# Illinois Environmental Protection Agency

Bureau of Land • 1021 North Grand Avenue East • P.O. Box 19276 • Springfield • Illinois • 62794-9276

## ILLINOIS EPA RCRA CORRECTIVE ACTION CERTIFICATION

This certification must accompany any document submitted to Illinois EPA in accordance with the corrective action requirements set forth in a facility's RCRA permit. The original and two copies of all documents submitted must be provided.

### 1.0 Facility Identification

Name: Equilon Enterprises LLC d/b/a/ SOPUS
County: Madison
Street Address: 900 South Central Ave
Site No. (IEPA): 1191150002
City: Roxana
Site No. (USEPA): ILD080 012 305

### 2.0 Owner Information

Name: Not Applicable
Mail Address:
City:
State: Zip Code:
Contact Name:
Contact Title:
Phone:

### 3.0 Operator Information

Name: Equilon Enterprises LLC d/b/a/ SOPUS
Mail Address: 128 East Center Street
City: Nazareth
State: PA Zip Code: 18064
Contact Name: Leroy Bealer
Contact Title: Senior Program Manager
Phone: 484-632-7955

### 4.0 Type of Submission (check applicable item and provide requested information, as applicable)

- ☐ RFI Phase I Workplan/Report
- ☐ RFI Phase II Workplan/Report
- ☐ CMP Report;
- ☒ Other (describe):

IEPA Permit Log No. B-43R
Date of Last IEPA Letter on Project August 22, 2022
Log No. of Last IEPA Letter on Project B-43R-CA-107
Does this submittal include groundwater information: ☒ Yes ☐ No

Resubmittal with new wet-signed form of 5 Routine SOP Updates submittals as requested by IEPA.

Date of Submittal August 29, 2022

### 5.0 Description of Submittal: (briefly describe what is being submitted and its purpose)

Resubmittal with new wet-signed form of 5 Routine SOP Updates submittals as requested by IEPA.

### 6.0 Documents Submitted (identify all documents in submittal, including cover letter; give dates of all documents)

Routine Updates to Previously Submitted SOPs letter dated 4/6/2018 (B-43R-CA-99); Routine Updates to Previously Submitted SOPs letter dated 2/11/2019 (B-43R-CA-100); Routine SOP Revisions letter dated 9/24/2019 (B-43R-CA-101); Routine Updates to Previously Submitted SOPs letter dated 12/20/2019 (B-43R-CA-103); Routine Updates to Previously Submitted SOPs letter dated 6/18/2020 (B-43R-CA-104).

### 7.0 Certification Statement

(This statement is part of the overall certification being provided by the owner/operator, professional and laboratory in Items 7.1, 7.2 and 7.3 below). The activities described in the subject submittals have been carried out in accordance with procedures approved by Illinois EPA. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

For: Resubmittal with new wet-signed form of 5 Routine SOP updates submittals as requested by IEPA

Date of Submission: August 29, 2022

## 7.1 Owner/Operator Certification

(Must be completed for all submittals. Certification and signature requirements are set forth in 35 IAC 702.126.) All submittals pertaining to the corrective action requirements set forth in a RCRA Permit must be signed by the person designated below (or by a duly authorized representative of that person):

1. For a Corporation, by a principal executive officer of at least the level of vice president.
2. For a Partnership or Sole Proprietorship, by a general partner or the proprietor, respectively.
3. For a Governmental Entity, by either a principal executive officer or a ranking elected official.

A person is a duly authorized representative only if:

1. the authorization is made in writing by a person described above; and
2. the written authorization is provided with this submittal (a copy of a previously submitted authorization can be used).

Owner Signature: Not Applicable Date: ____________

Title: ____________

Operator Signature: ____________ Date: 8/29/2022

Title: **Senior Program Manager**

For: Resubmittal with new wet-signed form of 5 Routine SOP Updates submittals as requested by IEPA.

Date of Submission: August 29, 2022

## 7.2 Professional Certification (if necessary)

Work carried out in this submittal or the regulations may also be subject to other laws governing professional services, such as the Illinois Professional Land Surveyor Act of 1989, the Professional Engineering Practice Act of 1989, the Professional Geologist Licensing Act, and the Structural Engineering Licensing Act of 1989. No one is relieved from compliance with these laws and the regulations adopted pursuant to these laws. All work that falls within the scope and definitions of these laws must be performed in compliance with them. The Illinois EPA may refer any discovered violation of these laws to the appropriate regulating authority.

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44 (h))

Professional's Signature: Not Applicable Date: ____________

Professional's Name ____________

Address ____________ Professional's Seal:

City ____________

State ______ Zip Code ____________

Phone ____________

For: Resubmittal with new wet-signed form of 5 Routine SOP Updates submittals as requested by IEPA.

Date of Submission: August 29, 2022

## 7.3 Laboratory Certification (if necessary)

The sample collection, handling, preservation, preparation and analysis efforts for which this laboratory was responsible were carried out in accordance with procedures approved by Illinois EPA.

Name of Laboratory Not Applicable

______________________________ Date: __________

Signature of Laboratory Responsible Officer

Mailing Address of Laboratory

Address ______________________________

City ______________________________

State _____ Zip Code __________

______________________________

Name and Title of Laboratory Responsible Officer

AECOM
100 N. Broadway
20th Floor
St. Louis, MO 63102
aecom.com

August 29, 2022

Mr. Kenneth Smith, PE
Manager, Permit Section
Illinois Environmental Protection System
Bureau of Land
1021 North Grand Ave East
Springfiled, IL 62794

**Resubmittal with new wet-signed form of 5 Routine SOP Updates submittals as requested by IEPA**
**Equilon Enterprises LLC d/b/a Shell Oil Products US**
**WRB Refining LP Wood River Refinery**
**Roxana, Illinois**
**1191150002 - Madison County (ILD080012305)**
**Log No. B-43R-CA-99, CA-100, CA-101, CA-103, CA-104**

Dear Mr. Smith;

On behalf of Equilon Enterprises LLC d/b/a Shell Oil Products US (Shell), AECOM Technical Services, Inc. (AECOM) is resubmitting the five (5) items listed below under one new wet-signed RCRA Corrective Action Certification form as requested by Illinois Environmental Protection Agency (IEPA) in an email on August 23, 2022.

- *Routine Updates to Previously Submitted SOPs* letter dated April 6, 2018 (B-43R-CA-99) received on April 9, 2018
- *Routine Updates to Previously Submitted SOPs* letter dated February 11, 2019 (B-43R-CA-100) received on February 13, 2019
- *Routine SOP Revisions* letter dated September 24, 2019 (B-43R-CA-101) received on September 25, 2019
- *Routine Updates to Previously Submitted SOPs* letter dated December 20, 2019 (B-43R-CA-103) received on December 23, 2019
- *Routine Updates to Previously Submitted SOPs* letter dated June 18, 2020 (B-43R-CA-104) received on June 19, 2020

If you have any questions concerning this request, please contact Leroy (Buddy) Bealer, Shell Senior Program Manager, at (484) 632-7955 or leroy.bealer@shell.com, or me at (314) 452-8929 or wendy.pennington@aecom.com.

Sincerely,

Wendy Pennington, PE
Project Manager
AECOM
M: 314-452-8929
E: wendy.pennington@aecom.com

**Enclosures**

**cc:** Buddy Bealer, Shell
Repository (Roxana website, Public Library)
Project File

# Illinois Environmental Protection Agency

Bureau of Land • 1021 North Grand Avenue East • P.O. Box 19276 • Springfield • Illinois • 62794-9276

## ILLINOIS EPA RCRA CORRECTIVE ACTION CERTIFICATION

This certification must accompany any document submitted to Illinois EPA in accordance with the corrective action requirements set forth in a facility's RCRA permit. The original and two copies of all documents submitted must be provided.

### 1.0 Facility Identification

Name Equilon Enterprises LLC d/b/a Shell Oil Products US | County Madison

Street Address 900 South Central Ave | Site No. (IEPA) 1191150002

City Roxana | Site No. (USEPA) ILD 080 012 305

### 2.0 Owner Information

Name Not Applicable

Mail Address

City

State Zip Code

Contact Name

Contact Title

Phone

### 3.0 Operator Information

Name Equilon Enterprises LLC d/b/a SOPUS

Mail Address 17 Junction Drive, PMB #399

City Glen Carbon

State IL Zip Code 62034

Contact Name Kevin Dyer

Contact Title Senior Principal Program Manager

Phone 618-288-7237

### 4.0 Type of Submission (check applicable item and provide requested information, as applicable)

- ☐ RFI Phase I Workplan/Report
- ☐ RFI Phase II Workplan/Report
- ☐ CMP Report;
- ☑ Other (describe):

IEPA Permit Log No. B-43R

Date of Last IEPA Letter on Project October 10, 2017

Log No. of Last IEPA Letter on Project B-43R-CA-82,88,94,97

Does this submittal include groundwater information: ☐ Yes ☑ No

Standard Operating Procedures update

Date of Submittal Apr 6, 2018

### 5.0 Description of Submittal: (briefly describe what is being submitted and its purpose)

Routine Updates to Standard Operating Procedures

### 6.0 Documents Submitted (identify all documents in submittal, including cover letter; give dates of all documents)

Cover Letter; SOPs 3, 4, 11, 44R, 48, 49, 52, 56

### 7.0 Certification Statement

(This statement is part of the overall certification being provided by the owner/operator, professional and laboratory in Items 7.1, 7.2 and 7.3 below). The activities described in the subject submittals have been carried out in accordance with procedures approved by Illinois EPA. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

## 7.1 Owner/Operator Certification

(Must be completed for all submittals. Certification and signature requirements are set forth in 35 IAC 702.126.) All submittals pertaining to the corrective action requirements set forth in a RCRA Permit must be signed by the person designated below (or by a duly authorized representative of that person):

1. For a Corporation, by a principal executive officer of at least the level of vice president.
2. For a Partnership or Sole Proprietorship, by a general partner or the proprietor, respectively.
3. For a Governmental Entity, by either a principal executive officer or a ranking elected official.

A person is a duly authorized representative only if:

1. the authorization is made in writing by a person described above; and
2. the written authorization is provided with this submittal (a copy of a previously submitted authorization can be used).

Owner Signature: ______________________ Date: ____________

Title: ______________________

Operator Signature: [signature] Date: 3/31/18

Title: Senior Principal Program Manager

## 7.2 Professional Certification (if necessary)

Work carried out in this submittal or the regulations may also be subject to other laws governing professional services, such as the Illinois Professional Land Surveyor Act of 1989, the Professional Engineering Practice Act of 1989, the Professional Geologist Licensing Act, and the Structural Engineering Licensing Act of 1989. No one is relieved from compliance with these laws and the regulations adopted pursuant to these laws. All work that falls within the scope and definitions of these laws must be performed in compliance with them. The Illinois EPA may refer any discovered violation of these laws to the appropriate regulating authority.

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44 (h))

Professional's Signature: ______________________ Date: ____________

Professional's Name ______________________

Address ______________________ Professional's Seal:

City ______________________

State ______ Zip Code ____________

Phone ______________________

## 7.3 Laboratory Certification (if necessary)

The sample collection, handling, preservation, preparation and analysis efforts for which this laboratory was responsible were carried out in accordance with procedures approved by Illinois EPA.

Name of Laboratory ______________________

______________________ Date: ____________

Signature of Laboratory Responsible Officer

Mailing Address of Laboratory

Address ______________________

City ______________________

State ______ Zip Code ____________

______________________

Name and Title of Laboratory Responsible Officer

AECOM

AECOM
1001 Highlands Plaza Drive West
Suite 300
St. Louis
MO, 63110
USA
aecom.com

April 6, 2018

Mr. Theodore Dragovich, PE
Acting Manager, Permit Section
Illinois Environmental Protection Agency
Bureau of Land
1021 North Grand Avenue East
Springfield, Illinois 62794

**Routine Updates to Previously Submitted Standard Operating Procedures**
**Equilon Enterprises LLC dba Shell Oil Products US**
**Roxana, Illinois**
**1191150002 - Madison County**
**ILD080012305**
**Log B-43R**

Dear Mr. Dragovich:

As part of AECOM Technical Services, Inc.'s (AECOM's) routine quality improvement process, we recently performed a review of some of the Standard Operating Procedures (SOPs) used by field staff performing activities at the investigation sites in Roxana, Illinois. Previously revised versions of SOPs have been submitted to the Illinois Environmental Protection Agency (IEPA), most recentlyd on April 4, 2017. These procedures were originally submitted, as requested by various IEPA correspondences, within various reports and work plans related to the Investigation Site in Roxana, Illinois. We are submitting this package of updated SOPs for your reference and in accordance with proposed revisions to Sections C.7.5. and C.8.4 of the RCRA Post-Closure Permit Application[1] for the Equilon Enterprises LLC d/b/a Shell Oil Products US (SOPUS) facility at the WRB Refining LP Wood River Refinery.

The SOPs included with this submittal are listed below. The SOPs listed received editorial and formatting revisions. A summary of any additional substantive revisions made to the SOPs are included in the table below.

| SOP No | SOP Title | Purpose of Revision |
|---|---|---|
| 3 | Calibration and Maintenance of Field Instruments | Clarification of interface probe field check procedures |
| 4 | Decontamination | Clarification of interface probe decontamination procedures and groundwater parameter equipment storage procedures |
| 11 | Well Wizard Operation and Sampling | This procedure not previously submitted but used for the program |
| 44R | Soil Vapor Purging and Sampling | Editorial and formatting; Figure revision |

[1] Class 1* Permit Modification – Section C Revision for SOP Reference (Log No. B-43R-CA-82, CA-88, CA-94 and CA-97) was submitted to IEPA on January 29, 2018. A response to this submittal is still pending as of the date of this submittal.

| SOP No | SOP Title | Purpose of Revision |
|---|---|---|
| 48 | SVE Well Data Collection and Sampling | Editorial and formatting |
| 49 | SVE Effectiveness Monitoring at VMPs | Editorial and formatting |
| 52 | Soil Vapor Field Laboratory Screening | Editorial and formatting |
| 56 | LNAPL Recovery | This procedure not previously submitted but used for the program |

Below is an SOP summary table, which indicates the most recent revision date for each SOP for your reference.

| SOP No. | SOP Title | Last Updated |
|---|---|---|
| 3 | Calibration & Maintenance of Field Instruments | 2/15/2018 |
| 4 | Decontamination | 2/15/2018 |
| 5 | Utility Clearance Procedures | 7/24/2015 |
| 8 | Field Reporting and Documentation | 4/4/2017 |
| 10 | Well Gauging Measurements | 6/22/2017 |
| 11 | Groundwater Sampling & Well Wizard Operation | 7/21/2015 |
| 12 | Grouting Procedures | 7/23/2015 |
| 14 | Headspace Soil Screening | 7/23/2015 |
| 17 | Logging | 7/23/2015 |
| 18 | Low Flow Groundwater Purging & Sampling | 7/1/2015 |
| 20 | Well Development | 7/21/2015 |
| 21 | Monitoring Well Installation | 7/24/2015 |
| 23 | Quality Assurance Samples | 4/4/2017 |
| 24 | Soil and Groundwater Sample Identification, Packaging & Shipping | 6/22/2017 |
| 25 | Sample Containers, Preservation & Holding Times | 7/23/2015 |
| 26 | Sample Control & Custody Procedures | 6/22/2017 |
| 28 | Soil Sampling | 7/24/2015 |
| 29 | Soil Probe Operation | 7/24/2015 |
| 42 | Groundwater Profiling | 7/22/2015 |
| 44R | Soil Vapor Purging & Sampling | 4/2/2018 |
| 46 | Indoor Air Sampling with Canisters | 7/23/2015 |
| 47 | Sub-slab Soil Gas Installation & Sampling with Canisters | 4/4/2017 |
| 48 | SVE Well Data Collection and Sampling | 3/6/2018 |
| 49 | SVE Effectiveness Monitoring at VMPs | 3/6/2018 |
| 51 | Vapor Sample Classification, Packaging & Shipping | 6/22/2017 |
| 52 | Soil Vapor Field Laboratory Screening | 3/6/2018 |
| 53 | Dwyer Digital Manometer | 7/23/2015 |
| 56 | LNAPL Recovery | 6/22/2017 |

AECOM

Copies of this submittal are being sent separately directly to Amy Boley (IEPA, Springfield) and Gina Search (IEPA, Collinsville).

If you have any questions, please contact Wendy Pennington at wendy.pennington@aecom.com (314-743-4166) or Bob Billman at bob.billman@aecom.com (314-743-4108).

Sincerely,

Wendy Pennington
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AECOM
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Robert B. Billman
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T: 314-743-4108
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**encl:** Revised SOPs
RCRA Corrective Action Certification Form

**cc:** Amy Boley (IEPA - Springfield, IL)
Gina Search (IEPA - Collinsville, IL)
Kevin Dyer (SOPUS)
Shannon Haney (Greensfelder Hemker)
Project File
Repositories (Roxana Public L brary, website)

## 1. Objective

This document defines the standard operating procedure for calibration and maintenance of field instruments frequently used during environmental field activities for the Shell projects in Hartford and Roxana, Illinois. This Standard Operating Procedure (SOP) gives descriptions of the most commonly used of these instruments and field procedures to calibrate and maintain these field instruments. Calibration and maintenance records are maintained with the project file.

## 2. Equipment

The following equipment is typically required during field instrument calibration and maintenance activities.

- Latex/Nitrile gloves
- Site logbook
- Field data sheets
- Equipment Calibration Record forms
- Distilled or deionized water
- Decontamination equipment
- Health and Safety Equipment
- Field Instrument Operations Manual
- Calibration gases for Air Monitoring Equipment
- Calibration solutions for Water Monitoring Equipment.

## 3. Types of Field Instruments Commonly used during Environmental Investigations

The following are some of the more commonly used instruments during environmental investigations.

- Photoionization Detector (PID)
- Flame Ionization Detector (FID)
- Multi-gas Meter (usually includes Explosimeter, Hydrogen Sulfide detector, Oxygen sensor, and Carbon Monoxide meter)
- Single-gas Meter (usually Benzene or Hydrogen Sulfide meters)

- Groundwater Level Indicator
- Petroleum/Groundwater Interface Probe
- Groundwater pH, Temperature, Conductivity, Dissolved Oxygen, Oxidation-Reduction Potential and/or Turbidity Meter(s).

### *4. Maintenance*

Each instrument has specific maintenance requirements, which are described in the instrument's manufacturer's manual. These maintenance requirements should be followed. General maintenance such as regular cleaning of the instrument, battery checks and replacement, and ensuring the instrument is handled and stored properly can be performed by AECOM employees. Other maintenance items such as sensor repair, annual calibrations and repair of a malfunctioning piece of equipment should be performed by the instrument manufacturer or licensed dealer and should NOT be performed by AECOM employees, unless specifically directed by the equipment supplier. Contact the manufacturer or licensed dealer to determine where the instrument should be submitted for maintenance tasks, if necessary.

### *5. Calibration*

Due to the wide variety of field instruments available, various parameters potentially monitored, and the wide range of functions potentially performed by each instrument, a description of the calibration of every type of instrument available is not feasible. However, a generalized SOP for general types of field equipment calibration is presented here. Refer to the manufacturer's manual for specific calibration instructions for the instrument being used.

The appropriate calibration field form for the equipment being calibrated should be completed in its entirety, including the equipment model and serial/ID number. If something on the calibration field form does not apply, fill in the space on the form with "NA".

*<u>Air Monitoring Instruments</u> (PID, FID, Multi-gas Meters, Single-gas meters, etc.)*

1. Turn the instrument on. The on/off switch may be a toggle switch, knob, or button to be depressed depending on the type and brand of instrument being used.
2. Allow the instrument to "warm up" and progress through the startup diagnostic routine.
3. Perform a "fresh air" calibration, if possible, for the air meter. This fresh air calibration should be performed using a zero air filter provided with the air monitor or using a zero air calibration gas.

4. Record the initial reading on the proper equipment calibration field form. Also record the fresh air calibration standard on the field form.
5. Apply the proper calibration gas and proceed with calibration as directed in the manufacturer's manual.
6. Record the final calibrated reading on the field equipment calibration forms.
7. Verify a moisture and dust filter is in place on the air meter intake nozzle, when applicable.
8. If directed in the manufacturer's manual, at periodic intervals throughout the day, the calibration of the instrument should be checked and re-evaluated as directed in the manufacturer's manual.

*Groundwater Parameter Instruments (YSI ProDSS, pH-Con 10, turbidimeters, etc.)*

Frequently one instrument will have multiple sensors for measuring various parameters in water. With the exception of temperature, each of these parameters can generally be field calibrated.

1. Turn the instrument on. The on/off switch may be a toggle switch, knob, or button to be depressed depending on the type and brand of instrument being used.
2. Allow the instrument to "warm up" and progress through the startup diagnostic routine.
3. Apply calibration solution(s) as instructed by the instrument prompts and/or the manufacturer's manual. Reseal calibration solution containers for future use.
4. Adjust the reading of the instrument to correlate to the corresponding calibration solution being applied.
5. Record calibration reading(s) on the proper field calibration form(s).
6. Dispose of used calibration solution.

*Water Level Indicator and Petroleum/Water Interface Probe*

Field calibration of this instrument is not required. Rather a series of field checks to ensure the instrument is in proper working order are described.

1. Turn the instrument on. The on/off switch is usually a knob located on the side of the reel which the measuring tape is rolled onto.

2. Push the "test" button to ensure that the batteries are in working order. If the batteries are working, an audible tone will be heard and a visible light located on the side of the real will illuminate.
3. Immerse the sensor probe in distilled water to ensure the audible tone is heard and visible light illuminates when the probe enters the water and make an observation of where the water level is at on the probe. Repeat this step several times to familiarize yourself with this contact point. If sensor probe does not react when immersed, contact the manufacturer or licensed dealer for troubleshooting or replacement.
4. Immerse the sensor probe (for interface probes only) in pure phase product (such as vegetable oil) to ensure the audible tone is heard and visible light illuminates when the probe enters the product. Make an observation of where the product level is at on the probe. Perform decontamination on the probe as outlined in SOP No. 4 Decontamination after this step. If sensor probe does not react when immersed, contact the manufacturer or licensed dealer for troubleshooting or replacement

### *6. Decontamination*

Small instruments and equipment that comes into contact with environmental media shall be cleaned according to SOP No. 4 – Decontamination between each use, and shall be stored in such a way as to prevent contamination.

## *1. Objective*

This document defines the standard procedure for decontamination of field equipment and personnel for Shell projects in Hartford and Roxana, Illinois. This SOP is intended to be used together with several other SOPs.

The overall objective of multimedia sampling programs is to obtain samples that accurately depict the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminants can be brought onto the sampling location and/or introduced into the medium of interest during the sampling program (e.g. using sampling equipment that is not properly or fully decontaminated). Trace quantities of contaminants can consequently be captured in a sample and lead to false positive analytical results and an incorrect assessment of the contaminant conditions associated with the site. Decontamination of drilling, sampling and other equipment (e.g., all non-disposable equipment that will come in direct contact with samples) is, therefore, required prior to, between, and after uses to ensure that sampling cross-contamination is prevented, and that on-site contaminants are not carried off-site.

## *2. Equipment*

The following is a list of equipment that may be needed to perform decontamination:

- Brushes
- Wash tubs
- Buckets
- Scrapers, flat bladed
- Hot water - high-pressure sprayer
- Sponges or paper towels
- Liquinox detergent (or equivalent)
- Isopropyl alcohol
- Potable tap water
- Deionized or distilled water
- Garden-type water sprayers
- Plastic sheeting or trash bags
- Gast® high-flow pump (or equivalent)

## 3. Decontamination Procedures

Proper mixing instructions for Liquinox detergent: use 2.5 tablespoons Liquinox detergent per gallon of water. If another detergent is being used, verify the proper mixing instructions prior to use.

Detergent water and rinse water shall be mixed fresh each morning and shall be replaced with new solutions at least at mid-day. More frequent replacement of solutions may be necessary if gross contamination (i.e., light non-aqueous phase liquid [LNAPL], sheen, or suspended particles) is observed.

### 3.1 Personnel

Personnel shall be provided space to wash and rinse gloves, and any other non-disposable personal protective equipment (PPE). A container shall be available to dispose of used disposable items such as gloves, or tyvek (if used).

The decontamination procedure for field personnel shall include:

1. Glove wash in an Liquinox (or similar) solution
2. Glove rinse in distilled water
3. Outer glove removal, if present
4. Coverall removal, if present
5. Inner glove removal

Refer to the project Health and Safety Plan (HASP) for additional information. If conditions change and/or upgrade of PPE is required, refer to the task or project specific HASP for more specific information.

### 3.2 Groundwater Parameter Equipment (e.g., YSI ProDSS or similar)

Equipment used to measure groundwater parameters, which does not come into contact with the sample, may be decontaminated between wells if necessary (i.e., gross contamination observed on the sonde probes, history of elevated benzene results at a particular well[1], etc.) (Steps 1 through 6 below). This equipment will, at a minimum, be decontaminated at the end of each sampling day (Step 7 below). The following steps shall be used when decontaminating groundwater parameter measuring equipment:

[1] Elevated levels of benzene may cause accelerated deterioration of the optical dissolved oxygen lens, which in turn will require more frequent lens replacement.

1. Personnel shall dress in appropriate PPE to reduce the potential of personal exposure as required by the project (HASP).
2. Spray or wash sensors with a soap and water solution (Liquinox or similar and potable or distilled water).
3. Spray or rinse sensors with distilled water.
4. Wash Flow Cell in a wash tub or bucket containing soap and water solution (Liquinox or similar along with potable or distilled water) and scrubbed with a bristle brush or similar utensil.
5. Rinse Flow Cell with distilled water in a second tub or bucket.
6. Detergent water and rinse water shall be mixed fresh each morning and shall be replaced with new solutions at least at mid-day. More frequent replacement of solutions may be necessary if gross contamination (i.e., LNAPL, sheen, or suspended particles) is observed.
7. At the end of each sampling day,
    a. Soak the optical dissolved oxygen (DO) cap in distilled vinegar for 10 to 15 minutes.
    b. Rinse the optical DO cap in distilled water.
    c. Wash the Flow Cell in a wash tub or bucket containing soap and water solution (Liquinox or similar along with potable or distilled water and scrubbed with a bristle brush or similar utensil.
    d. Rinse Flow Cell with distilled water in a second tub or bucket.
    e. If flow through cell is still odorous, soak in a wash tub or bucket containing soap and water solution (Liquinox or similar along with potable or distilled water) for 10 to 15 minutes. Also consider performing decontamination activities more often during the next sampling day/event.

Following decontamination, equipment shall be placed in a clean area (i.e., in the truck, in a dedicated container, etc.) or on clean plastic sheeting in the work zone to prevent contact with contaminated media. If the equipment is not used immediately after decontamination, the equipment shall be stored in a manner which minimizes potential contact with contaminants. Overnight, the equipment will be stored with the sonde sensors submerged in potable water.

