BoRit Asbestos Superfund Site,
Operable Unit 1
Ambler, Pennsylvania

November 16, 2017
Response Action Contract
for Remedial Planning and Oversight Activities at Sites
in EPA Region 3

U.S. EPA Contract No. EP-S3-07-06

Final
Site Management Plan for
Post Remedial Action Confirmation Sampling and Long-Term
Monitoring
BoRit Asbestos Superfund Site
Operable Unit 1
Ambler, Pennsylvania

Part I – Field Sampling Plan
Part II – Data Management Plan
Part III – Pollution Control and Mitigation Plan

Work Assignment No.: 029-RICO-A3EN

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TITLE AND APPROVAL SHEET

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BoRit Asbestos Superfund Site
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Abbreviations and Acronyms

°F degrees Fahrenheit
AA ambient air
ABS activity-based sampling
AC/DC alternating current/direct current
ACM asbestos-containing material
ARARs applicable and/or relevant and appropriate requirements
ASC Analytical Services Coordination
CADD computer aided design and drafting
cc⁻¹ per cubic centimeter
CDM Smith CDM Federal Programs Corporation
CD-ROM Compact Disc Read-Only Memory
CLP Contract Laboratory Program
COC chemical of concern
CS confirmation sampling
DAS Delivery of Analytical Services
DI deionized
DMP data management plan
EDD electronic data deliverable
EPA U.S. Environmental Protection Agency
EQuIS EarthSoft’s EQuIS Data Management System
ESAT Environmental Services Assistant Team
FSDSs Field Sample Data Sheets
FSP Field Sampling Plan
FTL field team leader
FYR five-year review
GPS global positioning system
HHRA human health risk assessment
HRS Hazard Ranking System
HV high-volume
ID identification
IDW investigation-derived waste
K&M Keasby and Mattison
L liters
L/min liters per minute
LTM long-term monitoring
LV low-volume
MCE mixed cellulose ester
Abbreviations and Acronyms (cont’d)

MET  meteorological  
µm  micrometer, or micron  
MFL  million fibers per liter  
µg/kg  microgram per kilogram  
mm  millimeter  
mph  miles per hour  
MS/MSD  matrix spike/matrix spike duplicate  
MVS  Mining Visualization System  
NESHAP  National Emission Standards for Hazardous Air Pollutants  
NOA  Extended Service Air Sampling System Naturally Occurring Asbestos  
NOAA  National Oceanic Atmospheric Administration  
NOAEI  no-observed-adverse-effect level  
NPL  National Priorities List  
OASQA  Office of Analytical Services and Quality Assurance  
O&M  operations and maintenance  
ORP  oxidation reduction potential  
PDAEP  Pennsylvania Department of Environmental Protection  
PADER  Pennsylvania Department of Environmental Resources  
PLM  polarized light microscopy  
PPE  personal protective equipment  
PVC  polyvinyl chloride  
QA  quality assurance  
QAPP  Quality Assurance Project Plan  
QAS  Quality Assurance Specialist  
QC  quality control  
QMP  quality management plan  
RA  remedial action  
RAC  Response Action Contract  
RAO  remedial action objective  
RCRA  Resource Conservation and Recovery Act  
RG  remedial goal  
RI  remedial investigation  
ROD  record of decision  
RPM  Regional Project Manager  
The Site  BoRit Asbestos Superfund Site  
SLERA  screening level ecological risk assessment  
SMP  site management plan  
SOP  standard operating procedure
Abbreviations and Acronyms (cont’d)

TAL  target analyte list
TBD  to be determined
TCL  target compound list
TEM  transmission electron microscopy
TRV  toxicity reference value
VOC  volatile organic compound
WA  work assignment
Part I

Field Sampling Plan
Section 1

Introduction

This document serves as the site management plan (SMP) for confirmation sampling (CS) and long-term monitoring (LTM) specified in the Record of Decision (ROD) for the BoRit Asbestos Superfund Site (the Site) in Ambler, Pennsylvania. This SMP was prepared by CDM Federal Programs Corporation (CDM Smith) under work assignment (WA) 029-RICO-A3EN of the U.S. Environmental Protection Agency (EPA) Region 3 Response Action Contract (RAC) 2 contract EP-S3-07-06. CS includes activity-based sampling (ABS) scenarios (including both air and soil sampling), ambient air (AA) monitoring, and surface water sampling. LTM includes ABS scenarios (including both air and soil sampling), AA, soil, sediment, and surface water sampling.

This SMP includes the following plans: the Field Sampling Plan (FSP) as Part I (Sections 1 through 4), the Data Management Plan in Part II (Section 5), and the Pollution Control and Mitigation Plan as Part III (Section 6). Appendix A provides technical standard operating procedures (SOPs) that apply to work performed during CS and LTM. Appendix B includes Blank Field Sample Data Sheets (FSDSs) that will be used during sampling activities. Appendix C provides details for equipment shelters for AA monitor stations during AA sampling activities. The Quality Assurance Project Plan (QAPP) for the Site will be developed as part of the Remedial Action Work Plan.

This SMP should be used in conjunction with the Operations and Maintenance (O&M) plan provided in Attachment A (CDM Smith 2017) which presents activities necessary for inspecting, operating, monitoring, and maintaining the effectiveness of the remedial action (RA), including the CS and LTM components of the Selected Remedy.

1.1 Project Objectives

The Selected Remedy for the Site includes capping of waste, contaminated soil, and Reservoir sediment with clean material. Capping was designed to physically contain asbestos and prevent migration from the Site and prevent exposure to human and ecological receptors.

The objective of CS is to demonstrate the effectiveness of the remedial action in achieving remedial action objectives (RAOs) and remedial goals (RGs) for Site-related chemicals of concern (COCs). The objective of LTM is to periodically confirm RGs are not exceeded and to demonstrate that the capping remedy continues to perform as designed. The following activities for CS and LTM are planned to help meet these objectives:

**Confirmation Sampling**

- Perform ABS scenarios (including both air and soil sampling) on the Park and Asbestos Pile parcels in areas where asbestos was previously detected.
- Collect AA samples from locations where asbestos was detected in AA during the remedial investigation (RI).
Collect soil samples and analyze for soil COCs (asbestos, bis(2-ethylhexyl)phthalate, dioxins and furans [Asbestos Pile Subarea 1 only], chromium, nickel, and zinc).

Collect Reservoir sediment samples and analyze for sediment COCs (asbestos and carbon disulfide).

Collect surface water samples from locations where asbestos was detected in Wissahickon Creek surface water during RI sampling and from four locations in the Reservoir and analyze for the COC (asbestos).

**Long-Term Monitoring**

- Perform ABS scenarios (including both air and soil sampling) on the Park and Asbestos Pile parcels in areas where asbestos has previously been detected.
- Collect AA samples from locations where asbestos was detected in AA during the RI.
- Collect soil samples and analyze for soil COCs (asbestos, bis(2-ethylhexyl)phthalate, dioxins and furans [Asbestos Pile Subarea 1 only], chromium, nickel, and zinc).
- Collect Reservoir sediment samples and analyze for sediment COCs (asbestos and carbon disulfide).
- Collect surface water samples from locations where asbestos was detected in Wissahickon Creek surface water during RI sampling and from four locations in the Reservoir and analyze for the COC (asbestos).

All sampling activities will be conducted in accordance with CDM Smith technical SOPs, including Site-specific SOPs developed for the Site during the RI, and EPA and CDM Smith guidance documents listed in Section 7.

**1.2 Project Schedule**

CS will be conducted upon remedy construction completion as soon as practicable. Per the ROD, the LTM will be conducted annually for the first four years leading up to the first five-year review (FYR), and then at least once during every FYR cycle thereafter.

**1.3 Distribution List**

Copies of this document will be distributed to the recipients show in Exhibit 1 below:
### Exhibit 1: Distribution List

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Section 2

Site Background

2.1 Site Location and Background

The Site includes the following three adjacent parcels near the intersection of West Maple Street and Butler Pike in Ambler Borough, Montgomery County, Pennsylvania:

- the Park parcel (parcel #660004408008), located in Whitpain Township, which occupies 19.02 acres and contains a former asbestos disposal area (now the closed Whitpain Wissahickon Park);
- the Reservoir parcel (comprised of parcel #660004409007 [3.13 acres] and parcel #540011581002 [15.04 acres]), primarily located in Upper Dublin Township, which occupies 18.17 acres and contains a reservoir (the Reservoir was man-made using asbestos waste as fill in some areas and is not used for drinking water supply); and
- the Asbestos Pile parcel (comprised of parcel #010002939003 [6.056 acres] and #540011581209 [0.597 acres]), located in Ambler Borough, which occupies 6.653 acres and contains an asbestos waste pile.

The Site also includes portions of Wissahickon Creek, Rose Valley Creek, and Tannery Run which flow adjacent to the three Site parcels. The Site map is shown in Figure 2-1.

Site contamination is a result of disposal operations by the former Keasby & Mattison (K&M) Company. K&M produced asbestos products (including paper, millboard, electrical insulation, brake linings, piping, conveyor belts, high pressure packings, roofing shingles, and cement siding) from 1897 to 1962 at their Ambler, Pennsylvania facility. K&M ceased operations in 1962.

The EPA and the Pennsylvania Department of Environmental Resources (PADER), now the Pennsylvania Department of Environmental Protection (PADEP), conducted sampling in late 1983 and in the spring of 1984, respectively. Asbestos, specifically chrysotile, was identified as the primary contaminant on the Site.

EPA performed a preliminary assessment of the Asbestos Pile parcel in March 1987. The Asbestos Pile was found to be fenced and vegetated, but there was evidence of trespassers. A soil sample collected from the Asbestos Pile was found to contain asbestos. These data, as well as other information, were used to evaluate the Site. This evaluation ultimately resulted in a Hazard Ranking System (HRS) screening score below the threshold score of 28.5 for possible inclusion on the National Priorities List (NPL). The surface water and groundwater migration pathway were not scored because risk receptors were not identified. Therefore, the surface water and groundwater pathway contributed minimally to the Site score.

For approximately 20 years, PADEP regulated the parcel according to the applicable National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations. NESHAP regulations require the parcel to be fenced, have a vegetated cover, and have signs indicating the presence of...
asbestos, since asbestos-containing material (ACM) had not been covered with 2 feet of clean material.

In April 2006, EPA's Site Assessment Program conducted sampling and found asbestos in the air, soil, surface water, and sediments at the Site. EPA re-evaluated the BoRit parcels, prompting proposal to the NPL on September 3, 2008. The Site received final listing to the NPL on April 9, 2009.

In 2013, CDM Smith completed the Final RI Report (CDM Smith 2013a) to document Site conditions and to fill data gaps that had been identified from review of previous investigations. Data collected by CDM Smith for EPA were used to characterize the Site and to define the nature and extent of source material and Site-related contaminants in soil, sediment, surface water, groundwater, and seeps. CDM Smith also completed a human health risk assessment (HHRA) (CDM Smith 2013a) and a screening level ecological risk assessment (SLERA) (CDM Smith 2013a) to characterize potential human health and ecological risks associated with the Site in the absence of any remedial action. In 2014, additional data were collected to further characterize the Site setting and to better understand potential fate and transport of Site contaminants. The post-RI data collected in 2014 are presented in the Final RI Addendum Report (CDM Smith 2015a). A feasibility study was completed in November 2016, and a ROD for the Site was signed on July 28, 2017.

2.2 Components of the Selected Remedy

EPA Removal Program activities, which occurred from December 2008 through Summer 2017, largely mitigated exposure to contamination across the Site through the removal of surface soils and capping of waste, soil, and Reservoir sediment. The Selected Remedy for the Site, Alternative WSS2 Capping, encompasses and essentially completes EPA Removal Program work. Alternative WSS2 Capping includes the following major components with the status of each component noted in parentheses:

- Stream bank stabilization at Rose Valley Creek, Tannery Run, and Wissahickon Creek
- Installation of cover at Asbestos Pile
- Installation of cover at Park
- Dewatering of Reservoir with treatment of surface water prior to discharge
- Re-grading and lining of Reservoir berm interior slopes
- Installation of a cover on the Reservoir bottom
- Refilling of the Reservoir
- ABS at residences adjacent to the Site
- Implementation of Intuitional controls
- CS
- LTM for Site-related COCs
- O&M
- FYRs (first FYR projected to be conducted in 2022)
2.3 Remedial Action Objectives and Remedial Goals

The analytical results of both CS and LTM will be used to evaluate the effectiveness of the remedy in achieving the RAOs and RGs specified in the ROD.

2.3.1 Remedial Action Objectives

Several RAOs have been developed to mitigate the potential present and/or future risks associated with exposure to contamination at the Site. For each medium, RAOs address both human health and/or environmental protection. It should be noted that the RAOs listed below are based on pre-Removal (unremediated) conditions at the Site.

2.3.1.1 RAOs for Waste/Soil

Protection of Human Health

- Minimize the inhalation of asbestos associated with waste/soil disturbances such that related cancer risks from airborne asbestos fibers are within or below EPA’s acceptable risk range of 1 in 10,000 (1x10⁻⁴) to 1 in 1,000,000 (1x10⁻⁶).

Environmental Protection

- Prevent direct contact (i.e., inhalation, incidental ingestion, and dermal absorption) by ecological receptors to contaminated waste and soil containing ecological COCs [asbestos, bis(2-ethylhexyl) phthalate, dioxins and furans, chromium, nickel, and zinc] concentrations exceeding the respective RGs.

2.3.1.2 RAOs for Reservoir Sediment

Protection of Human Health

- None

Environmental Protection

- Prevent direct exposure of ecological receptors to contaminated sediment containing concentrations of carbon disulfide exceeding the ecological screening level of 4.1 microgram per kilogram (μg/kg).
  
- Minimize migration of asbestos from sediment to surface water to prevent surface water concentrations of asbestos exceeding the surface water screening level of 0.0001 million fibers per liter (MFL).

2.3.2 Remediation Goals

In conjunction with narrative RAOs such as those established above, the ROD established final RGs, which are acceptable exposure levels that are protective of human health and the environment (EPA 2017a). They have been derived from applicable and/or relevant and appropriate requirements (ARARs), risk-based levels (human health and ecological), and from comparison to the background concentrations. Consideration was also given to analytical detection limits, guidance values, and other pertinent information. Where possible, RGs are expressed as contaminant-specific RGs. The RGs established for the Site are risk-based values that fall within EPA’s acceptable risk range. RGs, developed to protect human health and the environment, are listed in Table 2-1.
2.3.2.1 Remediation Goals for Waste/Soil

Soil contaminated with asbestos poses risks to human health and ecological receptors. RGs to remediate the contaminated soil to protect human health and the environment are listed in Table 2-1. The surrogate human health RG for asbestos in soil is a Site-specific value calculated by the EPA Region 3 Toxicologist for asbestos in air during ABS. This proposed Site-specific RG is based on human health risks. For asbestos, successful remediation of source waste material and soil will be assessed by achievement of the Site-specific air RG. Ecological screening levels for asbestos are not available. The surrogate ecological RG for asbestos in air is based on the no-observed-adverse-effect level (NOAEL) toxicity reference value (TRV) for inhalation. Successful remediation of source waste material and soil will be assessed by achievement of the Site-specific air RGs for asbestos.

Soil contaminated with bis(2-ethylhexyl) phthalate, dioxins and furans, chromium, nickel, and zinc pose risk to ecological receptors. Ecological RGs for contaminated soil are listed in Table 2-1. Ecological RGs are based on either ecological screening levels or the maximum background concentrations.

2.3.2.2 Remediation Goals for Reservoir Sediment

Sediment contaminated with carbon disulfide in the Reservoir poses risks to ecological receptors. An RG based on the ecological screening level for carbon disulfide is listed in Table 2-1.

Even though asbestos was not detected at levels in Reservoir sediment that potentially posed a risk in the SLERA, the Reservoir bench study demonstrated that Reservoir surface water is directly affected by Reservoir sediment (CDM Smith 2015a). Therefore, EPA used a conservative approach and assumed that asbestos is also a potential ecological risk in Reservoir sediment. Table 2-1 provides a target medium RG for asbestos in surface water.
Section 3
Sampling Program, Rationale, and Locations

The FSP for the Site has been developed to provide rationale and procedures that will be followed during the performance of CS and LTM. The FSP was based on requirements of the ROD. Table 3-1 provides sample locations, sampling frequency, and analyses for sampling to be conducted during the CS event. Table 3-2 provides preliminary sample locations, sampling frequency, and analyses for sampling to be conducted during LTM. Table 3-3 provides coordinates for pre-determined CS and LTM sample locations.

Per the ROD, the ultimate design of the LTM program will be based on the results of the CS. Additionally, the LTM program may be modified based on results indicating the remedy is protective of human health and the environment. As the O&M period progresses, it is expected that the number of sample locations and analyses will decrease assuming that the sample results demonstrate that the remedy is protective of human health and the environment. Modifications to the sampling and analysis plan, including the rationale for the changes, will be summarized in an addendum to this SMP.

3.1 Confirmation Sampling
The ROD specified that CS locations be based on the presence of asbestos detected prior to capping (EPA 2017a). The locations of the ABS scenarios (including both air and soil sample), outdoor AA, and surface water sampling are shown on the figures referenced below; the geographic coordinates of these samples are listed in Table 3-3.

3.1.1 Activity-Based Sampling – Rationale and Locations
The ROD specified performance of ABS scenarios at locations on the Park and Asbestos Pile parcels where asbestos was previously detected (EPA 2017a). Air samples from all six Park parcel ABS locations sampled during the RI contained detectable asbestos. Therefore, ABS (both air and soil samples) will be conducted at these same locations, as shown on Figure 3-1, during the CS.

Similarly, asbestos was detected in personal air samples collected during all three ABS scenarios conducted at the Asbestos Pile parcel during the RI. ABS (both air and soil samples) will be conducted at the same locations, shown on Figure 3-1, during the CS.

All ABS scenarios will be raking scenarios. ABS air samples will be collected for the duration of sampling activities. The methods and procedures for the performance of ABS activities and sample collection are described in Section 4.4.

The ABS program will include the raking standardized activity scenario outlined in Sections 7.5 and 7.6 of EPA ERT SOP 2084 (EPA 2007). This scenario is considered to represent realistic examples of relatively vigorous soil disturbance activities and is consistent with the scenario used on both the Park and Asbestos Pile parcels during the RI (Appendix A).

Sampling associated with ABS includes both air samples and soil samples:
High-Volume/Low-Volume Air sampling: Each ABS sampling event will occur over a two-hour time interval, using high-volume (HV) and low-volume (LV) pumps to collect air samples during each two-hour period, while simulating adult and child activity. Both the HV and LV samples will be submitted to the laboratory for analysis by TEM-ISO 10312. If the HV sample is not readable by transmission electron microscopy (TEM) after a direct preparation method, either the low flow sample may be evaluated for analysis by direct preparation, or the high flow sample may be used by applying an indirect sample preparation technique (TEM ISO 13794). The laboratory must consult with EPA in order to select which is the most appropriate approach to follow.

Perimeter Air Sampling: In each of the areas where ABS is to be conducted, three ABS perimeter air samples will be collected and analyzed for asbestos by TEM ISO 10312. No samples will be archived. The samples will be collected in one upwind and two downwind directions.

Perimeter air samples will be collected concurrent with ABS activities. The methods and procedures for perimeter ABS air sampling during ABS activities are described in Section 4.4.

Soil Sampling: Per the ROD, surface soil samples will be collected in association with ABS, i.e., at locations where ABS scenarios are performed. One 30-point composite surface soil sample will be collected from each ABS location prior to implementation of the ABS scenario and analyzed for asbestos. Soil moisture will be measured in the field. Soil sample collection locations on the Park and Asbestos Pile parcels are shown on Figures 3-1.

All surface soil samples will be collected from a depth of 0 to 3 inches to be consistent with the requirements of the HHRA (CDM Smith 2013a).

### 3.1.2 Outdoor Ambient Air Monitoring – Rationale and Locations

The ROD specifies that CS of AA be conducted at locations where asbestos was previously detected (EPA 2017a). During the RI, AA samples were collected monthly for 15 months at seven locations in the residential/commercial area outside of the Site boundary. Asbestos was detected in all six of the locations. Accordingly, AA sampling will be conducted at the six locations shown on Figure 3-2.

Meteorological data reported in the RI Report indicated that the windiest months of the year include December, February, March, and April. However, the highest concentrations of asbestos were detected in August and September. AA sampling will be scheduled to occur in one of these six months.

Each event will be 24 hours in duration. The methods and procedures for outdoor AA sampling are described in Section 4.8. All samples collected will be analyzed by TEM ISO 10312 for asbestos.

### 3.1.3 Surface Soil Sampling – Rationale and Locations

Bis(2-ethylhexyl) phthalate, dioxins and furans, chromium, nickel, and zinc are COCs in soil and waste because they pose risk to ecological receptors. The source of the COCs in soil is considered to be the waste material, now covered by the cap. If the cap fails, these constituents may be eroded from the waste and transported via surface runoff or wind to the surface soil.

Surface soil samples will be collected from each of three parcels (Park, Reservoir and Asbestos Pile) and analyzed for asbestos, bis(2-ethyl hexyl)phthalate, dioxins/furans, chromium, nickel
and zinc. All surface soil samples will be 30‐point composite samples collected from depths of 0 to 3 inches. There are no RGs for asbestos in soil.

During the RI, soil samples were collected from subareas in each of the three parcels for purposes of compositing samples to characterize the soil. For the CS event, the same subareas (see Figure 3-3 through 3-5) will be used to designate points for soil monitoring. Some of the COCs (bis(2-ethyl hexyl)phthalate, chromium, nickel, and zinc) were generally not detected in the surface soil, but were detected in waste material on the three parcels. If the cap fails, these COCs may be present in surface soil.

The following soil samples will be collected and analyzed for asbestos, bis(2-ethyl hexyl phthalate, chromium, nickel, and zinc:

- 2 surface soil samples from each of the 5 subareas on the Park Parcel
- 2 surface soil samples from each of the 5 subareas on the Reservoir Parcel
- 2 surface soil samples from each of the 5 subareas on the Asbestos Pile Parcel

Dioxins/furans were generally only a concern in the former fire training and slag disposal areas on the Asbestos Pile Parcel. One sample will be collected from Subarea 1 of the Asbestos Pile parcel (where the fire training and slag disposal areas were located, for dioxin/furan analyses (Figure 3-5).

The locations for the soil samples will be selected by gridding each parcel on an approximately 100 x 100‐foot spacing, numbering each grid node, and using a random number generator to select two points for sampling.

### 3.1.4 Sediment Sampling – Rationale and Locations

Reservoir sediment was determined to contain carbon disulfide at concentrations posing a risk to ecological receptors. In addition, it was determined that asbestos in Reservoir sediment could impact the concentration of asbestos in Reservoir surface water.

CS will include 4 composite sediment samples each collected from four separate locations in the Reservoir. The Reservoir area will be divided into four quadrants and one composite sediment sample, consisting of 3 to 5 composited grab samples, will be collected from the center of each quadrant of the Reservoir (see Figure 3-6). Table 3-3 includes global positioning system (GPS) coordinates for Reservoir sampling locations. Each of the 3 to 5 grab samples will be collected from the top 6 inches of sediment and then composited. The methods and procedures for the collection of sediment samples are described in Section 4.7. Sediment samples will be analyzed for carbon disulfide and asbestos by polarized light microscopy (PLM).

### 3.1.5 Surface Water Sampling – Rationale and Locations

The ROD specifies that CS of surface water for asbestos be conducted at locations where it has previously been detected (EPA 2017a). During the RI, asbestos was found in eight samples collected from four locations in the Reservoir and four locations in Wissahickon Creek. During CS, samples will be collected from:

- The same four locations in Wissahickon Creek where asbestos was detected in the RI (see Figure 3-7). As shown on Figure 3-7, three of the locations are outside (but downstream)
of the Site boundary. The locations are being sampled to demonstrate that the stream bank remedies are functioning as designed. **Table 3-3** includes GPS coordinates for Wissahickon Creek sampling locations.

- Four locations in the Reservoir (see Figure 3-8). Note that the Reservoir was dewatered and the bottom reconstructed during the remedy. Therefore, the four locations sampled in the CS will be determined by dividing the Reservoir into 4 quadrants of approximately equal area and collecting one surface water sample from the approximate midpoint of each quadrant. **Table 3-3** includes GPS coordinates for Reservoir sampling locations.

The methods and procedures for collecting the surface water samples are described in Section 4.6. All surface water samples will be analyzed for asbestos by TEM-EPA 100.1.

### 3.2 Long-Term Monitoring Sampling

LTM will be conducted annually for the first four years leading up to the first FYR, and then at least once during every FYR cycle thereafter (every five years). LTM will include ABS, ambient air, soil, sediment, and surface water sampling to confirm RGs continue to be achieved and to demonstrate that the capping remedy continues to perform as designed.

The specific LTM protocols will be designed based on CS (Section 3.1), and may be modified based on results indicating the selected remedy is protective of human health and the environment. It is anticipated that the number of sample locations and analyses likely will decrease as the O&M period progresses, if sample results demonstrate that the cap continues to perform as designed.

LTM sampling locations and rationale are described below. Modifications to the LTM sampling locations, including those that may be made based on the results of the CS, will be documented in an addendum to this SMP.

#### 3.2.1 Activity Based Sampling – Rationale and Locations

The initial LTM ABS scenarios will be the same as those in the CS (Section 3.1.1). Therefore, ABS will be conducted at the locations shown on Figure 3-1.

All ABS scenarios will be raking scenarios. ABS air samples will be collected for the duration of sampling activities. The methods and procedures for the performance of ABS activities and sample collection are described in Section 4.4.

The ABS program will include the raking standardized activity scenario outlined in Sections 7.5 and 7.6 of EPA ERT SOP 2084 (EPA 2007). This scenario is considered to be a realistic example of relatively vigorous soil disturbance activities and is consistent with the scenario used on both the Park and Asbestos Pile parcels during the RI.

Sampling associated with ABS includes both air samples and soil samples:

**High-Volume/Low-Volume Air sampling:** Each ABS sampling event will occur over a two-hour time interval, using HV and LV pumps to collect air samples during each two-hour period, while simulating adult and child activities. Both the HV and LV samples will be submitted to the laboratory for analysis by TEM-ISO 10312. If the HV sample is not readable by TEM after a direct preparation method, either the low flow sample may be evaluated for analysis by direct
preparation, or the high flow sample may be used by applying an indirect sample preparation technique (TEM ISO 13794). The laboratory must consult with EPA in order to select which is the most appropriate approach to follow.

Perimeter Air Sampling: In each of the areas where ABS is to be conducted, three ABS perimeter air samples will be collected and analyzed for asbestos by TEM ISO 10312. No samples will be archived. The samples will be collected in one upwind and two downwind directions.

Perimeter air samples will be collected concurrent with ABS activities. The methods and procedures for perimeter ABS air sampling during ABS activities are described in Section 4.4.

Soil Sampling: Surface soil samples will be collected in association with the ABS, i.e., at locations where ABS scenarios are performed. One 30-point composite surface soil sample will be collected from each ABS location prior to implementation of the ABS scenario and analyzed for asbestos. Soil moisture will be measured in the field. Soil sample collection locations on the Park and Asbestos Pile parcels are shown on Figures 3-1.

All surface soil samples will be collected from a depth of 0 to 3 inches to be consistent with the requirements of the RI Human Health Risk Assessment.

3.2.2 Outdoor Ambient Air Monitoring – Rationale and Locations
LTM AA sampling events will take place at six locations in the residential / commercial area surrounding the Site (Figure 3-2). These six locations are the same locations where asbestos was detected in AA samples during the RI. Meteorological (MET) station data (wind speed, direction, temperature, humidity, precipitation) will be downloaded daily from a local MET station.

MET data reported in the RI Report indicated that the windiest months of the year include December, February, March, and April. However, the highest concentrations of asbestos were detected in August and September. AA will be scheduled to occur in one of these six months.

All samples collected will be analyzed by TEM ISO 10312 for asbestos.

The methods and procedures for outdoor AA sampling are described in Section 4.8.

3.2.3 Surface Soil Sampling – Rationale and Locations
Bis(2-ethylhexyl) phthalate, dioxins and furans, chromium, nickel, and zinc are COCs in soil and waste because they pose risk to ecological receptors. LTM of surface soil for these constituents provide data to evaluate the continuing effectiveness of the remedy. The source of the COCs in soil is considered to be the waste material, now covered by the cap. If the cap fails, these constituents may be eroded from the waste and transported via surface runoff or wind to the surface soil.

Surface soil samples will be collected from each of three parcels (Park, Reservoir and Asbestos Pile) and analyzed for asbestos, bis(2-ethyl hexyl)phthalate, dioxins/furans, chromium, nickel and zinc. All surface soil samples will be 30-point composite samples collected from depths of 0 to 3 inches. There are no RGs for asbestos in soil. However, LTM sampling is also used to demonstrate the continuing effectiveness of the capping remedy. Therefore, soil samples will be collected from the soil cap during each LTM event.

During the RI, soil samples were collected from subareas in each of the three parcels for purposes of compositing samples to characterize the soil. For the initial LTM event, the same subareas (see
Figure 3-3 through 3-5) will be used to designate points for soil monitoring. Some of the COCs (bis(2-ethyl hexyl)phthalate, chromium, nickel, and zinc) were generally not detected in the surface soil, but were detected in waste material on the three parcels. If the cap fails, these COCs may be present in surface soil.

The following soil samples will be collected and analyzed for asbestos, bis(2-ethyl hexyl phthalate, chromium, nickel, and zinc:

- 2 surface soil samples from each of the 5 subareas on the Park Parcel
- 2 surface soil samples from each of the 5 subareas on the Reservoir Parcel
- 2 surface soil samples from each of the 5 subareas on the Asbestos Pile Parcel

Dioxins/furans were generally only a concern in the former fire training and slag disposal areas on the Asbestos Pile Parcel. One sample will be collected from Subarea 1 of the Asbestos Pile parcel (where the fire training and slag disposal areas were located, for dioxin/furan analyses (Figure 3-5).

The locations for the soil samples will be selected by gridding each parcel on an approximately 100 x 100-foot spacing, numbering each grid node, and using a random number generator to select two points for sampling.

In subsequent LTM monitoring events, the number and locations of samples will be evaluated based on the results of the prior sampling and the condition of the cap. Soil samples will be biased toward areas where the cap appears eroded, unvegetated, or otherwise deteriorated.

3.2.4 Sediment Sampling – Rationale and Locations
Reservoir sediment was determined to contain carbon disulfide at concentrations posing a risk to ecological receptors. In addition, it was determined that asbestos in Reservoir sediment could impact the concentration of asbestos in Reservoir surface water.

LTM will include 4 composite sediment samples each collected from four separate locations in the Reservoir. The Reservoir area will be divided into four quadrants and one composite sediment sample, consisting of 3 to 5 composited grab samples, will be collected from the center of each quadrant of the Reservoir (see Figure 3-6). Table 3-3 includes GPS coordinates for Reservoir sampling locations. Each of the 3 to 5 grab sample will be collected from the top 6 inches of sediments and then composited. The methods and procedures for the collection of sediment samples are described in Section 4.7. Sediment samples will be analyzed for carbon disulfide and asbestos by PLM.

3.2.5 Surface Water – Rationale and Locations
During the RI, asbestos was found in eight samples (excluding the seep which was removed during the removal action) collected from four locations in the Reservoir and four locations in Wissahickon Creek.

The locations of the Reservoir LTM samples will be determined by dividing the Reservoir into quadrants (see Figure 3-8) and collecting samples at the approximate middle of each quadrant. The locations of Wissahickon Creek LTM surface water samples will be the same as those that
contained asbestos (Figure 3-7). Wissahickon Creek LTM surface water sample locations are the CS creek surface sample locations and are provided in Table 3-3. The methods and procedures for collecting the surface water samples are described in Section 4.6. All surface water samples will be analyzed for asbestos by TEM-EPA 100.1.
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Section 4

Field Activity Methods and Procedures

The following tasks will be performed by CDM Smith during CS and LTM:

- Site mobilization
- Procurement of rental equipment, supplies, and containers
- Field logbook and photographic documentation
- ABS and associated air and soil sampling
- AA sampling
- Surface water sampling
- Surface soil sampling
- Sediment sampling
- Packaging and shipping of environmental samples
- Equipment decontamination
- Investigation-derived waste (IDW) management

Where applicable, CDM Smith technical SOPs, CDM Smith Site-specific SOPs, and other SOPs to be utilized in the field are referenced in this section. Referenced SOPs are provided in Appendix A. In addition, Table 4-1 identifies and summarizes equipment and supplies necessary to support field activities. Table 4-2 lists the media, analyses, bottleware, preservative, and holding time information.

4.1 Site Mobilization – CS and LTM

CDM Smith will identify and provide all necessary personnel, equipment, and materials for mobilization and demobilization to and from the Site. It is anticipated that rental equipment and supplies will be received at CDM Smith’s Wayne, Pennsylvania office and delivered by the field team to the Site or received directly at the Site. Sampling equipment will either include pre-cleaned single-use trowels and bowls, or will be decontaminated at CDM Smith’s Wayne office prior to use.

4.2 Control of Equipment, Supplies, and Containers – CS and LTM

Equipment and supplies necessary to support field activities have been identified and are summarized in Table 4-1. This table separates field items into several categories, including sampling consumables, rental equipment, and supplies. All measurement and testing equipment will be handled in accordance with CDM Smith Technical SOP 5-1, Control of Measurement and Test Equipment. SOP 5-1 is included in Appendix A.
All sample containers will be pre-cleaned and traceable to the facility that performed the cleaning. Sampling containers will not be cleaned or rinsed in the field.

4.3 Field Logbook, FSDSs, and Photographic Documentation—CS and LTM

All field activities will be documented in a field logbook and through photographic documentation. Sample collection locations will also be documented on FSDSs. Blank FSDSs for ABS air, perimeter ABS air, AA, soil, surface water, and sediment sampling are included in Appendix B. FSDSs will be numbered sequentially and will reference the corresponding field logbook number and page(s). All documentation activities will be performed in accordance with CDM Smith Technical SOP 4-1, Field Logbook Content and Control, and CDM Smith Technical SOP 4-2, Photographic Documentation of Field Activities.

4.4 Activity Based Sampling – CS and LTM

ABS will be performed as part of both the CS and LTM. Sampling protocols for soil and air sampling and performance of the ABS scenario, will be the same for both CS and LTM events.

4.4.1 ABS Sampling Protocols

The areas where ABS activities are performed will be delineated with stakes, pin flags, or equivalent visual markers. A sketch of the sampling area will also be prepared to indicate the approximate locations and size of the ABS activity area. The sketch will indicate the soil condition at the ABS location, including the extent of vegetative cover and any other important visual features. Soil sampling and observations about soil characteristics will occur close to the time that the ABS air samples are collected. If these tasks cannot be carried out in sequence (within the same 24-hour period), it will be noted in the field logbook.

ABS air samples will be collected from the breathing zone of the ABS participants (hereafter referred to as “actors”), in accordance with EPA ERT SOP 2084, Activity Based Sampling for Asbestos (EPA 2007). The ABS program will include the standardized raking activity scenario outlined in Sections 7.5 and 7.6 of EPA ERT SOP 2084, with project-specific modifications.

During all sampling scenarios, if it becomes necessary to relieve an actor from an activity, a relief (backup) actor will be properly suited in time to make the exchange. When the relief actor is ready, the activity actor will stop, remove the backpack or belt, pass it to the relief actor, and assist the relief actor with donning and adjusting the backpack or belt. The exchange is anticipated to take less than 60 seconds, so the sampling pumps and event time clock will not be halted during the exchange. If the exchange requires more than 60 seconds, the pump and event clock will be stopped until activity is re-initiated. The FTL will be responsible for moderating any exchanges to relieve an actor.

Air samples will be collected at two flow rates (HV and LV), at two breathing zone heights (adult and child), using three pumps during a two-hour sampling event. The three pumps will be secured in a backpack carried by the actor. The actor will wear two air sample cassettes (HV and LV) at the shoulder to simulate the breathing zone of an adult, and one sample cassette (HV) at the waist to simulate the breathing zone of a child. The breathing zone can be visualized as a hemisphere approximately six to nine inches around an individual’s face.
Flow rates will be determined according to Section 4.2 of EPA SOP 2084, with the following project-specific modification: the flow rates for ABS sample collection should be 5.5 liters per minute (L/min) (for adult and child HV) and 2.0 L/min (for adult LV) resulting in target volumes of 660 L and 240 L, respectively. These flow rates were chosen for this sampling event in order to maximize the volume of air collected which in turn helps achieve the analytical sensitivities required for risk assessment evaluations. For all asbestos sampling, an asbestos sampling train consisting of 0.80 micrometer (μm), 25-millimeter (mm) mixed cellulose ester (MCE) filter connected to a sampling pump will be used. The top cover from the cowl extension on the sampling cassette shall be removed (“open-face”) and the cassette oriented face down.

Both the HV and LV samples will be submitted to the laboratory for analysis by TEM-ISO 10312. If the high-volume sample is not readable after a direct preparation method, either the low flow sample may be evaluated for analysis by direct preparation, or the high flow sample may be used by applying an indirect sample preparation technique. The laboratory must consult with EPA in order to select which is the most appropriate approach to follow. The target analytical sensitivity for ABS air analysis for this investigation is 0.0005 per cubic centimeter (cc⁻¹).

Pump flow rates will be verified at 30-minute intervals or when participants are relieved from an activity by a backup participant, whichever occurs sooner. If at any time, the observed flow rates are ±10 percent of the target rate, the sampling pump should be re-calibrated. If at any time an air sampling pump is found to have faulted or the observed flow rates are 30 percent below or 50 percent above the target rate, Figure 4-1 should be consulted to determine the appropriate action. The time elapsed from the start of the activity until the fault/flow observation will be used to determine the appropriate action according to Figure 4-1.

To calculate the percentage of an observed flow to the target flow, the following formula is used:

\[ X\% = \frac{\text{Observed Flow Rate (L/min)}}{\text{Target Flow Rate (L/min)}} \times 100 \]

Estimation of human health risk from exposure to asbestos in outdoor air following a series of active outdoor soil disturbances is based on the average concentration that occurs across the series of disturbances. It is recognized that the level of asbestos in outdoor ABS air may depend on factors that vary seasonally (disturbance patterns, soil moisture, wind speed, humidity, etc.), and that multiple samples from each area, spanning a range of time points and MET conditions are preferable for this effort to help ensure that reliable estimates of long-term average concentrations may be computed from the individual short-term measurements. However, for CS and LTM sampling for evaluating the remedy, one ABS scenario per location is scoped and will be performed during a known dry period of the year for this region, which should account for the most conservative seasonal conditions.

All ABS air samples should be collected under conditions when the soil is relatively dry and a field moisture deficiency of at least 50 percent, to help ensure that the data are not biased low. Soil moisture will be estimated for each ABS activity area using a Delta-T Device or equivalent moisture meter. Ten random points will be measured at each ABS sampling location prior to ABS activities – the average cannot exceed 30 percent and no point can exceed 50 percent.

ABS sampling will not occur if rainfall has exceeded ¼ inch in the preceding 36 hours. During days when ABS activities are scheduled, MET weather station data will be downloaded from the
local National Oceanic Atmospheric Administration (NOAA) station to calculate the total accumulation of rain.

A portable MET station will be deployed in accordance with EPA SOP 2084 Section 7.3 to record parameters representative of each sampling location. The following parameters will be recorded every 30 seconds during each event: wind speed, wind direction, relative humidity, temperature, and barometric pressure. The MET station should be placed close enough to the activities so the observations of the MET station reflect the conditions of the activity area.

The ABS sample locations (latitude and longitude of the location of each aliquot of the composite) will verified using a hand-held GPS and recorded in a field logbook. In addition, selected samples or sample locations may be photographed.

### 4.4.2 ABS Soil Sample Collection

All surface soil samples for CS and LTM will be 30-point composite samples. ABS soil sampling for the CS and LTM will be collected as follows:

- The ABS surface soil sampling will be collected as a 30-point composite across the same area that the ABS scenario will cover. All composite soil samples will have 30 sub-samples (i.e., 30-point composite sample) of approximately equal size, located equi-distant from each other.

- Since soil moisture is a critical parameter of ABS, a sprayer will not be used to reduce dust generation during sampling. Level C personal protective equipment (PPE) must be worn to perform this activity.

- The sub-sample locations will be cleaned of twigs, leaves, and other vegetative material that can be easily removed by hand and a trowel will be used to remove surface vegetation.

- Using a disposable, plastic spoon, sampling personnel will remove soil from a 2-inch diameter hole down to 3 inches deep while placing the excavated material directly inside a gallon-sized ziploc plastic bag. The excavated material will be thoroughly mixed in the ziploc plastic bag.

- Once the sample is homogenized, sampling personnel will place soil in an 8-ounce glass jar and a 2-inch by 5-inch glass jar with cap. The diameter of the composite holes can be increased or decreased if additional or less soil is required but the depth of the hole must remain the same.

- Excess soil will be placed back into composite holes.

- Sample index identification (ID) labels will be affixed to the outside of the sample jars. Sample index ID numbers will be assigned based on the investigation-specific guidance document.

- **Field duplicates and rinsate blanks are not required for asbestos media for this WA.**

- After the ABS scenario has been completed, topsoil will be added to the cap soil cover to fill composite holes and any areas scoured by the ABS scenario. Grass seed will be available and added on an as needed basis.

- Soil moisture will be collected in the field using a Delta-T Device or equivalent moisture meter.
4.4.3 **ABS Perimeter Air Sampling**

Perimeter air monitoring will take place daily during all ABS activities (including soil sampling) using the procedures described below.

- Each perimeter sample pump will be operated at approximately 3-3.5 L/min. Target flow rate is 1200 liters (L), with a minimum of 500 L. A second sample will be collected at 1.5 L/min over the same period of time. This additional sample is intended to serve as a backup for use if the sample collected at the high flow rate is compromised. Thus, the low flow sample will initially be archived, and will not be analyzed unless the primary sample is determined to be overloaded by laboratory analyst and the low flow sample is not overloaded. The top cover from the cowl extension on the sampling cassette will be removed (“open-face”) and the cassette oriented face down for all asbestos filters. All samples will be collected open-faced unless a specific requirement for sampling closed-faced exists. The project-specific standard operating procedure for Perimeter Air Sample Collection (CDM-BoRit-1, Rev 1) is included in Appendix A.

- Sample pumps will be calibrated using an electronic primary calibrator prior to and after use each day using a cassette reserved for calibration (from the same lot of the sample cassettes to be used in the field). Pre-sampling calibration will be considered complete when ± 5 percent of the desired flow rate is attained, as determined by three measurements with the calibrator. For post-sampling, three separate constant flow calibration readings will be obtained, and those flow readings will be averaged. If the averaged post-sampling flow rate has changed by more than 5 percent during the sampling period, the average of the pre- and post-sampling rates will be used to calculate the total sample volume. Flow rates that have more than a 10 percent difference for a sample pump will be noted with sampling documentation. Samples for which there is more than a 25 percent difference from initial calibration to end calibration will be considered as potentially invalid and noted with sampling documentation. The pump serial number, calibration device serial number, sample number, initial flow rate, sample start/end times, sample locations, and final flow rate will be recorded in the field logbook and on applicable FSDSs.

Perimeter air sample locations (latitude and longitude of the location of each aliquot of the composite) will determined using a hand-held GPS and recorded in a field logbook. In addition, selected samples or sample locations may be photographed.

4.5 **Surface Soil Sampling – CS and LTM**

For CS and LTM, surface soil composite samples will be collected from the Park, Reservoir, and Asbestos Pile parcels as described in Section 3.

All surface soil samples for LTM sampling will be 30-point composite samples as follows:

- All composite soil samples will have 30 sub-samples (i.e., 30-point composite sample) of approximately equal size, located equi-distant from each other.

- The sub-sample locations will be cleaned of twigs, leaves, and other vegetative material that can be easily removed by hand and a trowel will be used to remove surface vegetation.

- Using a disposable, plastic spoon, sampling personnel will remove soil from a 2-inch diameter hole down to 3 inches deep while placing the excavated material directly inside
a gallon-sized ziploc plastic bag. The excavated material will be thoroughly mixed in the ziploc plastic bag.

- Once the sample is homogenized, sampling personnel will place soil in appropriate sample bottles (see Table 4-2).
- The diameter of the composite holes can be increased or decreased if additional or less soil is required but the depth of the hole must remain the same.
- Excess soil will be placed back into composite holes.
- Sample index ID labels will be affixed to the outside of the sample jars. Sample index ID numbers will be assigned based on the investigation-specific guidance document.
- **Field duplicates and rinsate blanks are not required for asbestos media for this WA.** Field duplicates, matrix spike/matrix spike duplicate (MS/MSD), and rinsate blanks for chemical analytes will be required at the frequency listed in Table 4-3.
- Topsoil will be added to the cap soil cover to fill composite holes. Grass seed will be available and added on an as needed basis.

The location of all surface soil samples will be determined using a handheld GPS unit to record the latitude and longitude of each sample location. In addition, selected samples or sample locations may be photographed.

### 4.6 Surface Water Sampling - CS and LTM

Surface water samples will be collected in accordance with CDM Smith Technical SOP 1-1, Surface Water Sampling. Surface water samples from Wissahickon Creek will be collected directly into sample bottles (Table 4-2). General water quality (dissolved oxygen, turbidity, temperature, pH, specific conductance, and oxidation reduction potential [ORP]) parameters will be collected from the same depth as sample collection.

Reservoir surface water samples will be collected from a motorless boat from the locations shown on Figure 3-8. General water quality (dissolved oxygen, turbidity, temperature, pH, specific conductance, and ORP) parameters will be collected from two depths (at one third of water column and at two thirds of water column) from the surface water locations.

The locations of all surface water sampling locations will be confirmed using a GPS and recorded in a field logbook. In addition, select samples or sample locations may be photographed. Water samples will be analyzed for asbestos by TEM-EPA 100.1. MS/MSD and field blanks for chemical analytes will be required at the frequency listed in Table 4-3.

### 4.7 Sediment Sampling – CS and LTM

Reservoir sediment samples will be collected from a motorless boat from the locations shown on Figure 3-6. At each location, the depth to the Reservoir bottom from the water surface will be measured and recorded using a rod with a metal plate on the end.

Sediment samples will be collected from the top six inches of the substrate using a stainless steel or polyvinyl chloride (PVC) dredge sampler per CDM Smith Technical SOP 1-11 (Appendix A). The contents of the dredge will be placed in a stainless steel bowl and a sample for volatile organic compound (VOC) (i.e., carbon disulfide) analysis will be collected with an Encore™
Sampler, if possible. If it is not possible to collect the sample with an Encore™ Sampler due to the sediment consistency, the sample will be collected into a sample jar (Table 4-2).

The sediment composition (grain size, color, organic matter, etc.) will be noted in the field logbook.

The sediment sample locations (latitude and longitude of the location of each aliquot of the composite) will be verified using a hand-held GPS and recorded in a field logbook. In addition, selected samples or sample locations may be photographed.

Sediment samples will be analyzed for target compound list (TCL) VOCs (carbon disulfide) and asbestos. Field duplicate, MS/MSD, and rinsate blanks for chemical analytes will be required at the frequency listed in Table 4-3. Note, field duplicate samples for asbestos are not required.

**4.8 Ambient Air Sampling – CS and LTM**

AA samples will be collected using an ems® alternating current/direct current (AC/DC) Extended Service Air Sampling System Naturally Occurring Asbestos (NOA) sample pump. The pumps are powered by 12-volt deep cycle marine batteries at each location. Batteries will be replaced after 8 to 12 hours of run time. The sampling train consisted of an open-faced cassette that contains a 25-mm diameter MCE filter with a pore size less than or equal to 0.80 μm, attached to a length of Tygon® tubing which is connected to a manifold on the NOA sampling pump. The manifold allows both a HV sample and a LV sample to be collected simultaneously. Sample cassettes will be placed at a minimum height of 3 feet, and no higher than 5 feet. Cases will be locked and secured at each sampling location. Sampling will be suspended if adverse weather conditions arise (e.g., precipitation that could interfere with sample viability and/or equipment function). If this occurs EPA will be notified immediately.

For the HV sample, the target volume of air to be collected is 3,600 L, with a target flow rate between 2.0 to 4.0 L/min. A LV sample will also be collected within a target flow rate of 1.0 to 2.0 L/min over the same period of time. This additional LV sample is intended to serve as a backup for use if the HV sample is compromised. Thus, the LV sample will be archived, and only analyzed if the laboratory analyst determines that the HV sample is overloaded.

All AA samples collected will be analyzed by TEM-ISO 10312 for asbestos. The target analytical sensitivity for AA is 0.0005 cc⁻¹.

Sampling details can be found in CDM-BORIT-2, REV 0; Collection of Outdoor Ambient Air Samples, found in Appendix A.

**4.8.1 Ambient Air Sampling Locations and Pump Placement**

Outdoor AA sampling will be conducted at six locations (Figure 3-2) in the residential / commercial area surrounding the Site, as described in Section 3.2.2. AA sample locations (latitude and longitude of the location of each aliquot of the composite) will be verified using a hand-held GPS and recorded in a field logbook. In addition, selected samples or sample locations may be photographed.

The locations of the offsite ambient air samples are widely distributed in all directions (north, south, east, and west) throughout the community, outside the perimeter of the Site. The distribution of samples throughout the community appears to cover most areas adjacent to the
Site and is geographically representative of the area of concern.

Outdoor AA sampling pumps will be placed at each sampling location in such a way as to reduce potential structural interference with wind patterns and allow the samples to be exposed to the dominant air patterns in the area (Appendix C).

4.8.2 Collection of Meteorological Data
MET station data will be collected during days when ABS activities are occurring. MET data will be downloaded from the local personal weather station, KPAAMBLE2, found at:


The following parameters are recorded hourly at this station:

- temperature (degrees Fahrenheit [°F])
- dew point (°F)
- relative humidity (%)
- wind speed (miles per hour [mph])
- wind gust (mph)
- wind direction
- barometric pressure
- precipitation (inches)

MET data may be used to understand temporal patterns of results and sample representativeness.

4.9 Packaging and Shipping of Environmental Samples – CS and LTM

Samples collected during the CS or LTM will be analyzed by an EPA Office of Analytical Services and Quality Assurance (OASQA), the CLP, EPA’s Delivery of Analytical Services (DAS) program, or by a CDM Smith subcontracted laboratory. All samples will be packaged and shipped in accordance with CDM Smith Technical SOP 2-1, Packaging and Shipping of Environmental Samples included in Appendix A.
4.10 Equipment Decontamination – CS and LTM

Sampling equipment will be decontaminated at the Site. Decontamination water will be collected and placed in a labeled drum staged at the Park parcel. Equipment decontamination will be performed prior to the start of sampling activities, between samples if equipment will be re-used, and at the conclusion of sampling activities. Decontamination activities will be performed in accordance with CDM Smith Technical SOP 4-5, Field Equipment Decontamination at Non-Radioactive Sites (Appendix A). The EPA Region 3-required solvent, methanol, and a 10 percent nitric acid solution will be used to clean all sampling equipment if sampling for TCL organics and target analyte list (TAL) metals, respectively. The following procedure will be used to clean sampling equipment used during sampling:

(1) Liquinox detergent scrub
(2) Rinse with clean potable water
(3) Rinse with deionized (DI) water
(4) Rinse with 10 percent nitric acid (for TAL metals analysis only)
(5) Rinse with DI water
(6) Rinse with methanol (for TCL organics only)
(7) Rinse with DI water
(8) Air dry
(9) Wrap with aluminum foil (shiny side out)

4.11 Investigation-Derived Waste Management – CS and LTM

The CDM Smith FTL will ensure that all sampling wastes are handled in accordance with CDM Smith Technical SOP 2-2, Guide to Handling of Investigation-Derived Waste, provided in Appendix A. Wastes generated from sampling activities are likely to include used PPE, dry solid waste (plastic sheeting, bags, sampling equipment, etc.) and decontamination water. Dry solid wastes and PPE will be disposed of as municipal waste. Decontamination water will be containerized in 55-gallon drums for off-site disposal. Management of IDW is discussed in detail in Section 6.
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Part II

Data Management Plan
Section 5

Data Management Plan

This Data Management Plan (DMP) has been prepared to describe how CDM Smith will manage, manipulate, and present data collected during CS and LTM activities. This plan covers all data including laboratory results and other field data.

