended for disposal. IDW may therefore include, but is not limited to, the following items:

#### Media

- Soil
- Sediment
- Bedrock
- Surface water
- Drill cuttings
- Purge water
- Development water

#### Debris

- Concrete, asphalt, building materials, etc.
- Slag
- Used glassware
- Clean trash
- PPE
- Decontamination equipment (buckets, brushes, clothing, tools, etc.)
- Field analytics waste (immunoassay, chlor-n-oil, chlor-n-soil, HACH kits, sample extracts, etc.)
- Dedicated/expendable equipment (bailers, fitters, hose, buckets, x-ray fluorescence [XRF] cups, etc.)

#### Other Materials

- Sludge
- Drum solids
- Biological tissue
- Drilling fluids
- Fluid and sludge from the dewatering of drilling mud
- Decontamination fluids

#### 3.2.2 Hazardous IDW

To handle IDW properly, the ERT contractor's TL must know whether it contains CERCLA hazardous substances as defined under Section 101(14) and whether those



SOP: ERT-PROC-2049-20 PAGE: 6 of 12 REV: 0.1 EFFECTIVE DATE: 04/29/20

### INVESTIGATION-DERIVED WASTE MANAGEMENT

substances are RCRA hazardous wastes or contaminants regulated under other statutes such as TSCA, CWA, CAA, and SDWA. The complete list of CERCLA hazardous substances is found at 40 CFR 302.4. To handle IDW in compliance with regulations, reasonable efforts should be made to characterize it. However, these efforts should be consistent with the scope and purpose of the site investigation.

Contaminated environmental media is not solid waste (i.e. because it was in place and not discarded), cannot be considered RCRA hazardous waste (i.e., because it is not solid waste), but is subject to regulation under RCRA Subtitle C when it contains hazardous waste. The "contained-in" policy requires environmental media to be managed as hazardous waste when it is mixed with listed hazardous constituents (F-, K-, P-, or U-codes identified under 40 CFR 261.31 to 261.33) at concentrations above health-based levels or is mixed with enough hazardous constituents that it exhibits one of four hazardous characteristics (ignitability, corrosivity, reactivity, or toxicity) based on comparison of analytical results to limits established in 40 CFR 261.21 to 261.24. Once the characteristic is eliminated (i.e., through treatment), the environmental media is no longer considered to contain hazardous waste and be subject to RCRA regulations. A formal "contained-out determination" is not required because the determination can be easily made through analytical testing. However, in the case of environmental media that are no longer contaminated by high concentrations of a listed hazardous waste, EPA recommends that the Regions or authorized states make the "contained-out determination" using site-specific health-based standards. Environmental media that contained listed hazardous waste when first generated (i.e., removed from the ground) remain subject to Land Disposal Restriction (LDR) regulations known as Universal Treatment Standards (UTS) following an approved "contained out determination", except under certain circumstances.

The "contained-in" policy also applies to debris contaminated with RCRA-listed hazardous waste (51 Federal Register 37225, August 18, 1992), which must be handled as hazardous material until it no longer contains hazardous waste at concentrations above health-based levels [40 CFR 261.3(f)(2)]. Hazardous contaminated debris are also subject to LDR standards. Hazardous debris treated to comply with those standards would no longer be subject to RCRA regulation if the debris does not exhibit any hazardous waste characteristics. Agency action is not required; a "contained-out determination" is automatic.

A combination of solid IDW, such as sludge or drum solids, and listed or characteristic waste is considered a mixture under the "mixture rule". Mixtures of solid IDW and listed wastes are RCRA hazardous wastes under 40 CFR 261.3(a)2(iv).

#### 3.2.3 Polychlorinated Biphenyl-Containing IDW

Management of IDW contaminated with polychlorinated biphenyls (PCBs) involves compliance with the requirements for PCB remediation waste as specified in the TSCA PCB regulations at 40 CFR 761.50(b)(3) and 761.61. However, PCBs mixed with RCRA hazardous waste become RCRA regulated material. Waste materials containing PCBs as the result of a spill, an intentional or accidental release or uncontrolled discharges of PCBs or other unauthorized disposal of PCBs is called PCB remediation waste which is managed at its "as-found" PCB concentration. Most of the PCB remediation waste encountered during site investigations consists of "bulk PCB remediation waste" (including, but not limited to, existing piles of soil, in-situ soil, sediments, dredged materials, muds, PCB



SOP: ERT-PROC-2049-20 PAGE: 7 of 12 REV: 0.1 EFFECTIVE DATE: 04/29/20

## INVESTIGATION-DERIVED WASTE MANAGEMENT

sewage sludge, and industrial sludge) or "liquid PCBs" (homogeneous, flowable material containing PCBs and no more than 0.5 percent (%) by weight non-dissolved material).