### *3.3 Groundwater Sampling Pumps*

Submersible, non-dedicated, non-disposable groundwater sampling pumps shall be decontaminated between each sampling location. The following steps shall be used to decontaminate groundwater sampling pumps:

1. Personnel shall dress in appropriate PPE to reduce the potential of personal exposure as required by the HASP.
2. Exterior of the sampling pump, including the electrical cord, shall be sprayed and/or wiped off with isopropyl alcohol to remove gross contamination. The outer sampling pump casing may be removed, if necessary, to remove gross contamination on sampling pump motor module.
3. Sampling pump, including electrical cord, shall be placed in a wash tub or bucket containing a soap and water solution (Liquinox or similar along with potable or distilled water). Sampling pump shall be turned on to circulate the soapy water for a minimum of 5 minutes.
    a. Sampling pump may be scrubbed with a bristle brush, sponge or similar utensil.
    b. If the electrical cord will not fit into the wash tub or bucket, it can be wiped down with a paper towel saturated with a detergent water solution.
4. Sampling pump, including electrical cord, shall be placed in a second tub or bucket containing distilled water. Sampling pump shall be turned on to circulate rinse water for a minimum of 5 minutes and until water coming out of the pump no longer contains soapy solution.
    a. If the electrical cord will not fit into the tub or bucket, it can be wiped down with a paper towel saturated with distilled water.
5. Detergent water and rinse water shall be mixed fresh each morning and shall be replaced with new solutions at least at mid-day. More frequent replacement of solutions may be necessary if gross contamination (i.e., LNAPL, sheen, or suspended particles) is observed.

Following decontamination, equipment shall be placed in a clean area (i.e., in the truck, in a dedicated container, etc.) or on clean plastic sheeting in the work zone to prevent potential contact with contaminants. If the equipment is not used immediately after decontamination, the equipment shall be stored in a manner which minimizes potential contact with contaminants.

### 3.4 Water Level / Interface Probes

The following steps shall be used to decontaminate water level meters and oil/water interface probes:

1. Personnel shall dress in appropriate PPE to reduce the potential of personal exposure as required by the HASP.
2. A paper towel or other disposable media shall be saturated with isopropyl alcohol.
3. A portion of a second paper towel or other disposable media shall be saturated with a detergent water solution and the remaining portion of the same paper towel or other disposable media shall be saturated with distilled water.
4. The measuring tape shall be wiped clean as it is removed from the monitoring well by passing through the saturated disposable media. The tape must pass through the detergent water solution first, and the distilled water last.
5. Care shall be taken to replace saturated paper towels if gross contamination is observed or to replace paper towels which become dry during the process.
6. Probe tip shall also be sprayed off with Liquinox (or similar) detergent water solution and distilled water after wiping.
    a. Solinst and Heron brand probe tips should NOT be cleaned with isopropyl alcohol.
    b. If another brand interface probe is being used, check the equipment manual to verify proper decontamination procedures and solutions.

Following decontamination, equipment shall be placed in a clean area (i.e., in the truck, in a dedicated container, etc.) or on clean plastic sheeting in the work zone to prevent potential contact with contaminants. If the equipment is not used immediately after decontamination, the equipment shall be stored in a manner which minimizes potential contact with contaminants.

### 3.5 Other Sampling Equipment

The following steps shall be used to decontaminate other sampling equipment:

1. Personnel shall dress in appropriate PPE to reduce the potential of personal exposure as required by the HASP.
2. Gross contamination on equipment shall be scraped/wiped off at the sampling or construction site.

3. Equipment shall be sprayed and/or wiped off with isopropyl alcohol.
4. Equipment that cannot be damaged by liquid or water shall be placed in a wash tub or bucket containing soap and water solution (Liquinox or similar along with potable or distilled water) and scrubbed with a bristle brush or similar utensil.
5. Equipment that cannot be damaged by liquid or water shall then be rinsed with distilled water in a second tub or bucket.
6. Equipment that may be damaged by liquid/water shall be carefully wiped clean using a sponge/paper towel with isopropyl alcohol, followed by a sponge/paper towel with detergent water and a sponge/paper towel with deionized or distilled water. Care shall be taken to prevent equipment damage.
7. Detergent water and rinse water shall be mixed fresh each morning and shall be replaced with new solutions at least at mid-day. More frequent replacement of solutions may be necessary if gross contamination (i.e., LNAPL, sheen, or suspended particles) is observed.

Following decontamination, equipment shall be placed in a clean area (i.e., in the truck, in a dedicated container, etc.) or on clean plastic sheeting in the work zone to prevent contact with contaminated media. If the equipment is not used immediately after decontamination, the equipment shall be stored in a manner which minimizes potential contact with contaminants.

### *3.6 Drilling and Heavy Equipment*

Drilling rigs shall be decontaminated at a decontamination station located near a central staging area. The decontamination station may consist of a temporary or permanent structure capable of collecting all decontamination fluids. Mobile decontamination trailers may be used to decontaminate heavy equipment at each site. The following steps shall be used to decontaminate drilling and heavy equipment:

1. Review JSA for drilling and heavy equipment decontamination.
2. Personnel shall dress in appropriate PPE to reduce personal exposure as required by the HASP.
3. Equipment showing gross contamination or having caked-on drill cuttings shall be scraped with a flat-bladed scraper at the sampling or construction site.
4. Equipment that cannot be damaged by water, such as drill rigs, augers, drill bits, and shovels, shall be washed with a hot water, high-pressure sprayer then rinsed with

potable water. Care shall be taken to adequately clean the insides of the hollow-stem augers, backhoe buckets, etc.[2]

Following decontamination, drilling equipment shall be placed on the clean drill rig and moved to a clean area. If the equipment is not used immediately, it shall be stored in a designated clean area.

### *3.7 Equipment Leaving the Site*

Vehicles used for site activities shall be cleaned on an as-needed basis, as determined by the Site Safety Officer, using soap and water on the outside and vacuuming the inside. On-site cleaning shall be required for dirty vehicles (i.e., muddy tires) leaving the site. Construction equipment, such as hollow stem augers, other drilling equipment, etc., shall be pressure washed before the equipment is removed from the site to limit exposure of off-site personnel to potential contaminants.

### *3.8 Wastewater*

Liquid waste water from decontamination activities shall be containerized and left at the site where it originated, unless otherwise specified. Check the project/task work plan or with the Project Investigative-derived Waste (IDW) Coordinator for additional information/guidance.

### *3.9 Tedlar® Bags*

The following steps shall be used to decontaminate used Tedlar® bags for reuse:

1. Personnel shall dress in appropriate PPE to reduce the potential of personal exposure as required by the HASP.
2. Tedlar® bags shall be pre-sorted into the following purge categories based on previous concentration:

[2] Use of steam cleaning during decontamination warrants a Hot Work Permit, which must be evaluated and approved prior to use.

| Oxygen (%) | Total Hydrocarbon Concentration (ppm) | Minimum Number of Purges Required |
|---|---|---|
| 20.9 | 0.0 | none |
| 15 – 20.9 | 0.1 - 10 | 1 |
| 10 - 15 | 10 - 100 | 2 |
| 5 - 10 | 100 – 1,000 | 3 |
| <5 | 1,000 – 10,000 | 4 |
| | 10,000 – 100,000 | 5 |
| N/A | > 100,000 | Discard bag |

If the oxygen and total hydrocarbon concentration (THC) values in the previous Tedlar® bag concentration do not line up on the table above, the more conservative approach (i.e., the most number of purges) shall be chosen.

3. In a well ventilated area, begin the purge process by introducing ambient air into the Tedlar® bag through a Gast® sampling pump (or equivalent). Fill the Tedlar® bag approximately 80% full and then expel the ambient air from the Tedlar® bag. Repeat until the required number of purges outlined in Step 2 above has been performed.
4. After the final purge is complete, introduce ambient air into the Tedlar® bag through the pump and screen the Tedlar® bag to ensure that Oxygen is 20.9% and THC is 0.0 ppm (ambient conditions). If ambient conditions are not present in the Tedlar® bag after purging is complete, discard the Tedlar® bag.
5. Once ambient conditions are verified and the Tedlar® bag is examined to ensure that it is structurally intact, expel the remaining air and affix a new sampling label. Place the Tedlar® bag in the designated storage location for future use.

### *4. Documentation*

Sampling personnel shall be responsible for documenting the decontamination of sampling and drilling equipment. The documentation shall be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination shall include the following:

- Decontamination personnel

- Date and start and end times
- Decontamination observations
- Weather conditions.

Refer to SOP No. 8 Field Reporting and Documentation for further information regarding logbook entries and logbook management.

## *5. Quality Assurance Requirements*

Equipment rinsate samples of the decontaminated sampling equipment may be taken to verify the effectiveness of the decontamination procedures. The rinsate sampling procedure shall include passing distilled water through or over a decontaminated sampling tool (such as a split spoon) and collecting the rinsate water into the appropriate sample bottles. The rinsate sampling procedure, including the sample number, shall be recorded in the field notebook.

## 1. Objective

This document gives descriptions of equipment and field procedures necessary to collect groundwater samples and operate the dedicated Well Wizard pumps for monitoring wells in the Shell Wood River Refinery (WRR) groundwater monitoring program.

## 2. Equipment

Equipment typically used during well purging and sampling:

- Well keys
- Water level indicator or water/product interface probe with 0.01-foot increments
- Assorted tools (safety knife, screwdriver, etc.)
- Water quality parameter meter(s) with appropriate sensors
- Calibration fluids
- Polyethylene or glass container (for field parameter measurements)
- Paper towels or Kimwipes
- Calculator
- Field notebook
- Waterproof and permanent marker
- Field data paperwork
- Panasonic Toughbook/Toughpad
- Plastic buckets
- 55-gallon drums or truck-mounted tank for holding purged water
- Plastic sheeting, plastic tote or other means of secondary containment to use during purging and sampling
- Compressor
- Controller for the QED Well Wizard pumps
- Air hoses and connections/splitters
- Appropriate health and safety equipment
- Well completion information sheet

- Appropriate decontamination equipment
- Cooler with ice
- Sample jars and labels. Sample bottles with preservatives added will be obtained from the analytical laboratory. Several extra sample bottles will be obtained in case of breakage or other problems.
- Plastic sheeting, plastic tote or other means of keeping sample bottles off the ground and clean.

### *3. Sampling Procedures*

This section provides the step-by-step procedures for collecting groundwater samples in the field via dedicated Well Wizard pumps. Observations made during groundwater sample collection should be recorded in the field notebook, on field data sheets and/or in the Toughbook/Toughpad in accordance with procedures described in SOP No. 8 Field Reporting and Documentation.

1. Before any purging or sampling begins, all reusable well probes, and other sampling devices shall be decontaminated. Mobile decontamination supplies will be provided so that equipment can be decontaminated in the field.
2. Electronic equipment used during sampling includes water quality parameter meter(s), and a water level or water/product interface measurement probe. Before going into the field, the sampler shall verify that these instruments are operating properly. The water quality parameter meter(s) require calibration prior to use every day. Calibration times and readings will be recorded in the field notebook and/or on daily calibration sheets to be kept in the project file. Specific instructions for calibrating the field instruments are provided in SOP No. 3 Calibration and Maintenance of Field Instruments and the instrument manuals.
3. Before well purging begins, the following procedures will be performed at each well:
    - The condition of the outer well casing, concrete well pad, protective posts (if present), and any unusual conditions of the area around the well will be noted on the field sheets and/or in the Toughbook/Toughpad.
    - The presence of a working lock and its condition (e.g., locked) will be verified.
    - Clean plastic sheeting or other form of secondary containment for purgewater collection will be placed around the well.

- The well will be opened.
- Appropriate readings will be taken in the breathing zone with a flame ionization detector (FID) or photoionization detector (PID) according to the Health and Safety Plan. The reading will be recorded on the field sheets and/or in the Toughbook/Toughpad.
- The condition of the inner well cap, tubing connects and casing will also be noted.

4. Groundwater elevations will be measured to the nearest 1/100 foot at each monitoring well using an electronic water level or interface probe. The groundwater measurements, screened intervals, and total monitoring well depth will be recorded on the field data sheet and/or in the Toughbook/Toughpad. A detailed description of monitoring well gauging activities, including well head vapor readings, is provided in SOP No. 10 Well Gauging Measurements.

5. The presence of nonaqueous-phase liquids (NAPL), dense or light, will be determined using an oil-water interface probe and confirmed by observation on the probe or via clear bailer. If NAPL is identified, its thickness will be measured. The presence of light or dense NAPLs will preclude sampling of the groundwater itself.

6. Following measurement of the static water levels, the monitoring wells will be purged of at least three (3) well volumes. The well purge volume is calculated with one of the following equations:

   **If a packer is present to isolate the water column around the screened interval**:

   [(TD of well) – (bottom of packer)] x (ft to gal conversion[1]) x 3 = __________ gallons
   (ft btoc) (ft btoc) (see footnote) # Vols Calculated Purge Volume

   **If no packer is present and the full water column height is to be considered**:

   [(TD of well) – (WL)] x (ft to gal conversion[1]) x 3 = __________ gallons
   (ft btoc) (ft btoc) (see footnote) # Vols Calculated Purge Volume

   If work is being performed at a group of wells, perform this calculation for all wells in the group prior to proceeding to the next step.

7. Set up the compressor and connections as follows to maximize groundwater flow and minimize sampling time:

[1] For a 1-inch diameter well, use 0.0408 gal/ft; For a 1.5-inch diameter well, use 0.0918 gal/ft; For a 2-inch diameter well, use 0.163 gal/ft; For a 4-inch diameter well, use 0.652 gal/ft; For a 6-inch diameter well, use 1.468 gal/ft.

a. If a packer is present in the well, attached the pressure gauge (black hose with gauge attached) to the smaller quick-connect fitting at the well head. If no packer is present, skip this step. Attach one end of the air hose to the pressure gauge hose, if present, or the larger quick-connect fitting at the well head. If only one well is being sampled, use the vented air hose, with the vent at the well head. If multiple wells are being sampled at a time, do not use the vented air hose for either well.

b. Attach the other end of the air hose to the "out" connection of the control box. If multiple wells are being sampled at a time, connect the "+" splitter to the "out" connection of the control box and connect the air line from each well to the splitter.

- If you use the splitter to sample multiple wells at a time at a cluster of 4 wells (e.g., P-89A, P-89B, P-89C, P-89D), the sequence is typically as follows but will vary from well cluster to cluster depending on operational packers and purge volume calculations:

  i. Purge "A" and "C" well first. Typically the volume required to be removed from "A" is twice that to be removed from "C".

  ii. Sample "C" well first.

  iii. Once "C" well is sampled, disconnect the air hose from the "C" well and move to "B" well

  iv. Begin purging "B" well.

  v. Sample "A" well.

  vi. Once "A" well is sampled, disconnect the air hose from the "A" well and move to "D" well.

  vii. Begin purging "D" well.

  viii. Sample "D" well.

  ix. Once "D" well is sampled, disconnect both ends of the air hose connected to "D" well.

  x. Sample "B" well.

- Typically, using the splitter to sample multiple wells at a time can make for fast paced work. Make sure to keep watch of the 5-gallon buckets used to collect/measure purged water to prevent overflow.

8. Verify the compressor has enough gasoline in its tank to perform the sampling to be done. Connect the compressor air hose to the "in" connection of the control box.
9. Verify the compression ring in the open end of the elbow joint for the tubing at the well head is in good condition. Replace if necessary.
10. Place the elbow joint and accompanying rigid tubing to the water tubing at the well head and tighten the fitting for a secure fit.
11. Place secondary containment (shallow totes or plastic sheeting) on the ground and place the 5-gallons buckets to collect the purged water within the secondary containment.
12. Prepare the sample bottles and labels for each sample to be collected.
13. Start the compressor, turn the control box on, and begin purging the well(s).
14. Purging will continue until the required volume of water has been removed (minimum 3 well volumes).
15. If the well is bailed or pumped dry during evacuation, it can and will be assumed that the purpose of removing 3 well volumes of water has been accomplished, that is, removing all stagnant water which had prolonged contact with the well casing or air. Samples will be collected as soon as sufficient water is available to facilitate sampling.
16. Once the appropriate amount of water has been purged from the well, collect a set of groundwater quality parameters:
    - Rinse the sample cup with distilled water and fill with sample water.
    - Rinse the probes with distilled water. Blot excess.
    - Immerse the probes in the sample and swirl gently, keeping the probes in the sample until the display stops flashing or readings have generally stabilized.
    - Record the water quality parameters of the sample.
    - Repeat previous steps for additional readings to be collected.
    - When finished, decontaminate the sample cup and sonde as described in SOP No. 4 Decontamination.

17. Samples for chemical analysis will be collected within 24 hours after purging is completed. For quickly recovering wells, a sample may be collected immediately after purging is completed.

    The following sampling procedure is to be used:

    a) Identification labels for sample bottles will be filled out for each well.

    b) Bottles will be kept clean and off the ground using plastic sheeting, plastic tote or similar.

    c) If collecting a sample for VOC analysis, attempt to obtain the ideal flow rate of 200-300 mL/minute. VOC sample vials should be completely filled so the water forms a convex meniscus at the top, then capped so that no air space exists in the vial. Turn the vial over and tap it to check for bubbles in the vial which indicate air space. If air bubbles are observed in the sample vial, repeat the procedure until no air bubbles appear (reattempting zero headspace within a sample vial may be performed up to 3 times prior to a new sample vial being required).

    d) After VOC sample bottles are filled, sample bottles for additional analysis should be filled in the order given below:

        - Gas sensitive parameters (e.g., ferrous iron, methane, alkalinity)
        - Semivolatiles organic compounds
        - Petroleum hydrocarbons
        - Total metals
        - Any filtered analytes (use in-line filters if possible) – about 100-1000 mL should be purged through the filter prior to sample collection.

    e) Fill bottles for metals and general minerals almost full.

    f) Time of sampling will be recorded in the field book, Toughbook/Toughpad and/or on the groundwater sampling data sheet.

    g) The well cap will be replaced and locked.

    h) Field documentation will be completed, including the chain-of-custody (SOP No. 26 Sample Control and Custody Procedures).

i) Place the sample containers on ice in a cooler to maintain the samples at approximately 4$^{o}$C as described in SOP No. 25 Sample Containers, Preservation and Holding Times.

j) Begin chain-of-custody procedures. A sample chain-of-custody form is included in SOP No. 26 Sample Control and Custody Procedures. Ship the cooler to the laboratory for analysis within 24-48 hours of sample collection in accordance with the procedures described in SOP No. 24 Sample Classification, Packaging and Shipping.

k) Decontaminate the sample equipment as summarized below and described in detail in SOP No. 4 Decontamination.

l) If a field sampling data sheet for groundwater samples will be completed with information from each sampling location, the data sheet will be completely filled in. If items on the sheet do not apply to a specific location, the item will be labeled as not applicable (NA).

m) Field notes shall be kept in a bound field book and/or the Toughbook/Toughpad. Refer to SOP No. 8 Field Reporting and Documentation for additional information.

18. Once purging and sampling is completed, either turn off the compressor, or move the air hose connection to the next week to be sampled (refer to **Step 7** above for clarification).

The well sampling order will be dependent on expected levels of contamination in each well, if known, and will be determined prior to sampling. Sampling will typically progress from lesser contaminated wells to more contaminated wells. Quality assurance/quality control (QA/QC) samples will be collected during groundwater sampling (SOP No. 23 Quality Assurance Samples).

### *4. Decontamination*

Decontamination of any reusable field/sampling equipment will be performed as described in SOP No. 4 Decontamination.

## 1. Objective

This document defines the standard operating procedure (SOP) and necessary equipment for collection of soil vapor samples from vapor monitoring points / sampling ports using stainless steel canisters for Shell projects in Hartford and Roxana, Illinois.

## 2. Equipment

The following equipment is typically needed:

- Field book
- Disposable nitrile gloves
- Cut resistant gloves
- Ultra-fine permanent marker
- Paper towels
- Decontamination equipment
- Soil vapor sampling logs
- Small brush or broom
- Charcoal filter
- 15 mL hand pump
- 60 mL syringe or equivalent
- Peristaltic pump
- Rotameter or equivalent
- Photoionization Detector (PID) (e.g., RAE Instruments MiniRAE 3000 or equivalent)
- Flame Ionization Detector (FID) (e.g., Thermo Scientific TVA-1000 or equivalent)
- Lower Explosive Limit (LEL) meter (e.g., RAE Instruments QRAE II or equivalent)
- Landfill gas detector (e.g., LANDTEC GEM-2000 or equivalent)
- Stainless steel canisters with flow controllers (supplied by the laboratory)
- 1-Liter Tedlar® bags (new or decontaminated as outlined in SOP No. 4 Decontamination) – 2 per sample

- Sample train assembly (configuration and parts shown on **Figure 1**)
- Vacuum gauge (0 – 30 inches Hg)
- Teflon® tubing (laboratory-grade) – 1/8” ID – ¼” OD
- Tygon® tubing (laboratory-grade) – 3/16” ID – 3/8” OD
- Tracer gas (e.g., Grade 5 helium)
- Tracer gas shroud (e.g., plastic tote)
- Tracer gas meter (e.g., Dielectric Technologies MGD-2002 or equivalent)
- Watch or timer
- Standard field tools (e.g., ratchet set, safety cutting tools, pry bar, etc.)
- Shipping supplies (e.g., UN boxes, shipping labels, hazard labels, packing tape)

### *3. Vapor Port Development Purging*

If the port has been newly installed, the port must be developed by purging 3 volumes of the sampling assembly including 3 volumes of the sand pack. If development is not required, proceed to **Section 4** or **Section 5** below for the appropriate sampling procedures

1. Open vapor point vault to check integrity of individual soil vapor monitoring port(s) (VMP). Each port should have a hose barb connected to a 3-way polycarbonate stopcock (3-way) using silicone tubing. The 3-way should be in the “off” position.
2. Connect peristaltic pump and Tygon tubing connected to the 3-way.
3. Connect charcoal filter exhaust to the discharge end of the tubing assembly.
4. Calculate Purge volume:
    - Vapor Port tubing (1/8-in diameter): 2.41 mL/foot (single volume)
    - Sample train assembly / Tygon® tubing (1/4-in diameter): 9.65 mL/foot (single volume)
    - Sand Pack: 18,765 mL (4.95 gallons – single volume – assuming 18 inch thick sand pack)
5. Open 3-way and begin purging port at a rate no greater than 2 L/min. Document time started.
6. Once 3 volumes are reached, stop pump and close 3-way. Document time stopped.
7. Move to next depth or replace vault cover and clean up at location.

### *4. Vapor Port Sampling – With No Tracer Gas*

To perform vapor port sampling with tracer gas shroud, proceed to **Section 5** below.

1. Set up at VMP. Turn off vehicle. If vehicle will be left running per health and safety procedures, prevent sample and sample media from being exposed to vehicle exhaust.
2. Open vapor point vault to check integrity of individual soil VMP(s). Each port should have a hose barb fitting connected to a 3-way valve using silicone tubing. The 3-way should be in the "off" position.
3. Perform stainless steel canister vacuum check, per the steps listed in **Section 6** of this SOP.
4. Remove hose barb fitting from port and set up the sample assembly using the configuration shown in **Figure 2**. The flow controller (one for each stainless steel canister provided by the laboratory) shall be connected to the stainless steel canister inlet. Do not re-use flow controllers between samples. Flow controllers can be set to different rates as specified by the project work plan, depending on size of container to be filled. For a 1-Liter stainless steel canister, approximately 5 minutes is a standard collection time (~167 ml/min).
5. Perform sample train leak check, per the steps listed in **Section 6** of this SOP.
6. Calculate Purge volume:
   - Vapor Port tubing (1/8-in diameter): 2.41 mL/foot (single volume)
   - Sample train assembly (1/4-in diameter): 9.65 mL/foot (single volume)
7. Purge the three volumes from the vapor monitoring port purge using the 60 mL syringe. If pullback is observed on the 60 mL syringe and the purge cannot be completed, the VMP screen may be saturated with water and will not yield a representative sample. If this happens, do not sample the VMP. Similarly, if water or LNAPL is observed in the syringe during the purge, do not sample the VMP. Record purge results in Toughpad and on sample sheets.
8. Remove the 3-way and connect the sample train to the VMP using Swagelok® fittings.
9. Open Port Valve and Valve #1. Use 60 mL syringe to purge 30 mL (approximately three times the volume of the sample train assembly).
10. Close Valve #1.
11. Open stainless steel canister valve completely and record the time in the Toughpad or on sample sheets.

12. Allow the canister to fill until the vacuum gauge reads between -5 and -10 inches Hg; however, an ideal sample shall be have approximately -5 inches Hg remaining after sampling is complete. For a 1-Liter canister, filling shall take approximately 5 minutes but may require more or less time depending on formation materials.[1] If the vacuum gauge reading drops below -5 inches Hg before approximately 5 minutes, close the stainless steel canister valve completely. Record the time in the Toughpad and on sample sheets.
13. Connect peristaltic pump to tubing connected to Valve #1 and open Valve #1 to collect a sample in a sample bag. The sample bag should be filled at a rate no greater than 200 ml/min. Use a rotameter to measure flow rate, and adjust pump speed to approximately 200 mL/min.
14. Disconnect the sample train from the VMP and reconnect the 3-way.
15. Disconnect flow controller, stainless steel canister, and used tubing from sample assembly.
16. From the soil vapor in the sample bag obtain readings for total volatile organics with a PID and for CO2, $CH_4$, LEL, and oxygen (O2) with a combustible gas detector. Record readings in Toughpad and on sample sheets. If FID or PID is not on-site, label and retain bag for reading at field trailer.
17. Perform stainless steel canister vacuum check, per the steps listed in **Section 6** of this SOP.
18. Setup on the next depth or replace vault cover and clean up at location.
19. Decontaminate any non-designated equipment (e.g., sample assembly) following procedures listed in **Section 7**.

## *5. Vapor Port Sampling – With Tracer Gas Shroud*

To perform vapor port sampling with no tracer gas shroud, proceed to **Section 4** above.

1. Set up at VMP. Turn off vehicle. If vehicle will be left running per health and safety procedures, prevent sample and sample media from being exposed to vehicle exhaust.
2. Open vapor point vault to check integrity of individual VMP(s). Each port should have a hose barb fitting connected to a 3-way valve using silicone tubing. The 3-way should be in the “off” position.
3. Perform stainless steel canister vacuum check, per the steps listed in **Section 6** of this SOP.

[1] Other sized canisters will take different amounts of time to sufficiently fill.

4. Remove hose barb fitting from port and set up the sample assembly using the configuration shown in **Figure 3**. The flow controller (one for each stainless steel canister provided by the laboratory) shall be connected to the stainless steel canister inlet. Do not re-use flow controllers between samples. Flow controllers can be set to different rates as specified by the project work plan, depending on size of container to be filled. For a 1-Liter stainless steel canister, approximately 5 minutes is a standard collection time (~167 ml/min).
5. Perform sample train leak check, per the steps listed in **Section 6** of this SOP.
6. Calculate Purge volume:
   - Vapor Port tubing (1/8-in diameter): 2.41 mL/foot (single volume)
   - Sample train assembly (1/4-in diameter): 9.65 mL/foot (single volume)
7. Purge the three volumes from the vapor monitoring port purge using the 60 mL syringe. If pullback is observed on the 60 mL syringe and the purge cannot be completed, the VMP screen may be saturated with water and will not yield a representative sample. If this happens, do not sample the VMP. Similarly, if water or LNAPL is observed in the syringe during the purge, do not sample the VMP. Record purge results in Toughpad and on sample sheets.
8. Remove the 3-way and connect the sample train to the VMP using Swagelok® fittings.
9. Open Port Valve and Valve #1. Use 60 mL syringe to purge 30 mL (approximately three times the volume of the sample train assembly).
10. Close Valve #1.
11. Place an enclosure shroud over the VMP and assembled sample train as shown in **Figure 3**. The shroud should have openings for:
    - Introduction of tracer gas;
    - Pressure relief to the atmosphere and access of a tracer gas monitoring device;
    - Tygon tubing to connect to the peristaltic pump for Valve #1

    The shroud should have sufficient glove access to open or close all valves within. As shown in **Figure 3**, the shroud must also be sealed to the ground with hydrated bentonite or equivalent.
12. Introduce tracer gas into the shroud at a known rate until the atmosphere within the shroud contains a sufficient quantity (typically 20% to 50%) of tracer gas.

