403139

WSP

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February 27, 2015

Tim Hornosky, P. G.
State Remediation Section
Division of Site Assessment, Remediation and Revitalization
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201-1708

Re: Remedial Investigation Work Plan Addendum and AS/SVE System Evaluation
Wix Filtration Corp LLC Plant, Dillon, South Carolina
Voluntary Cleanup Contract No. 13-5996-RP

Dear Mr. Hornosky:

On behalf of Wix Filtration Corp LLC (Wix), WSP USA Corp is submitting this Remedial Investigation (RI) Work Plan Addendum for the Wix Plant located in Dillon, South Carolina (Site). The 2014 RI sampling results showed the presence of volatile organic compounds (VOCs) in sub-slab vapor samples collected from the southwest portion of the manufacturing building at concentrations above the human health screening levels. The South Carolina Department of Health and Environmental Control (SCDHEC) indicated in its September 23, 2014 *Approval of Remedial Investigation Report* that future remedial actions would need to address the chlorinated VOCs along with the more prevalent toluene. Additional site data was deemed necessary to further characterize the chlorinated VOC distribution in sub-slab vapor and allow for the evaluation of risk and potential remedial alternatives for mitigating any unacceptable risk.

In conjunction with the supplemental investigation activities, WSP will conduct a performance evaluation of the existing air sparge/soil vapor extraction (AS/SVE) system in the toluene release area. This review will assess the effectiveness of the remedial system and its ability to achieve the remediation goals for the impacted groundwater. The findings of the system evaluation will be considered during the completion of the Focused Feasibility Study (FFS) for the Site.

This RI Work Plan Addendum has been prepared based on information provided in the *FFS Work Plan and RI Report (August 2014) Response to Com ments* submittal, which was forwarded to the South Carolina Department of Health and Environmental Control (SCDHEC) on October 29, 2014, and approved by the department on January 12, 2015. The site RI activities are being performed in accordance with the requirements of Voluntary Cleanup Contract (VCC) Number 13-5996-RP between Wix Filtration Corp LLC and the SCDHEC. As with the toluene issue, Wix's work on the VOCs will be subject to, and pursuant to, that current VCC.

Site Background

Site Description

The Wix Plant Site is located at 1422 Wix Road in Dillon, Dillon County, South Carolina. The plant property is approximately 80 acres in size and includes a manufacturing and office building along with small, separate ancillary structures (hazardous waste and tractor shed, water pump house, and paint storage building; Figure 1). The facility is located in a mixed industrial, agricultural, and residential area north and west of the city of Dillon and Interstate 95.

Plant operations have been ongoing from 1977 to the present and involve the manufacture of fuel filters, oil filters, and air filters for automotive, diesel, racing, agricultural, and industrial applications. Production activities include metal parts fabrication, element curing, assembly, painting, printing, packaging, and shipping.

Historical Storage and Use of Chlorinated Solvents

At present, no chlorinated solvents are utilized as part of the manufacturing activities at the Wix Dillon plant. Parts washers and equipment head cleaning use non-chlorinated products.

No facility documentation was available for review related to the historical use of chlorinated solvents at the Wix Plant. The only record of probable chlorinated solvent use is from a July 2012 environmental database report, which lists U.S. Environmental Protection Agency (EPA) hazardous waste code D039 for one of the hazardous waste streams generated at the facility. This waste code is for material containing a characteristically hazardous concentration of tetrachloroethene (PCE).

The only other available information concerning chlorinated solvent use was obtained via conversations with long-tenured plant workers. Based on these discussions, it is believed that chlorinated solvents were used for a period of time in a production area of the plant. Using this anecdotal information, it is believed the majority of the solvent storage and use occurred in a relatively small area in the southwestern portion of the facility. The approximate location of this previous solvent use area is shown in Figure 1.

Regulatory Program Activities

RI Sub-Slab Vapor Sampling Results in Main Building Area

As part of the 2014 site investigation activities, four sub-slab vapor samples (including one duplicate sample, Figure 2) were collected from the sample points located in the southwestern portion of the building. (These samples were obtained using Vapor Pin™ sample ports temporarily installed in the concrete floor of the building and analyzed for VOCs using USEPA Test Method TO-15.) Using the USEPA industrial air Regional Screening Levels as comparative criteria, toluene was not detected at levels of concern in any of the sub-slab vapor samples. (It should also be noted the results of the human health risk assessment [HHRA] indicated toluene did not pose a risk to workers via the vapor intrusion pathway). However, other VOCs (benzene, ethylbenzene, 4-ethyl toluene, 2-hexanone, tetrachloroethene [PCE] and trichloroethene [TCE]) were detected at concentrations greater than the comparative criteria in the sub-slab vapor samples (Figure 2). Overall, PCE was the predominant compound with concentrations in the samples from the SSV-1 and SSV-2 locations greater than 1,000

micrograms per cubic meter (µg/m^3). A significantly lower PCE level (less than 10 µg/m^3) was detected in the sample and duplicate from the SSV-3 location. TCE was the other chlorinated VOC detected in all three vapor samples, with measured concentrations ranging from less than 5 µg/m^3 (SSV-3) to 64 µg/m^3 (SSV-1). Very low concentrations of chlorinated ethanes (1,1,1-trichloroethane and 1,1-dichloroethane [1,1-DCA]) were also detected in the SSV-1 vapor sample.

Interim Groundwater Monitoring Program

As discussed in Section 2.5.5 of the RI Work Plan, Wix has implemented an interim, semi-annual groundwater sampling program to monitor VOC concentrations in the toluene-impacted area west of the main building. At present, the monitoring activities involve the collection of water level data from all existing monitoring wells and obtaining groundwater samples for VOC analysis from the following wells:

- MW-1
- MW-2
- MW-3
- MW-4
- MW-7
- MW-10
- MW-11/MW-11D
- MW-12/MW-12D
- MW-13
- MW-14
- MW-15

The locations of site monitoring wells are provided in Figure 2.

Trace to very low levels of PCE and TCE have been consistently present in recent samples collected from MW-14, along with being occasionally detected in samples from shallow wells located west of the building. The primary chlorinated VOC detected in the monitoring well samples from the Site is *cis*-1,2-dichloroethene (*cis*-DCE). The highest levels of *cis*-DCE are associated with samples from well MW-14, with concentrations greater than 1,000 micrograms per liter (µg/l) in the 2014 semi-annual groundwater samples[1]. The *cis*-DCE concentration exceeds the promulgated South Carolina Maximum Contaminant Level (MCL) of 70 µg/l. Lower levels of *cis*-DCE, which are below the applicable groundwater standard, have been detected in several other monitoring wells in this portion of the Site. For these wells, the highest concentrations have been detected in samples from shallow wells MW-4/MW-4R, MW-12, and MW-13, and deeper well MW-11D, with recent levels ranging from 8 µg/l to 63 µg/l (ERM 2014). The presence of slightly elevated *cis*-DCE concentrations in the MW-13 samples coincides with the detection of this compound in RI soil samples collected from the canopy area along the southwestern corner of the building.

Conceptual Site Model

As indicated above and in the August 2014 RI Report, toluene, benzene, and *cis*-DCE have been detected in several soil and groundwater samples at concentrations above their respective applicable criteria. Industrial grade toluene may contain benzene at levels of up to 25%; however, the presence of *cis*-DCE does not appear to be related to the historical toluene release. *cis*-DCE is commonly found in environmental media as a result of the biodegradation of more highly chlorinated VOCs such as PCE or TCE. Accordingly, the presence of chlorinated VOCs in sub-slab vapor and shallow groundwater is likely related to the historical solvent use in the southwestern portion of the building at the Site.

[1] Environmental Resources Management. 2014. Ground Water Monitoring Report. Wix Filtration Facility. Dillon, South Carolina. October.

Several VOCs, including PCE, TCE, and 1,1-DCA, were detected at levels of concern in the sub-slab vapor samples collected in 2014. *cis*-DCE was detected at concentrations above EPA Soil Screening Levels in surficial and near-surface soil samples collected from the canopy area adjoining the southwestern corner of the manufacturing building. In addition, groundwater samples collected from shallow monitoring well MW-14 have *cis*-DCE concentrations above the MCL, with lower levels detected in samples from other wells adjacent to or hydraulically downgradient of the southwestern corner of the building. Given the elevated method detection limits reported for some of the soil and groundwater samples, it is possible that additional VOCs are present but not detected in the soil and groundwater at the Site.

Based on the detection of chlorinated VOCs in environmental media, particularly the sub-slab vapor, and associated potential adverse human-health risks to facility workers, additional investigation is proposed to define the extent of VOCs in the sub-slab vapor and to further evaluate the potential for these compounds to migrate to indoor air inside the building.

Supplemental Remedial Investigation Activities

Building Sub-Slab Vapor Sampling

Sub-slab vapor samples will be collected at ten new sampling locations (SSV-05 through SSV-14). The proposed locations are shown on Figure 3; the final locations will be determined in the field by WSP personnel. Four samples will be collected in the former PCE use and storage area located in the southwestern portion of the building (Figure 3). The location of the other four samples have been preliminarily identified; however, these locations may be adjusted during the site reconnaissance to ensure sample collection in areas where building structures, such as floor drains, or historical operational information may indicate the historical use of chlorinated solvents.

All sampling will be conducted in accordance with the SCDHEC-approved Sampling and Analysis Plan (SAP, January 2014) and WSP's standard operating procedures (SOPs; Enclosure A), and will be consistent with the 2014 sub-slab vapor sampling activities. All sampling activities will be conducted with cleaned, dedicated equipment. All non-dedicated sampling equipment will be decontaminated after each use, using procedures outlined in WSP's SOPs.

Prior to implementation of the field investigation, WSP will conduct a sub-floor utility survey in the proposed sampling areas, and identify and locate points of interest.

Sub-slab vapor samples will be collected using Vapor Pin™ sample ports. The Vapor Pin™ installation and extraction procedures are presented in Enclosure A. Qualitative leak testing to evaluate the seal between the probe and slab will be conducted by placement of a water dam; repairs and retesting, as necessary, will be conducted before sampling commences.

Sub-slab vapor samples will be collected at each of the sampling locations in accordance with the procedures described in Section 5 of the Soil Gas Sampling SOP presented in Enclosure A. Specifically, all stagnant or ambient air will be removed from the sample port and any tubing. This volume, equal to approximately three times the volume of the sample port and tubing will be purged with a personal air sampling pump (or similar) into a Tedlar® bag. Air purged from the port will be screening with a photoionization detector. Field screening measurements will be recorded in the field logbook, After all stagnant/ambient air has been removed, the pump will be removed and an evacuated, laboratory-

certified clean 6-liter canister (e.g. SUMMA® canister) fitted with a pneumatic flow controller provided by the analytical laboratory, will be attached using a suitable secure connection (e.g., Swagelock® fitting). The canister valve will then be opened initiating sample collection and the initial vacuum reading (approximately 25 inches to 30 inches of mercury) will be recorded. The sample collection time, approximately 1 hour, will depend on the pre-set pneumatic flow controller. Field personnel will monitor the vacuum of the canister during sample collection. Once the required pressure is reached (approximately 5 inches of mercury or less, vacuum, absolute), sample collection will be completed by closing the canister valve. The sample name, location, time and date of sample collection, sample regulator and canister number, pre- and post-sampling canister pressures, and the analytical method will be recorded in the field logbook and on the chain-of-custody form.

Quality assurance/quality control (QA/QC) samples, including a duplicate, will be collected in accordance with WSP's SOPs (Enclosure A). The duplicate sample will be collected simultaneously with the sample, using a "T-fitting" supplied by the laboratory. The field duplicate identity will not be provided to the laboratory. The unique sample identification will be chosen from the range of WSP-100 through WSP-199.

At the conclusion of the sampling activities, the sample probes will be either left in place for future testing or removed and the borehole filled in with concrete. If left in place, the sample probes will be covered with a flush-mount cover for protection. The elevations of the sampling locations will be surveyed by a South Carolina-licensed surveyor to the nearest +/- 0.01-foot. The horizontal location of each sample point will be measured to the nearest +/- 0.1-foot.

Any investigation-derived waste (IDW) generated during the sampling activities will be contained in Department of Transportation-compliant 55-gallon drums, which will be labeled and moved to a staging area. IDW will be promptly characterized and disposed of in accordance with applicable state and federal requirements.

Laboratory Analysis

All samples will be sealed, labeled, and placed in a shipping container for shipment to Pace Analytical Services, Inc. of Huntersville, North Carolina, for laboratory analyses. The laboratory will analyze the samples using EPA Method TO-15. Appropriate chain-of-custody procedures will be followed. A "standard turn-around time" and a Level III deliverable will be requested for the sample analysis. To ensure the necessary data quality, the laboratory data package will be validated by a third party consistent with the protocols specified in Section 5.6 of the approved RI Work Plan, and the SAP.

Data Evaluation

The information gathered during the supplemental RI activities will be used to further characterize the nature and extent of contamination in the building area and ensure adequate data has been generated to evaluate risks and remedial alternatives to mitigate unacceptable risks to receptors. During performance of the investigation activities, the results will be continually assessed to determine if the data objectives have been attained or whether further data collection is deemed necessary. If additional data needs are identified while conducting the supplemental investigations, Wix will discuss the data gap(s) and the additional work needed to address the gap(s) with SCDHEC. Any additional work deemed necessary will be conducted as soon as possible following regulatory approval in order to minimize any major delay in the project schedule.

Air Sparge/Soil Vapor Extraction System Evaluation

As requested in Comment 1 of SCDHEC's January 12, 2015 *Approval of Focused Feasibility Study and Response to Comments* letter, WSP will evaluate the existing AS/SVE system in advance of the FFS. To perform an adequate evaluation, WSP will request background information from Environmental Resources Management, the contractor responsible for the design, installation, and operation and maintenance (O&M) of the AS/SVE system, including system as-built drawings and O&M records.

The evaluation will include the following:

- Review of the technology's suitability for the site characteristics (e.g., groundwater depth, soil permeability, toluene concentrations) using regulatory guidance.
- Compare the system's mass removal of toluene to the estimated mass of toluene in the system's radius of influence.
- Perform equipment sizing calculations for AS/SVE components (e.g., wells, piping, compressor, blower, vapor-phase treatment equipment) to confirm if the existing components are appropriately sized for maximum treatment capacity.
- Confirm the remedial system configuration optimizes the influence on the plume, thereby maximizing the removal efficiency of the system.
- Review site O&M records to confirm the existing equipment is operating properly and at the appropriate settings.

The AS/SVE evaluation will conclude whether continued system operation is beneficial in achieving the remedial goals, and recommend any enhancements, modifications, and maintenance activities to improve system operations.

RI Report Addendum

An RI Report Addendum will be submitted to SCDHEC following completion of the supplemental investigation activities. The report addendum will describe the sampling activities and results and, if appropriate, include recommendations for further action. Specifically, the following information will be included in the report addendum:

- A map of the site showing the additional sampling locations.
- A table listing the detected constituents and observed concentrations.
- Data validation report and laboratory analytical reports, including sampling dates, analysis dates, analytical methods used, signed chain-of-custody forms, method detection limits and QA/QC control results.
- Evaluation of AS/SVE system and recommendations to improve operations.

Schedule

The field activities will commence after final written approval of the RI Work Plan Addendum by SCDHEC. Based on the scope of work described above, the field work will take approximately 2 days to complete. In accordance with the VCC, the WSP Project Coordinator or his designee will notify SCDHEC of the field activities schedule a minimum of 5 working days prior to commencing work to allow the opportunity for agency oversight. The analytical testing of the samples will be completed within 30 days after finishing the field work, and the completed data package will be sent to a third-party data validator. Within 60 days of receiving the validated laboratory analytical results, the RI Report Addendum will be submitted to SCDHEC.

A detailed project schedule will be developed following agency approval of the supplemental investigation activities. This schedule will be provided to SCDHEC under separate cover.

If you have any questions concerning the RI Work Plan Addendum, please do not hesitate to contact us or Ken McCutcheon of Wix at (803) 774-5623.

Sincerely yours,

Robert E. Johnson, Ph.D., P. G.
Senior Technical Manager
South Carolina Professional Geologist #2296

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Enclosures

cc\encl: Ken McCutcheon, Wix Filtration Corp, Dillon, South Carolina
Paul Caulford, Wix Filtration Corp., Dillon, South Carolina
Keith Clark, Affinia Group
James Hiller, Affinia Group
Weston Adams III, Esquire, McAngus, Goudelock and Courie, LLC

Figures

PUMP HOUSE

WATER STORAGE TANK

FORMER RAILROAD SPUR

2 30,000-GALLON PROPANE TANKS

4,000-GALLON NATURAL GAS TANK

METERING STATION

BOTTLE FILL STATION

RECEIVING WAREHOUSE

SHIPPING WAREHOUSE

BATTERY STORAGE

DIE SHOP

CHEMICAL ROOM

PLANT STORE

OFFICES

APPROXIMATE AREA OF HISTORICAL PCE STORAGE AND USE

CANOPY

CONF. ROOM

LUNCH ROOM

PARKING

PARKING

WIX ROAD

B

N

LEGEND

PROPERTY BOUNDARY

DRAINAGE DITCH

FENCE

TREE LINE

REFERENCES:

1. ERM FIGURE TITLED AIR SPARGE/SOIL VAPOR EXTRACTION SYSTEM LAYOUT, DRAWING S-1, DATED SEPTEMBER 22, 2008, 86002SRS.DWG.
2. GOOGLE EARTH PRO AERIAL.