#### 3.2.4 Asbestos-Containing IDW

Asbestos-containing IDW is most likely to be derived from building, landfill, or fill materials during Superfund site investigations. However, soil and rock may also contain naturally-occurring asbestos (NOA) at some sites. Asbestos-containing material (ACM) as defined in the National Emission Standards for Asbestos, found in Subpart M of the National Emission Standards for Hazardous Air Pollutants (NESHAP), 40 CFR Part 61, consists of: Category I and Category II nonfriable ACM containing greater than 1% asbestos as analyzed using polarizing light microscopy (PLM). Office of Solid Waste and Emergency Response (OSWER) Directive 9345.4-05 (Clarifying Cleanup Goals and Identification of New Assessment Tools for Evaluating Asbestos at Superfund Cleanups, EPA, August 2004) indicated that the 1% definition may not be reliable for assessing potential human health hazards from asbestos-contaminated soils at Superfund sites and that a risk-based, site-specific action level is generally more appropriate. Furthermore, OSWER Directive 9200.0-68 (Framework for Investigating Asbestos-Contaminated Superfund Sites, EPA, September 2008) indicated that accurate quantification is very difficult when the asbestos content of soil is less than 1% PLM and that the results should be interpreted semi-quantitatively.

U.S. EPA does not classify ACM as hazardous waste under RCRA; however, it can be designated a hazardous waste if it is located in a state that regulates asbestos (e.g., California classifies ACM as hazardous waste if it is friable [i.e., can be reduced to powder or dust under hand pressure when dry] and contains 1% or more asbestos). State solid waste regulations generally have asbestos handling and disposal requirements and the states determine which landfills can accept ACM. If the landfills accept regulated ACM (i.e., friable ACM; Category I nonfriable ACM that have become or will become friable or have been subject to grinding, cutting, abrading or burning; or Category II nonfriable ACM that have a high probability of becoming or that have become crumbled, pulverized, or reduced to powder due to work practices used during the course of demolition or renovation), they must comply with Asbestos NESHAP requirements.

3.2.5 Non-Hazardous IDW

Non-hazardous IDW is waste that does not meet the EPA's definition of hazardous waste.

Even if the IDW does not contain RCRA hazardous waste, the ERT contractor's TL should determine whether the IDW contains other CERCLA hazardous substances. CERCLA hazardous substances include, in addition to RCRA hazardous wastes, substances, elements, compounds, solutions, or mixtures designated as hazardous or toxic under CERCLA itself or under the authority of other laws such as TSCA, CWA, CAA, and SDWA. Therefore, even if RCRA is not applicable, one of these statutes may be.



SOP: ERT-PROC-2049-20 PAGE: 8 of 12 REV: 0.1 EFFECTIVE DATE: 04/29/20

## INVESTIGATION-DERIVED WASTE MANAGEMENT

#### 3.3 Management of IDW

#### 3.3.1 Waste Minimization

The ERT contractor's TL will obtain input from their HSO and Hazardous Waste Coordinator to support selection of site investigation methods that minimize the generation of IDW, particularly TSCA or RCRA hazardous wastes. The site investigation team should limit contact with contaminants and use drilling and decontamination methods (such as steam cleaning) that minimize PPE, disposable equipment, decontamination fluids, and soil cuttings. In particular, the inspection team should minimize the amounts of solvents used for decontamination or eliminate solvents altogether. Minimizing the amount of wastes generated reduces the number of IDW handling problems and costs of disposal.

#### 3.3.2 Types, Hazards, and Quantities of IDW

Extensive testing of the IDW is not warranted in most cases; instead, the nature of the wastes should be assessed by applying professional judgment, using readily available information about the site (such as Safety Data Sheets, manifests, storage reports, process descriptions, preliminary assessments, and results of earlier studies), as well as direct observation of the wastes for discoloration, odor, or other indicators of contamination. Similarly, RCRA procedures for determining whether a waste exhibits RCRA hazardous characteristics do not require testing if the decision can be made by applying knowledge of the characteristic in light of the materials or process used. In most instances, a determination may be made based on available information and professional judgment. This does not mean that IDW can be assumed to be nonhazardous unless clearly proven otherwise. Given the limited information available, the ERT contractor's TL, in conjunction with the ERT WAM, must determine whether it more likely than not that the wastes are hazardous.

To handle IDW properly, the contractor's TL must determine the types (such as soil cuttings, groundwater, decontamination fluids, PPE, or disposable equipment), characteristics (whether RCRA hazardous or containing other CERCLA hazardous substances), and quantities of anticipated wastes. As discussed previously, testing will generally not be required to characterize IDW if available information indicates that it does not likely contain hazardous waste or hazardous constituents.