5.1 Data Assembly

Data collected during the field investigation will be organized, formatted, and entered into the analytical database for use in the data evaluation phase.

CDM Smith assumes that all CLP data will be validated by the EPA Region III ESAT or by the EPA Region III OASQA in accordance with all EPA Region III Functional Guidelines.

CDM Smith will use EarthSoft’s EQuIS Data Management System (EQuIS) and Microsoft’s Excel spreadsheet software for managing all data collected during the sampling program. This software is a full-featured environmental data management system designed for both geological and analytical data management. EQuIS enables the user to organize, manage, import, export, analyze, and model:

- Scheduled and ad hoc sampling and analysis events as well as boring installation and construction features;
- Sampling locations;
- Testing methods; and
- Analytical parameters and results.

EQuIS will provide data storage, retrieval and analysis capabilities, and is able to interface with a variety of spreadsheets, word processing, and statistical and graphics software packages.

5.2 Data Entry and Format

CDM Smith assumes that all analytical data generated from the CS and LTM activities will be provided by EPA as EDDs. Based on CDM Smith’s experience, the EDDs provided by OASQA require editing by CDM Smith prior to upload into the data management database. Sample data will be uploaded and entered by CDM Smith. CDM Smith will perform a quality assurance (QA) review of the file for data entry errors and uploading problems.

Data managed by this system will include laboratory results and field sampling data.

5.3 Data Usability Evaluation

Upon receipt of CDM Smith validated EPA data, CDM Smith will review the data and the data validation report to determine if the data are of sufficient quality to be relied upon for reporting
purposes. The review will also include an evaluation of the data validation report conclusions concerning whether the data meets the established quality goals.

5.4 Electronic Database File Storage
The database will be maintained on a CDM Smith server with backups performed daily.

5.5 Quality Assurance and Quality Control
During the Remedial Action, and prior to conducting CS or LTM, a QAPP for all sampling will be prepared in accordance with EPA QA/R-5 guidance for preparing QAPPs (EPA 2001a), CDM Smith's RAC Region III Quality Management Plan (QMP) (CDM Smith 2013b), and EPA Region III requirements. The QAPP will include details on project management, project organization, background and purpose, project description, quality objectives and criteria, special training, and documentation and records.

Additionally, electronically available data will be transferred into the project database and a 10 percent quality control (QC) check will be performed by the CDM Smith data management staff. If errors are found during the 10 percent QC check, then CDM Smith data management staff will switch to a 100 percent QC check. A 100 percent QC check will be performed on the information that required manual data entry by the CDM Smith data management staff. The database has internal validation checks to verify that the type of information in each field is a valid entry and that the required information has been entered. Resulting project reports will include a QA section to meet requirements for a measurement report.

5.6 Retrieval and Data Analysis Capabilities
Using the EQuIS database system, data are easily retrievable. Tables of analytical results will be organized in a logical manner such as by sample location number, sampling zone, or some other logical format. Data tables comparing the results of various phases of sampling efforts will be prepared and evaluated. CDM Smith will coordinate the table organization with the EPA RPM. Examples of data analysis capabilities include generation of:

- Tables of compounds detected; and
- Comparison of reported concentrations to RGs or other criteria.

5.7 Graphic Software Packages
Analytical data results will interface with graphics packages to illustrate contaminants detected. Graphic illustrations, such as contaminant concentration maps, will be presented in technical memoranda and letter reports.

EQuIS has excellent compatibility with:

- Microsoft Excel®, a common spreadsheet, data analysis, and presentation application;
- ArcGIS®, a powerful geographic information system application and display tool;
- Surfer®, a widely used application for plotting spatial data and generating post, contour, and surface plots; and
- Mining Visualization System (MVS), a 3-dimension data visualization tool.
CDM Smith also has the ability to export this data into additional formats such as AutoCAD, if needed.

Examples of client deliverables include crosstab reports showing all analytical data and/or comparing the data to standards, computer-aided design and drafting (CADD) maps, graphics, and electronic media to contain the final analytical data in a format specified by EPA. Examples of internal data requirements are statistical reports, variations of the crosstab reports (hit tables), data exported to other software applications for mapping, graphing, or modeling and reports to track the data management effort.
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Part III

Pollution Control and
Mitigation Plan
Section 6

Pollution Control and Mitigation Plan

6.1 Waste Management Plan
The purpose of this Pollution Control and Mitigation Plan is to outline the procedures that will be taken to ensure that contaminants are not released off site during CS and LTM activities for the Site. This plan will detail procedures for the following:

- Ensuring that contaminants are not mobilized or released by sampling activities
- The handling of IDW to include storage, treatment, and disposal

CS and LTM sampling field activities will generate IDW, defined as discarded materials resulting from field activities such as sampling and decontamination processes that, in their present form, possess no inherent value or additional usefulness without treatment. Wastes may be solid, liquid, or multiphase materials that may be classified as hazardous or nonhazardous. Every effort will be made to minimize the amount of IDW.

Non-hazardous solid waste generated during the independent sampling event (plastic, cardboard, paper, tubing, and personal protective equipment) will be disposed of in a municipal dumpster. Decontamination water and/or purge water generated during the independent sampling event will be stored and disposed of in accordance with applicable Resource Conservation and Recovery Act (RCRA) regulations. All activities will follow the EPA guidance document, *Guide to Management of Investigation-Derived Wastes, 9345-03FS, January 1992*. In addition, the CDM Smith FTL will ensure that all sampling wastes are handled in accordance with CDM Smith Technical SOP 2-2, Guide to Handling Investigation-Derived Wastes (*Appendix A*).

6.2 Transportation and Disposal Plan
Transportation and disposal of IDW generated during the CS and LTM events will be coordinated by CDM Smith’s IDW Subcontractor.
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Section 7

References


CDM Smith 2015a. Final Remedial Investigation Addendum, BoRit Asbestos Superfund Site, Operable Unit 1, Ambler Pennsylvania. May 22.


EPA, Emergency Response Team. 2007. Activity-Based Air Sampling for Asbestos, Standard Operating Procedure #2084, Revision 0.0. May.

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BoRit Asbestos Superfund Site
Ambler, Pennsylvania

Figure 2-1
Site Map

Notes:
Notes: 
2. The following nomenclature is proposed for sample locations:
   SS = the sampling event, LL indicates the parcel type, AA indicates the media type, and NN indicates the location number.

The event codes include:
- CS = confirmation sampling
- L1 = long-term monitoring, event 1

The parcel types include:
- AP = asbestos pile parcel
- PK = park parcel

The media type includes:
- ABS = activity-based sampling

Legend:
- Asbestos Pile ABS Location
- Park Parcel ABS Location
- Site Boundary
Notes:
2. The following nomenclature is proposed for AA sample locations:
   LLNN-AA
   Where LL indicates the parcel type, NN indicates the location number, and AA indicates the media type.

The event codes include:
CS = confirmation sampling
L1 = long-term monitoring, event 1

The parcel type includes:
CM = commercial property

The media type includes:
AA = ambient air

Legend
- Ambient Air Sampling Locations
- Site Boundary

BoRit Asbestos Superfund Site
Ambler, Pennsylvania

Proposed Confirmation Sampling and Initial Long-term Monitoring
Ambient Air Locations
Two surface soil samples: one each from two randomly-selected grids in Subarea 1

Two surface soil samples: one each from two randomly-selected grids in Subarea 2

Two surface soil samples: one each from two randomly-selected grids in Subarea 3

Two surface soil samples: one each from two randomly-selected grids in Subarea 4

Two surface soil samples: one each from two randomly-selected grids in Subarea 5

Notes:
2. Grid dimensions are 100 feet by 100 feet.
Notes:
2. Grid dimensions are 100 feet by 100 feet.
Figure 3-5

Proposed Confirmation Sampling and Initial Long-term Monitoring Surface Soil Sampling - Asbestos Pile Parcel

Notes:
2. Grid dimensions are 100 feet by 100 feet.
* One sample will be collected from Subarea 1 of the Asbestos Pile parcel where the fire training and slag disposal areas were located, for dioxin/furan analyses.

Legend
- Asbestos Pile Parcel Subareas
- Former Fire Training and Slag Disposal Area
- Site Boundary
Figure 3-6
Proposed Confirmation Sampling and Initial Long-term Monitoring of Reservoir Sediment

Legend
- Sediment
- Site Boundary

Notes:
2. The following nomenclature is proposed for sample locations:
   SS|LL|AA-NN
   Where SS indicates the sampling event, LL indicates the parcel type,
   AA indicates the media type, and NN indicates the location number.

   The event code includes:
   CS = confirmation sampling
   L1 = long-term monitoring, event 1

   The parcel type includes:
   RV = Reservoir

   The media type includes:
   SD = sediment

BoRit Asbestos Superfund Site
Ambler, Pennsylvania

Path: F:\BoRit\GIS\ArcGIS\Projects\SMP LTM\Figure 3-6 CS LTM Reservoir Sediment.mxd
Figure 3-7
Proposed Confirmation Sampling and Initial Long-term Monitoring of Wissahickon Creek Surface Water

Notes:
2. The following nomenclature is proposed for sample locations:
   SSSLAA-NN
   Where SS indicates the sampling event, LL indicates the parcel type, AA indicates the media type, and NN indicates the location number.

   The event codes include:
   CS = confirmation sampling
   L1 = long-term monitoring, event 1

   The parcel type includes:
   CK = creek

   The media type includes:
   SW = surface water

Legend
- Surface Water Sample Location
- Site Boundary
- Direction of Streamflow

BoRit Asbestos Superfund Site
Ambler, Pennsylvania
Proposed Confirmation Sampling and Initial Long-term Monitoring of Reservoir Surface Water

Notes:
2. The following nomenclature is proposed for sample locations:
   SSLAA-NN
   Where SS indicates the sampling event, LL indicates the parcel type,
   AA indicates the media type, and NN indicates the location number.

The event codes include:
CS = confirmation sampling
L1 = long-term monitoring, event 1

The parcel type includes:
RV = Reservoir

The media type includes:
SW = surface water

Legend
- Surface Water
- Site Boundary
Pump Fault or Flow Rate Observed
<30% or >50% of Target Rate

- Time Elapsed In Activity
  - ≤ 30 minutes
    - Stop activity
    - Collect and archive all personal air cassettes
    - Replace all personal cassettes
    - Restart activity
    - Complete 2 hours of activity
  - > 30 to ≤ 90 minutes
    - Stop activity
    - Collect and archive all personal air cassettes
    - Analysis of samples will be directed by EPA as required to meet DQOs
  - > 90 minutes
    - Stop activity
    - Collect all personal air cassettes
    - Submit samples for analysis

Notes:
EPA = U.S. Environmental Protection Agency
DQO = data quality objectives
## Table 2-1
### Target Media, Chemicals of Concern, and Remediation Goals

**BoRit Asbestos Superfund Site**
**Ambler, Pennsylvania**

<table>
<thead>
<tr>
<th>Soil/Waste</th>
<th>Chemical of Concern</th>
<th>RGs</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BoRit</strong></td>
<td><strong>Superfund</strong> Site</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reservoir</td>
<td>Sediment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asbestos</td>
<td>0.04 f/cc (ABS)(PCME)</td>
<td>0.003 f/cc (PCME)</td>
<td>Human Health Protection</td>
</tr>
<tr>
<td>Asbestos</td>
<td>25 f/cc (WHO)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bis(2-ethylhexyl)phthalate</td>
<td>925 µg/kg</td>
<td></td>
<td>Ecological Protection; ESL</td>
</tr>
<tr>
<td>Dioxins and Furans</td>
<td>0.199 ng/kg</td>
<td></td>
<td>Ecological Protection; ESL</td>
</tr>
<tr>
<td>Chromium</td>
<td>26 mg/kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nickel</td>
<td>38 mg/kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>104 mg/kg</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reservoir Sediment</th>
<th>Chemical of Concern</th>
<th>RGs</th>
<th>Reservoir Surface Water</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos</td>
<td></td>
<td></td>
<td>0.0001 MFL</td>
<td>Ecological Protection; ESL</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>4.1 µg/kg</td>
<td></td>
<td></td>
<td>Ecological Protection; ESL</td>
</tr>
</tbody>
</table>

Notes:
1. Asbestos is the dominant environmental concern and primary risk driver at the BoRit Site. RADs are focused on preventing release of asbestos from source material and preventing exposure to asbestos in both source material and primary exposure media. The remaining chemicals of concern in the table are likely attributed to source material or past activities at the Site and the remedial action implemented to address asbestos in source material will address these additional contaminants. Although the HHRA and SLERA proposed additional COPCs, including COPCs for groundwater, surface water, and seep water beyond those listed above, those remaining COPCs were not included because they are not considered to be related to past Site activities (i.e., they come from off the Site or occur naturally at elevated levels in the soil) or they no longer occur at concentrations of concern.
2. Groundwater, surface water, and seep water are not considered target media. The RI data suggest that the presence of ACM and other contaminants in soil has not resulted in a Site-related groundwater contaminant plume or location with levels above the MCL of 7 MFL. Additionally, although PAHs were found above soil RSLs in many samples, they were not detected in the upper bedrock aquifer, and only one SVOC, bis(2-ethylhexyl)phthalate, was detected in groundwater at concentrations above the RSL. The detections of bis(2-ethylhexyl)phthalate above the RSL were limited to samples collected from MW-02, MW-05, and MW-06 in the first round of sampling conducted in 2010. Bis(2-ethylhexyl)phthalate was not detected in any of the three subsequent rounds of sampling completed at these wells in 2013. Manganese, which occurred at high concentrations in two wells that are not hydraulically connected to each other and which do not constitute a plume, is not a Site-related COPC in contaminated soil or waste and does not appear to be related to historical Site activities.
3. Even though asbestos was not detected at levels that potentially posed a risk in the SLERA, the Reservoir bench study (discussed in Section 1.6 of the FS and in detail in the RI Addendum) demonstrated that Reservoir surface water is directly affected by the Reservoir sediment. Therefore, EPA used a conservative approach and assumed that asbestos is also a potential ecological risk in Reservoir sediment.

- `µg/kg` = micrograms per kilogram
- `ABS` = activity-based sampling
- `ACM` = asbestos-containing material
- `COPC` = chemical of potential concern
- `ESL` = ecological screening level
- `f/cc` = fibers per cubic centimeter
- `FS` = Feasibility Study
- `HHRA` = Human Health Risk Assessment
- `MCL` = maximum contaminant level
- `MFL` = million fibers per liter
- `mg/kg` = milligrams per kilogram
- `Mn` = manganese
- `NOAEL` = no observed adverse effect level
- `PCME` = phase contrast microscopy equivalent
- `RAD` = remedial action objective
- `RI` = remedial investigation
- `RIAO` = Remedial Investigation Action Objectives
- `PCME` = phase contrast microscopy equivalent
- `RSL` = Remedial Site Level
- `SLERA` = Screening Level Ecological Risk Assessment
- `TRV` = Toxicity Reference Value
- `WHO` = World Health Organization

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**Notes:**

1. Asbestos is the dominant environmental concern and primary risk driver at the BoRit Site. RADs are focused on preventing release of asbestos from source material and preventing exposure to asbestos in both source material and primary exposure media. The remaining chemicals of concern in the table are likely attributed to source material or past activities at the Site and the remedial action implemented to address asbestos in source material will address these additional contaminants. Although the HHRA and SLERA proposed additional COPCs, including COPCs for groundwater, surface water, and seep water beyond those listed above, those remaining COPCs were not included because they are not considered to be related to past Site activities (i.e., they come from off the Site or occur naturally at elevated levels in the soil) or they no longer occur at concentrations of concern.
2. Groundwater, surface water, and seep water are not considered target media. The RI data suggest that the presence of ACM and other contaminants in soil has not resulted in a Site-related groundwater contaminant plume or location with levels above the MCL of 7 MFL. Additionally, although PAHs were found above soil RSLs in many samples, they were not detected in the upper bedrock aquifer, and only one SVOC, bis(2-ethylhexyl)phthalate, was detected in groundwater at concentrations above the RSL. The detections of bis(2-ethylhexyl)phthalate above the RSL were limited to samples collected from MW-02, MW-05, and MW-06 in the first round of sampling conducted in 2010. Bis(2-ethylhexyl)phthalate was not detected in any of the three subsequent rounds of sampling completed at these wells in 2013. Manganese, which occurred at high concentrations in two wells that are not hydraulically connected to each other and which do not constitute a plume, is not a Site-related COPC in contaminated soil or waste and does not appear to be related to historical Site activities.
3. Even though asbestos was not detected at levels that potentially posed a risk in the SLERA, the Reservoir bench study (discussed in Section 1.6 of the FS and in detail in the RI Addendum) demonstrated that Reservoir surface water is directly affected by the Reservoir sediment. Therefore, EPA used a conservative approach and assumed that asbestos is also a potential ecological risk in Reservoir sediment.
<table>
<thead>
<tr>
<th>Field Activity</th>
<th>Task</th>
<th>Description/Sampling Frequency</th>
<th>Location</th>
<th>Number of Samples</th>
<th>Analysis</th>
<th>Notes</th>
</tr>
</thead>
</table>
| ABS Sampling          | Air Sampling                    | One ABS Air sampling event (raking scenarios). | Park Parcel: CSPK-ABS01, CSPK-ABS02, CSPK-ABS03, CSPK-ABS04, CSPK-ABS05, CSPK-ABS07  
Asbestos Pile Parcel: CSAP-ABS01, CSAP-ABS02, CSAP-ABS03 | 9                  | Asbestos by TEM             | HV and LV pumps at each location.                                      |
|                       |                                 | Collect three (3) perimeter air monitoring samples at each ABS location. Perimeter sampling will follow the same frequency listed for ABS air sampling. | TBD in the field. Locations will be stationed to account for one upwind and two downwind directions. | 27                 | Asbestos by TEM          | TBD in the field. Locations will be stationed to account for one upwind and two downwind directions. |
| Soil Sampling         |                                 | Collect one (1) 30-point composite surface soil samples 0-3" from each proposed activity-based sampling location (6 locations at the Park parcel and 3 locations at the Asbestos Pile parcels). Perimeter sampling will follow the same frequency listed for ABS air sampling. | Park Parcel: CSPK-ABS01, CSPK-ABS02, CSPK-ABS03, CSPK-ABS04, CSPK-ABS05, CSPK-ABS07  
Asbestos Pile Parcel: CSAP-ABS01, CSAP-ABS02, CSAP-ABS03 | 9                  | Asbestos by PLM            | One composite soil sample at each of the 9 ABS locations.               |
| AA Sampling           | AA Monitoring                   | One event for a 24-hour duration. | Commercial properties: CSCM01-AA, CSCM02-AA, CSCM03-AA, CSCM04-AA, CSCM05-AA, CSCM07-AA | 6                  | Asbestos by TEM          | Sampling will occur during one of the following months: February, March, April, |
| Surface Soil Sampling | Surface Soil at Park, Asbestos Pile and Reservoir | Two surface soil samples: one each from two randomly selected grid locations for each Subarea. Surface soil sampling will follow the same frequency listed under ABS for air sampling. | Park Parcel: Subareas 1 through 5  
Reservoir Parcel: Subareas 1 through 5  
Asbestos Pile Parcel: Subareas 1 through 5 | 30                 | All locations: Asbestos by TEM, bis-2(ethylhexyl) phthalate, chromium, nickel, and zinc. Asbestos Pile Subarea 1: also includes dioctylphthalate  | The locations for the soil samples will be selected by gridding each parcel on an approximately 100 x 100-foot spacing, numbering each grid node, and using a random number generator to select two points for sampling. |
| Sediment Sampling     | Reservoir sediment samples      | Collect sediment samples from 4 locations. Each location is comprised of 3 to 5 sediment grabs to collect one composite. Each sediment location will be advanced to 6" and a composite sample will be collected from 0-6". Each composite should be comprised of 3 to 5 grab samples from locations surrounding the proposed sediment sample. Sediment sampling will follow the same frequency listed under ABS for air sampling. | Reservoir Parcel: CSRVS3D-01, CSRVS3D-02, CSRVS3D-03, and CSRVS3D-04 | 4                  | All samples: Asbestos by PLM and carbon disulfide. | Sediment composition (grain size, color, organic matter, etc.) will also be noted. |
| Surface Water Sampling| Surface water samples along Wissahickon Creek | One event to collect one surface water grab sample from each location. | Wissahickon Creek: CSCKSW-W4, CSCKSW-W5, CSCKSW-W7, and CSCKSW-W8 | 4                  | Asbestos by TEM          | Water quality parameters including: dissolved oxygen, turbidity, temperature, pH, specific conductance, and ORP will be collected by depth at one third of water column and two thirds of water column. |
|                       | Surface water samples from the Reservoir | One event to collect one surface water grab sample from each location from the bottom of the water column. | Reservoir Parcel: CSRVSW-01, CSRVSW-02, CSRVSW-03, CSRVSW-04 | 4                  | Asbestos by TEM          | Water quality parameters including: dissolved oxygen, turbidity, temperature, pH, specific conductance, and ORP will be collected by depth at one third of water column and two thirds of water column. |

**Notes:**
1. The total number of perimeter air samples includes 3 perimeters air samples being collected from all 9 ABS sample locations.
2. Meteorological data reported in the RI Report indicated that the windiest months of year include December, February, March, and April. However, the highest concentrations of asbestos were detected in August and September. Air sampling will be scheduled to occur in one of these six months.

ABS = activity-based sampling  
AA = ambient air  
CS = confirmation sampling  
TBD = to be determined  
TEM = transmission electron microscopy  
PLM = polarized light microscopy  
NA = not applicable  
ORP = oxidation reduction potential  
HV = high-volume  
LV = low-volume
<table>
<thead>
<tr>
<th>Field Activity</th>
<th>Task</th>
<th>Description/Activity</th>
<th>Location*</th>
<th>Number of Samples</th>
<th>Analysis*</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS Sampling</td>
<td>Air Sampling</td>
<td>ABS air sampling (taking scenario). ABS air sampling will occur annually for the first four years, leading up to the first FYR and then at least once every FYR thereafter.</td>
<td>Park Parcel: LxPK-ABS01, LxPK-ABS02, LxPK-ABS03, LxPK-ABS04, LxPK-ABS05, LxPK-ABS07 Asbestos Pile Parcel: LxAP-ABS01, LxAP-ABS02, LxAP-ABS03</td>
<td>9</td>
<td>Asbestos by TEM</td>
<td>HV and LV pumps at each location</td>
</tr>
<tr>
<td>Soil Sampling</td>
<td>Collect three (3) perimeter air monitoring samples at each ABS location. Perimeter sampling will follow the same frequency listed under ABS for air sampling.</td>
<td>TBD in the field. Locations will be stationed to account for one upwind and two downwind directions.</td>
<td>27</td>
<td>Asbestos by TEM</td>
<td>TBD in the field. Locations will be stationed to account for one upwind and two downwind directions.</td>
<td></td>
</tr>
<tr>
<td>AA Sampling</td>
<td>AA Monitoring</td>
<td>AA monitoring will occur over a 24-hour duration. AA will follow the same frequency listed under ABS for air sampling.</td>
<td>Commercial Properties: LxCM01- AA, LxCM02- AA, LxCM03- AA, LxCM04- AA, LxCM05- AA, LxCM07- AA</td>
<td>6</td>
<td>Asbestos by TEM</td>
<td>Sampling will occur during one of the following months: February, March, April, August, September, or December.</td>
</tr>
<tr>
<td>Surface Soil Sampling</td>
<td>Surface Soil at Park, Asbestos Pile and Reservoir</td>
<td>Two surface soil samples: one each from two randomly selected grid locations for each Subarea. Surface soil sampling will follow the same frequency listed under ABS for air sampling.</td>
<td>Park Parcel: Subareas 1 through 5 Reservoir Parcel: Subareas 1 through 5 Asbestos Pile Parcel: Subareas 1 through 5</td>
<td>30</td>
<td>All locations: Asbestos by TEM, bos-2(ethylhexyl) phthalate, chromium, nickel, and zinc. Asbestos Pile Subarea 1: also includes dioxin/furans</td>
<td>The locations for the soil samples will be selected by gridding each parcel on an approximately 100 x 100-foot spacing, numbering each grid node, and using a random number generator to select two points for sampling.</td>
</tr>
<tr>
<td>Sediment Sampling</td>
<td>Reservoir sediment samples</td>
<td>Collect sediment samples from 4 locations. Each location is comprised of 3 to 5 sediment grabs to collect one composite. Each sediment location will be advanced to 6&quot; and a composite sample will be collected from 0-6&quot;. Each composite should be comprised of 3 to 5 grab samples from locations surrounding the proposed sediment sample. Sediment sampling will follow the same frequency listed under ABS for air sampling.</td>
<td>Reservoir Parcel: LxRVS0-01, LxRVS0-02, LxRVS0-03, and LxRVS0-04</td>
<td>4</td>
<td>All samples: Asbestos by PLM and carbon disulfide.</td>
<td>Sediment composition (grain size, color, organic matter, etc.) will also be noted.</td>
</tr>
<tr>
<td>Surface Water Sampling</td>
<td>Surface water samples along Wissahickon Creek</td>
<td>Collect one surface water grab sample from each location. Surface water sampling will follow the same frequency listed under ABS for air sampling.</td>
<td>Wissahickon Creek: CSCKSW-04, CSCKSW-05, CSCKSW-07, and CSCKSW-08</td>
<td>4</td>
<td>Asbestos by TEM</td>
<td>Water quality parameters including: dissolved oxygen, turbidity, temperature, pH, specific conductance, and ORP will be collected by depth at one third of water column and two thirds of water column.</td>
</tr>
<tr>
<td>Reservoir surface water samples</td>
<td>Collect one surface water sample from each location from the bottom of the water column. Surface water sampling will follow the same frequency listed under ABS for air sampling.</td>
<td>Reservoir Parcel: LxRVSW-01, LxRVSW-02, LxRVSW-03, LxRVSW-04</td>
<td>4</td>
<td>Asbestos by TEM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 3-3

**Sample Location Coordinates**

**BoRit Asbestos Superfund Site**

**Ambler, Pennsylvania**

<table>
<thead>
<tr>
<th>Sample Location</th>
<th>Northing</th>
<th>Easting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Park Parcel - ABS and Soil Sample Locations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSPK-ABS01 / LxPK-ABS01</td>
<td>310398.7248</td>
<td>2672090.0575</td>
</tr>
<tr>
<td>CSPK-ABS02 / LxPK-ABS02</td>
<td>310256.9534</td>
<td>2672356.3003</td>
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<tr>
<td>CSPK-ABS03 / LxPK-ABS03</td>
<td>310042.6144</td>
<td>2672607.7923</td>
</tr>
<tr>
<td>CSPK-ABS04 / LxPK-ABS04</td>
<td>309897.4000</td>
<td>2672831.1870</td>
</tr>
<tr>
<td>CSPK-ABS05 / LxPK-ABS05</td>
<td>309813.2365</td>
<td>2672972.4385</td>
</tr>
<tr>
<td>CSPK-ABS07 / LxPK-ABS07</td>
<td>310280.1204</td>
<td>2672163.6093</td>
</tr>
<tr>
<td><strong>Asbestos Pile Parcel - ABS and Soil Sample Locations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSAP-ABS01 / LxAP-ABS01</td>
<td>308989.2354</td>
<td>2673696.4180</td>
</tr>
<tr>
<td>CSAP-ABS02 / LxAP-ABS02</td>
<td>309041.8640</td>
<td>2673795.1211</td>
</tr>
<tr>
<td>CSAP-ABS03 / LxAP-ABS03</td>
<td>308984.0281</td>
<td>2673623.1043</td>
</tr>
<tr>
<td><strong>Ambient Air Sample Locations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSCM01-AA / LxCM01-AA</td>
<td>309063.1963</td>
<td>2672613.3709</td>
</tr>
<tr>
<td>CSCM02-AA / LxCM02-AA</td>
<td>308460.0682</td>
<td>2673795.8240</td>
</tr>
<tr>
<td>CSCM03-AA / LxCM03-AA</td>
<td>308731.5405</td>
<td>2674899.9558</td>
</tr>
<tr>
<td>CSCM04-AA / LxCM04-AA</td>
<td>309864.8810</td>
<td>2674426.8822</td>
</tr>
<tr>
<td>CSCM05-AA / LxCM05-AA</td>
<td>311314.6328</td>
<td>2671974.4790</td>
</tr>
<tr>
<td>CSCM07B-AA / LxCM07B-AA</td>
<td>309196.1022</td>
<td>2673874.9600</td>
</tr>
<tr>
<td><strong>Wissahickon Creek - Surface Water Sample Locations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSCKSW-04 / LxCCKSW-04</td>
<td>309068.3653</td>
<td>2672730.768</td>
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<tr>
<td>CSCKSW-05 / LxCCKSW-05</td>
<td>308607.6278</td>
<td>2673167.163</td>
</tr>
<tr>
<td>CSCKSW-07 / LxCCKSW-07</td>
<td>308462.5233</td>
<td>2673355.073</td>
</tr>
<tr>
<td>CSCKSW-08 / LxCCKSW-08</td>
<td>308081.4743</td>
<td>2673325.853</td>
</tr>
<tr>
<td><strong>Reservoir Parcel - Surface Water and Sediment Sample Locations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSRVSW-01 / LxCRVSW-01 / LxRVSW-01 / LxRVSD-01</td>
<td>309565.2096</td>
<td>2673235.2893</td>
</tr>
<tr>
<td>CSRVSW-02 / LxCRVSW-02 / LxRVSW-02 / LxRVSD-02</td>
<td>309355.6366</td>
<td>2673485.0486</td>
</tr>
<tr>
<td>CSRVSW-03 / LxCRVSW-03 / LxRVSW-03 / LxRVSD-03</td>
<td>309273.2413</td>
<td>2672984.1306</td>
</tr>
<tr>
<td>CSRVSW-04 / LxCRVSW-04 / LxRVSW-04 / LxRVSD-04</td>
<td>309053.9741</td>
<td>2673238.0920</td>
</tr>
</tbody>
</table>

**Notes:**
1. Northing and easting are NAD83 Pennsylvania South State Plane (feet).
2. **CS** = confirmation sampling
3. **Lx** = long-term monitoring, event number
4. **PK** = park parcel
5. **AP** = asbestos pile parcel
6. **ABS** = activity-based sampling
7. **AA** = ambient air
8. **CK** = creek
9. **SW** = surface water
10. **SD** = sediment
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consumables</strong></td>
</tr>
<tr>
<td>Air Cassettes 0.8μm 25mm MCE</td>
</tr>
<tr>
<td>Bags, garbage</td>
</tr>
<tr>
<td>Bags, Ziploc - large</td>
</tr>
<tr>
<td>Bags, Ziploc - small</td>
</tr>
<tr>
<td>Book, log / Rite in the Rain</td>
</tr>
<tr>
<td>Environmental</td>
</tr>
<tr>
<td>Bottle, amber, 1-liter</td>
</tr>
<tr>
<td>Bottle, glass vial, 40-ml</td>
</tr>
<tr>
<td>Bottle, short glass jar, 8-ounce</td>
</tr>
<tr>
<td>Calibration Gas (Isobutylene)</td>
</tr>
<tr>
<td>Camera, disposable</td>
</tr>
<tr>
<td>Caution Tape</td>
</tr>
<tr>
<td>Custody Seals</td>
</tr>
<tr>
<td>Eyeglasses, safety</td>
</tr>
<tr>
<td>Eyewash (Portable)</td>
</tr>
<tr>
<td>Film Developing</td>
</tr>
<tr>
<td>First Aid Kit (1/vehicle)</td>
</tr>
<tr>
<td>Foil, aluminum</td>
</tr>
<tr>
<td>Gloves, Nitrile disposable</td>
</tr>
<tr>
<td>Water, Bottled</td>
</tr>
<tr>
<td>Water De-ionized</td>
</tr>
<tr>
<td>Ice</td>
</tr>
<tr>
<td>Knife, utility</td>
</tr>
<tr>
<td>Liquinox</td>
</tr>
<tr>
<td>Markal Paintstick B</td>
</tr>
<tr>
<td>P100 Particulate HEPA Filter</td>
</tr>
<tr>
<td>Pens, ball point</td>
</tr>
<tr>
<td>Pens, Sharpies</td>
</tr>
<tr>
<td>Plain Vinyl Flags</td>
</tr>
<tr>
<td>Plastic Spoons</td>
</tr>
<tr>
<td>Paper Plates</td>
</tr>
<tr>
<td>Poly Sheeting - Hazco</td>
</tr>
<tr>
<td>Respirators</td>
</tr>
<tr>
<td>Stakes, Wooden, 3' bundle of 100</td>
</tr>
<tr>
<td>Stay Ties (100 ct)</td>
</tr>
<tr>
<td>Tape, clear</td>
</tr>
<tr>
<td>Tape, duct</td>
</tr>
<tr>
<td>Tape, strap</td>
</tr>
<tr>
<td>Tyvek (Standard Coveralls w/Hood,</td>
</tr>
<tr>
<td>Elastic Wrists &amp; Ankles - XX Large,</td>
</tr>
<tr>
<td>25/case</td>
</tr>
<tr>
<td>Tyvek booties (100 pair)</td>
</tr>
<tr>
<td>Wipes, respirator</td>
</tr>
<tr>
<td><strong>Rental Equipment</strong></td>
</tr>
<tr>
<td>Dust Monitor with tripod and alarm</td>
</tr>
<tr>
<td>system</td>
</tr>
<tr>
<td>GPS Trimble backpack</td>
</tr>
<tr>
<td>Heat Stress Monitor</td>
</tr>
<tr>
<td>Met Station w/tripod</td>
</tr>
<tr>
<td>DESCRIPTION</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Boat (motorless)</td>
</tr>
<tr>
<td>SKC PC XR8 Sampling Pump (Low-Vol)</td>
</tr>
<tr>
<td>Flow Meter, Flow-Mate Portable</td>
</tr>
<tr>
<td>Soil Moisture Meter</td>
</tr>
<tr>
<td>Horiba U-22 or YSI Water Quality meter</td>
</tr>
<tr>
<td>Calibration fluid (pH, ORP, conductivity, turbidity)</td>
</tr>
<tr>
<td>Electronic Water Level Indicator - 100 ft</td>
</tr>
<tr>
<td>Container, 8 cubic yds w/1 pickup</td>
</tr>
<tr>
<td>Toilet, Portable</td>
</tr>
<tr>
<td><strong>Supplies</strong></td>
</tr>
<tr>
<td>Folding Tables</td>
</tr>
<tr>
<td>Folding Chairs</td>
</tr>
<tr>
<td>Backpack for ABS Sampling</td>
</tr>
<tr>
<td>Boots, hipwaders</td>
</tr>
<tr>
<td>Bowls, Stainless Steel</td>
</tr>
<tr>
<td>Bucket, w/cover</td>
</tr>
<tr>
<td>Decon Tub</td>
</tr>
<tr>
<td>Rake (20 to 28 inches wide)</td>
</tr>
<tr>
<td>Trenching Shovel</td>
</tr>
<tr>
<td>Coolers - Large</td>
</tr>
<tr>
<td>Coolers - Medium</td>
</tr>
<tr>
<td>Scrub brush, long handle</td>
</tr>
<tr>
<td>Scrub brush, short handle</td>
</tr>
<tr>
<td>Steel Sprayer</td>
</tr>
<tr>
<td>Suit, Rain</td>
</tr>
<tr>
<td>Tool Box w/ tools</td>
</tr>
<tr>
<td>Traffic Cones</td>
</tr>
<tr>
<td>Trowel, Stainless Steel</td>
</tr>
<tr>
<td>Water tank 250 gallons</td>
</tr>
<tr>
<td>High-volume ABS pumps, extra batteries, and charger (&lt; 7 lbs each)</td>
</tr>
<tr>
<td>Low-volume ambient air pumps, extra batteries, and charger</td>
</tr>
<tr>
<td>Deep-cycle marine batteries</td>
</tr>
<tr>
<td>Rotameter, 1 to 10 LPM</td>
</tr>
<tr>
<td>Bios® dry-cal defender, 510 H, 0.3 to 30 LPM</td>
</tr>
</tbody>
</table>

**Notes:**
- $\mu$m = micrometer
- mm = millimeter
- MCE = mixed cellulose ester
- ml = milliliter
- HEPA = high-efficiency particulate air
- ct = count
- PID = photoionization detector
- GPS = global positioning system
- ABS = activity-based sampling
- LPM = one liter per minute
<table>
<thead>
<tr>
<th>Sampling Media</th>
<th>Analysis</th>
<th>Container Type / Number</th>
<th>Analytical Method</th>
<th>Important Notes</th>
<th>Preservation</th>
<th>Holding Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment</td>
<td>TCL VOCs (carbon disulfide)</td>
<td>4 x Encores, 1 x 40 mL *</td>
<td>CLP SOW SOM02.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>If sediment can not be collected with Encores, fill 1</td>
<td>None</td>
<td>48 hours</td>
</tr>
<tr>
<td></td>
<td>Asbestos - PLM</td>
<td>1-8 oz glass jar</td>
<td>EPA/600/R-93/116, 1000 point count&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Soil</td>
<td>TCL SVOCs (bis-2(ethylhexyl)phthalate)</td>
<td>1-8 oz glass jar, fitted with screw-cap lined with PTFE</td>
<td>CLP SOW SOM02.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>None</td>
<td>Cool all samples to ≤ 6°C immediately after collection.</td>
<td>7 days</td>
</tr>
<tr>
<td></td>
<td>TAL Metals (chromium, nickel, zinc)</td>
<td>1-8 oz glass jar</td>
<td>CLP SOW ISM02.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>None</td>
<td>Cool all samples to ≤ 6°C immediately after collection.</td>
<td>6 months</td>
</tr>
<tr>
<td></td>
<td>Asbestos - PLM</td>
<td>1-8 oz glass jar</td>
<td>EPA/600/R-93/116, 1000 point count&lt;sup&gt;b&lt;/sup&gt;</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Dioxin / furans</td>
<td>1-8 oz glass jar</td>
<td>HRSM01.2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>None</td>
<td>None</td>
<td>30 days</td>
</tr>
<tr>
<td>Surface Water</td>
<td>Asbestos - TEM Total</td>
<td>2 x 1 L amber glass bottles, fitted with screw-caps lined with PTFE</td>
<td>EPA 100.1&lt;sup&gt;d&lt;/sup&gt;</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Air</td>
<td>Asbestos - TEM</td>
<td>0.8 µm MCE, 25 mm</td>
<td>ISO 10131&lt;sup&gt;e&lt;/sup&gt;</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Particulates</td>
<td>Field Measurement</td>
<td>Field Measurement</td>
<td>Field Measurement</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Notes:
- L = liter
- mL = milliliter
- mm = millimeter
- µm = micrometer
- oz = ounce
- HDPE = High Density Polyethylene
- MCE = Mixed Cellulose Ester
- PTFE = Teflon
- SOW = Statement of Work
- SVOC = Semivolatile Organic Compound
- TEM = Transmission Electron Microscopy
- UV = Ultraviolet
- VOC = Volatile Organic Compound
- °C = degrees Celsius
- MS/MSD = matrix spike/matrix spike duplicate

<sup>a</sup> EPA. Statement of Work for Organic Superfund Methods Multi-Media, Multi-Concentration ISM02.4, EPA Contract Laboratory Program. October 2016.
<sup>b</sup> EPA. Method 100.1. Determination of Asbestos Structures Over 10 µm in Length in Drinking Water. September 1983.
<sup>d</sup> EPA. Statement of Work for High Resolution Superfund Methods, Multi-Media, Multi-Concentration HRSM01.2, EPA Contract Laboratory Program. October 2014.
<sup>e</sup> International Organization for Standardization (ISO). Ambient air determination of asbestos fibers by direct transfer transmission electron microscopy method. 1995.
<sup>f</sup> * = Triple volume for MS/MSD analysis is required for VOC analysis. This means that twelve 5-gram Encore samples must be collected for an MS/MSD sample.
### Table 4-3
**Required QC Samples**

<table>
<thead>
<tr>
<th>BoRit Asbestos Superfund Site</th>
<th>Ambler, Pennsylvania</th>
</tr>
</thead>
</table>

#### Sampling Media

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Field Duplicates</th>
<th>MQ/MSD</th>
<th>Trip Blanks</th>
<th>Routine Blanks</th>
<th>Field Blanks</th>
<th>Lot Blanks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>Asbestos - PLM</td>
<td>NA</td>
<td>1 per 10 samples</td>
<td>2-oz. glass jar, fitted with screw-cap lined with PTFE</td>
<td>NA</td>
<td>1 per 10 samples</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2-oz. glass jar, fitted with screw-cap lined with PTFE</td>
<td>1 per 10 samples</td>
<td>2 x 1. ler amber glass bottles, fitted with screw-caps lined with PTFE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Surface Water</td>
<td>Asbestos - TEM/PLM</td>
<td>4 x 1 l amber glass bottles, fitted with screw-caps lined with PTFE</td>
<td>NA</td>
<td>1 per 10 samples</td>
<td>2 x 1 l amber glass bottles, fitted with screw-caps lined with PTFE</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 per 10 samples</td>
<td>2 x 1 l amber glass bottles, fitted with screw-caps lined with PTFE</td>
<td>NA</td>
</tr>
<tr>
<td>Air</td>
<td>Asbestos - TEM</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 per 10 samples</td>
<td>2 x 1 l amber glass bottles, fitted with screw-caps lined with PTFE</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Particulates</td>
<td>1 per 20 samples</td>
<td>Field Measurement</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

#### Long-Term Monitoring

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Field Duplicates</th>
<th>MQ/MSD</th>
<th>Trip Blanks</th>
<th>Routine Blanks</th>
<th>Field Blanks</th>
<th>Lot Blanks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Soil / Soil</td>
<td>TAL Metals</td>
<td>1 per 20 samples</td>
<td>1-oz glass jar</td>
<td>1 per 10 samples</td>
<td>2-oz. glass jar, fitted with screw-cap lined with PTFE</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 per 20 samples</td>
<td>2-oz. glass jar, fitted with screw-cap lined with PTFE</td>
<td>1 per 10 samples</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Asbestos - TEM</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Sediment</td>
<td>1 per 20 samples</td>
<td>4 x 40 ml</td>
<td>1 per 10 samples</td>
<td>12 x 40 ml</td>
<td>5 x 40 ml glass containers with PTFE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12 x 40 ml</td>
<td>1 x 40 ml</td>
<td>5 x 40 ml glass containers with PTFE</td>
</tr>
<tr>
<td></td>
<td>Asbestos - PLM</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Surface Water</td>
<td>Asbestos - TEM/PLM</td>
<td>4 x 1 l amber glass bottles, fitted with screw-caps lined with PTFE</td>
<td>NA</td>
<td>1 per 10 samples</td>
<td>2 x 1 l amber glass bottles, fitted with screw-caps lined with PTFE</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 per 10 samples</td>
<td>2 x 1 l amber glass bottles, fitted with screw-caps lined with PTFE</td>
<td>1 per 10 samples</td>
</tr>
<tr>
<td></td>
<td>Air</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Particulates</td>
<td>1 per 20 samples</td>
<td>Field Measurement</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

#### Notes:

1. [1] For surface water samples, a rinse blank will be collected from field equipment; if disposable sampling equipment is used, a field blank will be collected.
2. [2] Triplicate volume for MQ/MSD analysis is required for VOC analysis. This means that twelve 5-gram Environ samples must be collected for an MQ/MSD sample.

#### L = liter

mL = milliliter
mm = millimeter
um = micrometer
oz = ounce
HNO₃ = Nitric Acid
MCE = Mixed Cellulose Ester
MQ/MSD = matrix spike/matrix spike duplicate
PCLM = Phase Contrast Microscopy
PLM = Polarized Light Microscopy
PTFE = Teflon
SVOC = Semi-Volatile Organic Compound
TAL = Target Analyte List
TCL = Target Compound List
TEM = Transmission Electron Microscopy
VOC = Volatile Organic Compound

#### Sources:


Appendix A
Technical Standard Operating Procedures
CDM Smith Technical SOPs:

- SOP 1-1, Surface Water Sampling
- SOP 1-2, Sample Custody
- SOP 1-3, Surface Soil Sampling
- SOP 1-10, Field Measurement of Total Organic Vapors
- SOP 1-11, Sediment and/or Sludge Sampling
- SOP 2-1, Packaging and Shipping of Environmental Samples
- SOP 2-2, Guide to Handling of Investigation-Derived Waste
- SOP 4-1, Field Logbook Content and Control
- SOP 4-2, Photographic Documentation of Field Activities
- SOP 4-5, Field Equipment Decontamination at Non-radioactive Sites
- SOP 5-1, Control of Measurement and Test Equipment
# Surface Water Sampling

<table>
<thead>
<tr>
<th>Approved:</th>
<th>Signature</th>
<th>Technical Review:</th>
<th>Curt Coover</th>
</tr>
</thead>
</table>

## 1.0 Objective
The purpose of this technical standard operating procedure (SOP) is to define requirements for collection and containment of surface water samples.

## 2.0 Background
Surface water samples are collected to determine the type(s) and level(s) of contamination in a particular surface water body and/or its biological disposition.

### 2.1 Definitions

- **Surface Water** - Water that flows over or rests on the land and is open to the atmosphere. This includes ditches, streams, rivers, lakes, pools, ponds, and basins.

- **Shallow Surface Water** - Water within 1 to 3.3 feet (0.3 to 1 meter) of the surface of a body of water.

- **Deep Surface Water** - Water deeper than 3.3 feet (1 meter) of the surface of a body of water.

- **Grab Sample** - A discrete portion or aliquot taken from a specific location at a given point in time.

- **Simple Composite** - Two or more subsamples taken from a specific media and site at a specific point in time. The subsamples are collected and mixed, and then a single average sample is taken from the mixture.

- **Temporal Composite** - Two or more subsamples taken from a specific media and site over a period of time. The subsamples are collected and mixed, and then a single average sample is taken from the mixture.

- **Churn Splitter** - Large vessel for compositing subsamples. Includes a mechanism to agitate the water to keep solids suspended.

## 2.2 Associated Procedures
- SOP 1-2, Sample Custody
- SOP 2-1, Packaging and Shipping Environmental Samples
- SOP 4-1, Field Logbook Content and Control
- SOP 4-2, Photographic Documentation of Field Activities
- SOP 4-5, Field Equipment Decontamination at Nonradioactive Sites

## 3.0 General Responsibilities

- **Site Manager** - The site manager is responsible for ensuring that field personnel are trained in the use of this SOP, related SOPs, and the required equipment.

- **Field Team Leader** - The field team leader (FTL) is responsible for ensuring that sampling efforts are conducted in accordance with this procedure and any other SOPs pertaining to specific media sampling. The FTL also must ensure that the quantity and location of surface water samples collected meet the requirements of the site-specific plans.

**Note:** Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).
Surface Water Sampling

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4.0 Required Equipment
All or part of the equipment listed under the “as needed” category may be required at any specific site, depending on the plan(s) for that site.

- Site-specific plans
- Field logbook
- Indelible black-ink pens and markers
- Labels and appropriate forms/documentation for sample shipment
- Appropriate sample containers
- Insulated cooler and waterproof sealing tape
- Ice bags or “blue ice”
- Plastic zip-top bags
- Clear waterproof tape
- Personal protective clothing and equipment
- Latex or appropriate gloves
- Rubber boots and/or rubberized waders
- Life jacket
- Kimwipe or paper towels
- Clean plastic sheeting
- Tap and deionized water
- Appropriate photographic equipment and supplies
- Appropriate decontamination equipment and supplies

As needed:
- Pond sampler with 1-liter (L) beaker (preferably Teflon*), clamp, and heavy-duty telescoping pole
- Weighted bottle sampler, 1-L capacity (preferably Teflon) and handle; see USGS Open File Report 2005-1087 for selection of sampler; a Kemmerer or Van Dorn sampler may be used if Teflon is not required
- Churn splitter
- Peristaltic pump or suitable replacement
- Temperature, pH, and conductivity meter(s), dissolved oxygen meter, redox potential meter (as required by project plan)
- Boat with depth finder for deep water or inaccessible shorelines
- Global positioning system (GPS) unit
- Tape measure
- Any personal protective equipment specified in the site-specific health and safety plan
- Spare parts for all equipment

5.0 Procedures
5.1 Preparation
The following steps should be taken when preparing for sampling surface water:

1. Review site-specific health and safety plan and project plans before initiating sampling activity.
2. Don the appropriate personal protective clothing as dictated by the site-specific health and safety plan.
3. Select wadeable stream/river sampling locations that exhibit cross-sectional homogeneity and are well-mixed. Avoid areas where the channel is constricted or bends where scouring may have occurred. For lake samples, the investigator should consider the lake stratification caused by seasonal temperature differences. If possible, select a location that can be described precisely, such as xx feet upstream of xx bridge. Use caution when wading streams more than 1 to 2 feet deep. Flowing water can be a safety hazard.
4. Prepare sampling site by laying out clean plastic sheeting on the ground or any flat, level surfaces near the sampling area and place equipment to be used on the plastic.
5. Make field measurements as required by the project plans in physical, chemical, and biological characteristics of the water (e.g., discharge, gage height, temperature, dissolved oxygen, conductivity, pH).
Surface Water Sampling

6. The samples shall be collected from areas of least to greatest contamination (when known) and, when collecting several samples in 1 day, always collect from downstream to upstream.

7. The sampler should be facing upstream when sampling, both for proper sample collection and for safety (ability to observe floating objects).

8. Document the sampling events, recording all information in the designated field logbook and take photographs if required or if possible. Document any and all deviations from this SOP and include rationale for changes.

9. The collection points shall be located on a site map and described in the field logbook. Use GPS if required or if possible.

10. Label each sample container with the appropriate information. Secure the label by covering it with a piece of waterproof clear tape.

11. Decontaminate reusable sampling equipment after sample collection according to SOP 4-5.

12. Processes for verifying depth of samples must be included in site-specific project plans.

13. Check that a trip blank/temperature blank, when necessary, is included in the chilled cooler. Quality assurance/quality control sample requirements vary from project to project. Consult the project-specific work plan for quality requirements.

5.2 Shallow Surface Water Sample Collection for Wadeable Streams

5.2.1 Method for Collecting Samples for Volatile Organic Compound Analysis

All volatile organic compound (VOC) samples should be discrete samples. The following steps must be taken when collecting shallow surface water VOC samples:

If the volatile organic analysis (VOA) vials do not require a preservative:

1. Approach the sample location from downstream; do not enter the sample area. Slowly submerge VOA vials completely into an area of gently flowing water and fill. Do not disturb bottom sediments. The open end of the vials should be pointed upstream.

Note: When collecting samples for VOC analysis, avoid collecting from a surface water point where water is cascading and aerating.

2. Cap the VOA vial while it is underwater. Be sure to dislodge all air bubbles from the cap before sealing the vial.

3. Turn the capped vial upside down and check for air bubbles. Tap the bottom of the vials to dislodge any bubbles that may have formed around the cap or sides. Discard and resample if bubbles are present.

4. Proceed to Step 5 below.

If the VOA vials require a preservative:

1. Collect a sufficient sample in a clean glass jar as in Steps 1 and 2 above for unpreserved vials. Specific sampling devices to be used must be specified in site-specific plans.

2. Decant the sample immediately into prepreserved VOA vials. It is recommended that the amount of preservative be predetermined on a separate aliquot of sample that is subsequently discarded. Tip vials slightly while filling to reduce turbulence until nearly filled. Then straighten vial to vertical for final filling. Ensure that a meniscus is raised above the lip of the vial before capping.

3. Cap each vial once the meniscus has formed.
### Surface Water Sampling

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<tr>
<th>Step</th>
<th>Instruction</th>
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<tr>
<td>4.</td>
<td>Turn the capped vial upside down and check for air bubbles. Tap the bottom of the vials to dislodge any bubbles that may have formed around the cap or sides. Discard and resample if bubbles are present.</td>
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<td>5.</td>
<td>Wipe the outside of sample vials with a Kimwipe or clean paper towel. Affix a completed sample label.</td>
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<tr>
<td>6.</td>
<td>Place sample vial(s) in a zip-top plastic bag and seal the bag.</td>
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<tr>
<td>7.</td>
<td>Immediately pack all samples into a chilled cooler.</td>
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#### 5.2.2 Method for Collecting Discrete Shallow Surface Water Samples for Nonvolatile Organic or Inorganic Compound Analysis

The following steps must be followed when collecting discrete shallow surface water samples for nonvolatile organic or inorganic compound analysis:

1. Directly dip the sample container, with the opening facing upstream, into the surface water and fill. If wading is necessary, approach the sample location from downstream; do not enter the actual sample area. Do not disturb underlying sediments.