13. Connect peristaltic pump to Valve #1 using Tygon tubing, open Valve #1, and collect sample bag #1. The sample bag should be filled at a rate no greater than 200 ml/min.
14. Close Valve #1.
15. From the soil vapor in sample bag #1, obtain readings for tracer gas with tracer gas detector. If tracer gas readings are elevated, analyze sample bag #1 using a landfill gas detector to obtain a direct methane reading. See **Section 6** for acceptance criteria.
16. Open stainless steel canister valve completely and record the time in Toughpad or on sample sheets.
17. Allow the canister to fill until the vacuum gauge reads between -5 and -10 inches Hg; however, an ideal sample shall be have approximately -5 inches Hg remaining after sampling is complete. For a 1-Liter canister, filling shall take approximately 5 minutes but may require more or less time depending on formation materials.[2] If the vacuum gauge reading drops below -5 inches Hg before approximately 5 minutes, close the stainless steel canister valve completely. Record the time in the Toughpad and on sample sheets. Record the concentration of tracer gas within the shroud after closing the canister valve.
18. Connect peristaltic pump to tubing connected to Valve #1 and open Valve #1 to collect sample bag #2. The sample bag should be filled at a rate no greater than 200 ml/min.
19. Break seal on the shroud and disconnect flow controller, stainless steel canister, and used tubing from sample assembly.
20. From the soil vapor in sample bag #2 obtain readings for total volatile organics with a PID, for $CO_2$, $CH_4$, LEL, and oxygen ($O_2$) with a landfill gas meter, and for tracer gas concentration with the tracer gas detector. See **Section 6** for acceptance criteria. Record readings in Toughpad or on field sheets. If FID or PID is not on-site, label and retain sample bag #2 for reading at field trailer.
21. Perform stainless steel canister vacuum check, per the steps listed in **Section 6** of this SOP.
22. Disconnect the sample train from the VMP and reconnect the 3-way.
23. Move to next depth or replace vault cover and clean up at location.
24. Decontaminate any non-designated equipment (e.g., sample assembly) following procedures listed in **Section 7**.

[2] Other sized canisters will take different amounts of time to sufficiently fill.

## 6. Quality Control

Quality control procedures have been developed to verify equipment integrity, sample quality, and sample repeatability.

In addition to the procedures listed below, the following items are also of concern:

- Care should be taken to keep all sampling equipment, especially the stainless steel canisters, safe from damage.
- No samples are to be collected in an area where vehicle or other equipment exhaust is being discharged. Do not place samples or sample media directly on asphalt, gravel, or other ground surfaces.

**Field Duplicates**

A field duplicate shall be collected for 10% of the samples collected.

Field duplicates are collected by using a sample assembly with an additional 3-way union. A stainless steel canister with a flow controller is attached to each of the 3-way unions on the assembly. For sampling, both stainless steel canister valves should be opened and closed simultaneously. Use the appropriate procedure described above to collect samples.

**Stainless Steel Canister Vacuum Check**

The stainless steel canister vacuum check shall be performed for 100% of the stainless steel canisters.

*Prior to Sampling*

1. Remove brass cap from stainless steel canister.
2. Attach the pressure gauge provided by the laboratory to the stainless steel canister inlet.
3. Open valve completely.
4. Record reading on the canister tag. If the canister does not show a vacuum or shows a vacuum of less than -26 inches Hg, then:
   - Label the canister tag with “Insufficient vacuum – No Sample”;
   - Set canister aside for return to the laboratory; and
   - Contact task manager and lab coordinator if canister failures affect field work.
5. Close valve completely.
6. Remove the pressure gauge.

7. If not immediately using the stainless steel canister for sample, place and tighten brass cap on stainless steel canister.

*After Sampling*

1. Attach the pressure gauge provided by the laboratory to the stainless steel canister inlet.
2. Open valve completely.
3. Record reading. There should still be a vacuum in the stainless steel canister. The final vacuum on the canister should be between -10 inches of Hg to -2 inches of Hg. If the final vacuum does not fall within this range, contact the task manager immediately to determine the value of using another stainless steel canister to recollect the sample.
4. Close valve completely.
5. Remove the pressure gauge.
6. Place and tighten brass cap on stainless steel canister.

**Sample Train Vacuum Leak Check**

The sample train leak check shall be performed for 100% of the samples collected.

1. Assemble the sampling apparatus as shown in **Figure 1**.
2. Keep the stainless steel canister closed, and Valve #1 in the "open" position.
3. Attach the 15 mL hand pump to sample train at Valve #1.
4. Withdraw air from the sampling apparatus until a vacuum between 15 and 20 inches Hg is achieved. Close Valve #1. Use flow controller's built-in vacuum gauve to observe the induced vacuum for at least five minutes. If the flow controller's vacuum gauge does not function properly, notify the task manager.
5. If the change in vacuum over five minutes is equal to or less than 0.5 inch Hg, the system leak rate is acceptable.
6. If the change in vacuum over five minutes is greater than 0.5 inch Hg, check, tighten or replace the fittings and connections and repeat the leak check.

**Tracer Gas Check**

An appropriate number of samples shall be collected using a tracer gas, as per the project work plan or activity plan.

1. Tracer gas should be introduced near the VMP to test the integrity of the probe seal and the above ground connections.

2. Collect the soil vapor sample per procedures in **Section 5**.
3. If the concentration of the tracer gas in a sample is $\leq$10% of the concentration of the tracer gas in the shroud:
   - Prior to stainless steel canister sampling: continue with sample collection.
   - Following stainless steel canister sampling: the sample is acceptable.
4. If the concentration of the tracer gas in the sample is >10% of the concentration of the tracer gas in the shroud:
   - Prior to stainless steel canister sampling: check methane levels.
     - If methane reading $\geq$2%, continue with sample collection.
     - If methane reading $\leq$2%, stop sample collection. Check fittings and valves before restarting sample collection.
   - Following stainless steel canister sampling: check methane levels.
     - If methane reading $\geq$2%, the results may be biased high by methane.
     - If methane reading <2%, sample likely compromised. Call task manager to inform of need for re-sample.
   - If a sample is found to be compromised, 2 additional attempts (3 attempts total) should be made to collect a sample.
     - With each additional attempt, visually check stainless steel tubing and fittings for holes and loose connections, and place an additional layer of bentonite seal in the interior of the well vault.
     - After 3 attempts, if a successful sample has not been collected, the VMP shall not be sampled for that quarter.

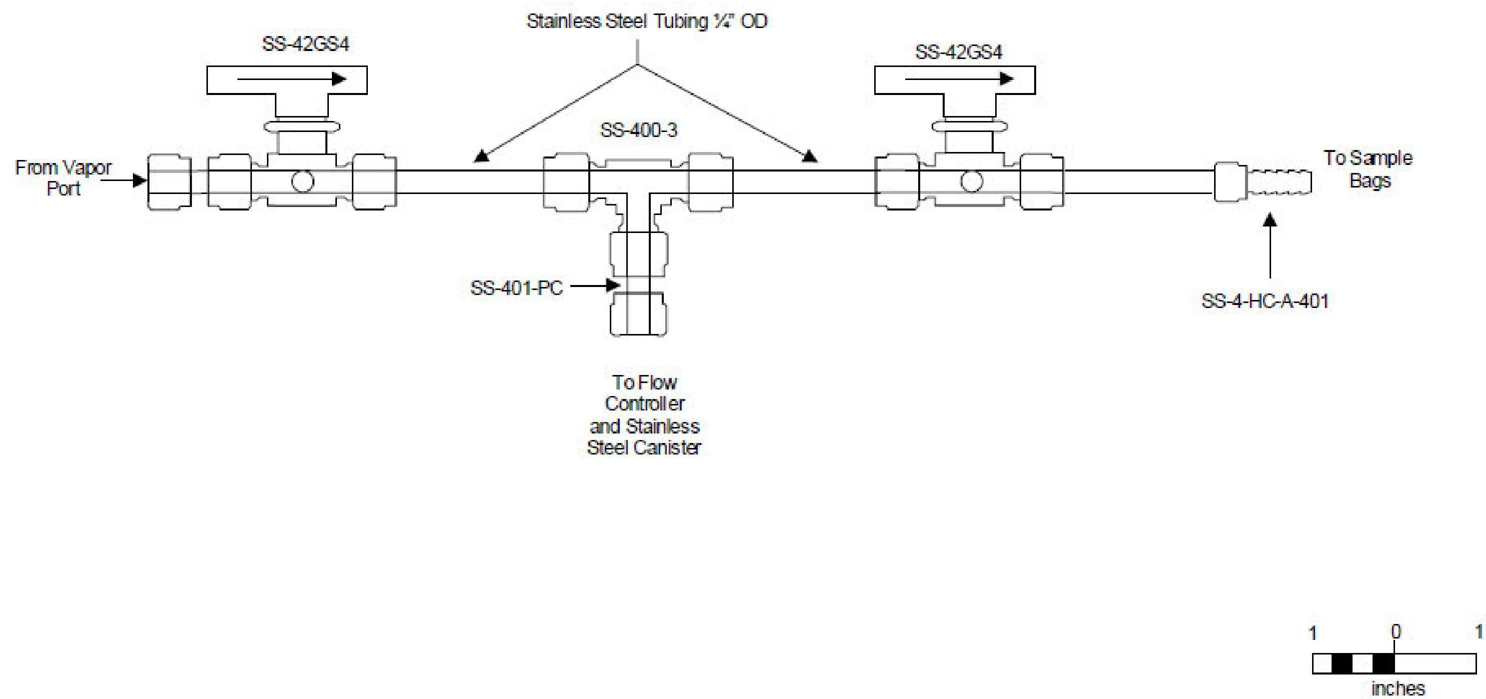
## *7. Decontamination*

- Non-designated stainless steel assemblies shall be thoroughly decontaminated by purging with at least half a liter of air (e.g., with hand pump or peristaltic pump).
- Should a stainless steel assembly come into contact with groundwater, it shall be decontaminated using a Liquinox® detergent wash followed by a distilled water rinse.
- Multiple stainless steel assemblies shall be available to sample crews to allow for equipment to be cleaned and dried sufficiently before being reused.

- Tedlar® bags may be decontaminated if it meets the criteria listed in Section 3.9 of SOP No. 4 Decontamination.

## 8. Shipping

- Sample information shall be recorded on a chain of custody for the laboratory following procedures outlined in SOP No. 26 Sample Control and Custody Procedures.
- Samples shall be shipped to the laboratory following DOT regulations. If there is the possibility that samples may be classified as hazardous, samples must be shipped as such. For procedures, see SOP No. 51 Vapor Sampling Classification, Packaging and Shipping, and check with one of the office hazardous shipping personnel.



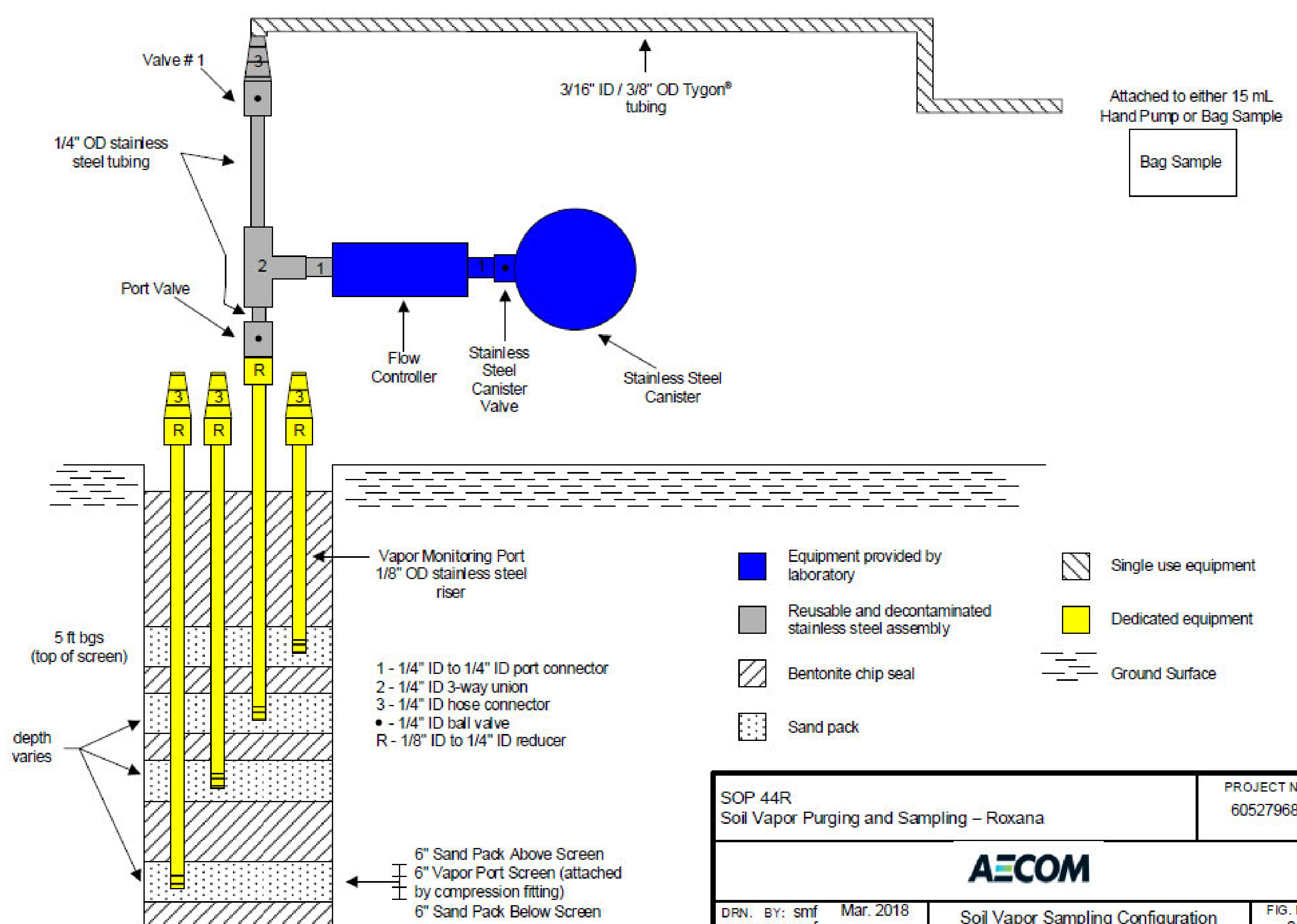

Notes:
1) All components listed with Swagelok part numbers.
2) Assembly shown for standard sample.
3) Duplicate assembly includes an additional 3-way union between the two shown.
4) All fittings shown are compression fittings with SS-400-Set ferules and SS-402-1 nuts.

Source: http://swagelok.com/products.aspx; Accessed March 23, 2018.

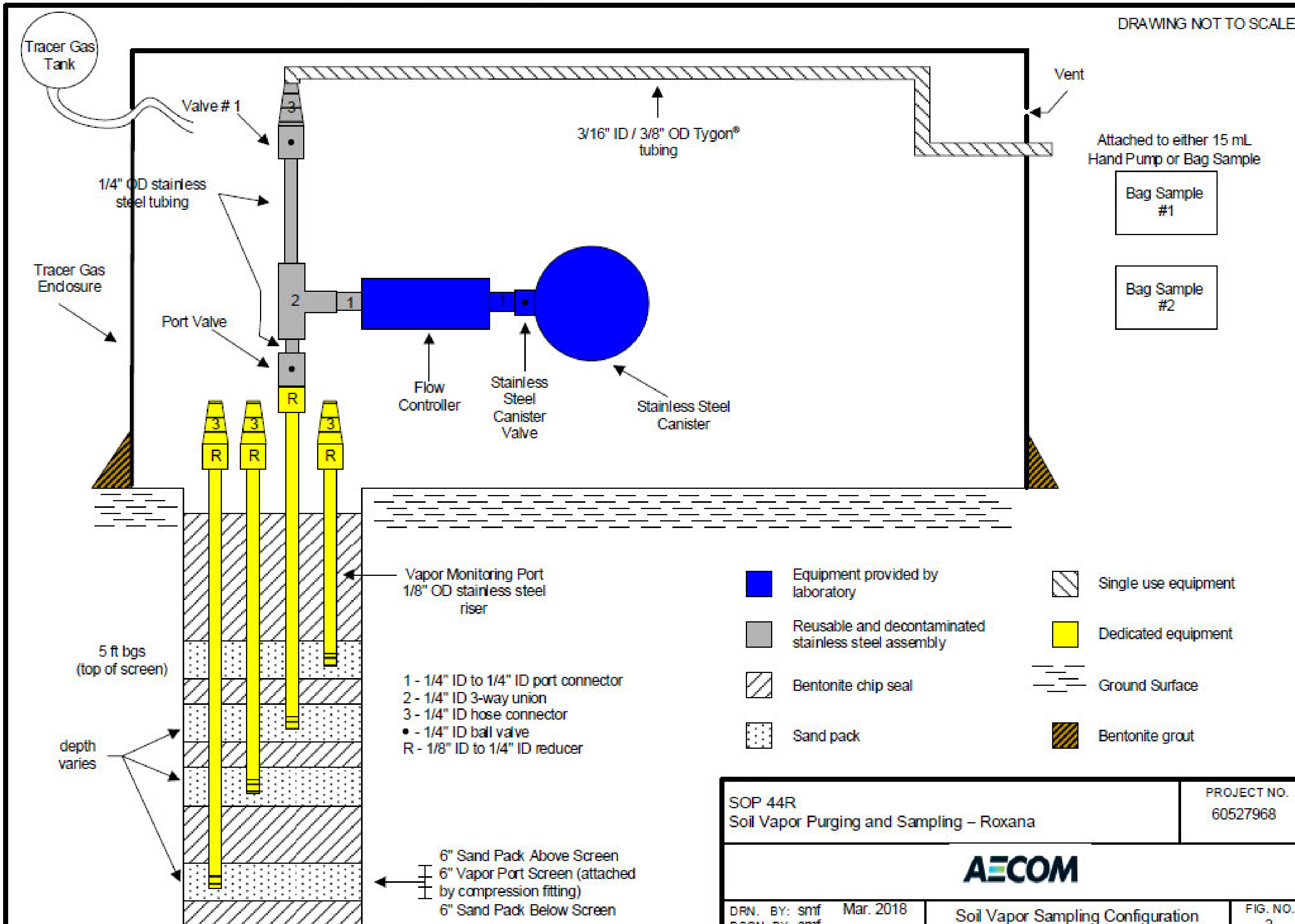
| | | |
|---|---|---|
| SOP 44R<br>Soil Vapor Purging and Sampling – Roxana | | PROJECT NO.<br>60527968 |
| AECOM | | |
| DRN. BY: smf<br>DSGN. BY: smf<br>CHKD. BY: bbb<br>Mar. 2018 | Soil Vapor Sampling Assembly | FIG. NO.<br>1 |

P:\Projects\Environmental\SHELL\01-MGMT SPT\SOPs\SOP No 44R Figure 2 - SV Configuation no Shroud_updated.vsd 3/23/2018 9:44 AM

DRAWING NOT TO SCALE




| SOP 44R<br>Soil Vapor Purging and Sampling – Roxana | | PROJECT NO.<br>60527968 |
|---|---|---|
| AECOM | | |
| DRN. BY: smf Mar. 2018<br>DSGN. BY: smf<br>CHKD. BY: bbb | Soil Vapor Sampling Configuration<br>No Tracer Gas | FIG. NO.<br>2 |




| SOP 44R<br>Soil Vapor Purging and Sampling – Roxana | | PROJECT NO.<br>60527968 |
|---|---|---|
| AECOM | | |
| DRN. BY: smf Mar. 2018<br>DSGN. BY: smf<br>CHKD. BY: bbb | Soil Vapor Sampling Configuration With Tracer Gas | FIG. NO.<br>3 |

## 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to provide a consistent methodology for data and soil vapor sample collection related to the Shell Roxana soil vapor extraction (SVE) remediation system. This SOP is applicable to:

- Collecting data from and sampling Roxana Soil Vapor Extraction (SVE) wells
- Collecting data from and sampling the West Fenceline and Public Works header lines and/or the RTO exhaust stack.

## 2. Equipment

The following equipment is typically used for SVE well data collection and sampling:

- Crow bars (2) (if needed)
- Extension cord (if needed)
- SVE Data Collection sheets and Toughbook with SVE Monitoring software
- Impact driver (or socket set) with 3/4 and 9/16 sockets (if needed)
- Oil/Water Interface probe
- Isopropyl alcohol
- Dwyer Series 475 Mark III Digital manometer (measuring appropriate range(s)), or equivalent
- Nut driver – 5/16 (if needed)
- Paper towels
- PPE
    - ANSI Class II safety vest
    - Hardhat
    - Nitrile gloves
    - Leather gloves
    - Safety glasses
    - Safety goggles (when working within Wood River Refinery (WRR))
    - Steel-toe boots
    - FRC Clothing (when working within WRR)

- Power inverter (if needed)
- Sump pump (if needed)
- Geotech® peristaltic pump (or equivalent)
- 1- Liter Tedlar® bags (new or decontaminated as outlined in SOP No. 4 Decontamination)
- Traffic barricades (orange cones)
- Tygon® tubing – 3/16" ID x 3/8" OD
- Teflon® tubing – 3/16" ID x 1/4" OD
- Black collection bag (trash bag)

The following equipment is typically used for the West Fenceline and Public Works header line and RTO exhaust stack data collection and sampling:

- Combination wrench 1/2 and 9/16 inch
- Extension cord
- Gast high flow vacuum pump
- Geotech® peristaltic pump
- Dwyer Series 475 Mark III Digital manometer (measuring appropriate range(s)), or equivalent
- 
- PPE
  - ANSI Class II safety vest
  - Hardhat
  - Nitrile gloves
  - Safety glasses
  - Safety goggles
  - Steel-toe boots
  - FRC Clothing

- Summa canister
- Pressure gauge
- Regulators (flow controllers)
- Calibrated rotameter (or equivalent)
- Sample train
- 1- Liter Tedlar® bags (new or decontaminated as outlined in SOP No. 4 Decontamination)
- Tygon® tubing – 3/16" ID x 3/8" OD
- Teflon® tubing – 1/8" ID x 1/4" OD
- Black collection bag (trash bag)

### *3. Procedures for SVE Wells*

This section provides step-by-step procedures for data collection and soil vapor sampling of SVE wells. The field data sheet or the appropriate fields in the SVE Monitoring software should be filled out completely with the appropriate observations and data collected during sampling. All applicable components of the Health and Safety Plan, including completion of Job Safety Analysis (JSA) forms, shall be followed while performing the activities described in this SOP.

Upon Arrival at Well

1. Position truck between the well to be sampled (work zone) and on-coming traffic, turn on hazard lights.
2. Place traffic cones in front of and behind the truck.
3. Unlock the well vault, remove well vault bolts, use crow bars (if needed) to release vault latch, and pry open vault lid for underground wells or open above ground well vault to access well. Engage safety latch or chain (if present) to secure vault lid in open position. Record position of main SVE valve.
4. If sufficient rain water is present in vault to impede work, use a sump pump to drain the vault.
    - If water in vault has no evidence of sheen water can be pumped to ground surface.
    - If water in vault has evidence of sheen water must be pumped into 5–gallon containers and transferred to polyethylene tank located in rear of work

vehicle. Containerized water from wells located within the refinery is transported to Site 9 in WRR for proper management. Containerized water from wells located outside the refinery is transported to Tannery property for proper management.

Sample Collection

1. Connect manometer to sample port and record the vacuum on the SVE well by connecting the appropriate digital manometer (SOP No. 53 Dwyer Digital Manometer) to the sample port of the well and turning the sample port lever to the open position. If the vacuum reading fluctuates, record the highest, lowest, and the most consistent reading.
2. Write the well ID, date, sample time, vacuum, and sampler's initials on the Tedlar® bag.
3. Connect a clean piece of disposable Tygon® tubing to the sample port of the SVE well, or use dedicated tubing if present.
4. Insert Tygon® tubing into the peristaltic pump head.
5. Connect power cord to peristaltic pump and plug into battery, vehicle cigarette lighter, or other available power source (car battery adapter).
6. Inset hard plastic (e.g. Teflon) reducer on end of Tedlar® bag which shall later connect to Tygon® tubing.
7. Turn on the peristaltic pump with sample port open to purge Tygon® tubing for approximately 10 seconds.
8. Connect Tedlar® bag to Tygon® tubing.
9. Once the Tedlar® bag is full, close valve on Tedlar® bag, turn peristaltic pump off, close sample port, remove Tygon® tubing from Tedlar® bag and sample port.
10. Place Tedlar® bag sample in black collection bag to minimize exposure to sunlight while other samples are being collected and transported to on-site screening lab.

Fluid Level Measurement

1. Turn the main SVE valve to its fully closed position, if necessary.
2. Remove the sample plug from the well cap.
3. Turn the interface probe on and lower probe into the SVE well. Record fluid levels and total depth as described in SOP No. 10 Well Gauging Measurements.

Additionally, record if the bottom surface of the well is hard or soft. Decontaminate the probe and tape as described in SOP No. 4 Decontamination.

4. Record the condition of the probe and tape upon removal (e.g. clean, visual or olfactory evidence of petroleum hydrocarbon, sludge, foam, silt) and any well defects or maintenance issues.
5. Replace the sample plug into the well cap.
6. Return the main SVE valve to its original position, if closed in Step 1 above.
7. Disengage safety latch and lower vault lid. Replace well vault bolts (if needed) and lock the well vault.
8. Load traffic cones and other equipment and move to next well location.

## *4. Procedures for the Header Lines and Exhaust Stack*

This section provides step-by-step procedures for data collection and soil vapor sampling of the Public Works and West Fenceline Headers located immediately upstream of the VLS units and the RTO Exhaust stack.

### 4.1. Data/Sample Collection at the Regenerative Thermal Oxidizer (RTO) Unit – PW and WFL Header Lines

1. Connect appropriate manometer to sample port on the header line and record the vacuum (SOP No. 53 Dwyer Digital Manometer). Write the sample ID, date, sample time, vacuum, and sampler's initials on the Tedlar® bag.
2. Connect one end of a clean piece of disposable Tygon® tubing, or dedicated tubing if present,to the header sample port and the other end to the inlet port of the Gast® high flow sample pump.
3. Connect clean section of Tygon® tubing to the outlet port of the Gast® high flow sample pump.
4. Connect power cord to Gast® high flow pump and plug into ac power source, (extension cord with GFI plugged into wall outlet)
5. Inset hard plastic reducer on end of Tedlar® bag which shall later connect to Tygon® tubing.
6. Turn on the Gast® high flow pump with sample port open and allow pump to run for approximately 10 seconds to purge the tubing.