Upon determining the types of anticipated IDW, the contractor's TL should determine IDW characteristics, in particular whether it is expected to be RCRA hazardous or to contain high concentrations of PCBs. For RCRA hazardous IDW (listed or characteristic), the contractor's TL should determine whether it poses an increased hazard to human health and the environment relative to conditions that existed prior to the site investigation. Field analytical screening results, if available, may be helpful indicators of IDW characteristics. However, the contractor's TL must remember that these are not RCRA tests and that the test results usually do not identify RCRA hazardous wastes. The contractor's TL must also determine the exact properties of RCRA nonhazardous IDW to select an appropriate disposal facility when the off-site disposal is required.

Upon determining the type and characteristics of IDW to be generated, the ERT contractor's TL must assess the anticipated quantities of waste. This should be done based on past experience with site investigations of similar scope.



SOP: ERT-PROC-2049-20 PAGE: 9 of 12 REV: 0.1 EFFECTIVE DATE: 04/29/20

## INVESTIGATION-DERIVED WASTE MANAGEMENT

#### 3.3.3 On-Site IDW Handling Options

In planning the scope of work, the ERT contractor's TL must decide if IDW can be left on site or if it must be disposed off-site. Handling of RCRA hazardous IDW and IDW with high PCB concentrations (greater than 50 parts per million [ppm]) may involve either moving the IDW within an AOC unit, or containerization, storage, testing, treatment, and off-site disposal. It is preferable to leave both RCRA hazardous and nonhazardous IDW on site within an AOC unit whenever it complies with regulations, does not pose any immediate threat to human health and the environment, or there is not a high probability of serious community concerns. The contractor's TL must determine procedures for handling IDW on site in conjunction with the WAM.

#### **RCRA Nonhazardous IDW**

If IDW are RCRA nonhazardous soil or water, they should be left on site unless other circumstances, such as state ARARs or a high probability of serious community concerns, require off-site disposal. RCRA hazardous soil also may be left on site. The on-site handling options available when IDW are RCRA nonhazardous are listed below.

For soil cuttings:

- 1. Spread around the well.
- 2. Put back into the boring.
- 3. Put into a pit within the AOC.
- 4. Dispose of at the site's operating treatment/disposal unit (TDU).

#### For groundwater:

- 1. Pour onto ground next to well to allow infiltration.
- 2. Dispose of at the site's TDU.

For decontamination fluids:

- 1. Pour onto ground (from containers) to allow infiltration
- 2. Dispose of at the site's TDU.

For decontaminated PPE and disposable equipment:

- 1. Double bag and deposit the bags on the site or in a U.S. EPA dumpster, or in any municipal landfill.
- 2. Dispose at the site's TDU if available.

#### **RCRA Hazardous IDW**

If IDW are considered RCRA nonhazardous due to lack of information on the waste hazard, the ERT contractor's TL should have an alternate plan for handling IDW if field conditions indicate that these wastes are hazardous. In such a case, there should be an adequate number of containers available for collecting groundwater, decontamination water, soil cuttings, etc.



SOP: ERT-PROC-2049-20 PAGE: 10 of 12 REV: 0.1 EFFECTIVE DATE: 04/29/20

## INVESTIGATION-DERIVED WASTE MANAGEMENT

If IDW consists of RCRA hazardous soils that pose no immediate threat to human health and the environment, plan on leaving it on site within a delineated AOC unit. However, one must also consider the proximity of residents and workers in the surrounding area and use best professional judgment to make these decisions. Planning for leaving RCRA hazardous waste on site involves:

- Delineating the AOC unit.
- Determining pit locations close to the borings within the AOC unit for waste burial.
- Covering hazardous IDW in the pits with surficial soil.
- Not containerizing and testing wastes designated to be left on site.

Another alternative for handling RCRA hazardous soil is disposal in a TDU located on the same property as the AOC under investigation. If the TDU is outside the AOC, it must comply with the off-site policy. If any decontamination fluids are generated which are RCRA hazardous wastes, they should be disposed off-site in compliance with the off-site policy or in compliance with the conditionally exempt small quantity generator exemption. Small quantities (i.e., no more than 100 kg/month) of decontamination fluids may be containerized prior to delivery to a hazardous waste facility.

#### 3.3.4 Options Available for Off-Site Disposal of IDW

IDW should be disposed of off-site in the following situations:

- When identified as RCRA hazardous water
- When identified as RCRA hazardous soil that may pose a substantial risk if left at the site
- When identified as RCRA hazardous PPE and disposable equipment
- If leaving them on site would create increased risks at the site

RCRA nonhazardous wastes could be disposed off-site at appropriate RCRA nonhazardous facilities that are in compliance with CERCLA section 121(d)(3) and off-site policy when it is necessary to comply with legally enforceable requirements such as state ARARs that preclude on-site disposal. IDW designated for off-site disposal must be properly containerized, tested, and stored before pick up and disposal. Decontaminated PPE and disposable equipment should be double-bagged if sent to an off-site dumpster or municipal landfill.