2. Filter samples if required by the site-specific plan.

3. Add appropriate preservatives to the sample containers if required and check pH.

**Note:** Use a separate container when field testing pH, conductivity, temperature, etc. Do not insert pH paper or probe directly into sample container.

4. Cap the sample containers and wipe the outer surfaces of the sample containers clean with a Kimwipe or clean paper towel. Affix a completed sample label.

5. Place sample container(s) in individual zip-top plastic bags, if possible, and seal the bags.

6. Immediately pack all samples into a chilled cooler.

#### 5.2.3 Method for Collecting Simple Composite Shallow Surface Water Samples for Nonvolatile Organic or Inorganic Compound Analysis

If the QAPP requires the use of simple composite samples, then a sampler capable of collecting composite samples is required. For width and depth integrated (WDI) composite samples, a DH-48 or DH-81 are recommended, but the QAPP may specify an alternative. The following steps must be followed when collecting simple composite shallow surface water samples for nonvolatile organic or inorganic compound analysis:

1. Record the gage height, if any, before and after sampling.

2. Select the number of width increments based on the requirements of the QAPP. Generally, small well mixed streams require few increments while large or poorly mixed streams require more increments.

3. For fewer than six width increments, subsample locations can be visually estimated. For more than five width increments, string a tape measure across the stream above the water surface to be able to accurately identify the subsample locations. Increments should be evenly spaced across the stream for equal width-integrated (EWI) sampling.
### Surface Water Sampling

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<td><strong>Surface Water Sampling</strong></td>
<td><strong>SOP 1-1</strong></td>
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<td><strong>Revision: 10</strong></td>
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<td><strong>Date: February 2015</strong></td>
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4. If depth-integrated sampling is required, collect a subsample at each width increment by submerging the sampler, orifice facing upstream, from the surface to near the bottom and back up to the surface again in an even steady motion. Do not disturb the sediment at the bottom. The sampler should be retrieved less than full. If the sampler is full, empty it and repeat the subsample collection.

5. If depth-integrated sampling is not required, submerge the sampler with the orifice facing upstream into the surface water and fill.

6. Empty the sampler into a churn splitter or temporary container for later splitting.

7. Repeat Steps 4 to 6 for each width increment.

8. If temporary containers were used, empty into churn splitter. Operate the churn splitter by moving the churn up and down in a steady motion fast enough to homogenize the sample without causing aeration. While the churn is in motion, fill the sample bottles from the tap on the churn.

9. Follow Steps 2 though 6 in Section 5.2.2.

#### 5.2.4 Method for Collecting Temporal Composite Shallow Surface Water Samples for Nonvolatile Organic or Inorganic Compound Analysis

If the QAPP requires the use of temporal composite samples, this can be accomplished using a series of discrete samples collected by hand or an automated sampler, or using a series of simple composite samples. Refer to the preceding sections for collecting the subsamples. The compositing scheme can be time-based (e.g., once per hour for 4 hours) or time-discharge (or time gage height) based (e.g., once per hour until the gage height exceeds xx feet, then change to once per 15 minutes).

Because of the project-specific nature of temporal composite sampling, the specific requirements should be identified in the QAPP. The following are general steps to be followed to collect temporal composite samples:

1. Provide for a method of measuring discharge or gage height before, during, and after sample collection as required in the QAPP.

2. Select the number of time increments based on the requirements of the QAPP. If the time increments change based on a change in flow or water quality, specify the trigger, the new time increment, and any additional trigger to return to the previous increment.

3. Calculate the storage volume for the subsamples and provide a churn splitter of adequate size to contain the entire sample to be composited.

4. Collect the samples according to a method described in this SOP or alternate specified in the QAPP.

5. Provide for cold storage of subsamples, if possible. Do not process any subsamples by filtering or preserving unless specified in the QAPP.

6. Following collection of all subsamples, empty the containers into a churn splitter. If discrete data are required including laboratory or field analysis, retain a portion of the subsample.

7. Operate the churn splitter by moving the churn up and down in a steady motion fast enough to homogenize the sample without causing aeration. While the churn is in motion, fill the sample bottles from the tap on the churn.

8. Follow Steps 2 though 6 in Section 5.2.2.
### Surface Water Sampling

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<th>Step</th>
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<td>9.</td>
<td>Field parameters should be measured in the surface water at the time of collection. Some field parameters can be measured on the subsamples at the time of compositing, but the temperature and temperature-dependant parameters will not be representative.</td>
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#### 5.3 Deep Surface Water Sample Collection

**5.3.1 Method for Collecting Samples at Specified Depth Using a Weighted Bottle Sampler**  
The following steps must be followed when collecting surface water samples at specific depths using a weighted bottle sampler:

1. Lower the weighted bottle sampler to the depth specified in the site-specific plan.
2. Remove the stopper by pulling on the sampler line; allow the sampler to fill with water.
3. Release the sampler line to reseat the stopper and retrieve the sampler to the surface.
4. Wipe the weighted bottle sampler dry with a Kimwipe or clean paper towel.
5. Remove the stopper slowly. Fill the specified number of sample containers by slightly tipping the sampler against each sample bottle. Samples to be used for VOC analysis should be decanted directly from the sampler first into prepreserved VOA vials. It is recommended that the amount of preservative be predetermined on a separate aliquot of sample that is subsequently discarded. Add appropriate preservatives to the other sample containers and check pH. Samples may be pooled in stainless steel, glass, or Teflon containers to obtain the necessary volumes. Filter samples if required. Collect sample in separate container for pH, conductivity, temperature, and other measurements if necessary.
6. Close each sample container with the Teflon-lined cap once it is filled. Check for air bubbles in the VOC sample containers. If bubbles are present, discard and resample.
7. Wipe the outside of the sample containers clean with a Kimwipe or clean paper towel. Affix a completed sample label.
8. Place sample container(s), if possible, in individual zip-top plastic bags, and seal the bags.
9. Immediately pack all samples into a chilled cooler.

**5.3.2 Method for Deep Surface Water Sample Collection Using a Peristaltic Pump**  
The following steps must be followed when collecting deep surface water samples using a peristaltic pump:

1. Install clean medical-grade silicon or Teflon tubing on the pump head. Leave sufficient tubing on the discharge side for convenient dispensing of liquid directly into sample containers.
2. Select the appropriate length of Teflon intake tubing necessary to reach the specified sampling depth. Attach the intake sampling tube to the intake pump tube.
3. Lower the intake tube into the surface water at the specified sampling location to the specified depth; make sure the end of the intake tube does not touch underlying sediments.
4. Start the pump and allow at least three tubing volumes of liquid to flow through and rinse the system before collecting any samples. Do not immediately dispense the purged liquid back to the surface water body. Instead, collect the purged liquid and return it to the source after sample collection is complete.
5. Fill the specified number of sample containers directly from the discharge line. Filter samples if required by the site-specific plan. While filling, allow the liquid to flow gently down the inside of the sample bottle to minimize turbulence.
Surface Water Sampling

For VOC samples, fill prepreserved VOA vials and allow a meniscus to form above the top of the container before capping. It is recommended that the amount of preservative be predetermined on a separate aliquot of sample that is subsequently discarded. Check VOA vials to ensure that there are no air bubbles. Add appropriate preservatives to the other samples and check pH.

**Note:** Use a separate container when field-testing pH, conductivity, temperature, etc. Do not insert pH paper or probe directly into sample container.

6. Cap the sample container(s). Wipe the outside of sample containers clean with a Kimwipe or clean paper towel. Affix a completed sample label.
7. Place sample container(s) in individual zip-top plastic bags and seal the bags.
8. Immediately pack all samples into a chilled cooler.
9. Drain the pump system, rinse it with deionized water, and wipe it dry. Replace all tubing with new tubing before sampling at another sampling location. Place all used tubing in plastic bags to be discarded or decontaminated according to the site-specific plans.

### 6.0 Restrictions/Limitations

Peristaltic pumps are generally not capable of lifting water distances greater than 20 to 25 feet (6 to 7.5 meters) above the normal hydrostatic level.

Grab sampling for VOC analysis or for analysis of any other compound(s) that may be degraded by aeration is necessary to minimize sample disturbance and, hence, analyte loss. The representativeness of this sample, however, is difficult to determine because the collected sample represents a single point and has been disturbed.

### 7.0 References


1.0 Objective

Because of the evidentiary nature of samples collected during environmental investigations, possession must be traceable from the time the samples are collected until their derived data are introduced as evidence in legal proceedings. To maintain and document sample possession, sample custody procedures are followed. All paperwork associated with the sample custody procedures will be retained in CDM Smith files unless the client requests that it be transferred to them for use in legal proceedings or at the completion of the contract.

Note: Sample custody documentation requirements vary with the specific EPA region or client. This technical standard operating procedure (SOP) is intended to present basic sample custody requirements, along with common options. Specific sample custody requirements shall be presented in the project-specific quality assurance (QA) project plan or project-specific modification or clarification form (see Section U-1).

2.0 Background

2.1 Definitions

Sample - A sample is material to be analyzed that is contained in single or multiple containers representing a unique sample identification number.

Sample Custody - A sample is under custody if:

1. It is in your possession
2. It is in your view, after being in your possession
3. It was in your possession and you locked it up
4. It is in a designated secure area

Chain-of-Custody Record - A chain-of-custody record is a form used to document the transfer of custody of samples from one individual to another.

Custody Seal - A custody seal is a tape-like seal that is part of the chain-of-custody process and is used to detect tampering with samples after they have been packed for shipping.

Sample Label - A sample label is an adhesive label placed on sample containers to designate a sample identification number and other sampling information.

Sample Tag - A sample tag is attached with string to a sample container to designate a sample identification number and other sampling information. Tags may be used when it is difficult to physically place adhesive labels on the container (e.g., in the case of small air sampling tubes). Check with your EPA regional Contract Laboratory Program (CLP) coordinator as not all Regions require sample tags.

3.0 General Responsibilities

Sampler - The sampler is personally responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

Field Team Leader - The field team leader (FTL) is responsible for ensuring that strict chain-of-custody procedures are maintained during all sampling events. The FTL is also responsible for coordinating with the subcontractor laboratory to ensure that adequate information is recorded on custody records. The FTL determines whether proper custody procedures were followed during the fieldwork.
Sample Custody

Field Sample Custodian - The field sample custodian, when designated by the FTL, is responsible for accepting custody of samples from the sampler(s) and properly packing and shipping the samples to the laboratory assigned to do the analyses. A field sample custodian is typically designated only for large and complex field efforts.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).

4.0 Required Supplies
- Chain-of-custody records (applicable client or CDM Smith forms)
- Sample labels and/or tags
- Scribe software (if required)
- Custody seals
- Clear tape
- Computer
- Printer and paper

5.0 Procedures
5.1 Chain-of-Custody Record
This procedure establishes a method for maintaining custody of samples through use of a chain-of-custody record. This procedure will be followed for all samples collected or split samples accepted.

Field Custody
1. Collect only the number of samples needed to represent the media being sampled. To the extent possible, determine the quantity and types of samples and sample locations before the actual fieldwork. As few people as possible shall handle samples.
2. Complete sample labels or tags for each sample using waterproof ink.
3. Maintain personal custody of the samples (in your possession) at all times until custody is transferred for sample shipment or directly to the analytical laboratory.

Transfer of Custody and Shipment
1. Complete a chain-of-custody record for all samples (see Figure 1 for an example of a chain-of-custody record. Similar forms may be used when requested by the client). When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the sample custodian in the appropriate laboratory.
   - The date/time will be the same for both signatures when custody is transferred directly to another person. When samples are shipped via common carrier (e.g., Federal Express), the date/time will not be the same for both signatures. Common carriers are not required to sign the chain-of-custody record.
   - In all cases, it must be readily apparent that the person who received custody is the same person who relinquished custody to the next custodian.
   - If samples are left unattended or a person refuses to sign, this must be documented and explained on the chain-of-custody record.

Note: If a field sample custodian has been designated, he/she may initiate the chain-of-custody record, sign, and date as the relinquisher. The individual sampler(s) must sign in the appropriate block, but does (do) not need to sign and date as a relinquisher (refer to Figure 1).
2. Package samples properly for shipment and dispatch to the appropriate laboratory for analysis. Each shipment must be accompanied by a separate chain-of-custody record. If a shipment consists of multiple coolers, a chain-of-custody record shall be filled out for each cooler documenting only samples contained in that particular cooler.
Sample Custody

3. The original record will accompany the shipment, and the copies will be retained by the FTL and, if applicable, distributed to the appropriate sample coordinators. Freight bills will also be retained by the FTL as part of the permanent documentation. The shipping number from the freight bill shall be recorded on the applicable chain-of-custody record and field logbook in accordance with SOP 4-1, Field Logbook Content and Control.

Procedure for Completing CDM Smith Example Chain-of-Custody Record

The following procedure is to be used to fill out the CDM Smith chain-of-custody record. The record provided herein (Figure 1) is an example chain-of-custody record. If another type of custody record (i.e., provided by the EPA Contract Laboratory Program (CLP) or a subcontract laboratory or generated by Scribe) is used to track the custody of samples, the custody record shall be filled out in its entirety.

1. Record project number.
2. Record FTL for the project (if a field sample custodian has been designated, also record this name in the “Remarks” box).
3. Record the name and address of the laboratory to which samples are being shipped.
4. Enter the project name/location or code number.
5. Record overnight courier’s airbill number.
6. Record sample location number.
7. Record sample number.
8. Note preservatives added to the sample.
9. Note media type (matrix) of the sample.
10. Note sample type (grab or composite).
11. Enter date of sample collection.
12. Enter time of sample collection in military time (24 hour clock).
13. When required by the client, enter the names or initials of the samplers next to the sample location number of the sample they collected.
14. List parameters for analysis and the number of containers submitted for each analysis.
15. Enter appropriate designation for laboratory quality control (e.g., matrix spike/matrix spike duplicate [MS/MSD], matrix spike/duplicate [MS/D]), or other remarks (e.g., sample depth).
16. Sign the chain-of-custody record(s) in the space provided. All samplers must sign each record.
17. If sample tags are used, record the sample tag number in the “Remarks” column.
18. The originator checks information entered in Items 1 through 16 and then signs the top left “Relinquished by” box, prints his/her name, and enters the current date and time (military).
19. Send the top two copies (usually white and yellow) with the samples to the laboratory; retain the third copy (usually pink) for the project files. Retain additional copies for the project file or distribute as required to the appropriate sample coordinators.
20. The laboratory sample custodian receiving the sample shipment checks the sample label information against the chain-of-custody record. Sample condition is checked and anything unusual is noted under “Remarks” on the chain-of-custody record. The laboratory custodian receiving custody signs in the adjacent “Received by” box and keeps the copy. The white copy is returned to CDM Smith.

5.2 Sample Labels and Tags

Unless the client directs otherwise, sample labels or tags will be used for all samples collected or accepted for CDM Smith projects.

1. Complete one label or tag with the information required by the client for each sample container collected. A typical label or tag would be completed as follows (see Figure 2 for example of sample tag; labels are completed with the equivalent information):

- Record the project code (i.e., project or task number).
- Enter the station number (sample number or EPA CLP identification number) if applicable.
- Record the date to indicate the month, day, and year of sample collection.
- Enter the time (military) of sample collection.
- Place a check to indicate composite or grab sample.
Sample Custody

- Record the station (sample) location.
- Sign in the space provided.
- Place a check next to “yes” or “no” to indicate if a preservative was added.
- Place a check under “Analyses” next to the parameters for which the sample is to be analyzed. If the desired analysis is not listed, write it in the empty slot. Note: Do not write in the box for “laboratory sample number.”
- Place or write additional relevant information under “Remarks.”

2. Place adhesive labels directly on the sample containers. Place clear tape over the label to protect from moisture.

3. Securely attach sample tags to the sample bottle if required. On 2.27 liter (80 oz.) amber bottles, the tag string may be looped through the ring-style handle and tied. On all other containers, it is recommended that the string be looped around the neck of the bottle, then twisted, and relooped around the neck until the slack in the string is removed. In some instances, when the tag cannot be physically attached to the sample container, it is acceptable to simply place the sample tag in the zip lock bag with a sample container.

4. Double-check that the information recorded on the sample label or tag is consistent with the information recorded on the chain-of-custody record.

5.3 Custody Seals

Two custody seals must be placed on opposite corners of all shipping containers (e.g., cooler) before shipment. The seals shall be signed and dated by the shipper.

Custody seals may also be required to be placed on individual sample bottles. Check with the client or refer to EPA regional guidelines for direction. In these instances the custody seal is placed over or in some cases around the lid or cap of the sample container.

5.4 Sample Shipping

SOP 2-1, Packaging and Shipping Environmental Samples defines the requirements for packaging and shipping environmental samples.

6.0 Restrictions/Limitations

Check with the EPA region or client for specific guidelines. If no specific guidelines are identified, this procedure shall be followed.

For EPA CLP sampling events, combined chain-of-custody/traffic report forms generated with Scribe or other EPA-specific records may be used. Refer to regional guidelines for completing these forms.

The EPA Scribe software may be used to customize sample labels and custody records when directed by the client or the CDM Smith project manager.
7.0 References

U. S. Environmental Protection Agency. Revised March 1992 or current revision. National Enforcement Investigations Center, Multi-


___________. 2002 or current revision. EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, EPA/240/R-02/009. Section
2.2.3. December.

January.
**Note:** If requested by the client, different chain-of-custody records may be used. Copies of the template for this record may be obtained from the Chantilly Graphics Department.
Figure 2
Example Sample Tag

Preservative:
Yes ☐ No ☐

ANALYSES
- BOD
- Anions
- Solids (TSS, TDS, ESP)
- COD, TOC, Nutrients
- Phenolics
- Mercury
- Metals
- Cyanide
- Oil and Grease
- Organics GC/MS
- Priority Pollutants
- Volatile Organics
- Pesticides
- Mutagenicity
- Bacteriology

Remarks:

Note: Equivalent sample labels or tags may be used.
## Surface Soil Sampling

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**Revision: 9**  
**Date: February 2015**

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### 1.0 Objective

The purpose of this technical standard operating procedure (SOP) is to define the general techniques and requirements for the collection of surface soil samples.

### 2.0 Background

The techniques and protocols described herein may be used to collect other surface media, including sediment and sludge.

#### 2.1 Definitions

- **Grab Sample** - A discrete portion of sample material or an aliquot taken from a specific sample location at a given point in time.
- **Spoon/Scoop** - A small stainless steel, Teflon®, or Teflon®-lined utensil measuring approximately 15 cm (6 inches) in length with a stem-like handle (for manual operation). Samples are collected using a scooping action.
- **Surface Soil** - Soils generally defined as the soils extending from ground surface to approximately 30 centimeters (cm), or approximately one foot, below ground surface (bgs). Surface soil samples are frequently collected from 0 to 15 cm (0 to 6 inches) bgs. Depending on the soil interval sampled will vary.
- **Syringe** - A hand-held, T-shaped, disposable plastic sampling device used to obtain undisturbed, unconsolidated material samples (e.g., soil or sediment) for laboratory analyses. Samples are collected by pushing the open end of the sampling device into the material to be sampled to retrieve a discrete sample, typically in the amount of 5 or 10 grams.
- **Trowel** - A small stainless steel or Teflon or Teflon®-lined shovel measuring approximately 15 to 20 cm (6 to 8 inches) in length with a slight (approximately 140°) curve across the length. The trowel has a stem-like handle (for manual operation). Samples are collected with a scooping action.

#### 2.2 Associated Procedures

- SOP 1-2, Sample Custody
- SOP 2-1, Packaging and Shipping Environmental Samples
- SOP 4-1, Field Logbook Content and Control
- SOP 4-5, Field Equipment Decontamination at Nonradioactive Sites

#### 2.3 Discussion

Surface soil samples are collected to determine the type(s) and level(s) of contamination in soil and often provide information important to the completion of risk assessments for a given site. Surface soil samples may be collected as part of a site investigation or as part of a site-specific sampling plan, and/or as a screen for “hot spots”, which may require more extensive sampling based on the results of the initial surface soil sampling.

Sediment(s) and sludge(s) that have been exposed by evaporation, stream rerouting, or any other means are collected by the same methods as those for surface soil(s). Typically the top 1 to 2 cm of material are carefully removed before collection of the sample. If a thick, matted root zone is encountered at or near the surface, it shall be removed before collecting the representative soil sample. Surface soil, exposed sediment, or sludge is collected using stainless steel and/or Teflon-lined trowels or scoops.

### 3.0 General Responsibilities

- **Site Manager** - The site manager is responsible for ensuring that sampling efforts are conducted in accordance with this procedure and any other SOPs pertaining to the sampling of specific media. The site manager must also ensure that the quantity and location of surface soil samples collected meet the requirements of the site-specific sampling plan.
Surface Soil Sampling

**Field Team Leader** - The field team leader is responsible for ensuring that field personnel collect surface soil samples in accordance with this SOP and other relevant guidance for surface soil sampling.

**Note:** Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).

### 4.0 Required Equipment
- Insulated cooler and clear waterproof sealing tape
- Securely-sealed bags of ice or "blue ice" packs
- Nitrile or other appropriate protective gloves
- Plastic zip-top bags
- Personal protective clothing and equipment
- Stainless steel and/or Teflon-lined spatulas and pans, trays, or bowls
- Plastic sheeting (disposable, protective ground cover)
- Stainless steel and/or Teflon-lined trowels or spoons/scoops (or other equipment as specified in the site-specific sampling plan)
- Appropriate project documents (including sampling or work plan, and health and safety plan)
- Appropriate sample containers
- Field logbook
- Indelible black ink pen and/or marker
- Sample chain-of-custody forms
- Custody seals
- Decontamination supplies
- Paper towels or Kimwipes

Additional equipment is discussed in Section 5.2.2, VOC Field Sampling/Preservation Methods.

### 5.0 Procedures

#### 5.1 Preparation
The following steps must be followed when preparing for sample collection:

1. Review site-specific health and safety plan and project plans before initiating sampling activity.
2. Don the appropriate personal protective clothing as specified in the site-specific health and safety plan.
3. Locate sampling location(s) in accordance with project documents (e.g., work plan) and document pertinent information in the field logbook. When possible, reference sampling locations back to known, existing site features such as buildings, roads, intersections, etc.
4. Processes for verifying sample collection depth must be specified in the site-specific sampling or work plans.
5. Place clean plastic sheeting on a flat, level surface near the sampling area, if possible, and place sampling equipment on the plastic; place the insulated cooler(s) on separate plastic sheeting to avoid the potential for any cross-contamination.
6. A clean, new or sufficiently decontaminated trowel, scoop, or spoon will be used to obtain sample material from each specified sample location. Other equipment may be used (e.g., shovels) to collect sample material if constructed of stainless steel and decontaminated appropriately prior to use.

#### 5.2 Sample Collection
The following general steps must be followed when collecting surface soil samples.

1. Wear new, clean gloves during handling of all sample containers and sampling devices. Change out gloves at each sampling location, or each time a new sample is to be collected, to avoid cross-contamination.
2. Surface soil samples are typically collected from the areas of least contamination to the areas of the greatest contamination, if known.
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<table>
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3. Document the sampling process by recording applicable information in the designated field logbook. Document any and all deviations from SOPs and the sampling plan in the field logbook and include rationale for changes. See SOP 4-1 for guidance on entering information into field log books.


5. Carefully remove stones, vegetation, snow, etc. from the ground surface in the sampling location area. Clear the sample location using a new and/or appropriately decontaminated spoon, scoop, or other tool as described to expose a fresh sampling surface.

6. Collect the required sample aliquot for volatile analyses, as appropriate, as well as any other samples that may be degraded by aeration, followed by the collection of samples for other analyses. Note that samples are typically not collected from ground surface to approximately six (6) to twelve (12) inches below ground surface for volatile organic compound analysis because of the potential for volatile loss. Sample collection and preservation techniques, as appropriate, are discussed in the following subsections of this SOP.

7. Store samples at 4° Celsius (C) (±2°C) until samples are delivered to the designated analytical laboratory. An appropriate amount of ice or number of cold packs should be used according to the number of samples and/or the volume of sample material collected in order to ensure that a temperature of 4°C is achieved and maintained for delivery to the analytical laboratory. Sample holding times shall be determined with the appropriate analytical laboratory.

8. Pack all samples as required by the work plan and/or laboratory requirements. Include properly completed documentation and affix signed and dated custody seals to the cooler lid. See SOPs 1-2 and 2-1 for guidance on sample custody procedures and packaging and shipping environmental samples.

9. Decontaminate sampling equipment between sample locations. See SOP 4-5 for guidance on decontamination of field equipment at non-radioactive sites.

## 5.2.1 Method for Collecting Samples for Nonvolatile Organic or Inorganic Compound Analysis

The requirements for collecting samples of surface soil for nonvolatile organic or inorganic analyses are as follows:

1. Wear new, clean gloves during handling of all sample containers and sampling devices. Change out gloves at each sampling location, or each time a new sample is to be collected, to avoid cross-contamination.

2. Clear the area to be sampled of debris as described in Section 5.2 of this SOP. Determine sample depth as described in the sampling plan.

3. Label each sample container with the appropriate sample collection information.

4. Use a decontaminated stainless steel or Teflon-lined trowel or spoon to obtain sufficient sample material from the required interval and subsampling points, if necessary, to fill the specified sample containers.

5. Empty the contents of the sampling device directly into a clean stainless steel or Teflon-lined tray or bowl.

6. Homogenize the sample by mixing with a spoon, spatula, or trowel.

7. Use the spoon, spatula, or trowel to distribute the mixture into the labeled sample containers. Fill organic sample containers first, then inorganic sample containers.
### Surface Soil Sampling

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
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<tbody>
<tr>
<td>8.</td>
<td>Secure the respective cap on each sample container immediately after filling.</td>
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<tr>
<td>9.</td>
<td>Wipe the sample containers with a clean paper towel or Kimwipe to remove any residual soil from the sample container surface.</td>
</tr>
<tr>
<td>10.</td>
<td>Place sample containers in individual zip-top plastic bags and seal the bags.</td>
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<tr>
<td>11.</td>
<td>Store samples at 4°C (±2°C) until samples are delivered to the designated analytical laboratory.</td>
</tr>
<tr>
<td>12.</td>
<td>Pack all samples as required by the work plan and/or laboratory requirements. Include properly completed documentation and affix signed and dated custody seals to the cooler lid. See SOPs 1-2 and 2-1 for guidance on sample custody procedures and packaging and shipping environmental samples.</td>
</tr>
<tr>
<td>13.</td>
<td>Decontaminate all non-disposable sampling equipment in accordance with SOP 4-5.</td>
</tr>
</tbody>
</table>

#### 5.2.2 Method for Collecting Soil Samples for Volatile Organic Compound Analysis

The requirements for collecting grab samples of surface soil for volatile organic compounds (VOCs) or other samples degraded by aeration are as follows:

1. VOC samples shall be collected with the least disturbance to the soil as possible. When grab sampling for VOC analysis or for analysis of any other compound(s) that may be degraded by aeration, it is necessary to minimize sample disturbance and consequently minimize analyte loss. The representativeness of a VOC grab sample is difficult to determine because the collected sample represents a single point, is not homogenized, and has been disturbed.

2. VOC samples shall be collected as grab samples as discussed in section 5.2.2 of this SOP. Although the method of collection may vary from site to site based on data quality objectives and the degree of known or suspected contamination, collection of samples for VOC analysis should follow the sampling and preservation methodology as described below.

3. Complete the sample label by filling in the appropriate information (e.g., sample identification, date and time of sample collection, and requested analyses) and securing the label to the container.

4. Use a clean stainless steel or Teflon-lined trowel or spoon/scoop to collect sufficient material in one grab to fill the sample containers.

5. With the aid of a clean stainless steel spatula, quickly fill the sample containers directly from the sampling device, removing stones, twigs, grass, etc., from the sample material, as needed. Fill the sample containers, compacting the sample material as much as possible to minimize headspace in each of the containers.

6. Immediately secure the Teflon-lined cap(s) on the sample container(s).

7. Wipe the containers with a clean Kimwipe or paper towel to remove any residual soil from the exterior of the container.

8. Place the sample containers in individual zip-top plastic bag(s) and seal the bag(s).

9. Store samples at 4°C Celsius (±2°C) until samples are delivered to the designated analytical laboratory. Determine sample holding times with the appropriate analytical laboratory.

10. Pack all samples as required by the work plan and/or laboratory requirements. Include properly completed documentation and affix signed and dated custody seals to the cooler lid. See SOPs 1-2 and 2-1 for guidance on sample custody procedures and packaging and shipping environmental samples.

11. Decontaminate all non-disposable sampling equipment in accordance with SOP 4-5.
### Surface Soil Sampling

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**Note:** A trip blank shall be included with sample coolers containing VOC samples. QC sample requirements vary from project to project. Consult the project-specific sampling plan for requirements.

#### 5.2.3 VOC Field Sampling/Preservation Methods

The following four sections contain SW-846 test methods for sampling and field preservation of soil samples for VOC analysis. These methods include the EnCore™ Sampler Method for low-level VOC analyses, EnCore Sampler Method for high-level VOC analyses, acid preservation for low-level VOC analyses, and methanol preservation for high-level VOC analyses. Equipment requirements in addition to the equipment specified in Section 4.0 of this SOP for each method are indicated at the beginning of each subsection as follows.

When collecting soil samples using the EnCore Sampler Method, collection of soil for moisture content analysis is required. Results of the moisture analysis are used to adjust “wet” concentration results to “dry” concentrations to meet analytical method requirements.

**Note:** Some variation from these methods may be required depending on the contracted analytical laboratory. For example, sample volume requirements are general requirements. Actual sample volumes, sizes, and quantities may vary depending on client or laboratory requirements.

#### 5.2.3.1 EnCore Sampling Equipment and Collection for Low Level VOC Analyses (<200 µg/kg)

The following equipment is required for low-level analysis:

- Three new 5-gram (g) EnCore samplers
- One 110-milliliter (mL) (4-ounce) wide-mouth glass jar or applicable container for moisture analysis
- One EnCore sampler T-handle

The requirements for collecting samples for low level analysis (<200 µg/kg) of VOCs by the EnCore Sampler Method are as follows:

1. Wear new, clean gloves during handling of all sample containers and sampling devices. Change out gloves at each sampling location, or each time a new sample is to be collected, to avoid cross-contamination.
2. Clear the area to be sampled of debris as described in Section 5.2 of this SOP. Determine sample depth as described in the sampling plan.
3. Remove EnCore sampler and cap from package and attach T-handle to sampler body.
4. Push the sampler into the freshly-exposed sampling surface until the O-ring is visible within the hole on the side of the T-handle. If the O-ring is not visible within this window, then the sampler is not full.
5. Extract the sampler and wipe the sampler head with a clean paper towel or Kimwipe so that the sampler cap can be tightly attached.
6. Push the sampler cap on the head of the sampler with a twisting motion to secure it to the sampler body.
7. Rotate the sampler stem counterclockwise until the stem locks in place to retain the sample within the sampler body.
8. Fill out the sample label with the appropriate sample information (e.g., sample identification, date/time of sample collection, requested analyses) and attach to sampler.
9. Repeat procedure for each of the remaining two samplers.
10. Collect a representative moisture sample in a 110 milliliter (mL) (4-ounce) wide-mouth jar using a new or clean Teflon-lined stainless steel spoon, scoop, or trowel.
Surface Soil Sampling

11. Store samples at 4°C (±2°C) until samples are delivered to the designated analytical laboratory. Samples must be shipped and delivered to the analytical laboratory for extraction within 48 hours.

12. Pack all samples as required by the work plan and/or laboratory requirements. Include properly completed documentation and affix signed and dated custody seals to the cooler lid. See SOPs 1-2 and 2-1 for guidance on sample custody procedures and packaging and shipping environmental samples.

13. Decontaminate all non-disposable sampling equipment in accordance with SOP 4-5.

Note: Verify analytical laboratory requirements for extraction/holding times.

5.2.3.2 Acid Preservation Equipment and Sampling Requirements for Low Level VOC Analyses (<200 µg/kg)

Note: Although not common, acid preservation may be required and should only be performed if specified in the project specific sampling plans. If required, determine the specific field acid preservation procedure based on the requirements specified in the analytical method to be employed. Variations between analytical methods exist with respect to field acid preservation.

The following equipment and supplies are required if field acid preservation is required:
- One 40-mL VOA vial with acid preservation (for field testing of soil pH)
- Two preweighed 40-mL VOA vials with acid preservative and stir bar (for lab analysis)
- Two preweighed 40-mL VOA vials with water and stir bar (in case samples cannot be pre-preserved)
- One pre-weighed jar containing methanol or a pre-weighed empty jar accompanied by a pre-weighed VOA vial containing methanol (for sample screening and/or high level VOC analysis)
- One 110-mL (4-oz) wide-mouth glass jar or other container appropriate for retaining a representative sample for moisture analysis
- One 55-mL (2-oz) jar containing acid preservative (additional acid may be needed because of high soil pH)
- One appropriately sized, non-reactive scoop or measuring spoon capable of delivering 1 g of solid sodium bisulfate
- pH paper
- Weighing scale capable of reading to 0.01 g
- Set of balance weights used in daily balance calibration
- Sodium bisulfate acid solution (NaHSO₄)
- A plastic syringe or other sampling device capable of collecting a sufficient sample volume of approximately 5 g

Testing Effervescing Capacity of Soils

Soils must be tested with acid to determine the amount of effervescing that will occur when preserved with acid. Effervescing will drive off VOCs as well as create a high pressure in a sealed VOA vial that could result in the explosion of the sample container. The following steps provide information on the effervescing capacity of the soil.

1. Wear new, clean gloves during handling of all sample containers and sampling devices. Change out gloves at each sampling location, or each time a new sample is to be collected, to avoid cross-contamination.

2. Clear the area to be sampled of debris as described in Section 5.2 of this SOP. Determine sample depth as described in the sampling plan.

3. Using a new, clean syringe, pace approximately 5 g of soil into a VOA vial that contains acid preservative and no stir bar.

4. Do not cap this vial as it may EXPLODE upon interaction with the soil.

5. Observe the sample for gas formation, or effervescence (bubbles that form due to the interaction of carbonates in the soil with the acid preservative).
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6. If vigorous or sustained effervescence is observed, then acid is not an acceptable preservative for the sample.
   - In this case the samples need to be collected in the VOA vials containing only water as a preservative and a stir bar. The vials with acid preservative CANNOT be used.

7. If a small amount or no effervescence occurs, then acid is acceptable to preserve the sample. Keep this initial testing VOA vial for use in the buffering test as detailed below.
   - In this case the samples need to be collected in the VOA vials containing acid preservative and a stir bar.

Testing Buffering Capacity of Soils

The soils must be tested to determine the quantity of acid that is required to achieve a pH reading of ≤2 standard units (SUs). The following steps will assist in determining this quantity.

1. If acid preservation is acceptable for sampling soils, then the sample vial that was used to test the effervescing capacity of the soils can be used to test the buffering capacity.

2. Wear new, clean gloves during handling of all sample containers and sampling devices. Change out gloves at each sampling location, or each time a new sample is to be collected, to avoid cross-contamination.

3. Clear the area to be sampled of debris as described in Section 5.2 of this SOP. Determine sample depth as described in the sampling plan.

4. Cap the VOA vial containing the 5 g of soil, acid preservative, and no stir bar as retained during Step 7 of the effervescing test as described above.

5. Shake the VOA vial gently to homogenize the contents.

6. Open the VOA vial and test the pH of the acid solution with pH paper by dipping one end of a pH paper strip into the soil/acid solution.
   - If the pH paper indicates a pH below 2, then samples can be collected in the two preweighed 40-mL VOA vials with the acid preservative and stir bar. As the pH reading is below 2, it is not necessary to add additional acid to the VOA vials.
   - If the pH paper indicates a pH above 2, then additional acid needs to be added to the VOA vial.

7. To add acid to a sample with a pH above 2, measure out 1 g of the solid sodium bisulfate acid and add to the appropriate VOA vial.

8. Cap the VOA vial and shake thoroughly.

9. After an additional 1 g of solid sodium bisulfate has been added to the VOA vial containing sample material with a pH above 2, repeat Step 4.
   - If the pH paper reads below 2, then the samples can be collected in the two preweighed 40-mL VOA vials containing acid preservative, a stir bar, and 1 g of sodium bisulfate.
   - On the Chain of Custody and in the field log book, note that one additional gram of acid was added such that the laboratory can analyze the samples accordingly.
   - If the pH paper reads above 2, repeat Steps 5 through 7 until the sample pH is less than or equal to 2 SUs.

After the soil chemistry has been determined, samples can be collected. The procedure summarized below assumes the appropriate acid- or water-preserved VOA vials are used based on the guidance discussed.

Sample Preservation Steps

1. Wear new, clean gloves during handling of all sample containers and sampling devices. Change out gloves at each sampling location, or each time a new sample is to be collected, to avoid cross-contamination.
2. Add more acid to the sample if necessary (based on the buffering capacity testing discussed in the previous section).

3. Collect an approximately 5-g soil sample using a cutoff plastic syringe or other sampling device designed to obtain 5 g of soil from a freshly exposed sampling surface.

4. Carefully wipe exterior of sample collection device with a clean paper towel or Kimwipe.

5. Transfer the sample from the sample collection device to the appropriate VOA vial, using caution when extruding the sample to prevent splashing the acid outside of the vial.

6. Remove any soil from the threads of the VOA vial using a clean paper towel or Kimwipe.

7. Cap the VOA vial and weigh the jar to the nearest 0.01 g.

8. Record the exact weight on the sample label.

9. Repeat this sampling procedure for the duplicate VOA vial.

10. Weigh the VOA vial containing methanol preservative to the nearest 0.01 g. If the weight of the vial with methanol varies by more than 0.01 g from the original weight recorded on the vial, discard the vial. If the weight is within tolerance, it can be used for soil preservation as discussed below.

11. Take a clean, empty sample jar or the jar that contains the methanol preservative and collect a 5-g or 25-g sample using a cutoff plastic syringe or other coring device designed to deliver 5 g or 25 g of soil from a freshly exposed sample surface. The 5-g or 25-g size is dependent on the client or analytical laboratory requirements, or as specified in the sampling plan.

12. Carefully wipe the exterior of the collection device with a clean paper towel or Kimwipe.

13. Transfer the soil to a clean, empty jar or a VOA vial that contains methanol. If extruding into a jar that contains methanol, be careful not to splash the methanol outside of the sample container.

14. If the jar used to collect the soil sample did not contain preservative before the soil was added, immediately preserve with the methanol provided, using only one vial of methanol preservative per sample jar.

15. Remove any soil from the threads of the VOA vial using a clean paper towel or Kimwipe and cap the vial.

16. Weigh the jar with sample to the nearest 0.01 g and record the weight on the sample label.

17. Collect dry weight sample using a clean stainless steel spoon or trowel.

18. Store samples at 4°C (±2°C) until samples are delivered to the designated analytical laboratory.

19. Pack all samples as required by the work plan and/or laboratory requirements. Include properly completed documentation and affix signed and dated custody seals to the cooler lid. See SOPs 1-2 and 2-1 for guidance on sample custody procedures and packaging and shipping environmental samples.

20. Decontaminate all non-disposable sampling equipment in accordance with SOP 4-5.
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5.2.3.3 *EnCore Sampling Equipment and Sampling Requirements for High Level Analysis (≥200 µg/kg)*

The following equipment is required for high-level analysis:

- One 5-g sampler or one 25-g sampler

**Note:** The volume requirements specified are general requirements. Actual sample volumes, container sizes, and quantities may vary depending on client or laboratory requirements.

- One 110-mL (4-oz) wide-mouth glass jar or applicable container specified for moisture analysis
- One T-handle *EnCore* sampler

The requirements for collecting high level analysis by the *EnCore* Sampler Method are as follows:

1. Wear new, clean gloves during handling of all sample containers and sampling devices. Change out gloves at each sampling location, or each time a new sample is to be collected, to avoid cross-contamination.

2. Clear the area to be sampled of debris as described in Section 5.2 of this SOP. Determine sample depth as described in the sampling plan.

3. Remove the *EnCore* sampler and cap from package and attach the T-handle to sampler body.

4. Push the sampler into freshly exposed soil surface until the O-ring is visible within the hole/window on the side of the T-handle. If the O-ring is not visible within the window/hole, then the sampler is not full.

5. Use a clean paper towel or Kimwipe to wipe the sampler head so that the cap can be tightly attached.

6. Push the sampler cap on the sampler head with a twisting motion to secure it to the sampler body.

7. Fill out the sample label and attach it to sampler.

8. Rotate the sampler stem counterclockwise until the stem locks in place to retain the sample within the sampler body.

9. Collect a representative moisture sample in 110-mL (4-oz) wide-mouth glass jar or designated container using a clean stainless steel spoon or trowel.

10. Store samplers at 4°C (±2°C) until samples are delivered to the designated analytical laboratory. Samples must be shipped and delivered to the analytical laboratory for extraction within 48 hours.

11. Pack all samples as required by the work plan and/or laboratory requirements. Include properly completed documentation and affix signed and dated custody seals to the cooler lid. See SOPs 1-2 and 2-1 for guidance on sample custody procedures and packaging and shipping environmental samples.

12. Decontaminate all non-disposable sampling equipment in accordance with SOP 4-5.

**Note:** Verify requirements for extraction/holding times.

5.2.3.4 *Methanol Preservation Equipment and Sampling Requirements for High Level Analyses (≥200 µg/kg)*

The following equipment is required for high-level analysis:

- One pre-weighed jar that contains methanol or a pre-weighed empty jar accompanied by a pre-weighed VOA via that contains methanol (laboratory grade)
- Cutoff plastic syringe or other sampling device to obtain 5 g or 25 g of soil
- Set of balance weights used in daily balance calibration
- One dry weight cup
- Weighing balance that accurately weighs to 0.01 g
## Surface Soil Sampling

The requirements for sampling and preservation are as follows:

1. Wear new, clean gloves during handling of all sample containers and sampling devices. Change out gloves at each sampling location, or each time a new sample is to be collected, to avoid cross-contamination.

2. Clear the area to be sampled of debris as described in Section 5.2 of this SOP. Determine sample depth as described in the sampling plan.

3. Weigh the VOA vial containing methanol preservative to the nearest 0.01 g. If the weight of the VOA vial containing methanol varies by more than 0.01 g from the original weight recorded on the vial, discard the vial. If the weight is within tolerance, it can be used for soil preservation/collection as described below. (Commercial sources are available which supply pre-preserved and tared vials which eliminates the need to transport and handle larger quantities of methanol and eliminates the need for a precision scale vials with preservative).

4. Quickly collect a 5-g or 25-g sample using a plastic syringe or other sampling device designed to obtain 5 g or 25 g of soil from a freshly exposed sampling surface.

5. Carefully wipe the exterior of the collection device with a clean paper towel or Kimwipe.

6. Quickly transfer the soil to an empty jar or a jar that contains methanol. If extruding into a jar that contains methanol, be careful not to splash the methanol outside of the vial. The type of jar used and the sample volume needed is dependent on the client or laboratory requirements.

7. If the jar used to collect the soil sample was empty before the soil was added, immediately preserve with the methanol provided, using only one vial of methanol preservative per sample jar.

8. Remove any soil from the exterior of the vial using a clean paper towel or Kimwipe and cap the sample container.

9. Weigh the jar containing the soil to the nearest 0.01 g and record the weight on the sample label.

10. Collect a dry weight sample in a clean, unpreserved sample container using a clean stainless steel spoon or trowel.

11. Store samples at 4°C (±2°C) until samples are delivered to the designated analytical laboratory.

12. Pack all samples as required by the work plan and/or laboratory requirements. Include properly completed documentation and affix signed and dated custody seals to the cooler lid. See SOPs 1-2 and 2-1 for guidance on sample custody procedures and packaging and shipping environmental samples.

13. Decontaminate all non-disposable sampling equipment in accordance with SOP 4-5.

14. If dropping the samples off at the analytical laboratory or requesting a sample pick-up is not an option, sample containers may need to be shipped to the analytical laboratory. Samples should be packed with ice packs sufficient to maintain a temperature of 4°C in the cooler, and shall be shipped in accordance with Department of Transportation (DOT) regulations. Consult CDM Smith’s Health and Safety website (http://cdmweblegacy/h&s/hazmat_transport.html) for guidance on shipping hazardous materials.

### 6.0 Restrictions/Limitations

As presented in Section 5.2 of this SOP, when grab sampling for VOC analysis or for analysis of any other compound(s) that may be degraded by aeration, it is necessary to minimize sample disturbance and consequently minimize analyte loss. The representativeness of a VOC grab sample is difficult to determine because the collected sample represents a single point, is not homogenized, and has been disturbed.
Surface Soil Sampling

7.0 References


__________. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846)*, Third Edition, November 1986, (as amended by Updates I, II, IIA, IIB, III, and IIIA, IIB, and IVA, IVB). Method 5035 *(Note: § 6.2.1.8 of this method says samples stored in EnCore™ samplers shall be analyzed within 48 hours or transferred to soil sample vials in the laboratory within 48 hours):* December 1996, Revision O, Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples.

1.0 Objective
The objective of this technical standard operating procedure (SOP) is to define the techniques and the requirements for the measurement of total organic vapors in the field.

2.0 Background
2.1 Definitions
Photoionization Detector (PID) - A portable, hand-held instrument that measures the concentration of gaseous organic compounds through the photoionization of organic vapors.

Flame Ionization Detector (FID) - A portable, hand-held instrument that measures the concentration of gaseous organic compounds through the flame ionization of organic vapors.

2.2 Associated Procedures
- SOP 1-4, Subsurface Soil Sampling
- SOP 1-5, Groundwater Sampling Using Bailers
- SOP 1-6, Water Level Measurement
- SOP 1-8, Volatile Organic Compound Air Sampling Using USEPA Method TO-15 with SUMMA Canister
- SOP 1-12 Low-Stress (Low-Flow) Groundwater Sampling
- SOP 3-1, Geoprobe® Sampling
- SOP 3-5, Lithologic Logging
- SOP 4-3, Well Development and Purging

2.3 Discussion
The measurement of organic vapors is a required step during numerous field activities. The primary purpose of such measurements is health and safety monitoring to determine if the breathing zone in a work area is acceptable or if personal protective equipment such as a respirator or a supplied air device is necessary for field personnel. At the perimeter of a work area, measurements can be taken as part of a perimeter air monitoring plan to document protection of surrounding community. In addition to health and safety monitoring, total organic vapor measurement is also used in conjunction with sampling activities, including screening subsurface soil samples, soil vapor and indoor air sampling, and groundwater sampling, where measurements are useful for establishing approximate contaminant levels or ranges.

The two types of instruments most commonly used to measure total organic vapors are PIDs and FIDs. Both instruments first ionize the gaseous compound and then measure the response, which is proportional to the concentration.

2.3.1 PID Operation
The PID is preferred when the compound of interest is an aromatic or halogenated volatile organic compound (VOC). The PID ionizes the sampled vapors using an ultraviolet lamp that emits light energy at a specific electron voltage (eV - labeled on the lamp). The ultraviolet lamp produces photons that are absorbed by the sampled vapor molecule. The molecule becomes excited, producing a positively charged ion and emitting an electron. The number of electrons emitted is proportional to the concentration of the sampled gases. Every organic compound has a specific ionization potential in electron volts. The energy emitted by the lamp must be higher than the ionization potential of the compound for the compound to become ionized and emit an electron. If the ionization potential of the compound is higher than the eV of the lamp, there will be no response on the instrument. Therefore, the ionization potential of the known or suspected compounds shall be checked against the energy of the ultraviolet lamp to verify that the energy provided by the lamp is greater. The manufacturer’s manual shall be consulted to determine the appropriate ultraviolet lamp to be used for the known or suspected compounds. Additionally, manufacturer’s manuals shall be consulted to obtain the appropriate correction factors for known or suspected contaminants.
Field Measurement of Total Organic Vapors

Water vapor in the vapor sample can interfere with the PID detector and cause the instrument to stop responding or cause the zero baseline to drift. This can occur using the PID on a rainy day or when sampling headspace samples that have been in the sun. If moisture interference is suspected, the calibration gas shall be used to check the instrument response by inserting the gas as a check sample, not by recalibrating. If the response is lower than the gas level, then the probe and the ionization chamber shall be dried out before reusing the instrument.

The sampling probe shall not be inserted directly into soil samples or dusty areas, as the instrument vacuum will pull dirt into the ionization chamber. Under particularly dirty or dusty conditions, the lamp may become covered with a layer of dust. If dirty conditions are encountered, or if the instrument response seems to have decreased, then the lamp shall be cleaned. The instrument manual provides instructions on how to remove the instrument cover to access the lamp, and how to clean the screen in the ionization chamber and the surface of the lamp.

The instrument manual may provide instruction on use of disposable dust and/or moisture filters for minimizing effects from dust and/or moisture.

The ultraviolet lamp in the PID is sensitive to shock, especially when using the higher eV lamps. Therefore, they shall be handled and transported carefully.

2.3.2 FID Operation

The FID is preferred when sampling for petroleum hydrocarbons and methane (landfill gases). It responds well to aromatic hydrocarbons but is not as convenient to use as the PID. The FID allows measurement of a wide variety of compounds, but in general its sensitivity is not as high as the PID for compounds where the PID is applicable. The FID is virtually unaffected by ambient levels of water vapor.

The FID ionizes the vapor sample by burning it in a hydrogen/air flame, and measuring the response beyond what is caused by the hydrogen alone. This instrument requires a hydrogen supply, contained in a small tank in the instrument. This hydrogen, including the gas in the instrument tank, is considered a flammable gas and appropriate requirements must be adhered to when shipping. The instrument shall be emptied of hydrogen before shipping. Federal Express Hazardous Material shipping manifests must be completed when shipping the gas.

The hydrogen gas in the FID combustion chamber is ignited by pressing a red button on the side of the instrument, which sends electrical current to a small resistance coil igniter in the combustion chamber. This igniter is very sensitive, and if the red button is pressed for longer than 5 seconds, the coil will burn out and the instrument will be unusable unless another igniter is available. If the instrument will not light, check the electrical connections and switches for proper settings. Check that the pump is pumping, and allow fresh air to flow through the combustion chamber for several minutes before lighting. Check to see if the exhaust port of the combustion chamber is dirty.

3.0 Responsibilities

Site Manager - The site manager is responsible for ensuring that field activities are conducted in accordance with this procedure and any other SOPs pertaining to the specific activity.

Field Team Leader - The field team leader is responsible for ensuring that field personnel conduct field activities in accordance with this and other relevant procedures.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance plan.
## Field Measurement of Total Organic Vapors

| SOP 1-10 | Revision: 7 | Date: February 2015 |

### 4.0 Required Equipment

- Site-specific plans (i.e., scope of work)
- Health and safety plan
- Field logbook
- Waterproof black ink pen
- Personal protective clothing and equipment
- Photoionization detector or flame ionization detector
- Calibration gases in a range appropriate for the expected use
- 0.5 liter (16-ounce) or “Mason” type glass jar or Ziploc-type plastic bags
- Hydrogen canister and fill valve and hose (if using FID for a period of more than 1 day)

### 5.0 Procedures

#### 5.1 Direct Reading Measurement

1. Connect the measurement probe to the instrument and make necessary operational checks (e.g., battery check, etc.) as outlined in the manufacturer’s manual.

2. Calibrate the instrument following the applicable manufacturer’s manual.

3. Make sure the instrument is reading zero and all function and range switches are set appropriately.

4. Insert the end of the probe directly into the atmosphere to be measured (e.g., breathing zone, monitoring well casing, split spoon, etc.) and read the total organic vapor concentration in parts per million (ppm) from the instrument display. Apply the appropriate correction factor if necessary. Record the highest instrument response.

5. Immediately document the reading in the field logbook or on the appropriate field form.

#### 5.2 Headspace Measurement

1. Connect the measurement probe to the instrument and make necessary operational checks (e.g., battery check, fan check, etc.) as outlined in the manufacturer’s manual.

2. Calibrate the instrument following the applicable manufacturer’s manual.

3. Make sure the instrument is reading zero and all function and range switches are set appropriately.

4. Fill a clean glass jar or Ziploc-type plastic bag approximately half-full of the sample to be measured. For a jar, quickly cover the top of the jar with one or two sheets of clean aluminum foil and apply cap to seal the jar. For a bag, quickly seal the bag minimizing volume of air in bag.