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SCALE, FEET

Drawn By: RL Checked: Approved: DWG Name: 00031999-B09

WIX FILTRATION FACILITY
DILLON, SOUTH CAROLINA

PREPARED FOR
WIX FILTRATION CORP LLC
DILLON, SOUTH CAROLINA

FIGURE 1

SITE LAYOUT

WSP USA Corp.
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Reston, Virginia 20191
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www.wspgroup.com/usa

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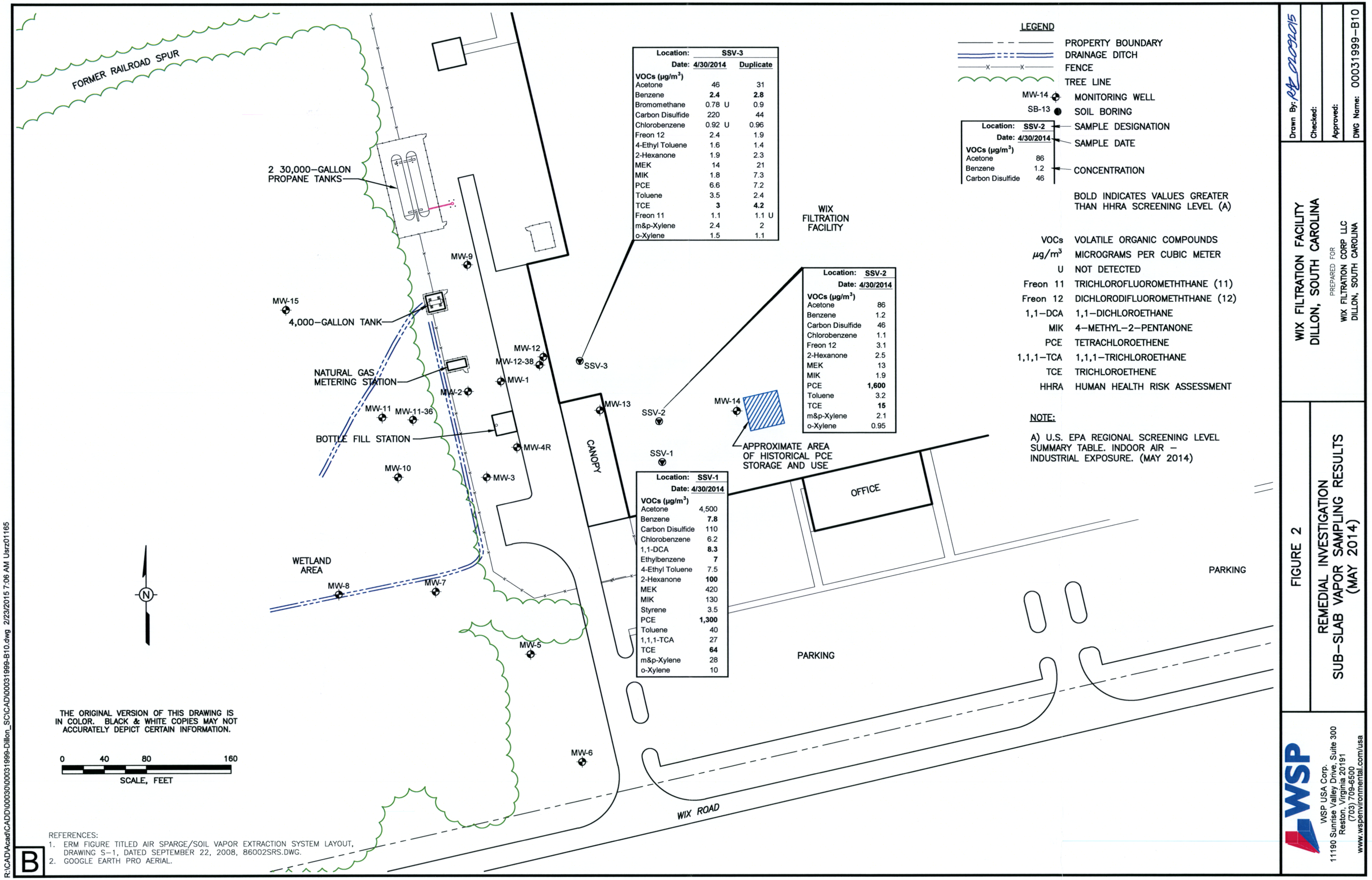

Location:	SSV-3	
Date:	4/30/2014	Duplicate
VOCs (µg/m³)		
Acetone	46	31
Benzene	**2.4**	**2.8**
Bromomethane	0.78 U	0.9
Carbon Disulfide	220	44
Chlorobenzene	0.92 U	0.96
Freon 12	2.4	1.9
4-Ethyl Toluene	1.6	1.4
2-Hexanone	1.9	2.3
MEK	14	21
MIK	1.8	7.3
PCE	6.6	7.2
Toluene	3.5	2.4
TCE	**3**	**4.2**
Freon 11	1.1	1.1 U
m&p-Xylene	2.4	2
o-Xylene	1.5	1.1

Location:	SSV-2
Date:	4/30/2014
VOCs (µg/m³)	
Acetone	86
Benzene	1.2
Carbon Disulfide	46
Chlorobenzene	1.1
Freon 12	3.1
2-Hexanone	2.5
MEK	13
MIK	1.9
PCE	**1,600**
Toluene	3.2
TCE	**15**
m&p-Xylene	2.1
o-Xylene	0.95

Location:	SSV-1
Date:	4/30/2014
VOCs (µg/m³)	
Acetone	4,500
Benzene	**7.8**
Carbon Disulfide	110
Chlorobenzene	6.2
1,1-DCA	**8.3**
Ethylbenzene	**7**
4-Ethyl Toluene	7.5
2-Hexanone	**100**
MEK	420
MIK	130
Styrene	3.5
PCE	**1,300**
Toluene	40
1,1,1-TCA	27
TCE	**64**
m&p-Xylene	28
o-Xylene	10

LEGEND

- PROPERTY BOUNDARY
- DRAINAGE DITCH
- FENCE
- TREE LINE
- MW-14 MONITORING WELL
- SB-13 SOIL BORING

Location:	SSV-2	SAMPLE DESIGNATION
Date:	4/30/2014	SAMPLE DATE
VOCs (µg/m³)		
Acetone	86	
Benzene	1.2	CONCENTRATION
Carbon Disulfide	46	

BOLD INDICATES VALUES GREATER THAN HHRA SCREENING LEVEL (A)

VOCs	VOLATILE ORGANIC COMPOUNDS
µg/m³	MICROGRAMS PER CUBIC METER
U	NOT DETECTED
Freon 11	TRICHLOROFLUOROMETHTHANE (11)
Freon 12	DICHLORODIFLUOROMETHTHANE (12)
1,1–DCA	1,1–DICHLOROETHANE
MIK	4–METHYL–2–PENTANONE
PCE	TETRACHLOROETHENE
1,1,1–TCA	1,1,1–TRICHLOROETHANE
TCE	TRICHLOROETHENE
HHRA	HUMAN HEALTH RISK ASSESSMENT

NOTE:

A) U.S. EPA REGIONAL SCREENING LEVEL SUMMARY TABLE. INDOOR AIR – INDUSTRIAL EXPOSURE. (MAY 2014)

REFERENCES:
1. ERM FIGURE TITLED AIR SPARGE/SOIL VAPOR EXTRACTION SYSTEM LAYOUT, DRAWING S–1, DATED SEPTEMBER 22, 2008, 86002SRS.DWG.
2. GOOGLE EARTH PRO AERIAL.

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Drawn By: RAE 4/30/15
Checked:
Approved:
DWG Name: 00031999–B10

WIX FILTRATION FACILITY
DILLON, SOUTH CAROLINA

PREPARED FOR
WIX FILTRATION CORP LLC
DILLON, SOUTH CAROLINA

FIGURE 2

REMEDIAL INVESTIGATION
SUB–SLAB VAPOR SAMPLING RESULTS
(MAY 2014)

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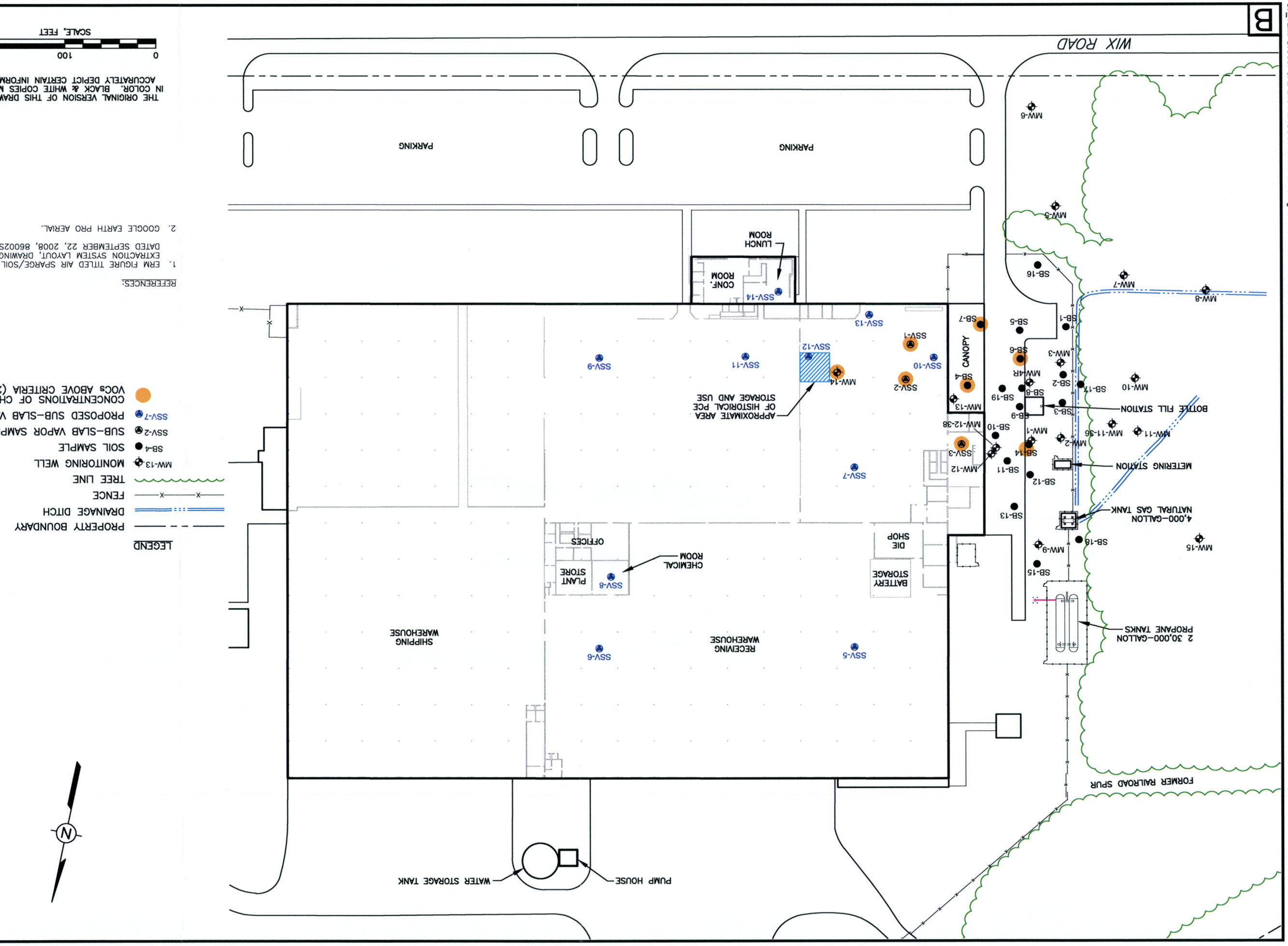

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REFERENCES:

1. ERM FIGURE TITLED AIR SPARGE/SOIL VAPOR EXTRACTION SYSTEM LAYOUT, DRAWING S-1, DATED SEPTEMBER 22, 2008, B60025RS.DWG.
2. GOOGLE EARTH PRO AERIAL.

LEGEND

- PROPERTY BOUNDARY
- DRAINAGE DITCH
- FENCE
- TREE LINE
- MW-13 MONITORING WELL
- SB-4 SOIL SAMPLE
- SSV-2 SUB-SLAB VAPOR SAMPLE
- SSV-7 PROPOSED SUB-SLAB VAPOR SAMPLE
- CONCENTRATIONS OF CHLORINATED VOCs ABOVE CRITERIA (2014)

FIGURE 3

PROPOSED SUB-SLAB VAPOR SAMPLING LOCATIONS

WIX FILTRATION FACILITY
DILLON, SOUTH CAROLINA

PREPARED FOR
WIX FILTRATION CORP LLC
DILLON, SOUTH CAROLINA

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Checked:
Approved:
DWG Name: 00031999-B08

Enclosure A – Standard Operating Procedures

FIELD STANDARD OPERATING PROCEDURE #1
Note Taking and Field Book Entries Procedure

The field book is a record of the day's activities that serves as a reference for future reporting and analyses. The field book is also a legal record for projects that may become involved in litigation. It is of the utmost importance that your notes be complete and comprehensive. The user is advised to read the entire standard operating procedure (SOP) and review the site health and safety plan (HASP) before beginning any onsite activities.

1.1 Acronyms and Abbreviations

HASP	health and safety plan
IDW	investigation-derived waste
SOP	standard operating procedure

1.2 Materials

- Permanently-bound waterproof field book (e.g., Rite-in-the-Rain® #550, or equivalent)
- Black or blue ballpoint pen (waterproof ink recommended; do not use felt-tip pens)

1.3 Preconditions and Background

This SOP has been prepared as part of the WSP USA Corp. Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel and will ensure that the tasks are performed in safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of WSP employees and will be revised periodically to reflect updates to WSP policies, work practices, and the applicable state and/or federal guidance. WSP employees must verify that this document is the most recent version of the WSP SOPs. WSP employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

The purpose of the field book is to provide a log of all of field events and conditions. The notes must include sufficient detail (i.e., who, what, when, where, why, and how) to enable others to reconstruct the day's activities for analysis, reporting, or litigation. It is important to be objective, factual, and thorough. Language must be free of personal comments or terminology that might prove inappropriate. Additional data logs or worksheets, such as low flow groundwater sampling sheets, may be used as a supplement; however, under no circumstances should the data sheets be used as a substitute for the daily record of events to be recorded in the field book.

The field book forms the foundation upon which most of the project work (reports, subsequent work plans, etc.) will be based. It is critical that field book chain of custody is maintained at all times.

1.4 Set-Up Procedures

The first step in setting up a new field book is to add the information necessary for you to identify the field book in the future and for others to return the book to WSP, should it be lost. On the first page of the field book (or, for some field books, the inside cover), place a "Return for Reward" notice. Include the following information:

- An "If Found – Return for Reward" notice in bold letters
- Our company name
- Our company address (usually the office where the project is being managed)
- Our company phone number

Reserve the second page of the field book for project-specific information, such as:

- The project name and number
- The project manager's name
- The site telephone number, address, and onsite contact (if appropriate)
- The names and telephone numbers for all key (onsite) personnel
- The emergency telephone numbers including the police, fire, and ambulance (found in the HASP)

Business cards from individuals who visit the site, (including the person in charge of the field book) can be affixed to the inside back cover.

1.5 Field Book Entries

Start each day on a new page. Include the following information in the header of the first page (and all subsequent pages):

- The date
- The project name
- The page number (often pre-printed in Rite-in-the-Rain® style field books)

Precede field book entries by the time entered along the left margin of the page using a 24-hour or military clock (e.g., 1330 for 1:30 PM). The first entry of the day must include your and your subcontractor's arrival time at the site, a description of the planned activities, key onsite personnel (including subcontractors), and the weather forecast. The first entry must also detail the tailgate review of the site-specific HASP with the onsite personnel. Be sure that field book entries are LEGIBLE and contain factual, accurate, and inclusive documentation of project field activities. Do not leave blank lines between field book entries. If a mistake is made in an entry, cross out the mistake with a single line and place your initials the end of the line. Any acronyms written in the field book (including your initials) must be spelled out prior to the first use. Record your initials and date at the bottom of each page.

Subsequent log entries must document the day's activities in sequence and must be completed throughout the day as events occur (i.e., do not wait until the end of the work day to complete the notes); should out of sequence notes need to be entered, please identify using a footnote or by clearly indicating "Late Entry." Notes must be descriptive and provide location information or diagrams (if appropriate) of the work area or sample locations. Note any changes in the weather and document all deviations from the work plan. Arrival and departure times of all personnel, and operational periods of standby, decontamination, and specific activities must be recorded.