Planning for off-site disposal should include the following guidelines:

- Informing the WAM that containerized IDW may be temporarily stored on site while awaiting pick up for off-site disposal
- Initiating the procurement process for IDW testing, pick up and disposal
- Coordinating IDW testing and pick-up activities
- Preparing adequate numbers and types of containers. Drums should be used for collecting small amounts of IDW. Larger amounts of soil and water can be contained in Baker tanks, poly tanks, and bins. PPE and disposable equipment should be double-bagged for disposal at a municipal landfill or collected in drums for disposal at a hazardous waste facility.
- Designating a storage area (either within the site's existing storage facility, existing



SOP: ERT-PROC-2049-20 PAGE: 11 of 12 REV: 0.1 EFFECTIVE DATE: 04/29/20

## INVESTIGATION-DERIVED WASTE MANAGEMENT

fenced area, or within a temporary fence constructed for the site investigation). No humans, children in particular, may have access to the storage area.

All IDW shipped off site, whether RCRA hazardous or not, must go to facilities that comply with the RCRA disposal policy, and the ERT contractor's TL, in conjunction with their Purchasing Department, must verify that the facilities operate in accordance with this policy.

3.4 Equipment/Apparatus

Equipment, materials, and supplies needed for containerizing IDW are generally selected based on waste characteristics or constituents. Other considerations include the case of decontaminating or disposing of the equipment. Most equipment and supplies can be easily procured. For example, 5-gallon buckets, plastic bags, etc. can help segregate contaminated materials. Contaminated liquid can be stored temporarily in metal or plastic cans or drums.

- 3.4.1 Waste Disposal
  - Trash bags
  - Trash containers
  - 55-gallon drums or 5-gallon pails
  - Metal/plastic buckets/containers for storage and disposal of decontamination solutions
- 3.4.2 Decontamination Equipment
  - Drop cloths of plastic or other suitable materials
  - Large galvanized tubs
  - Wash solutions
  - Rinse solutions
  - Long-handled, soft-bristled brushes
  - Paper or cloth towels
  - Metal or plastic cans or drums
  - Soap or wash solution

#### 4.0 **RESPONSIBILITIES**

4.1 ERT Work Assignment Manager

The ERT WAM is responsible for providing technical expertise and technical direction to the contractor, preparing task orders/work assignments, reviewing deliverables, interacting with the Regional customers and monitoring the financial and administrative management of the project.

4.2 ERT Contractor's Task Leader

The contractor's TL becomes familiar with the available site history, sampling process and the waste(s) generated before and during field activities. Ensures proper storage/containerization of IDW so it is protected from the elements, covered except for when waste is added, and accessible by equipment needed to remove it. Takes samples of waste(s) for analysis if needed. Provides a physical description of the waste(s) and works closely with the hazardous waste coordinator to



SOP: ERT-PROC-2049-20 PAGE: 12 of 12 REV: 0.1 EFFECTIVE DATE: 04/29/20

## INVESTIGATION-DERIVED WASTE MANAGEMENT

complete waste profiles. They share site history, known contaminants, information about likely IDWs with their HSO and Hazardous Waste Coordinator well in advance of site mobilization. This would not apply to emergency responses with rapid start-up.

4.3 ERT Contractor's Health and Safety Officer

The contractor's HSO works with the contractor's TL and Hazardous Waste Coordinator to ensure that IDW management is compliant with applicable regulations. The HSO works with the TL to convene meetings as necessary to ensure necessary parties participate and that necessary investigation and planning are conducted in advance of field work to determine proper disposition of IDWs.

4.4 ERT Contractor's Hazardous Waste Coordinator

Obtains the federal hazardous waste generator identification number from the ERT WAM if needed. Contracts a reputable waste disposal service, completes waste profiles, and schedules waste removal. Requests additional analysis if required. Complies with Off-Site Rule 40 CFR 300.440. Reviews all paperwork for accuracy prior to signature by the ERT WAM. Maintains documentation in an organized file for all IDW removed. Provides ERT WAM with copies of manifests, Off-Site Rule communications and waste profiles.

#### 5.0 REFERENCES

U.S. EPA, Management of Investigation-Derived Wastes During Site Inspections, Office of Emergency and Remedial Response Directive 9345.3-02, May 1991.

U.S. EPA, Guide to Management of Investigation Derived Wastes, Office of Solid Waste and Emergency Response Memorandum 9345.3.03FS, January 1992.

Code of Federal Regulations, Title 40, Part 261, Section 23, Section 11 (a) (3), and Section 24 (a) (b).

CFR Proposed Criteria: 51 FR 21685, June 30, 1986 and 51 FR 21450, May 20, 1992.

#### 6.0 APPENDICES

This section is not applicable to this SOP.