7. Connect Tedlar® bag to Tygon® tubing on the outlet port of the Gast® high flow sample pump.
8. Once the Tedlar® bag is full, close valve on Tedlar® bag.
9. Turn Gast® high flow pump off, close sample port, and remove/dispose of Tygon® tubing from Tedlar® bag and sample port.
10. Place Tedlar® bag with sample in black collection bag to minimize exposure to sunlight while other samples are being collected and transported to on-site screening lab.

### 4.2. Summa Canister Sample Collections - PW and WFL Header Lines

*Prior to Sampling - PW and WFL Header Lines*

1. Remove brass cap from stainless steel canister.
2. Attach the pressure gauge provided by the laboratory to the stainless steel canister inlet.
3. Open valve completely.
4. Record the vacuum reading on the canister tag. If the canister does not show a vacuum or shows a vacuum of less than -26 inches of Hg, then:
   - Label the canister tag with "Insufficient vacuum – No Sample";
   - Set canister aside for return to the laboratory; and
   - Contact task manager and lab coordinator if canister failures affect field work.
5. Close valve completely.
6. Remove the pressure gauge.
7. If not immediately using the stainless steel canister for sample, place and tighten brass cap on stainless steel canister.

*Sampling - PW and WFL Header Lines*

1. Collect a Tedlar® bag sample using steps 1 through 9 from Section 4.1 above.
2. Remove brass cap, attach particulate filter and sample train to the canister using wrenches.
3. Using a clean piece of disposable silicone tubing, connect the hose barb attached to the sample train to the exhaust port on the Gast® pump.

4. Open the sample canister. Allow sample to enter the canister until the vacuum reads approximately between -5 and -10 inches of Hg. **The vacuum gauge should reach less than -10 inches Hg, but should not be allowed to drop below -2 inches of Hg.**
5. Turn off Gast® pump and close valve to the sample port.
6. Close the sample canister valve completely and remove the sample train using wrenches. Replace brass cap onto canister while leaving the particulate filter in place.
7. Close the sample port on the exhaust/header line and properly dispose of any used silicone tubing.

*After Sampling - PW and WFL Header Lines*

1. Attach the pressure gauge provided by the laboratory to the stainless steel canister inlet.
2. Open valve completely.
3. Record reading. There should still be a vacuum in the stainless steel canister. If the final vacuum reading is not between -10 and -2 inches Hg, contact the task manager or project manager immediately to determine the value of using another stainless steel canister to recollect the sample.
4. Close valve completely.
5. Remove the pressure gauge.
6. Place and tighten brass cap on stainless steel canister.

### 4.3. Data/Sample Collection at the Regenerative Oxidizer Unit – Exhaust Stack

1. Connect appropriate manometer to sample port on the exhaust stack and record the vacuum (SOP No. 53 Dwyer Digital Manometer). Write the sample ID, date, sample time, vacuum, differential pressure, and sampler's initials on the Tedlar® bag.
2. Connect a clean piece of disposable Tygon® tubing to the sample port of the exhaust stack and insert into peristaltic pump.
3. Inset hard plastic reducer on end of Tedlar® bag which shall later connect to Tygon® tubing.
4. Turn on the Geotech® peristaltic pump with sample port open. Allow pump to run for at least 60 seconds to purge the sample line.
5. Use a calibrated rotameter or equivalent to set the speed of the peristaltic pump at approximately 125mL/min to 140mL/min.
6. At the beginning of poppet valve switch, connect Tedlar® bag to Tygon® tubing.

7. After 2 cycles of poppet valve switching, close valve on Tedlar® bag,
8. Turn peristaltic pump off, close sample port, and remove/dispose of Tygon® tubing from Tedlar® bag and sample port.
9. Place Tedlar® bag with sample in black collection bag to minimize exposure to sunlight while other samples are being collected and transported to on-site screening lab.

### 4.4. Summa Canister Sample Collection – Exhaust Stack

*Prior to Sampling - Exhaust Stack*

1. Remove brass cap from stainless steel canister.
2. Attach the pressure gauge provided by the laboratory to the stainless steel canister inlet.
3. Open valve completely.
4. Record reading on the canister tag. If the canister does not show a vacuum or shows a vacuum of less than -26 inches of Hg, then:
   - Label the canister tag with "Insufficient vacuum – No Sample";
   - Set canister aside for return to the laboratory; and
   - Contact task manager and lab coordinator if canister failures affect field work.
5. Close valve completely.
6. Remove the pressure gauge.
7. If not immediately using the stainless steel canister for sample, place and tighten brass cap on stainless steel canister.

*Sampling - Exhaust Stack*

1. Collect a Tedlar® bag sample using steps 1 through 7 from **Section 4.3** above.
2. Remove brass cap, attach particulate filter and sample train to the canister using wrenches.
3. Using a clean piece of disposable silicone tubing, connect the hose barb attached to the sample train to the sample tubing on the peristaltic pump.
4. At the beginning of the poppet valve switch, open the sample canister. Allow sample to enter the canister though 2 cycles of poppet valve switching and the vacuum reads approximately between -5 and -10 inches of Hg. **The vacuum gauge should reach less than -10 inches Hg, but should not be allowed to drop below -2 inches of Hg.**

5. Close the sample canister valve completely and remove the sample train using wrenches.
6. Close the sample port on the exhaust line and properly dispose of any used silicone tubing.

*After Sampling - Exhaust Stack*

1. Attach the pressure gauge provided by the laboratory to the stainless steel canister inlet.
2. Open valve completely.
3. Record reading. There should still be a vacuum in the stainless steel canister. If the final vacuum reading is not between -10 and -2 inches Hg, contact the task manager or project manager immediately to determine the value of using another stainless steel canister to recollect the sample.
4. Close valve completely.
5. Remove the pressure gauge.
6. Place and tighten brass cap on stainless steel canister.

## 5. *Sample Screening, Classification, Packaging and Shipping*

Refer to SOP No. 51 Vapor Sample Classification, Packaging and Shipping for information related to packing and shipping samples to the laboratory for analysis, if necessary. Refer to SOP No. 52 Soil Vapor Field Laboratory Screening for information related to on-site field laboratory screening of samples collected.

## 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to provide a consistent methodology for the collection of soil vapor samples from vapor monitoring points related to the Shell Roxana Soil Vapor Extraction (SVE) system. This SOP details the necessary procedures to follow so that representative samples are collected. These procedures are applicable to any soil vapor sample collected at vapor monitoring points (VMPs). Important uses of these data include:

- SVE system performance evaluation
- Hydrocarbon plume definition

## 2. Equipment

The following equipment is typically used for sample collection.

- Dwyer Series 475 Mark III Digital manometer (or equivalent)
- 1-Liter Tedlar® bags (new or decontaminated as outlined in SOP No. 4 Decontamination)
- Tygon® or silicone tubing (or equivalent) - 3/16” ID x 3/8” OD
- Polyethylene tubing – 3/16” ID x 1/4” OD
- Peristaltic pump – 60-350 RPM
- BIOS DC-LITE flow calibrator or calibrated rotameter (0-500 mL/min)
- 60-mL syringe
- Crescent wrench (or equivalent hand tools)
- Ratchet with ½, 9/16, ¾, and 15/16 inch sockets
- Black collection bag (trash bag)
- New or dedicated 3-way micro valves for purging and sampling
- SVE System Effectiveness Monitoring Forms or Toughbook® with SVE Monitoring software

## 3. Procedures

### Initial Vacuum/Pressure Measurement

Using a Dwyer Series 475 Mark III digital manometer, the initial vacuum/pressure is measured. Basic manometer operation instructions can be found in SOP No. 53 Dwyer Digital Manometer.

At VMP monitoring locations the positive fitting of the manometer shall be connected to the VMP. The negative fitting on the manometer shall remain open to the atmosphere. The pressure and time, are immediately read and recorded to the nearest hundredth of an inch (or tenth of an inch if using 0-200 manometer) of water column on the SVE System Effectiveness Monitoring Form or Toughbook/Toughpad with SVE Monitoring software. Immediately following the recording of the vacuum/pressure measurement, the VMP shall be closed to the atmosphere.

*VMP Purging*

After obtaining the initial vacuum/pressure measurements and prior to soil vapor sample collection, each monitoring location shall be purged a predetermined amount based on the volume of the VMP riser and screen. The purge volume shall be equivalent to a minimum of three VMP volumes. The actual purge volume removed shall be recorded on the appropriate field form. If the VMP will not yield the purge volume or if water and/or light non-aqueous phase liquid (LNAPL) are encountered during purging, this observation shall be documented in the appropriate field form. The VMP screen is presumed to be submerged when this condition is encountered. No sample is to be collected and no stabilized reading is required.

To purge VMP monitoring locations, a 60-mL plastic syringe is attached to the VMP to allow the removal of the required purge volume. The syringe plunger shall be drawn back to evacuate a purge volume.

*VMP Sampling*

Upon completion of VMP purging, soil vapor sample collection using Tedlar® bags may commence. If water and/or LNAPL are encountered during sample collection, this observation shall be documented on the appropriate field form. Note that samples which indicate the presence of water and/or LNAPL shall not be analyzed.

*Tedlar® Bag Samples*

Air samples for on-site screening shall be collected using a Tedlar® bag and a peristaltic pump. For VMP monitoring locations, the inlet of the peristaltic pump tubing is attached to the VMP and the positive pressure (output) side of the peristaltic pump shall be attached to the inlet side of the flow calibrator (or rotameter) using designated tubing. Prior to flow-rate adjustment and sample collection, the sample identification, date, time of initial vacuum reading, and initial vacuum/pressure reading (if applicable) shall be clearly marked on the Tedlar® bag.

*Flow Rate Adjustment*

The rotameter[1] shall be used to adjust the flow rate of the peristaltic pump to allow a flow rate of 200 mL/minute. For VMPs, this adjustment shall be performed by observing the flow rate indicated by the ball height and adjusting the peristaltic pump to allow a flow rate of 200 mL/minute. *Notes: The initial settings on the pump should be set to allow for the minimum flow possible. It is important to set the flow rate as quickly as possible in order to minimize the amount of additional sample purge.* After setting the sample flow, sample collection shall be immediately initiated. Care shall be taken at this time to avoid unintentionally adjusting (by bumping or handling) the pump speed control.

*Sample Collection*

After setting the sample flow, the rotameter shall be removed from the sample train and a new or decontaminated, pre-labeled one-liter Tedlar® bag shall be connected to the tubing exiting from the output side of the peristaltic pump. A wire tie shall be used, if necessary, to make the connection between the bag and the pump a leak-proof fitting. Immediately open the valve on the Tedlar® bag approximately one turn. *Please note: The sample time is the same time as the acquisition of the initial vacuum/pressure reading. If a vacuum/pressure reading was not collected, the sample start time shall be documented on the appropriate field form.* Based on the flow rate to collect a 1-liter vapor sample, the peristaltic pump shall be allowed approximately five (5) minutes to collect the sample. Total sample collection time, which may exceed five (5) minutes, is dependent on the soil characteristics of the stratum from which the sample is being collected. Upon retrieval of the one-liter sample volume, close the valve on the Tedlar® bag, turn off the peristaltic pump, and leave the VMP open to the atmosphere to allow for venting. Place the sample bag in a black trash bag or container that will minimize exposure to sunlight. These samples are taken to the field laboratory for screening throughout the day (refer to SOP No. 52 Soil Vapor Field Laboratory Screening).

Duplicate samples shall be collected by repeating the procedure detailed above. The duplicate sample shall be collected immediately after the first sample (original sample) has been collected. Due to the nature of the coarse-adjustment valves that are typically installed on Tedlar® bags, the use of a sample splitter is not recommended and will often result in the collection of unequal sample volumes. Duplicate samples shall be obtained at a frequency of one per every twenty original samples collected.

*Post-Sample Collection*

Dismantle the sample train, dispose of all non-dedicated lines used for sample collection. New sample lines at each sample location shall be used, except for dedicated equipment. Non-

[1] Rotameters are checked and calibrated on an annual basis.

dedicated, reusable equipment shall be decontaminated according to SOP No 4 Decontamination.

*Venting*

Following sample collection, VMPs are vented (opened to atmosphere) for a minimum of 15 minutes. This allows for VMP stabilization to occur.

*Final (Stabilized) Vacuum/Pressure Measurement*

After venting, a final, stabilized vacuum/pressure measurement shall be recorded. A pressure is considered to be stabilized when it does not fluctuate more than 5% in one minute. The manometer shall be allowed a maximum of thirty (30) minutes to stabilize before the vacuum/pressure is recorded. If the manometer does not stabilize within the 30-minute period, the range in which the vacuum/pressure fluctuates over an additional one (1) minute period shall be documented on the appropriate field form. The highest reading observed within the observed range shall also be recorded on the appropriate field form. (*Please note: If the manometer reading fluctuates between two vacuums, the lowest vacuum observed shall be recorded on the field form. If the manometer reading fluctuates between a vacuum and a pressure, the highest pressure observed shall be recorded on the field form. If the manometer reading fluctuates between two pressures, the highest/strongest pressure observed shall be recorded on the field form. In all cases, the range in the manometer readings over the additional one-minute period shall be recorded on the field form.)*

At VMP monitoring locations, the manometer should be turned on, zeroed, and connected to the well as it was for the initial pressure. Once the pressure is stabilized the reading should be taken. The manometer can then be removed and the VMP can be closed to the atmosphere.

Note: Any monitoring location where water/LNAPL is encountered during purge or Tedlar® bag collection, where the requisite volume cannot be purged, or where the VMP screen is submerged will not have a stabilized pressure collected.

## SVE Monthly Effectiveness

| Well ID | Date | Tech | Time Arrived | Valve Position Arrival | % Open | Vacuum (in H2O) | Tedlar Sample Time | DTP | DTW | DTB | Hard/Soft Bottom | Tape Condition | Valve Position Departure | % Open | Time Left | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SVE-3R | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-4 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-5 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-6 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-7 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-8 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-9 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-10 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE 11 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-12 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-13 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-14 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-15 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-16 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-17 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-18 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-19 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-20 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-21 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-22 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-23 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-24 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-25 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-26 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-27 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-28 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-29 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |

## SVE Monthly Effectiveness

| Well ID | Date | Tech | Time Arrived | Valve Position Arrival | % Open | Vacuum (In H2O) | Tedlar Sample Time | DTP | DTW | DTB | Hard/Soft Bottom | Tape Condition | Valve Position Departure | % Open | Time Left | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SVE-30 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-31 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-32 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-33 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-34 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-35 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-36 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-37 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-38 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-39 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-40 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-41 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-42 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-43 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-44 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-45 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-46 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-47 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |

Page 2 of 2

## 1. Introduction

The purpose of this Standard Operating Procedure (SOP) is to provide a consistent methodology for the screening of soil vapor samples from the Shell projects in Hartford and Roxana, Illinois. Whenever possible, the soil vapor samples collected for the various work tasks shall be screened on the same day of collection. If same-day screening is not possible due to time constraints, instrument problems, etc., the samples shall be screened within 24-hours of sample collection. This SOP details the necessary procedures to follow in order to ensure that valid total vapor phase hydrocarbons, oxygen, methane and carbon dioxide concentration data is collected and adequately documented. These procedures are applicable to any vapor sample collected at the Roxana site, but are particularly useful for samples collected from vapor monitoring ports (VMPs), soil vapor extraction (SVE) wells, and sub-slab (SS) ports that are located throughout the Village. Important uses of these data include:

- Evaluation of indoor air or sub-slab methane concentrations
- Screening of indoor air or sub-slab petroleum hydrocarbon concentrations
- Evaluation of the performance of the Roxana Soil Vapor Extraction System.
- Evaluation of the performance of the Rand Avenue Remediation System
- Ambient air samples can either be collected and analyzed on-location using real-time instrumentation, or collected in Tedlar® bags and analyzed at a dedicated sample screening station.

## 2. Equipment

The following materials are typically used to perform sample screening, either on-site or at a dedicated sample screening station:

- Thermo Scientific TVA-1000 (TVA-1000), RAE Instruments MiniRAE 3000 (MiniRAE), and LANDTEC GEM-2000 (GEM-2000) real-time monitors (or similar);
- Calibration gas cylinders, including;
  - Methane in air at concentrations of 50; 500; 5,000, and 32,500 ppmv
  - Isobutylene in air at concentrations of 10, 50 and 1,000 ppmv
  - Hydrocarbon-free air
  - 35 percent by volume concentration CO2

- Regulators for calibration gas cylinders
- SKC sorbent tubes (part # 226-09) used for methane determination
- ¼-inch O.D. Teflon™ or Tygon™ tubing cut to length
- 10-to-1 dilution probe (Thermo Environmental Instruments Part #CR010MR)
- Disposable 3-way plastic valves used to switch the sample between methane and total hydrocarbon analyses.
- 1-liter Tedlar® bags (new or decontaminated as outlined in SOP No. 4 Decontamination)

## *3. Procedure*

The following instruments shall be used to screen soil vapor samples:

- TVA-1000 or performance equivalent for volatile organic compounds (VOCs) and methane by flame ionization detector (FID) and for VOCs by photoionization detector (PID)
- MiniRAE or performance equivalent for VOCs by PID for low-concentration samples
- LANDTEC GEM-2000 or performance equivalent for methane, lower explosive limit (LEL), oxygen and carbon dioxide.

Immediately prior to use, each instrument shall undergo a calibration check. In the event that instrument accuracy is not within 15-percent of the designated calibration check standard concentration, the instrument shall be recalibrated. Field personnel shall follow applicable instrument operation SOP's and/or manufacturer's recommended procedures for the calibration and operation of the instruments. Calibration data shall be documented on the appropriate calibration forms for each instrument.

### Calibration Procedures Applicable to All Field Screening Analyses

Instruments shall be calibrated in accordance with applicable SOPs and/or manufacturers recommended procedures immediately prior to sample screening. If the screening instruments are to be used throughout the work day, a mid-day and end-day calibration check shall be performed. Further, the TVA-1000 instrument detectors and associated dilution probe shall be bump checked (1-point accuracy check) approximately every two hours in order to document instrument stability. In the event that a bump check indicates a deviation greater than ± 15percent from the designated bump-gas concentration, a full instrument calibration shall be performed. Due to negligible (<5-percent) instrument drift throughout the day, the GEM-2000 and MiniRAE shall not undergo bi-hourly bump checks. Instead, if the GEM-2000 is used throughout the work day, calibration accuracy checks shall be conducted at approximately midday, and again at the conclusion of the sample event.

As stated above, calibration of the GEM-2000, TVA-1000, and MiniRAE shall be performed in accordance with applicable SOPs and/or manufacturer recommended procedures. However, the wide range of petroleum hydrocarbons and methane concentrations present at the site (i.e., greater than four orders-of magnitude) may be outside of the linear range of the TVA-1000 FID. To meet a primary data quality objective of the project (i.e., to quickly and accurately determine whether a potentially explosive condition is present at a sampling location), the FID calibration shall be based on a calibration standard that is approximately 10% of the LEL for methane (5,000 ppmv). However, additional QC procedures shall be implemented to ensure quality data for both hydrocarbon and methane concentrations.

The linearity of instrument response shall be verified by using 50 ppmv, 500-ppmv methane standards. If significant non-linear response (i.e., greater than 15% relative root mean square error) is observed, a nonlinear calibration curve shall be developed. The relative response factor for isobutylene (which is used here as a surrogate for petroleum vapors) shall be determined by using a 1,000 ppmv (nominal) isobutylene calibration standard. (1,000 ppmv is approximately 10% of the LEL for gasoline.)

Calibration shall be considered adequate when check standards are within +/- 15%. If the calibration check standards are outside that range, a second check standard shall be run and if the check standard fails again, the instrument shall be recalibrated and data obtained since the last check standard was successfully run shall be flagged as estimated values.

Screening of Concentrated Samples Utilizing a Dilution Probe

Because samples will need to be analyzed which are above the measurement range of the FID or which may not have sufficient oxygen content to analyze reliably, dilution of some samples shall be required prior to screening. The 10:1 dilution probe shall be calibrated using the 32,500 ppmv methane standard. Calibration of the dilution probe is considered complete when the FID response to this standard is within ± 15-percent of 3,250 ppmv.

The critical orifice in the dilution probe is density-dependent. As it will be calibrated using a 3.25% methane standard that has a density of 98.6% that of air, samples that have a density significantly different from that shall be subject to some level of deterministic error. Samples that have extremely high hydrocarbon or methane concentrations have the potential to have significantly varying densities, which can introduce significant error when the screening relies on the dilution probe. For example, error in excess of 10% will be present at concentrations of methane above 40% (if significant concentrations of petroleum hydrocarbons are not present).

Because the average density of petroleum hydrocarbon vapors is variable, the error is not as readily quantified for elevated concentrations petroleum hydrocarbons. Assuming an average density of 2.5 times that of air (i.e., density equivalent to isopentane), error in excess of 10% will be present at concentrations of petroleum hydrocarbon above 17% (if significant concentrations of methane are not present).

The density error associated with methane and heavier hydrocarbons have the potential to offset each other. Because the average density of measured hydrocarbon will not be known, data associated with an estimated error greater than 10% due to the presence of hydrocarbon or methane shall be flagged as estimated, rather than corrected for an assumed density. As the concentrations at which significant error is introduced are well above project action levels, estimated concentrations at these ranges are considered adequate to meet project data quality objectives.

Screening of Samples Utilizing a Charcoal Scrubber Tube to Filter Heavy Hydrocarbons

Use of the sorbent tube to screen out hydrocarbons other than methane affects the function of the FID instrument by lessening the flow of air through the detector. Preliminary testing indicates that a 25% to 30% reduction in instrument response occurs over the linear calibration range of the instrument. To calibrate the instrument for use of the sorbent tube, the 50, 500 and 5,000-ppmv methane standards shall be run with the sorbent tube to determine the relative response of the instrument to methane passed through the sorbent tube. The relative response factor (RRF) for each calibration standard shall be calculated as:

$$RRF = \frac{FID_{sorb}}{FID_{raw}}$$

Where;

RRF = relative response factor;

$FID_{sorb}$ = Instrument response with sorbent tube; and

$FID_{raw}$ = Instrument response to calibration standard without sorbent tube

The average RRF shall be used as a correction factor for samples analyzed using the sorbent tube. It is not necessary to correct instrument response (other than multiplying the displayed value by 10) when using the 10:1 dilution probe in conjunction with the sorbent tube. When using the dilution probe, the majority (approximately 90-percent) of the sample that is analyzed is actually dilution air that does not pass through the sorbent tube.

*4. Sample Screening*

Most soil vapor samples collected in Tedlar® bags shall be screened at a fixed location using the instrumentation noted above. The fixed location facilitates the use of the instrumentation, allows for a more stable environment in which to screen the samples, and provides adequate space in which to perform the screening and complete the associated documentation. However, to allow rapid screening of indoor air and sub-slab soil vapor, such samples can be analyzed on site, using the same field instrumentation. The calibration of these instruments, as outlined in **Section 3.0**, shall be performed in such a way that instrument response is most accurate in the concentration range that corresponds to project action levels.

The TVA-1000 has been configured with a switching device (disposable 3-way valve) to allow sample to be passed through an SKC carbon sorbent tube to remove petroleum hydrocarbons (i.e., site data indicate that the remainder will be primarily methane).

Procedures for Sample Screening On Site

- Screen air sample with GEM-2000 landfill gas analyzer. Quickly document methane, LEL, oxygen and carbon dioxide concentrations on the appropriate sample screening data sheet;
- Screen sample with the TVA-1000 PID or MiniRAE PID instrument and quickly document the concentration on the appropriate data sheet; and
- Set the TVA-1000 to sample through the SKC sorbent tube used in conjunction with the FID.

  Calculate the methane concentration as;

  $$C_{meth} = \frac{FID}{RRF};$$

  Where

  $C_{meth}$ = methane concentration (ppmv); and

  FID = FID reading (ppmv)

- Switch the TVA-1000 to sample without the sorbent tube. Screen the sample with the TVA-1000 and quickly record the vapor concentration by FID on the appropriate data sheet; and

- The hydrocarbon concentration portion of the FID response should be calculated as;

$$PHC = C_{raw} - C_{meth};$$

Where

PHC = petroleum hydrocarbon concentration (ppmv); and

$C_{raw}$ = FID reading without sorbent tube (ppmv)

Procedures for Sample Screening at a Dedicated Sample Screening Station

The sampling instrumentation for the dedicated sample screening station has been configured such that the TVA-1000 can be operated with a 10:1 dilution valve, if concentrations are outside the operational range of the FID (i.e., if there is insufficient oxygen to support the FID flame or if the sample is above the linear range of the instrument).

- Open the valve on the Tedlar® bag sample approximately one turn and attach to the inlet of the GEM-2000 landfill gas analyzer. Quickly document oxygen and carbon dioxide concentrations on the appropriate sample screening data sheet;
- Immediately connect the sample bag to the MiniRAE PID instrument and quickly document the concentration on the appropriate data sheet. If the instrument registers over range, the VOC concentration by PID shall be completed using the TVA-1000 PID;
- If the oxygen concentration in the sample is less than approximately 16-percent, configure the TVA-1000 for use with a 10-to-1 dilution probe. The dilution probe will allow for the sample to be screened by FID without flameout associated with low oxygen concentration samples. If the oxygen concentration is below 16 percent in a sample but a flameout does not occur on the TVA-1000, it should be screened without the 10-to-1 dilution probe. The dilution probe must be separately calibrated and should be used for sample screening by FID only;
- Set the TVA-1000 to sample through the SKC sorbent tube. Record the reading as the methane concentration. If the 10-to-1 dilution probe is used, the displayed concentration (FID) must be multiplied by 10;
- Switch the TVA-1000 to sample without the sorbent tube. Immediately connect the sample bag to the TVA-1000 probe inlet and quickly record the vapor concentration by FID on the appropriate data sheet. If the 10-to-1 dilution probe is used, the displayed concentration (FID) must be multiplied by 10; and

- The hydrocarbon (HC) concentration portion of the FID response should be calculated as:

$$HC = C_{raw} - C_{meth} .$$

- After screening of the Tedlar® bag sample is complete, set aside the Tedlar® bag for cleaning if it meets the decontamination criteria listed in Section 3.9 of SOP No. 04 Decontamination.

Procedures Applicable to All Sample Screening

Because concentrations of hydrocarbons in some samples are elevated, the carbon in the sorbent tube can be saturated with hydrocarbon relatively quickly. If possible, use historical data to screen samples from low hydrocarbon concentration to high hydrocarbon concentration to avoid sorbent tube saturation. Therefore, the following protocols are in place to assure quality data:

- The sorbent tube shall be replaced at least every 10 samples;
- The sorbent tube shall also be replaced, if breakthrough is observed (readily apparent) or if concentrations do not go to zero after sample is removed from analyzer inlet; and Associated sample lines (Teflon™ or Tygon™ tubing), valves, etc. shall be replaced if concentrations do not return to zero after sample is removed from analyzer inlet.

## 5. *Conclusion*

The screening of soil gas samples must be conducted in an organized and precise manner. The resultant data will be valid only if proper procedure and associated QA/QC is followed. It is imperative that personnel conducting the sample screening strictly adhere to the protocol detailed above. Because the samples are collected in 1-liter bags, the samples must be removed from the instrument inlets as soon as a stable reading can be documented. Failure to do so will result in an inadequate amount of sample volume to complete all the screening parameters. Larger bags cannot be used due to time constraints during sample collection.