List all field equipment used (e.g., photoionization detector, water testing equipment, personal protective equipment, etc.) and equipment calibration activities, and record field measurements, including distances, monitoring and testing instrument readings. Include the following information in entries describing sampling activities:

- The equipment and materials used by subcontractors, if appropriate (e.g., drill rig type, boring sizes, well casing materials, etc.)
- The sample media and analyses to be performed

- The sampling procedures (e.g., split-spoon sampling, hand trowel, low flow, etc.)
- The equipment used to obtain the sample (e.g., bailers, pump types, geochemical monitoring equipment, etc.)
- The sizes and types of containers, preservation (if any), and any resulting reactions
- The sample identification (especially for duplicate samples)
- The sample collection time
- The shipping and handling procedures, including chain-of-custody, air bill, and seal numbers
- If supplemental data recording logs (digital or hard copy), such as low flow groundwater sheets, the above information must be entered in the field book and the supplemental records cross-referenced.

For most sampling activities, the log entries must also include:

- The decontamination and disposal procedures for all equipment, samples, and protective clothing
- An inventory of the investigation-derived waste (IDW) materials generated during the site activities
- A description of the IDW labeling procedures and the onsite staging information

Maintain a sequential log if the sample locations and areas of interest are photographed (strongly recommended). The photographic log must include:

- The date and time of the photograph
- The sequential number of the photograph (e.g., photograph-1, photograph-2, etc.)
- The general direction faced when the photograph was made
- A description of the subject in the image

1.6 Closing Notes

The last entry of the day must include a brief wrap up of the work accomplished, a description of how the site is being secured, and a description of any near hits, accidents, and incidents that occurred during the day's work. Draw a line through the remainder of the page from the row of text diagonally through any blank lines and initial at the end of the diagonal line.

FIELD STANDARD OPERATING PROCEDURE #14

Sub-Slab Vapor Sampling Procedures

The procedures outlined in this Standard Operating Procedure (SOP) are designed to ensure that sub-slab vapor (SSV) samples are representative of the zone from which they were collected and that they have not been altered or contaminated by the sampling and handling methods. Sub-slab vapor sampling is generally conducted to assess the presence of volatile compounds (e.g., volatile organic compounds [VOCs], mercury) in SSV as part of a vapor intrusion (VI) investigation. The user is advised to read the entire SOP and review the site health and safety plan (HASP) before beginning any onsite activities. In accordance with the HASP, proper personal protective equipment (PPE) must be selected and used appropriately.

14.1 Acronyms and Abbreviations

IDW	investigation derived waste
HASP	health and safety plan
PID	photoionization detector
PPE	personal protective equipment
QAPP	Quality Assurance Project Plan
SOP	standard operating procedure
SSV	sub-slab soil vapor
VI	vapor intrusion
VOCs	volatile organic compounds

14.2 Materials

- Field book
- Camera
- Portable weather station, if required
- Sample containers
- Labeling and shipping supplies
- PPE
- Photoionization detector (PID)
- Sample point installation materials
  - Power drill (e.g., demolition hammer, direct push hammer, auger drill)
  - SSV probe assembly
  - Teflon®, Teflon®-lined, or stainless steel tubing
  - Tube fittings (e.g. Swagelok®, Qwik-Lok®)
  - Sealant material (e.g., hydrated bentonite, silicone stopper, non-shrinking, non-volatile clay)
  - Potable water
- Leak testing materials (if required):
  - Tracer compound detector (e.g., helium gas detector)

- Tracer compound gas (e.g., helium)
- Shroud (e.g., 5-gallon bucket or stainless steel dome)
- Shroud sealant material (e.g., bentonite pellets or modeling clay)
- Tedlar® bags (to capture purged soil gas)

- Air purging pump or vapor syringe
- Adjustable wrenches (if required)
- Air sampling pump (if required)
- Inline flow meter (if required)
- Tedlar® bags (for sample collection)

14.3 Preconditions and Background

This SOP has been prepared as part of the WSP USA Corp. Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel and will ensure that the tasks are performed in a safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of WSP employees and will be revised periodically to reflect updates to WSP policies, work practices, and the applicable state and/or federal guidance. WSP employees must verify that this document is the most recent version of the WSP SOP. WSP employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

This SOP is designed to provide the user with a general outline for conducting SSV sampling activities and assumes the user is familiar with basic field procedures, such as recording field notes (SOP 1), utility location (SOP 2), sample shipment procedures (SOP 3), sample collection and quality assurance procedures (SOP 4), investigation derived waste (IDW) management procedures (SOP 5), equipment decontamination (SOP 6), and the use and calibration of SSV sampling and monitoring equipment (SOP 7). This SOP does not cover other vapor sampling activities, such as air sampling (SOP 13) or soil vapor sampling (SOP 15). Additionally, this SOP does not cover investigation planning, nor does it cover the analysis of the analytical results. These topics require a significant amount of planning and are more appropriately addressed in a project-specific work plan. Before implementing the SSV sampling, be sure to review the project-specific work plan or Quality Assurance Project Plan (QAPP) and any applicable state and federal guidelines or sampling procedures.

All sampling and monitoring references must be available for consultation in the field, including:

- WSP's SOPs
- Applicable state and federal guidelines or sampling procedures
- Manufacturer's manuals
- Project-specific work plan and HASP
- QAPP

14.4 General Procedures

Sub-slab vapor can be affected by a multitude of sources, as well as the integrity of the structure, the weather (e.g., barometric fluctuations), the heating, ventilation and air conditioning systems, the use of the building (e.g., whether

any manufacturing processes are active), and the amount of access to the structure (e.g., how many doors or windows are being opened and closed during a given period). It is important to carefully note the use of the building and minimize the number of factors that could influence the SSV results (e.g., keeping the windows closed during the sampling). The user should also be aware that a number of regulatory agencies have specific guidelines as to timing or the sequence of the sampling activities, particularly if performed as part of a VI investigation.

Although the specific procedures used to sample SSV vary between investigations, most sampling can be broken down into a five-step sequence:

1. **Building Inspection and Inventory**: documenting all of the materials used or stored in the structure that could potentially interfere with the sample collection.
2. **Sample Point Installation**: installing the SSV probe in the sub-slab material.
3. **Leak Testing**: testing the integrity of the SSV sample point (if required).
4. **Purging:** removing any non-representative vapor from the SSV sample point.
5. **Sample Collection**: collecting samples over a specified period (typically grab, 1-hour, 8-hour, or 24-hour), using a laboratory-supplied container, such as an evacuated sample canister with the appropriate regulator, or a Tedlar® bag with an air sampling pump.

Information regarding weather conditions, including temperature, barometric pressure, wind speed and direction, and precipitation, should be noted and recorded in the field notebook during all steps. A portable weather station is often sufficient for documenting the weather conditions. Consult the project-specific work plan and applicable regulatory guidance to determine if fixed weather monitoring during the sample collection is required.

The project team should discuss the project-specific SSV sampling procedures and equipment in advance of site mobilization. While the investigation is underway, the project team should avoid other environmental activities which may release volatile vapors into the investigation area, including soil sampling, excavation, and groundwater monitoring.

To ensure the integrity of the samples collected, the following common procedures shall be employed:

- The use of new, disposable or decontaminated sample installation equipment
- The use of the appropriate PPE
- Selection of a suitable sampling location and staging area

A clean pair of new, disposable gloves should be worn at each sample location; and the gloves should be donned immediately prior to mobilizing to each location. This limits the possibility of cross-contamination from accidental contact with affected media from the previous location. The gloves should also be changed any time during sample collection when their cleanliness is compromised.

14.5 Building Inspection and Materials Survey

A building inspection and materials inventory is often a prerequisite activity before initiating SSV sampling. The scope of this activity, including completion of an inspection questionnaire (with a building representative, if possible), shall be performed in accordance with the project-specific work plan and applicable regulatory guidance. Before embarking on the inspection, confirm that there are no access limitations for the inspection, sampling activities, and photography.

Components of a typical building walkthrough and survey include:

- Identification of potential background sources of volatile compounds, such as vapor releases from neighboring properties, or materials stored within the building, such as paint, fuels, solvents, cleaners, etc. Some states may require scanning of the potential background sources with an appropriately sensitive PID.
- Review of current and historical building operations and chemical use.

- Assessment of the building construction and condition (e.g., whether or not a basement is present, poured or block foundation, concrete slab present, air flow, etc.).
- Identifying areas of potential VI into a building (e.g. cracks in the concrete slab or walls, pipe penetrations, sumps, etc.).
- Inspection and photographic documentation, if necessary, of proposed sample locations.
- Identification of building pressure/ventilation system location and specifications.

At the conclusion of the building inspection and survey, discuss the sampling procedures with building occupants and prepare building conditions for the SSV sampling in accordance with the project-specific work plan. Building preparations typically include requesting that the building owners shut the building windows, remove sources of background VOCs (e.g., paint, fuels, solvents, household cleaners, beauty items), and that they refrain from smoking in the investigation area during sampling activities.

14.6 Sample Point Installation

The SSV sample collection devices are installed through the concrete floor of the lowest level in the building being evaluated. Before drilling, inspect the proposed location for potential hazards, including utilities (see SOP 2). In buildings with an earthen floor on the lowest level, consult the project-specific work plan and applicable regulatory guidance to determine if SSV samples collected from the available concrete area (e.g., concrete pads beneath a furnace, hot water heater, or other equipment) should be combined with either air samples (SOP 13) or soil vapor samples (SOP 15) collected from the space overlying the earthen floor.

The SSV sample point is created in a suitable concrete floor or surface by installing two concentric holes in the floor using an electric hammer drill. The outer hole, typically 1-inch in diameter, is advanced from the surface to a depth of approximately 1 inch deep. This hole will serve as an annular space to be filled with a seal (e.g., hydrated bentonite, silicone stopper, non-shrinking, non-volatile clay, etc.). Once the outer hole is complete, a second, smaller diameter hole, typically 3/8-inch, is drilled through the center of the outer hole and advanced through the bottom of the concrete surface and a short distance into the soil beneath. The intent is to create a small space suitable for insertion of the sampling tubing or implant (if required) below the slab. Once the targeted depth has been reached, remove the drill from the hole and use a hand vacuum or shop vacuum to remove concrete dust from the hole and surrounding work area.

The SSV sampling set-up typically consists of Teflon® or Teflon®-lined tubing inserted through a cored 1-inch diameter silicone stopper or a polyethylene or stainless steel soil gas implant. All construction materials must be selected in accordance with the project-specific work plan and relevant regulatory guidance. Once the set-up is complete, connect the SSV sampling device is connected to the aboveground tubing and inserted into the recessed 3/8-inch hole. If using a silicone stopper and tube sampler, the stopper should fit snugly into the outer hole creating an airtight seal, which should be augmented by adding a non-shrinking, non-volatile material, such as modeling clay or hydrated bentonite, around the stopper and tubing assembly. For implants, the clay or bentonite is placed directly into the outer hole filling the annual space to form a seal. This should be done quickly to prevent any vapors present below the slab from being released into the indoor air. Attach the appropriate fittings (e.g., a 3-way valve) and additional tubing, if appropriate. Be sure that the tubing is clamped or otherwise closed off to avoid discharging vapor to the air.

Sampling should not be performed until equilibrium has been re-established below the slab and any vapors that have escaped from the subsurface have had a chance to dissipate. Equilibrium is typically re-established in about 24 hours after the sample point installation, or as otherwise specified in the project-specific work plan or regulatory guidance.

14.7 Leak Testing Procedures

If required, the integrity of the seal between the concrete floor and the SSV sample point assembly can be verified using a tracer gas such as helium. This type of leak testing is typically performed before sampling and involves creating an enclosure above the sample point, which is then charged with the tracer gas. A meter capable of detecting the tracer is then connected to the sampling tube and monitored to ensure that the gas (an analog for indoor air) is not passing through the floor seal and being introduced into the sample.

The leak testing methodology presented below is a generic procedure that may suffice for regulatory programs that do not have specific leak testing procedures or requirements. The user should verify the leak testing procedures in the project-specific work plan and relevant regulatory guidance.

The generic leak testing procedures are as follows:

1. Select a container to serve as the shroud (e.g., 5-gallon bucket or stainless steel dome). This device should be of sufficient size to cover the SSV sample point and the aboveground tubing and fittings connected to the SSV sample point. Dedicated testing shrouds with fittings and sample ports are available from some laboratories.
2. Fit the shroud with two hose barbs or quick-lock connectors, one sized appropriately to connect to the sample tubing and the other sized appropriately for tubing from the tracer gas (e.g., helium). These fitting allow the tracer gas to be introduced to the enclosure and the SSV sample point tubing to be connected to the detector outside of the shroud.
3. Connect the sample tubing to the appropriate connector inside the shroud and then place it over the sample point and aboveground tubing and fittings. The shroud should be sealed to the floor using modeling clay, bentonite, or other appropriate material.
4. Connect the detector to the sample barb or quick-connect via a short length of tubing and start the detector.
5. Charge the shroud with a tracer gas through the second hose barb or quick-lock connector. A target concentration of 10% to 20% is generally recommended for within the shroud, or as otherwise specified in the project-specific work plan and relevant regulatory guidance.
6. Measure the tracer compound concentrations by alternatingly connecting the gas detector to the first and second quick-lock connectors.
7. Monitor the SSV sample point over a period of at least 2 minutes, or as otherwise specified in the site-specific work plan or regulatory guidance. A leak is occurring if the concentration in the SSV sample point is greater than 10% of its concentration within the shroud, or as otherwise specified in the project-specific work plan and relevant regulatory guidance. If a leak is detected, the floor seal around the SSV sample point must be repaired and the process repeated until the results indicate the seal is competent.
8. Close the valve port connected to the SSV discharge tubing.
9. Record the leak detection procedures and observations in the field book.

14.8 SSV Probe Purging Procedures

Before collecting the SSV sample, the sample probe and sample train must be purged to remove any ambient air. Purging can be accomplished by connecting a hand-powered air pump or vapor syringe to the SSV discharge tubing. A "low-flow" purge rate (typically a maximum of 200 milliliters per minute) is required by many regulatory agencies to avoid potential short-circuiting or desorbing of volatile compounds from soil particles; a calibrated sampling pump or inline flow meter may be used to ensure the flow rate is maintained. A minimum of 3 tubing/probe volumes should be purged from the SSV sampling assembly prior to sample collection. The volume is calculated as follows:

$$\text{Purge Volume} = (3.0\ \pi\ r^2\ h)_{probe} + (3.0\ \pi\ r^2\ h)_{tubing}$$

Where:

r = the inner radius of the probe and connecting tubing

h = the height of the probe and the connected tubing.

Purged vapor from the SSV probe should be contained in Tedlar® bags to prevent the release of SSV into the indoor airspace. As required by the project-specific work plan or regulatory guidance, collect air quality readings from the purged air (e.g., PID).

14.9 SSV Sampling Procedures

SSV samples are collected using either passive (vacuum, no pump required) Entech Instruments, Inc. (Entech)-style or SUMMA®-equivalent stainless steel canisters supplied by the analytical laboratory, or active (requires a pump) equipment, such as a Tedlar® bag and hand-powered pump. The passive sampling equipment typically includes a canister under vacuum, a flow regulator with an in-line vacuum gauge, and in-line particulate filters. The flow regulator is pre-set by the laboratory to collect a sample over the collection period specified in the project-specific work plan and the laboratory task order. Instructions for connecting the sample canister to the flow regulator are typically provided by the laboratory. Tedlar® bag sampling is only appropriate for "grab" samples.

Collect quality assurance/quality control samples in accordance with SOP 4 and the project-specific work plan.

14.9.1 Canister Sampling

1. Record the initial conditions at the sample location in accordance with the project-specific work plan or regulatory guidance, often including the weather conditions (e.g., precipitation, barometric pressure, and indoor and outdoor temperature), PID readings, and any observations (e.g., odor, staining, or spills).
2. Connect the sample canister to its dedicated, pre-set flow controller with an in-line vacuum gauge. If using a SUMMA®-equivalent canister, tighten (hand-tight) the fitting with adjustable wrenches. Do not over tighten. If using an Entech canister, connect the canister to the flow controller by sliding back the collar on the female end of the regulator's fitting and inserting it into the male end of the canister's fitting.
3. Open the appropriate valve port on the SSV discharge tubing to allow vapor flow from the SSV probe to the sample canister.
4. Place physical and visual barriers around the canisters, as necessary, so they are not disturbed during sample collection. The barriers should be placed in a manner so as to not compromise air flow around the canisters.
5. Record initial vacuum, open the canister's intake valve, and begin sample collection. Do not use canisters that show unacceptable initial vacuum readings as provided in the laboratory instructions or project-specific work plan.
6. Attach a label to the sample container and enter information (sample number, start date, start time, sampler's initials, analysis, initial vacuum readings, and place of collection).
7. As possible, check the canister vacuum gauge reading at least once during the sample collection period to ensure the canister's pressure is changing at the appropriate rate. If the canister's pressure is not changing at the appropriate rate, contact the WSP project manager.
8. Once the sample collection period is completed, record the final vacuum, close the canister's intake valve, close the valve port connected to the SSV discharge tubing, disconnect the sample canister's intake port to the tubing from the SSV probe, and disconnect the pre-set flow controller from the canister. Enter the remaining information on the sample label and field book (stop date, stop time, and final vacuum reading).