5. Allow headspace to develop for approximately 10 minutes. It is generally preferable to shake the sealed jar for 10 to 15 seconds at the beginning and end of headspace development. For a bag, kneed the bag to break apart the sample and maximize sample surface area.

**Note:** When the ambient temperature is below 0°C (32°F), the headspace development and subsequent measurement shall occur within a heated vehicle or building.

6. For a jar, remove the jar cap and quickly puncture the foil and insert the instrument probe to a point approximately one-half of the headspace depth. Do not let the probe contact the soil. For a bag, quickly puncture the bag wall and insert the probe, wrapping the bag wall around the probe stem to minimize loss of vapors. If using a PID and there is condensation on the inside of the jar or bag, only leave the probe in the jar or bag long enough to obtain a reading. Remove the probe and allow fresh air to flow through the instrument to avoid excess water vapor to build up.
7. Read the total organic vapor concentration in ppm from the instrument display. Apply the appropriate correction factor if necessary. Record the highest instrument response.

8. Immediately record the reading in the field logbook or on the appropriate field form.

6.0 Restrictions/Limitations

The two methods outlined above are the most commonly used for field measurement of total organic vapors but do not apply to all circumstances. Consult project- or program-specific procedures and guidelines for deviations. Both the PID and FID provide quantitative measurement of total organic vapors, but generally neither instrument is compound-specific. The typical reading range of the PID is 0 to 2,000 ppm, and the typical reading range of the FID is 0 to 10,000 ppm. The FID will measure methane while the PID will not. **Note:** The presence of methane will cause erratic PID measurements. In methane rich environments, toxic organic vapors shall be monitored with an FID. If desired, a charcoal filter can be placed temporarily on the FID inlet probe, which will trap all organic vapors except methane. The filtered (methane only) reading can be subtracted from unfiltered (total organic vapors) to provide an estimate of non-methane organic vapors. The reading accuracy of both instruments can be affected by ambient temperature, barometric pressure, humidity, lithology, etc.

7.0 References

Department of Defense. *Environmental Field Sampling Handbook, Revision 1.* April 2013 or current revision.
Sediment and/or Sludge Sampling

1.0 Objective

The purpose of this technical standard operating procedure (SOP) is to define requirements for collection and containment of samples collected from freshwater or marine sediment, and/or sludge samples.

2.0 Background

2.1 Definitions

Sediment - Bottom substrate underlying a body of surface water, whether freshwater or marine, such as a lake pond, harbor, river, bay or other surface water bodies.

Sludge - Bottom substrate underlying an engineered wastewater pond or solid material removed from a wastewater treatment stream or effluent. Sludge materials range in type from dewatered solids to high viscosity liquids. Sludge particles may be suspended throughout the water column or settled to the bottom as the bottom substrate.

Grab Sample - A surface sample from the sediment or sludge taken from a specific location at a given point in time. Used for horizontal characterization of sediment or sludge.

Core Sample - A subsurface sample taken from the sediment or sludge using a coring device that allows for penetration to a greater vertical depth; used for more comprehensive, vertical characterization of sediment or sludge.

Composite - Two or more subsamples taken from the sediment or sludge at a specific location at a specific point in time, which are then combined and homogenized (mixed) to form a single sample when removed from the homogenate.

Discrete - An individual sample that is taken from the sediment or sludge and analyzed as an individual sample, rather than combined or homogenized to create a composite sample.

2.2 Associated Procedures

- SOP 1-2, Sample Custody
- SOP 2-1, Packaging and Shipping Environmental Samples
- SOP 4-1, Field Logbook Content and Control
- SOP 4-2, Photographic Documentation of Field Activities
- SOP 4-5, Field Equipment Decontamination at Nonradioactive Sites

2.2 Discussion

Sediment/sludge samples are collected to physically, chemically, and/or biologically characterize the nature of the substrate within a given surface water body. Sediment and sludge samples offer the advantage over surface water samples that they provide a more stable, site-specific, and possibly historical account of contamination or other features than surface water samples, as surface water may be flowing, is transitory, and thus more difficult to ascribe specific characteristics to any given specific location.
## 3.0 General Responsibilities

**Site Manager** - The site manager is responsible for ensuring that field personnel are trained in the use of this and related SOPs and the required equipment.

**Field Team Leader** - The field team leader (FTL) is responsible for ensuring that sampling efforts are conducted in accordance with this procedure and any other specific SOPs pertaining to specific sample collection requirements. The FTL must also ensure that the quantity, locations, and procedures for collecting sediment/sludge sampling meet the requirements of any approved site-specific plans such as sampling and analysis plans (SAPs), field sampling plans (FSPs), and quality assurance project plans (QAPPs).

*Note:* Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field sampling plan and/or site quality assurance project plan (QAPP).

## 4.0 Required Equipment

All or part of the equipment listed under the “as needed” category may be required at any specific site, depending on the plan(s) for that site.

- Site-specific plans
- Field logbook
- Indelible black ink pens and markers
- Labels and appropriate forms/documentation for sample shipment
- Appropriate sample containers
- Insulated cooler and waterproof sealing tape
- Ice bags or “blue ice”
- Plastic zip-top bags
- Clear waterproof tape
- Personal protective clothing and equipment (e.g. hard hat, etc.)
- Latex or other appropriate gloves, boots
- Rubber boots and/or rubberized waders
- Stainless steel or Teflon® spoons, spatulas, or scoops
- Teflon or stainless steel mixing bowls or trays
- Aluminum foil
- Kimwipe or paper towels
- ½- to ¾-inch (12- to 19-mm) braided nylon line or Teflon-coated wire rope
- Clean plastic sheeting
- Tap and deionized water with spray bottles
- Appropriate photographic equipment and supplies
- Appropriate decontamination equipment and supplies (e.g. detergent, scrub brushes, buckets for capturing investigation-derived waste)
- Eckman, Ponar, Van Veen, or other grab sampling device for depositional area (e.g. stream) sediment or lake sampling
- Chain of Custody forms from laboratory(ies) as appropriate
- Motorized or other coring device
- Boat with depth finder for deep water or inaccessible shorelines
- Any personal protective equipment specified in the site-specific health and safety plan
- Spare parts for all equipment
- Tape measure
5.0 Procedures

5.1 Preparation
The following steps shall be taken when preparing for sampling sediment/sludge:

1. Review site-specific health and safety plan (HSP) and project plans (FSP, QAPP) before initiating sampling activity.

2. Don the appropriate personal protective clothing as described by the HSP.

3. Use field GPS unit to identify selected sediment or sludge samples within the specified tolerance (e.g. within 2 meters, etc.).

4. Where specific locations are unspecified in the project plans, within a stream or river, avoid areas where the channel has been scoured or where bedrock is present, as it may not be possible to collect samples at these locations.

5. Where excessive organic materials (e.g., root mass, leaf litter) or large grain sizes (e.g. medium to coarse gravel) are present, these material should be minimized in the collected sample.

6. Prepare sampling site by laying out clean plastic sheeting on the ground or any flat, level surfaces near the sampling area and place equipment to be used on the plastic.

7. If surface water is present at the sample location, make field measurements in physical, chemical, and biological characteristics of the water (e.g., temperature, dissolved oxygen, conductivity, pH, etc.), as described by the project-specific plans.

8. The samples shall be collected from areas of least to greatest contamination (when known) and, when collecting several samples in one day in a flowing water body, should be always collected from downstream to upstream.

9. When sampling sediment and surface water from the same surface water body, collect surface water samples before sediment samples to avoid collection of resuspended sediment or sludge particulates.

10. Document the sampling events, recording all information in the designated field logbook and take photographs (as appropriate). Document any and all deviations from this SOP in the field notebook and include rationale for changes.

11. The sample collection points should be shown on a site map and described in the field logbook; any deviations from the site plans should be documented, as well as the rationale for this deviation.

12. Label each sample container with the appropriate information. Secure the label by covering it with waterproof clear tape.

13. Decontaminate reusable sampling equipment after sample collection according to SOP 4-5.

14. Procedures for verifying depths of samples must be included in site-specific project plans.

15. Check that a trip blank/temperature blank, when necessary, is included in the chilled cooler. Quality assurance/quality control requirements vary from project to project. Consult the project-specific work plan for quality requirements.

5.2 Sediment/Sludge Sample Collection from Shallow Waters

5.2.1 Method for Collecting Samples for Volatile Organic Compound (VOC) Analysis

The following steps must be followed when collecting shallow water sediment/sludge VOC samples:
**Sediment and/or Sludge Sampling**

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<tbody>
<tr>
<td>1.</td>
<td>Use a decontaminated stainless steel or Teflon, long-handled scoop, corer, push tube, or dredge to collect the entire sample in one grab. If wading is necessary, approach the sample location from downstream. Do not enter the actual sample area.</td>
</tr>
<tr>
<td>2.</td>
<td>Retrieve the sampling device and slowly decant off any liquid phase.</td>
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</table>
| 3. | Immediately fill the specified sample container(s) with the solid. Use a clean stainless steel or Teflon spoon or spatula to completely fill the container(s), ensuring no headspace.  

**Note:** Samples to be analyzed for VOC or other compounds degraded by aeration shall be taken as grab samples. Do not homogenize or composite these samples. |
| 4. | Once each container is filled, close the container with the Teflon-lined cap. Wipe the outside of the container clean with a Kimwipe or clean paper towel. Affix a completed sample label. |
| 5. | Place the sample container(s) in individual zip-top plastic bags and seal the bags. |
| 6. | Immediately pack all samples into a chilled cooler. |

**5.2.2 Method for Collecting Samples for Non-volatile, Semi-Volatile Organic and Inorganic Compound Analysis**

The following steps must be taken when collecting shallow water sediment or sludge samples for analytes not immediately degraded by aeration:

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<tbody>
<tr>
<td>1.</td>
<td>Collect sufficient volume to fill specified sample containers using decontaminated stainless steel or Teflon-lined equipment (scoops, corer, dredge sampler, etc.). If wading is necessary, approach the sample location from downstream. Do not enter the actual sample area.</td>
</tr>
<tr>
<td>2.</td>
<td>Retrieve the sampling device with the sample and slowly decant off any liquid phase.</td>
</tr>
<tr>
<td>3.</td>
<td>Pool and homogenize samples in a stainless steel, Teflon, or appropriate pan or mixing bowl, using stainless steel spatula or spoon.</td>
</tr>
<tr>
<td>4.</td>
<td>Fill each sample container with the homogenized sample to approximately 75 to 90 percent capacity, filling sample containers for organics analyses first.</td>
</tr>
<tr>
<td>5.</td>
<td>Once each container is filled, close the container with a Teflon-lined cap. Wipe the outside of sample containers clean with a Kimwipe or clean paper towel. Affix a completed sample label.</td>
</tr>
<tr>
<td>6.</td>
<td>Place the sample container(s) in individual zip-top plastic bags and seal the bags.</td>
</tr>
<tr>
<td>7.</td>
<td>Immediately pack all samples into a chilled cooler, if required for preservation.</td>
</tr>
</tbody>
</table>

**5.3 Subsurface Sediment/Sludge Sample Collection Using a Corer or Auger from Shallow Waters**

**5.3.1 Method for Collecting Samples for Volatile Organic Compound Analysis Using an Unlined Corer** (also applies to augers)

The following steps must be taken when collecting subsurface sediment or sludge VOC samples that underlie shallow water:

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</thead>
<tbody>
<tr>
<td>1.</td>
<td>At the specified sampling location, force or drive the corer to the specified depth.</td>
</tr>
</tbody>
</table>
### Sediment and/or Sludge Sampling

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<tbody>
<tr>
<td>2.</td>
<td>Twist and withdraw the corer in a smooth motion.</td>
</tr>
<tr>
<td>3.</td>
<td>Retrieve the sampling device, remove the corer nosepiece (if possible), and extrude the sample into the specified sampling container(s). Use a clean stainless steel or Teflon spoon or spatula to completely fill the container(s), ensuring no headspace.</td>
</tr>
<tr>
<td>4.</td>
<td>Once each container is filled, close the container with the Teflon-lined cap. Wipe the outside of the sample container clean with a Kimwipe or clean paper towel. Affix a completed sample label.</td>
</tr>
<tr>
<td>5.</td>
<td>Place the sample container(s) in individual zip-top plastic bags and seal the bags.</td>
</tr>
<tr>
<td>6.</td>
<td>Immediately pack all samples into a chilled cooler.</td>
</tr>
</tbody>
</table>

#### 5.3.2 Method for Collecting Samples for Volatile Organic Compound Analysis Using a Lined Corer

The following steps must be followed when collecting shallow water subsurface sediment/sludge VOC samples that underlie shallow water:

<p>| | |</p>
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<tbody>
<tr>
<td>1.</td>
<td>Install decontaminated liner(s) in the corer barrel.</td>
</tr>
<tr>
<td>2.</td>
<td>At the specified sampling location, force or drive the corer to the specified depth.</td>
</tr>
<tr>
<td>3.</td>
<td>Twist and withdraw the corer in a smooth motion.</td>
</tr>
<tr>
<td>4.</td>
<td>Retrieve the sampling device, remove the corer nosepiece (if possible) and remove the liner(s), cap the liner(s), and seal the caps with Teflon tape.</td>
</tr>
<tr>
<td>5.</td>
<td>Wipe the outside of the liner clean with a Kimwipe or clean paper towel. Label the top and bottom ends of the liner(s). Affix a completed sample label.</td>
</tr>
<tr>
<td>6.</td>
<td>Place capped and sealed liners in individual zip-top plastic bags and seal the bags.</td>
</tr>
<tr>
<td>7.</td>
<td>Immediately pack all samples into a chilled cooler.</td>
</tr>
</tbody>
</table>

#### 5.3.3 Method for Collecting Samples for Non-volatile, Semi-Volatile Organic and Inorganic Compound Analysis Using a Corer (also applies to augers)

The following steps must be followed when collecting subsurface sediment/sludge samples that underlie shallow water for analytes not degraded by aeration:

<p>| | |</p>
<table>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>At the specified sampling location, force or drive the corer to the specified depth.</td>
</tr>
<tr>
<td>2.</td>
<td>Twist and withdraw the corer in a smooth motion.</td>
</tr>
<tr>
<td>3.</td>
<td>Retrieve the sampling device. Remove the corer nosepiece (if possible) and extrude the sample into a stainless steel or Teflon-lined pan or bowl. Collect sufficient sample volume to fill all containers.</td>
</tr>
<tr>
<td>4.</td>
<td>Use a stainless steel or Teflon spoon or spatula to homogenize and then divide the sample material into the appropriate number of sample containers.</td>
</tr>
</tbody>
</table>
5. Fill each container to approximately 75 to 90 percent capacity, filling containers for organics analyses first. Close the container with a Teflon-lined cap. Wipe the outside of sample containers clean with a Kimwipe or clean paper towel. Affix a completed sample label.

6. Place the sample container(s) in individual zip-top plastic bags and seal the bags.

7. Immediately pack all samples into a chilled cooler.

5.4 Sediment or Sludge Sample Collection Using a Dredge (Grab) Sampler from Deeper Waters

5.4.1 Method for Collecting Samples for Volatile Organic Compound Analysis

The following steps must be followed when collecting deep-water sediment/sludge VOC samples:

1. Attach a clean piece of ½- to ¾-inch (12- to 19-mm) braided nylon line or Teflon-coated wire rope to the top of the dredge sampler. The line must be of sufficient length to reach the sediment or sludge and have enough slack to release the mechanism. Mark the distance to the bottom on the line.

2. Attach the free end of the sampling line to a fixed support to prevent loss of the sampler.

3. At the specified sampling location, open the sampler jaws and slowly lower the sampler until contact with the bottom (sediment/sludge) is felt.

4. Release tension on the line; allow sufficient slack for the mechanism (latch) to release. Slowly raise the sampler to reduce disturbance of the sampler to the extent possible.

5. Once the sampler is above the water surface, place the sampler in a stainless steel or Teflon-lined tray or pan. Open the sampler. Immediately collect the sample for VOC analysis, using a stainless steel or Teflon spoon or spatula. Fill each container completely to minimize headspace.

6. Once each container is filled, close the container with the Teflon-lined cap. Wipe the outside of sample containers clean with a Kimwipe or clean paper towel. Affix a completed sample label.

7. Place the sample container(s) in individual zip-top plastic bags and seal the bags.

8. Immediately pack all samples into a chilled cooler.

5.4.2 Method for Collecting Samples for Non-volatile, Semi-volatile Organic and Inorganic Compounds

The following steps must be followed when collecting deep-water sediment/sludge samples for analytes not degraded by aeration:

1. Attach a clean piece of ½- to ¾-inch (12- to 19-mm) braided nylon line or Teflon-coated wire rope to the top of the sampler. The line must be of sufficient length to reach sediment or sludge and have enough slack to release the mechanism. Mark the distance to the bottom on the line.

2. Attach the free end of the sampling line to a fixed support to prevent loss of the sampler.

3. At the specified sampling location, open the sampler jaws and slowly lower the sampler until contact with the bottom (sediments/sludge) is felt.

4. Release tension on the line; allow sufficient slack for the mechanism (latch) to release. Slowly raise the sampler to reduce disturbance of the sampler to the extent possible.
Sediment and/or Sludge Sampling

5. Once the sampler is above the water surface, place the sampler in a stainless steel or Teflon-lined tray or pan. Open the sampler.

6. Collect sufficient volume of sample to fill the specified sampler containers, and place the material into a clean stainless steel bowl or other container to homogenize the sample. If compositing is required, pool the grab samples in a tray or other container, and homogenize the pooled samples by mixing them together with a stainless steel or Teflon spoon or spatula.

7. Fill the specified sample containers to approximately 75 to 90 percent capacity with the homogenized sample using the stainless steel or Teflon spoon or spatula. Fill sample containers for organics analyses first.

8. Once each container is filled, close the container with the Teflon-lined cap. Wipe the outside of sample containers clean with a Kimwipe or clean paper towel. Affix a completed sample label.

9. Place sample container(s) in individual zip-top plastic bags and seal the bags.

10. Immediately pack all samples into a chilled cooler.

6.0 Restrictions/Limitations

Core sampling devices may not be usable if cobbles exist in the sediment/sludge. Bumping of core sampling devices and Ponar dredge samplers may result in the loss of some of the sample.

Grab sampling for VOC analysis or for analysis of any other compound(s) that may be degraded by aeration is necessary to minimize sample disturbance and, hence, analyte loss. The representativeness of this sample, however, is difficult to determine because the collected sample represents a single point, is not homogenized, and has been disturbed.

7.0 References


U.S. Environmental Protection Agency, Region IV. Science and Ecosystem Support Division, Operating Procedure SESDPROC-300-R3. August 2014 or current revision.

1.0 Objective
The objective of this technical standard operating procedure (SOP) is to outline the requirements for the packaging and shipment of environmental samples. Additionally, Sections 2.0 through 7.0 outline requirements for the packaging and shipping of regulated environmental samples under the Department of Transportation (DOT) Hazardous Materials Regulations, the International Air Transportation Association (IATA), and International Civil Aviation Organization (ICAO) Dangerous Goods Regulations for shipment by air and applies only to domestic shipments. This SOP does not cover the requirements for packaging and shipment of equipment (including data loggers and self-contained breathing apparatus [SCBAs] or bulk chemicals that are regulated under the DOT, IATA, and ICAO).

1.1 Packaging and Shipping of All Samples
This SOP applies to the packaging and shipping of all environmental samples. If the sample is preserved or radioactive, the following sections may also be applicable.

Section 2.0 - Packaging and Shipping Samples Preserved with Methanol
Section 3.0 - Packaging and Shipping Samples Preserved with Sodium Hydroxide
Section 4.0 - Packaging and Shipping Samples Preserved with Hydrochloric Acid
Section 5.0 - Packaging and Shipping Samples Preserved with Nitric Acid
Section 6.0 - Packaging and Shipping Samples Preserved with Sulfuric Acid
Section 7.0 - Packaging and Shipping Limited-Quantity Radioactive Samples

NOTE: This SOP does not address shipment of hazardous materials. Don’t ship a hazardous material unless you have received training that meets the requirements of CDM Smith and the DOT. Check with CDM Smith University for training courses.

1.2 Background
1.2.1 Definitions
Environmental Sample - An aliquot of air, water, plant material, sediment, or soil that represents the contaminant levels on a site. Samples of potential contaminant sources, like tanks, lagoons, or non-aqueous phase liquids are normally not “environmental” for this purpose. This procedure applies only to environmental samples that contain less than reportable quantities for any foreseeable hazardous constituents according to DOT regulations promulgated in 49 CFR - Part 172.101 Appendix A.

 Custody Seal - A custody seal is a narrow adhesive-backed seal that is applied to individual sample containers and/or the container (i.e., cooler) before offsite shipment. Custody seals are used to demonstrate that sample integrity has not been compromised during transportation from the field to the analytical laboratory.

 Inside Container - The container, normally made of glass or plastic, that actually contacts the shipped material. Its purpose is to keep the sample from mixing with the ambient environment.

 Outside Container - The container, normally made of metal or plastic, that the transporter contacts. Its purpose is to protect the inside container.

 Secondary Containment - The outside container provides secondary containment if the inside container breaks (i.e., plastic overpackaging if liquid sample is collected in glass).

 Excepted Quantity - Excepted quantities are limits to the mass or volume of a hazardous material in the inside and outside containers below which DOT, IATA, ICAO regulations do not apply. The excepted quantity limits are very low. Most regulated shipments will be made under limited quantity.
Limited Quantity - Limited quantity is the maximum amount of a hazardous material below which there are specific labeling or packaging exceptions.

Performance Testing - Performance testing is the required testing of outer packaging. These tests include drop and stacking tests.

Qualified Shipper - A qualified shipper is a person who has been adequately trained to perform the functions of shipping hazardous materials.

1.2.2 Associated Procedures
- SOP 1-2, Sample Custody

1.2.3 Discussion
Proper packaging and shipping is necessary to ensure the protection of the integrity of environmental samples shipped for analysis. These shipments are potentially subject to regulations published by DOT, IATA, or ICAO. Failure to abide by these rules places both CDM Smith and the individual employee at risk of serious fines. The analytical holding times for the samples must not be exceeded. The samples shall be packed in time to be shipped for overnight delivery. Make arrangements with the laboratory before sending samples for weekend delivery.

1.3 Required Equipment
- Coolers with return address of the appropriate CDM Smith office
- Heavy-duty plastic garbage bags
- Plastic zip-type bags, small and large
- Clear tape
- Nylon reinforced strapping tape
- Duct tape
- Kitty litter/pine bedding (or an equivalent nonflammable material that is inert and absorbent)*
- Bubble wrap (optional)
- Ice
- Custody seals
- Completed chain-of-custody record or contract laboratory program (CLP) custody records, if applicable
- Completed bill of lading
- This End Up and directional arrow labels

*Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

1.4 Packaging Environmental Samples
The following steps must be followed when packing sample bottles and jars for shipment:

1. Verify the samples undergoing shipment meet the definition of “environmental sample” and are not a hazardous material as defined by DOT. Professional judgment and/or consultation with qualified persons such as the appropriate health and safety coordinator or the health and safety manager shall be observed.

2. Select a sturdy cooler in good repair. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Ensure the handles used for carrying the cooler are in good repair. Also, tape the drain plug from the outside of the cooler. Line the cooler with a large heavy-duty plastic garbage bag.

3. Be sure the caps on all bottles are tight (will not leak); check to see that labels and chain-of-custody records are completed properly (SOP 1-2, Sample Custody).

4. Place all bottles in separate and appropriately sized plastic zip-top bags and close the bags. Up to three volatile organic analyte (VOA) vials may be packed in one bag. Binding the vials together with a rubber band on the outside of the bag, or separating them so that they do not contact each other, will reduce the risk of breakage. VOA vials may be packaged in foam containers designed for packaging them as well. Bottles may be wrapped in bubble wrap. Optionally, place three to six VOA vials in a quart metal can and then fill the can with kitty litter/pine bedding or equivalent. **Note:** Trip blanks must be included in coolers containing VOA samples.
5. Place 2 to 4 inches of an absorbent material into a cooler that has been lined with a garbage bag, and then place the bottles and cans in the bag with sufficient space to allow for the addition of packing material between the bottles and cans. It is preferable to place glass sample bottles and jars into the cooler vertically. Glass containers are less likely to break when packed vertically rather than horizontally.

6. While placing sample containers into the cooler, conduct an inventory of the contents of the shipping cooler against the chain-of-custody record. The chain-of-custody with the cooler shall reflect only those samples within the cooler.

7. Put ice in large plastic zip-top bags (double bagging the zip-tops is preferred) and properly seal. Place the ice bags on top of and/or between the samples. Several bags of ice are required (dependant on outdoor temperature, staging time, etc.) to maintain the cooler temperature at approximately 4° Celsius (C) if the analytical method requires cooling. Fill all remaining space between the bottles or cans with packing material. Securely fasten the top of the large garbage bag with fiber or duct tape.

8. Place the completed chain-of-custody record or the CLP traffic report form (if applicable) for the laboratory into a plastic zip-top bag, seal the bag, tape the bag to the inner side of the cooler lid and close the cooler.

9. The cooler lid shall be secured with nylon reinforced strapping tape by wrapping each end of the cooler a minimum of two times. Attach a completed chain-of-custody seal across the opening of the cooler on opposite sides. The custody seals shall be affixed to the cooler with half of the seal on the strapping tape so that the cooler cannot be opened without breaking the seal. Complete two more wraps around with fiber tape and place clear tape over the custody seals.

10. The shipping container lid must be marked “THIS END UP” and arrow labels that indicate the proper upward position of the container shall be affixed to the cooler. A label containing the name and address of the shipper (CDM Smith) shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted on the outside of containers used to transport environmental samples and shall not be used. The name and address of the laboratory shall be placed on the container, or when shipping by common courier, the bill of lading shall be completed and attached to the lid of the shipping container.

2.0 Packaging and Shipping Samples Preserved with Methanol

2.1 Containers
1. The maximum volume of methanol in a sample container is limited to 30 milliliters (ml).

2. The sample container must not be full of methanol.

2.2 Responsibility
It is the responsibility of the qualified shipper to:

1. Ensure that the samples undergoing shipment contain no other contaminant that meets the definition of “hazardous material” as defined by DOT.

2. Determine the amount of preservative in each sample so that accurate determination of quantities can be made.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

2.3 Additional Required Equipment
The following equipment is needed in addition to the required equipment listed in Section 1.3:

1. Inner packing may consist of glass or plastic jars
### Packaging and Shipping Environmental Samples

| 2. | Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test |
| 3. | Survey documentation (if shipping from Department of Energy [DOE] or radiological sites) |
| 4. | Class 3 flammable liquid labels |
| 5. | Orientation labels |
| 6. | Consignor/consignee labels |

#### 2.4 Packaging Samples Preserved with Methanol

The following steps are to be followed when packaging limited-quantity sample shipments:

1. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.

2. All sample containers will be properly labeled and the label protected with waterproof tape before sampling.

   At a minimum the label must contain:
   - Project name
   - Project number
   - Date and time of sample collection
   - Sample location
   - Sample identification number
   - Collector’s initials
   - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)

3. Wrap each container (40-ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.

4. Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.

5. Place wrapped containers inside a polyethylene bottle filled with an absorbent; seal the bottle. (Maximum of 4 VOA vials will fit inside a 500-ml wide-mouth polyethylene bottle.)

6. Total volume of methanol per shipping container must not exceed 500 ml.

7. Place sufficient amount of an absorbent in the bottom of the cooler to absorb any leakage that may occur.

8. Place a garbage bag in the cooler.

9. Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.

10. Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.

11. Seal the garbage bag by tieing or taping.

12. The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.

13. Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.

14. If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
15. Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.

16. Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.

17. Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

   Methanol Mixture
   UN1230
   LTD. QTY.

18. Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.

19. Affix a Flammable Liquid label to the outside of the cooler.

20. Affix package orientation labels on two opposite sides of the cooler.

21. Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment. An example of cooler labeling/mark ing locations is shown in Figure 1.

   Note: No marking or labeling can be obscured by strapping or duct tape.

   Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

22. When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 millirem/hour (mrem/h) on all sides. This survey will be documented and the results reviewed by the qualified shipper.


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Figure 1
Example of Cooler Label/Marking Locations

![Diagram of cooler labeling locations](image-url)
3.0 Packaging and Shipping Samples Preserved with Sodium Hydroxide

3.1 Containers
The inner packaging container (and amount of preservative) that may be used for these shipments includes:

<table>
<thead>
<tr>
<th>Preservative</th>
<th>Desired in Final Sample pH</th>
<th>Concentration</th>
<th>Quantity of Preservative (ml) for Specified Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaOH</td>
<td>30%</td>
<td>&gt;12, 0.08%</td>
<td>0.25, 0.5, 1, 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5 drops = 1 ml

3.2 Responsibility
It is the responsibility of the qualified shipper to determine the amount of preservative in each sample so that accurate determination of quantities can be made.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific QAPP.

3.3 Additional Required Equipment
The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test
- Inner packings may consist of glass or plastic jars no larger than 1 pint
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

3.4 Packaging Samples Preserved with Sodium Hydroxide
Samples containing sodium hydroxide (NaOH) as a preservative that exceed the excepted concentration of 0.08 percent (2 ml of a 30 percent NaOH solution per liter) may be shipped as a limited quantity per packing instruction Y819 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity samples shipments:

1. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
2. All sample containers will be properly labeled and the label protected with waterproof tape before sampling.

At a minimum the label must contain:

- Project name
- Project number
- Date and time of sample collection
- Sample location
- Sample identification number
- Collector’s initials
- Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)

3. This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
Packaging and Shipping Environmental Samples

4. Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.

5. Place glass containers inside a polyethylene bottle filled with an absorbent; seal the bottle.

6. The total volume of sample in each cooler must not exceed 1 liter.

7. Place sufficient amount of an absorbent in the bottom of the cooler to absorb any leakage that may occur.

8. Place a garbage bag in the cooler.

9. Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.

10. Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.

11. Seal the garbage bag by tieing or taping.

12. The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.

13. Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.

14. If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.

15. Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.

16. Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.

17. Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

   Sodium Hydroxide Solution  
   UN1824  
   LTD. QTY.

18. Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.

19. Affix a Corrosive label to the outside of the cooler.

20. Affix package orientation labels on two opposite sides of the cooler.

21. Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment. An example of cooler labeling/marking locations is shown in Figure 1.

   Note: Samples meeting the exception concentration of 0.08 percent NaOH by weight may be shipped as nonregulated or nonhazardous following the procedure in Section 1.4.

   Note: No marking or labeling can be obscured by strapping or duct tape.

   Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.
22. When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.


24. Complete a Dangerous Goods Air Bill.

4.0 Packaging and Shipping Samples Preserved with Hydrochloric Acid

4.1 Containers
The inner packaging container (and amount of preservative) that may be used for these shipments includes:

<table>
<thead>
<tr>
<th>Preservative</th>
<th>Desired in Final Sample</th>
<th>Quantity of Preservative (ml) for Specified Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCl</td>
<td>pH 2N</td>
<td>40 ml 125 ml 250 ml</td>
</tr>
</tbody>
</table>

5 drops = 1 ml

4.2 Responsibility
It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT.
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific QAPP.

4.3 Additional Required Equipment
The following equipment is needed in addition to the required equipment listed in Section 1.3.

- Inner packing may consist of glass or plastic jars no larger than 1 pint.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

4.4 Packaging Samples Preserved with Hydrochloric Acid
The following steps are to be followed when packaging limited-quantity sample shipments:

1. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
2. All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
Packaging and Shipping Environmental Samples

At a minimum the label must contain:

- Project name
- Project number
- Date and time of sample collection
- Sample location
- Sample identification number
- Collector’s initials
- Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)

- Wrap each container (40-ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.

- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.

- Place wrapped containers inside a polyethylene bottle filled with an absorbent; seal the bottle. (No more than 4 VOA vials will fit inside a 500-ml wide-mouth polyethylene bottle.)

- Total volume of sample inside each cooler must not exceed 1 liter.

- Place sufficient amount of an absorbent in the bottom of the cooler to absorb any leakage that may occur.

3. Place a garbage bag in the cooler.

4. Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.

5. Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.

6. Seal the garbage bag by tying or taping.

7. The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.

8. Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.

9. If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.

10. Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.

11. Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.

12. Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

    Hydrochloric Acid Solution
    UN1789
    LTD. QTY.

13. Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.

14. Affix a Corrosive label to the outside of the cooler.

15. Affix package orientation labels on two opposite sides of the cooler.
16. Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment. An example of cooler labeling/marking locations is shown in Figure 1.

**Note:** Samples containing less than the exception concentration of 0.04 percent HCl by weight will be shipped as nonregulated or nonhazardous following the procedure in Section 1.4.

**Note:** No marking or labeling can be obscured by strapping or duct tape.

**Note:** The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

17. When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.


### 5.0 Packaging and Shipping Samples Preserved with Nitric Acid

#### 5.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

<table>
<thead>
<tr>
<th>Preservative</th>
<th>Desired in Final Sample</th>
<th>Quantity of Preservative (ml) for Specified Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>HNO₃</td>
<td>pH Conc. 40 ml 125 ml 250 ml 500 ml 1 L</td>
<td></td>
</tr>
<tr>
<td>HNO₃ 6N</td>
<td>&lt;1.62 0.15% 2 4 5 8</td>
<td></td>
</tr>
</tbody>
</table>

5 drops = 1 mg/L

#### 5.2 Responsibility

It is the responsibility of the qualified shipper to:

1. Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT.

2. Determine the amount of preservative in each sample so that accurate determination of quantities can be made.

**Note:** Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific QAPP.

#### 5.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Inner packings may consist of glass or plastic jars no larger than 100 ml.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels
### 5.4 Packaging Samples Preserved with Nitric Acid

Samples containing nitric acid (HNO₃) as a preservative that exceed the excepted concentration of 0.15 percent HNO₃ will be shipped as a limited quantity per packing instruction Y807 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity sample shipments:

1. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.

2. All sample containers will be properly labeled and the label protected with waterproof tape before sampling.

   At a minimum the label must contain:
   - Project name
   - Project number
   - Date and time of sample collection
   - Sample location
   - Sample identification number
   - Collector’s initials
   - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)

3. This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.

4. Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.

5. Place glass containers inside a polyethylene bottle filled with an absorbent; seal the bottle.

6. Place sufficient amount of an absorbent in the bottom of the cooler to absorb any leakage that may occur.

7. Place a garbage bag in the cooler.

8. Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.

9. Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.

10. Seal the garbage bag by tying or taping.

11. The maximum volume of preserved solution in the cooler must not exceed 500 ml.

12. The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.

13. Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.

14. If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.

15. Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.

16. Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.

17. Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

   **Nitric Acid Solution (with less than 20 percent)**
   - UN2031
   - Ltd. Qty.
18. Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.

19. Affix a Corrosive label to the outside of the cooler.

20. Affix package orientation labels on two opposite sides of the cooler.

21. Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment. An example of cooler labeling/marking locations is shown in Figure 1.

   **Note:** Samples meeting the exception concentration of 0.15 percent HNO3 by weight will be shipped as nonregulated or nonhazardous following the procedure in Section 1.4.

   **Note:** No marking or labeling can be obscured by strapping or duct tape.

   **Note:** The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

22. When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.


### 6.0 Packaging and Shipping Samples Preserved with Sulfuric Acid

#### 6.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

<table>
<thead>
<tr>
<th>Preservative</th>
<th>Desired in Final Sample</th>
<th>Quantity of Preservative (ml) for Specified Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₂SO₄</td>
<td>pH Conc. 40 ml 125 ml 250 ml 500 ml 1 L</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;1.15 0.35% .1 .25 0.5 1 2</td>
<td></td>
</tr>
</tbody>
</table>

5 drops = 1 ml

#### 6.2 Responsibility

It is the responsibility of the qualified shipper to:

1. Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT.

2. Determine the amount of preservative in each sample so that accurate determination of quantities can be made.

   **Note:** Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific QAPP.
6.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Inner packings may consist of glass or plastic jars no larger than 100 ml.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

6.4 Packaging of Samples Preserved with Sulfuric Acid

Samples containing sulfuric acid (H₂SO₄) as a preservative that exceed the excepted concentration of 0.35 percent will be shipped as a limited quantity per packing instruction Y809 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity samples shipments:

1. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.

2. All sample containers will be properly labeled and the label protected with waterproof tape before sampling.

   At a minimum the label must contain:

   - Project name
   - Project number
   - Date and time of sample collection
   - Sample location
   - Sample identification number
   - Collector’s initials
   - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)

3. Wrap each glass container in bubble wrap (secure with waterproof tape) to prevent breakage.

4. Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.

5. Place glass containers inside a polyethylene bottle filled with an absorbent; seal the bottle.

6. Place sufficient amount of an absorbent in the bottom of the cooler to absorb any leakage that may occur.

7. Place a garbage bag in the cooler.

8. Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.

9. Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.

10. Seal the garbage bag by tieing or taping.

11. The maximum volume of preserved solution in the cooler must not exceed 500 ml.

12. The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.

13. Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
14. If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.

15. Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.

16. Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.

17. Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

   **Sulfuric Acid Solution**  
   UN2796  
   LTD. QTY.

18. Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.

19. Affix a Corrosive label to the outside of the cooler.

20. Affix package orientation labels on two opposite sides of the cooler.

21. Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment. An example of cooler labeling/marking locations is shown in Figure 1.

   **Note:** Samples containing less than the exception concentration of 0.35 percent H₂SO₄ by weight will be shipped as nonregulated or nonhazardous in accordance with the procedure described in Section 1.4.

   **Note:** No marking or labeling can be obscured by strapping or duct tape.

   **Note:** The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

22. When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.


### 7.0 Packaging and Shipping Limited-Quantity Radioactive Samples

#### 7.1 Containers

The inner packaging containers that may be used for these shipments include:

1. Any size sample container
Packaging and Shipping Environmental Samples

7.2 Description/Responsibilities

The qualified shipper will determine that the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT.

The qualified shipper will ship all samples that meet the Class 7 definition of radioactive materials and meet the activity requirements specified in Table 4 and 7 of 49 CFR 173.425, as Radioactive Materials in Limited Quantity. The qualified shipper will verify that all packages and their contents meet the requirements of 49 CFR 173.421, Limited Quantities of Radioactive Materials.

The packaging used for shipping will meet the general requirements for packaging and packages specified in 49 CFR 173.24 and the general design requirements provided in 173.410. These standards state that a package must be capable of withstanding the effects of any acceleration, vibration, or vibration resonance that may arise under normal condition of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use.

If the shipment is from a DOE facility, radiological screenings will be completed on all samples taken. The qualified shipper will review the results of each screening (alpha, beta, and gamma speciation). Samples will not be shipped offsite until the radiological screening has been performed.

The total activity for each package will not exceed the relevant limits listed in Table 4 and 7 of 49 CFR 173.425. The A2 value of the material will be calculated based on all radionuclides found during previous investigations (if any) in the area from which the samples are derived. The A2 values to be used will be the most restrictive of all potential radionuclides as listed in 49 CFR 173.435.

The radiation level at any point on the external surface of the package bearing the sample(s) will not exceed 0.005 millisievert per hour (mSv/h) (0.5 mrem/hour). These will be verified by dose and activity monitoring before shipment of the package.

The removable radioactive surface contamination on the external surface of the package will not exceed the limits specified in 49 CFR 173.443(a). CDM Smith will apply the DOE-established free release criteria for removable surface contamination of less than 20 dpm/100 cm² (alpha) and 1,000 dpm/100 cm² (beta/gamma). It shall be noted that these values are more conservative than the DOT requirements for removable surface contamination.

The qualified shipper will verify that the outside of the inner packaging is marked “Radioactive.”

The qualified shipper will verify that the excepted packages prepared for shipment under the provisions of 49 CFR 173.421 have a notice enclosed, or shown on the outside of the package, that reads, “This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910.”

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific QAPP.

7.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Survey documentation/radiation screening results (if shipping from DOE or radiological sites)
- Orientation labels
- Excepted quantities label
- Consignor/consignee labels
7.4 Packaging of Limited-Quantity Radioactive Samples
The following steps are to be followed when packaging limited-quantity sample shipments:

1. The cooler is to be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.

2. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.

3. All sample containers will be properly labeled and the label protected with waterproof tape before sampling. At a minimum the label must contain:
   - Project name
   - Project number
   - Date and time of sample collection
   - Sample location
   - Sample identification number
   - Collector’s initials

4. This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.

5. Place sufficient amount of an absorbent, or approved packaging material, in the bottom of the cooler to absorb any leakage that may occur.

6. Place a garbage bag in the cooler.

7. Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.

8. If required, place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.

9. Seal the garbage bag by tying or taping.

10. Place a label marked Radioactive on the outside of the sealed bag.

11. Enclose a notice that includes the name of the consignor or consignee and the following statement: “This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910.”

12. Note that both DOT and IATA apply different limits to the quantity in the inside packing and in the outside packing.

13. The maximum weight of the package shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.

14. Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.

15. If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.

16. If a cooler is used, wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.

17. Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
18. Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.

19. Affix package orientation labels on two opposite sides of the cooler/package.

20. Affix a completed Excepted Quantities label to the side of the cooler/package.

21. Secure any marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment. An example of the cooler labeling/marking is shown in Figure 2.

   Note: No marking or labeling can be obscured by strapping or duct tape.


   Note: Except as provided in 49 CFR 173.426, the package will not contain more than 15 grams of $^{235}$U.

   Note: A declaration of dangerous goods is not required.

---

**Figure 2**

Radioactive Material – Limited-Quantity Cooler Marking Example

- **Address Label**
- **Strapping Tape**
- **Limited Quantity Notice**
- **Exempted Quantities Label**
- **Orientation Labels**
- **Taped Drain**

This package conforms to the conditions and limitations specified in 49 CFR 173.421 for Radioactive Material, excepted package - limited quantity of material, UN2910.
8.0 References

U. S. Environmental Protection Agency. Region IV. May 2013, or current revision. *Field Branches Quality Management Plan.*

________. August 2011 or current revision. Region IV. *Field Branches Quality Policy.*


Appendix A

Dangerous Goods and Hazardous Materials Inspection Checklist
for Shipping Limited-Quantity

Sample Packaging

Yes No N/A

☐ ☐ ☐ The VOA vials are wrapped in bubble wrap and placed inside a zip-type bag.
☐ ☐ ☐ The VOA vials are placed into a polyethylene bottle, filled with an absorbent, and tightly sealed.
☐ ☐ ☐ The samples plug is taped inside and outside to ensure control of interior contents.
☐ ☐ ☐ The samples have been placed inside garbage bags with sufficient bags of ice to preserve samples at 4°C.
☐ ☐ ☐ The cooler weighs less than the 66-pound limit for limited-quantity shipment.
☐ ☐ ☐ The garbage bag has been sealed with tape (or tied) to prevent movement during shipment.
☐ ☐ ☐ The chain-of-custody has been secured to the interior of the cooler lid.
☐ ☐ ☐ The cooler lid and sides have been taped to ensure a seal.
☐ ☐ ☐ The custody seals have been placed on both the front and back hinges of the cooler, using waterproof tape.

Air Waybill Completion

Yes No N/A

☐ ☐ ☐ Section 1 has the shipper’s name, company, and address; the account number, date, internal billing reference number; and the telephone number where the shipper can be reached.
☐ ☐ ☐ Section 2 has the recipient’s name and company along with a telephone number where they can be reached.
☐ ☐ ☐ Section 3 has the Bill Sender box checked.
☐ ☐ ☐ Section 4 has the Standard Overnight box checked.
☐ ☐ ☐ Section 5 has the Deliver Weekday box checked.
☐ ☐ ☐ Section 6 has the number of packages and their weights filled out. Was the total of all packages and their weights figured up and added at the bottom of Section 6?
☐ ☐ ☐ Under the Transport Details box, the Cargo Aircraft Only box is obliterated, leaving only the Passenger and Cargo Aircraft box.
☐ ☐ ☐ Under the Shipment Type, the Radioactive box is obliterated, leaving only the Non-Radioactive box.
☐ ☐ ☐ Under the Nature and Quantity of Dangerous Goods box, the Proper Shipping Name, Class or Division, UN or ID No., Packing Group, Subsidiary Risk, Quantity and Type of Packing, Packing Instructions, and Authorization have been filled out for the type of chemical being sent.
☐ ☐ ☐ The Name, Place and Date, Signature, and Emergency Telephone Number appears at the bottom of the FedEx Airbill.
☐ ☐ ☐ The statement “In accordance with IATA/ICAO” appears in the Additional Handling Information box.
☐ ☐ ☐ The Emergency Contact Information at the bottom of the FedEx Airbill is truly someone who can respond any time of the day or night.
## Packaging and Shipping Environmental Samples

**SOP 2-1**  
Revision: 6  
Date: February 2015

<table>
<thead>
<tr>
<th>Proper Shipping Name</th>
<th>Class or Division</th>
<th>UN or ID No.</th>
<th>Packing Group</th>
<th>Sub Risk</th>
<th>Quantity</th>
<th>Packing Instruction</th>
<th>Authorization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrochloric Acid Solution</td>
<td>8</td>
<td>UN1789</td>
<td>II</td>
<td></td>
<td>1 plastic box × 0.5 L</td>
<td>Y809</td>
<td>Ltd. Qty.</td>
</tr>
<tr>
<td>Nitric Acid Solution (with less than 20%)</td>
<td>8</td>
<td>UN2031</td>
<td>II</td>
<td></td>
<td>1 plastic box × 0.5 L</td>
<td>Y807</td>
<td>Ltd. Qty.</td>
</tr>
<tr>
<td>Sodium Hydroxide Solution</td>
<td>8</td>
<td>UN1824</td>
<td>II</td>
<td></td>
<td>1 plastic box × 0.5 L</td>
<td>Y809</td>
<td>Ltd. Qty.</td>
</tr>
<tr>
<td>Sulfuric Acid Solution</td>
<td>8</td>
<td>UN2796</td>
<td>II</td>
<td></td>
<td>1 plastic box × 0.5 L</td>
<td>Y809</td>
<td>Ltd. Qty.</td>
</tr>
<tr>
<td>Methanol</td>
<td>3</td>
<td>UN1230</td>
<td>II</td>
<td></td>
<td>1 plastic box × 1 L</td>
<td>Y305</td>
<td>Ltd. Qty.</td>
</tr>
</tbody>
</table>

### Sample Cooler Labeling

- **Yes**  
- **No**  
- **N/A**

- The proper shipping name, UN number, and Ltd. Qty. appears on the shipping container.
- The corresponding hazard labels are affixed on the shipping container; the labels are not obscured by tape.
- The name and address of the shipper and receiver appear on the top and side of the shipping container.
- The air waybill is attached to the top of the shipping container.
- **Up Arrows** have been attached to opposite sides of the shipping container.
- Packaging tape does not obscure markings or labeling.
Appendix B

Shipment Quality Assurance Checklist

Date: ______________ Shipper: _____________________________ Destination: _____________________________

Item(s) Description: ____________________________________________________________

Radionuclide(s): ________________________________________________________________

Radiological Survey Results: surface ______________________ mrem/hr 1 meter ______________

Instrument Used: Mfr: ___________________________ Model: ____________________________

S/N: ___________________________ Cal Date: _____________________________

Limited-Quantity or Instrument and Article

Yes  No

1. Strong tight package (package that will not leak material during conditions normally incidental to transportation).

2. Radiation levels at any point on the external surface of package less than or equal to 0.5 mrem/hr.

3. Removable surface contamination less than 20 dpm/100 cm² (alpha) and 1,000 dpm/100 cm² (beta/gamma).

4. Outside inner package bears the marking “Radioactive.”

5. Package contains less than 15 grams of ²³⁵U (check yes if ²³⁵U not present).

6. Notice enclosed in or on the package that includes the consignor or consignee and the statement, “This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910.”

7. Activity less than that specified in 49 CFR 173.425. Permissible package limit: Package Quantity:

8. On all air shipments, the statement Radioactive Material, excepted package-limited quantity of material shall be noted on the air waybill.

Qualified Shipper: ___________________________ Signature: ___________________________
1.0 Objective
This technical standard operating procedure (SOP) presents guidance for the management of investigation-derived waste (IDW). The primary objectives for managing IDW during field activities include:

- Leaving the site in no worse condition than existed before field activities
- Removing wastes that pose an immediate threat to human health or the environment
- Proper handling of onsite wastes that do not require offsite disposal or extended aboveground containerization
- Complying with federal, state, local, and facility applicable or relevant and appropriate requirements (ARARs)
- Careful planning and coordination of IDW management options
- Minimizing the quantity of IDW

2.0 Background
2.1 Definitions
Hazardous Waste - Discarded material that is regulated listed waste, or waste that exhibits ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261.3 or state regulations.

Investigation-Derived Wastes - Discarded materials resulting from field activities such as sampling, surveying, drilling, excavation, and decontamination processes that, in present form, possess no inherent value or additional usefulness without treatment. Wastes may be solid, sludge, liquid, gaseous, or multiphase materials that may be classified as hazardous or nonhazardous.

Mixed Waste - Any material that has been classified as both hazardous and radioactive.

Radioactive Wastes - Discarded materials that are contaminated with radioactive constituents with specific activities in concentrations greater than the latest regulatory criteria (i.e., 10 CFR 20).

Treatment, Storage, and Disposal Facility (TSDF) - Permitted facilities that accept hazardous waste shipments for further treatment, storage, and/or disposal. These facilities must be permitted by the U. S. Environmental Protection Agency (EPA) and appropriate state and local agencies.

Aqueous liquid – a water based polar solution with a specific gravity at or near 1. Light non-aqueous phase liquids, also known as (a.k.a) LNAPL (non-polar), such as oils, typically float on aqueous (polar) solutions (or pure water). Dense non-aqueous phase liquids (a.k.a. DNAPL), such as chlorinated organic solvents or PCB containing oils, sink in aqueous based liquids.

2.2 Discussion
Field investigation activities result in the generation of waste materials that may be characterized as hazardous or radioactive. IDWs may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials from collection of samples; residues from testing of treatment technologies and pump and treat systems; personal protective equipment (PPE); solutions (aqueous or otherwise) used to decontaminate nondisposable protective clothing and equipment; and other wastes or supplies used in sampling and testing potentially hazardous or radiologically contaminated material.

Note: The client’s representatives may not be aware of all potential contaminants. The management of IDW must comply with applicable regulatory requirements.
3.0 General Responsibilities

**Site Manager** - The site manager is responsible for ensuring that all IDW procedures are conducted in accordance with this SOP. The site manager is also responsible for ensuring that handling of IDW is in accordance with site-specific requirements.

**Project Manager** - The project manager is responsible for identifying site-specific requirements for the disposal of IDW in accordance with federal, state, and/or facility requirements.

**Field Crew Members** - Field crew members are responsible for implementing this SOP and communicating any unusual or unplanned condition to the project manager’s attention.

*Note*: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/project specific quality assurance plan.

4.0 Required Equipment

Equipment required for IDW containment will vary according to site-specific/client requirements. Management decisions concerning the necessary equipment required shall consider: containment method, sampling, labeling, maneuvering, and storage (if applicable). Equipment must be onsite and inspected before commencing work.

The selection of the container type and size for containerizing IDW must consider:

- waste/contaminant segregation (i.e. do not mix hazardous and non-hazardous wastes or incompatible materials),
- efficiency/ability to move the containerized waste (i.e. size of equipment needed vs. accessibility and bulk vs. individual containers),
- cost of storage, (i.e. rental vs. purchase)
- transportation and disposal of the material in the containers selected.

4.1 IDW Containment Devices

The appropriate containment device (drums, tanks, etc.) will depend on site- or client-specific requirements and the ultimate disposition of the IDW. Typical IDW containment devices can include:

- Plastic sheeting (polyethylene) with a minimum thickness of 20 micrometers
- Department of Transportation (DOT)-approved steel containers
- Polyethylene or steel bulk storage tanks

Containment of IDW shall be segregated by waste type (i.e., solid or liquid, corrosive or flammable, etc.) and source location. Volume of the appropriate containment device will depend on site-specific requirements.

4.2 IDW Container Labeling

A “Waste Container” or “IDW Container” label or indelible marking shall be applied to each container. Labeling or marking requirements for onsite IDW not expected to be transported offsite are as detailed below.