## 1. Objective

This document defines the standard procedure for recovering Light Non-Aqueous Phase Liquid (LNAPL) from groundwater monitoring wells piezometers, soil vapor extraction (SVE) wells, etc. for the Shell projects in Hartford and Roxana, Illinois. This SOP serves as a supplement to information which might be in a project Work Plan and is intended to be used together with other SOPs. This SOP is not intended to be used for situations where a dedicated pump/removal system is warranted due to the amount of product.

## 2. Equipment

The following equipment is typically needed:

- Oil/Water Interface probe with 0.01-foot increments;
- Well keys;
- Hand tools;
- Photo Ionization Detector (PID);
- Lower Explosive Limit (LEL) Monitor;
- Nitrile gloves;
- Site logbook;
- Field data sheets;
- Toughbook/Toughpad (optional);
- Appropriate NAPL recovery instruments (i.e. bailers, peristaltic pump, etc.);
- Container for collecting recovered LNAPL and to measure amount recovered;
- Appropriate decontamination equipment;
- Appropriate health and safety equipment; and
- Permanent ink pen.

## 3. Groundwater/LNAPL Level Measurement Procedures

Observations made during the fluid level measurement should be recorded in the field logbook, on appropriate field forms, and/or in the appropriate program in the Toughbook/Toughpad in accordance with the procedures defined in SOP No. 8 Field Reporting and Documentation.

Appropriate personal protective equipment (PPE), as described in the Health and Safety Plan (HASP), should be worn during well opening, fluid level measurement, LNAPL recovery and decontamination. Groundwater/LNAPL level measurement procedures shall be completed in accordance with SOP No. 10 Well Gauging Measurements.

### *4. LNAPL Recovery Procedures*

When LNAPL is encountered while performing fluid level measurements, LNAPL presence should be confirmed by visual observations of the interface probe or by use of a clear plastic bailer or similar.

1. At SVE well locations, verify that the valve is closed so that the well is turned off and not under a vacuum from the SVE system.
2. Record static depths of LNAPL and groundwater and calculate the LNAPL thickness. Multiply the LNAPL thickness by the area of the inside diameter of the well casing to calculate the volume of LNAPL in the well.

| Well Diameter (in) | Gallons per Foot | Liters per Foot |
|---|---|---|
| 1 | 0.041 | 0.155 |
| 2 | 0.163 | 0.617 |
| 4 | 0.653 | 2.472 |
| 6 | 1.469 | 5.561 |

3. If the thickness of the LNAPL is measureable, but not practically recoverable (check with task manager regarding potential particular recovery thresholds), LNAPL recovery will not be attempted. If LNAPL is measureable and practically recoverable, LNAPL recovery shall be attempted.
4. If LNAPL recovery will not be performed, perform decontamination procedures in accordance with SOP No. 4 Decontamination. If LNAPL recovery is to be performed, determine the most effective and practical means of recovery by use of, but not limited to, any of the following equipment:
   a. Bailer (may be dedicated or designated to a particular well);
   b. Peristaltic pump (tubing may be dedicated or designated to a particular well);
   c. Spill Buddy™ pump, or similar;
   d. Absorbent sock.

5. Use plastic sheeting, or similar, to minimize the potential for downhole equipment, LNAPL, or recovered water coming into contact with the ground. If the primary concern is with respect to recovered material, a tub or similar may suffice.
6. If using a bailer:
7. Slowly lower a bottom-filling bailer into the well until it reaches LNAPL/groundwater interface;
    a. Pull bailer out of the well.
    b. Discharge the collected LNAPL into a designated temporary storage container[1]).
        i. If the temporary storage container is a 5-gallon bucket or similar, the bailer contents may be discharged by carefully inverting the bailer to pour the contents from the top.
        ii. If the temporary storage container is a metal gas can or similar, the bailer contents shall be discharged using a sample release device (typically included in the package with the bailer).
    c. Repeat as necessary.
8. If using a peristaltic pump, Spill Buddy™ pump, or similar:
    a. Lower the pump intake to the appropriate depth with the LNAPL thickness.
    b. Begin recovering LNAPL from the well.
9. Periodically take another depth to groundwater and depth to LNAPL reading, removing the LNAPL recovery equipment, if necessary.
10. LNAPL recovery activities should cease when one of the following has occurred:
    a. Only a sheen of LNAPL is observed within the bailer;
    b. No more LNAPL is practically recoverable (i.e., too much water also being collected); or
    c. A maximum of 30 minutes has been reached (assuming that 30 minutes is sufficient time to remove about 1 volume of the LNAPL within the well).

[1] The temporary storage container will typically be a 5-gallon bucket at the Rand Site or within the Wood River Refinery. The temporary storage container will typically be a metal gasoline can at the Roxana Site.

11. If using an absorbent sock, lower the sock into the well no deeper than the LNAPL/groundwater interface, and allow the absorbent sock to remain in the well for a predetermined amount of time, or as specified by the manufacturer. Then, pull the sock from the well, collect a LNAPL/groundwater interface reading, and dispose of the sock in an appropriate container, or squeeze the sock out into a temporary storage container, and place the sock back in the well, as manufacturers specifications allow.
12. Take a depth to groundwater and depth to LNAPL reading upon completion of LNAPL recovery activities.
13. Record all pertinent information on the LNAPL Recovery during Well Gauging field sheet (example attached). If something on the field form does not apply, that should be indicated using "NA". Include a comment regarding the reason recovery efforts were ceased (refer to Step 8 above for guidance).
14. Place disposable equipment in a plastic garbage bag for proper disposal. Decontamination of impacted equipment or PPE may be required prior to disposal. Check with the project IDW Coordinator or designee for additional information.
15. Transfer LNAPL into designated storage container (e.g., drum, lube cube, or similar) for staging pending recycling/recovery.

### *5. Documentation*

An LNAPL recovery sheet (attached) shall be completed for each well requiring LNAPL recovery. Field data sheets shall include field personnel, date, well ID, interface probe ID, Toughbook ID, initial and final fluid levels, height of LNAPL column, volume of LNAPL in well, volume of LNAPL recovered, and any additional field observations or comments. The appropriate information may also be entered into the Toughbook (as required) in the field during gauging activities. A field logbook shall also be kept during field activities describing, among other things, LNAPL recovery procedures, LNAPL recovery amounts, and other field observations. Both the data sheets and notebook shall be legibly completed using indelible ink, and shall be signed and dated by the person completing the page.

# LNAPL RECOVERY DURING WELL GAUGING

PROJECT NO: ____________________ WELL ID: ____________________

DATE: ____________________ INTERFACE PROBE ID: ____________________

PERSONNEL: ____________________ TOUGHBOOK ID: ____________________

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DEPTH TO LNAPL: ____________ ft btoc SCREEN SATURATED? Yes No

DEPTH TO WATER: ____________ ft btoc HEIGHT OF LNAPL: ____________ ft

DEPTH TO TOP OF SCREEN: ____________ ft btoc VOLUME OF LNAPL: ____________ gal

(ht * 0.041 for 1" well)
(ht * 0.163 for 2" well)
(ht * 0.653 for 4" well)

**DURING LNAPL RECOVERY:**

| Time | DTP (ft btoc) | DTW (ft btoc) | Ht of LNAPL (ft) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
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**NOTES:**

Gauge periodically during LNAPL recovery to monitor for recharge.

LNAPL recovery will continue until one of the following has occurred:
a) Only a sheen of LNAPL is observed within he bailer
b) No more LNAPL is prac ically recoverable (i.e., too much water also being collected); or
c) A maximum of 30 minutes has been reached

VOLUME RECOVERED: ____________ gal
(if amount recovered is not measurable (i.e., <0.5 gal), record "TRACE" above)

DEDICATED BAILER ESTABLISHED AT WELL? Yes No

**COMMENTS:**

# Illinois Environmental Protection Agency

Bureau of Land • 1021 North Grand Avenue East • P.O. Box 19276 • Springfield • Illinois • 62794-9276

## ILLINOIS EPA RCRA CORRECTIVE ACTION CERTIFICATION

This certification must accompany any document submitted to Illinois EPA in accordance with the corrective action requirements set forth in a facility's RCRA permit. The original and two copies of all documents submitted must be provided.

### 1.0 Facility Identification

Name: Equilon Enterprises LLC d/b/a Shell Oil Products US
County: Madison
Street Address: 900 South Central Ave
Site No. (IEPA): 1191150002
City: Roxana
Site No. (USEPA): ILD 080 012 305

### 2.0 Owner Information

Name: Not Applicable
Mail Address:
City:
State: Zip Code:
Contact Name:
Contact Title:
Phone:

### 3.0 Operator Information

Name: Equilon Enterprises LLC d/b/a SOPUS
Mail Address: 17 Junction Drive, PMB #399
City: Glen Carbon
State: IL Zip Code: 62034
Contact Name: Kevin Dyer
Contact Title: Senior Principal Program Manager
Phone: 618-288-7237

### 4.0 Type of Submission (check applicable item and provide requested information, as applicable)

- ☐ RFI Phase I Workplan/Report
- ☐ RFI Phase II Workplan/Report
- ☐ CMP Report;
- ☑ Other (describe): Standard Operating Procedures update

IEPA Permit Log No. B-43R
Date of Last IEPA Letter on Project: October 10, 2017
Log No. of Last IEPA Letter on Project: B-43R-CA-82,88,94,97

Does this submittal include groundwater information: ☐ Yes ☑ No

Date of Submittal: Feb 11, 2019

### 5.0 Description of Submittal: (briefly describe what is being submitted and its purpose)

Routine Updates to Standard Operating Procedures

### 6.0 Documents Submitted (identify all documents in submittal, including cover letter; give dates of all documents)

Cover Letter; SOPs 18 & 24

### 7.0 Certification Statement

(This statement is part of the overall certification being provided by the owner/operator, professional and laboratory in Items 7.1, 7.2 and 7.3 below). The activities described in the subject submittals have been carried out in accordance with procedures approved by Illinois EPA. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

## 7.1 Owner/Operator Certification

(Must be completed for all submittals. Certification and signature requirements are set forth in 35 IAC 702.126.) All submittals pertaining to the corrective action requirements set forth in a RCRA Permit must be signed by the person designated below (or by a duly authorized representative of that person):

1. For a Corporation, by a principal executive officer of at least the level of vice president.
2. For a Partnership or Sole Proprietorship, by a general partner or the proprietor, respectively.
3. For a Governmental Entity, by either a principal executive officer or a ranking elected official.

A person is a duly authorized representative only if:

1. the authorization is made in writing by a person described above; and
2. the written authorization is provided with this submittal (a copy of a previously submitted authorization can be used).

Owner Signature: ______________________ Date: ____________

Title: Not Applicable

Operator Signature: [signature] Date: 2/11/19

Title: Senior Principal Program Manager

## 7.2 Professional Certification (if necessary)

Work carried out in this submittal or the regulations may also be subject to other laws governing professional services, such as the Illinois Professional Land Surveyor Act of 1989, the Professional Engineering Practice Act of 1989, the Professional Geologist Licensing Act, and the Structural Engineering Licensing Act of 1989. No one is relieved from compliance with these laws and the regulations adopted pursuant to these laws. All work that falls within the scope and definitions of these laws must be performed in compliance with them. The Illinois EPA may refer any discovered violation of these laws to the appropriate regulating authority.

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44 (h))

Professional's Signature: ______________________ Date: ____________

Professional's Name Not Applicable

Address ______________________ Professional's Seal:

City ______________________

State ______ Zip Code ____________

Phone ______________________

## 7.3 Laboratory Certification (if necessary)

The sample collection, handling, preservation, preparation and analysis efforts for which this laboratory was responsible were carried out in accordance with procedures approved by Illinois EPA.

Name of Laboratory Not Applicable

______________________ Date: ____________

Signature of Laboratory Responsible Officer

Mailing Address of Laboratory

Address ______________________

City ______________________

State ______ Zip Code ____________

______________________

Name and Title of Laboratory Responsible Officer

AECOM
100 North Broadway
20th Floor
St. Louis, MO 63110
USA
aecom.com

February 11, 2019

Mr. Kenneth E. Smith, PE
Manager, Permit Section
Illinois Environmental Protection Agency
Division of Land Pollution Control
Bureau of Land
1021 North Grand Avenue East
Springfield, Illinois 62794

**Routine Updates to Previously Submitted Standard Operating Procedures**
**Equilon Enterprises LLC dba Shell Oil Products US**
**Roxana, Illinois**
**1191150002 - Madison County**
**ILD080012305**
**Log B-43R**

Dear Mr. Smith:

As part of AECOM Technical Services, Inc.'s (AECOM's) routine quality improvement process, we recently performed a review of some of the Standard Operating Procedures (SOPs) used by field staff performing activities at the investigation sites in Roxana, Illinois. Previously revised versions of SOPs have been submitted to the Illinois Environmental Protection Agency (IEPA), most recently on April 6, 2018. These procedures were originally submitted, as requested by various IEPA correspondences, within various reports and work plans related to the Investigation Site in Roxana, Illinois. We are submitting this package of updated SOPs for your reference and in accordance with proposed revisions to Sections C.7.5 and C.8.4 of the RCRA Post-Closure Permit Application[1] for the Equilon Enterprises LLC d/b/a Shell Oil Products US (SOPUS) facility at the WRB Refining LP Wood River Refinery.

The SOPs included with this submittal are listed below. The SOPs listed received editorial and formatting revisions. A summary of any additional substantive revisions made to the SOPs are included in the table below.

| SOP No | SOP Title | Purpose of Revision |
|---|---|---|
| 18 | Low-Flow Groundwater Purging and Sampling | Editorial and formatting |
| 24 | Soil and Groundwater Sample Identification, Packaging and Shipping | Editorial and formatting |

Below is an SOP summary table, which indicates the most recent revision date for each SOP for your reference.

[1] Class 1* Permit Modification – Section C Revision for SOP Reference (Log No. B-43R-CA-82, CA-88, CA-94 and CA-97) was submitted to IEPA on January 29, 2018. A response to this submittal is still pending as of the date of this submittal.

| SOP No. | SOP Title | Last Updated |
|---|---|---|
| 3 | Calibration & Maintenance of Field Instruments | 2/15/2018 |
| 4 | Decontamination | 2/15/2018 |
| 5 | Utility Clearance Procedures | 7/24/2015 |
| 8 | Field Reporting and Documentation | 4/4/2017 |
| 10 | Well Gauging Measurements | 6/22/2017 |
| 11 | Groundwater Sampling & Well Wizard Operation | 7/21/2015 |
| 12 | Grouting Procedures | 7/23/2015 |
| 14 | Headspace Soil Screening | 7/23/2015 |
| 17 | Logging | 7/23/2015 |
| 18 | Low Flow Groundwater Purging & Sampling | 2/1/2019 |
| 20 | Well Development | 7/21/2015 |
| 21 | Monitoring Well Installation | 7/24/2015 |
| 23 | Quality Assurance Samples | 4/4/2017 |
| 24 | Soil and Groundwater Sample Identification, Packaging & Shipping | 2/1/2019 |
| 25 | Sample Containers, Preservation & Holding Times | 7/23/2015 |
| 26 | Sample Control & Custody Procedures | 6/22/2017 |
| 28 | Soil Sampling | 7/24/2015 |
| 29 | Soil Probe Operation | 7/24/2015 |
| 42 | Groundwater Profiling | 7/22/2015 |
| 44R | Soil Vapor Purging & Sampling | 4/2/2018 |
| 46 | Indoor Air Sampling with Canisters | 7/23/2015 |
| 47 | Sub-slab Soil Gas Installation & Sampling with Canisters | 4/4/2017 |
| 48 | SVE Well Data Collection and Sampling | 3/6/2018 |
| 49 | SVE Effectiveness Monitoring at VMPs | 3/6/2018 |
| 51 | Vapor Sample Classification, Packaging & Shipping | 6/22/2017 |
| 52 | Soil Vapor Field Laboratory Screening | 3/6/2018 |
| 53 | Dwyer Digital Manometer | 7/23/2015 |
| 56 | LNAPL Recovery | 6/22/2017 |

Copies of this submittal are being sent separately directly to Amy Butler (IEPA, Springfield) and Gina Search (IEPA, Collinsville).

AECOM

If you have any questions, please contact Wendy Pennington at wendy.pennington@aecom.com (314-802-1196) or Bob Billman at bob.billman@aecom.com (314-802-1122).

Sincerely,

Wendy Pennington
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Robert B. Billman
Senior Project Manager
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**encl:** Revised SOPs 18 and 24
RCRA Corrective Action Certification Form

**cc:** Amy Butler (IEPA - Springfield, IL)
Gina Search (IEPA - Collinsville, IL)
Kevin Dyer (SOPUS)
Shannon Haney (Greensfelder Hemker)
Project File
Repositories (Roxana Public L brary, website)

## 1. Objective

This document defines the standard operating procedure (SOP) and typical equipment for collection of groundwater samples in monitoring wells, extraction wells, or piezometers using low-flow techniques for Shell projects in Hartford and Roxana, Illinois. The term "Low Flow" refers to the velocity that the groundwater is removed from the soil formation immediately adjacent to the well screen.

In this technique, in order to withdraw water from within the well screen and to lessen drawdown, a pump that minimizes disturbance to the groundwater is operated at a low flow rate. The well is only purged within the screened interval until specific parameters have stabilized. Therefore, the groundwater samples collected are representative of the water bearing formation and hydraulically isolated from the water in the casing. The need to purge three well volumes, as required in traditional techniques, is not necessary with low flow purging and sampling. The low flow procedure described in this SOP is not necessarily applicable for every site or for wells screened in materials with very low permeability.

## 2. Equipment

The following equipment is typically needed:

- Well construction information for well to be sampled
- Well keys
- Disposable latex or nitrile gloves
- Assorted tools (socket, screwdriver, clamps, etc.)
- New synthetic rope (to alleviate raising and lower of the submersible pump by the electrical wires)
- Pump and required accessories (described in more detail in following section)
- Deep cycle marine battery, or vehicle battery
- Electronic water level indicator or water/product interface probe with 0.01-foot increments
- Graduated cylinder, measuring cup, or similar
- Water quality instrument with appropriate sensors
- Flow-through cell

- Calibration fluids
- Paper towels or Kimwipes
- Trash bags
- Calculator
- Stopwatch
- Panasonic Toughbook®
- Bound field logbook (logbook)
- Waterproof pen and permanent marker
- Plastic buckets
- 55-gallon drums or truck-mounted tank
- Plastic sheeting or similar for clean working surface at each well (i.e. for flow thru cell, sample bottles, etc.)
- Appropriate decontamination equipment (see SOP No. 4)
- Cooler with ice
- Sample containers and labels
- Clear tape
- Groundwater sampling form
- Chain-of-Custody form
- Appropriate health and safety equipment (e.g., photoionization detector (PID))
- Canopy

### 3. Sampling Procedure

This section provides the step-by-step procedure for collecting groundwater samples in the field. Observations made during groundwater purging and sampling should be recorded in a logbook and Toughbook/Toughpad in accordance with procedures described in SOP No. 8 Field Reporting and Documentation.

The well sampling order should be dependent on expected levels of contamination in each well, if known, and should be determined prior to sampling. Sampling should progress from the least contaminated to the most contaminated well, to the extent possible. Quality assurance/quality control (QA/QC) samples should also be collected during groundwater sampling (SOP No. 23 Quality Assurance Samples).

A. Any reusable equipment used in the sampling procedure that could contact groundwater should be properly decontaminated before each use (see SOP No.4 Decontamination).

B. Equipment should be calibrated based on the manufacturers' instructions. Refer to SOP No. 3 Calibration and Maintenance of Field Instruments for additional information.

C. Before well purging begins, the following steps should be performed at each well:

- Inspect the well and surrounding site for security, damage, and evidence of tampering. If damage or tampering is evident, contact the task or project manager for guidance.
- Place clean plastic sheeting or similar in the work area near the well to keep equipment and sample bottles clean.
- Measure ambient volatile organic compounds (VOCs) background levels in the immediate vicinity of the well (i.e., using a PID or a flame ionization detector (FID) per the Health and Safety Plan (HASP).
- Remove the well cap and immediately measure VOCs at the rim of the well and record the readings in the logbook, in the Toughbook®, and on the groundwater sampling form. Give the water in the well adequate time to reach equilibrium.

D. After the well has reached equilibrium, the groundwater elevation should be measured to the nearest 1/100-foot. The total well depth and screened interval should be obtained from the well construction information. Measuring the total depth prior to sampling should be avoided to prevent resuspension of settled solids in the well casings and to minimize the necessary purge time. The total depth of the well should be confirmed after sampling has been completed, if necessary. A detailed description of monitoring well gauging activities is provided in SOP No. 10 Well Gauging Measurements.

E. Following measurement of the static groundwater elevation, the appropriate equipment will be slowly and carefully placed in the well. If the wells have light or dense non-aqueous-phase liquids (LNAPLs or DNAPLs) and are still to be sampled, care should be taken to place sampling equipment below or above the NAPL. If NAPL is encountered, contact the task or project manager for further direction.

F. Selection of the proper pump is important for low-flow sampling activities. USEPA guidance (1996) notes that dedicated sampling devices capable of purging and sampling are preferred over any other type of device. In addition, the pump must be capable of flow rates between about 50 and 500 mL per minute. A variety of portable sampling devices are available, such as bladder pumps, peristaltic pumps, electrical submersible pumps, gas-driven pumps, inertial lift foot-valve samplers (e.g. check-ball systems), and bailers. However, some of this sampling equipment has drawbacks or has been specifically rejected for low-flow sampling. The peristaltic pump can only be used for shallow applications and it can cause degassing of groundwater and loss of volatiles. Degassing results in the alteration of pH and alkalinity values as well as some loss of volatiles. Also, USEPA guidance asserts that inertial lift foot-valve type samplers and bailers cause too much groundwater disturbance and may invite unacceptable operator variability. Therefore, these sampling devices should be avoided for low-flow sampling activities.

G. Submersible pumps require a battery as a power source. If a deep cycle marine battery will be used, proceed to **Step H**. If a vehicle battery with the vehicle running will be used for an adequate power supply, the following will be performed:

- The vehicle will be positioned such that it is not over a significant amount of vegetation.
- The parking brake will be applied.
- A fire extinguisher will be staged nearby for easy access, if necessary.
- Personnel will remain in attendance of the vehicle while running so the vehicle may be promptly shut off in case of fire, etc.

H. When placing the equipment in the well, the pump intake should be set as follows. Pump placement is best measured from the top of the well down to the pump. Lowering the pump to the bottom of the well and pulling it up the required distance will cause agitation of the sediment and create unnecessary turbidity in the water.

   a. If the well screen is ≤ 10 feet, place the pump intake near the midpoint of the well screen or water column, whichever is deeper.

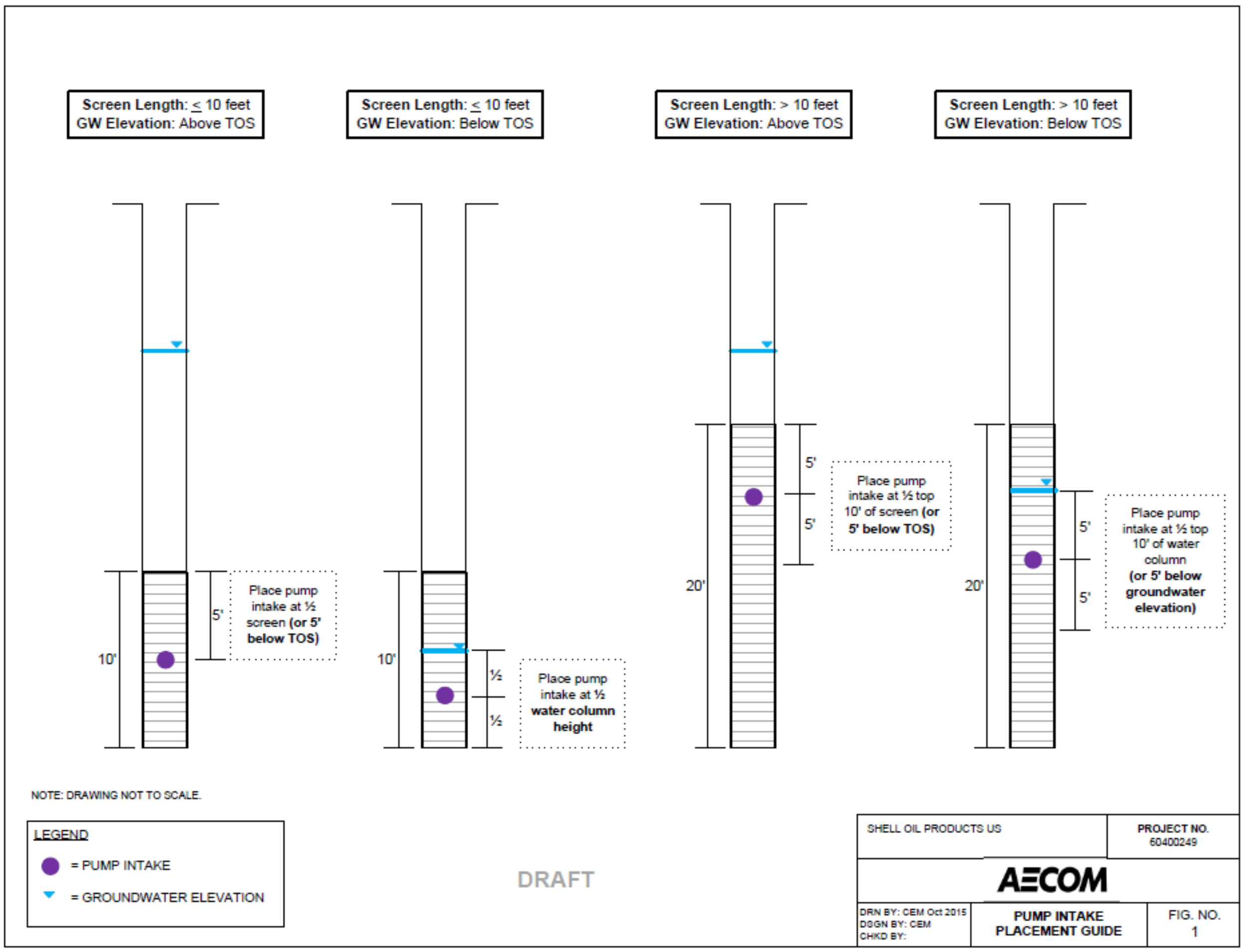
- *Pump intake (saturated screen) = depth to top of screen + ½ screen length*
- *Pump intake (open screen) = depth to top of water + ½ water column height*

b. If the well screen is > 10 feet, place the pump intake near the midpoint of the upper 10 feet of the well screen or water column, whichever is deeper.

- *Pump intake (saturated screen) = depth to top of screen + 5 feet*
- *Pump intake (open screen) = depth to top of water + 5 feet*

*(if water column height is <10 feet, + ½ water column height)*

c. In situations in which contaminants of interest are known to concentrate in a certain location of the screened zone (i.e. at the bottom), it may be desirable to position the pump intake to target this zone instead.



I. Tubing should be connected from the pump to a flow-through cell. Then, calculate the volume of water to fill the flow-through cell. According to American Society for Testing and Materials (ASTM) Standard D 6771 (2002), the frequency of measurements should be equal to the time required to completely evacuate one volume of the cell (minimum). This ensures that independent measurements are made.

J. The pump should be started at a low flow rate, approximately 50 to 100 mL/min or the lowest flow rate possible. The pumping rate can be increased up to 500 mL/min as long as significant drawdown does not occur (200 to 300 mL/min is the optimum flow rate for sampling VOCs).