9. Record the final conditions at the sample location in accordance with the project-specific work plan or regulatory guidance, often including the weather conditions (e.g., precipitation, barometric pressure, and indoor and outdoor temperature), PID readings, and any observations (e.g., odor, staining, or spills).

14.9.2 Tedlar® Bag Sampling

1. Record the initial conditions at the sample location in accordance with the project-specific work plan or regulatory guidance, often including the weather conditions (e.g., precipitation, barometric pressure, and indoor and outdoor temperature), PID readings, and any observations (e.g., odor, staining, or spills).
2. Attach a new, appropriately-sized section of Teflon® or Teflon®-lined tubing to the air sampling pump.
3. Purge the tubing by operating the pump in accordance with the manufacturer's specifications (this will remove whatever air was present in the tube and pump mechanism allowing the air to be sampled to enter the sampling assembly).
4. Connect the pump's intake to the SSV discharge tubing, and the pump's discharge to the Tedlar® bag sample port.
5. Open Tedlar® bag valve and the appropriate valve port for the SSV discharge tubing to allow air flow from the SSV point to the Tedlar® bag.
6. Turn on the air sampling pump (or use the hand-powered pump) and begin filling the Tedlar® bag. Ensure the air sampling pump's flow rate meets any requirements in the project-specific work plan or regulatory guidance, using a calibrated air sampling pump or inline flow meter.
7. Once the Tedlar® bag is approximately two-thirds full, close the valve on the Tedlar® bag and the valve on the SSV discharge tubing.
8. Discontinue the pump operation and disconnect the air sampling pump from the Tedlar® bag.
9. Attach a label to each bag and enter information (sample number, date, start/stop time, sampler's initials, analysis, and place of collection).
10. Record the final conditions at the sample location in accordance with the project-specific work plan or regulatory guidance, often including the weather conditions (e.g., precipitation, barometric pressure, and indoor and outdoor temperature), PID readings, and any observations (e.g., odor, staining, or spills).

14.10 Sample Labeling and Preparation for Shipment

Once sample collection is complete, prepare the air sample canisters for offsite laboratory analysis:

1. Clean the outside of the sample container, if necessary.
2. Ensure all required information is completed on each sample label (see above).
3. Record sample designation, date, time, and the sampler's initials in the field book.
4. Complete chain-of-custody forms with appropriate sampling information:
   - Sample name
   - Location
   - Sample collection start and end times
   - Initial vacuum measurement
   - Ending vacuum measurement

- Date
- Sample regulator number
- Sample canister number
- Analytical method

5. Complete sample packing and shipping in accordance with proper procedures. Note that air samples are typically shipped under ambient temperatures.

14.11 Closing Notes

Once sampling is completed, secure the sample port or abandon the location boreholes/locations in accordance with the project-specific project work plan. Decontaminate all equipment prior to departure and properly manage all PPE and IDW in conformance with applicable regulations.

FIELD STANDARD OPERATING PROCEDURE #2
Utility Locating Procedure

The purpose of this procedure is to ensure that all required and appropriate procedures are followed to locate and mark subsurface utilities (e.g., electrical lines, natural gas lines, communication lines) before initiating any intrusive field activities (e.g., drilling, test pits, trenching, excavation). WSP's preference, as indicated in our standard and remediation subcontractor agreement templates, is for our Contractors to be responsible for both public and private utility mark-outs; this includes contacting the public authority and obtaining a subcontractor for private utility locating services, if needed. Guidance for Contractor's to follow to conduct utility clearance is provided in our Request for Proposal (RFP) template and must be included in all RFP's for intrusive field activities. **In certain extraordinary circumstances, WSP may choose to be responsible for clearing utilities, this will require a change in the template language of our subcontractor agreement and the revised agreement requires the approval and signature of a member of the Environmental Leadership Team (ELT).**

For projects where WSP will be responsible for clearing utilities, compliance with this procedure is mandatory. **ALL** deviations from this standard operating procedure (SOP) **MUST** be approved by the project manager and a member of the ELT **BEFORE** beginning intrusive work.

Field personnel have the authority and responsibility to postpone intrusive activities if a Contractor has not completed utility clearances to WSP's satisfaction; if sufficient information, as stipulated in this SOP, is not available; or if onsite reconnaissance identifies inconsistencies in the findings of utility locators. In these instances, field personnel must notify the project manager or the WSP health and safety officer, or their designee, before proceeding with the proposed work; approval from a member of the ELT is required before the work commences.

The user is advised to read the entire SOP and review the site health and safety plan (HASP) before beginning any onsite activities.

2.1 Acronyms and Abbreviations

HASP	health and safety plan
ELT	Environmental Leadership Team
RFP	Request for Proposal
SOP	standard operating procedure

2.2 Materials

- Utility Locating Form (Attachment 1)
- Field book
- Wood stakes
- Spray paint
- Flagging tape
- As-built drawings for sub grade utilities (if available)
- Hand auger or post-hole digger

2.3 Preconditions and Background

This SOP has been prepared as part of the WSP USA Corp. Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel and will ensure that the tasks are performed in a safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of WSP employees and will be revised periodically to reflect updates to WSP policies, work practices, and the applicable state and/or federal guidance. WSP employees must verify that this document is the most recent version of the WSP SOPs. WSP employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

This procedure is intended to allow the work to proceed safely and minimize the potential for damaging underground and aboveground utilities. Intrusive work includes all activities that require WSP's employees or its subcontractors to penetrate the ground surface. Examples of intrusive work include, but are not limited to, hand augering, probing, drilling, injections, test pit excavations, trenching, and remedial excavations.

This SOP assumes the user is familiar with basic field procedures, such as recording field notes (SOP 1).

2.4 Pre-Field Mobilization Procedures

Regardless of who is responsible for completing these activities (WSP or a Contractor), public rights-of-way and private property must be cleared of potential buried utilities before any intrusive work can begin. The first step in this process is notifying the state public utility locating service of the planned work. These services provide a link between the entities performing the work and the various utility operators (e.g., the water company, the electric company, etc.). All of the public utility locating service call centers in the United States have been streamlined under a single "Call Before You Dig" phone number: 811.

Please note, some state laws have changed such that the person who will actually be conducting the intrusive work must be the person who places the call to the public utility locating service. This means that WSP cannot make this call on the Contractor's behalf; the Contractor must place the call in those states where required. The Common Ground Alliance has established a web site that includes state-specific information to assist in making this determination (http://www.call811.com/state-specific.aspx) for sites in the US and some parts of Canada. If there is any doubt about the requirements for the state where a project is located, the relevant state authority must be contacted.

When the call center is contacted, information regarding the site (e.g., location, nearest cross street, township, etc.) and work activity (e.g., drilling, excavation) will need to be provided to the operator to aid in locating the likely utilities at the work site. The information provided on WSP's Utility Locating Form (Attachment 1) must be recorded (by the Contractor or WSP) and a completed copy of this form must be maintained as part of the project file. Be aware that several states, including California, require that the proposed drilling locations be marked with white spray paint before contacting the locating services.

The following information must accompany the WSP field team at all times during the field project:

- The utility clearance ticket number
- The ticket's legal dig date
- The ticket's expiration date
- Utility providers that were contacted

The ticket number serves as a point of reference for both the utility service providers and for WSP or Contractor personnel should follow up (e.g., renewing the ticket) with the locating service be required. The legal dig and expiration dates reflect the times when it will be legal to perform the proposed work. The legal dig date reflects the

lead time necessary, typically between 48 and 72 hours after you call, for the utility service providers to mark the utilities in you work area. Be sure to include this delay when planning your work. Most utility clearance tickets expire about 2 weeks after the legal dig date. If your work is delayed beyond the expiration date, 811 will need to be called again and the ticket renewed. The renewed ticket will have a new legal dig date that incorporates the same lead-time as the original ticket.

The locating service will also provide the caller with a list of utility companies that will be notified. Compare this list with utilities generally expected at all sites (e.g., sewer, water, gas, communication, and electric). Some utilities (e.g., sewer, water, cable TV) may not be included. If any expected utilities are absent from the contact list, you **MUST** contact the utilities directly for clearance before the start of intrusive activities. Record all contacts on the Utility Locating Form.

2.4.1 Private Utility Locators and Other Sources

Public utility service providers will generally mark their underground lines within the public right-of-way up to the private property boundary. You can request that the utility companies locate their utilities in work areas on private property; however, be aware that most service providers will not mark their utilities on private property. If your work is to be conducted on private property, you **MUST** use a private utility locating service. These companies typically use a variety of methods (e.g., electromagnetic detectors, ground-penetrating radar, acoustic plastic pipe locator, trace wire, etc.) to locate buried utilities in both inside and outside locations (witching is not an acceptable method).

For all operating facilities and the extent possible for closed facilities, identify a site contact familiar with the utilities on the property (e.g., plant manager, facility engineer, maintenance supervisor), and provide this individual with a site plan showing the proposed locations of all soil borings, monitoring wells, test pits, and other areas where intrusive activities will be conducted. These individuals often have knowledge of buried structures or process-specific utilities that may not be identified by the private utility locator. This is particularly important for work performed inside industrial buildings where reinforced concrete and other metallic components of the structure may interfere with the scanning devices used by the private utility locator. You should ask the site contact for all drawings concerning underground utilities in the proposed work areas for future reference.

Keep in mind that no intrusive work may be done before the legal dig date provided by the state utility locating service and no digging, drilling, or other ground-breaking activities may be begin until all utilities on the list have been marked and visually verified in the work area (see below). It is **NOT ACCEPTABLE** to rely solely on as-built drawings or verbal utility clearances from the site contact (these should be used as guides only). A private locator may not be necessary in rare instances; however, nonconformity with the private locate requirement must be approved by the project manager **AND** a member of the ELT before work proceeds.

2.5 Site Mobilization Procedures

Upon arrival, the first step in determining if you are clear of buried and overhead utilities is to locate all of the proposed drilling and trenching locations and mark them with spray paint, stakes, or other appropriate markers. This will help you judge distances from marked utilities and minimizes any potential misunderstandings regarding the locations between you, the subcontractors (drillers, excavators, private utility locator), and the site contact.

Once you have the proposed work areas marked, verify that ALL utility companies listed by the state public utility locating service, and any contacted directly by WSP or the Contractor, have either marked the underground lines in the specified work areas or have responded (via telephone, facsimile, or e-mail) with "no conflict." Document on the Utility Locating Form (Attachment 1) and in the field book as each utility mark is visually confirmed. When receiving verbal clearances by telephone from utility companies, or their subcontractors, it is imperative that you verify which utilities are being cleared, particularly when dealing with subcontractors that may be marking more than one utility.

Review all available as-built utility diagrams and plans and conduct a site walk to identify potential areas where underground lines may be present; include the site contact in these activities. It is a good idea to survey your surroundings during the walk to identify any features that may indicate the presence of underground utilities, such

as linear depressions in the ground, old road cuts, catch basins, or manholes. Keep in mind that many sewer lines can be offset from catch basins. The presence of aboveground utilities, such as parking lot lights or pad-mounted transformers, is also a good indicator of buried electrical lines. Check these items against the Utility Locating Form checklist and discuss the locations with the private utility locating service.

2.5.1 Safe Working Distances and Hand Clearing

A minimum of 4 feet clearance must exist between utilities and proposed drilling locations, and a minimum of 6 feet between utilities and proposed trenching locations. Be aware that some states and localities (e.g., New York City, Long Island) may require greater minimum working distances, depending on the utility (e.g., for high pressure gas mains). A minimum distance of 15 feet must be maintained by heavy equipment (e.g., excavator buckets, drill rig towers and rods) from overhead power lines and a safe distance of 25 feet must be maintained from high-tension overhead power lines. In the event that work must be conducted within 25 feet of high tension wires, the lines must be wrapped and insulated by the local utilities. Increase these minimum distances whenever possible to offer additional assurance that buried or overhead utilities will not be encountered.

If a utility conflict is identified within the minimum safe clearance distance, adjust the proposed location(s) using the criteria given above. It is a good idea to have the private utility locator sweep a relatively large area (e.g., a 20-foot circle around a proposed drilling location) to provide room for adjustment should the proposed drilling or excavation area need to be moved to avoid a buried utility.

Uncertainty may exist in some circumstances (inside a building, for example) even after the area has been swept for utilities. In these cases, advance the first few feet of a soil boring (or probe the area for excavation) using a hand auger or post-hole digger. If hand digging is unable to penetrate the subsurface soils, soft dig or air knife equipment service providers are often retained to clear the location. This equipment applies high pressure air to penetrate, loosen, and extract subsurface soils in the borehole, thereby safely exposing any utilities. If using either hand digging or soft digging, the probe hole should be advanced a minimum of 5 feet below ground surface at each proposed drilling or excavation location. Complete a sufficient number of probe holes so that the area is cleared for the proposed intrusive activity (i.e., use several holes for a proposed excavation). The use of hand digging or soft digging methods **does not** replace the need for state and private utility locating services.

2.5.2 Expanded Work Areas and Ticket Renewal

Many projects begin with well-defined work areas only to expand quickly as the investigation or remediation progresses. If the scope of the intrusive activity locations changes, the scope of intrusion expands or includes new onsite or offsite area(s), you will need to review the existing ticket and work performed by the private utility locator to determine whether work can progress into the new area safely. It may be necessary, depending on the scope, to contact (or for the Contractor to contact) the state locating service and request another clearance for the new area(s) of investigation and retain a private locating service. Remember, the new request will provide a new legal dig date before which NO INTRUSIVE WORK CAN BEGIN. Additionally, if a clearance ticket will expire while the work is ongoing (typically after 14 days), a new clearance must be requested before the first ticket expires so that work can continue uninterrupted. Refer to the Utility Locating Form (Attachment 1) for the legal dig date time frame required by the state locating service.

2.5.3 Utility Damage

It is possible, even if you followed all of the procedures outlined in this SOP, to damage an underground or overhead utility. Assuming it can be done safely, quickly turn off the drilling or excavating equipment, or move the equipment from the damaged line. Avoid contact with escaping liquids, live wires, and open flames. Abandon the equipment, evacuate the personnel from the area, and maintain a safe perimeter if there are any concerns about safety. If a fiber optic cable is damaged, do not handle the cable or look into the end of the cable as serious eye damage may occur. Once personnel are in a secure location, immediately notify the facility operator or site contact,

811, and the WSP project manager. If the damaged utility has the potential to cause, or is causing, dangerous conditions, immediately notify the local emergency response number listed in your HASP.

** This form is mandatory for all intrusive work performed by WSP or a WSP subcontractor, regardless of who is responsible for the public and/or private locate

Utility Locating Form

Project Name	Project No. and Task	Work being done for (Company or Individual Name)	Project Manager

WSP Office Address	WSP Office Phone	WSP Field Contact	WSP Field Contact Phone

Project Location: Street Address	City/Township	County	State

Nearest Intersecting Street

Description of Work Area (street working on, which side of street, how far in which direction from nearest intersecting street; etc.)

Type of Work	Explosives (Y/N)	Directional Borings (Y/N)	Dig Locations Marked (Y/N)	Mark Type (e.g., stake)

Scheduled Work Start (Date & Time)	Estimated Work Stop Date	One-call Phone Number/Website Address	One-call Service Name

Call/Web Notification Made By (Name, Title and Company)	Date & Time of Call/Web Notification	Operator Name

Ticket No.	Legal Dig Date	Ticket Expiration Date	Ticket Renewal Date

Utilities Notified	Complete After Receiving Notification (e.g., e-mail, facsimile) from Utilities or Subcontactor		
	Utilities Present (Y/N)	Onsite Meeting (Y/N; if "Y" Date & Time)	Contact Name and Phone
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Form Completed By (Signature)	
	(e-mail completed page 1 to Project Manager)

** This form is mandatory for all intrusive work performed by WSP or a WSP subcontractor, regardless of who is responsible for the public and/or private locate

Utility Locating Form

Private Utility Locator Information Company	Contact Name	Phone	E-mail

Who Contracted Locator?	Scheduled Start (Date & Time)	WSP Contract Executed (Y/N/NA)

Onsite Visual Confirmation of Utilities

Marking Color	Utility Type and Visual Clues	Cleared or Marked (Y/N)	No Markings - Comments
Blue	Potable water fire hydrant, manholes; water meter, ASTs, interior connections, hose bib, valve box		
Yellow	Gas, oil steam, petroleum. gas meter, manholes; yellow bollards, interior connections, valve box		
Red	Electric power lines, lighting cables, parking lot lights, overhead lines (telephone poles), conduits· interior connections, underground vaults, manholes, transformers/switchgear, conduit on buildings		
Green	Sewer and drain lines: underground vaults, manholes, drain grates, leach field, sand mound, no evidence of sanitary sewer (for septic system)		
Orange	Communication, alarm or signal lines, cables or conduits: red/orange bollards, telephone poles, interior connections, manholes; conduit on buildings		
Purple	Reclaimed water, irrigation, and slurry lines· sprinkler heads, hose bibs		
Pink	Survey markings		
White	Proposed locations for excavation and drilling		

Project Manager Notified of any Conflicts? (Y/N)

Notes:

Marks Verified By (Signature)

	(scan and save to client file)

FIELD STANDARD OPERATING PROCEDURE #3
Sample Packaging and Shipment Procedure

Shipping samples is a basic but important component of field work. Nearly all of the WSP activities include the collection of environmental samples. Proper packing and preservation of those samples is critical to ensuring the integrity of WSP's work product. The user is advised to read the entire standard operating procedure (SOP) and review the site health and safety plan (HASP) before beginning any onsite activities. In accordance with the HASP, proper personal protective equipment (PPE) must be selected and used appropriately.