- Labels and markings must contain the following information: project name, generation date, location of waste origin, container identification number, sample number (if applicable), and contents (drill cuttings, purge water, PPE, etc.).
- Each label or marking will be applied to the upper one-third of the container at least twice, on opposite sides.
- Containers that are 5 gallons or less may only require one label or set of markings.
- Labels or markings will be positioned on a smooth part of the container. The label must not be affixed across container bungs, seams, ridges, or dents.
- Labels must be constructed of a weather-resistant material with markings made with a permanent marker or paint pen and capable of enduring the expected weather conditions. If markings are used, the color must be easily distinguishable from the container color.
- Labels will be secured in a manner to ensure that they remain affixed to the container.
Labeling or marking requirements for IDW expected to be transported offsite must be in accordance with the requirements of 49 CFR 172.

4.3 IDW Container Movement
Staging areas for IDW containers shall be predetermined and in accordance with site-specific and/or client requirements. Arrangements shall be made before field mobilization as to the methods and personnel required to safely transport IDW containers to the staging area. Transportation of IDW containers offsite via a public roadway is prohibited unless 49 CFR 172 requirements are met.

4.4 IDW Container Storage
Containerized IDW awaiting results of pending chemical analysis or further onsite treatment shall be staged on site. Staging areas and bulk storage procedures are to be determined according to site-specific requirements. Containers are to be stored in such a fashion that the labels can be easily read. A secondary/spill container must be provided for liquid IDW storage and as appropriate for solid IDW storage (e.g., steel drums shall not be stored in direct contact with the ground).

5.0 Procedures
The three general options for managing IDW are: (1) collection and onsite disposal, (2) collection for offsite disposal, and (3) collection and interim management. Attachment 1 summarizes media-specific information on generation processes and management options. The option selected shall take into account the following factors:

- Type (soil, sludge, liquid, debris), quantity, and source of IDW
- Risk posed by managing the IDW onsite
- Compliance with regulatory requirements
- IDW minimization and consistency with the IDW remedy and the site remedy

In all cases the client shall approve the plans for IDW. Formal plans for the management of IDW must be prepared as part of a work plan or separate document.

5.1 Collection and Onsite Disposal
5.1.1 Soil/Sludge/Sediment
The options for handling soil/sludge/sediment IDW are:

1. Return IDW to boring, pit, or source immediately after generation as long as returning the media to these areas will not increase site risks (e.g., so that “clean” areas are not contaminated, the IDW material will not be replaced at a greater depth, or in a different area than from where it was originally obtained.

2. Spread IDW around boring, pit, or source within the area of contamination (AOC) as long as returning the media to these areas will not increase site risks (e.g., direct contact with surficial contamination).

3. Consolidate IDW in a pit within the AOC as long as returning the media to these areas will not increase site risks (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate “clean” areas).

4. Send to onsite TSDF. This option may require results of laboratory analysis before treatment/disposal.

Note: These options may require client and/or regulatory approval.

5.1.2 Aqueous Liquids
The options for handling aqueous liquid IDW are:
1. Discharge to surface water, only when IDW is not contaminated, and with written client approval.

2. Discharge to ground surface close to the well from which it was extracted, only if soil contaminants will not be mobilized in the process and the action will not contaminate clean areas. If IDW from the sampling of background upgradient wells is not a community concern or associated with soil contamination, this presumably uncontaminated IDW may be released on the ground around the well with written client approval.

3. Discharge to sanitary sewer, only when IDW is not contaminated and with written client approval.

4. Send to onsite treatment/disposal facility, with facility acceptance and written client approval.

**Note:** These options may require results of laboratory analysis to obtain client and/or regulatory approval.

5. When small amounts (i.e., less than 5 gallons) of used decontamination fluids are generated during site characterization activities (e.g., during soil sampling using direct push technology methods), the fluids may be allowed to evaporate by spreading them on an asphalted surface, or allowing for evaporation from an open bucket.

### 5.1.3 Disposable PPE
The options for handling disposable PPE are:

1. Double-bag contents in nontransparent trash bags and place in onsite industrial dumpster, only if PPE is not contaminated.

2. Containerize, label, and send to onsite TSDF. This may require results of laboratory analysis before treatment/disposal.

### 5.2 Collection for Offsite Disposal
Before sending IDW to an offsite TSDF or to a publicly owned treatment works (POTW), laboratory analysis may be required. Manifests are required to accompany any IDW determined to be hazardous. In some instances, a bill of lading can be used for nonhazardous solid IDW (i.e., wooden pallets, large quantities of plastic sheeting). Arrangements must be made with the client responsible for the site to sign as generator on any waste profile and all manifests or bill of ladings; it is CDM Smith’s policy not to sign any waste profile or manifest. The TSDF and transporter must be permitted for the respective wastes. Nonbulk containers (e.g., drums) must have a DOT-approved label adhered to the container and all required associated placard stickers before leaving for an offsite TSDF. These labels must include information as required in 49 CFR 172. Bulk containers (i.e., rolloffs, tanks) do not require container specific labels for transporting offsite, but must include appropriate placards as required in 49 CFR 172.

#### 5.2.1 Soil/Sludge/Sediment
When the final site remedy requires offsite treatment and disposal, the IDW may be stored (e.g., drummed, covered in a waste pile) or returned to its source until final disposal. The management option selected shall take into account the potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

#### 5.2.2 Aqueous Liquids
When the final site remedy requires offsite treatment and disposal, the IDW may be stored (e.g., mobile tanks or drums with appropriate secondary containment) until final disposal. The management option selected shall take into account the potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

#### 5.2.3 Disposable PPE
When the final site remedy requires offsite treatment and disposal, the IDW may be containerized and stored. The management option selected shall take into account potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).
5.3 Collection and Interim Management
All interim measures must be approved by the client and regulatory agencies.

1. Storing IDW onsite until the final action may be practical in the following situations:
   - Returning wastes (especially sludges and soils) to their onsite source area would require reexcavation for disposal as determined for the final site remedy.
   - Interim storage in containers may be necessary to provide adequate protection to human health and the environment.
   - Offsite disposal options may trigger land disposal regulations under the Resource Conservation and Recovery Act (RCRA). Storing IDW until the final disposal of all wastes from the site will eliminate the need to address this issue more than once.
   - Interim storage may be necessary to provide time for sampling and analysis.

2. Segregate and containerize all waste for future treatment and/or disposal.
   - Containment options for soil/sludge/sediment may include drums or covered waste piles in AOC.
   - Containment options for aqueous liquids may include mobile tanks or drums.
   - Containment options for PPE may include drums or roll-off boxes.

6.0 Restrictions/Limitations
Site managers shall determine the most appropriate disposal option for aqueous liquids on a site-specific basis. Parameters to consider, especially when determining the level of protection, include the volume of IDW, the contaminants present in the aqueous liquid, the nature of contaminants present in the site soil, and whether groundwater or surface water is a drinking water supply, and if obtained from contaminated groundwater, whether the plume is contained or migrating. Special disposal/handling may be needed for drilling fluids because they may contain significant solid components and therefore may need to be handled, treated, disposed as non-liquid wastes.

Disposable sampling materials, disposable PPE, decontamination fluids, etc. will always be managed on a site-specific basis. Under no circumstances shall these types of materials be stored in a site office or warehouse.

7.0 References


# Attachment 1
## IDW Management Options

<table>
<thead>
<tr>
<th>Type of IDW</th>
<th>Generation Processes</th>
<th>Management Options</th>
</tr>
</thead>
</table>
| **Soil**    | Well/Test pit installations  
             | Borehole drilling  
             | Soil sampling      | **Onsite Disposal**  
                               | Return to boring, pit, or source immediately after generation  
                               | Spread around boring, pit, or source within the AOC  
                               | Consolidate in a pit (within the AOC)  
                               | Send to onsite TSDF  
                               | **Offsite Disposal**  
                               | Client to send to offsite TSDF  
                               | **Interim Management**  
                               | Store for future treatment and/or disposal |
| **Sludge/Sediment** | Sludge pit/sediment sampling | **Onsite Disposal**  
                               | Return to pit or source immediately after generation  
                               | Send to onsite TSDF  
                               | **Offsite Disposal**  
                               | Send to offsite TSDF*  
                               | **Interim Management**  
                               | Store for future treatment and/or disposal |
| **Aqueous Liquids** (groundwater, surface water, drilling fluids, wastewater) | Well installation/development  
                              | Well purging during sampling  
                              | Groundwater discharge during pump tests  
                              | Surface water sampling  
                              | Wastewater sampling | **Onsite Disposal**  
                               | Pour onto ground close to well (nonhazardous waste)  
                               | Discharge to sewer  
                               | Send to onsite TSDF  
                               | **Offsite Disposal**  
                               | Send to offsite TSDF*  
                               | Client to send to publicly owned treatment works (POTW)  
                               | **Interim Management**  
                               | Store for future treatment and/or disposal |
| **Decontamination Fluids** | Decontamination of PPE and equipment | **Onsite Disposal**  
                               | Send to onsite TSDF  
                               | Evaporate (for small amounts of low contamination organic fluids)  
                               | Discharge to ground surface  
                               | **Offsite Disposal**  
                               | Send to offsite TSDF*  
                               | Discharge to sewer  
                               | **Interim Management**  
                               | Store for future treatment and/or disposal |
| **Disposable PPE and Sampling Equipment** | Sampling procedures or other onsite activities | **Onsite Disposal**  
                               | Place in onsite industrial dumpster  
                               | Send to onsite TSDF  
                               | **Offsite Disposal**  
                               | Send to offsite TSDF*  
                               | **Interim Management**  
                               | Store for future treatment and/or disposal |

* Client must sign waste profile, manifest, etc. for any waste sent offsite.  
1.0 Objective
The objective of this technical standard operating procedure (SOP) is to set criteria for content entry and form of field logbooks. Field logbooks are an essential tool to document field activities for historical and legal purposes.

2.0 Background
2.1 Definitions
Biota - The flora and fauna of a region.

Magnetic Declination Corrections - Compass adjustments to correct for the angle between magnetic north and geographical meridians.

2.2 Discussion
Information recorded in field logbooks includes field team names; observations; data; calculations; date/time; weather; and description of the data collection activity, methods, instruments, and results. Additionally, the logbook may contain deviations from plans and descriptions of wastes, biota, geologic material, and site features including sketches, maps, or drawings as appropriate.

3.0 General Responsibilities
Field Team Leader (FTL) - The FTL is responsible for ensuring that the format and content of data entries are in accordance with this procedure.

Site Personnel - All CDM Smith employees who make entries in field logbooks during onsite activities are required to read this procedure before engaging in this activity. The FTL will assign field logbooks to site personnel who will be responsible for their care and maintenance. Site personnel will return field logbooks to the records file at the end of the assignment.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities should be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

4.0 Required Equipment
- Site-specific plans
- Field logbook
- Indelible black or blue ink pen
- Ruler or similar scale

5.0 Procedures
5.1 Preparation
In addition to this SOP, site personnel responsible for maintaining logbooks must be familiar with all procedures applicable to the field activity being performed. These procedures should be consulted as necessary to obtain specific information about equipment and supplies, health and safety, sample collection, packaging, decontamination, and documentation requirements. These procedures should be available electronically, or located at the field office or vehicle for easy reference.

Field logbooks shall be bound with lined, consecutively numbered pages. All pages must be numbered before initial use of the logbook. Before use in the field, each logbook will be marked with a specific document control number issued by the document control administrator, if required by the contract quality implementation plan (QIP). Not all contracts require document control numbers. The following information shall be recorded on the cover of the logbook:
- Field logbook document control number (if applicable).
- Start date of entries.
Field Logbook Content and Control

- Activity (if the logbook is to be activity-specific), site name, and location.
- Name of CDM Smith contact and phone number(s) (typically the project manager).
- End date of entries.
- In specific cases, special logbooks may be required (e.g., waterproof paper for stormwater monitoring).

The first few (approximately three) pages of the logbook will be reserved for a table of contents (TOC). Mark the first page with the heading and enter the following:

**Table of Contents**

<table>
<thead>
<tr>
<th>Date/Description</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Start Date)/Reserved for TOC</td>
<td>1-3</td>
</tr>
</tbody>
</table>

The remaining pages of the table of contents will be designated as such with “TOC” written on the top center of each page. The table of contents should be completed as activities are completed and before placing the logbook in the records file.

### 5.2 Operation

Requirements that must be followed when using a logbook:

- Record work, observations, quantities of materials, calculations, drawings, and related information directly in the logbook. If data collection forms are specified by an activity-specific plan, this information does not need to be duplicated in the logbook. However, any forms used to record site information must be referenced in the logbook.
- Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of each page.
- Do not erase or blot out any entry at any time. Indicate any deletion by a single line through the material to be deleted. Initial and date each deletion. Take care to not obliterate what was written previously.
- Do not remove any pages from the book.
- All entries must be clearly written and legible.

Specific requirements for field logbook entries include:

- Initial and date each page.
- Sign and date the final page of entries for each day.
- Initial and date all changes.
- Multiple authors must sign out the logbook by inserting the following:
  Above notes authored by:
  - (Sign name)
  - (Print name)
  - (Date)
- A new author must sign and print his/her name before additional entries are made.
- Draw a diagonal line through the remainder of the final page at the end of the day.
- Record the following information on a daily basis:
  - Date and time
  - Name of individual making entry
  - Names of field team and other persons onsite
  - Description of activity being conducted including station or location (i.e., well, boring, sampling location number) if appropriate
  - Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction, and speed) and other pertinent data
  - Level of personal protection used
  - Serial numbers of instruments
  - Equipment calibration information
  - Serial/tracking numbers on documentation (e.g., carrier air bills)
Field Logbook Content and Control

Entries into the field logbook shall be preceded with the time (written in military units) of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (e.g., data logger) or on a separate form required by an operating procedure. In these cases, the logbook must reference the automatic data record or form.

At each station where a sample is collected or an observation or measurement made, a detailed description of the location of the station is required. Use a compass (include a reference to magnetic declination corrections), scale, or nearby survey markers, as appropriate. A sketch of station location may be warranted. All maps or sketches made in the logbook should have descriptions of the features shown and a direction indicator. It is preferred that maps and sketches be oriented so that north is toward the top of the page. Maps, sketches, figures, or data that will not fit on a logbook page should be referenced and attached to the logbook to prevent separation.

Other events and observations that should be recorded include:

- Changes in weather that impact field activities.
- Deviations from procedures outlined in any governing documents. Also record the reason for any noted deviation.
- Problems, downtime, or delays.
- Upgrade or downgrade of personal protection equipment.
- Visitors to the site.

5.3 Post-Operation

To guard against loss of data as a result of damage or disappearance of logbooks, completed pages shall be periodically photocopied or scanned (weekly, at a minimum) and forwarded to the field or project office. Other field records shall be photocopied or scanned and submitted regularly and as promptly as possible to the office. When possible, electronic media such as flash drives or disks should be copied and forwarded to the project office. Follow the records control procedures specified in the site-specific plan.

At the conclusion of each activity or phase of site work, the individual responsible for the logbook will ensure that all entries have been appropriately signed and dated and that corrections were made properly (single lines drawn through incorrect information, then initialed and dated). The completed logbook shall be submitted to the records file.

6.0 Restrictions/Limitations

Field logbooks constitute the official record of onsite technical work, investigations, and data collection activities. Their use, control, and ownership are restricted to activities pertaining to specific field operations carried out by CDM Smith personnel and their subcontractors. They are documents that may be used in court to indicate dates, personnel, procedures, and techniques employed during site activities. Entries made in these logbooks should be factual, clear, precise, and nonsubjective. Field logbooks, and entries within, are not to be used for personal use.

7.0 References


1.0 Objective
The purpose of this technical standard operating procedure (SOP) is to provide standard guidelines and methods for photographic documentation, which include digital photography and recordings of field activities and site features (geologic formations, core sections, lithologic samples, water samples, general site layout, etc.). This SOP is intended for circumstances when formal photographic documentation is required. Based on project requirements, it may not be applicable for all photographic activities.

2.0 Background
2.1 Definitions
Photographer - A photographer is the camera operator of digital photography or recordings whose primary function with regard to this SOP is to produce documentary or data-oriented visual media.

Identifier Component - Identifier components are visual components used within a photograph such as visual slates, reference markers, and pointers.

Standard Reference Marker - A standard reference marker is a reference marker that is used to indicate a feature size in the photograph and is a standard length of measure, such as a ruler, meter stick, etc. In limited instances, if a ruled marker is not available or its use is not feasible, it can be a common object of known size placed within the visual field and used for scale.

Slates - Slates are blank white index cards, marker boards, or paper used to present information pertaining to the subject/procedure being photographed. Letters and numbers on the slate will be bold and written with black indelible marking pens.

Arrows and Pointers - Arrows and pointers are markers/pointers used to indicate and/or draw attention to a special feature within the photograph.

Contrasting Backgrounds - Contrasting backgrounds are backdrops used to lay soil samples, cores, or other objects on for clearer viewing and to delineate features.

Date Stamp - A date stamp is a built-in feature that will record the date and time directly on a digital image or recording.

2.2 Associated Procedures
- SOP 4-1, Field Logbook Content and Control

2.3 Discussion
Digital photographs and recordings made during field investigations are used as an aid in documenting and describing site features, sample collection activities, equipment used, and possible lithologic interpretation. This SOP is designed to illustrate the format and desired placement of identifier components, such as visual slates, standard reference markers, and pointers. The use of a photographic logbook and standardized entry procedures are also outlined. These procedures and guidelines will minimize potential ambiguities that may arise when viewing the images or recordings and ensure the representative nature of the photographic documentation.

3.0 General Responsibilities
Field Team Leader - The field team leader (FTL) is responsible for ensuring that the format and content of photographic documentation are in accordance with this procedure. The FTL is responsible for directing the photographer to specific situations, site features, or operations that the photographer will be responsible for documenting.
Photographic Documentation of Field Activities

Photographer - The photographer shall seek direction from the FTL and regularly discuss the visual documentation requirements and schedule. The photographer is responsible for maintaining a logbook per Sections 5.1, 5.2.4, and 5.3.1 of this SOP. Responsibilities will be defined in the project sampling plan.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).

4.0 Required Equipment
A general list of equipment that may be used:

- Digital camera and appropriate storage media
- Extra batteries for camera
- Digital video camera and appropriate storage media (e.g., SD card)
- Logbook
- Indelible black or blue ink pen
- Standard reference markers (e.g. ruler)
- Slates or marker boards
- Arrows or pointers
- Contrasting backgrounds

5.0 Procedures
5.1 Documentation
Documentation requirements for digital photographs and recordings should be specified in the site-specific plan. Otherwise, a commercially available, bound logbook will be used to log and document photographic activities. Review SOP 4-1, Field Logbook Content and Control and prepare all supplies needed for logbook entries.

Note: A separate photographic logbook is not required. A portion of the field logbook may be designated as the photographic log and documentation section.

Field Health and Safety Considerations
There are no hazards that an individual will be exposed to specific to photographic documentation. However, site-specific hazards may arise depending on location or operation. Personal protective equipment used in this operation will be site-specific and dictated through requirements set by the site safety officer, site health and safety plan, and/or prescribed by the CDM Smith Corporate Health and Safety Program. The photographer should contact the site safety officer for health and safety orientation before commencing field activities. The site health and safety plan must be read before entry to the site, and all individuals must sign the appropriate acknowledgement that this has been done.

The photographer should be aware of any potential physical hazards while photographing the subject (e.g., traffic, low overhead hazard, edge of excavation).

5.2 Operation
5.2.1 General Photographic Activities in the Field
The following sections provide general guidelines that should be followed to visually document field activities and site features using digital still and video cameras. Listed below are general suggestions that the photographer should consider when performing activities under this SOP:

- The photographer should be prepared to make a variety of shots, from close-up to wide-angle. Many shots will be repetitive in nature or format, especially close-up site feature photographs. Consideration should therefore be given to designing a system, camera settings, or technique that will provide a reliable repetition of performance.
Photographic Documentation of Field Activities

- No preference of digital storage medium is specified and is left to the discretion of the photographer.

- Digital cameras have multiple photographic quality settings. A camera that obtains a higher resolution (quality) has a higher number of pixels and will store a fewer number of photographs per digital storage medium. Project resolution requirements should be determined prior to implementing field work.

5.2.2 General Guidelines for Still Photography

Caption Information
Unless otherwise specified in a site-specific plan, all still photographs will have a full caption added after the images are downloaded on a photo log sheet. The caption should contain the following information:

- Photograph sequence number
- Date and time
- Photographer
- Description of activity/item shown (e.g., name of facility/site, specific project name, project number)
- Direction (if applicable)

When directed by the sampling plan, a standard reference marker should be used in all documentary visual media. While the standard reference marker will be predominantly used in close-up feature documentation, inclusion in all scenes should be considered.

Digital images should be downloaded at least once each day to a personal computer; the files should be in either “JPEG” or “TIFF” format. Files should be renamed at the time of download to correspond to the logbook or as directed in the site-specific plan. It is recommended the electronic files be copied to a compact disc for backup.

Close-Up and Feature Photography
When directed by the sampling plan, close-up photographs should include a standard reference marker of appropriate size as an indication of the feature size and contain a slate or marker board marked with the site name and any identifying label, such as a well number or core depth, that clearly communicates to the viewer the specific feature being photographed.

Feature samples, core pieces, and other lithologic media should be photographed as soon as possible after they have been removed from their in situ locations. This enables a more accurate record of their initial condition and color. When directed by the sampling plan, include a standard reference color strip (color chart such as Munsell Soil Color Chart) within the scene. This is to be included for the benefit of the viewer of the photographic document and serves as a reference aid to the viewer for formal lithologic observations and interpretations.

Site Photography
Site photography, in general, will consist predominantly of medium- and wide-angle shots. If required by the sampling plan, a standard reference marker should be placed adjacent to the feature or, when this is not possible, within the same focal plane.

While it is encouraged that a standard reference marker and slate/marker board be included in the scene, it is understood that situations will arise that preclude their inclusion within the scene. This will be especially true of wide-angle shots. In such a case, the image number shall be entered in the photographic logbook along with other information pertinent to the scene.

5.2.3 General Photographic Documentation Using Digital Video Cameras
Documentary digital recordings of field activities may include an audio slate for all scenes. At the beginning of each video session, an announcer will recite the following information: date, time (in military units), photographer, site ID number, and site location. This oral account may include any additional information clarifying the subject matter being recorded.
A standard reference marker may be used when taking close-up shots of site features with a video camera. The scene may also include a caption/slate. It should be placed adjacent and parallel to the feature being photographed.

It is recommended that a standard reference marker and slate/marker board be included in all scenes. The caption information is vital to the value of the documentary visual media and should be included. If it is not included within the scene, it should be placed before the scene.

Original video recordings will not be edited. This will maintain the integrity of the information contained on the videotape or DVD. If editing is desired, a working copy of the original video recording can be made.

A digital recording filename should be created with the appropriate identifying information (project name, project number, date, location, etc.).

### 5.2.4 Photographic Documentation

If required by the site-specific plan, photographic activities must be documented in a photographic logbook or in a section of the field logbook. The photographer will be responsible for making proper entries.

In addition to following the technical standards for logbook entry as referenced in SOP 4-1, the following information should be maintained in the appropriate logbook:

- Photographer name.
- Sequential tracking number for each photograph taken (the camera-generated number may be used).
- Date and time (military time).
- Location.
- A description of the activity/item photographed.
- If needed, a description of the general setup, including approximate distance between the camera and the subject, may be recorded in the logbook.
- Record as much other information as possible to assist in the identification of the photographic document.

### 5.3 Post Operation

The photographer shall be responsible for downloading image files or recordings to the project files.

As required, the photographer(s) will ensure that the appropriate logbook has been completely filled out and maintained as outlined in SOP 4-1. Images and recordings will be handled according to contract records requirements. The project manager will ensure their proper distribution. Completed pages of the appropriate logbook will be copied weekly and submitted to the project files.

### 6.0 Restrictions/Limitations

This document is designed to provide a set of guidelines to ensure that an effective and standardized program of visual documentation is maintained.

It is not within the scope of this document to provide instruction in photographic procedures, nor is it within the scope of this document to set guidelines for presentation or “show” photography.

The procedures outlined herein are general by nature. The photographer is responsible for specific operational activity or procedure described in site-specific plans. Questions concerning specific procedures or requirements should be directed to the project manager or FTL.

**Note:** Some sites do not permit photographic documentation. Check with the site contact for any restrictions.
7.0 References


Field Equipment Decontamination at Nonradioactive Sites

1.0 Objective
The objective of this technical standard operating procedure (SOP) is to describe the general procedures required for decontamination of field equipment at nonradioactive sites. This SOP serves as a general guide and is applicable at most sites; however, it shall be noted that site-specific conditions (i.e., type of contamination, type of media sampled), the governing agency (e.g., EPA, DOE, USACE), and site-specific work plans, sampling and analysis plans and/or quality assurance (QA) project plans may require modifications to the decontamination procedures provided in this SOP. Decontamination of field equipment is necessary to ensure acceptable quality of samples by preventing cross contamination. Further, decontamination reduces health hazards and prevents the spread of contaminants offsite.

2.0 Background
2.1 Definitions

**Acid Rinse** - A solution of 10 percent nitric or hydrochloric acid made from reagent grade acid and analyte-free water.

**Analyte-Free Water** - Tap water that has been treated so that the water contains no detectable heavy metals or other inorganic compounds. Analyte-free water shall be stored only in clean glass, stainless steel, or plastic containers that can be closed when not in use.

**Clean** - Free of contamination and when decontamination has been completed in accordance with this SOP.

**Cross Contamination** - The transfer of contaminants through equipment or personnel from the contamination source to less contaminated or noncontaminated samples or areas.

**Decontamination** - The process of rinsing or otherwise cleaning the surfaces of sampling or other equipment to rid them of contaminants and to minimize the potential for cross contamination of samples or exposure to personnel.

**Safety Data Sheets (SDS)** - These documents discuss the proper storage and physical and toxicological characteristics of a particular substance used during decontamination. These documents, generally included in site health and safety plans, shall be kept on site at all times during field operations.

**Organic-Free/Analyte-Free Water** - Tap water that has been treated so that the water meets the analyte-free water criteria and contains no detectable organic compounds. Organic-free/analyte-free water shall be stored only in clean glass, Teflon™, or stainless steel containers that can be closed when not in use.

**Potable Water** - Tap water may be obtained from any municipal system. Chemical analysis of the water source may be required before it is used for decontamination purposes.

**Sampling Equipment** - Equipment that comes into direct contact with the sample media. Such equipment includes split spoon samplers, well casing and screens, and spatulas or bowls used to homogenize samples.

**Soap** - Low-sudsing, nonphosphate detergent such as Liquinox™.

**Solvent Rinse** - Pesticide grade, or better, isopropanol, acetone, or methanol.
2.2 Associated Procedures

- SOP 1-1 – Surface Water Sampling
- SOP 1-3 – Surface Soil Sampling
- SOP 1-4 – Subsurface Soil Sampling
- SOP 1-5 – Groundwater Sampling Using Bailers
- SOP 1-7 – Wipe Sampling
- SOP 1-9 – Tap Water Sampling
- SOP 1-11 – Sediment/Sludge Sampling
- SOP 1-12 – Low Flow (Low-Stress) Groundwater Sampling
- SOP 1-13 – Drum Sampling
- SOP 1-14 – Lagoon Sampling
- SOP 1-15 – Procedures for Determination of Screening-Level Elemental Concentrations in Soil and Sediment using Field Portable X-Ray Fluorescence Spectrometry
- SOP 2-2 – Guide to Handling Investigation-Derived Waste
- SOP 3-1 – Geoprobe® Sampling

3.0 Responsibilities

The project manager or designee, generally the field team leader (FTL), ensures that field personnel are trained in the performance of this procedure and that decontamination is conducted in accordance with this SOP and site-specific work plans. The FTL may also be required to collect and document rinse water samples (also known as equipment blanks) to provide quantitative verification that these procedures have been correctly implemented.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

4.0 Required Equipment

- Stiff-bristle scrub brushes
- Plastic buckets and troughs
- Soap
- Nalgene or Teflon sprayers or wash bottles or 2- to 5-gallon, manual-pump sprayer (pump sprayer material must be compatible with the solution used)
- Plastic sheeting, plastic bags, and/or aluminum foil to keep decontaminated equipment clean between uses
- Disposable wipes, rags, or paper towels
- Potable water
- Analyte-free water
- Organic-free/analyte-free water
- Gloves, safety glasses, and other protective clothing as specified in the site-specific health and safety plan
- High-pressure pump with soap dispenser or steam-spray unit (for large equipment only)
- Appropriate decontamination solutions pesticide grade or better and traceable to a source (e.g., 10 percent and/or 1 percent nitric acid [HNO₃], acetone, methanol, isopropanol, hexane)
- Tools for equipment assembly and disassembly (as required)
- 55-gallon drums or tanks for temporary storage of decontamination water (as required)
- Pallets for drums or tanks holding decontamination water (as required)

* Potable water may be required to be tested for contaminants before use. Check field plan for requirements.
### Field Equipment Decontamination at Nonradioactive Sites

| SOP 4-5 | Revision: 10 | Date: February 2015 |

#### 5.0 Procedures

All reusable equipment (non-dedicated) used to collect, handle, or measure samples shall be decontaminated before coming into contact with any sampled media or personnel using the equipment. Decontamination of equipment shall occur either at a central decontamination station or at portable decontamination stations set up at the sampling location, drill site, or monitoring well location. The centrally located decontamination station shall include an appropriately sized bermed and lined area on which equipment decontamination shall occur and shall be equipped with a collection system and storage vessels. In certain circumstances, berming is not required when small quantities of water are being generated and for some short duration field activities (i.e., pre-remedial sampling). Equipment shall be transported to and from the decontamination station in a manner to prevent cross contamination of equipment and/or area. For example, precautions taken may include enclosing augers in plastic wrap while being transported on a flatbed truck.

The decontamination area shall be constructed so that contaminated water is either collected directly into appropriate containers (5-gallon buckets or steel wash tubs) or within the berms of the decontamination area that then drains into a collection system. Water from the collection system shall be transferred into 55-gallon drums or portable tanks for temporary storage. Typically, decontamination water shall be staged until sampling results or waste characterization results are obtained and evaluated and the proper disposition of the waste is determined (SOP 2-2, Guide to Handling Investigation-Derived Waste). The exact procedure for decontamination waste disposal shall be discussed in the work plan. Also, solvent and acid rinse fluids may need to be segregated from other investigation-derived wastes.

All items that shall come into contact with potentially contaminated media shall be decontaminated before use and between sampling and/or drilling locations. If decontaminated items are not immediately used, they shall be covered either with clean plastic or aluminum foil depending on the size of the item. All decontamination procedures for the equipment being used are as follows:

#### General Guidelines

- Potable, analyte-free, and organic-free/analyte-free water shall be free of all contaminants of concern. Following the field QA sampling procedure described in the sampling plan, analytical data from the water source may be required.
- Sampling equipment that has come into contact with oil and grease shall be cleaned with methanol or other approved alternative to remove the oily material. This may be followed by a hexane rinse and then another methanol rinse. Regulatory or client requirements regarding solvent use shall be stated in the sampling plan.
- All solvents and acids shall be pesticide grade or better and traceable to a source. If provided, certificates of analyses should be placed in the project files. The corresponding lot numbers shall be recorded in the appropriate logbook.

**Note:** Solvents and acids are potentially hazardous materials and must be handled, stored, and transported accordingly. Solvents shall never be used in a closed building. See the site-specific health and safety plan and/or the chemical’s MSDS for specific information regarding the safe use of the chemical.

- Decontaminated equipment shall be allowed to air dry before being used.
- Documentation of all equipment type, date, time, and method of decontamination along with associated field QA sampling shall be recorded in the appropriate logbook.
- Gloves, boots, safety glasses, and any other personnel protective clothing and equipment shall be used as specified in the site-specific health and safety plan.

#### 5.1 Heavy Equipment Decontamination

Heavy equipment includes drilling rigs, well development rigs, and backhoes. Follow these steps when decontaminating this equipment:

1. Establish a bermed decontamination area that is large enough to fully contain the equipment to be cleaned. If available, an existing wash pad or appropriate paved and bermed area may be used; otherwise, use one or more layers of heavy plastic sheeting to cover the ground surface and berms. All decontamination pads shall be upwind of the area under investigation.
2. With the rig in place, spray areas (rear of rig or backhoe) exposed to contaminated media using a hot water high-pressure sprayer. Be sure to spray down all surfaces, including the undercarriage.

3. Use brushes, soap, and potable water to remove dirt whenever necessary.

4. Remove equipment from the decontamination pad and allow it to air dry before returning it to the work site.

5. After decontamination activities are completed, collect all contaminated wastewater, plastic sheeting, and disposable gloves, boots, and clothing in separate containers or receptacles. All receptacles containing contaminated items must be properly labeled for disposal as detailed in the field plan. Liquids and solids must be drummed separately.

5.2 Downhole Equipment Decontamination
Downhole equipment includes hollow-stem augers, drill pipes, rods, stems, etc. Follow these steps when decontaminating this equipment:

1. Set up a centralized decontamination area, if possible. This area shall be set up to collect contaminated rinse waters and to minimize the spread of airborne spray.

2. Set up a “clean” area upwind of the decontamination area to receive cleaned equipment for air-drying. At a minimum, clean plastic sheeting must be used to cover the ground, tables, or other surfaces on which decontaminated equipment is to be placed. All decontamination pads shall be upwind of any areas under investigation.

3. Place the object to be cleaned on aluminum foil or plastic-covered wooden sawhorses or other supports. The objects to be cleaned shall be at least 2 feet above the ground to avoid splashback when decontaminating.

4. Using soap and potable water in the hot water high-pressure sprayer (or steam unit), spray the contaminated equipment. Aim downward to avoid spraying outside the decontamination area. Be sure to spray inside corners and gaps especially well. Use a brush, if necessary, to dislodge dirt.

5. If using soapy water, rinse the equipment using clean, potable water. If using hot water, the rinse step is not necessary if the hot water does not contain a detergent. If the hot water contains a detergent, this final clean water rinse is required.

6. Using a suitable sprayer, rinse the equipment thoroughly with analyte-free water.

7. Remove the equipment from the decontamination area and place in a clean area upwind to air dry.

8. After decontamination activities are completed, collect all contaminated wastewaters, plastic sheeting, and disposable gloves, boots, and clothing in separate containers or receptacles. All receptacles containing contaminated items must be properly labeled for disposal. Liquids and solids must be drummed separately.

5.3 Sampling Equipment Decontamination
Follow these steps when decontaminating sampling equipment:

1. Set up a decontamination line on plastic sheeting. The decontamination line shall progress from "dirty" to "clean." A clean area shall be established upwind of the decontamination wash/rinse activities to dry the equipment. At a minimum, clean plastic sheeting must be used to cover the ground, table, or other surfaces that the decontaminated equipment is placed for drying.

2. Disassemble any items that may trap contaminants internally. Do not reassemble the items until decontamination and air drying are complete.
### Field Equipment Decontamination at Nonradioactive Sites

**SOP 4-5**  
Revision: 10  
Date: February 2015

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Wash the items with potable water and soap using a stiff brush as necessary to remove particulate matter and surface films. The items may be steam cleaned using soap and hot water as an alternative to brushing. Note: Polyvinyl chloride or plastic items shall not be steam cleaned. Items that have come into contact with concentrated and/or oily contaminants may need to be rinsed with a solvent such as hexane and allowed to air dry prior to this washing step.</td>
</tr>
<tr>
<td>4.</td>
<td>Thoroughly rinse the items with potable water.</td>
</tr>
<tr>
<td>5.</td>
<td>The specific chemicals and/or fluids to be used in the decontamination process will be defined in the sampling plan. If sampling for metals, typically the potable water and soap wash is followed by a potable water rinse then an analyte-free water rinse; alternatively, an acid solution (e.g., 10 percent nitric acid) rinse followed by a rinse using analyte-free water may be specified in some instances. If sampling for organic compounds, thoroughly rinse the items with solvent (e.g., isopropanol) followed by a rinse using organic-free/analyte-free water. Again, the specific chemicals used in any acid rinse or solvent rinse phases shall be specified in the sampling plan. Any acid rinsate and solvent rinsate must each be containerized separately. Acids and solvents are potentially hazardous materials and care must be exercised when using these chemicals to prevent adverse health affects (e.g., skin burns, irritation to the eyes and respiratory system). Appropriate personal protective equipment must be worn when using these chemicals. The use of acids and solvents for decontamination should be carefully considered. These chemicals (including spent rinsate) must be managed and stored appropriately. Special measures such as proper labels, paperwork, notification, etc. may be required when transporting or shipping these chemicals.</td>
</tr>
<tr>
<td>6.</td>
<td>Allow the items to air dry completely.</td>
</tr>
<tr>
<td>7.</td>
<td>After drying, reassemble the parts as necessary and wrap the items in clean plastic wrap or in aluminum foil.</td>
</tr>
<tr>
<td>8.</td>
<td>After decontamination activities are completed, collect all contaminated waters, used solvents and acids, plastic sheeting, and disposable personal protective equipment. Place the contaminated items in properly labeled drums for disposal. Liquids and solids must be drummed separately. Refer to site-specific plans for labeling and waste management requirements.</td>
</tr>
</tbody>
</table>

### 5.4 Pump Decontamination

Follow the manufacturer’s recommendation for specified pump decontamination procedures. At a minimum, follow these steps when decontaminating pumps:

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Set up the decontamination area and separate “clean” storage area using plastic sheeting to cover the ground, tables, and other surfaces. Set up four containers: the first container shall contain dilute (nonfoaming) soapy water, the second container shall contain potable water, the third container shall be empty to receive wastewater, and the fourth container shall contain analyte-free water.</td>
</tr>
<tr>
<td>2.</td>
<td>The pump shall be set up in the same configuration as for sampling. Submerge the pump intake (or the pump, if submersible) and all downhole-wetted parts (tubing, piping, foot valve) in the soapy water of the first container. Place the discharge outlet in the wastewater container above the level of the wastewater. Pump soapy water through the pump assembly until it discharges to the waste container. Scrub the outside of the pump and other wetted parts with a metal brush.</td>
</tr>
<tr>
<td>3.</td>
<td>Move the pump assembly to the potable water container while leaving discharge outlet in the waste container. All downhole-wetted parts must be immersed in the potable water rinse. Pump potable water through the pump assembly until it runs clear.</td>
</tr>
<tr>
<td>4.</td>
<td>Move the pump intake to the analyte-free water container. Pump the water through the pump assembly. Pump the volume of water through the pump specified in the field plan. Usually, three pump-and-line-assembly volumes shall be required.</td>
</tr>
<tr>
<td>5.</td>
<td>Decontaminate the discharge outlet by hand, following the steps outlined in Section 5.3.</td>
</tr>
</tbody>
</table>
Field Equipment Decontamination at Nonradioactive Sites

6. Remove the decontaminated pump assembly to the clean area and allow it to air dry upwind of the decontamination area. Intake and outlet orifices shall be covered with aluminum foil to prevent the entry of airborne contaminants and particles.

5.5 Low Stress (Low Flow) Sampling Pump Decontamination

Sampling equipment used for Low Stress (Low Flow) Groundwater Sampling (SOP 1-12) must be decontaminated thoroughly each day before use (daily decontamination) and after each well is sampled (between-well decontamination). All non-disposable equipment, including the pump (support cable and electrical wires which are in contact with the sample) will be decontaminated as described below. Dedicated, in-place pumps and tubing must be thoroughly decontaminated using “daily decontamination” procedures prior to their initial use or installation.

5.5.1 Prior to Sampling Event Decontamination

Please Note: Steps 5 through 13 should only be performed once (for each pump that is to be used) before the commencement of a particular sampling event by a person qualified to disassemble pumps.

1. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and thoroughly flush other equipment with potable water.

2. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Liquinox™, for 5 minutes and thoroughly flush other equipment with fresh detergent solution. Use the detergent sparingly.

3. Rinse: Operate pump in a deep basin of potable water for 5 minutes and thoroughly flush other equipment with potable water for 5 minutes.

4. Analyte-Free Rinse: Operate pump in a deep basin of analyte-free water to pump out 1 to 2 gallons of this final rinse water.

5. Disassemble pump.

6. Wash pump parts (inlet screen, shaft suction interconnector, motor lead assembly, stator house): Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.

7. Rinse pump parts with potable water for five minutes.

8. Rinse the pump parts with demonstrated analyte-free water.

9. If sampling for metals, an acid rinse may be specified in the sampling plan; if so, place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HNO3).

10. Rinse impeller assembly with potable water for five minutes.

11. If sampling for organics, a solvent rinse may be specified; if so, place impeller assembly in a large glass bleaker and rinse with isopropanol or appropriate organic solvent specified in the site-specific plan.

12. Thoroughly rinse impeller assembly with demonstrated analyte-free water.

13. Reassemble pump.

5.5.2 Daily and Between-Well Decon

1. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and thoroughly flush other equipment with potable water for five minutes.
2. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Liquinox™, for 5 minutes and thoroughly flush other equipment with fresh detergent solution. Use the detergent sparingly.

3. Rinse: Operate pump in a deep basin of potable water for 5 minutes and thoroughly flush other equipment with potable water for five minutes.

4. Final Rinse: Operate pump in a deep basin of analyte-free water to pump out 1 to 2 gallons of this final rinse water.

5.6 Instrument Probe Decontamination

Instrument probes used for field measurements such as pH meters, conductivity meters, etc. shall be decontaminated between samples and after use with analyte-free, or better, water.

5.7 Waste Disposal

Refer to site-specific plans and SOP 2-2 for waste disposal requirements. The following are guidelines for disposing of wastes:

- All wash water, rinse water, and decontamination solutions that have come in contact with contaminated equipment are to be handled, packaged, labeled, marked, stored, and disposed of as investigation-derived waste.
- Small quantities of decontamination solutions may be allowed to evaporate to dryness.
- If large quantities of used decontamination solutions shall be generated, each type of waste shall be contained in separate containers.
- Unless otherwise required, plastic sheeting and disposable protective clothing may be treated as solid, nonhazardous waste.
- Waste liquids shall be sampled, analyzed for contaminants of concern in accordance with disposal regulations, and disposed of accordingly.

6.0 Restrictions/Limitations

Nitric acid and polar solvent rinses are necessary only when sampling for metals or organics, respectively. These steps shall not be used, unless required, because of the potential for acid burns and ignitability hazards.

If the field equipment is not thoroughly rinsed and allowed to completely air dry before use, volatile organic residue, which interferes with the analysis, may be detected in the samples. The occurrence of residual organic solvents is often dependent on the time of year sampling is conducted. In the summer, volatilization is rapid, and in the winter, volatilization is slow. Check with your EPA region, state, and client for approved decontamination solvents.

7.0 References


1.0 Objective
The objective of this technical standard operating procedure (SOP) is to establish the baseline requirements, procedures, and responsibilities inherent to the control and use of all measurement and test equipment (M&TE). Contractual obligations may require more specific or stringent requirements that must also be implemented.

2.0 Background
2.1 Definitions
Traceability - The ability to trace the history, application, or location of an item and like items or activities by means of recorded identification.

2.2 Associated Procedures
- SOP 4-1, Field Logbook Content and Control
- CDM Smith Quality Procedures (QPs) 2.1 and QP 6.3
- Manufacturer’s operating and maintenance and calibration procedures

2.3 Discussion
M&TE may be government furnished (GF), rented or leased from an outside vendor, or purchased. It is essential that measurements and tests resulting from the use of this equipment be of the highest accountability and integrity. To facilitate that, the equipment shall be used in full understanding and compliance with the instructions and specifications included in the manufacturer’s operations and maintenance and calibration procedures and in accordance with any other related project-specific requirements.

3.0 Responsibilities
All staff with responsibility for the direct control and/or use of M&TE are responsible for being knowledgeable of and understanding and implementing the requirements contained herein as well as any other related project-specific requirements.

The project manager (PM) or designee (equipment coordinator, quality assurance coordinator, field team leader, etc.) is responsible for initiating and tracking the requirements contained herein.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance plan.

4.0 Requirements for M&TE
- Determine and implement M&TE related project-specific requirements
- The maintenance and calibration procedures must be followed when using M&TE
- Obtain the maintenance and calibration procedures if they are missing or incomplete
- Attach or include the maintenance and calibration procedures with the M&TE
- Prepare and record maintenance and calibration in an equipment log or a field log as appropriate (Figure 1)
- Maintain M&TE records
- Label M&TE requiring routine or scheduled calibration (when required)
- Perform maintenance and calibration using the appropriate procedure and calibration standards
- Identify and take action on nonconforming M&TE
5.0 Procedures

5.1 Determine if Other Related Project-Specific Requirements Apply
For all M&TE:
The PM or designee shall determine if M&TE related project-specific requirements apply. If M&TE related project-specific requirements apply, obtain a copy of them and review and implement as appropriate.

5.2 Obtain the Operating and Maintenance and Calibration Documents
For GF M&TE that is to be procured:
Requisitioner - Specify that the maintenance and calibration procedures be included.

For GF M&TE that is acquired as a result of a property transfer:
Receiver - Inspect the M&TE to determine whether maintenance and calibration procedures are included with the item. If missing or incomplete, order the appropriate documentation from the manufacturer.

For M&TE that is to be rented or leased from an outside vendor:
Requisitioner - Specify that the maintenance and calibration procedures, the latest calibration record, and the calibration standards certification be included. If this information is not delivered with the M&TE, ask the procurement division to request it from the vendor.

5.3 Prepare and Record Maintenance and Calibration Records
For all M&TE:
PM or Designee - Record all maintenance and calibration events in a field log unless other project-specific requirements apply.

For GF M&TE only (does not apply to rented or leased M&TE): If an equipment log is a project specific requirement, perform the following:

Receiver - Notify the PM or designee for the overall property control of the equipment upon receipt of an item of M&TE.

PM or Designee and User:
- Prepare a sequentially page numbered equipment log for the item using the maintenance and calibration form (or equivalent) (Figure 1).
- Record all maintenance and calibration events in an equipment log.

5.4 Label M&TE Requiring Calibration
For GF M&TE only (does not apply to rented or leased M&TE): If calibration labeling is a project specific requirement, perform the following:

PM or Designee:
- Read the maintenance and calibration procedures to determine the frequency of calibration required.
- If an M&TE item requires calibration before use, affix a label to the item stating “Calibrate Before Use.”
- If an M&TE item requires calibration at other scheduled intervals, e.g., monthly, annually, etc., affix a label listing the date of the last calibration, the date the item is next due for a calibration, the initials of the person who performed the calibration, and a space for the initials of the person who shall perform the next calibration.

5.5 Operating, Maintaining or Calibrating an M&TE Item
For all M&TE:
PM or Designee and User - Operate, maintain, and calibrate M&TE in accordance with the manufacturer’s maintenance and calibration procedures. Record maintenance and calibration actions in the equipment log or field log.
5.6 Shipment
For GF M&TE:
Shipper - Inspect the item to ensure that the maintenance and calibration procedures are attached to the shipping case, or included, and that a copy of the most recent equipment log entry page (if required) is included with the shipment. If the maintenance and calibration procedures and/or the current equipment log page (if required) is missing or incomplete, do not ship the item. Immediately contact the PM or designee and request a replacement.

For M&TE that is rented or leased from an outside vendor:
Shipper - Inspect the item to ensure that the maintenance and calibration procedures and latest calibration and standards certification records are included prior to shipment. If any documentation is missing or incomplete, do not ship the item. Immediately contact the procurement division and request that they obtain the documentation from the vendor.

Note that some M&TE equipment must remain upright to maintain calibration. Such M&TE should be shipped only in containers labeled appropriately with “This End Up” labels.

Receiver – Some M&TE equipment must remain upright to maintain calibration. Upon receipt, inspect the container to verify that it is upright per “This End Up” labels. If it is not upright, notify the PM and vendor.

5.7 Records Maintenance
For GF M&TE:
PM or Designee - Create a file upon the initial receipt of an item of M&TE or calibration standard. Organize the files by contract origin and by M&TE item and calibration standard. Store all files in a cabinet, file drawer, or other appropriate storage media at the pertinent warehouse or office location.

Receiver - Forward the original packing slip to the procurement division and a photocopy to the PM or designee.

PM or Designee and User:
- Maintain all original documents in the equipment file except for the packing slip and field log.
- File the photocopy of the packing slip in the M&TE file.
- Record all maintenance and calibration in an equipment log or field log (as appropriate). File the completed equipment logs in the M&TE records. Forward completed field logs to the PM for inclusion in the project files.

For M&TE rented or leased from an outside vendor:
Receiver - Forward the packing slip to the procurement division.

User:
- Forward the completed field log to the PM for inclusion in the project files.
- Retain the most current maintenance and calibration record and calibration standards certifications with the M&TE item and forward previous versions to the PM for inclusion in the project files.

5.8 Traceability of Calibration Standards
For all items of M&TE:
PM or Designee and User:
- When ordering calibration standards, request nationally recognized standards as specified or required. Request commercially available standards when not otherwise specified or required. Or, request standards in accordance with other related project-specific requirements.
- Require certifications for standards that clearly state the traceability.
- Require Material Safety Data Sheets to be provided with standards.
- Note standards that are perishable and consume or dispose of them on or before the expiration date.
5.9 M&TE That Fails Calibration
For any M&TE item that cannot be calibrated or adjusted to perform accurately:
PM or Designee
- Immediately discontinue use and segregate the item from other equipment. Notify the appropriate PM and take appropriate action. in accordance with the CDM Smith QP 6.3 for nonconforming items.
- Review the current and previous maintenance and calibration records to determine if the validity of current or previous measurement and test results could have been affected and notify the appropriate PM(s) of the results of the review.

6.0 Restrictions/Limitations
On an item-by-item basis, exemptions from the requirements of this SOP may be granted by the Headquarters health and safety manager and/or Headquarters quality assurance director. All exemptions shall be documented by the grantor and included in the equipment records as appropriate.

7.0 References

## Maintenance and Calibration

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### Maintenance

Maintenance Performed:

Comments:

Signature: ______________ Date: ______________

### Calibration/Field Check

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<th>Pre-Field Check Reading:</th>
<th>Post-Field Check Reading:</th>
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</table>

Adjustment(s):

Calibration: □ Passed □ Failed

Comments:

Signature: ______________ Date: ______________
Other SOPs

Project-Specific SOP, CDM-BoRit-1, Rev 1, Collection of Perimeter Air Samples
Project-Specific SOP, CDM-BoRit-2, Rev 0, Collection of Ambient Air Samples
EPA SOP 2008 General Air Sampling Guidelines
EPA SOP 2084 Activity-Based Air Sampling for Asbestos
EPA SOP 2015 Asbestos Sampling
1.0 Objective
The objective of this standard operating procedure (SOP) is to establish baseline requirements, procedures, and responsibilities for collecting perimeter air samples to support investigations within the BoRit Asbestos Superfund Site (site). Modifications to this SOP may be detailed in governing documents referencing this SOP, such as the Site Management Plan for Remedial Investigation, Phase 1 (SMP) (CDM 2009). The U. S. Environmental Protection Agency (EPA) Region III task order manager must approve major changes to the procedures outlined in this document prior to initiating the sampling activity.

2.0 Background
2.1 Definitions
Perimeter air sample – For the purpose of this SOP, a perimeter air sample is a sample intended to provide data of sufficient quality to meet the data quality objectives defined in the governing document.

BoRit Asbestos Superfund Site (site) - All buildings and land within the boundaries of operable unit 1 (OU 1) of the site as illustrated on the most recent version of the OU boundary map.

2.2 CDM Technical Standard Operating Procedures (TSOPs)
The following TSOPs apply to this procedure:

- TSOP 4-1, Field Logbook Content and Control
- TSOP 5-1, Control of Measurement and Test Equipment
2.3 Discussion
Perimeter air sampling at the site generally consists of using sampling pumps to draw air over a sample filter for a pre-determined period in order to measure airborne quantities of asbestos.

Perimeter air sample data serves many purposes at the site. Perimeter air samples may be investigatory in nature, be used to determine compliance with Occupational Safety and Health Administration requirements, or measure attainment of site-specific action levels established by EPA to evaluate remedial investigations.

3.0 Responsibilities
Successful execution of this SOP requires a clear hierarchy of assigned roles with different sets of responsibilities associated with each role. All staff responsible for collecting perimeter air samples will understand and implement the requirements contained herein, as well as any additional requirements stated in the governing document.

Task Leader (TL) or Field Team Leader (FTL) - The TL or FTL is responsible for overseeing sample collection processes as described in this SOP. The TL or FTL is also responsible for checking all work performed and verifying that the work satisfies the objectives of the data collection effort as specified in the governing document. The TL or FTL will communicate with the field team members regarding the specific collection objectives and anticipated situations that require deviation from this SOP. It is also the responsibility of the TL or FTL to communicate the need for any deviations from the SOP with the appropriate EPA personnel and document the deviation using a BoRit Asbestos Project Field Modification Form provided in the governing document.