K. Water level measurements should continue as calculated until the measurements indicate that significant drawdown is not occurring. According to ASTM standards (2002), allowable drawdown should never exceed the distance between the top of the well screen and the pump intake. Including a safety factor, also provided by ASTM, drawdown should actually not exceed 25% of this distance. This ensures that water stored in the casing is not purged or sampled. For example, for a 4-foot screen (saturated), the pump should be placed at the midpoint of the screen (two feet from the top of the screen to the pump intake). With a safety factor of 25%, this would require drawdown not to exceed six inches.

   If drawdown surpasses 25% of the distance from the pump intake to the top of the screen even while pumping is occurring at the lowest flow rate possible, samplers should refer to project specific criteria.

   If drawdown is encountered in exceedance of the above scenario and does not stabilize, contact the task or project manager for further guidance.

L. Allow water to flow through the flow-through cell. Parameter readings should be documented on the groundwater sampling form, in the logbook and/or in the Toughbook/Toughpad. The time between parameter measurements is calculated as follows:

$$T = \frac{V}{Q}$$ , where

$T$ = time between measurements (minutes)

$V$ = volume of the flow-through cell (liters)

$Q$ = purge flow rate (liters per minute)

M. Sampling should be in accordance with a Work Plan or other project specific documentation or approved Agency correspondence. However, in most cases, purging will continue until specific parameters have stabilized over three consecutive flow-through cell volumes or until a specific time requirement is met, whichever happens first. **Table 1** provides guidelines that may be used for parameter stabilization as specified by USEPA, ASTM, and in the Nielsen and Nielsen Technical Guidance on Low-Flow Purging and Sampling and Minimum-Purge Sampling (Nielsen and Nielsen, 2002). These guidelines are to be used in combination with professional judgment. **Table 2** provides the guidelines to be used for groundwater sampling activities on Shell projects. **Table 2** combines relevant stabilization guidelines from **Table 1** in combination with limitations in accuracy for readings collected by the Troll9500 (typical low flow equipment used on the Shell groundwater projects).

**Table 1. Stabilization Guidelines for Low-Flow Sampling**

| Parameter | Stabilization Guidelines | | |
|---|---|---|---|
| | **EPA** | **ASTM** | **Nielsen & Nielsen** |
| DO | +/- 10% | +/- 10% or +/-0.2 mg/L, whichever is greatest | +/- 10% or +/-0.2 mg/L, whichever is greatest |
| ORP | +/- 10 mV | +/- 20 mV | +/- 20 mV |
| PH | +/- 0.1 units | +/- 0.2 units | +/- 0.2 units |
| Specific Conductivity | +/- 3% | +/- 3% | +/- 3% |
| Temperature | Not Specified | Not Specified | +/- 0.2 ºC |
| Turbidity | +/- 10% | Not Specified | Not Specified |

**Table 2. Stabilization Guidelines used for GW Sampling**

| Parameter | Stabilization Guidelines (using above standards combined with Troll9500 accuracies) |
|---|---|
| DO | +/- 10% or +/-0.2 mg/L, whichever is greatest |
| ORP | +/- 20 mV |
| PH | +/- 0.2 units |
| Specific Conductivity | +/- 5% or +/-2µs/cm |
| Temperature | Not Specified; Monitor and record |
| Turbidity | Visually Sediment Free, when practical; Monitor and record |

N. After the relevant parameters have stabilized, the flow-through cell should be disconnected or bypassed for sampling. If, after a considerable number of readings have been taken, parameters have not stabilized, samplers should contact the task or project manager for further guidance. For Rand and Roxana GW sampling activities, contact the Task Manager after two hours of purging for further guidance.

O. A canopy or modified sampling order should be utilized, as feasible, in an effort to shield the flow-through cell from the weather and elements that may interfere with stabilization parameter readings (i.e. sun and wind). When temperature is not being used as a stabilization parameter, care should still be taken to shield the flow-through cell from the sun so temperature can more accurately be monitored for anomalous readings.

P. A new pair of disposable latex or nitrile gloves should be put on immediately before sampling.

Q. Verify sample bottles, including lids and seals, are intact. This can be done by removing and replacing bottle lid and also inspecting lid for presence of seal, if applicable.

R. During sampling, the sample shall be collected directly from the tubing (e.g. sample shall not flow through the flow-through cell while filling bottle sets), do NOT allow the sample tubing to come into contact with the sample bottles, and do NOT place sample bottles on the ground (e.g., place bottles in plastic tub or similar).

S. The constituents should be sampled for in the order given below:

- VOCs – Vials should be filled completely so that the water forms a convex meniscus then capped so that no air space exists in the vial. Turn the vial over and tap it to check for bubbles. If air bubbles are observed in the sample vial, remove the lid and attempt to fill the vial two more times, (being careful not to dump out any groundwater currently in the vial). If air bubbles are present twice more, discard the sample vial and repeat the procedure with a new vial. If, after three attempts, air bubbles are still in the vial, make a note of this and place the vial in the cooler.
- Gas sensitive parameters (e.g., ferrous iron, methane, alkalinity)
- Semivolatile organic compounds, pesticides, polychlorinated biphenyls, and herbicides
- Petroleum hydrocarbons
- Metals (unfiltered)
- Explosives
- Any filtered analytes (use in-line filters if possible) – About 100-1000 mL should be purged through the filter prior to sample collection

T. Check sample bottle cap tightness and verify the lid of the sample bottle is not cross threaded.

U. Wipe off sample bottles to remove any dirt, moisture and/or contamination that may have become adhered to the outside of the bottle.

V. Label each sample bottle. Each sample should be identified with the Sample ID, location, analysis number, preservatives, date and time of sampling event, and sampler.

W. Place all samples on ice in a cooler to maintain the samples at approximately 4oC as described in SOP No. 25 Sample Containers, Preservation and Holding Times.

X. The sample time and constituents to be analyzed for should be recorded in the logbook, in the Toughbook®, and on the groundwater sampling form.

Y. Chain-of-custody procedures should be started (SOP No. 26 Sample Control and Custody Procedures).

Z. Ship the cooler to the laboratory for analysis within 24-48 hours of sample collection in accordance with the procedures described in SOP No. 24 Sample Classification, Packaging and Shipping.

AA. Sample equipment should be decontaminated (SOP No. 4 Decontamination).

BB. PPE and other disposable supplies will be collected within a trash bag and disposed appropriately. Check with IDW Coordinator for further instructions.

## 4. References

ASTM 2002, Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations, ASTM D6771-02, American Society for Testing and Materials. West Conshohocken, PA.

Nielsen, David and Nielsen, Gillian. Technical Guidance on Low-Flow Purging and Sampling and Minimum-Purge Sampling. Second Edition. NEFS-TG001-02. April 2002.

USEPA. 1996. Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. EPA/540/S-95/504. OSWER, April 1996.

## 1. Objective

This document defines the standard protocols for soil and groundwater sample identification, labeling, packaging, and shipping for Shell projects in Hartford and Roxana, Illinois. This SOP serves as a supplement to work plan, sampling and analysis plan or other project documentation, and is intended to be used together with several other SOPs.

## 2. Equipment

The following equipment is typically needed for sample identification, packaging and shipping:

- Chain of custody form
- Sample bottles (laboratory provided)
- Sample labels
- Water proof pen or similar
- Trash bag or similar for lining cooler
- Bubble wrap
- Ice
- Re-sealable storage bags
- Custody seal
- Clear packing tape
- Shipping label
- Waterproof cooler

## 3. Procedures

### Sample Identification

Samples collected during site activities shall have discrete and site specific sample identification code (ID). These sample IDs are necessary to identify and track each of the many samples collected for analysis during the life of project. In addition, the sample IDs can be used in a database to identify and retrieve the analytical results received from the laboratory.

Each sample is identified by a unique code which indicates the specific project, site identification, sample location number, sample matrix identifier, sample depth, and/or date. If used, sample matrix identifiers may include the following:

GP - Geoprobe

GWP - Groundwater Profile

PZ - Piezometer

MW - Monitoring Well

CPT – Cone Penetrometer Testing

ROST - Rapid Optical Screening Tool

VMP - Vapor Monitoring Point

TB - Trip Blank

EB - Equipment Blank

DUP - Duplicate Sample

MS - Matrix Spike Sample

MSD - Matrix Spike Duplicate Sample

An example of the sample identification number codes for a groundwater monitoring well sample collected for field analysis for the Shell Sites will be:

MW13-PROJ-070713-EB.

Where "MW" indicates Monitoring Well, "13" indicates the well location, "PROJ" indicates the abbreviated project name (ROX, WRR, etc.), "070713" indicates the date, and "EB" indicates an equipment blank.

The project abbreviation, sample sequence, sampling locations, and sample type will be established prior to field activities for each sample to be collected. On-site personnel will obtain assistance from the Task or Project Manager in defining any special sampling requirements.

***Sample Labeling***

Sample labels will be filled out as completely as possible by a designated member of the sampling team prior to beginning field sampling activities each day. The date, time, sampler initials/signature should not be completed until the time of sample collection. All sample labels shall be filled out using waterproof ink, preferably black. Below is information typically included on a sample label:

- Sampler's company affiliation
- Project/Site location

- Sample identification code
- Date and time of sample collection
- Analyses required
- Method of preservation or preservative (if any)
- Sample matrix (i.e., soil, groundwater, surface water)
- Sampler's signature or initials.

The sample bottle will be wiped off to remove any dirt, moisture and/or contamination that may have become adhered to the outside of the bottle. Labels will be affixed to the sample bottle(s). Clear tape will be applied in order to keep the label attached to the sample and to keep the label legible. If waterproof or weatherproof labels are used to label sample bottles, clear tape is NOT required. If a sample bottle displays a tared weight from the laboratory, clear tape will NOT be used.

***Sample Packaging and Shipping***

For packaging and shipping of air or soil vapor samples, refer to SOP No. 51 Vapor Sampling Classification, Packaging and Shipping. For packaging and shipping of LNAPL samples, refer to SOP No. 58 Westhollow LNAPL Sampling. Below describes packaging and shipping procedures for water and soil samples.

After sample collection, each container will be labeled as described above, and then stored on ice at 4°C (+/- 2°C) in an insulated cooler until packed for shipment to the laboratory. Coolers will be lined with a trash bag or similar and either the ice or the sample bottles will be bagged in sealed storage bags, or as otherwise recommended by the laboratory.

Caps of sample bottles will be checked for proper tightness and to verify the lid of the sample bottle is not cross threaded. Sample bottles will be wiped off to remove any dirt, moisture and/or contamination that may have become adhered to the outside of the bottle. To the extent possible, the sample containers will be placed in re-sealable storage bags and wrapped in protective packing material (bubble wrap). Samples will then be placed right side up in a lined cooler with ice and a completed chain-of-custody (COC) form (placed in a separate zip-locked bag). The COC may be specific to the samples included within each shipping container or may be comprehensive of all samples collected during a particular day/sampling period, regardless of the number of shipping containers.

A custody seal will be placed over the lid and body of the cooler on the side from which the cooler is opened. The cooler will be wrapped with clear packing tape, including over the custody seal, for delivery to the laboratory. Samples will be hand delivered or shipped by overnight express carrier for delivery to the analytical laboratory. All samples must be shipped for laboratory receipt and analyses within specific holding times. This may require daily shipment of samples with short holding times. The temperature of all coolers will be measured upon receipt at the laboratory. A temperature blank may be included in each cooler for temperature measurement purposes, per laboratory specific requirements.

***Sample Documentation and Tracking***

***Field Notes -*** Documentation of observations and data acquired in the field will recorded on field sampling sheets, in a bound field logbook and/or in a Toughbook/Toughpad to provide a permanent record of field activities. Refer to SOP No. 8 Field Reporting and Documentation for additional information.

***Sample Chain-of-Custody -*** During field sampling activities, traceability of the sample must be maintained from the time the samples are collected until laboratory data are issued. The sampling team member(s) will be responsible for initiating and filling out the COC form during sample collection. Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form. The COC should contain project and sample specific information. Sample labels should be checked against the COC to ensure everything intended for analysis is listed on the COC.

A member of the sampling crew will sign the COC form over to the person or party responsible for delivery of the samples to the laboratory, retain a copy of the COC form, document the method of shipment, and send the original COC form with the samples. Additionally, an electronic copy of the COC should be forwarded to applicable project contacts (e.g., task manager, project chemist, etc.). Each time custody of the samples is transferred, the COC should be signed by both parties. Refer to SOP No. 26 Sample Control and Custody Procedures for additional information about COCs.

# Illinois Environmental Protection Agency

Bureau of Land • 1021 North Grand Avenue East • P.O. Box 19276 • Springfield • Illinois • 62794-9276

## ILLINOIS EPA RCRA CORRECTIVE ACTION CERTIFICATION

This certification must accompany any document submitted to Illinois EPA in accordance with the corrective action requirements set forth in a facility's RCRA permit. The original and two copies of all documents submitted must be provided.

### 1.0 Facility Identification

Name Equilon Enterprises LLC d/b/a Shell Oil Products US
County Madison
Street Address 900 South Central Ave
Site No. (IEPA) 1191150002
City Roxana
Site No. (USEPA) ILD 080 012 305

### 2.0 Owner Information

Name Not Applicable
Mail Address
City
State
Zip Code
Contact Name
Contact Title
Phone

### 3.0 Operator Information

Name Equilon Enterprises LLC d/b/a SOPUS
Mail Address 17 Junction Drive, PMB #399
City Glen Carbon
State IL
Zip Code 62034
Contact Name Kevin Dyer
Contact Title Senior Principal Program Manager
Phone 618-288-7237

### 4.0 Type of Submission (check applicable item and provide requested information, as applicable)

☐ RFI Phase I Workplan/Report
IEPA Permit Log No. B 43R

☐ RFI Phase II Workplan/Report
Date of Last IEPA Letter on Project October 10, 2017

☐ CMP Report;
Log No. of Last IEPA Letter on Project B-43R CA-82,88,94,97

☑ Other (describe):
Does this submittal include groundwater information: ☐ Yes ☑ No

Standard Operating Procedures update

Date of Submittal Sep 24, 2019

### 5.0 Description of Submittal: (briefly describe what is being submitted and its purpose)

Routine Standard Operating Procedure Revisions; SOPs 3, 4, 8, 10, 18, 20, 23, 24, 25, 26, 44R, 49, 51, 52, 53 and 56

### 6.0 Documents Submitted (identify all documents in submittal, including cover letter; give dates of all documents)

Cover Letter; Revised SOPs

### 7.0 Certification Statement

(This statement is part of the overall certification being provided by the owner/operator, professional and laboratory in Items 7.1, 7.2 and 7.3 below). The activities described in the subject submittals have been carried out in accordance with procedures approved by Illinois EPA. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

IEPA RCRA Corrective Action Certification
For: Equilon Enterprises LLC dbaSOPUS
Date of Submission: September 24, 2019

## 7.1 Owner/Operator Certification

(Must be completed for all submittals. Certification and signature requirements are set forth in 35 IAC 702.126.) All submittals pertaining to the corrective action requirements set forth in a RCRA Permit must be signed by the person designated below (or by a duly authorized representative of that person):

1. For a Corporation, by a principal executive officer of at least the level of vice president.
2. For a Partnership or Sole Proprietorship, by a general partner or the proprietor, respectively.
3. For a Governmental Entity, by either a principal executive officer or a ranking elected official.

A person is a duly authorized representative only if:

1. the authorization is made in writing by a person described above; and
2. the written authorization is provided with this submittal (a copy of a previously submitted authorization can be used).

Owner Signature: ____________________ Date: __________

Title: Not Applicable

Operator Signature: Kevin E Kelger Date: 9/23/19

Title: Senior Principal Program Manager

## 7.2 Professional Certification (if necessary)

Work carried out in this submittal or the regulations may also be subject to other laws governing professional services, such as the Illinois Professional Land Surveyor Act of 1989, the Professional Engineering Practice Act of 1989, the Professional Geologist Licensing Act, and the Structural Engineering Licensing Act of 1989. No one is relieved from compliance with these laws and the regulations adopted pursuant to these laws. All work that falls within the scope and definitions of these laws must be performed in compliance with them. The Illinois EPA may refer any discovered violation of these laws to the appropriate regulating authority.

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44 (h))

Professional's Signature: ____________________ Date: __________

Professional's Name Not Applicable

Address ____________________ Professional's Seal:

City ____________________

State _____ Zip Code __________

Phone ____________________

## 7.3 Laboratory Certification (if necessary)

The sample collection, handling, preservation, preparation and analysis efforts for which this laboratory was responsible were carried out in accordance with procedures approved by Illinois EPA.

Name of Laboratory Not Applicable

____________________ Date: __________

Signature of Laboratory Responsible Officer

Mailing Address of Laboratory

Address ____________________

City ____________________

State _____ Zip Code __________

____________________

Name and Title of Laboratory Responsible Officer

AECOM
100 North Broadway
20th Floor
St. Louis, MO 63110
USA
aecom.com

September 24, 2019

Mr. Kenneth E. Smith, PE
Manager, Permit Section
Illinois Environmental Protection Agency
Division of Land Pollution Control
Bureau of Land
1021 North Grand Avenue East
Springfield, Illinois 62794

**Routine Standard Operating Procedure Revisions**
**SOPs Nos. 3, 4, 8, 10, 18, 20, 23, 24, 25, 26, 44R, 49, 51, 52, 53 and 56**
**Equilon Enterprises LLC dba Shell Oil Products US**
**Roxana, Illinois**
**1191150002 - Madison County**
**ILD080012305**
**Log B-43R**

Dear Mr. Smith:

As part of AECOM Technical Services, Inc.'s (AECOM's) routine quality improvement process, we recently performed a review of some of the Standard Operating Procedures (SOPs) used by field staff performing activities at the investigation sites in Roxana, Illinois. Previously revised versions of SOPs have been submitted to the Illinois Environmental Protection Agency (IEPA), most recently on February 12, 2019. These procedures were originally submitted, as requested by various IEPA correspondences, within various reports and work plans related to the Investigation Site in Roxana, Illinois. We are submitting this package of updated SOPs for your reference and in accordance with proposed revisions to Sections C.7.5 and C.8.4 of the RCRA Post-Closure Permit Application[1] for the Equilon Enterprises LLC d/b/a Shell Oil Products US (SOPUS) facility at the WRB Refining LP Wood River Refinery.

The SOPs included with this submittal are listed below. The SOPs listed below were revised as indicated.

| SOP No | SOP Title | Purpose of Revision |
|---|---|---|
| 3 | Calibration & Maintenance of Field Instruments | Editorial and formatting |
| 4 | Decontamination | Editorial and formatting; Clarification of tedlar bag decontamination |
| 8 | Field Reporting and Documentation | Editorial and formatting |
| 10 | Well Gauging Measurements | Editorial and formatting |
| 18 | Low-Flow Groundwater Purging and Sampling | Editorial and formatting; Clarification of pump placement and decontamination |

[1] Class 1* Permit Modification – Section C Revision for SOP Reference (Log No. B-43R-CA-82, CA-88, CA-94 and CA-97) was submitted to IEPA on January 29, 2018. A response to this submittal is still pending as of the date of this submittal.

AECOM

| SOP No | SOP Title | Purpose of Revision |
|---|---|---|
| 20 | Well Development or Redevelopment | Editorial and formatting; Revision of procedure due to change in equipment to be used |
| 23 | Quality Assurance Samples | Editorial and formatting |
| 24 | Soil and Groundwater Sample Identification, Packaging and Shipping | Editorial and formatting |
| 25 | Sample Containers, Preservation & Holding Times | Editorial and formatting |
| 26 | Sample Control & Custody Procedures | Editorial and formatting |
| 44R | Soil Vapor Purging & Sampling | Editorial and formatting; Revision due to use of quick-connect fittings |
| 49 | SVE Effectiveness Monitoring at VMPs | Editorial and formatting |
| 51 | Vapor Sample Classification, Packaging & Shipping | Editorial and formatting |
| 52 | Soil Vapor Field Laboratory Screening | Editorial and formatting |
| 53 | Dwyer Digital Manometer | Editorial and formatting |
| 56 | LNAPL Recovery | Editorial and formatting |

Below is an SOP summary table, which indicates the most recent revision date for each SOP for your reference.

| SOP No. | SOP Title | Last Updated |
|---|---|---|
| 3 | Calibration & Maintenance of Field Instruments | 9/6/19 |
| 4 | Decontamination | 9/6/19 |
| 5 | Utility Clearance Procedures | 7/24/2015 |
| 8 | Field Reporting and Documentation | 9/24/19 |
| 10 | Well Gauging Measurements | 9/13/19 |
| 11 | Groundwater Sampling & Well Wizard Operation | 7/21/2015 |
| 12 | Grouting Procedures | 7/23/2015 |
| 14 | Headspace Soil Screening | 7/23/2015 |
| 17 | Logging | 7/23/2015 |
| 18 | Low Flow Groundwater Purging & Sampling | 9/23/19 |
| 20 | Well Development | 8/28/19 |
| 21 | Monitoring Well Installation | 7/24/2015 |
| 23 | Quality Assurance Samples | 9/13/19 |
| 24 | Soil and Groundwater Sample Identification, Packaging & Shipping | 9/13/19 |
| 25 | Sample Containers, Preservation & Holding Times | 9/20/19 |

| SOP No. | SOP Title | Last Updated |
|---|---|---|
| 26 | Sample Control & Custody Procedures | 9/20/19 |
| 28 | Soil Sampling | 7/24/2015 |
| 29 | Soil Probe Operation | 7/24/2015 |
| 42 | Groundwater Profiling | 7/22/2015 |
| 44R | Soil Vapor Purging & Sampling | 9/23/19 |
| 46 | Indoor Air Sampling with Canisters | 7/23/2015 |
| 47 | Sub-slab Soil Gas Installation & Sampling with Canisters | 4/4/2017 |
| 48 | SVE Well Data Collection and Sampling | 3/6/2018 |
| 49 | SVE Effectiveness Monitoring at VMPs | 8/28/19 |
| 51 | Vapor Sample Classification, Packaging & Shipping | 9/20/19 |
| 52 | Soil Vapor Field Laboratory Screening | 8/29/19 |
| 53 | Dwyer Digital Manometer | 8/29/19 |
| 56 | LNAPL Recovery | 9/20/19 |

Copies of this submittal are being sent separately directly to Amy Butler (IEPA, Springfield) and Gina Search (IEPA, Collinsville).

If you have any questions, please contact Wendy Pennington at wendy.pennington@aecom.com (314-802-1196) or Bob Billman at bob.billman@aecom.com (314-802-1122).

Sincerely,

Wendy Pennington
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**encl:** Revised SOPs 3, 4, 8, 10, 18, 20, 23, 24, 25, 26, 44R, 49, 51, 52, 53, 56
RCRA Corrective Action Certification Form

**cc:** Amy Butler (IEPA - Springfield, IL)
Gina Search (IEPA - Collinsville, IL)
Kevin Dyer (SOPUS)
Dan Kirk (SOPUS)
Shannon Haney (Greensfelder Hemker)
Project File
Repositories (Roxana Public L brary, website)

## 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to define the procedure for calibration and maintenance of field instruments frequently used during environmental field activities for the Shell projects in Hartford and Roxana, Illinois. This SOP gives descriptions of the most commonly used of these instruments and field procedures to calibrate and maintain these field instruments. Calibration and maintenance records are maintained with the project file.

## 2. Other SOPs referenced in this SOP

- SOP No. 4 – Decontamination

## 3. Equipment

The following equipment is typically required during field instrument calibration and maintenance activities.

- Nitrile gloves
- Site logbook
- Field data sheets
- Equipment Calibration Record forms
- Distilled or deionized water
- Decontamination equipment
- Health and Safety Equipment
- Field Instrument Operations Manual
- Calibration gases for Air Monitoring Equipment
- Calibration solutions for Water Monitoring Equipment.

## 4. Types of Field Instruments Commonly used during Environmental Investigations

The following are some of the more commonly used instruments during environmental investigations.

- Photoionization Detector (PID)
- Flame Ionization Detector (FID)

- Multi-gas Meter (usually includes Explosimeter, Hydrogen Sulfide detector, Oxygen sensor, and Carbon Monoxide meter)
- Single-gas Meter (usually Benzene or Hydrogen Sulfide meters)
- Groundwater Level Indicator
- Petroleum/Groundwater Interface Probe
- Groundwater pH, Temperature, Conductivity, Dissolved Oxygen, Oxidation-Reduction Potential and/or Turbidity Meter(s).

### *5. Maintenance*

Each instrument has specific maintenance requirements, which are described in the instrument's manufacturer's manual. These maintenance requirements should be followed. General maintenance such as regular cleaning of the instrument, battery checks and replacement, and ensuring the instrument is handled and stored properly can be performed by AECOM employees. Other maintenance items such as sensor repair, annual calibrations and repair of a malfunctioning piece of equipment should be performed by the instrument manufacturer or licensed dealer and should NOT be performed by AECOM employees, unless specifically directed by the equipment supplier. Contact the manufacturer or licensed dealer to determine where the instrument should be submitted for maintenance tasks, if necessary.

### *6. Calibration*

Due to the wide variety of field instruments available, various parameters potentially monitored, and the wide range of functions potentially performed by each instrument, a description of the calibration of every type of instrument available is not feasible. However, a generalized SOP for general types of field equipment calibration is presented here. Refer to the manufacturer's manual for specific calibration instructions for the instrument being used.

The appropriate calibration field form for the equipment being calibrated should be completed in its entirety, including the equipment model and serial/ID number. If something on the calibration field form does not apply, fill in the space on the form with "NA".

*Air Monitoring Instruments (PID, FID, Multi-gas Meters, Single-gas meters, etc.)*

1. Turn the instrument on. The on/off switch may be a toggle switch, knob, or button to be depressed depending on the type and brand of instrument being used.
2. Allow the instrument to "warm up" and progress through the startup diagnostic routine.

3. Perform a "fresh air" calibration, if possible, for the air meter. This fresh air calibration should be performed using a zero-air filter provided with the air monitor or using a zero-air calibration gas.
4. Record the initial reading on the proper equipment calibration field form. Also record the fresh air calibration standard on the field form.
5. Apply the proper calibration gas and proceed with calibration as directed in the manufacturer's manual.
6. Record the final calibrated reading on the field equipment calibration forms.
7. Verify a moisture and dust filter is in place on the air meter intake nozzle, when applicable.
8. If directed in the manufacturer's manual, at periodic intervals throughout the day, the calibration of the instrument should be checked and re-evaluated as directed in the manufacturer's manual.

*Groundwater Parameter Instruments (YSI ProDSS, pH-Con 10, turbidimeters, etc.)*

Frequently one instrument will have multiple sensors for measuring various parameters in water. With the exception of temperature, each of these parameters can generally be field calibrated.

1. Turn the instrument on. The on/off switch may be a toggle switch, knob, or button to be depressed depending on the type and brand of instrument being used.
2. Allow the instrument to "warm up" and progress through the startup diagnostic routine.
3. Apply calibration solution(s) as instructed by the instrument prompts and/or the manufacturer's manual. Reseal calibration solution containers for future use.
4. Adjust the reading of the instrument, if necessary, to correlate to the corresponding calibration solution being applied.
5. Record calibration reading(s) on the proper field calibration form(s).
6. Dispose of used calibration solution.