3.1 Acronyms and Abbreviations

CFR	Code of Federal Regulations
DOT	U.S. Department of Transportation
IATA	International Air Transport Association
HASP	health and safety plan
PPE	personal protective equipment
SOP	standard operating procedure

3.2 Materials

- Suitable shipping container (e.g., plastic cooler or lab-supplied styrofoam-insulated cooler)
- Chain-of-custody forms
- Custody seals
- WSP mailing labels
- Tape (strapping, clear packing, or duct tape)
- Heavy-duty zipper-style plastic bags
- Knife or scissors
- Permanent marker
- PPE
- Large plastic garbage bag
- Wet ice (as necessary)
- Bubble wrap or other packing material
- Universal sorbent materials
- Sample container custody seals (if required)
- Shipping form (with account number)

3.3 Preconditions and Background

This SOP has been prepared as part of the WSP USA Corp. Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel and will ensure that the tasks are performed in a safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of WSP employees and will be revised periodically to reflect updates to WSP policies, work practices, and the applicable state and/or federal guidance. WSP employees must verify that this document is the most recent version of the WSP SOPs. WSP employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

This SOP is designed to provide the user with a general outline for shipping samples and assumes the user is familiar with basic field procedures, such as recording field notes (SOP 1), sample collection and quality assurance procedures (SOP 4), and investigation derived waste management procedures (SOP 5), and has a current certificate for WSP's U.S. Department of Transportation (DOT) Hazardous Materials training.

> **NOTE: WSP employees shipping samples regulated as hazardous materials or exempt hazardous materials by air must have International Air Transport Association (IATA) training. IATA training is a separate training required in addition to DOT hazardous materials training for such shipments. Most WSP employees do not have IATA training and therefore, anyone who needs to ship by air MUST consult with a WSP IATA-trained compliance professional. The remainder of Section 3.3 covers shipments regulated by DOT only.**

Environmental samples can meet the definition of DOT hazardous materials when shipped by air, ground, or rail from a project site to the laboratory. As such, field staff must work with their assigned WSP compliance professional to determine whether the sample shipment is subject to any specific requirements (e.g., packaging, marking, labeling, and documentation) under the DOT hazardous materials regulations.

Title 49 Code of Federal Regulations (CFR) Section 171.8 defines a "hazardous material" as a substance which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. DOT hazardous materials are listed in the hazardous materials table at 49 CFR 172.101.

In most cases, WSP is collecting environmental samples in order to determine whether any hazardous chemicals are present in the sampled media. Therefore, we would not have the appropriate information to make a hazardous materials classification for the samples prior to shipment. 49 CFR 172.101(c)(11) allows the use of a tentative classification where the shipper is uncertain of the material's hazard class. Where WSP does not know the physical characteristics of the samples, a non-hazardous material classification may be made. Non-hazardous materials are not subject to the DOT hazardous materials regulations.

There are certain cases where the characteristics and hazard class of the samples are known (e.g., samples of free product, samples preserved with a hazardous material [TerraCore® samplers]). Contact your assigned WSP compliance professional or an internal DOT contact for guidance on shipment of these materials.

3.4 Sample Shipment Procedures

The two major concerns in shipping samples are incidental breakage during shipment and complying with applicable DOT and courier requirements for hazardous materials shipments.

> **NOTE: Many couriers, including Federal Express and UPS, have requirements that WSP register with them before shipping hazard materials. In most cases, it is the sampling location, not the WSP office address, which needs to be registered. Therefore, each project will likely have unique requirements. Please contact your WSP compliance**

professional to determine whether or not you will be required to register for your shipment.

Protecting the samples from incidental breakage can be achieved using "common sense." Pack all samples in a manner that will prevent them from moving freely about in the cooler or shipping container. Do not allow glass surfaces to contact each other. When possible, repack the sample containers in the same materials that they were originally received in from the laboratory. Cushion each sample container with plastic bubble wrap, styrofoam, or other nonreactive cushioning material. A more detailed procedure for packing environmental samples is presented below.

3.4.1 Non-Hazardous Material Environmental Samples

The first step in preparing your samples for shipment is securing an appropriate shipping container. In most cases, the analytical laboratory will supply the appropriate container for bottle shipment, which can be used to return samples once they have been collected. Be sure that the container is large enough to contain the samples plus a sufficient amount of packing materials, and if applicable, enough wet ice to maintain the samples at the preservation temperature (usually 4° Celsius). Use additional shipping containers as needed so that sample containers are protected from breakage due to overcrowding. Do not use lunch-box sized coolers or soft-sided coolers, which do not offer sufficient insulation or protection from damage.

3.4.1.1 Temperature-Preserved Samples Container Preparation

Temperature-preserved samples should be shipped to the laboratory in an insulated container (e.g., cooler). If using a plastic cooler with a drain, securely tape the inside of the drain plug with duct tape or other material to ensure that no water leaks from the cooler during shipment. Place universal sorbent materials (e.g., sorbent pads, Pig-brand absorbent blankets) in the bottom of the shipping container. The amount of sorbent material must be sufficient to absorb any condensation from the wet ice and a reasonable volume of water from melted wet ice (if a bag were to rupture) or a damaged (aqueous) sample container.

The next step is to line the shipping container with a large, heavy-duty plastic garbage bag. Place 2 to 4 inches of bubble wrap or other appropriate packing material inside the heavy-duty plastic bag in the bottom of the shipping container to form a cushion for the sample containers. Place the samples on the packing materials with sufficient space to allow for the addition of more bubble wrap or other packing material between the sample containers. Place large or heavy sample containers on the bottom of the cooler with lighter samples placed on top to minimize the potential for breakage. Place all sample containers in the shipping container right-side up. Do not overfill the cooler with samples; leave sufficient room for the wet ice if the samples are to be preserved during transit. Place wet ice to be used for sample preservation inside two sealed heavy-duty zipper-style plastic bags (1 gallon-sized, or less). Place the bags of ice on top of or between the samples. Place as much ice as possible into the cooler to ensure the samples arrive at the lab at the required preservation temperature, even if the shipment is delayed. Fill any remaining space in the container with bubble wrap or other packing material to limit the airspace and minimize the in-transit melting of ice. Securely close the top of the heavy-duty plastic bag and seal with tape.

3.4.1.2 Non-Temperature-Preserved Samples Container Preparation

Non-temperature-preserved samples should be shipped to the laboratory in a durable package (e.g., hard plastic container or cardboard box). If shipping breakable sample containers (e.g., glass), place bubble wrap or other packing materials on the bottom of the container. Place the samples on the packing materials with sufficient space to allow for the addition of more bubble wrap or other packing material between and on top of the sample containers. Place large or heavy sample containers on the bottom of the container with lighter samples placed on top to minimize the potential for breakage. Place all sample containers within the shipping container right-side up.

3.4.1.3 Container Shipment

Place the original, white top copy chain-of-custody form into a heavy-duty zipper-style plastic bag, affix the bag to the shipping container's inside lid, and then close the shipping container. Only one chain-of-custody form is required to accompany one of the shipping containers per sample shipment; the other coolers in the shipment do not need to include chain-of-custody forms. At this point, sample shipment preparations are complete if using a laboratory courier.

If sending the sample shipment through a commercial shipping vendor, place two signed and dated chain-of-custody seals on alternate sides of the shipping container lid so that it cannot be opened without breaking the seals. Securely fasten the top of the shipping container shut with clear packing tape; carefully tape over the custody seals to prevent damage during shipping. Once the shipping container is sealed, shake test the shipping container to make sure that there are no loose sample containers. If loose sample containers are detected, open the shipping container, repack the sample containers, and reseal the shipping container.

Using clear tape, affix a mailing label with WSP's return address to the top of the shipping container. Ship environmental samples to the contracted analytical laboratory using an appropriate delivery schedule. If applicable, check the appropriate box on the airbill for Saturday delivery (you need to verify with the laboratory that someone will be at the lab on a Saturday to receive the sample shipment). Declare the value of samples on the shipping form for insurance purposes, if applicable, and be sure to include the project billable number on the shipping form's internal billing reference section. When shipping samples to a lab, identify a declared value equal to the carrier's default value ($100); additional fees will be charged based on a higher value declared. Our preferred carrier, FedEx, will only reimburse for the actual value of the cooler and its contents if a sample shipment is lost; they will not reimburse for the cost of having to re-collect the samples. [Please note: if you are shipping something other than samples, such as field equipment, declare the replacement value of the contents.]

Record the tracking numbers from the shipping company forms (i.e., the airbill number) in the field book and on the chain-of-custody form and retain a copy of the shipping airbill. On the expected delivery date, confirm sample receipt by contacting the laboratory or tracking the package using the tracking number; provide this confirmation information to the WSP project manager.

> **NOTE: Most shipping carriers adhere to transit schedules with final pickup times each day; these schedules are subject to change and vary by service location. If shipping containers are dropped off at a service location after the final pickup time, transit to the laboratory will not be initiated until the following day, and samples may not be properly preserved. Therefore, confirm transit schedules in advance of each sampling event, and ensure samples are dropped off before the final pickup time of the day.**

3.4.2 Hazardous Materials Samples

WSP personnel rarely ship hazardous materials due to DOT shipping requirements. If you find that your samples could be considered a DOT hazardous material, first coordinate with the assigned WSP compliance professional and project manager to make a hazardous material classification and, if necessary, establish the necessary protocols and to receive the appropriate training/certification. **Do not ship hazardous materials samples without first consulting a WSP compliance professional.**

FIELD STANDARD OPERATING PROCEDURE #4
Sample Collection and Quality Assurance Procedure

The purpose of this procedure is to assure that sample volumes and preservatives are sufficient for analytical services required under U.S. Environmental Protection Agency (EPA) or other agency approved protocols. This operating procedure describes the ways and means of selecting the appropriate sampling containers for environmental sampling. The user is advised to read the entire standard operating procedure (SOP) and review the site health and safety plan (HASP) before beginning any onsite activities. In accordance with the HASP, proper personal protective equipment (PPE) must be selected and used appropriately.

4.1 Acronyms and Abbreviations

°C	degrees Celsius
COC	chain-of–custody [form]
DI	deionized water
DOT	U.S. Department of Transportation
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
HASP	health and safety plan
MS/MSD	matrix spike and matrix spike duplicate
MSA	Master Service Agreement
PPE	personal protective equipment
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
SOP	standard operating procedure
VOCs	volatile organic compounds

4.2 Materials

- Field book
- Indelible (waterproof) markers or pens
- PPE
- Sample containers
- Sample labels
- Clear tape
- Deionized (DI) water
- Cleaned or dedicated sampling equipment

4.3 Preconditions and Background

This SOP has been prepared as part of the WSP USA Corp. Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel and will ensure that the tasks are performed in safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of WSP employees and will be revised periodically to reflect updates to WSP policies, work practices, and the applicable state and/or federal guidance. WSP employees must verify that this document is the most recent version of the WSP SOPs. WSP employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

This SOP is designed to provide the user with a general outline for collecting environmental and quality assurance samples and assumes the user is familiar with basic field procedures, such as recording field notes (SOP 1), sample shipment procedures (SOP 3), investigation derived waste management procedures (SOP 5), and equipment decontamination (SOP 6). This SOP does not cover investigation planning, nor does it cover the analysis of the analytical results. These topics are more appropriately addressed in a site-specific work plan or a dedicated quality assurance project plan.

4.4 Sample Identification Procedures

Information on the sample labels must contain the site/project name, project/task number, unique alpha-numeric sample identification (ID) number, sample date, time of collection using the military or 24-hour clock system (e.g., 0000 to 2400 hours), analytical parameters, preservative, and sampling personnel. WSP personnel are advised to use pre-printed waterproof mailing labels (e.g., Avery® 5xxx Waterproof Address Labels) for all sample identification. WSP templates for the labels are available in each office.

The sample identification number must, unless otherwise approved by your project manager or specified in your site-specific work plan, follow the WSP naming protocol. This protocol was developed to aid in determining the type of sample collected (e.g., soil, groundwater, vapor, etc.), the sample location, and, where appropriate, the sample depth. The protocol was also designed to ensure consistency across the company.

Construct sample IDs in the following format:

SB-10A (4-6)

Where, in this example:

SB = the first two or three characters will define the sample type (see list of approved prefixes below); in this case, a soil boring

10A = the next two or three alpha-numeric digits (separated by a dash from the sample type identifier) indicate the location of the boring on the site; in this case, boring number 10A

(4-6) = the depth the sample was collected, with the first number (including decimals, if necessary) indicating the top of the sample interval and the second number indicating the bottom of the sample interval; not all sample types will include depth information.

Additional label information may be added after the last character of the sample ID (e.g., sample date, underground storage tank number, area of concern number, "Area" number, Client Identifier, etc.). Separate any additional information from the required portion of the sample name by dash(es).

Sample Prefix	Permitted Use
AA -	Ambient outdoor air samples
CC -	Concrete core/chip sample
CS -	Confirmation/verification soil samples collected from an excavation
HA -	Soil samples collected with a hand auger
IAB -	Indoor air samples – basement
IAC -	Indoor air samples – crawl space
IAF -	Indoor air samples – first floor
MW -	Soil samples collected from a monitoring well borehole or a groundwater sample collected from a monitoring well
PZ -	Groundwater samples collected from a piezometer
SB -	Soil samples collected from boreholes that will not be converted to monitoring wells
SED -	Sediment samples
SG -	Soil gas samples other than sub-slab samples (e.g., samples collected from temporary or permanent PVC sample points or stainless steel screen implants)
SL -	Sludge samples
SS -	Surface soil samples collected using hand tools (e.g., trowel, spoon, etc.) and typically at depths less than 2 feet below ground surface
SSV -	Sub-slab vapor samples
SW -	Surface water samples
TC -	Tree core samples
TP -	Soil samples collected from a test pit
WC -	Waste characterization samples
WP -	Wipe samples

4.5 Sample Containers, Preservatives, and Holding Times

The first step in sample collection is to verify that the analytical laboratory has provided the correct number and type of sample containers and each contains the appropriate preservatives for the proposed project (i.e., check against the sampling plan requirements outlined in the site-specific Quality Assurance Project Plan [QAPP]). Inspect all containers and lids for flaws (cracks, chips, etc.) before use. Do not use any container with visible defects or discoloration. Report any discrepancies, or non-receipt, of specific types of sample containers to the team leader or project manager immediately. Make arrangements with the laboratory to immediately ship missing or additional sampling containers.

Take special effort to prevent cross contamination and contamination of the environment when collecting samples. Protect equipment, sample containers and supplies from accidental contamination. Wear a clean pair of new, disposable gloves each time a different sample is collected and don the gloves immediately prior to sampling. The gloves must not come in contact with the medium being sampled and must be changed any time during sample collection when their cleanliness is compromised. Sample collection must follow all appropriate SOPs and state and federal regulations, or guidance, for the collection of environmental samples; the recommended order of sample collection is:

- Geochemical measurements (e.g., temperature, pH, specific conductance)

- Volatile organic compounds (VOCs)
- Extractable organics, petroleum hydrocarbons, aggregate organics, and oil and grease
- Total metals
- Dissolved metals
- Inorganic non-metallic and physical and aggregate properties
- Microbiological samples
- Radionuclides

Collected samples that require thermal preservation must be immediately (within 15 minutes) placed in a cooler with wet ice and maintained at a preservation temperature of 4° Celsius (C).

4.6 Field Quality Assurance/Quality Control Samples

Field quality assurance/quality control (QA/QC) samples include equipment blanks, trip blanks, duplicates, and split samples. The project manager or QAPP must specify the type and frequency of QA/QC sample collection. The QA/QC sample identification number must, unless otherwise approved by your project manager or specified in your site-specific work plan, follow the WSP naming protocol as discussed in the sections below. QA/QC samples must be clearly identified on WSP's copy of the COC form and in the field book. Failure to properly collect and submit required QA/QC samples can result in invalidation of an entire sampling event.

Collect, preserve, transport and document split samples using the same protocols as the related samples.