Field Team Members – Field team members (e.g., sampling technicians, etc.) performing remedial investigation perimeter air sampling are responsible for adhering to the procedures contained in this SOP. The field team members should have limited discretion with regard to collection procedures but should exercise judgment regarding the exact location of sample locations within the specified sampling area. Field team members are also responsible for communicating any consistent problems (e.g., equipment failure during cold weather conditions) with sample collection to the TL or FTL for the purpose of troubleshooting and information sharing with other field team members.

4.0 Required Equipment
- **Sampling pump** – Low-volume battery powered, such as an SKC Airchek Sampler Model 224-PCXR4, high-volume direct current Gast 1532 rotary vane pump, ems® AC/DC Extended Service Air Sampling System NOA (Naturally Occurring Asbestos) sample pump, or equivalent used for collecting air samples.

- **Phase contrast microscopy (PCM) sample cassettes** - commercially available 25-millimeter (mm), three-piece cassette with a 50mm electronically conductive extension cowl loaded with a 0.80 micron (µ) mixed cellulose ester (MCE) filter. A 0.80 µ MCE filter is recommended by the Office of Solid Waste and Emergency Response (OSWER) Framework for Investigating Asbestos-Contaminated Superfund Sites versus the 0.45 µ MCE filter recommended in ISO.
10312 method due to back pressure encountered with sampling pumps under dusty conditions. Therefore, a 0.80 µ MCE filter will be used for all perimeter air sample collection.

- **Sampling stands** – telescoping tripods or pelican brief telescoping handles designed specifically to hold sample cassettes at the desired height will be used to support the sample cassette in order to isolate the sample from the vibrations of the sampling pump.

- **Inert tubing** – Tygon tubing used in the sampling train to connect the outflow end of the sample cassette to the sampling pump. Tubing has a 3/16” inner diameter and 5/16” outer diameter.

- **Rotameter** – A rotameter calibrated such that the operator can measure flow rates to ±5% accuracy at the expected sampling flow rate. A rotameter is used as a secondary calibration device.

- **Drycal** – Drycal will be used to perform initial calibration on the rotameter on site. The calibration train must remain the same to ensure proper calibration. For example the same tubing must be used and a blank air cartridge must be attached to the train prior to calibration. A Drycal is used as a primary calibration device.

- **Perimeter air field sample data sheets (FSDSs)** – Specific data related to the collection of each sample will be recorded on a FSDS. This sheet will contain all relevant information regarding equipment used, flow rates, and collection times. An example copy of the perimeter air FSDS will be included as appendices in the governing document.

- **Permanent marking pen** - Used to complete field documentation (e.g., logbooks, FSDSs) and label sample cassettes and containers.

- **Sample Identification (ID) Labels (i.e., Index IDs)** – Pre-printed stickers used on field documentation (e.g., FSDSs) and to label sample cassettes and containers.

- **Half-quart sized plastic zip-top bags** – Used to store individual air sample cassettes to ensure sample integrity and prevent cross contamination.

- **Cooler or other rigid container** - Used to store bagged samples while in the field. Note that remedial investigation perimeter air samples do not require any preservatives (e.g., ice).

- **Custody Seals** - For ensuring integrity of samples while in the field and during handling and shipping.

- **Small standard screwdriver**

- **Logbook/hand-held personal digital assistant (PDA)**
5.0 Procedures
Prior to conducting work at any BoRit worksite, health and safety procedures, as specified in the governing health and safety plan will be reviewed and the appropriate personal protective equipment (PPE) donned.

5.1 Calibration of Rotameter with an Electronic Calibrator
Rotameters used for pump calibration are calibrated to a primary flow standard on a quarterly basis. The primary flow standard in use at the site is a Dry-Cal (DC)-Lite primary flow meter manufactured by Bios International Corporation. Procedures for rotameter calibration with the DC-Lite flow meter are as follows:

1. Obtain the actual temperature and pressure in Ambler, Pennsylvania from the local National Oceanic and Atmospheric Administration (NOAA) weather station or onsite meteorological station. Record actual temperature and pressure in the fields provided on the Precision Rotameter Calibration Data Sheet (Attachment 1).

2. Set up the calibration train as shown in EPA SOP #2015 (EPA 1994), Figure 4, with the sampling pump, rotameter, and primary flow meter (Attachment 2).

3. The rotameter will be held perpendicular to the plane of the table no greater than 6° off of vertical.

4. Turn the DC-Lite and sampling pump on.

5. Turn the flow adjust screw or knob on the pump until the desired flow rate is attained.

6. Calibrate rotameter to desired ball reading, as read from the middle of the flow ball, with a sampling pump and sample cassette in-line. The cassette used for calibration must be the same type and from the same lot of sample cassettes that will be used for sampling. Record value in the ball reading column on the rotameter calibration data sheet.

7. Check adjusted flow rate of sample pump to the DC-Lite flow calibrator primary flow standard. Ten repetitive flow measurements will be averaged and that result recorded in the flow rate column for the selected interval.

8. Repeat this process at 10 intervals over the range of the precision rotameter.

9. Input data into rotameter calculation sheet to generate the corrected flow rate (Attachment 1).

5.2 Flow Rates and Sample Volume
Remedial investigation perimeter air samples will be collected using flow rates ranging between 1.0 and 10.0 liters per minute (L/min), with a minimum total sample volume of 1,200 liters. Flow rates will be set at the discretion of the field team member in order to capture, at a minimum, 80 percent (%) of the workday. The sampling pump will provide a non-fluctuating
air flow through the filter, and will maintain the initial volume flow rate to within ±10% throughout the sampling period. If at any time the measurement indicates that the flow rate has increased or decreased by more than 10% of the set flow rate, sample collection will cease and the sample will be voided.

In no case will a sample be collected at a flow rate lower than 1.0 L/min, since the linear flow velocity would fall below 4 centimeters per second (cm/sec), which is the minimum velocity specified by the International Organization for Standardization (ISO) method 10312 (ISO 1995) that is used for BoRit project air samples.

As samples are initially collected during the sampling event and analyzed, flow rates and sample times may be adjusted to ensure the loading on the sample filter facilitates reaching the required sensitivity goals (i.e., to prevent filter overloading). Filter loading is discussed in more detail in Section 5.4.2 of this SOP.

5.3 Calibration of Sampling Pump with a Rotameter

Each sampling pump will be calibrated before and after each sampling event with a primary or secondary calibration device as described below. This is to ensure that each sampling pump is operating to project requirements as stated in Section 5.2.

The procedures used for sampling pump calibration are as follows:

1. Set up the calibration chain as shown in EPA SOP #2015 (EPA 1994), Figure 5 (Attachment 3) using a rotameter, sampling pump, and a representative sample cassette. The sample cassette to be used for sampling is installed between the pump and the calibrator.

2. To set up the calibration train, attach one end of tubing to the sample cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the sample cassette cap to the rotameter.

3. The flow meter should be held within 6 degrees (°) of vertical.

4. Turn the sampling pump on.

5. Turn the flow adjust screw or knob on the manifold regulating air flow to the samples until the middle of the float ball on the rotameter is lined up with the pre-calibrated flow rate value.

Note: A sampling pump, such as a Gast high volume pump, equipped with more than one manifold may be used to collect more than one sample at a time. In the case two samples will be collected from one pump, calibration must be checked after each alteration of the flow regulators. For example: Turn the knob on (manifold A) until the middle of the float ball on the rotameter is at the desired flow rate value. Turn the knob on (Manifold B) until the middle of the float ball on the rotameter is at the desired flow rate value. Verify the calibration of (manifold A), adjust as required. This process must be repeated until both (manifold A) and (manifold B) are at the desired flow rate.
Each rotameter used for field calibration will be transported to and from each sampling location in a sealed zip-top plastic bag.

5.4 Perimeter Air Sample Collection

5.4.1 Selection of Perimeter Air Sampling Locations

If not specifically discussed in the governing document, the location of each perimeter air sample will be determined by field personnel based on site-specific conditions (e.g., placement of the drilling rig, activity-based sampling (ABS), or any other intrusive activity, etc).

5.4.2 Sample Collection Protocol

Each perimeter air sample will be collected according to the following procedures:

1. Place an Index ID label on the sample cassette indicating a unique sampling ID number. Place the corresponding Index ID number on the FSDS.

2. Determine proper sample location.

3. Set up the sampling train: attach the air intake hose to the sample cassette base. Follow calibration procedures listed in Section 5.3. The sample cassette will be positioned such that it is held facing downwards at an angle equal to or less than 45° from horizontal. Set the sample cassette to a height of approximately 3 to 5 feet above ground surface. The preferred method is to use a telescoping sample stand or suitable means to place sample at such a desired height. Remove the sample cassette cap.

4. Connect the pump to a 12 volt deep cycle (marine) battery if using the ems® AC/DC Extended Service Air Sampling System NOA sample pump, otherwise just turn the pump on.

5. Record all pertinent information on the FSDS.

6. Check the sampling pump at a minimum of every 4 hours.

7. At the end of the sampling period, orient the sample cassette to face upwards. Do not remove the sampling cassette from the sampling train. Turn the pump off.

8. Collect the post-sampling flow rate with one of the calibration devices. The same sample cassette will be used to determine the post-sampling flow rate.

9. Record the post-sampling flow rate.

10. Record the stop date and time.

11. Remove the tubing from the sample cassette. Still holding the sample cassette upright, replace the inlet plug on the sample cassette cap and the outlet plug on the sample cassette base. Do not put sample cassettes in shirt or coat pockets as the filter can pick up fibers.
12. Wrap a sample custody seal around both ends of the sample cassette.

13. Place each sample cassette in a half-quart sized plastic zip-top sample bag. Each bag should be marked with indelible ink indicating the sample Index ID number.

14. Samples should be kept together in a cooler or a similar small transport box to eliminate misplacing or dropping a sample. Note that remedial investigation ambient air samples do not require any preservatives (e.g., ice).

15. Provide the sample coordinator with the appropriate documentation with the samples.

5.4.3 Pump Failure Procedures
If a sampling pump faults prior to the total desired run time, the following procedures will be used:

1. Record the time of the observed pump fault in the comments section of the FSDS.

2. If using a SKC low-volume pump, record the total sample time (in minutes) from the pump counter and note accordingly in the comments section of the FSDS sheet, then add total minutes collected to the start time and document the actual stop time in the stop time section of the FSDS.

3. If no minutes appear on the pump counter, void the sample and recollect as directed by the site health and safety officer or FTL.

4. If time allows, change out the pump and restart sampling. Turn the sampling pump back on and calibrate as required (Section 5.1) until desired sample volume requirements are met.

5.5 Equipment Decontamination
Non-disposable air sampling equipment will be decontaminated according to instructions provided in the governing document. In general, sampling pumps and tubing will be wet-wiped prior to and following sample collection.

5.6 Sample Custody
Custody requirements for perimeter air samples will be specified in the governing document.

6.0 Documentation
6.1 Logbooks
Documentation of field activities conducted as part of this program will be recorded in logbooks maintained specifically for this sampling program. Logbooks are maintained by the field administration staff and are assigned unique identification numbers.

The procedures specified in CDM SOP 4-1, Field Logbook Content and Control, Revision 5 (March 1, 2004) will be followed for logbook records.
6.2 Field Sample Data Sheets
Detailed sampling notes will be recorded for each sample on a FSDS (Attachment 1).

7.0 Quality Assurance/Quality Control

7.1 Collection of Field Quality Control Samples
Field quality control (QC) samples will consist of three types: lot blanks, field blanks, and co-located samples. The following sections describe each of these types of samples as well as their collection frequency:

Lot Blanks
Before samples are collected, two sample cassette lot blanks from each filter lot of 100 sample cassettes (1 per 50) used will be randomly selected and submitted for analysis. Lot blanks will be submitted for each filter type used. The lot blanks will be analyzed for asbestos fibers by the same method as will be used for field sample analysis. The entire batch of sample cassettes will be rejected if any asbestos fiber is detected on the lot blanks.

Field Blanks
One field blank will be collected and submitted for analysis each day sample collection begins. The field blanks will be analyzed for asbestos fibers by the same method as will be used for field sample analysis. The blanks will be collected at an area sampled during that day.

Field blanks are collected by opening the sample cassette to the ambient environment for 10 seconds then re-capping the sample cassette.

Co-located Samples
Co-located samples will be collected at a frequency of one per sampling event per filter type. Field co-located samples will be collected beside a field sample and given a unique index identification number. Each ambient air location will have a field co-located sample, collected at a lower flow rate. This lower flow sample will only be analyzed if the higher flow rate sample is compromised. The sampler will assign the same location ID to the co-located sample as the field sample, and will record the identification number of the field sample on the FSDS in the comments section. Co-located samples will be sent for analysis by the same method as field samples, if needed.

Quality assurance/quality control (QA/QC) for activities described in this SOP will be attained through a variety of processes, including, but not limited to, the items discussed below. Additional QA/QC requirements, such as audits or field assessments, will be addressed in the governing document.

7.2 Training
Every effort will be made to ensure consistency in collecting perimeter air samples. Consistency will be achieved to the extent possible through proper training, using designated field staff, and providing FTL oversight. Any deficiencies or inconsistencies in implementing this project-specific SOP noted by the FTL will require re-training of the field team.
7.3 Equipment Maintenance
The manufacturer’s instructions regarding operating procedures and maintenance will be reviewed prior to equipment use. Equipment and instrumentation will be utilized in accordance with manufactures instructions.

8.0 References


## BoRit Asbestos Project
### Precision Rotameter Calibration Data Sheet

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<th>Actual Pressure (in. Hg):</th>
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°F= Degrees Fahrenheit  
in. Hg= inches mercury

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### Rotameter Calibration Procedure.

1. Obtain the actual temperature and actual pressure in Ambler, PA from the project weather station. Record the actual temperature and actual pressure in the fields provided above.

2. Calibrate rotameter to desired ball reading with a sampling pump and cassette in-line. Cassette must be the same type and from the same lot of cassette that will be used for sampling. Record value in the Ball Reading column.

3. Check adjusted flowrate of sample pump to the Dry Cal flow calibrator primary flow standard. 10 repetitive flow measurements will be averaged and that result recorded in the Flow rate column for the selected interval.

4. Repeat this process at 10 intervals over the range of the precision rotameter.

Input data into rotameter calculation sheet to generate the corrected flow rate.
APPENDIX B (Cont’d)

Figures

FIGURE 4. Calibrating a Rotameter with a Bubble Meter
APPENDIX B (Cont'd)

Figures

FIGURE 5. Calibrating a Sampling Pump with a Rotameter
1.0 Objective
The objective of this standard operating procedure (SOP) is to establish the baseline requirements, procedures, and responsibilities inherent to the collection of outdoor ambient air samples. Air samples will be collected as part of the outdoor ambient air program conducted in accordance with the Site Management Plan for Remedial Investigation, Phase 2, Borit Asbestos Superfund Site, Operable Unit 1, Ambler, Pennsylvania, September 2010; herein referred to as BoRit Phase 2 SMP.

2.0 Background
2.1 Definitions
Outdoor ambient air sample – For the purpose of this SOP, an outdoor ambient air sample is a sample collected as specified in the BoRit Phase 2 SMP.

2.2 Discussion
The specific activities detailed in this SOP will be used to conduct sampling of outdoor ambient air in Ambler, Pennsylvania.

2.3 Associated Procedures
- CDM Federal SOP 1-2, Sample Custody, Revision 2
- CDM Federal SOP 2-1, Packaging and Shipping Environmental Samples, Revision 2
- CDM Federal SOP 2-2, Guide to Handling Investigation Derived-Waste, Revision 4
- CDM Federal SOP 4-1, Field Logbook Content and Control, Revision 5
3.0 Responsibilities

All staff with responsibility for the collection of outdoor ambient air samples are responsible for understanding and implementing the requirements contained herein as well as other related project-specific requirements.

Team Leader – The team leader is responsible for communication with EPA regarding status and progress of the sampling event and providing support to BoRit staff to ensure all necessary resources are available for implementation of the ambient air program.

Site-QA Coordinator – The site-QA coordinator is responsible for ensuring all quality assurance/quality control procedures related to this program are implemented.

Field Team Leader (FTL) – The FTL is responsible for ensuring that the specifics related to the collection of outdoor ambient air sampling described in this procedure are followed by all staff.

Field Team Members – The field team members are responsible collection and documentation of samples as described in the SAP and this SOP.

4.0 Required Equipment

The following is a general list of equipment that may be used:

- Sampling pump – An ems® AC/DC Extended Service Air Sampling System NOA (Naturally Occurring Asbestos) sample pump. The selected sampling pump will be capable of a flow-rate and pumping times sufficient to achieve the desired air sample volume. The sampling pump will provide a non-fluctuating air-flow through the filter, and will maintain the initial volume flow-rate to within ±10% throughout the sampling period.

- Phase contrast microscopy (PCM) sample cassettes - commercially available, 25mm, three-piece cassette with a 50mm electronically conductive extension cowl loaded with a 0.8µm MCE filter.

- Inert tubing – Tygon tubing used in the sampling train to connect the outflow end of the sample cassette to the sampling pump. Tubing has a 3/16” inner diameter and 5/16” outer diameter.

- Rotameter – A rotameter calibrated such that the operator can measure flow rates to ±5% accuracy at the expected sampling flow rate.

- Drycal – Drycal will be used to perform initial calibration on the rotameter on site. The calibration train must remain the same to ensure proper calibration. For example the same
tubing must be used and a blank air cartridge must be attached to the train prior to calibration. A Drycal is used as a primary calibration device.

- Air field sample data sheets – specific data related to the collection of each sample will be recorded on an ambient air field sample data sheet (FSDS), Attachment 1. This sheet will contain all relevant information regarding equipment used, flow rates, and collection times.

- Logbook

- Plastic bags

- Cooler or other rigid container - Used to store bagged samples while in the field. Note that remedial investigation stationary air samples do not require any preservatives (e.g., ice).

- 12 volt deep cycle (marine) batteries

- Custody Seals - For ensuring integrity of samples while in the field and during handling and shipping.

- Small standard screwdriver

- Permanent marking pen - Used to complete field documentation (e.g., logbooks, FSDSs) and label sample cassettes and containers.

- Sample labels

**5.0 Procedures**

**5.1 Selection of Air Volumes and Flow Rates**

Samples collected as part of the outdoor ambient air monitoring program are to be collected over a 24-hour sampling period. Samples will be collected at a flow rate of 2.5 liters/minute, which will result in a sample volume of approximately 3,600 liters.

In addition to the sample collected at the flow rate of 2.5 liters/minute, a second sample will be collected at a lower flow rate, 1.5 liters/minute. This sample is intended to serve as a backup for use if the sample collected at the 2.5 liters/minute flow rate is overloaded and can not be analyzed by TEM using direct methods.

In no event shall a sample be collected at a flow rate lower than 1.0 L/min, since the linear flow velocity would fall below 4 cm/sec, which is the minimum velocity specified by International Organization for Standardization (ISO) method 10312. As samples are initially collected during this program and analyzed, flow rates and sample times may be adjusted to ensure the sample filter has proper loading for the required analytical analysis and sensitivity goals.
5.2 Calibration Procedures and Flow Rate Adjustments

Each sampling pump will be calibrated before the start of each ambient air sample collection cycle. This is to ensure that each sampling pump is measuring the flow rate or volume of air correctly.

5.2.1 Calibration of Rotameter with an Electronic Calibrator

Rotameters used for pump calibration are calibrated to a primary flow standard on a quarterly basis. The primary flow standard in use at the site is a Dry-Cal (DC)-Lite primary flow meter manufactured by Bios International Corporation. Procedures for rotameter calibration with the DC-Lite flow meter are as follows:


   Record actual temperature and pressure in the fields provided on the Precision Rotameter Calibration Data Sheet (Attachment 2).

2. Set up the calibration train as shown in EPA SOP #2015, (Figure 4) with the sampling pump, rotameter, and primary flow meter.

3. Assemble the base of the flow meter with the screw provided and tighten in place. The flow meter should be mounted within 6° of vertical.

4. Turn the DC-Lite and sampling pump on.

5. Turn the flow adjust screw or knob on the pump until the desired flow rate is attained.

6. Calibrate rotameter to desired ball reading, as read from the middle of the flow ball, with a sampling pump and sample cassette in-line. Cassette must be the same type and from the same lot of sample cassettes that will be used for sampling. Record value in the Ball Reading column on the rotameter calibration data sheet.

7. Check adjusted flow rate of sample pump to the DC-Lite flow calibrator primary flow standard. Ten repetitive flow measurements will be averaged and that result recorded in the flow rate column for the selected interval.

8. Repeat this process at 10 intervals over the range of the precision rotameter.

9. Input data into rotameter calculation sheet to generate the corrected flow rate (Attachment 2).

5.2.2 Calibration of Sampling Pump with a Rotameter

Prior to sample collection, each sampling pump will be calibrated with a rotameter that has been calibrated as described in Section 5.2.1. The procedures used for sampling pump calibration are as follows:
1. Set up the calibration chain as shown in EPA SOP #2015 (Figure 5) using a rotameter, sampling pump and a representative sample cassette. The sample cassette to be used for sampling is installed between the pump and the calibrator.

2. To set up the calibration train, attach one end of tubing to the sample cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the sample cassette cap to the rotameter.

3. Assemble the base of the flow meter with the screw provided and tighten in place. The flow meter should be mounted within 6° of vertical.

4. Turn the sampling pump on.

5. Turn the flow adjust screw or knob on the manifold regulating air flow to the higher flow rate samples (manifold A) until the middle of the float ball on the rotameter is lined up with the pre-calibrated flow rate value.

6. Turn the flow adjust screw or knob on manifold regulating air flow to the lower flow rate samples (manifold B) until the middle of the float ball on the rotameter is lined up with the pre-calibrated flow rate value.

7. Verify the calibration of manifold A, adjust as required.

8. If adjustment of manifold A is required, verify the calibration of manifold B and adjust as required.

Each rotameter used for field calibration will be transported to and from each sampling location in a sealed zip-top plastic bag. The cap used at the end of the rotameter tubing will be replaced each morning it is used.

5.2.3 Adjustment of Flow Rates During Flow Checks

Flow checks will be performed within the first 4 hours of the sample event and at approximately 12 hours into the sampling event (during battery change out). During the checks, flow rates will be adjusted back to the target rate by adjustment of the flow adjust screw or knob. Adjustment of flow rates during flow checks will be performed as described below and as the last action before leaving a sampling location anytime the sampling pump is moved. Should the flow rate change by more than 10% the following procedure will be used to make the adjustment:

1. Connect the rotameter as described in Section 5.2.2 steps 1 to 3.

2. Record the observed flow rate and time of observation.

3. Adjust the flow rate, if necessary, to the target flow.

4. Record the new flow rate and the time flow adjustment was completed as the same minute recorded in step 2.
Each rotameter used for flow checks will be transported to and from each sampling location in a sealed zip-top plastic bag.

Should the flow rate change by more than 10% during the sampling period, the average of the pre- and post-flow rates will be used to calculate the sample volume during each check period. The individual volumes collected between these check periods will be added together to calculate the total sample volume collected.

If at any time the measurement indicated that the flow-rate has decreased by more than 30% or increased by more than 50%, the sampling shall be terminated, the affected sample archived. Figure 1 will be consulted to determine the proper procedure for further sample collection.

5.3 Sample Collection Procedures

5.3.1 Selection of Outdoor Ambient Air Sampling Locations

The position of each sampling location will be fixed; the sample will be collected from the same location for the duration of the outdoor ambient air sampling program. GPS points will be collected for the location of each station. The locations are to be positioned on the east or west side of buildings at least 15 feet from the outside wall, this will ensure the location is perpendicular to dominate wind directions in the Ambler area. The location should also be placed to minimize interference for other nearby building, structures, or large trees.

5.3.2 Sampling Protocol

Each outdoor ambient air sample will be collected, after pump calibration, according to the following procedures:
1. Place an Index ID label on the sample cassette indicating a unique sampling ID number. Place the corresponding Index ID number on the FSDS.

2. Determine proper sample location.

3. Set up the sampling train; attach the air intake hose to the sample cassette base. Follow calibration procedures listed in Section 5.2. The sample cassette will be positioned such that it is held facing downwards at an angle equal to or less than 45° from horizontal. Set the sample cassette to a height of 3 to 5 feet above ground surface. Remove the sample cassette cap.

4. Connect the pump to a 12 volt deep cycle (marine) battery.

5. Record the following in the field logbook and on the air field sample data sheet: date, time, location, sample number, pump number, starting flow rate, and starting time.

6. Turn the sampling pump on.

7. Check the sampling pump at the required frequency (within first four hours and at approximately 12 hours).

8. At the end of the sampling period, orient the sample cassette up, do not remove the sampling cassette for the sampling train. Turn the pump off.

9. Collect the post sampling flow rate. The same sample cassette will be used to determine the post sampling flow rate.

10. Record the post flow rate.

11. Record the stop date and time.

12. Remove the tubing from the sample cassette. Still holding the sample cassette upright, replace the inlet plug on the sample cassette cap and the outlet plug on the sample cassette base.

13. Place a sample label on the sample cassette indicating a unique sampling number. Do not put sample cassettes in shirt or coat pockets as the filter can pick up fibers.

14. Place sample custody seal around both ends of the sample cassette.

15. Place each sample cassette in a plastic sample bag. Each bag should be marked indicating the sample identification number.

16. Samples should be kept together in a cooler or a similar small transport box to eliminate misplacing or dropping a sample. Note that remedial investigation ambient air samples do not require any preservatives (e.g., ice).

17. Provide the sample coordinator with the appropriate documentation with the samples.
5.3.3 Pump Failure Procedures
If a sampling pump faults prior to the total desired run time, the following procedures should be used:

1. Record the time of the observed pump fault in the field notes.
2. Record the stop time as the time of the last field flow check.
3. Record the ending flow rate as the rate observed at the time of the last field flow check.
4. Turn the sampling pump back on and calibrate as required (Section 5.2.2).
5. Restart sample collection.

5.4 Collection of Meteorological (MET) Data
MET station data will be downloaded daily from the local personal weather station (PWS) KPAAMBLE2, found at:


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</tr>
<tr>
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5.5 Equipment Decontamination
Non-disposable air sampling equipment will be decontaminated according to instructions provided in the governing document. In general, sampling pumps and tubing will be wet-wiped prior to and following sample collection.

5.6 Sample Custody
Custody requirements for ambient air samples will be specified in the governing document.

5.7 Equipment Maintenance
The manufactures’ instructions regarding operating procedures and maintenance will be reviewed prior to equipment use. Equipment and instrumentation will be utilized in accordance with manufactures instructions.

5.8 Quality Assurance/Quality Control

5.8.1 Collection of Field Quality Control Samples

Field quality control (QC) samples will consist of three types: lot blanks, field blanks, and co-located samples. The following sections describe each of these types of samples as well as their collection frequency:

Lot Blanks

Before samples are collected, two sample cassette lot blanks from each filter lot of 100 sample cassettes (1 per 50) used will be randomly selected and submitted for analysis. Lot blanks will be submitted for each filter type used. The lot blanks will be analyzed for asbestos fibers by the same method as will be used for field sample analysis. The entire batch of sample cassettes will be rejected if any asbestos fiber is detected on the lot blanks.

Field Blanks

One field blank will be collected and submitted for analysis for each 24 hour sampling event. The field blanks will be analyzed for asbestos fibers by the same method as will be used for field sample analysis. The blanks will be collected at different sampling locations throughout the program (one collected at a different location each sampling event).

Field blanks are collected by opening the sample cassette to the ambient environment for 10 seconds then re-capping the sample cassette.

Co-located Samples

Co-located samples will be collected at a frequency of one per sampling event per filter type. Field co-located samples will be collected beside a field sample and given a unique index identification number. Each ambient air location will have a field co-located sample, collected at a lower flow rate. This lower flow sample will only be analyzed if the higher flow rate sample is compromised. The sampler will assign the same location ID to the co-located sample as the field sample, and will record the identification number of the field sample on the FSDS in the comments section. Co-located samples will be sent for analysis by the same method as field samples, if needed.

5.9 Documentation

5.9.1 Logbooks

Documentation of field activities conducted as part of this program will be recorded in logbooks maintained specifically for this sampling program. Logbooks are maintained by the field administration staff and are assigned unique identification numbers.

The procedures specified in CDM SOP 4-1, Field Logbook Content and Control, Revision 5 (March 1, 2004) will be followed for logbook records.
5.9.2 Field Sample Data Sheets
Detailed sampling notes will be recorded for each sample on a FSDS (Attachment 1).

5.9.3 Daily Observation Memo
A Daily Observation Memo (Attachment 3) will be completed for each Ambient Air sampling event to detail ongoing remedial activities during sampling, equipment issues and guidance document deviations.

6.0 Training
Every effort will be made to ensure consistency in collecting ambient air samples. Consistency will be achieved to the extent possible through proper training, using designated field staff, and providing FTL oversight. Any deficiencies or inconsistencies in implementing this project-specific SOP noted by the FTL will require re-training of the field team.

7.0 References


# BORIT FIELD SAMPLE DATA SHEET (FSDS) FOR AMBIENT AIR

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For Field Team Completion (Initials): Completed by: ______ QC by: ______ For Data Entry Entered by: ____ QC by: _____ For eFSDS validation Validated ______ Validated ______ Validated ______
BoRit Asbestos Project
Precision Rotameter Calibration Data Sheet

Task Order: ____________________________
Calibration Date: ____________________________ Calibrated By: ____________________________
Rotometer ID: ____________________________ Primary Standard ID: ____________________________
Actual Temp (°F): ____________________________ Actual Pressure (in. Hg): __________

°F=Degrees Fahrenheit
in. Hg= inches mercury

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<th>Ball Reading</th>
<th>Flow rate</th>
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<td>=Y (mid-ball)</td>
<td>= X₁ (L/min)</td>
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</tbody>
</table>

Rotameter Calibration Procedure.

1. Obtain the actual temperature and actual pressure in Ambler, PA from the project weather station. Record the actual temperature and actual pressure in the fields provided above.
2. Calibrate rotameter to desired ball reading with a sampling pump and cassette in-line. Cassette must be the same type and from the same lot of cassette that will be used for sampling. Record value in the Ball Reading column.
3. Check adjusted flowrate of sample pump to the Dry Cal flow calibrator primary flow standard. 10 repetitive flow measurements will be averaged and that result recorded in the Flow rate column for the selected interval.
4. Repeat this process at 10 intervals over the range of the precision rotameter.
5. Input data into rotameter calculation sheet to generate the corrected flow rate.
DAILY IMPACT/OBSERVATION MEMORANDUM
2010 Ambient Air Sampling Program - Ambler, PA

This report represents a summary of observations made during the day that could potentially impact the results of samples collected as part of the outdoor ambient air sampling program as described in the *Site Management Plan for Remedial Investigation, Phase 2, Borit Asbestos Superfund Site, Operable Unit 1, Ambler, Pennsylvania, (CDM 2010)*

- **Date:**
- **Sampler(s):**
- **Logbook No.:**
- **Weather Conditions:**

### REMEDIAL ACTIVITIES (list locations and describe project activities where OU1 remedial action is currently taking place)

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### OTHER OBSERVED ACTIVITIES (describe any activities that could impact sample viability)

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<th>Potentially Impacted Sample Location</th>
<th>Description of Activity</th>
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### EQUIPMENT ISSUES (describe any equipment issues that could affect sample viability)

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<th>Potentially Impacted Sample Location</th>
<th>Description of Activity</th>
<th>Description of Actions Taken to Rectify Issues</th>
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### DEVIATIONS FROM GUIDANCE DOCUMENTS (describe previously undocumented deviations related to the ambient air program)

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<th>Potentially Impacted Sample Location</th>
<th>Description of Deviation</th>
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GENERAL AIR SAMPLING GUIDELINES

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  Appendix B - Air Sampling Equipment and Media/Devices

SUPERCEDES: SOP #2008; Revision 1.0; 01/03/94; U.S. EPA Contract EP-W-09-031.
GENERAL AIR SAMPLING GUIDELINES

1.0 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) provides guidance in developing and implementing sampling plans to assess the impact of hazardous waste sites on ambient air. It presents the United States Environmental Protection Agency/Environmental Response Team's (U.S. EPA/ERT's) approach to air sampling and monitoring and identifies equipment requirements. It is not within the scope of this SOP to provide a generic air sampling plan. Experience, objectives, site characteristics, and chemical characteristics will dictate sampling strategy. This SOP does not address indoor air sampling.

Two basic approaches can be used to assess ambient air (also referred to as air pathway assessments): modeling and measurements. The modeling approach initially estimates or measures the overall site emission rate(s) and pattern(s). These data are input into an appropriate air dispersion model, which predicts either the maximum or average air concentrations at selected locations or distances during the time period of concern. This overall modeling strategy is presented in the first three volumes of the Air Superfund National Technical Guidance Series on Air Pathway Assessments. Specific applications of this strategy are presented in several additional Air Superfund Technical Guidance documents.

The measurement approach involves actually measuring the air impact at selected locations during specific time periods. These measurements can be used to document actual air impacts during specific time intervals (i.e., during cleanup operations) or to extrapolate the probable "worst case" concentrations at that and similar locations over a longer time period than was sampled.

This SOP addresses issues associated with this second assessment strategy. This SOP also discusses the U.S. EPA/ERT's monitoring instruments, air sampling kits, and approach to air sampling and monitoring at hazardous waste sites.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, depending on site conditions, equipment limitations, or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

Air monitoring is defined as the use of direct-reading instruments and other screening or monitoring equipment and techniques that provide instantaneous (real-time) data on the levels of airborne contaminants. The U.S. EPA/ERT maintains numerous monitors for real-time measurements. Examples of air monitoring equipment are hand-held photoionization detectors (PID), flame ionization detectors (FID), oxygen/combustible gas detectors, and remote optical sensors.

Air sampling is defined as those sampling and analytical techniques that require either off- or on-site laboratory analysis and therefore do not provide immediate results. Typically, air sampling occurs after use of real-time air monitoring equipment has narrowed the number of possible contaminants and has provided some qualitative measurement of contaminant concentration. Air sampling techniques are used to more accurately detect, identify and quantify specific chemical compounds relative to the majority of air monitoring technologies.
In the Superfund Removal Program, On-Scene Coordinators (OSCs) may request the U.S. EPA/ERT to conduct air monitoring and sampling during the following situations: emergency responses, site assessments, and removal activities. Each of these activities has a related air monitoring/sampling objective that is used to determine the potential hazards to workers and/or the community.

- Emergency Response

Emergency responses are immediate responses to a release or threatened release of hazardous substances presenting an imminent danger to public health, welfare, or the environment (i.e., chemical spills, fires, or chemical process failures resulting in a controlled release of hazardous substances). Generally these situations require rapid on-site investigation and response. A major part of this investigation consists of assessing the air impact of these releases.

- Removal Site Assessment

Removal site assessments (referred to as site assessments) are defined as any of several activities undertaken to determine the extent of contamination at a site and which help to formulate the appropriate response to a release or threatened release of hazardous substances. These activities may include a site inspection, multimedia sampling, and other data collection.

- Removal Actions

Removal actions clean up or remove hazardous substances released into the environment. Removal actions include any activity conducted to abate, prevent, minimize, stabilize, or eliminate a threat to public health or welfare, or to the environment.

Personal risk from airborne contaminants can be determined by comparing the results of on-site monitoring and sampling to health-based action levels such as the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) and the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs). Residential risk can be determined by comparing the results of off-site monitoring or sampling to health-based action levels such as those developed by the Agency for Toxic Substance and Disease Registry (ATSDR).

The extent to which valid inferences can be drawn from air monitoring/sampling depends on the degree to which the monitoring/sampling effort conforms to the objectives of the event. Meeting the project’s objectives requires thorough planning of the monitoring/sampling activities, and implementation of the most appropriate monitoring/sampling and analytical procedures. These issues will be discussed in this SOP.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Preservation, containers, handling and storage for air samples are discussed in the specific SOPs for the technique selected. In addition, the analytical method (i.e., U.S. EPA, National Institute for Occupational Safety and Health [NIOSH], and OSHA Methods) may be consulted for storage temperature, holding times and packaging requirements. After sample collection, the sampling media (i.e., cassettes or tubes) are immediately sealed. The samples are then placed into suitable containers (i.e., whirl bags, resealable bags or culture tubes) which are then placed into a shipping container.
Use bubble wrap or Styrofoam peanuts when packing air samples for shipment. DO NOT USE VERMICULITE.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Upwind sources can contribute to sample concentration. Natural sources, such as biological waste, can produce hydrogen sulfide and methane which may contribute to the overall contaminant level. Extraneous anthropogenic contaminants (i.e., burning of fossil fuels; emissions from vehicular traffic, especially diesel; and volatile compounds) from petrochemical facilities; effluvium from smoke stacks) may also contribute. Air sampling stations should be strategically placed to identify contributing sources.

Photoreactivity or reaction of the parameters of concern may occur with nonrelated compounds [i.e., nitrogen compounds and polyaromatic hydrocarbons (PAHs)]. Some sorbent media/samples should not be exposed to light during or after sampling due to photochemical effects (i.e., PAHs).

Various environmental factors, including humidity, temperature and pressure, also impact the air sampling methodology, collection efficiency and detection limit. Since the determination of air contaminants is specifically dependent on the collection parameters and efficiencies, the collection procedure is an integral part of the analytical method.

Detection limits depend on the contaminants being investigated and the particular site situation. It is important to know why the data are needed and how the data will be used. Care should be taken to ensure the detection limits are adequate for the intended use of the final results.

Some equipment may be sensitive to humidity and temperature extremes.

5.0 EQUIPMENT/APPARATUS

5.1 Direct Reading Instruments (Air Monitoring Instruments)

There are two general types of direct reading instruments: portable screening devices and specialized analytical instruments. Generally all these techniques involve acquiring, for a specific location or area, continuous or sequential direct air concentrations in either a real-time or semi- real-time mode. None of these instruments acquires true time-weighted average concentrations. In addition, these instruments are not capable of acquiring simultaneous concentration readings at multiple locations, although several are able to sequentially analyze samples taken remotely from different locations. The document, "Guide to Portable Instruments for Assessing Airborne Pollutants Arising from Hazardous Waste Sites" provides additional information about air sampling and monitoring. The hazard levels for airborne contaminants vary. See the ACGIH TLVs and the OSHA PELs for safe working levels. Common screening devices and analytical instruments are described in Appendix A.

5.2 Air Sampling Equipment and Media/Devices

5.3 Tools/Material and Equipment List

In addition to equipment and materials identified in Appendices A and B, the following equipment and materials may be required to conduct air sampling and monitoring at hazardous waste sites:

- Camera
- Site logbook
- Clipboard
- Chain of custody records
- Custody seals
- Air sampling worksheets
- Sample labels
- Small screwdriver set
- Aluminum foil
- Extension cords
- Glass cracker
- Multiple plug outlet
- Whirl bags or culture tubes
- Teflon tape
- Calibration devices
- Tygon and/or Teflon tubing
- Surgical gloves
- Lint-free gloves
- Ice
- Sample container

Use the following additional equipment when decontaminating glassware on site:

- Protective equipment (i.e., gloves, splash goggles, etc.)
  - Appropriate solvent(s)
  - Spray bottles
  - Liquinox (soap)
  - Paper towels
  - Distilled/deionized water
  - Five-gallon buckets
  - Scrub brushes and bottle brushes
Impinger sampling involves using reagents contained in a glass vial to absorb contaminants of concern (for example, NIOSH Method 3500 for formaldehyde uses 1% sodium bisulfite solution). Impinger solutions vary and are method-dependent.

Reagents such as acetone and hexane are required to decontaminate glassware and some air sampling equipment. Decontamination solutions are specified in ERT/REAC SOP #2006, Sampling Equipment Decontamination.

7.0 PROCEDURES

7.1 Air Monitoring Design

7.1.1 Initial Surveys

In general, the initial survey is considered to be a relatively rapid screening process for collecting preliminary data at hazardous waste sites. However, initial surveys may require many hours to complete and may consist of more than one entry.

Some information is generally known about the site; therefore, real-time instrumentation for specific compounds (i.e., detector tubes and electrochemical sensors) can be used to identify hot spots. Sufficient data should be obtained with real-time instruments during the initial entry to screen the site for various contaminants. When warranted, intrinsically safe or explosion-proof instruments should be used. An organic vapor analyzer (OVA) is typically used during this survey. These gross measurements may be used on a preliminary basis to (1) determine levels of personal protection, (2) establish site work zones, and (3) map candidate areas for more thorough qualitative and quantitative studies involving air sampling.

In some situations, the information obtained may be sufficient to preclude additional monitoring. Materials detected during the initial survey may call for a more comprehensive evaluation of hazards and analyses for specific compounds. Since site activities and weather conditions change, a continuous program to monitor the ambient atmosphere must be established.

7.1.2 Off-Site Monitoring

Typically, perimeter monitoring with the same instruments employed for on-site monitoring is utilized to determine site boundaries. Because air is a dynamic matrix, physical boundaries like property lines and fences do not necessarily delineate the site boundary or area influenced by a release. Whenever possible, atmospheric hazards in the areas adjacent to the on-site zone should be monitored with direct-reading instruments. Monitoring at the fenceline or at varying locations off site provides useful information regarding pollutant migration. Three to four locations downwind of the source (i.e., plume) at breathing-zone height provide a basic fingerprint of the plume. Negative instrument readings off site should not be interpreted as the complete absence of airborne toxic substances; rather, they should be considered another piece of information to assist in the preliminary evaluation. The interpretation of negative readings is instrument-
dependent. The lack of instrument readings off site should not be interpreted as the complete absence of all airborne toxic substances; rather, it is possible that the particular compound or class of compounds to which the monitoring instrument responds is not present or that the concentration of the compound(s) is below the instrument's detection limit.

7.2 Air Sampling Design

7.2.1 Sampling Plan Design

The goal of air sampling is to accurately assess the impact of a contaminant source(s) on ambient air quality. This impact is expressed in terms of overall average and/or maximum air concentrations for the time period of concern and may be affected by the transport and release of pollutants from both on- and off-site sources. The location of these sources must be taken into account as they impact the selection of sampling locations. Unlike soil and groundwater concentrations, air concentrations at points of interest can easily vary by orders of magnitude over the period of concern. This variability plays a major role in designing an air sampling plan.

Downwind air concentration is determined by the amount of material being released from the site into the air (the emission rate) and by the degree that the contamination is diluted as it is transported. Local meteorology and topography govern downwind dilution. Contaminant emission rates can also be heavily influenced by on-site meteorology and on-site activities. All of these concerns must be incorporated into an air sampling plan. A sampling strategy can be simple or complex, depending on the sampling program objectives. Programs involving characterization of the pollutant contribution from a single point source tend to be simple, whereas sampling programs investigating fate and transport characteristics of components from diverse sources require a more complex sampling strategy. In addition, resource constraints may affect the complexity of the sampling design.

An optimal sampling strategy accounts for the following site parameters:

- Location of stationary as well as mobile sources
- Analytes of concern
- Analytical detection limit to be achieved
- Rate of release and transport of pollutants from sources
- Availability of space and utilities for operating sampling equipment
- Meteorological monitoring data
- Meteorological conditions in which sampling is to be conducted

The sampling strategy typically requires that the concentration of contaminants at the source or area of concern as well as background contributions be quantified. It is important to establish background levels of contaminants in order to develop a reference point from which to evaluate the source data. Field blanks and lot blanks, as well as various other types of QA/QC samples, can be utilized to determine other sources. The impact of extraneous sources on sampling results can frequently be accounted for by
placing samplers upwind, downwind and crosswind from the subject source. The analytical data from these different sampling locations may be compared to determine statistical differences.

7.2.2 Sampling Objectives

The objectives of the sampling must be determined prior to developing the sampling plan. Does the sampling plan verify adequate levels of protection for on-site personnel, or address potential off-site impacts associated with the site or with site activities? In addition, the assumptions associated with the sampling program must be defined. These assumptions include whether the sampling is to take place under "typical," "worst case," or "one-time" conditions. If the conditions present at the time of sampling are different from those assumed during the development of the sampling plan, then quality of the data collected may be affected. The following definitions have been established:

- Typical: routine daily sampling or routine scheduled sampling at pre-established locations.
- Worst case: sampling conducted under the worst meteorological and/or site conditions which would result in elevated ambient concentrations.
- One-time: only one chance is given to collect a sample without regard to time or conditions. Qualitative data acquired under these conditions are usually applicable only to the time period during which the data were collected and may not provide accurate information to be used in estimating the magnitude of an air impact during other periods or over a long time interval.

The sampling objectives also dictate the detection limits. Sampling methods for airborne contaminants will depend upon the nature and state (solid, liquid or gas) of the contaminant. Gases and vapors may be collected in aqueous media or adsorbents, in molecular sieves, or in suitable containers. Particulates are collected by filters or impactors. The volume of sample to be collected is dependent upon an estimate of the contaminant concentration in the air, the sensitivity of the analytical method, and the standard or desired detection limit. A sufficient amount of sample must be collected to achieve the desired detection limit without interference from other contaminants. In addition, the selected method must be able to detect the target compound(s).

7.2.3 Location and Number of Individual Sampling Points

Choose the number and location of sampling points according to the variability, or sensitivity, of the sampling and analytical methods being utilized, the variability of contaminant concentration over time at the site, the level of precision required and cost limitations. In addition, determine the number of locations and placement of samplers by considering the nature of the response, local terrain, meteorological conditions, location of the site (with respect to other conflicting background sources), size of the site, and the number, size, and relative proximity of separate on-site emission sources and upwind sources. The following are several considerations for sampler placement:
GENERAL AIR SAMPLING GUIDELINES

- Location of potential on-site emission sources, as identified from the review of site background information or from preliminary on-site inspections.

- Location of potential off-site emission sources upwind of the sampling location(s). Review local wind patterns to determine the location of off-site sources relative to wind direction.

- Topographic features that affect the dispersion and transport of airborne toxic constituents. Avoid natural obstructions when choosing air sampling station locations, and account for channelization around those obstructions.

- Large water bodies, which affect atmospheric stability and the dispersion of air contaminants.

- Roadways (dirt or paved), which may generate dust that could mask site contaminants.

- Vegetation, such as trees and shrubs, which stabilizes soil and retards subsurface contaminants from becoming airborne. It also affects air flow and scrubs some contaminants from the air. Sometimes thick vegetation can make an otherwise ideal air monitoring location inaccessible.

Consider the duration of sampling activities when choosing the location and number of samples to be collected. For example, if the sampling period is limited to a few hours, one or two upwind and several downwind samples would typically be adequate, especially around major emission sources.

A short-term monitoring program ranges from several days to a few weeks and generally includes gathering data for site assessments, removal actions, and source determination data (for further modeling). Activities involved in a short-term sampling strategy must make the most of the limited possibilities for data collection. Consider moving upwind/downwind locations daily based on National Oceanic and Atmospheric Administration (NOAA) weather forecasts. Weather monitoring becomes critical where complex terrain and local meteorological effects frequently change wind direction. Often, a number of alternatives can fulfill the same objective.

Prevailing winds running the length of a valley usually require a minimum number of sampler locations; however, a complex valley may require more sampler locations to account for the wide variety of winds. Ocean/lake effects may require a radical plan to collect enough samples to reach a low detection limit. Two sets of samplers may be placed next to each other; one set would be activated during the sea breeze while the other set is turned off, and vice versa when there is no sea breeze. After the sampling event, the respective upwind and downwind samples would be combined. Another alternative for sampling near a large body of water may be to use automatic, wind-vector-operated samplers, which turn the sampler on only when the wind comes from a specified vector. At sites located on hillsides, wind will move down a valley and produce an upward fetch at the same time. Sampling locations may have to ring the site to measure
the wind's impact.

Off-site sources may affect on-site monitoring. In this case, on-site meteorological data, concurrent with sampling data, is essential to interpreting the acquired data. Also, additional upwind sampling sites may be needed to fully characterize ambient background contaminant levels. Multiple off-site sources may require several monitoring locations, but if the sources are at a sufficient distance, only one monitoring location is needed.

Topography and weather are not the only factors in sampler location; the sampling sites must be secure from vandals and mishap. Secure all sampling locations to maintain chain of custody, and to prevent tampering with samples or loss of sampling units. High-volume sampling methods often require the use of 110 VAC electric power. When portable generators are used, the power quality may affect sampler operation. Also, be aware that the generators themselves could be a potential pollution source if their placement is not carefully considered.

Air quality dispersion models can be used to place samplers. The models incorporate source information, surrounding topography, and meteorological data to predict the general distance and directions of maximum ambient concentrations. Modeling results should be used to select sampling locations in areas of maximum pollutant concentrations.

7.2.4 Time, Duration and Frequency of Sampling Events

After choosing appropriate sampling or monitoring locations, determine the sampling frequency and the number of samples to be collected. The time of day, duration and frequency of sampling events is governed by:

- The effects of site activities and meteorology on emission rates
- The diurnal effect of the meteorology on downwind dispersion
- The time period(s) of concern as defined by the objective
- The variability in the impact from other non-site-related sources
- If defined, the degree of confidence needed for either the mean or maximum downwind concentrations observed
- The precision requirements for single measurements
- Cost and other logistical considerations

The duration of the removal action and the number of hours per day that site work is conducted determine the time, duration, and frequency of samples. Short-term sampling programs may require daily sampling, while long-term programs may require 24-hour sampling every sixth or twelfth day. If the site will be undergoing removal activities 24 hours a day, continuous air sampling may be warranted. However, if the site activities will be conducted for only eight hours a day, and there are no emissions likely to occur during the remaining 16 hours, then sampling would be appropriate prior to the start of daily activities, would continue during operations, and end at the conclusion of the daily activities. An off-peak sample collection can ensure that emissions are not persisting
after the conclusion of daily cleanup activities. For some sites, emissions are still a factor several hours after daily site activities have been completed. Because of the typically decreased downwind dispersion in the evening, higher downwind concentrations than were present during daytime site activities may be detected. For sites where this is possible, the sampling duration needs to be lengthened accordingly.

Sampling duration and flow rate dictate the volume of air collected, and to a major degree, the detection limit. The analytical method selected will provide a reference to flow rate and volume. Flow rates are limited to the capacity of the pumps being employed and the contact time required by the collection media.

The duration or period of air sampling is commonly divided into two categories (1) samples collected over a brief time period are referred to as "instantaneous" or "grab" samples and are usually collected in less than five minutes and (2) average or integrated samples are collected over a significantly longer period of time. Integrated samples provide an average concentration over the entire sampling period. Integrated samples are not suited to determining cyclical releases of contaminants because periodic or cyclical events are averaged out by the proportionally long sampling duration.

Air quality dispersion models can predict the maximum air contaminant concentration expected from a source. The meteorological and site conditions expected to cause the highest concentration are known as worst-case conditions and can be identified by analyzing the modeling results. Depending upon the objective, one may sample when the model predicts worst-case conditions will exist.

7.2.5 Meteorological and Physical/Chemical Considerations

A meteorological monitoring program is an integral part of site monitoring activities. Meteorological data, which define local terrain impacts on air flow paths, are needed to interpret air concentration data. Meteorological data may be available from an existing station located near the site (i.e., at a local airport), otherwise a station should be set up at the site. This data will document the degree that samples actually were downwind and verify whether other worst-case assumptions were met. Meteorological parameters to be monitored are, at a minimum, wind speed, wind direction, and sigma theta (which is the horizontal wind direction standard deviation and an indicator of atmospheric stability). The remaining parameters primarily affect the amount of a contaminant available in the air.

- **Wind Speed**

  When the contaminant of concern is a particulate, wind speed is critical in determining whether the particulate will become airborne, the quantity of the particulate that becomes airborne, and the distance the particulate will travel from the source. Wind speed also contributes to the volatilization of contaminants from liquid sources.

- **Wind Direction**
Wind direction highly influences the path of airborne contaminants. In addition, variations in wind direction increase the dispersion of pollutants from a given source.

- Atmospheric Stability

  Atmospheric stability refers to the degree to which the atmosphere tends to dampen vertical and horizontal motion. Stable atmospheric conditions (i.e., evenings) result in low dispersion, and unstable atmospheric conditions (i.e., hot sunny days) result in higher dispersion.