*Water Level Indicator and Petroleum/Water Interface Probe*

Field calibration of this instrument is not required. Rather a series of field checks to ensure the instrument is in proper working order are described.

1. Turn the instrument on. The on/off switch is usually a knob located on the side of the reel which the measuring tape is rolled onto.
2. Push the "test" button to ensure that the batteries are in working order. If the batteries are working, an audible tone will be heard and a visible light located on the side of the real will illuminate.
3. Immerse the sensor probe in distilled water to ensure the audible tone is heard and visible light illuminates when the probe enters the water and make an observation of where the water level is at on the probe. Repeat this step several times to familiarize yourself with this contact point. If sensor probe does not react when immersed, contact the manufacturer or licensed dealer for troubleshooting or replacement.
4. Immerse the sensor probe (for interface probes only) in pure phase product (such as vegetable oil) to ensure the audible tone is heard and visible light illuminates when the probe enters the product. Make an observation of where the product level is at on the probe. Perform decontamination on the probe as outlined in SOP No. 4 Decontamination after this step. If sensor probe does not react when immersed, contact the manufacturer or licensed dealer for troubleshooting or replacement

### *7. Decontamination*

Small instruments and equipment that comes into contact with environmental media shall be cleaned according to SOP No. 4 – Decontamination between each use and shall be stored in such a way as to prevent contamination.

## 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to define the standard procedures for decontamination of field equipment and personnel for Shell projects in Hartford and Roxana, Illinois. This SOP is intended to be used together with several other SOPs.

The overall objective of multimedia sampling programs is to obtain samples that accurately depict the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminants can be brought onto the sampling location and/or introduced into the medium of interest during the sampling program (e.g. using sampling equipment that is not properly or fully decontaminated). Trace quantities of contaminants can consequently be captured in a sample and lead to false positive analytical results and an incorrect assessment of the contaminant conditions associated with the site. Decontamination of drilling, sampling and other equipment (e.g., all non-disposable equipment that will come in direct contact with samples) is, therefore, required prior to, between, and after uses to ensure that sampling cross-contamination is prevented, and that on-site contaminants are not carried off-site.

## 2. Other SOPs referenced in this SOP:

- SOP No. 8 - Field Reporting and Documentation

## 3. Equipment

The following is a list of equipment that may be needed to perform decontamination:

- Brushes
- Wash tubs
- Buckets
- Scrapers, flat bladed
- Hot or cold water - high-pressure sprayer
- Sponges or paper towels
- Liquinox detergent (or equivalent)
- Isopropyl alcohol
- Potable or distilled water
- Deionized or distilled water
- Garden-type water sprayers

- Plastic sheeting or trash bags
- GAST® high-flow pump (or equivalent)
- Appropriate PPE (i.e., Tyvek, face shield, goggles, gloves, etc.)

## 4. Decontamination Procedures

Proper mixing instructions for Liquinox detergent: use 2.5 tablespoons Liquinox detergent per gallon of water. If another detergent is being used, verify the proper mixing instructions prior to use.

Detergent water and rinse water shall be mixed fresh each morning and shall be replaced with new solutions at least at mid-day. More frequent replacement of solutions may be necessary if gross contamination (i.e., light non-aqueous phase liquid [LNAPL], sheen, or suspended particles) is observed.

### 4.1 Personnel

Personnel shall be provided space to wash and rinse gloves, and any other non-disposable personal protective equipment (PPE). A container shall be available to dispose of used disposable items such as gloves, or tyvek (if used).

The decontamination procedure for field personnel shall include:

1. Glove wash in a Liquinox (or similar) solution
2. Glove rinse in distilled water
3. Outer glove removal, if present
4. Coverall removal, if present
5. Inner glove removal

Refer to the project Health and Safety Plan (HASP) for additional information. If conditions change and/or upgrade of PPE is required, refer to the task or project specific HASP for more specific information.

### 4.2 Groundwater Parameter Equipment (e.g., YSI ProDSS or similar)

Equipment used to measure groundwater parameters, which does not come into contact with the analytical sample, may be decontaminated between wells if necessary (i.e., gross contamination observed on the sonde probes, history of elevated benzene results at a particular well[1], etc.) (Steps 1 through 6 below). This equipment will, at a minimum, be decontaminated at the end of each sampling day (Step 7 below). The following steps shall be used when decontaminating groundwater parameter measuring equipment:

1. Personnel shall dress in appropriate PPE to reduce the potential of personal exposure as required by the HASP.
2. Spray or wash sensors with a soap and water solution (Liquinox or similar and potable or distilled water).
3. Spray or rinse sensors with distilled water.
4. Wash Flow Cell in a wash tub or bucket containing soap and water solution (Liquinox or similar along with potable or distilled water) and scrubbed with a bristle brush or similar utensil.
5. Rinse Flow Cell with distilled water in a second tub or bucket.
6. Detergent water and rinse water shall be mixed fresh each morning and shall be replaced with new solutions at least at mid-day. More frequent replacement of solutions may be necessary if gross contamination (i.e., LNAPL, sheen, or suspended particles) is observed.
7. At the end of each sampling day,
    a. Soak the optical dissolved oxygen (DO) cap in distilled vinegar for 10 to 15 minutes.
    b. Rinse the optical DO cap in distilled water.
    c. Wash the Flow Cell in a wash tub or bucket containing soap and water solution (Liquinox or similar along with potable or distilled water and scrubbed with a bristle brush or similar utensil.
    d. Rinse Flow Cell with distilled water in a second tub or bucket.
    e. If flow through cell is still odorous, soak in a wash tub or bucket containing soap and water solution (Liquinox or similar along with potable or distilled water) for 10 to 15 minutes. Also consider performing decontamination activities more often during the next sampling day/event.

[1] Elevated levels of benzene may cause accelerated deterioration of the optical dissolved oxygen lens, which in turn will require more frequent lens replacement.

Following decontamination, equipment shall be placed in a clean area (i.e., in the truck, in a dedicated container, etc.) or on clean plastic sheeting in the work zone to prevent contact with contaminated media. If the equipment is not used immediately after decontamination, the equipment shall be stored in a manner which minimizes potential contact with contaminants. Overnight, the equipment will be stored with the sonde sensors submerged in potable water.

### *4.3 Groundwater Sampling Pumps*

Submersible, non-dedicated, reusable groundwater sampling pumps shall be decontaminated between each sampling location. The following steps shall be used to decontaminate groundwater sampling pumps:

1. Personnel shall dress in appropriate PPE to reduce the potential of personal exposure as required by the HASP.
2. Exterior of the sampling pump, including the electrical cord, shall be sprayed and/or wiped off with isopropyl alcohol to remove gross contamination. The outer sampling pump casing may be removed, if necessary, to remove gross contamination on sampling pump motor module.
3. Sampling pump, including electrical cord, shall be placed in a wash tub or bucket containing a soap and water solution (Liquinox or similar along with potable or distilled water). Sampling pump shall be turned on to circulate the soapy water for a minimum of 5 minutes.
    a. Sampling pump may be scrubbed with a bristle brush, sponge or similar utensil.
    b. If the electrical cord will not fit into the wash tub or bucket, it can be wiped down with a paper towel saturated with a detergent water solution.
4. Sampling pump, including electrical cord, shall be placed in a second tub or bucket containing distilled water. Sampling pump shall be turned on to circulate rinse water for a minimum of 5 minutes and until water coming out of the pump no longer contains soapy solution.
    a. If the electrical cord will not fit into the tub or bucket, it can be wiped down with a paper towel saturated with distilled water.
5. Detergent water and rinse water shall be mixed fresh each morning and shall be replaced with new solutions at least at mid-day. More frequent replacement of solutions may be necessary if gross contamination (i.e., LNAPL, sheen, or suspended particles) is observed.

Following decontamination, equipment shall be placed in a clean area (i.e., in the truck, in a dedicated container, etc.) or on clean plastic sheeting in the work zone to prevent potential contact with contaminants. If the equipment is not used immediately after decontamination, the equipment shall be stored in a manner which minimizes potential contact with contaminants.

### 4.4 Water Level / Interface Probes

The following steps shall be used to decontaminate water level meters and oil/water interface probes:

1. Personnel shall dress in appropriate PPE to reduce the potential of personal exposure as required by the HASP.
2. A paper towel or other disposable media shall be saturated with isopropyl alcohol.
3. A portion of a second paper towel or other disposable media shall be saturated with a detergent water solution and the remaining portion of the same paper towel or other disposable media shall be saturated with distilled water.
4. The measuring tape shall be wiped clean as it is removed from the monitoring well by passing through the saturated disposable media. The tape must pass through the isopropyl alcohol first, the detergent water solution second, and the distilled water last.
5. Care shall be taken to replace saturated paper towels if gross contamination is observed or to replace paper towels which become dry during the process.
6. Probe tip shall also be sprayed off with Liquinox (or similar) detergent water solution and distilled water after wiping.
    a. Solinst and Heron brand probe tips should NOT be cleaned with isopropyl alcohol.
    b. If another brand interface probe is being used, check the equipment manual to verify proper decontamination procedures and solutions.

Following decontamination, equipment shall be placed in a clean area (i.e., in the truck, in a dedicated container, etc.) or on clean plastic sheeting in the work zone to prevent potential contact with contaminants. If the equipment is not used immediately after decontamination, the equipment shall be stored in a manner which minimizes potential contact with contaminants.

### *4.5 Other Sampling Equipment*

The following steps shall be used to decontaminate other sampling equipment:

1. Personnel shall dress in appropriate PPE to reduce the potential of personal exposure as required by the HASP.
2. Gross contamination on equipment shall be scraped/wiped off at the sampling or construction site.
3. Equipment shall be sprayed and/or wiped off with isopropyl alcohol.
4. Equipment that cannot be damaged by liquid or water shall be placed in a wash tub or bucket containing soap and water solution (Liquinox or similar along with potable or distilled water) and scrubbed with a bristle brush or similar utensil.
5. Equipment that cannot be damaged by liquid or water shall then be rinsed with distilled water in a second tub or bucket.
6. Equipment that may be damaged by liquid/water shall be carefully wiped clean using a sponge/paper towel with isopropyl alcohol, followed by a sponge/paper towel with detergent water and a sponge/paper towel with deionized or distilled water. Care shall be taken to prevent equipment damage.
7. Detergent water and rinse water shall be mixed fresh each morning and shall be replaced with new solutions at least at mid-day. More frequent replacement of solutions may be necessary if gross contamination (i.e., LNAPL, sheen, or suspended particles) is observed.

Following decontamination, equipment shall be placed in a clean area (i.e., in the truck, in a dedicated container, etc.) or on clean plastic sheeting in the work zone to prevent contact with contaminated media. If the equipment is not used immediately after decontamination, the equipment shall be stored in a manner which minimizes potential contact with contaminants.

### *4.6 Drilling and Heavy Equipment*

Drilling rigs and other equipment shall be decontaminated at a decontamination station located near a central staging area. The decontamination station may consist of a temporary or permanent structure capable of collecting all decontamination fluids. Mobile decontamination trailers may be used to decontaminate heavy equipment at each site. The following steps shall be used to decontaminate drilling and heavy equipment:

1. Review JSA for drilling and heavy equipment decontamination.

2. Personnel shall dress in appropriate PPE to reduce personal exposure as required by the HASP.
3. Equipment showing gross contamination or having caked-on drill cuttings shall be scraped with a flat-bladed scraper at the sampling or construction site.
4. Equipment that cannot be damaged by water, such as drill rigs, augers, drill bits, and shovels, shall be washed with a high-pressure water sprayer then rinsed with potable water. Care shall be taken to adequately clean the insides of the hollow-stem augers, backhoe buckets, etc.[2]

Following decontamination, drilling equipment shall be placed on the clean drill rig and moved to a clean area. If the equipment is not used immediately, it shall be stored in a designated clean area.

### *4.7 Equipment Leaving the Site*

Vehicles used for site activities shall be cleaned on an as-needed basis, as determined by the Site Safety Officer, using soap and water on the outside and vacuuming the inside. On-site cleaning shall be required for dirty vehicles (i.e., muddy tires) leaving the site. Construction equipment, such as hollow stem augers, other drilling equipment, etc., shall be pressure washed before the equipment is removed from the site to limit exposure of off-site personnel to potential contaminants.

### *4.8 Wastewater*

Liquid waste water from decontamination activities shall be containerized and left at the site where it originated, unless otherwise specified. Check the project/task work plan or with the Project Investigative-derived Waste (IDW) Coordinator for additional information/guidance.

### *4.9 Tedlar® Bags*

The following steps shall be used to decontaminate used Tedlar® bags for reuse:

1. Personnel shall dress in appropriate PPE to reduce the potential of personal exposure as required by the HASP.
2. Tedlar® bags shall be pre-sorted into the following purge categories based on the concentrations of the most recent sample in the Tedlar® bag:

[2] Use of hot water and/or steam cleaning during decontamination warrants a Hot Work Permit, which must be evaluated and approved prior to use.

| Oxygen (%) | Minimum Number of Purges Required |
|---|---|
| 20.9 | none |
| 16 – 20.9 | 1 |
| 0 – 16 | 2 |

| Total Hydrocarbon Concentration (ppm) | Minimum Number of Purges Required |
|---|---|
| 0.0 | none |
| 0.1 - 10 | 1 |
| 10 - 100 | 2 |
| 100 – 1,000 | 3 |
| 1,000 – 10,000 | 4 |
| >10,000 | 5 |

If the oxygen and total hydrocarbon concentration (THC) values in the previous Tedlar® bag concentration do not line up on the table above, the more conservative approach (i.e., the most number of purges) shall be chosen.

3. In a well-ventilated area, begin the purge process by introducing ambient air into the Tedlar® bag through a GAST® sampling pump (or equivalent). Fill the Tedlar® bag approximately 80% full and then expel the ambient air from the Tedlar® bag using the intake hose on the GAST® sampling pump (or equivalent). Repeat until the required number of purges outlined in Step 2 above has been performed, or until ambient conditions are present in the Tedlar® bag.
4. After the final purge is complete, introduce ambient air into the Tedlar® bag through the pump and screen the Tedlar® bag to ensure that Oxygen is 20.9% and THC is 0.0 ppm (ambient conditions). If ambient conditions are not present in the Tedlar® bag after purging is complete, continue purging and screening the Tedlar® bag. If ambient conditions are not present after 10 purges, discard the Tedlar® bag.
5. Once ambient conditions are verified and the Tedlar® bag is examined to ensure that it is structurally intact, expel the remaining air and affix a new sampling label. Place the Tedlar® bag in the designated storage location for future use.

## *5. Documentation*

Sampling personnel shall be responsible for documenting the decontamination of sampling equipment, drilling equipment and/or personnel. The documentation shall be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination shall include the following:

- Decontamination personnel
- Date and start and end times
- Decontamination observations
- Weather conditions.

Refer to SOP No. 8 Field Reporting and Documentation for further information regarding logbook entries and logbook management.

### *6. Quality Assurance Requirements*

Equipment rinsate samples of the decontaminated sampling equipment may be taken to verify the effectiveness of the decontamination procedures. The rinsate sampling procedure shall include passing distilled water through or over a decontaminated sampling tool (such as a split spoon) and collecting the rinsate water into the appropriate sample bottles. The rinsate sampling procedure, including the sample number, shall be recorded in the field notebook.

## 1. *Objective*

The purpose of this Standard Operating Procedure (SOP) is to define the standard procedure for field reporting and documentation for Shell projects in Hartford and Roxana, Illinois. This procedure provides descriptions of equipment and field procedures necessary to properly document field activities.

## 2. *Other SOPs referenced in this SOP*

- None

## 3. *Equipment*

Equipment used during field reporting and documentation may include, but is not limited to:

- Calculator
- Bound field logbook
- Waterproof pen and/or permanent marker
- Necessary field forms/paperwork (various)
- Electronic data entry device (Panasonic Toughbook/Toughpad rugged tablet PC [Toughbook/Toughpad], or similar)
- Camera

## 4. *Field Reporting and Documentation*

Documentation of observations, activities and data acquired in the field shall provide information on the acquisition of samples and provide a permanent record of field activities. The observations and data shall be recorded using one or more of the following:

- Pens with permanent waterproof ink in a permanently bound weatherproof field logbook;
- On any necessary field forms/paperwork; and/or
- In an electronic data entry device.

Field investigation situations vary widely. No set of general rules can anticipate all information that must be collected for a particular project. The logbooks, field forms/paperwork and electronic data entry device shall be kept in the field team's possession or in a secure place during the investigation/task.

Since field records (field logbooks, field forms, and electronic data entries) are the basis for later written reports, and potentially subject to litigation, language should be objective, factual, and free of personal feelings or other terminology which might prove inappropriate. Once completed, these field records become project documents subject to potential legal holds and must be maintained as part of the official project files.

Changes or deletions in the field logbook or on field forms will be lined out with a single strike mark, initialed, and remain legible. Sufficient information will be recorded to allow the sampling event or task to be reconstructed without relying on the sampler's memory.

At the end of each day and/or task, a scanned copy of any field sheets used and/or logbook entries made, as appropriate, will be emailed to the task manager and project administrator for review and filing. The task manager will review these scanned copies in a timely manner to verify the quality of the information. Obtain further direction regarding documents to be provided and at what frequency from the task/project manager.

## 5. *Field Logbook*

Each project or task should have a dedicated logbook. The following information should be recorded on the front cover of each logbook:

- Project name/location (i.e., Rand, Roxana, WRR, etc.);
- Date range or year of activities included within; and
- Task the logbook is for (i.e., Quarterly Groundwater; Drilling and Well Installations, System O&M, etc.).

The information in the field logbook should typically include the following as appropriate for the task being performed, even if this information is also recorded on field forms and/or an electronic data entry device:

- Date;
- Names of field team members performing work;
- Change in field team members throughout the day, if any;
- Any PPE upgrades/downgrades (i.e., Tyvek, respirator, etc.);
- Weather conditions;
- Asset/Serial number of any equipment used;Names and company of subcontractors (if applicable);
- Names and title/organization of any site visitors (i.e., client, property owner, Agency representative, etc.);

- Time for each observation/entry;
- Time calibration of field equipment is performed (if applicable);
- Time of mobilizing to work location;
- Time work permit was obtained (if applicable);
- Work location (i.e., Property, Process Area, Location ID, etc.);
- Work to be performed at location (i.e., water level gauging, drilling/sampling, etc.);
- Location of Sample (i.e., monitoring well ID, borehole location and depth, etc.);
- Description of samples (matrix sampled – i.e., water, soil vapor, soil, etc.);
- Time of sample collection;
- Sample ID;
- QA/QC samples collected (if applicable);
- Sample analysis planned (i.e., VOC, SVOC, BTEX, etc.);
- Odor observations during field activities, if any (i.e., hydrocarbon- or petroleum-like, etc.);
- Information concerning sampling changes, scheduling modifications, and change orders;
- Time and details of any delay (i.e. operator unavailable, car parked over location, drill rig delays, equipment malfunction, etc.);
- Field observations and/or summary of daily tasks;
- Sketch (i.e. well construction details, utility locate markings, etc.);
- Signature/Initials and date by personnel responsible for observations at the end of the page/entry/day;
- If decontamination is performed and on what equipment.

It is recommended that each page in the logbook shall be numbered and dated. The entries should be legible and contain accurate and inclusive documentation of the project/task activities. Lines and pages should not be skipped within a logbook. If a page is inadvertently skipped, a diagonal line should be drawn across the page and "Page inadvertently skipped" should be written. The bottom of each page in the field books shall be signed or initialed by the person making the entry at the end of the day.

## 6. Field Forms/Paperwork

Data may also be recorded on various field forms for different tasks performed. If filling out a field form, verify that **every line** contains an entry with the appropriate information. If something on the field form does not apply, that will be indicated using "**NA**".

## 7. Electronic Data Entry Devices (Toughbooks/Toughpads or similar)

The AECOM employees working on the Shell project may also use a field laptop and/or other electronic data entry device (such as Panasonic Toughbook/Toughpad rugged tablet PC [Toughbook/Toughpad]) to collect field data. Currently, Toughbooks/Toughpads have a Microsoft Windows 7 operating system and Microsoft Office software. For data management purposes, they are referred to using sequential numbering (Toughpad 1, Toughbook 1, Toughbook 2, Toughbook 3, etc.). Multiple electronic data entry programs have been developed. The programs were created using Microsoft Access, a relational database software program. When completing an entry in an electronic data entry device, verify that **every line/box** contains an entry with the appropriate information. If something in the electronic data entry device does not apply, that will be indicated using "**NA**".

Dedicated electronic data entry devices are typically used for dedicated locations and routine activities; however, this may change over time or as tasks warrant.

The various electronic data entry devices are not automatically synchronized with one another or with a central database. Therefore, the database files are sent, typically via email, to the AECOM-St. Louis office at least once per week to mitigate the risk of data loss. The database files backed up in this manner also provide a means for aggregation of data into a central project database located in the AECOM-St. Louis office.

## 8. Document Control

Document control refers to the maintenance of inspection and investigation project files. All information below shall be kept in project files. Investigators may keep copies of reports in their personal files, however, all official and original documents relating to inspections and investigations shall be placed in the official project files. Information recorded in electronic format shall be saved in the project directory on the office network. The following documents shall be placed in the project file, if applicable:

- Chain-of-Custody Records and bound field logbooks
- Records obtained during the investigation
- Complete copy of the analytical data and memorandas transmitting analytical data

- Official correspondence received or transmitted, including records of telephone calls
- Photographs and/or digital files associated with the project
- One copy of the final report and transmittal memorandum
- Relevant documents related to the original investigation/inspection or follow-up activities related to the investigation/inspection.

Inappropriate personal observations and irrelevant information should not be placed in the official project files. Throughout the performance of field work as well as at the conclusion of the task/project, the Task Manager will review the file to ensure that it is complete or follow up with the field team member(s), if necessary.

***DUE TO THE LEGAL HOLD IN EFFECT FOR THE SHELL PROJECTS IN THE HARTFORD AND ROXANA, ILLINOIS AREAS, NO PAPERWORK, DOCUMENTATION, ELECTRONIC FILE, ETC. WILL BE DISCARDED OR DELETED.***

## 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to define the standard procedure for measuring water and non-aqueous phase liquid (NAPL) levels in monitoring wells for Shell projects in Hartford and Roxana, Illinois. This SOP serves as a supplement to information which might be in a project Work Plan or scope of work and is intended to be used together with other SOPs.

## 2. Other SOPs referenced in this SOP

- SOP No. 4 – Decontamination
- SOP No. 8 – Field Reporting and Documentation

## 3. Equipment

The following equipment is typically needed:

- Water Level or Product/Water Interface probe with 0.01-foot increments;
- Well keys;
- Photoionization Detector (PID) (e.g., RAE Instruments MiniRAE 3000 or equivalent);
- Nitrile gloves;
- Site logbook;
- Field data sheets;
- Toughbook/Toughpad;
- Appropriate decontamination equipment;
- Appropriate personal protective equipment (PPE); and

## 4. Fluid Level Measurement Procedures

Observations made during the fluid (water and/or NAPL) level measurement shall be recorded in the field logbook, on appropriate field forms, and/or in the appropriate program in the Toughbook/Toughpad in accordance with the procedures defined in SOP No. 8 Field Reporting and Documentation.

Appropriate PPE, as described in the Health and Safety Plan (HASP) shall be worn during well opening, fluid level measurement, and decontamination. The following procedures shall be completed when measuring fluid levels:

1. The water level probe shall be decontaminated prior to use in each monitoring well according to SOP No. 4 Decontamination.
2. Observations regarding the condition of the well, including the well pad, surface completion or protective casing, working padlock, etc. shall be documented in the field logbook, on appropriate field forms and/or in the Toughbook/Toughpad.
3. Put on a new, unused pair of disposable nitrile gloves.
4. The well will be approached from upwind, the well cap unlocked and removed, and the air quality monitored at the top of the casing and in the breathing zone with a PID. Air quality measurements shall be recorded on appropriate field forms and/or in the Toughbook/Toughpad. If the well appears to be under vacuum or pressure conditions, allow adequate time after removing the well cap to reach equilibrium.
   a. Vacuum or pressure conditions may cause the water and/or NAPL level within the well to rise or fall once the well cap is removed and the well is exposed to atmospheric conditions.
5. After the well has reached equilibrium, an electric water level or NAPL/water interface probe shall be used to measure the depth to water from the top-of-casing reference point (either PVC or steel monitoring well casing) and/or check for NAPLs in the water column, where applicable.
   a. If no reference point is marked on the well casing, measurements shall be made from the north side of the well casing.
   b. If a special well wizard dedicated pump cap is present, the cap shall be removed from the riser pipe and depth to water measured from the top of well casing reference point. If the well wizard dedicated pump cap is unable to be removed, gauge the fluid level through the opening in the cap.
6. Record the depth to water and/or NAPL, as applicable. Measurements will be made to the nearest 0.01 feet. Record the measured reading.
7. Regauge and check the recorded measurement(s) before the probe is removed from the well in order to confirm the measurement and verify that the water level is static.
   a. If the regauged depth to water and/or NAPL is the same or comparable to the initial measurement (i.e., ± 0.02 feet), the fluid level is considered static.
   b. If the regauged depth to water and/or NAPL is not comparable to the initial measurement, the water level is still equilibrating to atmospheric conditions.

Periodically regauge the depth to water and/or NAPL until two consecutive measurements are comparable, indicating a static fluid level.

8. If NAPL is detected within a well, the presence of NAPL should be confirmed by visual observations on the interface probe, a clear plastic bailer (disposable or dedicated), or similar. The confirmation method shall be documented along with the measurements on the field data sheet, and/or in the Toughbook/Toughpad.
9. This procedure can also be used to measure the total depth of the well, if required. A measuring tape, with a weight attached to the end if necessary, can be used in place of the water level or interface probe to measure the total well depth. Measurements will be made to the nearest 0.01 feet.
   a. If a special well wizard dedicated pump is present, the pump shall be removed completely from the well prior to measuring the total well depth.
10. The static water level, the total depth of the well, and the depth of NAPL (if applicable), shall be measured with the probe, recorded on the water level data sheet and/or in the Toughbook/Toughpad, and then immediately rechecked before the probe is removed from the well.
11. All columns/entries of field data sheets and/or Toughbook/Toughpad shall be completed, including date and time of measurements. An example water level data sheet is attached to this SOP. Verify that every line/box contains an entry with the appropriate information. If something on the field form or in the Toughbook/Toughpad does not apply, that should be indicated using "NA".
12. Care shall be taken to verify the readings during each water level measurement period. Any significant changes in water level will be noted by comparing the most recent measurement with past measurements. This comparison is easily performed on the Toughbook/Toughpad when entering the data.
13. After any measurement is taken, the water level probe shall be decontaminated as described in SOP No. 4 Decontamination.
14. Place disposable equipment into a plastic garbage bag for disposal. Check with the IDW Coordinator, or designee, for proper disposal guidance.

## *4. Documentation*

The appropriate information will be entered into the Toughbook/Toughpad and/or on the water level data sheet in the field during gauging activities. A field logbook will also be kept during water level measurement activities describing decontamination procedures, calibration procedures, monitoring procedures, and other activities/observations during water level measurement. Refer to SOP No. 8 Field Reporting and Documentation for additional documentation information.