4.6.1 Equipment Blanks

Equipment blanks are used to document contamination attributable to using non-dedicated equipment. Collect equipment blanks in the field at a rate of one per type of equipment per day, unless otherwise specified. If the site-specific work plan or QAPP indicates that an equipment blank is to be collected from dedicated sampling equipment, collect the equipment blank in the field before sampling begins. If field decontamination of sampling equipment is required, prepare the equipment blanks after the equipment has been used and field-decontaminated at least once. Prepare equipment blanks by filling or rinsing the pre-cleaned equipment with laboratory provided analyte-free water and collecting the rinsate in the appropriate sample containers. The samples must be labeled, preserved, and filtered (if required) in the same manner as the environmental samples. Record the type of sampling equipment used to prepare the blank. Have the equipment blanks analyzed for all the analytes for which the environmental samples are being analyzed, unless otherwise specified. Decontamination of the equipment following equipment blank procurement is not required. If laboratory-grade DI water is unavailable, store-grade distilled water can be used to prepare these blanks. If store-grade distilled water is used, be sure to record the source and lot number in the field book. Designate equipment blanks using "EB", followed by the date, and in the order of equipment blanks collected that day. For example, the first equipment blank collected on July 4, 2013, would be designated EB070413-1.

4.6.2 Trip Blanks

Trip blanks are used to document VOC contamination attributable to shipping and field handling procedures. Trip blanks are only required when analyzing samples for VOCs. Trip blank(s) will be prepared at the laboratory and will be sent to the facility along with sample containers. Never open trip blank sample bottles, but label them in the field and return them to the laboratory in the same shipping container in which the trip blank sample bottles arrived at the site. Keep the trip blank sample bottles in the same shipping container used to ship and store VOC sample bottles during the sampling event. To minimize the number of trip blanks needed per shipment, if possible, ship all of the VOC samples in the same shipping container with the trip blank. If laboratory-provided trip blanks are not

available, DI water, or store-grade distilled water and clean, empty VOC sample bottles can be used to prepare additional trip blanks. If store-grade distilled water is used, be sure to record the source and lot number in the field book. Identify trip blanks using "TB", followed by the date. For example, the trip blank shipped with a cooler of samples on July 4, 2013, would be designated TB070413-1. If a second trip blank is needed on that same day, the designation would be TB070413-2.

4.6.3 Temperature Blank

Temperature blanks are used to determine if proper sample thermal preservation has been maintained by measuring the temperature of the sample container upon arrival at the laboratory. A temperature blank should be included in each sample cooler used to ship and store the sample bottles during the sampling event. If laboratory-provided temperature blanks are not available, fill a clean, unpreserved sample bottle with potable, DI, or store-grade distilled water and identify the bottle as a temperature blank.

4.6.4 Duplicates

Duplicates are useful for measuring the variability and documenting the precision of the sampling process. Unless more stringent project requirements are in place, collect duplicate samples at least at a rate of 1 per 20 samples collected. Under no circumstances can equipment or trip blanks be used as duplicates. Sample locations where sufficient sample volume is available and where expected contamination is present should be selected for sample duplication.

Collect each duplicate sample at the same time, from the same sample aliquot and in the same order as the corresponding field environmental sample. When collecting aqueous duplicate samples, alternately fill sample bottle sets (i.e., the actual sample bottle and the bottle to be used for the duplicate) with aqueous samples from the same sampling device. If the sampling device does not hold enough volume to fill the sample containers, fill the first container with equal portions of the sample, and pour the remaining sample into the next sample containers. Obtain additional sample volume and pour the first portion into the last sample container, and pour the remaining portions into the first containers. Continue with these steps until all containers have been filled.

Duplicate samples will be assigned arbitrary sample ID and a false collection time so that they are not identified as duplicates by the laboratory (i.e., submit the samples blind to the lab). The blind duplicate sample "location designation" will be left up to the project manager; however, in no case will "Dup" be allowed to appear in the sample name. Have the duplicate samples analyzed for the same analytes as the original sample. Be sure to record the duplicate sample ID, the false time, and the actual time of collection in the field notebook. The duplicate should also be indicated on WSP's carbon copy of the chain-of-custody.

4.6.5 Matrix Spike and Matrix Spike Duplicates

Matrix spike and matrix spike duplicate samples, known as MS/MSD samples, are used to determine the bias (accuracy) and precision of a method for a specific sample matrix. Many of WSPs projects require the collection of MS/MSD samples; however, laboratory generated MS/MSD samples are sufficient for some projects. As required by your QAPP or site-specific work plan, collect MS/MSD samples at the required ratio; if the sampling ratio is not specified by your QAPP or site-specific work plan, collect MS/MSD samples at a rate of 1 for every 20 samples. Clearly convey the MS/MSD identity to the laboratory by adding "MS" or "MSD" after the sample name (e.g., MW-01MS) or in the comments section of the chain-of-custody. Under no circumstances can equipment or trip blanks be used as MS/MSD samples.

4.6.6 Split Samples

Split samples may be collected as a means of determining compliance or as an added measure of quality control. Unlike duplicate samples that measure the variability of both the sample collection and laboratory procedures, split

samples measure only the variability between laboratories. Therefore, the laboratory samples must be subsamples of the same parent sample and every attempt must be made to ensure sample homogeneity. Collect aqueous split samples in the same manner as a duplicate sample.

Collecting split samples of soils, sediments, wastes, and sludge is not recommended because the homogenization necessary for a true split sample in these matrices is not possible.

Spilt samples should have the same sample location (e.g., MW-01, SB-03 (4-6), but differentiated from each other by inserting the laboratory analyzing or the agency/consultant collecting the sample after the sample location (e.g., MW-01-WSP and MW-01-EPA).

4.7 Custody Documentation

Sample custody protocols are used to demonstrate that the samples and sample containers were handled and transferred in such a manner as to eliminate possible tampering. Legal chain of custody (COC) begins when the pre-cleaned sample containers are dispatched to the field from the laboratory and continues through the sample analysis and eventual disposal. Maintaining custody requires that samples must be in the actual possession or view of a person who is authorized to handle the samples (e.g., sample collector, laboratory technician), secured by the same person to prevent tampering, or stored in a designated secure area.

It is a good idea to limit, to the extent possible, the number of individuals who physically handle the samples. Samples must be placed in locked storage (e.g., locked vehicle, locked storeroom, etc.) at all times when not in the possession or view of authorized personnel. Do not leave samples in unoccupied motel or hotel rooms or other areas where access cannot be controlled by the person(s) responsible for custody without first securing samples and shipping or storage containers with tamper-indicating evidence tape or custody seals

The COC form is used to trace sample possession from the time of collection to receipt at the laboratory. Although laboratories commonly supply their own COC form, it is recommended that WSP's COC be used to ensure that all necessary data are recorded. At a minimum, the COC needs to have a unique COC number, accompany all the samples, and include the following information:

- Project number, name, and location
- Sampler's printed name(s) and signature(s)
- Sample identification number
- Date and time (military time) of collection
- Sample matrix
- Total number of containers per sample
- Parameters requested for analysis including number of containers per analyte
- Remarks (e.g., irreducible headspace, field filtered sample, expected concentration range, specific turn-around time requested, etc.)
- Signatures of all persons involved in the chain of possession in chronological order
- Requested turn-around-time
- Name and location of analytical laboratory
- Custody seal numbers
- Shipping courier name and tracking information
- Internal temperature of shipping container upon shipment to laboratory, as needed
- Internal temperature of shipping container upon delivery to laboratory

- WSP contact information

Affix tamper-indicating evidence tape or seals to all storage and shipping container closures when transferring or shipping sample container kits or samples to an off-property party. Place the seal so that the closure cannot be opened without breaking the seal. Record the time, calendar date and signatures of responsible personnel affixing and breaking all seals for each sample container and shipping container. Affix new seals every time a seal is broken until continuation of evidentiary custody is no longer required.

FIELD STANDARD OPERATING PROCEDURE #5
Investigation Derived Waste Management Procedure

The purpose of this standard operating procedure (SOP) is to provide instructions for handling, storing, and managing Investigation Derived Waste (IDW) pending disposal. All IDW, which includes (but is not limited to) soil cuttings, development water, purge water, drilling fluids, decontamination fluids, personal protective equipment (PPE), and sampling equipment, must be managed in compliance with applicable or relevant and appropriate requirements. The user is advised to read the entire SOP and review the site health and safety plan (HASP) before beginning any onsite activities. In accordance with the HASP, proper personal protective equipment (PPE) must be selected and used appropriately.

5.1 Acronyms and Abbreviations

DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
HASP	health and safety plan
IDW	investigation derived waste
PCB	polychlorinated biphenyl
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
SOP	standard operating procedure
TSCA	Toxic Substances Control Act

5.2 Materials

- Non-hazardous waste, hazardous waste, and/or polychlorinated biphenyl (PCB) labels
- Investigation derived waste (IDW) log (figure 1)
- Permanent ink marking pen, paint, stick/pen
- Sampling equipment (refer to sampling SOPs)
- Impermeable covers (e.g., tarps), as needed
- Duct tape, rope, or other material to secure tarp
- Copy of the waste manifest or bills of lading

5.3 Preconditions and Background

This SOP has been prepared as part of the WSP USA Corp. Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel and will ensure that the tasks are performed in safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of WSP employees and will be revised periodically to reflect updates to WSP policies, work practices, and the applicable state and/or federal guidance. WSP employees must verify that this document is the most recent version of the WSP SOPs. WSP employees are also strongly advised to review

relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

This SOP is designed to provide the user with a general outline for handling, storing, and managing IDW pending disposal and assumes the user holds a current U.S. Department of Transportation (DOT) training and Resource Conservation and Recovery training (if required) certificates and is familiar with basic field procedures, such as recording field notes (SOP 1), sample shipment procedures (SOP 3), sample collection and quality assurance procedures (SOP 4), and equipment decontamination (SOP 6). The SOP does not cover investigation planning, DOT regulations, nor does it cover the evaluation of the analytical results. **Consult and involve WSP's compliance professionals during all phases of IDW management and disposal.**

5.4 IDW General Procedures

Nearly all intrusive field activities performed at WSP will generate solid or liquid wastes. Examples include:

Solid Wastes	Liquid Wastes
■ Soil Cuttings	■ Decontamination water
■ Drilling mud	■ Development water
■ Plastic sheeting	■ Drilling fluids
■ Spent carbon or filters (e.g., bag filters)	■ Purge water
■ PPE (e.g., Tyvek, gloves, respirator cartridges, etc.)	■ Soap or wash solutions
■ Disposable or dedicated sampling equipment (e.g,, bailers, hose, clamps, buckets, cartridge filters, etc.)	■ Reagents (e.g,, hexane, nitric acid, methanol, etc.)
■ Field analytical waste (HACH kits, Chlor-n-Soil kits, etc.)	

The specific procedures for dealing with these materials after the field activities have been completed will vary depending on whether the materials are considered non-hazardous, Resource Conservation and Recovery Act (RCRA) hazardous (characteristic or listed wastes), or contain PCBs at concentrations above 50 milligrams per kilogram (i.e., PCB wastes regulated under the Toxic Substances Control Act [TSCA]). The characterization of the wastes to be generated is ideally determined in conjunction with a WSP compliance professional before the field event occurs, based on previously generated data; however, in some cases, particularly for new sites, the status of the wastes may not be known. In these cases, handle IDW as hazardous waste until the status can be verified. Field personnel must consult their assigned WSP compliance professionals for assistance in proper waste characterization.

It is important to note that information contained in this SOP is based on federal regulations and interpretive guidance provided by the U.S. Environmental Protection Agency (EPA) and other federal regulatory sources; therefore, information provided in this SOP may be superseded by state or local-specific statutes or regulations. Field personnel must discuss the handling procedures with the project manager and assigned WSP compliance professional before mobilizing to the field.

5.4.1 Waste Minimization

Select investigation methods and techniques that will minimize the amount of wastes generated during field activities, particularly if the IDW is hazardous. Examples include using direct-push methods instead of hollow stem augers (to minimize soil cuttings) during a soil investigation, if appropriate, and limiting contact with the materials to reduce the amount of PPE required. Minimizing the amount of waste generated will reduce handling requirements and overall project costs, and is consistent with WSP's corporate goals for sustainability.

5.4.2 Hazardous Waste Generator Status

The hazardous waste generator requirements that pertain to a site depend on how much hazardous waste is generated at a site in a calendar month. In coordination with your assigned WSP compliance professional, determine the site's hazardous waste generator status (conditionally exempt, small, or large quantity generator) before site work begins and inform the site contact and/or client representative of the quantity of hazardous waste that will be generated as a result of its activities.

The following table provides a summary of requirements for each class of hazardous waste generator: Conditionally Exempt Small Quantity Generators (CESQGs), Small Quantity Generators (SQGs), and Large Quantity Generators (LQGs). Note that this is provided for guidance purposes only and should not substitute for close coordination with your assigned WSP compliance professional for all IDW-related activities.

	CESQGs	**SQGs**	**LQGs**
Quantity Limits	≤100 kg/month ≤1 kg/month of acute hazardous waste ≤100 kg/month of acute spill residue or soil §§261.5(a) and (e)	Between 100 - 1,000 kg/month §262.34(d)	≥1,000 kg/month >1 kg/month of acute hazardous waste >100 kg/month of acute spill residue or soil Part 262 and §261.5(e)
EPA ID Number	Not required §261.5	Required §262.12	Required §262.12
On-Site Accumulation Quantity	≤1,000 kg ≤1 kg acute ≤100 kg of acute spill residue or soil §§261.5(f)(2) and (g)(2)	≤6,000 kg §262.34(d)(1)	No limit
Accumulation Time Limits	None §261.5	≤180 days or ≤270 days (if greater than 200 miles) §§262.34(d)(2) and (3)	≤90 days §262.34(a)

	CESQGs	SQGs	LQGs
Storage Requirements	None §261.5	Basic requirements with technical standards for tanks or containers §§262.34(d)(2) and (3)	Full compliance for management of tanks, containers, drip pads, or containment buildings §262.34(a)
Sent To:	State approved or RCRA permitted/interim status facility §§261.5(f)(3) and (g)(3)	RCRA permitted/interim status facility §262.20(b)	RCRA permitted/interim status facility §262.20(b)
Manifest	Not required §261.5	Required §262.20	Required §262.20
Biennial Report	Not required §261.5	Not required §262.44	Required §262.41
Personnel Training	Not required §261.5	Basic training required §262.34(d)(5)(iii)	Required §262.34(a)(4)
Contingency Plan	Not required §261.5	Basic plan §262.34(d)(5)(i)	Full plan required §262.34(a)(4)
Emergency Procedures	Not required §261.5	Required §262.34(d)(5)(iv)	Full plan required §262.34(a)(4)
DOT Transport Requirements	Yes (if required by DOT)	Yes §§262.30-262.33	Yes §§262.30-262.33

5.5 Onsite IDW Management Procedures

Onsite handling procedures typically involve containerization of the IDW for offsite disposal at a regulated facility (RCRA hazardous waste, TSCA PCB waste, or certain non-hazardous wastes) or, in the case of certain non-hazardous wastes, onsite disposal. The procedures for each type of waste are presented below.

5.5.1 Hazardous Waste Management

If site data or generator knowledge indicates that the IDW is determined to be RCRA hazardous, the following procedures will apply:

- Place IDW in DOT-authorized containers (e.g., 55-gallon drum, roll-off container, or temporary storage tank). Before placing IDW in the containers, ensure that they are in good condition and will not leak.
- Containers must remain closed except when adding, sampling, or inspecting the material. The containers cannot be used as a work surface once waste is put in the container.
- Mark the container with an appropriate waterproof, self-adhesive RCRA hazardous waste label. The label must include the accumulation start date, a description of the contents of the container (e.g., soil cuttings, purge water, etc.), the EPA identification number, the generator name (the client or the facility, never WSP), and the

hazardous waste codes, if known. Field personnel must consult the assigned WSP compliance professional for help in properly completing the labels.

- The IDW containers must be properly closed, wiped clean, and stored in a secure onsite location (facility hazardous waste storage area if one exists) to limit access. At a minimum, place the drums on an impermeable surface (if available) in an area of limited access. If stored outside, cover the containers with a secured tarp at the end of each field day until the containers are picked up for disposal.
- Complete the IDW Logs (Figure 1) before leaving the site. Present one copy of the log to the site contact and the original to the project manager.
- Ensure that weekly inspections are conducted and the proper inspection forms for documentation are completed during the entire time the waste is stored onsite.

If the IDW is presumed to be hazardous and sampling is required to confirm its classification, it must be labeled "Hazardous Waste-Pending Analysis" and sampled for the parameters specified by the project regulatory specialist or project manager before leaving the site (see sampling SOPs). Treatment, storage, and disposal facilities will usually specify the required analysis for waste profiles (see below).