- Temperature

  Higher temperatures increase the rate of volatilization of organic and some inorganic compounds and affect the initial rise of gaseous or vapor contaminants. Therefore, worst-case emission of volatiles and semivolatiles occurs at the hottest time of day, or on the hottest day.

- Humidity

  High humidity affects water-soluble chemicals and particulates. Humid conditions may dictate the sampling media used to collect the air sample, or limit the volume of air sampled and thereby increase the detection limit.

- Atmospheric Pressure

  Migration of landfill gases through the landfill surface and through surrounding soils are governed by changes in atmospheric pressure. Atmospheric pressure will influence upward migration of gaseous contaminants from shallow aquifers into the basements of overlying structures.

  In many cases, the transport and dispersion of air pollutants is complicated by local meteorology. Normal diurnal variations (i.e., temperature inversions) affect dispersion of airborne contaminants. Terrain features can enhance or create air inversions and can also influence the path and speed of air flow, complicating transport and dispersion patterns.

  The chemical characteristics of a contaminant (i.e., molecular weight, physical state, vapor pressure, aerodynamic size, temperature, reactive compounds, and photodegradation) affects its behavior and can influence the method used to sample and analyze it.

8.0 CALCULATIONS

  Volume is obtained by multiplying the sample time in minutes by the flow rate. Sample volume should be indicated on the chain of custody record. Adjustments for temperature and pressure differences may be required.

  Results are usually provided in parts per million (ppm), parts per billion (ppb), milligrams per cubic meter
(mg/m$^3$) or micrograms per cubic meter (µg/m$^3$).

Refer to the analytical method or regulatory guidelines for other applicable calculations.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The manufacturer's instructions should be reviewed prior to instrument use. Instruments must be utilized in accordance with manufacturer's instructions. Equipment checkout and calibration activities must occur prior to and after monitoring and sampling and must be documented.

9.1 QA/QC Samples

QA/QC samples provide information on the variability and usability of environmental sample results. Various QA/QC samples may be collected to detect error. QA/QC samples are submitted with the field samples for analysis to aid in identifying the origin of analytical discrepancies; then a determination can be made as to how the analytical results should be used. Collocated samples, background samples, field blanks, and lot blanks are the most commonly collected QA/QC field samples. Performance evaluation (PE) samples and matrix spikes provide additional measures of data QA/QC control. QA/QC results may suggest the need for modifying sample collection, preparation, handling, or analytical procedures if the resultant data do not meet site-specific QA or data quality objectives. Refer to ERT/REAC SOP #2005, Quality Assurance/Quality Control Samples, for further details, and suggested frequencies for submittal of QA/QC samples.

9.2 Sample Documentation

All sample and monitoring activities should be documented legibly, in ink. Any corrections or revisions should be made by lining through the incorrect entry and by initialing the error. All samples must be recorded on an Air Sampling Worksheet. A chain of custody record must be maintained from the time a sample is taken to the final deposition of the sample. Custody seals demonstrate that a sample container has not been opened or tampered with during transport or storage of samples. Refer to ERT/REAC SOP #2002, Sample Documentation, for further information.

10.0 DATA VALIDATION

Results for QA/QC samples should be evaluated for contamination. This information should be utilized to qualify the environmental sample results accordingly with data quality objectives.

11.0 HEALTH AND SAFETY

Personal protection equipment (PPE) requirements identified in federal and/or state regulations and 29 Code of Federal Regulations (CFR) 1910.120 for hazardous waste site work must be followed.

The majority of physical precautions involved in air sampling are related to the contaminant sampled. Attention should be given when sampling in potentially explosive, flammable or acidic atmospheres. On rare occasions, the collection media may be hazardous; for example, in the instance where an acidic or basic solution is utilized in an impinger.
GENERAL AIR SAMPLING GUIDELINES

When working with potentially hazardous materials, follow U.S. EPA, OSHA and corporate health and safety procedures.

12.0 REFERENCES


(5) Guide to Portable Instruments for Assessing Airborne Pollutants Arising from Hazardous Wastes, International Organization of Legal Metrology (OIML) U.S. National Working Group (NWG) for OIML, American Conference of Governmental Industrial Hygienists, Cincinnati, OH


(7) ASTM. 1990. Annual Book of Standards, Volume 11.03.

(8) Riggin, R.M. Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air. EPA/600/4-84/041.


BIBLIOGRAPHY

Removal Program Representative Sampling Guidance, Volume 2: Air, Environmental Response Branch,
APPENDIX A
Portable Screening Devices and Specialized Analytical Instruments
SOP #2008
November 1994
PORTABLE SCREENING DEVICES

Where possible, a datalogger should be used to minimize the length of time required for site personnel to be in a potentially contaminated area. Datalogger cable is available from manufacturers for linear output instruments and some nonlinear output instruments. U.S. EPA ERT/REAC has output cables for organic vapor analyzers (i.e., HNU and OVA), toxic gas analyzers (i.e., monitox) and real-time aerosol monitors (i.e., RAM and miniram).

- **Total Hydrocarbon Analyzers**

  Total hydrocarbon analyzers used to detect a variety of volatile organic compounds (VOCs) at hazardous waste sites principally employ either a photoionization detector (PID) or a flame ionization detector (FID). Compounds are ionized by a flame or an ultraviolet lamp. PIDs depend on the ionization potential of the compounds. PIDs are sensitive to aromatic and olefinic (unsaturated) compounds such as benzene, toluene, styrene, xylenes, and acetylene. Greater selectivity is possible by using low-voltage lamps. The ionization potential of individual compounds can be found in the NIOSH Pocket Guide to Chemical Hazards. These instruments are not compound-specific and are typically used as screening instruments. FIDs are sensitive to volatile organic vapor compounds such as methane, propanol, benzene and toluene. They respond poorly to organic compounds lacking hydrocarbon characteristics.

- **Oxygen and Combustible Gas Indicators**

  Combustible Gas Indicators (CGIs) provide efficient and reliable methods to test for potentially explosive atmospheres. CGI meters measure the concentration of a flammable vapor or gas in air and present these measurements as a percentage of the lower explosive limit (LEL). The measurements are temperature-dependent. The property of the calibration gas determines sensitivity. LELs for individual compounds can be found in the NIOSH Pocket Guide to Chemical Hazards. If readings approach or exceed 10% of the LEL, extreme caution should be exercised in continuing the investigation. If readings approach or exceed 25% LEL, personnel should be withdrawn immediately.

  CGIs typically house an electrochemical sensor to determine the oxygen concentration in ambient air. Normally, air contains approximately 20.9% oxygen by volume. Oxygen measurements are of particular importance for work in enclosed spaces, low-lying areas, or in the vicinity of accidents that have produced heavier-than-air vapors which could displace ambient air. The meters are calibrated for sea level and may indicate a false negative (i.e., O$_2$ content) at higher altitudes. Since the air has been displaced by other substances, these oxygen-deficient areas are also prime locations for taking additional organic vapor and combustible gas measurements. Oxygen-enriched atmospheres increase the potential for fires by their ability to contribute to combustion or to chemically react with flammable compounds and promote auto-ignition.

- **Toxic Atmosphere Analyzers**

  The toxic atmosphere analyzer is a compound-specific instrument, designed and calibrated to identify and quantify a specific compound or class of compounds in either gaseous or vapor form. Cross-sensitivity to air pollutants not of interest may be lead to erroneous results.

  U.S. EPA/ERT has the following toxic atmosphere analyzers: carbon monoxide, phosgene, nitrous oxide, hydrogen cyanide, sulfur dioxide, hydrogen sulfide, and chlorine gas.
GENERAL AIR SAMPLING GUIDELINES

- Aerosol/Particulate Monitors

A Real-Time Aerosol/Particulate Monitor (RAM) displays readings for total particulates. The instrument employs a pulse light emitting diode which generates a narrow band emission in conjunction with a photovoltaic cell to detect light scattered from particulates.

The U.S. EPA/ERT uses the RAM when the contaminant of concern is associated with particulates, and when responding to fires involving hazardous materials, to identify plume levels. The instrument is very useful in determining the presence of a plume when it is not visible. The U.S. EPA/ERT typically uses RAMs on tripods to obtain particulate concentrations at the breathing zone level. Personal dataloggers are used with the RAMs to document minimum, average and maximum concentrations. This provides real-time data without requiring those in personal protective equipment to be constantly present in the plume.

- Chemical Detector Tubes (Colorimetric Tubes)

A chemical detector tube is a hollow, tube-shaped, glass body containing one or more layers of chemically impregnated inert material. To use, the fused ends are broken off and a manufacturer-specified volume of air is drawn through the tube with a pump to achieve a given detection limit. The chemicals contained within the packing material undergo a chemical reaction with the airborne pollutant present, producing a color change during the intake of each pump stroke. The concentration of a pollutant is indicated by the length of discoloration on a calibrated scale printed on the detector tube.

- Radiation Meters

Radiation meters determine the presence and level of radiation. The meters use a gas or solid ion detection media which becomes ionized when radiation is present. The meters are normally calibrated to one probe. Meters that detect alpha, beta, and gamma radiation are available.

- Gold Film (Hydrogen Sulfide and Mercury Vapor) Monitors

Hydrogen sulfide (H$_2$S) and Mercury (Hg) monitors operate on the principle that electric resistivity increases across a gold film as a function of H$_2$S and Hg concentration. The monitors provide rapid and relatively low detection limits for H$_2$S and Hg in air. After extensive sampling periods or high concentrations of H$_2$S and Hg, the gold film must be heated to remove contamination and return the monitor to its original sensitivity.

- Infrared Detectors

Infrared detectors such as the Miniature Infrared Analyzer (MIRAN) use infrared (IR) absorption as a function of specific compounds. MIRAN instruments apply to situations where the contaminants are identified but concentrations are not. MIRAN instruments generally require AC power.
The continuous monitors described above provide qualitative measurement of air contaminants. Quantitative measurements in the field can be obtained using more sophisticated instruments, such as portable Gas Chromatographs, to analyze grab samples.

- **Direct Air Sampling Portable Gas Chromatographs (GCs)**

  Portable GCs use gas chromatography to identify and quantify compounds. The time it takes for a compound to move through a chromatographic column is a function of that specific compound or group of compounds. A trained technician with knowledge of the range of expected concentrations of compounds can utilize a portable GC in the field to analyze grab samples. GCs generally require AC power and shelter to operate. This method is limited by its reliance on a short-term grab sample to be representative of the air quality at a site.

- **Remote Optical Sensing**

  This technique, also referred to as long-path or open-path monitoring, involves transmitting either an infrared or ultraviolet light beam across a long open path and measuring the absorbance at specific wavelengths. The technique is capable of analyzing any preselected organic or inorganic volatile compound that can be resolved from compounds naturally occurring in ambient air. Current projected removal applications include perimeter monitoring during site cleanups and measurement of emission source strengths during site assessments.

- **TAGA Direct Air Sampling Mass Spectrometer/Mass Spectrometer**

  The Trace Atmospheric Gas Analyzer (TAGA), which is operated by the U.S. EPA/ERT, is capable of real-time detection of preselected organic compounds at low parts-per-billion concentrations. The instrument has been successfully used by the U.S. EPA/ERT for isolating individual emission plumes and tracking those plumes back to their sources.
APPENDIX B
Air Sampling Equipment and Media/Devices
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GENERAL AIR SAMPLING GUIDELINES

AIR SAMPLING EQUIPMENT

- High-Volume, Total Suspended Particulate (TSP) Samplers

High-volume TSP samplers collect all suspended particles by drawing air across an 8- by 10-inch glass-quartz filter. The sample rate is adjusted to 40 cubic feet per minute (CFM), or 1134 liters per minute (L/min), and it is held constant by a flow controller over the sample period. The mass of TSPs can be determined by weighing the filter before and after sampling. The composition of the filter varies according to the analytical method and the detection limit required.

- PM-10 Samplers

PM-10 samplers collect particulates with a diameter of 10 microns or less from ambient air. Particulates of this size represent the respirable fraction, and thus are of special significance. PM-10 samplers can be high-volume or low-volume. The high-volume sampler operates in the same manner as the TSP sampler at a constant flow rate of 40 CFM; it draws the sample through a special impactor head which collects particulates of 10 microns or less. The particulate is collected on an 8- by 10-inch filter. The low-volume sampler operates at a rate of approximately 17 L/min. The flow must remain constant through the impactor head to maintain the 10-micron cut-off point. The low-volume PM-10 collects the sample on 37-mm Teflon® filters.

- High-Volume PS-1 Samplers

High-volume PS-1 samplers draw a sample through polyurethane foam (PUF) or a combination foam and XAD-2 resin plug, and a glass quartz filter at a rate of 5-10 CFM (144 to 282 L/min). This system is excellent for measuring low concentrations of semivolatile compounds, PCBs, pesticides, or chlorinated dioxins in ambient air.

- Area Sampling Pumps

These pumps provide flow-rate ranges of 2-20 L/min and have a telescopic sampling mast with the sampling train. Because of the higher volume, this pump is suitable for sampling low concentrations of airborne contaminants (i.e., asbestos sampling). These pumps are also used for metals, pesticides and PAH sampling which require large sample volumes.

- Personal Sampling Pumps

Personal sampling pumps are reliable portable sampling devices that draw air samples through a number of sampling media including resin tubes, impingers, and filters. Flow rates are usually adjustable from 0.1 to 4 L/min (or 0.01 to .75 L/min with a restrictive orifice) and can remain constant for up to 8 hours on one battery charge or continuously with an AC charger/converter.

- Canister Samplers

Evacuated canister sampling systems use the pressure differential between the evacuated canister and ambient pressure to bleed air into the canister. The sample is bled into the canister at a constant rate over
the sampling period using a critical orifice, a mechanically compensated regulator, or a mass flow control device until the canister is near atmospheric pressure.

Pressure canister sampling systems use a pump to push air into the canister. To maintain a higher, more controlled flow, the pump typically controls the pressure differential across a critical orifice at the inlet of the canister, resulting in a pressurized canister at the completion of sampling.
AIR SAMPLING MEDIA/DEVICES

If possible, before employing a specific sampling method, consult the laboratory that will conduct the analyses. Many of the methods can be modified to provide better results or a wider range of results.

- Summa Canisters
  Summa canisters are highly polished passivated stainless steel cylinders. The Summa polishing process brings chrome and nickel to the surface of the canisters, which results in an inert surface. This surface restricts adsorption or reactions that occur on the canister's inner surface after collection. At the site, the canister is either placed in a sampler to control sample collection rate, or opened to collect a grab sample. Samples can be collected by allowing air to bleed into or be pumped into the canister. U.S. EPA/ERT uses 6-liter Summa canisters for VOC and permanent gas analysis.

- Passive Dosimeters
  Passive dosimeters are clip-on vapor monitors (samplers) in which the diffused contaminants are absorbed on specially prepared active surfaces. Industrial hygienists commonly use dosimeters to obtain time-weighted averages or concentrations of chemical vapors, as they can trap over 130 organic compounds. Selective dosimeters have also been developed for a number of chemicals including formaldehyde, ethylene oxide, hydrogen sulfide, mercury vapor, nitrogen dioxide, sulfur dioxide, and ozone. Dosimeters must be sent to a laboratory for analysis.

- Polyurethane Foam (PUF)
  PUF is a sorbent used with a glass filter for the collection of semivolatile organic compounds such as pesticides, PCBs, chlorinated dioxins and furans, and PAHs. Fewer artifacts (chemical changes that occur to collected compounds) are produced than with some other solid sorbents. PUF is used with the PS-1 sampler and U.S. EPA Method TO13. PUF can also be used with personal sampling pumps when sampling for PAHs using the Lewis/McCloud method. Breakthrough of the more volatile PCBs and PAHs may occur when using PUF.

- Sampling Bags (Tedlar)
  Sampling bags, like canisters, transport air samples to the laboratory for analysis. Samples are generally pumped into the bags, but sometimes a lung system is used, in which a pump creates a vacuum around the bag in a vacuum box. Then the sample flows from a source into the bag. This method is used for VOCs, fixed gases (CO₂, O₂, and N₂) and methane.

- Impingers
  An impinger allows an air sample to be bubbled through a solution, which collects a specific contaminant by either chemical reaction or absorption. For long sampling periods, the impinger may need to be kept in an ice bath to prevent the solution from evaporating during sampling. The sample is drawn through the impinger by using a sampling pump or more elaborate sampling trains with multiple impingers.

- Sorbent Tubes/Cartridges
A variety of sampling media are available in sorbent tubes, which are used primarily for industrial hygiene. A few examples are carbon cartridges, carbon molecular sieves, Tenax tubes and tubes containing the XAD-2 polymer. Depending upon the sorbent material, tubes can be analyzed using either a solvent extraction or thermal desorption. The former technique uses standard laboratory equipment and allows for multiple analyses of the same sample. The latter technique requires special, but readily available, laboratory equipment and allows only one analysis per sample. In addition, thermal desorption typically allows for lower detection limits by two or more orders of magnitude. Whenever sorbent tubes are being used for thermal desorption, they should be certified as "clean" by the laboratory doing the analysis.

Thermally Desorbed Media

During thermal desorption, high-temperature gas streams are used to remove the compounds collected on a sorbent medium. The gas stream is injected and often cryofocused into an analytical instrument, such as a GC, for compound analysis:

- **Tenax Tubes**
  
  Tenax tubes are made from commercially available polymer (p-phenylene oxide) packed in glass or stainless steel tubes through which air samples are drawn or sometimes pumped. These tubes are used in U.S. EPA Method TO1 and VOST for volatile nonpolar organic, some polar organic, and some of the more volatile semivolatile organics. Tenax is not appropriate for many of the highly volatile organics (with vapor pressure greater than approximately 200 mm Hg).

- **Carbonized Polymers**
  
  The carbonized molecular sieve (CMS), a carbonized polymer, is a commercially available, carbon sorbent packed in stainless-steel sampling tubes through which air samples are drawn or sometimes pumped. These are used in U.S. EPA Method TO2 for highly volatile nonpolar compounds which have low-breakthrough volumes on other sorbents. When high-thermal desorption temperatures are used with CMS, more variability in analysis may occur than with other sorbents.

- **Mixed Sorbent Tubes**
  
  Sorbent tubes can contain two type of sorbents. Combining the advantages of each sorbent into one tube increases the possible types of compounds to be sampled. The combination of two sorbents can also reduce the chance that highly volatile compounds will break through the sorbent media. An example of a mixed sorbent tube is the combination of Tenax and charcoal with a carbonized molecular sieve. A potential problem with mixed sorbent tubes is the breakthrough of a compound from an earlier sorbent to a later sorbent from which it cannot be desorbed.

Solvent-Extracted Media

Solvent-extracted media use the principle of chemical extraction to remove compounds collected on a sorbent media. The chemical solvent is injected into an instrument, such as a GC, for analysis of compounds. Examples of solvent-extracted media follow:

- **Chemically Treated Silica Gel**
Silica gel is a sorbent which can be treated with various chemicals. The chemically treated silica gel can then be used to sample for specific compounds in air. Examples include the DNPH-coated silica gel cartridge used with U.S. EPA Method TO11.

- **XAD-2 Polymers**

  XAD-2 polymers usually are placed in tubes, custom-packed sandwich-style with polyurethane foam, and prepared for use with U.S. EPA Method TO13 or the semi-VOST method. The polymers are used for the collection of semivolatile polar and nonpolar organic compounds. The compounds collected on the XAD-2 polymer are chemically extracted for analysis.

- **Charcoal Cartridges**

  Charcoal cartridges, consisting of primary and backup sections, trap compounds by adsorption. Ambient air is drawn through them so that the backup section verifies that breakthrough of the analytes on the first section did not occur, and the sample collection was therefore quantitative. Quantitative sample collection is evident by the presence of target chemicals on the first charcoal section and the absence on the second section. Next, the adsorbed compounds must be eluted, usually with a solvent extraction, and analyzed by GC with a detector, such as a Mass Spectrometer (MS).

- **Tenax Tubes**

  Cartridges are used in OSHA and NIOSH methods in a manner similar to charcoal cartridges but typically for less volatile compounds.

- **Particulate Filters**

  Particulate filters are used by having a sampling pump pass air through them. The filter collects the particulates present in the air and is then analyzed for particulate mass or chemical or radiological composition. Particulate filters are made from different materials which are described below.

- **Mixed Cellulose Ester (MCE)**

  MCE is manufactured from mixed esters of cellulose which are a blend of nitro-cellulose and cellulose acetate. MCE filters are used often for particulate sampling.

- **Glass Fiber**

  Glass fiber is manufactured from glass fibers without a binder. Particulate filters with glass fiber provide high flow rates, wet strength, and high, solid holding capacity. Generally, the filters are used for gravimetric analysis of particulates.

- **Polyvinyl Chloride**

  Particulate filters with polyvinyl chloride are resistant to concentrated acids and alkalis. Their low moisture pickup and light tare weight make them ideal for gravimetric analysis.
GENERAL AIR SAMPLING GUIDELINES

- **Teflon**
  
  Teflon is manufactured from polytetrafluorethylene (PTFE). Particulate filters with Teflon are easy to handle and exceptionally durable. Teflon filters are used for metal collection.

- **Silver**
  
  Particulate filters manufactured from pure silver have high collection efficiency and uniform pore size. These filters are used for mercury collection and analysis.

- **Cellulose**
  
  Particulate filters with cellulose contain less than 0.01% ash. These filters are used to collect particulates.
1.0 SCOPE AND APPLICATION

Asbestos has been used in many commercial products including building materials such as flooring tiles and sheet goods, paints and coatings, insulation, and roofing asphalts. These products and others may be found at hazardous waste sites hanging on overhead pipes, contained in drums, abandoned in piles, or as part of a structure. Asbestos tailing piles from mining operations can also be a source of ambient asbestos fibers. Asbestos is a known carcinogen and requires air sampling to assess airborne exposure to human health. This Standard Operating Procedure (SOP) provides procedures for asbestos air sampling by drawing a known volume of air through a mixed cellulose ester (MCE) filter. The filter is then sent to a laboratory for analysis. The U.S. Environmental Protection Agency/Environmental Response Team (U.S. EPA/ERT) uses one of four analytical methods for determining asbestos in air. These include: U.S. EPA's Environmental Asbestos Assessment Manual, Superfund Method for the Determination of Asbestos in Ambient Air for Transmission Electron Microscopy (TEM)\(^{(3)}\); U.S. EPA's Modified Yamate Method for TEM\(^{(2)}\); National Institute for Occupational Safety and Health (NIOSH) Method 7402 (direct method only) for TEM; and NIOSH Method 7400 for Phase Contrast Microscopy (PCM)\(^{(3)}\). Each method has specific sampling and analytical requirements (i.e., sample volume and flow rate) for determining asbestos in air.

The U.S. EPA/ERT typically follows procedures outlined in the TEM methods for determining mineralogical types of asbestos in air and for distinguishing asbestos from non-asbestos minerals. The Phase Contrast Microscopy (PCM) method is used by U.S. EPA/ERT as a screening tool since it is less costly than TEM. PCM cannot distinguish asbestos from non-asbestos fibers, therefore the TEM method may be necessary to confirm analytical results. For example, if an action level for the presence of fibers has been set and PCM analysis indicates that the action level has been exceeded, then TEM analysis can be used to quantify and identify asbestos structures through examination of their morphology crystal structures (through electron diffraction), and elemental composition (through energy dispersive X-ray analysis). In this instance samples should be collected for both analyses in side by side sampling trains (some laboratories are able to perform PCM and TEM analysis from the same filter). The Superfund method is designed specifically to provide results suitable for supporting risk assessments at Superfund sites, it is applicable to a wide range of ambient air situations at hazardous waste sites. U.S. EPA's Modified Yamate Method for TEM is also used for ambient air sampling due to high volume requirements. The PCM and TEM NIOSH analytical methods require lower sample volumes and are typically used indoors; however, ERT will increase the volume requirement for outdoor application.

Other Regulations pertaining to asbestos have been promulgated by U.S. EPA and OSHA. U.S. EPA's National Emission Standards for Hazardous Air Pollutants (NESHAP) regulates asbestos-containing waste materials. NESHAP establishes management practices and standards for the handling of asbestos and emissions from waste disposal operations (40 CFR Part 61, Subparts A and M). U.S. EPA's 40 CFR 763 (July 1, 1987)\(^{(4)}\) and its addendum 40 CFR 763 (October 30, 1987)\(^{(4)}\) provide comprehensive rules for the asbestos abatement industry. State and local regulations on these issues vary and may be more stringent than federal requirements. The OSHA regulations in 29 CFR 1910.1001 and 29 CFR 1926.58 specify work practices and safety equipment such as respiratory protection and protective clothing when handling asbestos. The OSHA standard for an 8-hour, time-weighted average (TWA) is 0.2 fibers/cubic centimeters of air. This standard pertains to fibers with a length-to-width ratio of 3 to 1 with a fiber length >5 µm\(^{(5,6)}\). An action level of 0.1 fiber/cc (one-half the OSHA standard) is the level U.S. EPA has established in which employers must initiate such activities as air monitoring, employee training, and
medical surveillance\(^{(5,6)}\). These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

### 2.0 METHOD SUMMARY

Prior to sampling, the site should be characterized by identifying on-site as well as off-site sources of airborne asbestos. The array of sampling locations and the schedule for sample collection, is critical to the success of an investigation. Generally, sampling strategies to characterize a single point source are fairly straightforward, while multiple point sources and area sources increase the complexity of the sampling strategy. It is not within the scope of this SOP to provide a generic asbestos air sampling plan. Experience, objectives, and site characteristics will dictate the sampling strategy.

During a site investigation, sampling stations should be arranged to distinguish spatial trends in airborne asbestos concentrations. Sampling schedules should be fashioned to establish temporal trends. The sampling strategy typically requires that the concentration of asbestos at the source (worst case) or area of concern (downwind), crosswind, as well as background (upwind) contributions be quantified. See Table 1 (Appendix A) for U.S. EPA/ERT recommended sampling set up for ambient air. Indoor asbestos sampling requires a different type of strategy which is identified in Table 2 (Appendix A). It is important to establish background levels of contaminants in order to develop a reference point from which to evaluate the source data. Field blanks and lot blanks can be utilized to determine other sources.

Much information can be derived from each analytical method previously mentioned. Each analytical method has specific sampling requirements and produce results which may or may not be applicable to a specific sampling effort. The site sampling objectives should be carefully identified so as to select the most appropriate analytical method. Additionally, some preparation (i.e., lot blanks results) prior to site sampling may be required, these requirements are specified in the analytical methods.

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

#### 3.1 Sample Preservation

No preservation is required for asbestos samples.

#### 3.2 Sample Handling, Container and Storage Procedures

1. Place a sample label on the cassette indicating a unique sampling number. Do not put sampling cassettes in shirt or coat pockets as the filter can pick up fibers. The original cassette box is used to hold the samples.

2. Wrap the cassette individually in a plastic sample bag. Each bag should be marked indicating sample identification number, total volume, and date.

3. The wrapped sampling cassettes should be placed upright in a rigid container so that the cassette cap is on top and cassette base is on bottom. Use enough packing material to prevent jostling or damage. Do not use vermiculite as packing material for samples. If possible, hand carry to lab.

4. Provide appropriate documentation with samples (i.e., chain of custody and requested analytical methodology).

### 4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Flow rates exceeding 16 liters/minute (L/min) which could result in filter destruction due to (a) failure of its physical support under force from the increased pressure drop; (b) leakage of air around the filter mount so that the filter is bypassed, or (c) damage to the asbestos structures due to increased impact velocities.
4.1 U.S. EPA's Superfund Method

4.1.1 Direct-transfer TEM Specimen Preparation Methods

Direct-Transfer TEM specimen preparation methods have the following significant interferences:

- C The achievable detection limit is restricted by the particulate density on the filter, which in turn is controlled by the sampled air volume and the total suspended particulate concentration in the atmosphere being sampled.
- C The precision of the result is dependent on the uniformity of the deposit of asbestos structures on the sample collection filter.
- C Air samples must be collected so that they have particulate and fiber loadings within narrow ranges. If too high a particulate loading occurs on the filter, it is not possible to prepare satisfactory TEM specimens by a direct-transfer method. If too high a fiber loading occurs on the filter, even if satisfactory TEM specimens can be prepared, accurate fiber counting will not be possible.

4.1.2 Indirect TEM Specimen Preparation Methods

Indirect TEM specimen preparation methods have the following interferences:

- C The size distribution of asbestos structures is modified.
- C There is increased opportunity for fiber loss or introduction of extraneous contamination.
- C When sample collection filters are ashed, any fiber contamination in the filter medium is concentrated on the TEM specimen grid.

It can be argued that direct methods yield an under-estimate of the asbestos structure concentration because many of the asbestos fibers present are concealed by other particulate material with which they are associated. Conversely, indirect methods can be considered to yield an over-estimate because some types of complex asbestos structures disintegrate during the preparation, resulting in an increase in the numbers of structures counted.

4.2 U.S. EPA's Modified Yamate Method for TEM

High concentrations of background dust interfere with fiber identification.

4.3 NIOSH Method for TEM

Other amphibole particles that have aspect ratios greater than 3:1 and elemental compositions similar to the asbestos minerals may interfere in the TEM analysis. Some non-amphibole minerals may give electron diffraction patterns similar to amphiboles. High concentrations of background dust interfere with fiber identification.

4.4 NIOSH Method for PCM

PCM cannot distinguish asbestos from non-asbestos fibers; therefore, all particles meeting the counting criteria are counted as total asbestos fibers. Fiber less than 0.25 um in length will not be detected by this method. High levels of non-fibrous dust particles may obscure fibers in the field of view and increase the detection limit.

5.0 EQUIPMENT/MATERIALS

5.1 Sampling Pump

The constant flow or critical orifice controlled sampling pump should be capable of a flow-rate and pumping time sufficient to achieve the desired volume of air sampled.

The lower flow personal sampling pumps generally provide a flow rate of 20 cubic centimeters/minute (cc/min) to 4 L/min. These pumps are usually battery powered. High flow pumps are utilized when flow rates between 2 L/min to 20 L/min are required. High flow pumps are used for short sampling periods so as to obtain the desired sample volume. High flow pumps usually run on AC power and can be plugged into a nearby outlet. If an outlet is not available then a generator should be obtained. The generator should be positioned downwind from the sampling pump. Additional voltage may be required if more than one pump is plugged into the same generator. Several
electrical extension cords may be required if sampling locations are remote.

The recommended volume for the Superfund method (Phase I) requires approximately 20 hours to collect. Such pumps typically draw 6 amps at full power so that 2 lead/acid batteries should provide sufficient power to collect a full sample. The use of line voltage, where available, eliminates the difficulties associated with transporting stored electrical energy.

A stand should be used to hold the filter cassette at the desired height for sampling and the filter cassette shall be isolated from the vibrations of the pump.

5.2 Filter Cassette

The cassettes are purchased with the required filters in position, or can be assembled in a laminar flow hood or clean area. When the filters are in position, a shrink cellulose band or adhesive tape should be applied to cassette joints to prevent air leakage.

5.2.1 TEM Cassette Requirements

Commercially available field monitors, comprising 25 mm diameter three-piece cassettes, with conductive extension cowls shall be used for sample collection. The cassette must be new and not previously used. The cassette shall be loaded with an MCE filter of pore size 0.45 µm, and supplied from a lot number which has been qualified as low background for asbestos determination. The cowls should be constructed of electrically conducting material to minimize electrostatic effects. The filter shall be backed by a 5 µm pore size MCE filter (Figure 1, Appendix B).

5.2.2 PCM Cassette Requirements

NIOSH Method 7400, PCM involves using a 0.8 to 1.2 µm mixed cellulose ester membrane, 25 mm diameter, 50 mm conductive cowl on cassette (Figure 2, Appendix B). Some labs are able to perform PCM and TEM analysis on the same filter; however, this should be discussed with the laboratory prior to sampling.

5.3 Other Equipment

- Inert tubing with glass cyclone and hose barb
- Whirlbags (plastic bags) for cassettes
- Tools - small screw drivers
- Container - to keep samples upright
- Generator or electrical outlet (may not be required)
- Extension cords (may not be required)
- Multiple plug outlet
- Sample labels
- Air data sheets
- Chain of Custody records

6.0 REAGENTS

Reagents are not required for the preservation of asbestos samples.

7.0 PROCEDURES

7.1 Air Volumes and Flow Rates

Sampling volumes are determined on the basis of how many fibers need to be collected for reliable measurements. Therefore, one must estimate how many airborne fibers may be in the sampling location.

Since the concentration of airborne aerosol contaminants will have some effect on the sample, the following is a suggested criteria to assist in selecting a flow rate based on real-time aerosol monitor (RAM) readings in milligrams/cubic meter (mg/m³).

<table>
<thead>
<tr>
<th>Concentration</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low RAM readings: ≤6.0 mg/m³</td>
<td>11-15. L/min</td>
</tr>
<tr>
<td>Medium RAM readings: &gt;6.0 mg/m³</td>
<td>7.5 L/min</td>
</tr>
<tr>
<td>High RAM readings: &gt;10. mg/m³</td>
<td>2.5 L/min</td>
</tr>
</tbody>
</table>

In practice, pumps that are available for environmental sampling at remote locations operate under a maximum load of approximately 12 L/min.

7.1.1 U.S. EPA’s Superfund Method

The Superfund Method incorporates an indirect preparation procedure to provide flexibility in the amount of deposit that can be tolerated on the sample filter and to allow for the selective concentration of asbestos prior to analysis. To minimize contributions to background contamination from asbestos present in the plastic matrices of membrane filters while allowing for sufficient quantities of asbestos to be collected, this method also requires the collection of a larger volume of air per unit area of filter than has traditionally been collected.
for asbestos analysis. Due to the need to collect large volumes of air, higher sampling flow rates are recommended in this method than have generally been employed for asbestos sampling in the past. As an alternative, samples may be collected over longer time intervals. However, this restricts the flexibility required to allow samples to be collected while uniform meteorological conditions prevail.

The sampling rate and the period of sampling should be selected to yield as high a sampled volume as possible, which will minimize the influence of filter contamination. Wherever possible, a volume of 15 cubic meters (15,000 L) shall be sampled for those samples intended for analysis only by the indirect TEM preparation method (Phase 1 samples). For those samples to be prepared by both the indirect and the direct specimen preparation methods (Phase 2 samples), the volumes must be adjusted so as to provide a suitably-loaded filter for the direct TEM preparation method. One option is to collect filters at several loadings to bracket the estimated optimum loading for a particular site. Such filters can be screened in the laboratory so that only those filters closest to optimal loading are analyzed. It has been found that the volume cannot normally exceed 5 cubic meters (5000 L) in an urban or agricultural area, and 10 cubic meters (10,000 L) in a rural area for samples collected on a 25 mm filter and prepared by a direct-transfer technique.

An upper limit to the range of acceptable flow rates for this method is 15 L/min. At many locations, wind patterns exhibit strong diurnal variations. Therefore, intermittent sampling (sampling over a fixed time interval repeated over several days) may be necessary to accumulate 20 hours of sampling time over constant wind conditions. Other sampling objectives also may necessitate intermittent sampling. The objective is to design a sampling schedule so that samples are collected under uniform conditions throughout the sampling interval. This method provides for such options. Air volumes collected on Phase I samples are maximized (<16 L/min). Air volumes collected on Phase 2 samples are limited to provide optimum loading for filters to be prepared by a direct-transfer procedure.

### 7.1.2 U.S. EPA’s Modified Yamate Method for TEM

U.S. EPA’s TEM method requires a minimum volume of 560 L and a maximum volume of 3,800 L in order to obtain an analytical sensitivity of 0.005 structures/cc. The optimal volume for TEM is 1200 L to 1800 L. These volumes are determined using a 200 mesh EM grid opening with a 25-mm filter cassette. Changes in volume would be necessary if a 37-mm filter cassette is used since the effective area of a 25 mm (385 sq mm) and 37 mm (855 sq m) differ.

### 7.1.3 NIOSH Method for TEM and PCM

The minimum recommended volume for TEM and PCM is 400 L at 0.1 fiber/cc. Sampling time is adjusted to obtain optimum fiber loading on the filter. A sampling rate of 1 to 4 L/min for eight hours (700 to 2800 L) is appropriate in non-dusty atmospheres containing 0.1 fiber/cc. Dusty atmospheres i.e., areas with high levels of asbestos, require smaller sample volumes (<400 L) to obtain countable samples. In such cases, take short, consecutive samples and average the results over the total collection time. For documenting episodic exposures, use high flow rates (7 to 16 L/min) over shorter sampling times. In relatively clean atmospheres where targeted fiber concentrations are much less than 0.1 fiber/cc, use larger sample volumes (3,000 to 10,000 L) to achieve quantifiable loadings. Take care, however, not to overload the filter with background dust. If > 50% of the filter surface is covered with particles, the filter may be too overloaded to count and will bias the measured fiber concentration. Do not exceed 0.5 mg total dust loading on the filter.

### 7.2 Calibration Procedures

In order to determine if a sampling pump is measuring the flow rate or volume of air correctly, it is necessary to calibrate the instrument. Sampling pumps should be calibrated immediately before and after each use. Preliminary calibration should be conducted using a primary calibrator such as a soap bubble type calibrator, (e.g., a Buck Calibrator, Gilibrator, or equivalent primary calibrator) with a representative filter cassette installed between the pump and the calibrator. The representative sampling cassette can be reused for calibrating other pumps that will be used for asbestos sampling. The same cassette lot used for sampling should also be used for the calibration. A sticker should be affixed to the outside of the extension cowl marked "Calibration Cassette."
A rotameter can be used provided it has been recently precalibrated with a primary calibrator. Three separate constant flow calibration readings should be obtained both before sampling and after sampling. Should the flow rate change by more than 5% during the sampling period, the average of the pre- and post-calibration rates will be used to calculate the total sample volume. The sampling pump used shall provide a non-fluctuating air-flow through the filter, and shall maintain the initial volume flow-rate to within ± 10% throughout the sampling period. The mean value of these flow-rate measurements shall be used to calculate the total air volume sampled. A constant flow or critical orifice controlled pump meets these requirements. If at any time the measurement indicates that the flow-rate has decreased by more than 30%, the sampling shall be terminated. Flexible tubing is used to connect the filter cassette to the sampling pump. Sampling pumps can be calibrated prior to coming on-site so that time is saved when performing on-site calibration.

7.2.1 Calibrating a Personal Sampling Pump with an Electronic Calibrator

1. See Manufacturer's manual for operational instructions.

2. Set up the calibration train as shown in (Figure 3, Appendix B) using a sampling pump, electronic calibrator, and a representative filter cassette. The same lot sampling cassette used for sampling should also be used for calibrating.

3. To set up the calibration train, attach one end of the PVC tubing (approx. 2 foot) to the cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the electronic calibrator.

4. Turn the electronic calibrator and sampling pump on. Create a bubble at the bottom of the flow chamber by pressing the bubble initiate button. The bubble should rise to the top of the flow chamber. After the bubble runs its course, the flow rate is shown on the LED display.

5. Perform the calibration three times until the desired flow rate of ± 5% is attained.

7.2.2 Calibrating a Rotameter with an Electronic Calibrator

1. See manufacturer's manual for operational instructions.

2. Set up the calibration train as shown in (Figure 4, Appendix B) using a sampling pump, rotameter, and electronic calibrator.

3. Assemble the base of the flow meter with the screw provided and tighten in place. The flow meter should be mounted within 6° vertical.

4. Turn the electronic calibrator and sampling pump on.

5. Create a bubble at the bottom of the flow chamber by pressing the bubble initiate button. The bubble should rise to the top of the flow chamber. After the bubble runs its course, the flow rate is shown on the LED display.

6. Turn the flow adjust screw or knob on the pump until the desired flow rate is attained.

7. Record the electronic calibrator flow rate reading and the corresponding rotameter reading. Indicate these values on the rotameter (sticker). The rotameter should be able to work within the desired flow range. Readings can also be calibrated for 10 cm³ increments for Low Flow rotameters, 500 cm³ increments for medium flow rotameters and 1 liter increments for high flow rotameters.

8. Perform the calibration three times until the desired flow rate of ± 5% is attained. Once on site, a secondary calibrator, i.e., rotameter may be used to calibrate sampling pumps.

7.2.3 Calibrating a Personal Sampling Pump with a Rotameter

1. See manufacturer's manual for Rotameter's Operational Instructions.
2. Set up the calibration train as shown in (Figure 5, Appendix B) using a rotameter, sampling pump, and a representative sampling cassette.

3. To set up the calibration train, attach one end of the PVC tubing (approx. 2 ft) to the cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the rotameter.

4. Assemble the base of the flow meter with the screw provided and tighten in place. The flow meter should be mounted within 6° vertical.

5. Turn the sampling pump on.

6. Turn the flow adjust screw (or knob) on the personal sampling pump until the float ball on the rotameter is lined up with the precalibrated flow rate value. A sticker on the rotameter should indicate this value.

7. A verification of calibration is generally performed on-site in the clean zone immediately prior to the sampling.

### 7.3. Meteorology

It is recommended that a meteorological station be established. If possible, sample after two to three days of dry weather and when the wind conditions are at 10 mph or greater. Record wind speed, wind direction, temperature, and pressure in a field logbook. Wind direction is particularly important when monitoring for asbestos downwind from a fixed source.

### 7.4 Ambient Sampling Procedures

#### 7.4.1 Pre-site Sampling 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.

2. Obtain necessary sampling equipment and ensure it is in working order and fully charged (if necessary).

3. Perform a general site survey prior to site entry in accordance with the site specific Health and Safety plan.

4. Once on-site the calibration is performed in the clean zone. The calibration procedures are listed in Section 7.2.

5. After calibrating the sampling pump, mobilize to the sampling location.

#### 7.4.2 Site Sampling

1. To set up the sampling train, attach the air intake hose to the cassette base. Remove the cassette cap (Figure 6 and 7, Appendix B). The cassette should be positioned downward, perpendicular to the wind.

2. If AC or DC electricity is required then turn it on. If used, the generator should be placed 10 ft. downwind from the sampling pump.

3. Record the following in a field logbook: date, time, location, sample identification number, pump number, flow rate, and cumulative time.

4. Turn the pump on. Should intermittent sampling be required, sampling filters must be covered between active periods of sampling. To cover the sample filter: turn the cassette to face upward, place the cassette cap on the cassette, remove the inlet plug from the cassette cap, attach a rotameter to the inlet opening of the cassette cap to measure the flow rate, turn off the sampling pump, place the inlet plug into the inlet opening on the cassette cap. To resume sampling: remove the inlet plug, turn on the sampling pump, attach a rotameter to measure the flow rate, remove the cassette cap, replace the inlet plug in the cassette cap and invert the cassette, face downward and perpendicular to the wind.

5. Check the pump at sampling midpoint if sampling is longer than 4 hours. The generators may need to be regased depending on tank size. If a filter darkens in appearance or if loose dust is seen in the filter, a second sample should be started.
6. At the end of the sampling period, orient the cassette up, turn the pump off.

7. Check the flow rate as shown in Section 7.2.3. When sampling open-faced, the sampling cap should be replaced before post calibrating. Use the same cassette used for sampling for post calibration (increase dust/fiber loading may have altered the flow rate.

8. Record the post flow rate.

9. Record the cumulative time or run.

10. Remove the tubing from the sampling cassette. Still holding the cassette upright, replace the inlet plug on the cassette cap and the outlet plug on the cassette base.

7.4.3. Post Site Sampling

1. Follow handling procedures in Section 3.2, steps 1-4.

2. Obtain an electronic or hard copy of meteorological data which occurred during the sampling event. Record weather: wind speed, ambient temperature, wind direction, and precipitation. Obtaining weather data several days prior to the sampling event can also be useful.

7.5 Indoor Sampling Procedures

PCM analysis is used for indoor air samples. When analysis shows total fiber count above the OSHA action level 0.1 f/cc then TEM (U.S. EPA's Modified Yamate Method) is used to identify asbestos from non-asbestos fibers.

Sampling pumps should be placed four to five feet above ground level away from obstructions that may influence air flow. The pump can be placed on a table or counter. Refer to Table 2 (Appendix A) for a summary of indoor sampling locations and rationale for selection.

Indoor sampling utilizes high flow rates to increased sample volumes (2000 L for PCM and 2800 to 4200 L for TEM) in order to obtain lower detection limits below the standard, (i.e., 0.01 f/cc or lower [PCM] and 0.005 structures/cc or lower [TEM]).

7.5.1 Aggressive Sampling Procedures

Sampling equipment at fixed locations may fail to detect the presence of asbestos fibers. Due to limited air movement, many fibers may settle out of the air onto the floor and other surfaces and may not be captured on the filter. In the past, an 8-hour sampling period was recommended to cover various air circulation conditions. A quicker and more effective way to capture asbestos fibers is to circulate the air artificially so that the fibers remain airborne during sampling. The results from this sampling option typifies worst case condition. This is referred to as aggressive air sampling for asbestos. Refer to Table 2 for sample station locations.

1. Before starting the sampling pumps, direct forced air (such as a 1-horsepower leaf blower or large fan) against walls, ceilings, floors, ledges, and other surfaces in the room to initially dislodge fibers from surfaces. This should take at least 5 minutes per 1000 sq. ft. of floor.

2. Place a 20-inch fan in the center of the room. (Use one fan per 10,000 cubic feet of room space.) Place the fan on slow speed and point it toward the ceiling.

3. Follow procedures in Section 7.4.1 and 7.4.2 (Turn off the pump and then the fan(s) when sampling is complete.).

4. Follow handling procedures in Section 3.2, steps 1-4.

8.0 CALCULATIONS

The sample volume is calculated from the average flow rate of the pump multiplied by the number of minutes the pump was running (volume = flow rate X time in minutes). The sample volume should be submitted to the laboratory and identified on the chain of custody for each sample (zero for lot, field and trip blanks).

The concentration result is calculated using the sample volume and the numbers of asbestos structures reported after the application of the cluster and matrix counting criteria.
9.0 QUALITY ASSURANCE/QUALITY CONTROL

Follow all QA/QC requirements from the laboratories as well as the analytical methods.

9.1 TEM Requirements

1. Examine lot blanks to determine the background asbestos structure concentration.

2. Examine field blanks to determine whether there is contamination by extraneous asbestos structures during specimen preparation.

3. Examine laboratory blanks to determine if contamination is being introduced during critical phases of the laboratory program.

4. To determine if the laboratory can satisfactorily analyze samples of known asbestos structure concentrations, reference filters shall be examined. Reference filters should be maintained as part of the laboratory's Quality Assurance program.

5. To minimize subjective effects, some specimens should be recounted by a different microscopist.

6. Asbestos laboratories shall be accredited by the National Voluntary Laboratory Accreditation Program.

7. At this time, performance evaluation samples for asbestos in air are not available for Removal Program Activities.

9.2 PCM Requirements

1. Examine reference slides of known concentration to determine the analyst's ability to satisfactorily count fibers. Reference slides should be maintained as part of the laboratory's quality assurance program.

2. Examine field blanks to determine if there is contamination by extraneous structures during sample handling.

3. Some samples should be relabeled then submitted for counting by the same analyst to determine possible bias by the analyst.

4. Participation in a proficiency testing program such as the AIHA-NIOSH proficiency analytical testing (PAT) program.

10.0 DATA VALIDATION

Results of quality control samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results accordingly with the project's data quality objectives.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and corporate health and safety procedures. More specifically, when entering an unknown situation involving asbestos, a powered air purifying respirator (PAPR) (full face-piece) is necessary in conjunction with HEPA filter cartridges. See applicable regulations for action level, PEL, TLV, etc. If previous sampling indicates asbestos concentrations are below personal health and safety levels, then Level D personal protection is adequate.

12.0 REFERENCES


U.S. Environmental Protection Agency. Asbestos-Containing Materials in Schools; Final Rule and Notice. 52 FR 41826.

# APPENDIX A

Tables

## TABLE 1.

SAMPLE STATIONS FOR OUTDOOR SAMPLING

<table>
<thead>
<tr>
<th>Sample Station Location</th>
<th>Sample Numbers</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upwind/Background</strong>&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td></td>
<td>Collect a minimum of two simultaneous upwind/background samples 30° apart from the prevailing windlines. Establishes background fiber levels.</td>
</tr>
<tr>
<td><strong>Downwind</strong></td>
<td></td>
<td>Deploy a minimum of 3 sampling stations in a 180 degree arc downwind from the source. Indicates if asbestos is leaving the site.</td>
</tr>
<tr>
<td><strong>Site Representative and/or Worst Case</strong></td>
<td></td>
<td>Obtain one site representative sample which shows average condition on-site or obtain worst case sample (optional). Verify and continually confirm and document selection of proper levels of worker protection.</td>
</tr>
</tbody>
</table>

<sup>(1)</sup> More than one background station may be required if the asbestos originates from different sources.
## APPENDIX A (Cont’d)

### Tables

**TABLE 2**

**SAMPLE STATIONS FOR INDOOR SAMPLING**

<table>
<thead>
<tr>
<th>Sample Station Location</th>
<th>Sample Numbers</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor Sampling</td>
<td>If a work site is a single room, disperse 5 samplers throughout the room.</td>
<td>Establishes representative samples from a homogeneous area.</td>
</tr>
<tr>
<td></td>
<td>If the work site contains up to 5 rooms, place at least one sampler in each room.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>If the work site contains more than 5 rooms, select a representative sample of the rooms.</td>
<td></td>
</tr>
<tr>
<td>Upwind/Background</td>
<td>If outside sources are suspected, deploy a minimum of two simultaneous upwind/background samples 30° apart from the prevailing windlines.</td>
<td>Establish whether indoor asbestos concentrations are coming from an outside source.</td>
</tr>
<tr>
<td>Worst Case</td>
<td>Obtain one worst case sample, i.e., aggressive sampling (optional).</td>
<td>Verify and continually confirm and document selection of proper levels of worker protection.</td>
</tr>
</tbody>
</table>
FIGURE 1. Transmission Electron Microscopy Filter Cassette
FIGURE 2. Phase Contrast Microscopy Filter Cassette
FIGURE 3. Calibrating a Personal Sampling Pump with a Bubble Meter
APPENDIX B (Cont’d)

Figures

FIGURE 4. Calibrating a Rotameter with a Bubble Meter
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Figures

FIGURE 5. Calibrating a Sampling Pump with a Rotameter
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FIGURE 6. Personal Sampling Train for Asbestos
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FIGURE 7. High Flow Sampling Train for Asbestos
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A - Tables
1.0 SCOPE AND APPLICATION

As a result of a directive issued by the United States Environmental Protection Agency (U.S. EPA) Office of Solid Waste and Emergency Response (OSWER Directive 9345.4), estimating asbestos exposures resulting from suspension of soils is an area of increased importance to the Superfund Program. Such exposures may be estimated via monitoring and/or modeling methods. At present, models are not available to accurately estimate asbestos exposure associated with the disturbance of contaminated soil. Therefore, personal monitoring in the form of activity-based sampling (ABS) is the most appropriate technique to estimate exposure. Personal exposure is influenced by the activities performed, the duration of the activity and the site-specific soils of interest.

At a number of diverse sites across the county (Clear Creek Management Area, San Benito County, California (CA), El Dorado Schools, North Ridge Estates, Klamath Falls, Oregon, Slodusty Road, Garden Valley CA, Ambler Alaska), the U.S. EPA has demonstrated that disturbance of soil with low levels of asbestos (including soil concentrations less than 1.0 percent (%) as measured by Polarized Light Microscopy) can potentially result in significant concentrations (>0.1 structures per cubic centimeter) of respirable asbestos fibers in the breathing zone of individuals engaged in various physical activities. This may result in a cancer risk in excess of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) remedial objectives.

Since personal monitoring is more representative of actual exposure than samples obtained from a fixed downwind location (McBride 1999, Rodes 1995, Hildemann 2005), personal monitoring results are generally most relevant to CERCLA risk characterizations. Thus the best measure of actual exposure to an individual would be through the collection of personal air samples over the exposure period of interest (NIOSH 1977). However, at CERCLA sites, it is neither always possible nor practical to do so. EPA has thus developed a sampling procedure called ABS, designed to mimic the activities of a potential receptor.

As part of ABS, U.S. EPA or contractor personnel trained in hazard recognition and mitigation, serve as surrogates for the potentially exposed populace of interest. ABS simulates routine activities in order to mimic and evaluate or predict personal exposures from disturbance of materials potentially contaminated with asbestos. Similar sampling approaches have been used to assess exposures to pesticides and lead (U.S. EPA 2000) and this technique has long been a cornerstone of industrial hygiene wherein workplace exposures are routinely assessed via personal exposure monitoring.

This document provides guidance for ABS for a particular set of activities or scenarios. Personal monitoring may be conducted during various activities such as raking, All-Terrain Vehicle (ATV) riding, rototilling, digging, a child playing in the dirt, weed whacking, lawn mowing, walking with a stroller, bicycling, and playing basketball.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.
This document is not intended to be used as a substitute for a site-specific Quality Assurance Project Plan (QAPP) or a detailed Sampling and Analysis Plan (SAP). This document is intended to be used as a reference for developing site-specific QAPPs and SAPs.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

There are two types of ABS that can be employed in the field: generic ABS and site-specific ABS. Generic ABS can be used with potentially contaminated soil and utilizes a rake to disturb the soil over a known area in conjunction with the collection of air samples to characterize potential exposure. Site-specific ABS is also used with contaminated soil; however, it utilizes site-specific activities to disturb the soil, such as riding ATVs, jogging or riding bikes. Although site-specific ABS provides a more realistic measure of fiber release, it can also be more resource intensive and it is recommended to be used after the generic ABS, if results deem necessary.

For all ABS events, asbestos samples should be collected from the breathing zones of the subjects at an appropriate flow rate. Special consideration should be given to characterizing exposure to children as it has been hypothesized that children are more prone to exposure than adults (U.S. EPA 2000) because they tend to be closer to the source. Sample flow rates, duration and final volume will need to be weighed against the number of grid openings that must be counted (cost factor) to obtain the needed sensitivity. Sampling periods should be of sufficient durations (averaging time) to facilitate collection of a representative sample and achieving the required level of sensitivity.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

3.1 Sample Preservation

No preservation is required for asbestos samples.

3.2 Sample Handling, Container, and Storage Procedures

1. Place a sample label on the cassette indicating a unique sampling number. Do not put sampling cassettes in shirt or coat pockets as the filter can pick up fibers or a static charge that could disturb the dust deposited on the filter media.

2. Samples must be handled gently with the filter inlet facing upward to avoid disturbing the particulate deposited on the filter and to minimize the potential of imparting a static charge to the cassette, which might alter the particulate deposition on the filter media.

3. Place the cassette individually in a manila-type envelope. Each envelope should be marked with the sample identification number, total volume, and date.
4. To the best extent possible, the sampling cassettes in the manila envelopes should be placed right side up so that the cassette inlet cap is on top and cassette base is on bottom. Place samples into a shipping container and use enough packing material to prevent jostling or damage. Samples must be handled gently so as not to disturb the dust deposited on the filter media. Do not use vermiculite or any other type of fibrous packing material for samples. If possible, hand carry to lab.

5. Provide appropriate documentation with samples (i.e., chain of custody and requested analytical methodology).

4.0  INTERFERENCES AND POTENTIAL PROBLEMS

4.1 Area Selection

When selecting areas for ABS, consideration should be given to the potential for off-site migration of contaminants and possible exposure of the public. Within the constraints of ABS, to the degree practical, particulate generation migration off-site should be minimized, and constraints or mitigation protocols established to eliminate public exposure. These constraints/mitigation protocols may include conducting the ABS in remote areas of the site, dust suppression using water mist, building a containment structure, etc. Air sampling should be conducted to document the airborne concentration of asbestos at the site perimeter during activities.

4.2 Flow Rate Considerations

For activities that generate a large quantity of dust (i.e., particulates), sample flow rates may need to be reduced accordingly to avoid overloading the filters. For example, a sampling pump flow rate of approximately 3.0 liters per minute (L/min) was found most effective at one site for monitoring for asbestos while riding ATVs on dusty soils while high soil moisture and reduced particulate generation at another site permitted a 5.0 L/min flow rate.

High flow rates may result in filter damage due to failure of its physical support associated with increased pressure drop, leakage of air around the filter mount so that the filter is bypassed or damage to the asbestos structures (breakup of bundles and clusters) due to increased impact velocities (ISO 10312). High flow rates can also tear the filters during initial pump startup due to the shock load placed on the filter when the pump is first started.

Sampling larger volumes of air and analyzing greater areas of the filter media can theoretically lower the limit of detection indefinitely. In practice, the total suspended particulate (TSP) concentration limits the volume of air that can be filtered as TSP can obscure asbestos fibers. The International Organization for Standardization (ISO) Method 10312 states that the direct analytical method cannot be used if the general particulate loading exceeds approximately 10% coverage of the collection filter. An airborne concentration of approximately 10 micrograms per cubic meter
(µg/m³), corresponding to clean rural air, results in approximately 10% coverage of the filter media based on a 4000-L sample.

The following formula from ISO 10132 may be used to calculate the analytical sensitivity:

\[
S = \frac{A_t}{KA_gV}
\]

Where:

- \( S \) = Analytical sensitivity expressed in structures per liter
- \( A_t \) = Active area in square millimeters of the collection media or filter
- \( A_g \) = Mean area in square millimeters (mm²) of the grid openings examined,
- \( K \) = Number of grid openings examined
- \( V \) = Volume of air sampled, in liters

NOTE: 25-millimeter (mm) cassettes have an effective filter area of 385 mm² and 37-mm cassettes have an effective filter area of 855 mm². The typical grid opening is 0.0057 mm². Note: Grid size will vary between laboratories and dimensions should be verified prior to calculating the number of grid openings that must be counted to achieve a particular level of sensitivity.

Table 1 provides an example of the minimum number of grid openings that must be counted in order to achieve various sensitivity and detection limits.

It is frequently more efficient to employ co-located samplers to collect a high and low volume of air. This increases the likelihood of at least one of the two samples being readable using the direct analytical method (ISO 10312) than to lose the sample due to overloading or having to analyze by the indirect method (ISO 13794).

4.3 Transmission Electron Microscopy (TEM) Specimen Preparation Methods

It can be argued that direct methods yield an under-estimate of the asbestos structure concentration because other particulate material with which they are associated conceals many of the asbestos fibers present. Conversely, indirect methods can be considered to yield an over-estimate because some types of complex asbestos structures disintegrate during the preparation, resulting in an increase in the numbers of structures counted.
4.3.1 Direct-Transfer TEM Specimen Preparation Methods

Direct-transfer preparation methods are intended to retain all particles in the same relative positions with respect to each other on the final TEM grids as on the original filter. The membrane filter, or a portion of it, is placed on a microscope slide with the sample face upward, and then collapsed by exposure to acetone vapor. The cleared filter is then etched in a low-temperature plasma asher, subsequently coated with carbon in a sputtering device and then peeled from the glass slide. A portion of the collapsed, etched and carbon-coated filter is then transferred to an electron microscope grid and then extracted with dimethylformamide, glacial acetic acid and water to remove the filter. Once the process is complete, the particles originally collected on the filter are bound in the carbon film and the grids can be observed on a transmission electron microscope (ISO 1995). Direct-transfer TEM specimen preparation methods have the following significant interferences:

- The particulate density on the filter, which in turn is controlled by the sampled air volume and the total suspended particulate concentration in the atmosphere being sampled, restricts the achievable detection limit.
- The precision of the result is dependent on the uniformity of the deposit of asbestos structures on the sample collection filter.
- Air samples must be collected so that they have particulate and fiber loadings within narrow ranges. If too high a particulate loading occurs on the filter, it is not possible to prepare satisfactory TEM specimens by a direct-transfer method. If too high a fiber loading occurs on the filter, even if satisfactory TEM specimens can be prepared, accurate fiber counting may not be possible.

4.3.2 Indirect TEM Specimen Preparation Methods

In the indirect preparation method the membrane filter, or a portion thereof, is placed on a microscope slide, sample face downward, and ashed in a low temperature asher until complete calcination of the filter is achieved. The ash is then recovered in distilled water and the solution then filtered on a polycarbonate filter. The indirect transfer method redistribute the particulate on a new membrane filter.

Indirect TEM specimen preparation methods have the following interferences:

- The size distribution of asbestos structures is modified (clusters, matrices bundles, etc. may be broken up during sample preparation).
- There is increased opportunity for fiber loss or introduction of extraneous contamination from laboratory glassware, process water, etc.
When sample collection filters are ashed, any fiber contamination in the filter medium is concentrated on the TEM specimen grid.

The direct analytical method (ISO 10312) is the preferred method and every reasonable effort should be made to prevent overloading of the filter, which would necessitate use of the indirect method. Samples that are overloaded may, at the discretion of the project management team, be analyzed by ISO Method 13794 “Ambient air – Determination of asbestos fibres – Indirect-transfer transmission electron microscopy method” (ISO 1999). Results of the ISO 13794 analysis should be reviewed discrete of the ISO 10312 samples and a decision made regarding combining the two data sets.

4.4 Sampling Cassette Orientation

Air sampling cassettes must be oriented with the open face pointing down to preclude large non-respirable particles from falling or settling onto the filter media.

5.0 EQUIPMENT/APPARATUS

- Personal sampling pumps, providing a flow rate from 0.020 L/min up to 4.0 L/min, battery powered
- High flow sampling pumps (i.e., Quik Take 30 or AirCon II), capable of providing a flow rate from 4.0 to 12 L/min, battery or alternating current (AC)
- Mixed cellulose ester (MCE) filter cassettes, 0.45 or 0.8 micrometer (µm), 25-mm diameter, purchased from a certified vendor with appropriate documentation (low filter background counts, consistent filter area, certified leak-free cassettes)
- Sampling setups, Tygon® tubing with Luer type adaptor
- Backpacks
- Sampling stands, for perimeter sampling
- Duct tape
- Tools, miscellaneous (e.g., screwdrivers, pliers, cutting tool, etc.)
- Envelopes, manila-type
- Whirlpak® bags
- Sample labels
• Chain of custody (COC) records
• Logbook and/or sampling worksheets
• Precision rotameter or primary flow standard appropriate for sampling flow rate
• Personal protective equipment (PPE), including but not limited to respirators, boots, gloves, eye protection, hard hat, to be determined based on type of activity and possible exposure
• Decon equipment (Plastic sheeting, liquinox®, buckets, brushes, water, Hudson sprayers, garbage bags, etc.)
• Power sources, e.g., line power, solar recharging batteries, power inverters, generators, etc.

6.0 REAGENTS

Reagents are not required for the preservation of asbestos samples.

7.0 PROCEDURES

7.1 Pre-Site Sampling Preparation

1. Determine the extent of the sampling effort (number of locations, repetitions, number of samples, etc.), the sampling methods to be employed, and the types and amounts of equipment and supplies needed.

2. Obtain necessary sampling equipment and ensure it is in working order and fully charged (if necessary).

3. Perform a general site survey prior to site entry in accordance with the site-specific Health and Safety Plan (HASP).

4. Once on-site the calibration is performed in the clean zone. The calibration procedures are listed in Section 7.2.

5. After calibrating the sampling pump, mobilize to the sampling location.
7.2 Calibration Procedures

To determine if a sampling pump is measuring the flow rate or volume of air correctly, it is necessary to calibrate the equipment. Sampling pumps should be calibrated on a routine basis and prior to use.

A rotameter can be used provided it has been calibrated with a primary calibrator. Typically rotameters are calibrated on a yearly basis. Sampling pumps can be calibrated prior to coming on-site in order to expedite on-site calibration. However, calibration must be verified on-site prior to use.

7.2.1 Calibrating a Personal Sampling Pump with a Rotameter

1. Refer to the manufacturer's manual for the Rotameter Operational Instructions.

2. Set up the calibration train using a rotameter, sampling pump and the sampling cassette that will be used during the sampling event. This train may be set up prior to field mobilization and will be checked in the field again prior to use.

3. To set up the calibration train, attach one end of the polyvinyl chloride (PVC) tubing (approx. 2 ft) to the cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the rotameter. Insure that the tubing and rotameter used to calibrate the pump do not restrict the airflow.

4. Assemble the base of the flow meter with the screw provided and tighten in place. The flow meter should be mounted within 6 degrees (°) of vertical (Omega 1987).

5. Turn the sampling pump on.

6. Turn the flow adjust screw (or knob) on the personal sampling pump until the float ball on the rotameter is lined up with the pre-calibrated flow rate value on the rotameter. Note: rotameters should be marked with the previous calibration date and corresponding flow rates and scale.

7. A verification of calibration is generally performed on-site in the clean zone immediately prior to the sampling.
7.2.2 Calibrating a Personal Sampling Pump with an Electronic Calibrator

1. Refer to the manufacturer's manual for operational instructions.

2. Set up the calibration train using a sampling pump, electronic calibrator, and the actual sampling cassette or a representative filter cassette. The same lot of cassettes used for sampling should also be used for calibration.

3. To set up the calibration train, attach one end of the PVC tubing (approx. 2 foot) to the cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the electronic calibrator.

4. Turn the electronic calibrator and sampling pump on. Select a flow rate to calibrate.

5. Turn the flow-adjust screw or knob on the pump until the desired flow rate is attained on the rotameter.

6. Using the primary calibrator, obtain approximately 10 readings three times until the flow rate of ± 5% of the required flow is attained.

7.3 Meteorology

It is recommended that an onsite, portable, 3-meter meteorological station be established. If possible, sample after two to three days of dry weather and when wind conditions are representative for the climatology of the location based on month and time of day. Historical hourly wind speed and wind direction data should be analyzed before mobilization. Wind speed, wind direction, temperature, and station pressure should be recorded on the meteorological station data logger and real-time data should be available for review on the station display panel. Suggested meteorological station specifications can be found in Table 2, Appendix A or ERT SOP #2129, *Met One Remote Meteorological Station*. Alternatively, a nearby representative meteorological station, as determined by a meteorologist, may be used to acquire the necessary data.

7.4 General Sampling Information

For all activity-based sampling events, except as noted otherwise, asbestos samples will be collected from the breathing zones of the event participants. The breathing zone can be visualized as a hemisphere approximately 6 to 9 inches around an individual’s face. Breathing zone samples provide the best approximation of the concentration of contaminants in the air that an individual is
actually breathing. Specific breathing zone heights should be determined on a project-by-project basis based on the anthropometrics for the study population and the participants’ positions during the performance of each task.

If it is necessary to relieve a participant from the activity, another sample collector should be suited and ready to participate in the ABS prior to the personnel exchange. The participant will stop the activity, remove the backpack or belt, and pass it to the relief participant similar to the transfer of a baton in a relay race. The original participant will assist the relief participant with donning and adjusting the backpack or belt. The exchange is anticipated to take less than 60 seconds, therefore the sampling pumps and event time clock will not be halted during the exchange. If the exchange requires more than 60 seconds, the pump and event clock will be stopped until activity is re-initiated.

Sample volumes and detection/quantification limits should be specified in the site-specific QAPP with flow rates and sampling periods adjusted accordingly. Typical sensitivity limits that have been employed for risk assessment have been approximately 0.001 S/cc for ABS samples and 0.0001 S/cc for background or reference samples. Based on ISO 10312 Table 1, a sensitivity limit of 0.001 S/cc would require a sample volume of greater than 500 liters to keep the number of grid openings to be counted below 100. Similarly, a sample volume greater than 5000 L would be required to reach 0.0001 S/cc and count fewer than 100 grid openings. For all asbestos sampling, an asbestos sampling train consisting of 0.8-µm, 25-mm mixed cellulose ester (MCE) filter connected to a personal sampling pump will be used. The top cover from the cowl extension on the sampling cassette shall be removed (“open-face”) and the cassette oriented face down for all asbestos filters. All samples should be collected open-faced unless a specific requirement for sampling closed-faced exists.

For activity based sampling, a personal sampling pump (or equivalent) or SKC Quick Take 30 will be calibrated to collect between 2 and 12 L/min of air through the filter depending on the capacity of the pump. The flow rate will be based upon the duration of time required to collect a minimum target volume of 560 L and provide a sensitivity limit of 0.001 S/cc.

Generally each activity based sampling event should be repeated a minimum of three times in an area to expose trends. This can be accomplished by a single participant repeating the activity three or more times or by having a single simulation with three or more participants. If soil moisture or seasonal variability is a concern, then three events for each different season or meteorological conditions may be appropriate.

The sampling pumps used should provide non-fluctuating airflows through the filter, and should maintain the initial volume flow rate to within ±10% throughout the sampling period. A constant flow or critical orifice controlled pump typically meets these requirements. If the flow rate changes by more than 5% during the sampling period, the average of the pre- and post-sampling
rates will be used to calculate the total sample volume. If at any time the measurement indicates that the flow-rate has decreased by more than 30%, sampling should be terminated. Depending on the type of sampling pump used, it may be possible to salvage the sample if sufficient volume was collected; however, it may not be representative of the time it takes for the actual activity to be completed. Depending on the type of sampling pump used, the actual sampling time in hours and minutes before the sampling fault may be displayed and an actual sample volume calculated. If the fault was due to battery failure, it may be possible to check the post-sampling flow.

During certain ABS activities, participants may be fitted with two sampling pumps to collect a high-flow or volume and a low-flow or volume sample. Co-located samples are collected to sample a high and low volume of air to increase the likelihood of at least one of the two samples being readable using the direct analytical method (ISO 10312). Approximately 560 L (40 CFR 763) is collected for the low-flow samples and up to 4000 L for the high-flow samples. The targeted high volume is typically 1200 L, which permits counting approximately 54 grid openings for a sensitivity level of 0.001 S/cc.

7.5 Generic Activity-Based Sampling Scenario / Raking

The raking scenario, also referred to as the generic scenario, is appropriate for all sites with soils potentially contaminated with asbestos. Generic ABS should be employed in a grid pattern to evaluate the potential for fiber release from soil over a portion of the site. If the analytical results are above the criteria that were derived for the site, then remediation or institutional controls should be implemented or additional site-specific ABS should be undertaken. If the analytical results are below the criteria that were derived, then no further action may be necessary.

In this activity or simulation a participant will rake a lawn or garden area to remove debris such as rocks, leaves, thatch and weeds using a leaf rake with a rake width of approximately 20 to 28 inches. Participants should strive to disturb the top half-inch of soil with an aggressive raking motion. This depth will vary based on the objective of the scenario.

Each raking participant donning appropriate PPE will be fitted with a personal sampling pump contained in a backpack with the cassette secured to the shoulder straps near the operator’s lapels in the breathing zone. Personnel will rake a lawn or garden area to remove debris for a minimum of 1 to 2 hours (flow rate and sensitivity level dependent). Raking will occur in a measured area with vegetation, soil or rocks/gravel and will occur in an arched motion raking from the left of the participant to the right. The participants will rake the debris towards themselves facing one side of the square for 15 minutes then the participant will turn 90 degrees clockwise and begin a new side. Participants will continue to rake each side of the square and rotate 90 degrees. Once several small piles of debris have been made, the participant shall pick up the debris and place it in a trashcan. The sequence of raking, rotating and picking up debris shall be repeated for the duration of the sampling period. The participant should stay in the same plot for the entire sampling period.
7.6 Site-Specific Activity-Based Sampling Scenarios

If site-specific ABS is undertaken, the number and types of activities as well as the types of scenarios should be based on current and potential land use. Reference to current and currently planned future land use and the effectiveness of institutional or legal controls placed on the future use of the land should be evaluated. Probable land use should be selected based on zoning and the existing land use of the site and adjacent areas.

Land use assumptions should be based on a factual understanding of site-specific conditions and reasonably anticipated use. The land use evaluated for the assessment should be based on a residential exposure scenario (i.e., the default worst-case) unless residential land use is not plausible for the site. Future land use assumptions should be consistent with reasonably anticipated future land use based on input from planning boards, appropriate officials, and the public.

7.6.1 ATV Riding

This scenario might be appropriate for recreational areas or other areas where ATVs are typically ridden where asbestos contamination is present. This activity is designed to be representative of two or more ATV participants riding on a course or trail. Riders should maintain their relative position (lead, middle, tail) throughout the activity.

Each ATV rider wearing appropriate PPE will be fitted with two personal sampling pumps set at two distinct flow rates, to collect approximately 560 and 1200 liters of air, because of filter overloading concerns. The cassettes for the personal sampling pumps will be attached to the shoulder straps of the backpack proximal to the riders’ lapels in the breathing zone. It may be beneficial to attach a dust monitor (e.g., DataRAM) to the tail ATV to record dust levels and gauge dust loading. The sampling pumps will be carried in a backpack while the dust monitor, if used, will be mounted to the ATV.

Personnel will ride the ATVs around a course at the same time until a sufficient volume of air has been collected to achieve the required sensitivity limit of 0.001 S/cc of air. The riders, one lead rider and one following rider, will vary the vehicle speed between 5 and 30 miles per hour (mph). Riders will strive for an average speed of 10 mph. The average speed is a target speed only; vehicle speeds will be adjusted to meet track conditions. Vehicles will be equipped with a speedometer and odometer to record speeds and distance traveled. ATV riding and sampling should be conducted for 30 to 120 minutes in duration, depending on dust loading and required detection limits.

ATVs and ATV tires should be selected as appropriate for the area being studied. Specifically, the size (i.e., weight, horsepower, etc.) of the ATV should be appropriate for
7.6.2 Child Playing in the Dirt

This scenario might be appropriate for sites where schools, playgrounds, parks or residential areas, etc. are contaminated with asbestos; the overarching criteria being areas where a child might be expected to play or dig in the dirt. This scenario was designed to be representative of a child playing in the dirt with a shovel and pail.

The event participant wearing appropriate PPE will be fitted with a personal sampling pump; the inlet to the filter will be at a height of approximately 1 to 3 feet above the ground to simulate a child’s breathing zone. The actual pump unit should be secured in a backpack or on a belt.

A participant should sit on the ground while digging or scraping the top 2 to 6 inches of surface soil, placing it in a small bucket or pail and dumping it back on the ground. The activity will be paced such that soil will be placed in the bucket and dumped approximately every two to five minutes, regardless of the amount of material in the bucket. The bucket should be emptied rapidly from a height of approximately 12 inches, based on observations of two to four-year-olds playing in a sandbox.

A sampling period and flow rate to collect a sufficient volume of air will be determined as to achieve the project-specific detection/quantification limit. The sampling period will be divided into equal sub-periods to facilitate having the participant face each compass direction for an equal amount of time during the activity. This approach is designed to mitigate the effect of wind direction on potential exposure. Random head and body movement during the activity should further mitigate the impact of wind direction on exposure. Ideally, the participants will face each compass direction at least twice during the sampling event. For example, during a two-hour or 120-minute event, the participant might face North for 15 minutes, rotate to the East for 15 minutes, then South for 15 minutes, then West for 15 minutes and return to the North to repeat the cycle. Participants should move to a fresh patch of soil after the completion of each cycle (360 degree rotation).

7.6.3 Gardening/Rototilling

This scenario might be appropriate for sites where gardening or surface disturbance to a depth of approximately one foot is anticipated. This activity is designed to be representative of individuals participating in gardening activities using a rototiller.
Each rototilling participant donning appropriate PPE will be fitted with a personal sampling pump. The actual pump unit will be contained in a backpack with the cassette secured to the shoulder straps near the operator’s lapels in the breathing zone.

Personnel will operate a rototiller for a minimum of two hours to loosen soil in the yard to a depth of approximately 12 inches. The depth chosen is area-specific and will need to be determined on a case-by-case basis. A rear tine rototiller in the six to eight horsepower range will be selected. Other types or sizes of tillers may be appropriate based on the soil conditions and type of gardening being conducted.

A 100 to 720-square-foot plot of land will be selected to till. The average size of a community garden in New Jersey was 720 square feet based on a survey conducted by Rutgers University in 1991 (Patel 1991). The edges will be delineated. Square plots are preferred. The rototiller operator will conduct typical associated activities such as removing rocks and debris from the tilled area. To account for the effects of varying wind direction on potential exposure, the operator will till the soil back and forth towards each side of the square continuously for 10 minutes, shut down the machine or place it in neutral, and rake or sort through the material for five minutes. The operator will then turn 90 degrees in a clockwise direction and repeat the previous 15-minute procedure. The operator will continue to rotate 90 degrees clockwise every 15 minutes until the two-hour sampling period is complete. The participant should stay in the same plot for the entire sampling period.

7.6.4 Weed Whacking/Cutting

This scenario might be appropriate for sites where lawn maintenance might be conducted such as in residential and commercial areas. This activity is designed to simulate a person trimming weeds and grasses.

Each weed-whacking participant will be fitted with a personal sampling pump. The actual pump unit will be contained in a backpack with the cassette secured to the shoulder straps near the operator’s lapels in the breathing zone. Personnel wearing appropriate PPE will operate a gas or electric-powered string trimmer. A 25 to 35-cc gas or electric-powered trimmer with a 16 to 18-inch cutting swath will be selected. Trimming and edging will occur in a measured area with thick vegetation (typically 100 to 720-square feet, based on a typical residential garden) (Patel 1991). Trimming will be done using a side to side sweeping motion with the operator moving in a series of straight lines back and forth towards one side of the selected area for 10 minutes, resting five minutes, and turning 90 degrees in a clockwise direction before repeating this 15-minute procedure for the
The participant should stay in the same plot for the entire sampling period.

7.6.5 Digging

Digging might be appropriate for sites where construction projects are likely to occur or where plants might be planted. Digging will occur in a measured area with vegetation, soil or rocks/gravel.

Each digger participant donning appropriate PPE will be fitted with a personal sampling pump contained in a backpack with the cassette secured to the shoulder straps near the operator’s lapels in the breathing zone. The participants will dig a hole to approximately two feet deep and two feet (representative of planting a small shrub or digging a fencepost; site-specific dimensions should be specified in the QAPP/SAP) in diameter (Vodak 2004) and will place the soil next to the hole. The participants will then refill the hole with the soil that had been removed. Participants will then rotate 90 degrees in a clockwise direction and continue to dig and refill additional holes until the sampling period is complete. The sequence of digging, filling and rotating shall be repeated for the duration of the sampling period.

7.6.6 Lawn Mowing

Lawn mowing might be appropriate for sites where lawn maintenance might be conducted such as residential and commercial areas.

Each lawn-mowing participant will be fitted with a personal sampling pump contained in a backpack with the cassette secured to the shoulder straps near the operator’s lapels in the breathing zone. Personnel wearing appropriate PPE will operate a gas-powered lawn mower. Mowing will occur in a measured area with thick vegetation and will occur in a shrinking square pattern. Participants will divide the area into a number of squares that decrease in size towards the center of the square by the width of the mower swath. Mower blades will be set at approximately 2 to 2.5 inches. A bag-less side discharge 3- to 5-horsepower lawn mower will be used for this exercise.

7.6.7 Walker with Stroller

This scenario might be appropriate for sites such as parks, paths or open-space. The actual pump unit will be secured in a backpack. The cassette for the personal sampling pump will be attached to the shoulder straps of the backpack proximal to the walker’s lapel in the breathing zone. A second pump will be placed in the stroller at a child’s breathing zone height.
During these events, walkers wearing appropriate PPE pushing a stroller will walk back and forth along a portion of a path until a sufficient volume of air has been collected to achieve the required detection limit. The walkers will vary their speed between 1.5 and 4 mph. Walkers will strive for an average speed of 2 mph. The average speed is a target speed only; speeds will be adjusted to meet trail conditions. Walkers should be equipped with a global positioning system (GPS) unit to estimate average speed and distance traveled.

7.6.8 Jogging

This scenario might be appropriate for sites such as parks, paths or open-space. The actual pump unit will be secured in a backpack. The cassette for the personal sampling pump will be attached to the shoulder straps of the backpack proximal to the jogger’s lapel in the breathing zone.

During these events, joggers wearing appropriate PPE will run/jog back and forth along a portion of a path until a sufficient volume of air has been collected to achieve the required detection limit. The joggers will vary their speed between 2.5 and 5 mph. Joggers will strive for an average speed of 4 mph. The average speed is a target speed only; speeds will be adjusted to meet trail conditions. Joggers should be equipped with a GPS unit to estimate average speed and distance traveled.

Two or more joggers can participate in this activity. When multiple joggers participate, they should maintain their relative position throughout the event (lead, middle, tail). Joggers should be spaced five feet apart.

7.6.9 Two Bicycles

Bicycling might be appropriate for sites such as parks, paths or open-space. Two bicyclists wearing appropriate PPE will ride back and forth with one leading and one following along the length of the site portion of a path or ride around a site (no trail) until a sufficient volume of air has been collected to achieve the required detection limit.

The bicycling participants will each be fitted with personal sampling pumps. The actual pump units will be contained in backpacks with the cassettes secured to the shoulder straps near the cyclists’ lapels in the breathing zone.

During these events, the bicycle riders will vary their speed between 3 and 15 mph. Riders will strive for an average speed of 8 mph. The average speed is a target speed only; bicycle speeds will be adjusted to meet trail conditions. Bicycles will be equipped
with a GPS to estimate average speed and distance traveled. Riders should maintain their relative position (lead, tail) throughout the activity.

7.6.10 Basketball Scenario

This scenario might be appropriate for sites where basketball courts are present. The basketball scenario was developed to simulate a group of recreational basketball players gathering to play a casual game of basketball for 120 minutes on an outdoor concrete or macadam court. Between four and 10 players wearing appropriate PPE can participate in this exercise.

- From 0 to 15 minutes, two of the players will sweep court with push brooms from the perimeter of the court to the center. While these two people are sweeping the court, the remaining personnel should mill about under the basket and take a few shots.

- From 15 to 30 minutes, shot practice participants stand around the key as for a free throw, with the exception that one of the participants is positioned under the basket to retrieve the ball after each shot. The player closest to the basket on the left side (facing the basket) takes two shots and the ball/shooter rotates counter clockwise after those two shots. Each person shoots consecutively until everyone has taken two shots. The entire group then rotates clockwise. This sequence should be repeated until time expires. Ideally, each player should shoot from each key position and take a turn retrieving the ball under the basket.

- From 30 to 45 minutes, each player takes turns practicing lay-ups. All players line up on the left side of the basket (facing the basket) and shoot one after another. The first person shoots then retrieves the ball for next person in line and so on. Players should use two basketballs with the second person bouncing the ball outside of the key as the first person shoots. Players should run a full cycle from left then a full cycle from right; repeating the left, right cycles until the interval time is up.

- From 45 to 60 minutes, shot practice as described in the 15 to 30 minute interval above will be conducted.

- From 60 to 75 minutes, a half-court game will be played to the degree practical.

- From 75 to 100 minutes, shot practice as described in the 15 to 30-minute interval above will be conducted.
• From 100 to 120 minutes, a lay-up drill as described in the 30 to 45 minute interval above will be conducted.

7.7 Cumulative Exposure Scenario

A cumulative exposure study might be appropriate for sites where individuals move about a site during the course of a day, with varying levels of exposure at multiple indoor and outdoor locations. The objective is to estimate aggregate and cumulative exposure to asbestos over the course of a day. Cumulative exposure studies should be conducted in order to increase understanding of linkages between sources of asbestos and subsequent exposure and dose to humans for use in mitigating risk and reducing exposure and disease.

Over periods of weeks, years or decades, exposures to environmental agents such as asbestos occur intermittently rather than continuously. Yet long-term health effects, such as cancer, are routinely projected based on an average dose over the period of interest (typically years), rather than as a series of intermittent exposures. Consequently, long-term doses are usually estimated by summing doses across discrete exposure episodes and then calculating an average dose for the period of interest (e.g., year, lifetime).

For the cumulative exposure studies, representative members of the population of interest should be selected for 24 hour sampling. The volunteers should be instructed to go about their day as usual. That is, they should not modify their schedule or activities just because they will be wearing a sampling pump.

A minimal description of exposure for a particular route must include exposure concentration and the duration. This is the method of choice to describe and estimate short-term doses, where integration times are of the order of minutes, hours or days. When projecting long term exposures, on the order of years or a lifetime, since it is typically impractical to sample for the entire exposure period, short-term exposure estimates are assumed to be representative of long-term periods and are integrated to estimate long-term exposures, typically with a safety factor to account for variability.

Observations of activities should be recorded throughout each cumulative exposure study, together with the other relevant factors including locations and activities during the study.

Samples will be collected using a personal air pump with a flow rate of approximately 3.5 L/min. Samples shall be collected open-faced with the inlet facing downward at a personal breathing zone height of 4 to 6 feet for 24 hours. Because the battery life for a personal monitor is typically eight to 10 hours, the pump shall be changed out at approximately 8-hour intervals (keeping the same filter cassette). Each pump shall be pre-calibrated to 3.5 L/min prior to use. Each monitor shall be worn at normal breathing height during all waking hours. During sleep, the monitor will be placed
in the same room as the sleeping individual. The sampling cassette will be placed proximal to the breathing zone of the reclined participant.

Should a study subject participate in a high dust generating activity such as riding an ATV, the 24 hour sampling cassette event should be paused and a short term exposure sample should be collected on a separate cassette with an appropriately calibrated sampling pump. Once the high dust activity has been terminated, the original 24-hour cassette and pump should be resumed for the remainder of the sampling period. Results of the 2 or more samples, depending on the number of high dust generating events should be summed to derive the total 24-hour exposure data.

7.8 Background/Reference Sampling

Background/reference samples should be collected for all sampling events. A background or reference sample is defined as a sample collected upwind at a distance sufficient to prevent being influenced by the simulated activities and outside the site perimeter. To the degree practical, the area selected for background or reference sampling should be free of known asbestos contamination. The background level should reflect the concentration of asbestos in air for the environmental setting on or near a site or activity location and can be used to evaluate whether or not a release from the site or activity has occurred. Background level does not necessarily represent pre-release conditions or conditions in the absence of influence from source at the site. A background level may or may not be less than the detection limit, but if it is greater than the detection limit, it should account for variability in local concentrations. Background or reference samples should be collected concurrent with ABS using stationary sampling pumps. Sampling and analytical parameters (sample volume grid opening count, etc.) should be prescribed to permit a detection limit approximately an order of magnitude below that of the ABS detection limit.

An Aircon II sampling pump (or equivalent) will be calibrated to collect 10 L/min for on-site and off-site air samples through the filter. The flow rate will allow a minimum target volume of 4000 L and will provide a sensitivity limit of 0.0001 S/cc. Lower volume air samples will be collected concurrently at the ambient air sampling locations. Personal sampling pumps will be utilized in the same manner with the same media at a flow rate between 2- and 3- L/min in order to collect a sample volume of approximately 1000 L. The target sensitivity of these samples is also 0.0001 S/cc when additional grids are counted in accordance with the method. Co-located samples are collected to sample a high and low volume of air to increase the likelihood of at least one of the two samples being readable using the direct analytical method (ISO 10312).

7.9 Perimeter Sampling

Perimeter samples are defined as samples collected upwind, downwind or crosswind of a specific activity. When selecting areas for ABS, consideration should be given to the potential for off-site migration of contaminants and possible exposure of the public. Within the constraints of ABS, to
the degree practical, particulate generation migration off-site should be minimized, and constraints or mitigation protocols established to eliminate public exposure. These constraints/mitigation protocols may include conducting the ABS in remote areas of the site, dust suppression using water mist, building a containment structure, etc. Air sampling should be conducted to document the airborne concentration of asbestos at the site perimeter during activities. Perimeter air monitoring should be conducted to:

- Document air quality during ABS and establish background or upwind levels of asbestos during site activities
- Monitor and document air quality during site activities near sensitive receptors
- Provide risk management information and address public confidence
- Reduce possible liabilities associated with ABS

Perimeter air sampling should be performed to ensure that ABS activities do not result in excessive airborne asbestos emissions from the site. Air samples should be collected and analyzed to determine the concentrations of asbestos at the site perimeter.

An Aircon II sampling pump (or equivalent) will be calibrated to collect 10 L/min for on-site and off-site air samples through the filter. The flow rate will allow a target volume of 4000 L and will provide a sensitivity limit of 0.0001 S/cc. Lower volume air samples will be collected concurrently at the perimeter sampling locations using personal sampling pumps, if loading is an issue. These pumps will be utilized in the same manner with the same media at a flow rate between 2- and 3-L/min in order to collect a sample volume of approximately 1000 L. The target sensitivity of these samples is also 0.0001 S/cc when additional grids are counted in accordance with the method. Co-located samples are collected to sample a high and low volume of air to increase the likelihood of at least one of the two samples being readable using the direct analytical method (ISO 10312).

7.10 Soil Sampling

A sufficient number of soil samples should be collected to characterize the study area. Since particulates are expected to be released from the entire study area, the primary objective of the soil sampling is to estimate the populations mean concentration. Composite samples are appropriate for characterizing study areas and a sampling design program such as Visual Sampling Plan is recommended for calculating the number and location of samples with the appropriate confidence intervals. Soil sampling should be conducted in accordance with ERT SOP #2012, Soil Sampling.

Soil characteristics should be documented in conjunction with the activity-based personal exposure monitoring using American Society of Testing and Materials (ASTM), Method D2488 - 00: Description and Identification of Soils (Visual- Manual Procedure), soil moisture by ASTM Method D2216-05: Standard Test Methods for Laboratory Determination of Water (Moisture)

Soil samples should be representative of the soil. Table 3 provides examples of soil sampling depths, which may be disturbed by the activity being performed.

The relationship between the concentration of asbestos in a source material (typically soil) and the concentration of fibers in air that results when the source is disturbed is very complex, depending on a wide range of variables. To date, no method has been found that reliably predicts the concentration of asbestos in air given the concentration of asbestos in the source. Because of this limitation, this SOP emphasizes an empiric approach, where concentrations of asbestos in air at the location of a source disturbance are measured rather than predicted.

8.0 CALCULATIONS

The sample volume is calculated from the average flow rate of the pump multiplied by the number of minutes the pump was running (volume = flow rate X time in minutes). The sample volume should be submitted to the laboratory and identified on the chain of custody for each sample (zero for lot, and field blanks).

The concentration result is calculated by dividing the number of asbestos structures reported after the application of the cluster and matrix counting criteria by the sample volume (concentration = number of asbestos structures / sample volume).

9.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The following general QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks. Record the following: date, time, location, sample identification number, pump number, flow rate, and cumulative time.

2. All instruments/equipment must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

3. Field blanks should be collected at a rate of one per twenty samples or one per sampling event, whichever is greater

4. Lot blanks should be collected at a rate of at least two per lot
5. Collocated samples should be collected at the frequency of one per sampling event. For TEM analysis, the following QC procedures apply:

1. Examine lot blanks to determine the background asbestos structure concentration.

2. Examine field blanks to determine whether there is contamination by extraneous asbestos structures during specimen preparation or handling.

3. Examine laboratory blanks to determine if contamination is being introduced during critical phases of the laboratory program.

4. To determine if the laboratory can satisfactorily analyze samples of known asbestos structure concentrations, reference filters shall be examined. Reference filters should be maintained as part of the laboratory's Quality Assurance program.

5. To minimize subjective effects, some specimens should be recounted by a different microscopist.

6. Asbestos laboratories shall be accredited by the National Voluntary Laboratory Accreditation Program.

7. At this time, performance evaluation samples for asbestos in air are not commonly available for Removal Program Activities; however, they should be considered on a case-by-case basis.

10.0 DATA VALIDATION

Results of QC samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results accordingly with the project's data quality objectives.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and corporate health and safety procedures. More specifically, when entering an unknown situation involving asbestos, a powered air-purifying respirator (PAPR) (full face-piece) is necessary in conjunction with high-efficiency particulate air (HEPA) filter cartridges. See applicable regulations for action levels, permissible exposure levels (PEL) and threshold limit values (TLV). If previous sampling indicates asbestos concentrations are below personal health and safety levels, then Level D personal protection is adequate.

For all ABS, appropriate PPE, including Tyvek coveralls, protective gloves and foot wear, and a respirator with HEPA filter cartridges (P-100 or equivalent) should be worn to protect participants. Details regarding PPE and other protective measures should be specified in the site-specific Health and Safety Plan.
consideration should be given to the physical safety of the event participants as well as heat stress associated with performing vigorous activities in impermeable clothing.

12.0 REFERENCES

40 CFR Part 763 Asbestos Worker Protection

ERT SOP #2015, Asbestos Sampling.


ACTIVITY-BASED AIR SAMPLING FOR ASBESTOS


13.0 APPENDICES

TABLE 1. Minimum Number of Grid Openings Required To Be Counted to Achieve a Given Analytical Sensitivity and Detection Limit. (Adapted from ISO 10312)

TABLE 2. Suggested Meteorological Station Specifications

TABLE 3. Soil Sampling Depth Based on Activities Performed
TABLE 1. Minimum Number of Grid Openings Required To Be Counted to Achieve a Given Analytical Sensitivity and Detection Limit. (Adapted from ISO 10312)

<table>
<thead>
<tr>
<th>Analytical Sensitivity Structures/cc</th>
<th>Limit of Detection Structures/cc</th>
<th>Volume of Air Sampled (Liters)</th>
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<tr>
<td></td>
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<td>500</td>
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<tr>
<td>0.0001</td>
<td>0.0003</td>
<td>1066</td>
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<td>0.0002</td>
<td>0.0006</td>
<td>533</td>
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<td>0.0003</td>
<td>0.0009</td>
<td>358</td>
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<td>0.0004</td>
<td>0.0012</td>
<td>267</td>
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<td>0.0005</td>
<td>0.0015</td>
<td>214</td>
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<td>0.0007</td>
<td>0.0021</td>
<td>153</td>
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<td>0.001</td>
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<td>107</td>
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<td>54</td>
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<td>0.003</td>
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<td>16</td>
</tr>
<tr>
<td>0.01</td>
<td>0.030</td>
<td>11</td>
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TABLE 2. Suggested Meteorological Station Specifications

<table>
<thead>
<tr>
<th>Variable</th>
<th>Accuracy</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Speed (horizontal and vertical)</td>
<td>± (0.2 m/s + 5% of observed)</td>
<td>0.1 m/s</td>
</tr>
<tr>
<td>Wind Direction (azimuth and elevation)</td>
<td>± 5 degrees</td>
<td>1.0 degrees</td>
</tr>
<tr>
<td>Ambient Temperature</td>
<td>± 0.5°C</td>
<td>0.1°C</td>
</tr>
<tr>
<td>Precipitation</td>
<td>± 10% of observed or ± 0.5 mm</td>
<td>0.3 mm</td>
</tr>
<tr>
<td>Pressure</td>
<td>± 3 mb (0.3 kPa)</td>
<td>0.5 mb</td>
</tr>
<tr>
<td>Solar Radiation</td>
<td>± 5% of observed</td>
<td>10 W/m^2</td>
</tr>
</tbody>
</table>

m/s = meters per second  
°C = degrees Centigrade  
mm = millimeters  
mb = millibar  
W/m^2 = watts per square meter  
kPa = kilopascal
### TABLE 3. Soil Sampling Depth Based on Activities Performed

<table>
<thead>
<tr>
<th>Activity Based Sampling Scenario</th>
<th>Soil Sampling Depth</th>
</tr>
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<tbody>
<tr>
<td>Raking (metal garden rake)</td>
<td>Surface to 3 inches</td>
</tr>
<tr>
<td>Raking (leaf rake)</td>
<td>Surface to 2 inches</td>
</tr>
<tr>
<td>ATV riding</td>
<td>Surface to 2 inch</td>
</tr>
<tr>
<td>Rototilling</td>
<td>Surface to 12 inches</td>
</tr>
<tr>
<td>Digging</td>
<td>Surface to depth of excavation</td>
</tr>
<tr>
<td>Child Playing in the dirt</td>
<td>Surface to 3 inches</td>
</tr>
<tr>
<td>Weed Whacking</td>
<td>Surface to 2 inches</td>
</tr>
<tr>
<td>Lawn Mowing</td>
<td>Surface to 2 inch</td>
</tr>
<tr>
<td>Walking with Stroller</td>
<td>Surface to 2 inch</td>
</tr>
<tr>
<td>Two Bicycles</td>
<td>Surface to 2 inch</td>
</tr>
<tr>
<td>Activities on solid surfaces such as asphalt or</td>
<td>Microvacuum ASTM D 5755</td>
</tr>
<tr>
<td>concrete</td>
<td></td>
</tr>
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Appendix B
Blank Field Sample Data Sheets
CDM Smith Blank Field Sample Data Sheets (FSDS):

- BoRit FSDS for Ambient Air
- BoRit FSDS for Perimeter Air
- BoRit FSDS for Personal Air
- BoRit FSDS for Soil
- BoRit FSDS for Surface Water and Sediment
BORIT FIELD SAMPLE DATA SHEET (FSDS) FOR AMBIENT AIR

Location: ______________________________________________  Sampling Date: ________________
Field Logbook No: ____________________  Page No: _______________________

Sampling Team: CDM Smith  Other ________ Names:___________________________________________

<table>
<thead>
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<th>Data Item</th>
<th>Cassette 1</th>
<th>Cassette 2</th>
<th>Cassette 3</th>
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</thead>
<tbody>
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<td></td>
<td></td>
</tr>
<tr>
<td>Location ID</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Group</td>
<td></td>
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<tr>
<td>Location Description</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category (circle)</td>
<td>FS</td>
<td>FB-(field blank)</td>
<td>FS</td>
</tr>
<tr>
<td></td>
<td>LB-(lot blank)</td>
<td>DB-(prep-dry blank)</td>
<td>LB-(lot blank)</td>
</tr>
<tr>
<td>Matrix Type (circle)</td>
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<td>Outdoor</td>
<td>NA</td>
</tr>
<tr>
<td>Filter Diameter (circle)</td>
<td>25mm</td>
<td>Other</td>
<td>25mm</td>
</tr>
<tr>
<td>Pore Size (circle)</td>
<td>PCM- 0.80</td>
<td>Other</td>
<td>PCM- 0.80</td>
</tr>
<tr>
<td>Flow Meter Type (circle)</td>
<td>Rotometer</td>
<td>DryCal</td>
<td>NA</td>
</tr>
<tr>
<td>Pump ID Number</td>
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</tr>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Start Date</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start Flow (L/min)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop Date</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Stop Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop Flow (L/min)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump fault? (circle)</td>
<td>No</td>
<td>Yes</td>
<td>NA</td>
</tr>
<tr>
<td>MET Station onsite? (circle)</td>
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<td>Yes</td>
<td>NA</td>
</tr>
<tr>
<td>Sample Type (circle)</td>
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<td>Post</td>
<td>Clear</td>
</tr>
<tr>
<td></td>
<td>2nd Clear</td>
<td>3rd Clear</td>
<td>NA</td>
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<td>Field Comments</td>
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</tr>
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<td>Cassette Lot Number:</td>
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<td></td>
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<td>Archive Blank (circle): Yes</td>
<td>No</td>
</tr>
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<td>Filename:_____________ NA</td>
<td>Filename:_____________ NA</td>
<td>Filename:_____________ NA</td>
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</table>

v 090210

For Field Team Completion (Initials)  Completed by: ______   For Data Entry  Entered by: ______
QC by: ______   QC by: ______

For eFSDS validation  Validated ______   Validated ______   Validated ______
### BORIT FIELD SAMPLE DATA SHEET (FSDS) FOR PERIMETER AIR

**Location:** ______________________________________________  **Sampling Date:** ____________________

**Field Logbook No:** __________________  **Page No:** __________________

**Sampling Team:** CDM Smith  Other ______  **Names:** ____________________________________________

---

<table>
<thead>
<tr>
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<th><strong>Cassette 2</strong></th>
<th><strong>Cassette 3</strong></th>
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<tbody>
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<tr>
<td>Location ID</td>
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<tr>
<td>Sample Group</td>
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<tr>
<td>Location Description</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Category (circle)</td>
<td>FS FB-(field blank)</td>
<td>FS FB-(field blank)</td>
<td>FS FB-(field blank)</td>
</tr>
<tr>
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<td>DB-(prep-dry blank)</td>
<td>LB-(lot blank)</td>
<td>DB-(prep-dry blank)</td>
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<td>Indoor Outdoor NA</td>
<td>Indoor Outdoor NA</td>
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<td>25mm Other ______</td>
<td>25mm Other ______</td>
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<td>PCM- 0.80 Other ______</td>
<td>PCM- 0.80 Other ______</td>
</tr>
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</tr>
<tr>
<td>Start Date</td>
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<tr>
<td>Start Time</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Start Flow (L/min)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop Date</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop Time</td>
<td></td>
<td></td>
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<tr>
<td>Stop Flow (L/min)</td>
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<td>No Yes NA</td>
<td>No Yes NA</td>
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<td>No Yes NA</td>
<td>No Yes NA</td>
</tr>
<tr>
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<td>Pre Post Clear 2nd Clear 3rd Clear NA</td>
<td>Pre Post Clear 2nd Clear 3rd Clear NA</td>
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For Field Team Completion (Initials)  Completed by: ______  QC by: ______  For Data Entry  Entered by: ______  QC by: ______

For eFSDS validation  Validated ______  Validated ______  Validated ______
BORIT FIELD SAMPLE DATA SHEET (FSDS) FOR PERSONAL AIR

Location: ________________________________  Sampling Date: ________________
Field Logbook No: ________________
Page No: ________________________

Sampling Team:  CDM Smith  Other ________  Names: ______________________________________
Person Sampled_______________________  Co. Name: _________  ID: _______  Task: ________________

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<tr>
<td>Location ID</td>
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<td></td>
</tr>
<tr>
<td>Sample Group</td>
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<tr>
<td>Location Description</td>
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<td>Category (circle)</td>
<td>FS</td>
<td>FB-(field blank)</td>
<td>LB-(lot blank)</td>
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<td>Other ______</td>
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<td>PCM- 0.80</td>
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<td>PCM- 0.80</td>
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</tr>
<tr>
<td>Start Date</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start Flow (L/min)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop Date</td>
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<td>Stop Time</td>
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<td>Stop Flow (L/min)</td>
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<td></td>
</tr>
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<td>Pump fault? (circle)</td>
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<tr>
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v 090210

For Field Team Completion
(Initials)  Completed by: ______  QC by: ______  For Data Entry  Entered by: ______  QC by: ______
For eFSDS validation  Validated ______  Validated ______  Validated ______
BORIT FIELD SAMPLE DATA SHEET (FSDS) FOR SOIL

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<tr>
<td>Location Description</td>
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<td>Park</td>
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<td>(circle)</td>
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<td>Surface Soil</td>
<td>Surface Soil</td>
</tr>
<tr>
<td>(Surface soil unless other</td>
<td>Other</td>
<td>Other</td>
<td>Other</td>
</tr>
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<td>Type (circle)</td>
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<td>Grab # subsamples = 0</td>
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<td>(Note if asbestos-</td>
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<td></td>
</tr>
<tr>
<td>containing material (ACM)</td>
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<td></td>
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</tr>
<tr>
<td>is observed in sample and</td>
<td></td>
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<td>percentage observed.)</td>
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<td>□ no ACM observed</td>
<td>□ no ACM observed</td>
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<tr>
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<td>% ACM: _____</td>
<td>% ACM: _____</td>
<td>% ACM: _____</td>
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For Field Team Completion
(Initials) Completed by: ______ QC by: ______ For Data Entry Entered by: ______ QC by: ______

For eFSDS validation Validated ______ Validated ______ Validated ______
BORIT FIELD SAMPLE DATA SHEET (FSDS) FOR SURFACE WATER AND SEDIMENT

Location: __________________________ Sampling Date: ________________
Field Logbook No: ________________
Page No: ________________
Sampling Team: CDM Smith  Other ________ Names:__________________________

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For Field Team Completion (Initials) Completed by: ______ QC by: ______
For Data Entry Entered by: _____ QC by: ____
For eFSDS validation Validated _____ Validated _____ Validated _____
Appendix C

Equipment Shelters for Ambient Air Monitor Stations
Asbestiform minerals occur naturally in rock and soil as the result of natural geologic processes, and are also found in many areas of the country. Naturally occurring asbestos (NOA) can take the form of long, thin, separable fibers. Natural weathering or human disturbance can break NOA down to microscopic fibers, easily suspended in air.

Outside air sampling in remote locations without access to AC power is no longer a problem. Easily secured, hermetically sealed against the weather with built in count-down timer and high output, overnight battery “smart” charger.

- Up to 24 hours performance between charges (100 amp hour battery)
- 12 Volt Deep Cycle (Marine) battery eliminates the need to provide external power (User Supplied)
- Wheeled case with extendable handle for rolling to sample site
- Durable case, sealed against the elements with external hose barb

**Flow Capability:** See flow rate comparison chart, page 40.

**Standard Features:**
- Built in sampling cassette holder
- Lockable case, to prevent tampering
- Convenient storage compartment
- Six Month warranty on parts & labor
- NIST Certifiable
- Digital Timer
- Built in charging system
- Quiet Performance
- Safety reset switch