5.5.2 Polychlorinated Biphenyl Waste Management

If information exists to classify the IDW as TSCA-regulated PCB-containing IDW, the following procedures must be implemented:

- Place the PCB-containing IDW in DOT-authorized containers (55-gallon drum, roll-off container, or temporary storage tank).
- Containers must remain closed except when adding, sampling, or inspecting the material. The containers cannot be used as a work surface once waste is put in the container.
- Mark the container with an appropriate waterproof, self-adhesive yellow label with the words "Caution Contains PCBs", the "removed from service" date (the accumulation start date), and a description of the contents of the container (e.g., soil cuttings). Complete the label with the name and phone number of the WSP field personnel to contact in the event of an accident or spill. Field personnel must consult the assigned WSP compliance professional for help in properly completing the labels.
- The IDW containers must be properly closed, wiped clean, and stored in a secure PCB storage area onsite. If a PCB storage area is not available, construct a temporary PCB storage area. Cover the containers with a secured tarp at the end of each field day until the drums are picked up for disposal. Place one yellow 6" x 6" "Caution Contains PCBs" label on the outside of the tarp, and note the "Removed from service date" on the label.
- Inspect the area and the containers for leaks once every 30 days in accordance with 40 Code of Federal Regulations 761.65(c)(5) during the entire period the waste is stored onsite.
- Complete the IDW Logs (Figure 1) before leaving the site. Present one copy of the log to the site contact and the original to the project manager.

5.5.3 Onsite Non-Hazardous Waste Management

If information exists to classify the IDW as non-hazardous waste, the following procedures must be implemented only after being discussed and approved by the project manager and assigned WSP compliance professional:

- Soil can be spread around the borehole or other onsite location (with the approval of the client and in accordance with any applicable regulatory requirements), placed back in the boring or excavated test pit, or containerized and disposed of offsite.

- Groundwater and decontamination fluids can be poured onto the ground next to well to allow infiltration, or discharged to either the publically-owned treatment works or onsite wastewater treatment plant with approval of the client.
- PPE can be double bagged and deposited in the site dumpster with approval of the client and facility personnel or containerized and disposed of offsite.

If the IDW is containerized and is classified as non-hazardous, the following procedures will apply:

- Place the non-hazardous IDW in DOT-authorized containers (55-gallon drum, roll-off container, or temporary storage tank).
- Containers must remain closed except when adding, sampling, or inspecting the material. The containers cannot be used as a work surface once waste is put in the container.
- Mark the container with an appropriate waterproof, self-adhesive non-hazardous waste label. The label must include a description of the contents of the container (e.g., soil cuttings, purge water, etc.) and the generator (the client or the facility, never WSP). Field personnel must consult the assigned WSP compliance professional for help in properly completing the labels.
- Complete the IDW Logs (Figure 1) before leaving the site. Present one copy of the log to the site contact and the original to the project manager.
- The IDW containers must be properly closed, wiped clean, and stored in a secure onsite location.

5.6 Post-Field IDW Management Activities

It is important to follow-up on the management of the IDW once the field personnel have returned from the field. RCRA Hazardous and TSCA-regulated PCB-containing wastes have time limits and periodic inspection requirements to remain in compliance with state and federal regulations. The general post-field activities are listed below.

5.6.1 Waste Classification and Waste Profiles

Waste classifications and waste profiles must be reviewed and approved by WSP's project manager, WSP compliance professional, and the client before field work begins. Waste profiles are generated based on new or existing site data (i.e., soil and groundwater results) and generator knowledge, although some disposal facilities may require additional composite or grab samples for characterization of the waste. WSP's compliance professionals must be consulted to verify that proper waste classifications have been identified. Waste profiles for the same waste stream are generally valid for one year; ensure that no additional sampling is required to update existing waste profiles before conducting field activities.

5.6.2 Waste Disposal Oversight

Although exceptions may apply, generally, disposal of RCRA hazardous must be completed within **90 days** of the accumulation start date. If the facility is a small quantity generator, up to **180 days** is allowed for shipment. Disposal of TSCA-regulated PCB-containing IDW must generally be completed within 30 days of the "removal of service" date. WSP's compliance professionals must be consulted to determine if any exemptions apply.

Before the IDW is removed, the waste disposal subcontractor must provide WSP with a copy of the waste profile and printed manifest for review and approval. Your assigned WSP compliance professional must review and approve these documents. WSP must have written authorization from the client on file to act **on behalf of (never "as an agent of")** the client for waste disposal (handled on a site-by-site basis).

- The transport driver will present you with a pre-printed manifest that has been reviewed and approved by WSP. Review and verify that all information is complete and correct and that the total estimated weight of the material is written on the manifest. (Note: Manifests for PCB wastes must be completed in accordance with TSCA regulations. 40 CFR 761.207 requires that the weight of the PCBs be in kilograms and the date removed from service be on the manifest.) Remember, only a DOT-trained WSP employee is allowed to review and sign the manifest.
- Sign the manifest "On behalf of [insert client name]." Do not us "as an agent of."
- Ensure that all containers are properly labeled and transferred to the transporting vehicle; ensure that the vehicle is properly placarded.
- Once the IDW has been removed from the site, the IDW log must be marked "Removed," placed in the project file, and a copy must be forwarded to WSP's DOT compliance manager.

The manifest, certificate of disposal, IDW log, and inspection reports must be maintained on file for at least 3 years.

Investigation Derived Waste Log

Date:_____

Site Information

Site Name:_____ Site EPA ID #:_____

Site Contact:_____ Site Address:_____

Contact Telephone No:_____

Waste Identification:

Type of Waste Generated (check one of the following):

☐ Soil Cuttings ☐ PPE ☐ Decontamination Water

☐ Groundwater ☐ Storm Water ☐ Drilling Fluids

☐ Other (Describe):_____

Field Activities that Generated the Waste:

☐ Soil Borings ☐ Well Sampling ☐ Well Installation

☐ Decon ☐ Excavation ☐ Pumping Tests

☐ Other (Describe):_____

Generation Date:_____ ***90-Day Deadline***:_____

Quantity of Waste Generated and Container Type:

_____

_____

Storage Location:_____

Waste Identification (Check One of the Following):

☐ Non Hazardous Waste (pending analysis)

☐ Non Hazardous Waste (based on site information or generator knowledge)

☐ Hazardous Waste (pending analysis)

☐ Hazardous Waste (based on site information or generator knowledge)

If generator knowledge or site information was used for identification, explain:_____

_____

_____

Type of Label Applied to Container: ☐ Non Haz ☐ Hazardous ☐ PCB ☐ Used Oil

WSP Information (Note: One copy to site contact - the original in project file)

Personnel/Contact:_____ Project No.:_____

Telephone:_____

FIELD STANDARD OPERATING PROCEDURE #6 Decontamination

The decontamination procedures outlined in this standard operating procedure (SOP) are designed to ensure that all equipment that contacts a sample during sample collection is free from the analytes that could potentially interfere with the sample results. The user is advised to read the entire SOP and review the site health and safety plan (HASP) before beginning any onsite activities. In accordance with the HASP, proper personal protective equipment (PPE) must be selected and used appropriately.

6.1 Acronyms and Abbreviations

DI	deionized water
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
HASP	health and safety plan
IDW	investigation derived waste
PPE	personal protective equipment
SOP	standard operating procedure

6.2 Materials

- Polyethylene sheeting and/or garbage bags
- Non-phosphate detergent (e.g., Luminox®, Liquinox®, or Alconox®)
- Cleaning reagents, as needed (e.g., isopropyl alcohol, methanol, hexane, etc.)
- Tap water
- Deionized (DI) water
- Containers (e.g., garbage cans, buckets, plastic tubs)
- Nylon brushes
- Aluminum foil
- Spray bottles
- Paper towels
- Duct tape
- Pressurized steam cleaner (e.g., steam jenny), as needed
- Portable wet/dry vacuum
- Shovel, funnel, and/or squeegee

6.3 Preconditions and Background

This SOP has been prepared as part of the WSP USA Corp. Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in

this document is mandatory for all field personnel and will ensure that the tasks are performed in safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of WSP employees and will be revised periodically to reflect updates to WSP policies, work practices, and the applicable state and/or federal guidance. WSP employees must verify that this document is the most recent version of the WSP SOPs. WSP employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

This SOP is designed to provide the user with a general outline for decontamination and assumes the user is familiar with basic field procedures, such as recording field notes (SOP 1), sample shipment procedures (SOP 3), sample collection and quality assurance procedures (SOP 4), and IDW management procedures (SOP 5).

The cleaning and decontamination procedures described below are designed to ensure that the equipment used for sample collection is free of analytes that could potentially alter the analytical results. These procedures are primarily targeted at reducing the incidence of cross-contamination (i.e., compounds of interest being transferred on the sampling equipment from one sample location or depth to another) and, when properly implemented, provide a methodology for obtaining high quality, representative results. As with all analytical sampling, the effectiveness of the cleaning procedures must be supported with the collection of equipment blanks. The sampling procedures and equipment blank collection frequency are discussed in SOP 4.

It is important for WSP personnel to evaluate the expected types of contamination prior to mobilization to a site. Some state programs (or the U.S. Environmental Protection Agency [EPA], depending on the site) may require more stringent decontamination procedures than those listed here or specify the types and grades of various cleaning detergents and reagents (e.g., acids and solvents). Many of these compounds, such as nitric acid or pesticide grade hexane, are available from a limited number of suppliers and can be difficult to obtain in short order (i.e., most solvents and acids must be shipped using a ground service and are not available for overnight delivery). These compounds may also require specialized PPE (e.g., eye protection for concentrated acids) or have other special handling or disposal procedures that must be considered before arriving onsite.

6.4 Decontamination Procedures

The decontamination procedures are based on a nine-step process, which is tailored in the field depending on the samples to be collected. Decontaminate all non-dedicated equipment that contacts the sample directly, including spools, trowels, pumps, etc., before and between each sample location or interval. Disposable, single-use items, such as bailers or tubing, do not require decontamination.

The process includes the following four basic steps[1]

1. Physical removal of debris
2. Bucket wash with non-phosphate soap such as Alconox®, or equivalent and scrub brush
3. Tap water rinse
4. Deionized (DI) water rinse (distilled water can be used as a substitute)
5. 10% nitric acid rinse (for metals sampling only; see below)
6. DI water rinse
7. Pesticide-grade solvent rinse (e.g., hexane or isopropyl alcohol)
8. Air dry (solvent must evaporate)
9. DI water rinse

[1] Steps 5-9 are for more critical sampling applications and are not typically performed.

The first step is to remove as much soil or other debris from the sampling device as possible near the sampling area to limit the spread of potentially-contaminated materials into clean areas of the site. If gross contamination or an oily film or residue is observed on the equipment, use a brush to remove the particulate matter or surface film. Heavy oils or grease may be removed with paper towels soaked with isopropyl alcohol.

The physical removal is followed by a wash using non-phosphate soap (mixed to the appropriate dilution in tap water) followed by a tap water rinse. The most common set-up uses 5-gallon pails or buckets for the wash and rinse, although garbage pails or plastic tubs can also be used. Place buckets on polyethylene sheeting to limit spillage of the cleaning fluids.

Be sure to scrub the equipment thoroughly and allow enough time for the non-phosphate soap to be effective and clean the surfaces (a simple dunk of the equipment in the soapy water is insufficient). If decontaminating submersible pumps, pump both the non-phosphate soap wash fluid and the tap water rinse through the pump body itself (usually done in the bucket) to ensure that the internal impeller and other components are thoroughly cleaned. Replace the soap solution and rinse water when it becomes oily or silty.

Place the DI water for the rinse in a small squirt bottle or poured over the equipment or device after the tap water rinse. **In some cases, such as decontaminating a split-spoon between sample recoveries or when working with submersible pumps, this level of decontamination (i.e., steps 1 through 4) may be sufficient.**

Steps 5 through 9 are for more critical sampling applications and are typically performed on non-motorized equipment. Isopropyl alcohol is the recommended solvent for organic contaminants because it is readily available (at most drug and department stores) and is not a U.S. Department of Transportation (DOT) hazardous material. However, other solvents (e.g., hexane and methanol) may be more effective in removing certain contaminants, such as oils or polychlorinated biphenyls, but any waste generated using these solvents must be managed accordingly.

Handle the solvents and acid with care and store them in their original, labeled, protective containers when not in use. It is a good idea to transfer small quantities of each solution into labeled, laboratory-grade squirt bottles, which offer a convenient and controllable way to rinse the equipment. The equipment can then be rinsed over a 5-gallon bucket or other suitable container placed on plastic sheeting as with the first part of the cleaning process. Steps 5 and 6 are for metals sampling only and must be used only for non-carbon steel sampling devices (do not spray acid into pumps) and can be skipped for projects where inorganics are not included in the sampling scheme.

6.5 Handling Decontaminated Equipment

After decontamination, handle equipment using clean gloves to prevent re-contamination. In addition, move the equipment away (preferably upwind) from the decontamination area to prevent re-contamination. As soon as the equipment is air-dried, protect decontaminated field equipment from environmental contamination by securely wrapping and sealing with aluminum foil (shiny side out) or clean, untreated, disposable plastic bags. Plastic bags may be wrapped directly around wet or dry equipment except when the expected contaminants include volatile and extractable organics; under those circumstances, allow the equipment to completely dry or wrap it in aluminum foil.

On completion of site work, decontaminate all equipment prior to departure, then label each piece of equipment with the date of decontamination, the initials of decontamination personnel, and the type of decontamination solution(s) used. Containerize all solvent rinsate, detergent wastes, and other decontamination materials for offsite or regulated disposal (see SOP 5). Dispose of all wastes in conformance with applicable regulations.

FIELD STANDARD OPERATING PROCEDURE #8
Air Quality Monitoring Equipment Procedure

The procedures outlined in this Standard Operating Procedure (SOP) are designed to ensure that direct-reading air quality monitoring equipment is calibrated and used properly. This SOP addresses the short-term or discrete-measurement use of portable direct-reading air quality monitoring equipment for the rapid collection of organic vapor, flammable or explosive atmospheres, carbon dioxide, and dust/aerosol measurements. The user is advised to read the entire SOP and review the site health and safety plan (HASP) before beginning any onsite activities. In accordance with the HASP, proper personal protective equipment (PPE) must be selected and used appropriately.

8.1 Acronyms and Abbreviations

CGI	combustible gas indicator
FID	flame ionization detector
HASP	health and safety plan
IDW	investigation derived waste
PID	photoionization detector
PPE	personal protective equipment
QAPP	Quality Assurance Project Plan
SOP	standard operating procedure

8.2 Materials

- Field book
- PPE
- Direct-read air monitoring equipment, as needed
- Calibration reagents or gases, as appropriate
- Decontamination supplies

8.3 Preconditions and Background

This SOP has been prepared as part of the WSP USA Corp. Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel and will ensure that the tasks are performed in a safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of WSP employees and will be revised periodically to reflect updates to WSP policies, work practices, and the applicable state and/or federal guidance. WSP employees must verify that this document is the most recent version of the WSP SOPs. WSP employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

This SOP is designed to provide the user with a general outline for preparing air quality monitoring equipment for use and assumes the user is familiar with basic field procedures, such as recording field notes (SOP 1), investigation derived waste (IDW) management procedures (SOP 5), and equipment decontamination (SOP 6). This SOP does not cover the selection of air quality monitoring equipment, nor does it cover air quality monitoring

equipment-specific calibration or use instructions. These topics require a significant amount of planning and are more appropriately addressed in a project-specific work plan. Be sure to review the project-specific work plan or Quality Assurance Project Plan (QAPP) and any applicable state and federal guidelines or calibration procedures. The sampler should be familiar with the use and calibration of all sampling and monitoring equipment. All sampling references must be available for consultation in the field, including:

- WSP's SOPs
- Applicable state and federal guidelines or sampling procedures
- Manufacturer's manuals
- Project-specific work plan, HASP, and QAPP

8.4 General Equipment Handling and Management Procedures

Generally, WSP uses single- or multi-parameter air quality meters bundled in a single housing unit. These types of units offer a convenient, easily portable device that is capable of measuring the parameters of concern (e.g., organic vapors, carbon monoxide, dust) during a typical sampling event for field screening and health and safety purposes. Individual parameter air quality meters are available and, in some cases, offer a higher degree of accuracy; however, they are typically relegated to specialty use because most tasks require multi-parameter monitoring.

Field personnel must consult their assigned WSP compliance professionals for assistance in proper use, storage, and disposal of all calibration reagents and gases.

The manufacturer's recommendations and instructions vary from one instrument to the next; however, all types of air quality monitoring equipment share common handling and management procedures designed to ensure the integrity of the measurements collected. Based on these procedures, the user should:

- Transport the air quality monitoring equipment in a padded case that is designed to protect the equipment.
- Follow the manufacturer's instructions for assembly, operation, calibration, and maintenance specific to your equipment. The manufacturer's instructions should be followed explicitly in order to obtain accurate results.
- Ensure that all equipment is in proper working condition, not damaged, and that batteries are properly charged before using the equipment for field testing measurements.
- Protect the instrument from discharges of static electricity.
- Clean the equipment using only the manufacturer's recommended solutions.
- Record manufacturer name and model number for each instrument used in the field book.
- Calibrate the instrument in the field, as close to the time of use as possible, and repeat at the frequency suggested by the manufacturer.
- Protect the instrument from direct sunlight, precipitation, and extremely hot or cold temperatures (e.g., do not store in vehicle).
- Store cables only after they are clean, dry, and neatly coiled – do not bend or crimp cables.
- Attach any provided storage caps and protect cables from abrasion or unnecessary tension when in use.
- Decontaminate air quality monitoring equipment with a small, nonabrasive brush, cotton swab or cloth (unless otherwise instructed by the manufacturer).

8.5 Common Direct-Read Monitoring Devices

The table below provides a summary of common direct-read air monitoring instruments used by WSP personnel. Note that the final selection of air monitoring equipment must be based on the technical and health and safety requirements of each project and more than one instrument may be needed.

Instrument	Parameter Monitored	Application	Detection Method	Limitations
Colorimetric Tubes	Organic and inorganic gases and vapors	Provide semi-quantitative concentrations of individual gases and vapors	Reaction with the indicator chemical in the tube produces a stain where length of color change is proportional to the compound's concentration	■ Compound-specific, i.e., a specific tube must be used for each compound being measured ■ Accuracy is limited (usually to a specific range of concentrations) ■ Results are affected by humidity and multi-chemical interference
Combustible Gas Indicator (CGI)	Combustible gases and vapors	Measures concentrations of combustible gases and vapors	A filament is heated by burning the combustible gas or vapor and the increase in heat is measured	■ Accuracy depends on the difference between the calibration and sampling temperatures ■ Sensitivity is a function of the differences in the chemical and physical properties between the calibration gas the gas being sampled ■ The filament can be damage by certain compounds ■ Does not produce a valid reading under oxygen deficient conditions
Flame Ionization Detector (FID)	Many organic gases and vapors	Measures total concentration of many organic gases and vapors	Gases and vapors are ionized in a flame. A current is produced in proportion to the number of carbon atoms present; a total concentration is provided	■ Does not detect inorganic gases and vapors or some synthetics ■ Compound-specific sensitivity ■ Should not be used below 40° F (degrees Fahrenheit) ■ Does not produce compound-specific results ■ Does not produce a valid reading under oxygen-deficient conditions ■ Readings must be reported relative to the calibration standard used
Photoionization Detector (PID)	Many organic and some inorganic gases and vapors	Measures total concentrations of many organic and some inorganic gases and vapors.	Ionizes molecules using ultraviolet radiation. Produces a current that is proportional to the number of ions; a total concentration is provided	■ Does not detect methane ■ Does not detect a compound if the probe used has a lower ionization energy (electron volt or eV) than the compound's ionization potential ■ Responses may change when gases are mixed ■ Does not produce compound–specific results ■ Other voltage sources may interfere with the operation of the instrument ■ Readings must be reported relative to the calibration standard used ■ Instrument response is affected by high humidity
Dust/Aerosol Monitor	Dust, smoke, fumes, and mists	Measures total concentration of airborne particulates	Light scattering laser photometers	■ Does not produce compound-specific results

8.6 Calibration Procedures

Air quality monitoring equipment must be inspected and calibrated before use. Consult the manufacturer's guidelines before beginning the calibration process and contact the manufacturer's technical support if problems or questions arise.

Conduct the following procedures to ensure proper testing and calibration and record observations in the field book:

- Inspect the intakes and sensors to be sure that they are clean, installed properly and are not damaged before calibrating and using air quality monitoring equipment in the field.
- Complete field calibration in an area sheltered from wind, dust, chemical gases or vapors, and temperature/sunlight fluctuations, such as inside a room or vehicle in which the ambient temperature of the calibration standards is maintained at >40° F and < 100°F.
- Record the brand, concentration, lot numbers and expiration dates of reagents or calibration standards in the field book.
- Handle reagents or gases in a manner that prevents their dilution or contamination. Do not reuse or use expired reagents or gases; ensure that reagents or gases are stored securely.
- Ensure that the air quality monitoring equipment has been set to display or record the appropriate measurement unit, as available.
- Calibration frequency is dependent on project specifications, instrument performance, and manufacturer's recommendations; repeat the calibration procedures as directed.
- Document the time, date, and calibration status for each instrument.
- If calibration fails to meet criteria, follow the manufacturer's instructions for corrective action to adjust instrument performance and note any indication of a substandard calibration.
- If the instrument does not start up, check out, or calibrate properly, the instrument should not be used.

8.7 Equipment Use Procedures

Use the monitoring equipment to complete the field measurement procedures directed in the project-specific work plan, HASP, or QAPP after each calibration process is complete. When using the device, the user should:

- Charge instrument batteries per the manufacturer's instructions, as necessary.
- Record background measurements before commencement of any field activities.
- Position the probe assembly close to the area to be monitored.
- Do not immerse the probe intake in water or soil and minimize direct exposure to excessive moisture (humidity), dirt or contamination.
- If continuous monitoring is required, follow the manufacturer's instructions for performing continuous data logging events.

Monitoring should be performed at regular intervals as specified in the work plan, QAPP, and/or HASP. Record all measurements in the field book or on field forms and note any conditions that may affect the quality of the data (e.g., changes in weather or background conditions).

8.8 Closing Notes

Once field activities are complete, secure the site in accordance with the project-specific work plan. Decontaminate all equipment prior to departure and properly manage all PPE and IDW in conformance with applicable regulations.

Cox-Colvin & ASSOCIATES, INC. ENVIRONMENTAL SERVICES

Standard Operating Procedure Use of the Vapor Pin™ Drilling Guide and Secure Cover

December 3, 2013

Scope:

This standard operating procedure (SOP) describes the methodology to use the Vapor Pin™ Drilling Guide and Secure Cover to install and secure a Vapor Pin™ in a flush mount configuration.

Purpose:

The purpose of this SOP is to detail the methodology for installing a Vapor Pin™ and Secure Cover in a flush mount configuration. The flush mount configuration reduces the risk of damage to the Vapor Pin™ by foot and vehicular traffic, keeps dust and debris from falling into the flush mount hole, and reduces the opportunity for tampering. This SOP is an optional process performed in conjunction with the SOP entitled "Installation and Extraction of the Vapor Pin™". However, portions of this SOP should be performed prior to installing the Vapor Pin™.

Equipment Needed:

- Vapor Pin™ Secure Cover (Figure 1);
- Vapor Pin™ Drilling Guide (Figure 2);
- Hammer drill;
- 1½-inch diameter hammer bit (Hilti™ TE-YX 1½" x 23" #00293032 or equivalent);
- 5/8-inch diameter hammer bit (Hilti™ TE-YX 5/8" x 22" #00226514 or equivalent);
- assembled Vapor Pin™;
- #14 spanner wrench;
- Wet/Dry vacuum with HEPA filter (optional); and
- personal protective equipment (PPE).

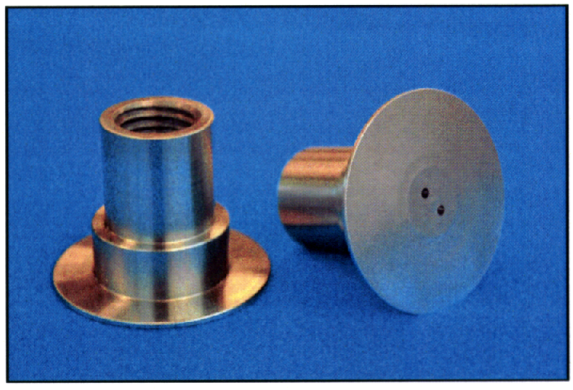

Figure 1. Vapor Pin™ Secure Cover.

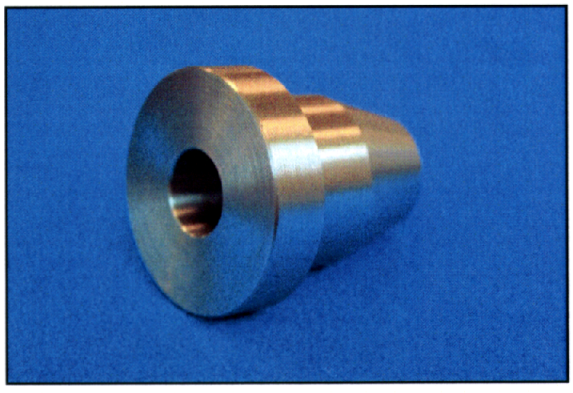

Figure 2. Vapor Pin™ Drilling Guide.

Installation Procedure:

1) Check for buried obstacles (pipes, electrical lines, etc.) prior to proceeding.

2) Set up wet/dry vacuum to collect drill cuttings.

3) While wearing PPE, drill a 1½-inch diameter hole into the concrete slab to a

depth of approximately 1 3/4 inches. Pre-marking the desired depth on the drill bit with tape will assist in this process.

4) Remove cuttings from the hole and place the Drilling Guide in the hole with the conical end down (Figure 3). The hole is sufficiently deep if the flange of the Drilling Guide lies flush with the surface of the slab. Deepen the hole as necessary, but avoid drilling more than 2 inches into the slab, as the threads on the Secure Cover may not engage properly with the threads on the Vapor Pin™.

Figure 3. Testing Depth with the Drilling Guide.

5) When the 1½-inch diameter hole is drilled to the proper depth, replace the drill bit with a $^{5}/_{8}$-inch diameter bit, insert the bit through the Drilling Guide (Figure 4), and drill through the slab. The Drilling Guide will help to center the hole for the Vapor Pin™, and keep the hole perpendicular to the slab.

6) Remove the bit and drilling guide, clean the hole, and install the Vapor Pin™ in accordance with the SOP "Installation and Extraction of the Vapor Pin™.

Figure 4. Using the Drilling Guide.

7) Screw the Secure Cover onto the Vapor Pin™ and tighten using a #14 spanner wrench by rotating it clockwise (Figure 5). Rotate the cover counter clockwise to remove it for subsequent access.

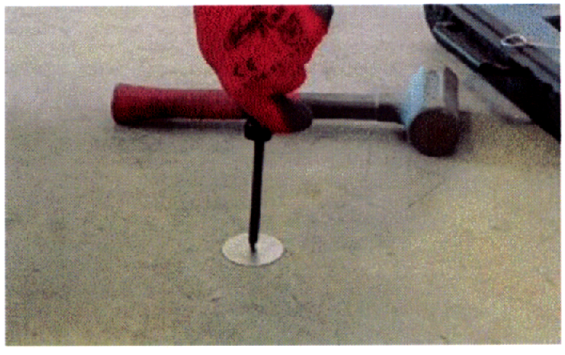

Figure 5. Tightening the Secured Cover.

Limitations:

On slabs less than 3 inches thick, it may be difficult to obtain a good seal in a flush mount configuration with the Vapor Pin™.

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Cox-Colvin & Associates, Inc. Environmental Services

Standard Operating Procedure Installation and Extraction of the Vapor Pin™

December 3, 2013

Scope:

This standard operating procedure describes the installation and extraction of the Vapor Pin™ for use in sub-slab soil-gas sampling.

Purpose:

The purpose of this procedure is to assure good quality control in field operations and uniformity between field personnel in the use of the Vapor Pin™ for the collection of sub-slab soil-gas samples.

Equipment Needed:

- Assembled Vapor Pin™ [Vapor Pin™ and silicone sleeve (Figure 1)];
- Hammer drill;
- 5/8-inch diameter hammer bit (Hilti™ TE-YX 5/8" x 22" #00206514 or equivalent);
- 1½-inch diameter hammer bit (Hilti™ TE-YX 1½" x 23" #00293032 or equivalent) for flush mount applications;
- ¾-inch diameter bottle brush;
- Wet/dry vacuum with HEPA filter (optional);
- Vapor Pin™ installation/extraction tool;
- Dead blow hammer;
- Vapor Pin™ flush mount cover, if desired;
- Vapor Pin™ protective cap; and
- VOC-free hole patching material (hydraulic cement) and putty knife or trowel.

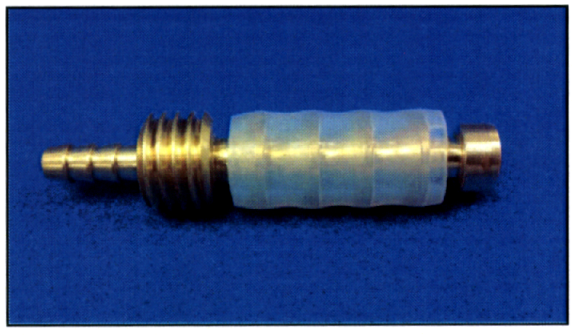

Figure 1. Assembled Vapor Pin™.

Installation Procedure:

1) Check for buried obstacles (pipes, electrical lines, etc.) prior to proceeding.

2) Set up wet/dry vacuum to collect drill cuttings.

3) If a flush mount installation is required, drill a 1½-inch diameter hole at least 1¾-inches into the slab.

4) Drill a 5/8-inch diameter hole through the slab and approximately 1-inch into the underlying soil to form a void.

5) Remove the drill bit, brush the hole with the bottle brush, and remove the loose cuttings with the vacuum.

6) Place the lower end of Vapor Pin™ assembly into the drilled hole. Place the small hole located in the handle of the extraction/installation tool over the Vapor Pin™ to protect the barb fitting and cap, and tap the Vapor Pin™ into place using a dead blow hammer (Figure 2). Make sure

the extraction/installation tool is aligned parallel to the Vapor Pin™ to avoid damaging the barb fitting.

Figure 2. Installing the Vapor Pin™.

For flush mount installations, unscrew the threaded coupling from the installation/extraction handle and use the hole in the end of the tool to assist with the installation (Figure 3).

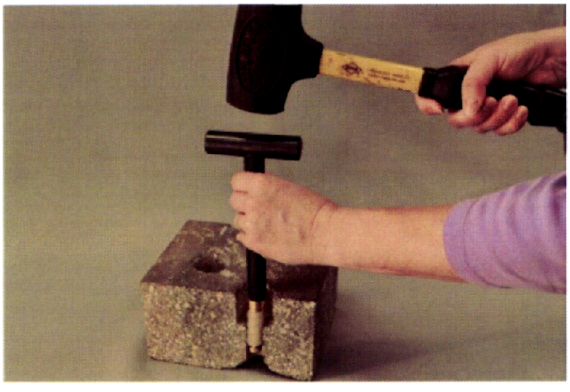

Figure 3. Flush-mount installation.

During installation, the silicone sleeve will form a slight bulge between the slab and the Vapor Pin™ shoulder. Place the protective cap on Vapor Pin™ to prevent vapor loss prior to sampling (Figure 4).

Figure 4. Installed Vapor Pin™.

7) For flush mount installations, cover the Vapor Pin™ with a flush mount cover, using either the plastic cover or the optional stainless-steel Secure Cover.

8) Allow 20 minutes or more (consult applicable guidance for your situation) for the sub-slab soil-gas conditions to equilibrate prior to sampling.

9) Remove protective cap and connect sample tubing to the barb fitting of the Vapor Pin™ (Figure 5).

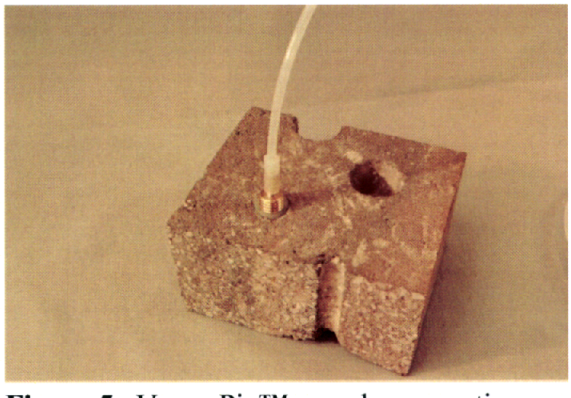

Figure 5. Vapor Pin™ sample connection.

10) Conduct leak tests in accordance with applicable guidance. If the method of leak testing is not specified, an attractive alternative can be the use of a water dam and vacuum pump, as described in SOP Leak Testing the Vapor Pin™ via Mechanical Means (Figure 6).

Figure 6. Water dam used for leak detection.

11) Collect sub-slab soil gas sample. When finished sampling, replace the protective cap and flush mount cover until the next sampling event. If the sampling is complete, extract the Vapor Pin™.

Extraction Procedure:

1) Remove the protective cap, and thread the installation/extraction tool onto the barrel of the Vapor Pin™ (Figure 7). Continue turning the tool to assist in extraction, then pull the Vapor Pin™ from the hole.

2) Fill the void with hydraulic cement and smooth with the trowel or putty knife. Urethane caulk is widely recommended for installing radon systems and can provide a tight seal, but it could also be a source of VOCs during subsequent sampling.

Figure 7. Removing the Vapor Pin™.

3) Prior to reuse, remove the silicone sleeve and discard. Decontaminate the Vapor Pin™ in a hot water and Alconox® wash, then heat in an oven to a temperature of 130° C.

The Vapor Pin™ to designed be used repeatedly; however, replacement parts and supplies will be required periodically. These parts are available on-line at www.CoxColvin.com.

Replacement Parts:

Vapor Pin™ Kit Case - VPC001
Vapor Pins™ - VPIN0522
Silicone Sleeves - VPTS077
Installation/Extraction Tool - VPIE023
Protective Caps - VPPC010
Flush Mount Covers - VPFM050
Water Dam - VPWD004
Brush - VPB026
Secure Cover - VPSCSS001
Spanner Wrench - VPSPAN001