## Water Level Record

Project No: ______________________ Toughbook ID: ______________________

Quarter: ______________________ Personnel: ______________________

Date: ______________________ Interface Probe make/ID: ______________________

| Well No. | Date | Time | Depth to Product (ft btoc) | Product Confirmed [if present] (circle one) | Product Thickness | Depth to Water (ft btoc) | Depth to Bottom (ft btoc) | Bolts Present or Bollard Condition | Lock Present | Working Cap Present | Well Labeled | Pad Condition | PID at Well Head | Comments/ Maintenance Performed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Village of Roxana Wells** | | | | | | | | | | | | | | |
| | | | | P B | | | | | | | | | | |
| | | | | P B | | | | | | | | | | |
| | | | | P B | | | | | | | | | | |
| | | | | P B | | | | | | | | | | |
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| | | | | P B | | | | | | | | | | |
| | | | | P B | | | | | | | | | | |

Product Confirmation Method:
P – on probe; B – using clear bailer

Bollard Condition:
G – good; L – leaning; D – damaged
M – missing (needed); NA – not needed

Well Pad Condition:
G – Good; B – broken/cracked; F – floating
NA – pad not visible or present

INTERFACE PROBE FIELD CHECKS PERFORMED PRIOR TO USE EACH DAY:

DATE: ____________ DATE: ____________ DATE: ____________ DATE: ____________
RESULTS: ____________ RESULTS: ____________ RESULTS: ____________ RESULTS: ____________

### 1. Objective

The purpose of this Standard Operating Procedure is to define the standard procedure and typical equipment for collection of groundwater samples in monitoring wells, extraction wells, or piezometers using low-flow techniques for Shell projects in Hartford and Roxana, Illinois. The term "Low Flow" refers to the velocity that the groundwater is removed from the soil formation immediately adjacent to the well screen.

In this technique, in order to withdraw water from within the well screen and to lessen drawdown, a pump that minimizes disturbance to the groundwater is operated at a low flow rate. The well is only purged within the screened interval until specific parameters have stabilized. Therefore, the groundwater samples collected are representative of the water bearing formation and hydraulically isolated from the water in the casing. The need to purge three well volumes, as required in traditional techniques, is not necessary with low flow purging and sampling. The low flow procedure described in this SOP is not necessarily applicable for every site or for wells screened in materials with very low permeability.

### 2. Other SOPs referenced in this SOP

- SOP No. 3 Calibration and Maintenance of Field Instruments
- SOP No. 4 Decontamination
- SOP No. 8 Field Reporting and Documentation
- SOP No. 10 Well Gauging Measurements
- SOP No. 24 Sample Classification, Packaging and Shipping
- SOP No. 25 Sample Containers, Preservation and Holding Times
- SOP No. 26 Sample Control and Custody Procedures

### 3. Equipment

The following equipment is typically needed:

- Well construction information for well(s) to be sampled
- Map showing location of well(s) to be sampled
- Well keys
- Disposable latex or nitrile gloves

- Assorted tools (socket, screwdriver, clamps, etc.)
- New synthetic rope (to alleviate raising and lower of the submersible pump by the electrical wires)
- Pump and required accessories (described in more detail in following section)
- Deep cycle marine battery, or vehicle battery
- Electronic water level indicator or water/product interface probe with 0.01-foot increments
- Graduated cylinder, measuring cup, or similar
- Water quality instrument with appropriate sensors
- Flow-through cell
- Paper towels or Kimwipes
- Trash bag or bucket
- Calculator/Stopwatch
- Panasonic Toughbook®
- Bound field logbook (logbook)
- Pen and permanent marker
- Plastic buckets
- 55-gallon drums or truck-mounted tank
- Plastic sheeting or similar clean working surface at each well (i.e. for flow thru cell, sample bottles, etc.)
- Secondary containment for purgewater buckets
- Appropriate decontamination equipment (see SOP No. 4)
- Cooler with ice
- Sample containers and labels
- Groundwater sampling form
- Chain-of-Custody form

- Appropriate health and safety equipment (e.g., photoionization detector (PID))
- Canopy

### *4. Sampling Procedure*

This section provides the step-by-step procedure for collecting groundwater samples in the field. Observations made during groundwater purging and sampling should be recorded in a logbook and Toughbook/Toughpad in accordance with procedures described in SOP No. 8 Field Reporting and Documentation.

The well sampling order should be dependent on expected levels of contamination in each well, if known, and should be determined prior to sampling. Sampling should progress from the least contaminated to the most contaminated well, to the extent possible. Quality assurance/quality control (QA/QC) samples should also be collected during groundwater sampling (SOP No. 23 Quality Assurance Samples).

A. Any reusable equipment used in the sampling procedure that could contact groundwater should be properly decontaminated before each use (see SOP No.4 Decontamination).

B. Equipment should be calibrated based on the manufacturers' instructions. Refer to SOP No. 3 Calibration and Maintenance of Field Instruments for additional information.

C. Before well purging begins, the following steps should be performed at each well:

- Inspect the well and surrounding site for security, damage, and evidence of tampering. If damage or tampering is evident, contact the task or project manager for guidance.
- Setup work/exclusion zone.
- Place clean plastic sheeting or similar in the work area near the well to keep equipment and sample bottles clean.
- Measure ambient volatile organic compounds (VOCs) background levels in the immediate vicinity of the well (i.e., using a PID or similar per the Health and Safety Plan (HASP).

- Check wind direction and stay upwind of well head to the extent possible.
- Remove the well cap and immediately measure VOCs at the rim of the well and record the readings in the logbook, in the Toughbook®, and/or on the groundwater sampling form. Give the water in the well adequate time to reach equilibrium (check with Task Manager for details).

D. Measure the groundwater depth to the nearest 1/100-foot. A detailed description of monitoring well gauging procedures is provided in SOP No. 10 Well Gauging Measurements.

E. If NAPL is encountered during gauging, contact the task or project manager for further direction.

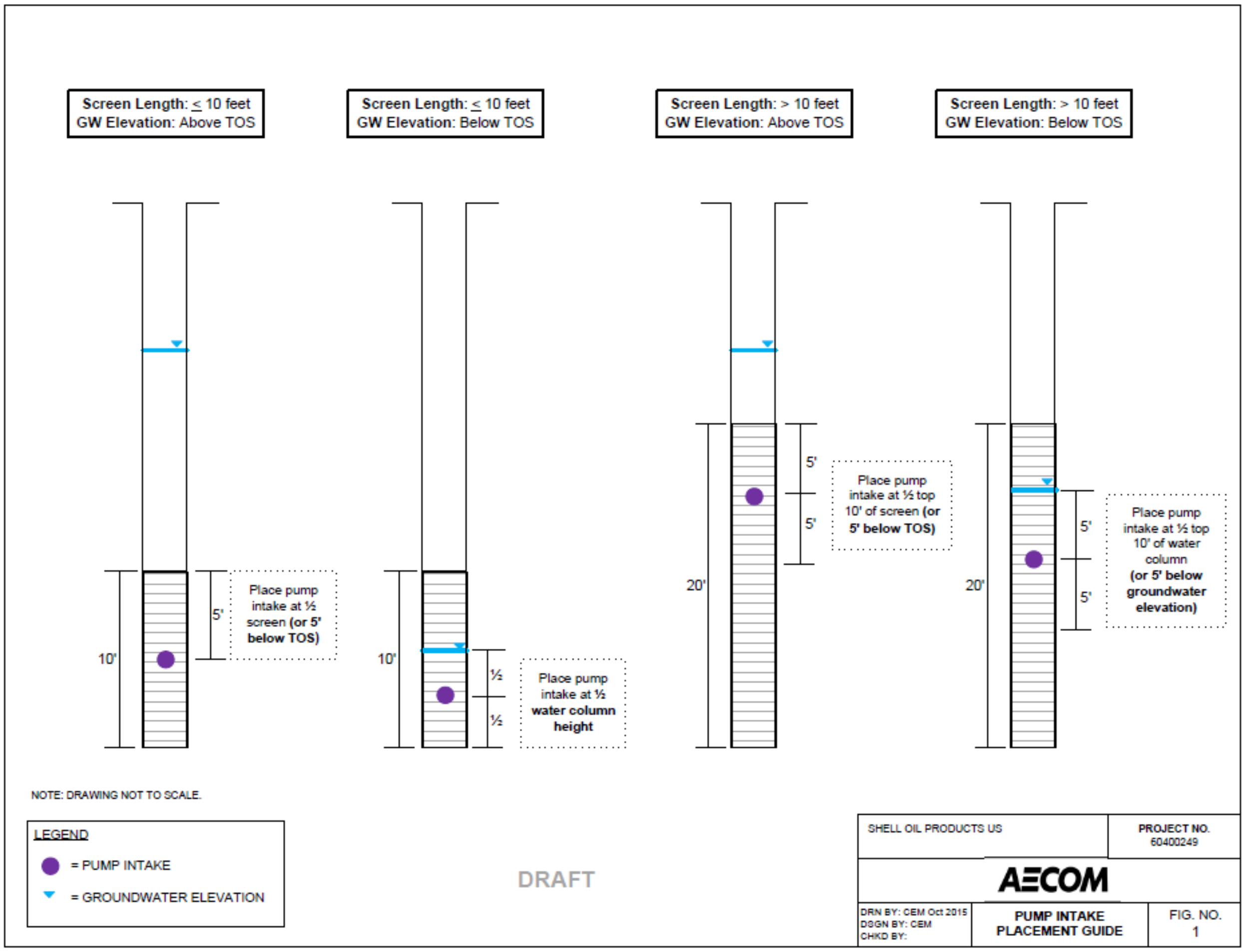
F. Slowly and carefully lower the sampling pump into the well. The pump must be capable of flow rates between about 50 and 500 mL per minute[1].

G. Place the pump intake as indicated below[2]. Measure pump placement from the top of the well down to the pump.

- If the well screen is ≤ 10 feet, place the pump intake near the midpoint of the well screen or water column, whichever is deeper.
- If the well screen is > 10 feet, place the pump intake 5 feet below the top of the well screen or water column, whichever is deeper. If water column height is <10 feet, place pump intake at midpoint of water column.

[1] A peristaltic pump can only be used for shallow applications as it can cause degassing of groundwater and loss of volatiles. Inertial lift foot-valve type samples and bailers cause too much groundwater disturbance and should not be used for low-flow sampling activities.

[2] In situations in which contaminants of interest are known to concentrate in a certain location of the screened zone (i.e., at the bottom), it may be desirable to position the pump intake to target this zone instead.




H. Connect tubing from the pump to the flow-through cell. Determine the volume of water to fill the flow-through cell.

I. Connect the submersible pump to the power source.

- If a deep cycle marine battery will be used, connect the pump power cord to the battery.
- If a vehicle battery with the vehicle running will be used for an adequate power supply, the following will be performed:
    - The vehicle will be positioned such that it is not over a significant amount of vegetation (e.g., vegetation should not contact the bottom of the vehicle) and exhaust will be interfere with work area.
    - The parking brake will be applied.

- A fire extinguisher will be staged nearby for easy access, if necessary.
- Personnel will remain in near the vehicle while running so the vehicle may be promptly shut off in case of fire, etc.

J. Start the pump at a low flow rate, approximately 50 to 100 mL/min or the lowest flow rate possible. The pumping rate can be increased up to 200 to 300 mL/min, which is the optimum flow rate for sampling VOCs[3].

K. Continue collecting water level measurements after every flow-through cell volume until the measurements indicate that significant drawdown is not occurring.

- Drawdown should not exceed 25% of the distance between the top of the well screen and the pump intake. For example, for a 4-foot screen (saturated), the pump should be placed at the midpoint of the screen (two feet from the top of the screen to the pump intake). With a safety factor of 25%, this would require drawdown not to exceed six inches.
- If drawdown exceeds 25% of the distance from the pump intake to the top of the screen even while pumping is occurring at the lowest flow rate possible, samplers should contact the task manager.

L. Collect parameter readings after each flow-through cell volume. Record parameter readings on the groundwater sampling form, in the logbook and/or in the Toughbook/Toughpad. The time between parameter measurements is calculated as follows:

$$T = \frac{V}{Q}$$ , where

$T$ = time between measurements (minutes)

$V$ = volume of the flow-through cell (liters)

$Q$ = purge flow rate (liters per minute)

[3] Low flow sampling can be performed up to 500 mL/min as long as significant drawdown does not occur.

M. Purging will continue until specific parameters have stabilized over three consecutive flow-through cell volumes (4 consecutive readings) or until a specific time requirement is met, whichever happens first.

- **Table 1** provides guidelines that may be used for parameter stabilization as specified by USEPA, ASTM, and in the Nielsen and Nielsen Technical Guidance on Low-Flow Purging and Sampling and Minimum-Purge Sampling (Nielsen and Nielsen, 2002).
- **Table 2** provides the guidelines to be used for groundwater sampling activities on Shell projects. **Table 2** combines relevant stabilization guidelines from **Table 1** in combination with limitations in accuracy for readings collected by the YSI Pro DSS (typical low flow equipment used on the Shell groundwater projects).

**Table 1. Stabilization Guidelines for Low-Flow Sampling**

| Parameter | Stabilization Guidelines | | |
|---|---|---|---|
| | EPA | ASTM | Nielsen & Nielsen |
| DO | +/- 10% or <0.5 mg/L | +/- 10% or +/-0.2 mg/L, whichever is greatest | +/- 10% or +/-0.2 mg/L, whichever is greatest |
| ORP | +/- 10 mV | +/- 20 mV | +/- 20 mV |
| PH | +/- 0.1 units | +/- 0.2 units | +/- 0.2 units |
| Specific Conductivity | +/- 3% | +/- 3% | +/- 3% |
| Temperature | +/- 3% | Not Specified | +/- 0.2 ºC |
| Turbidity | +/- 10% or <5 NTU | Not Specified | Not Specified |

**Table 2. Stabilization Guidelines used for GW Sampling**

| Parameter | Stabilization Guidelines (using above standards combined with Troll9500 accuracies) |
|---|---|
| DO | +/- 10% or +/-0.2 mg/L, whichever is greatest |
| ORP | +/- 20 mV |
| PH | +/- 0.2 units |
| Specific Conductivity | +/- 5% or +/-2µs/cm |
| Temperature | Not Specified; Monitor and record |
| Turbidity | Visually Sediment Free, when practical; Monitor and record |

- A canopy or other should be utilized, as feasible, in an effort to shield the flow-through cell from the weather and elements that may interfere with stabilization parameter readings (i.e. sun and wind).
- If, after a considerable number of readings have been taken, parameters have not stabilized, samplers should contact the task or project manager for further guidance.
- For Rand and Roxana GW sampling activities, contact the Task Manager after two hours of purging for further guidance.

N. After the relevant parameters have stabilized, disconnect or bypass the flow-through cell for sampling.

O. A new pair of disposable nitrile gloves should be put on immediately before sampling.

P. Verify sample bottles, including lids and seals (if present), are intact. This can be done by removing and replacing bottle lid, and by inspecting the lid for presence of seal, if applicable.

Q. Collect the sample directly from the tubing (e.g. sample shall not flow through the flow-through cell while filling bottle sets). Do NOT allow the sample tubing to come into contact with the sample bottles, and do NOT place sample bottles on the ground (e.g., place bottles in plastic tub, on plastic sheeting, or similar).

R. The constituents will be sampled for in the order given below:

- VOCs – Vials should be filled completely so that the water forms a convex meniscus then capped so that no air space exists in the vial. Turn the vial over and tap it to check for bubbles. If air bubbles are observed in the sample vial, remove the lid and attempt to fill the vial two more times, (being careful not to dump out any groundwater currently in the vial). If air bubbles are present twice more, discard the sample vial and repeat the procedure with a new vial. If, after three attempts, air bubbles are still in the vial, make a note of this and place the vial in the cooler.
- Gas sensitive parameters (e.g., ferrous iron, methane, alkalinity)
- Semivolatile organic compounds, polynuclear aromatic hydrocarbons (PAHs) pesticides, polychlorinated biphenyls, and herbicides

- Total petroleum hydrocarbons (TPH)
- Metals (unfiltered)
- Explosives
- Any filtered analytes (use in-line filters if possible) – About 100-1000 mL should be purged through the filter prior to sample collection

S. Check sample bottle cap tightness and verify the lid of the sample bottle is tight and not cross threaded.

T. Wipe off sample bottles to remove any dirt, moisture and/or contamination that may have become adhered to the outside of the bottle.

U. Label each sample bottle. Refer to SOP No. 24 Sample Classification, Packaging and Shipping.

V. Place all samples on ice in a cooler as described in SOP No. 25 Sample Containers, Preservation and Holding Times.

W. Remove the interface probe from the well and decontaminate (SOP No. 4 Decontamination)

X. Turn off the pump and remove from the well.

Y. Place designated tubing within a plastic zipper bag labeled with the well ID. If tubing is not to be saved, properly dispose (contact the IDW Coordinator or designee).

Z. Sample equipment should be decontaminated (SOP No. 4 Decontamination).

AA. The sample time and constituents to be analyzed for should be recorded in the logbook, in the Toughbook®, and/or on the groundwater sampling form.

BB. Chain-of-custody procedures should be started (SOP No. 26 Sample Control and Custody Procedures).

CC. Ship the cooler to the laboratory for analysis within 24-48 hours of sample collection in accordance with the procedures described in SOP No. 24 Sample Classification, Packaging and Shipping.

DD. PPE and other disposable supplies will be containerized and disposed appropriately. Check with IDW Coordinator for further instructions.

EE. Record all pertinent information in the logbook, Toughbook, and/or on all field sheets. Refer to SOP No. 8 Field Reporting and Documentation.

## 5. References

ASTM D6771-02, Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations, American Society for Testing and Materials. Dated September 1, 2018.

Nielsen, David and Nielsen, Gillian. Technical Guidance on Low-Flow Purging and Sampling and Minimum-Purge Sampling. Second Edition. NEFS-TG001-02. April 2002.

USEPA. Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells. EQA SOP – GW4. Dated July 3, 1996, revised September 19, 2017.

USEPA. Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. EPA/540/S-95/504. Dated April 1996.

## 1. Objective

The purpose of this SOP is to the standard procedure for developing or redeveloping a groundwater monitoring well. The objective of groundwater monitoring well development or redevelopment is to clear the well of accumulated sediments so that representative groundwater samples and water quality measurements and/or water levels may be collected for Shell projects in Hartford and Roxana, Illinois. Development activities are typically performed when a well, intended for sampling, is installed. Redevelopment activities are typically performed based on the following criteria[1]:

- If the well is sampled as part of a routine groundwater sampling program, when 10% or more of a well screen has been occluded by sediment; or
- If the well in only gauged (and not sampled) as part of a routine groundwater sampling program, when 75% or more of a well screen has been occluded by sediment.

Accumulated sediments are typically suspended in the water column in order to be removed. This procedure discusses the use of a check valve with an actuator pump to suspend and remove sediments. Other methods to suspend sediments include:

- using a surge block,
- injecting air into the water column of the well, or
- using a submersible pump, an air bladder pump, air-lift, or a bailer.

## 2. Other SOPs referenced in this SOP:

- SOP No. 10 Well Gauging Measurements

## 3. Equipment

Information and equipment typically used during well development includes:

- Well installation information
- Well keys
- Disposable latex or nitrile gloves
- Assorted tools (safety utility knife, screwdriver, tubing cutters, etc.)
- Pump and required accessories (battery, tubing, control box, etc.) or air-lift equipment (typically provided by a subcontractor)

[1] Redevelopment criteria presented are guidelines based on site knowledge and experience and are not a formal or regulatory requirement.

- Electronic water level indicator or oil/water interface probe with 0.01-foot increments
- Graduated cylinder, measuring cup or similar
- Paper towels or Kimwipes (decontamination equipment)
- Calculator
- Bound field logbook and/or groundwater development sheet
- Waterproof pen or permanent marker
- Plastic Buckets or truck-mounted poly tank
- 55-gallon drums or portable tanks, if needed
- Appropriate health and safety equipment (e.g. photoionization detector (PID), etc.)

Additional equipment typically used during well (re)development for wells with LNAPL includes:

- Water/product interface probe with 0.01-foot
- *NuWell 220* dispersant polymer

### *4. Procedure if no LNAPL present*

The following procedures will be used when using a check valve with an actuator pump (such as the Waterra Hydrolift II) to develop a new well or redevelop an existing well which does NOT contain LNAPL.

1. Put on a new, unused pair of disposable latex or nitrile gloves.
2. Approached the well from upwind, unlock and remove the well cap , and monitor the air quality at the well head and in the breathing zone with a PID.
3. Measure the depth to groundwater to the nearest hundredth of a foot (SOP No. 10 Well Gauging Measurements).
4. Measure the total depth of the well to the nearest hundredth of a foot (SOP No. 10 Well Gauging Measurements). Note whether the bottom of the well feels hard or soft (this may be easier to determine with a weighted tape measure).
5. Remove the water level indicator or interface probe from the well and decontaminate.
6. Calculate the amount of water to be removed.

installed depth – depth to water = height of water column

height of water column * gallons/foot conversion = 1 well volume

| Well Diameter | Gal/ft Conversion |
|---|---|
| 0.75 inch | 0.0229 |
| 1 inch | 0.0408 |
| 1.5 inches | 0.0918 |
| 2 inches | 0.163 |
| 4 inches | 0.652 |
| 6 inches | 1.468 |

- For Development of newly installed wells: Remove 1x the amount of water added by drillers during installation, along with 5 well volumes of water.
- For Redevelopment of existing wells: Remove 3 well volumes of water.

7. Attach a stainless-steel check valve to the appropriate sized
   - Waterra SS-19 standard flow check valve threads onto 1/2-inch inner diameter by 5/8-inch outer diameter HDPE tubing
     - May be used for wells up to 100 feet below ground surface
   - Waterra SS-32 high flow check valve threads onto 3/4-inch inner diameter by 1-inch outer diameter HDPE tubing
     - Recommended for wells deeper than 100 feet below ground surface
8. Lower check valve end of tubing into the well until the check valve reaches the bottom of the well.
9. Hang the Waterra Hydrolift, or similar actuator, on the well protector, if possible, and secure with ratchet strap. If this is not possible, find some other way to mount and secure the actuator near and above the well pipe.
10. Install the clamp arm into the top slot of the clamp arm support at the appropriate location for tubing placement within the center of the well pipe. Secure the clamp arm with the cotter pin.
11. Ensure check valve is resting at the bottom of the well. Ensure the actuator is resting as its lowest stroke position. This will ensure that any sediment at the bottom of the well will be suspending during (re)development.

12. Close the tubing clamp bracket with the tubing extending through the correct slot for its size (tight fit but tubing not crimped).
    - If the tubing is not a snug fit into one of the slots, hose clamps will be required above and below the tubing clamp bracket.
13. Tighten tubing clamp bracket by screwing down the knob.
14. Cut the tubing to the desired length for collection of discharged groundwater.
15. Secure the discharge end of the tubing into a drum, bucket, poly tank or similar purgewater collection vessel.
16. Plug the power cord for the actuator into a generator or inverter.
17. Turn the pump on. Adjust the speed/pumping rate as possible/necessary to pump at a sufficient rate to allow the sediments to be removed.
    - The actuator and check valve surge the well screen and purge the groundwater at the same time.
18. (Re)Development is potentially completed when the following criteria have been achieved:
    - Water being purged is visually sediment free.
    - Required volume of water has been removed (refer to Step 6 above).
    - Installed depth is measured.
19. Once (re)development is thought to be completed, turn off the actuator and unplug the power cord.
20. Open the tubing clamp bracket and free the tubing.
21. Remove the tubing and check valve from the well. Attempt to roll/coil tubing during removal.
22. Re-measure the total well depth.

$$\frac{\text{installed total well depth} - \text{sump length} - \text{measured total well depth}}{\text{screen length}} (100\%) = \%\ \text{occlusion}$$

    - If the measured depth indicates 10% or more occlusion for sampled well screens (or 75% or more occlusion for gauged well screens), repeat steps 8 through 21.

- If the measured depth indicates less than 10% well screen occlusion for sampled wells (or less than 75% well screen occlusion for gauged wells) and sediment has been removed from the screen to the extent practicable, go to Step 23.

23. Remove (unthread) check valve from end of tubing. Appropriately discard tubing (check with IDW Coordinator for further instruction) or designate for future use.

24. Decontaminate check valve

Note in the field log book and on any field data sheets the approximate number of gallons of water removed during development of each well, well screen depth interval, depth to bottom prior to well development, and depth to bottom after well development.

### *5. Procedure if LNAPL is present*

The following procedures will be used when using a check valve with an actuator pump (such as the Waterra Hydrolift II) to develop a new well or redevelop a submersible pump to develop a new well or redevelop an existing well in which LNAPL is observed. The procedures below assume that **Steps 1** and **2** in **Section 4** above have been completed

1. Measure the total depth of the well to the nearest hundredth of a foot. Note whether the bottom of the well feels hard or soft.

2. Calculate the amount of water to be removed.

   installed depth – depth to water = height of water column

   height of water column * gallons/foot conversion = 1 well volume

| Well Diameter | Gal/ft Conversion |
|---|---|
| 0.75 inch | 0.0229 |
| 1 inch | 0.0408 |
| 1.5 inches | 0.0918 |
| 2 inches | 0.163 |
| 4 inches | 0.652 |
| 6 inches | 1.468 |

6. Add *NuWell 220*, or similar, dispersant polymer into the well in accordance with the dosage guide below or the manufacturer's dosage recommendations

   - 2" monitoring well – add 0.12 ounces per foot of water within the well (Example: 20-foot deep 2" monitoring well, DTW = 7 feet;

     13 feet of water * 0.12 ounces per foot = 1.56 oz of *NuWell 220*)

- 4" monitoring well – add 0.46 ounces per foot of water within the well.

7. Complete **Steps 7** through **24** in **Section 4** above.

Note in the field log book and on any field data sheets the amount of *NuWell 220*, or similar, dispersant polymer added to the well, the approximate number of gallons of water removed during development of each well, well screen depth interval, depth to bottom prior to well development, and depth to bottom after well development.

### 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to define the standard Quality Assurance/Quality Control (QA/QC) samples for Shell projects in Hartford and Roxana, Illinois. QA/QC samples are typically collected during field studies for various purposes which include the isolation of site effects (control samples), define background conditions (background sample), and evaluate field/laboratory variability (e.g., matrix spikes/matrix spike duplicates (MS/MSDs), equipment blanks, trip blanks, duplicates, split samples). This SOP is intended to be used together with several other SOPs.

### 2. Other SOPs referenced in this SOP

- SOP No. 24 Sample Classification, Packaging and Shipping
- SOP No. 26 Sample Control and Custody Procedures

### 3. Equipment

The following equipment is typically used:

- Insulated coolers (hard plastic or metal)
- Nitrile gloves, or similar
- Field forms such as Chain of Custody (COC) or sample collection sheet
- Custody seals
- Logbook
- Ice
- Protective packing material
- Sealed storage bags
- Sample containers and labels
- Waterproof pen/marker
- Trash bags

### 3. QA/QC Samples

Refer to the scope of work for a description of relevant QA/QC samples.

- Background Sample – a sample (usually a grab sample) collected from an area, water body, or site similar to the one being studied, but located in an area known or thought to be free from pollutants of concern.
- Split Sample – Two or more representative subsamples taken from one environmental sample in the field. Prior to splitting, the environmental sample is homogenized to correct for sample heterogeneity that would adversely impact data comparability. Field split samples are usually analyzed by different laboratories (interlaboratory comparison) or by the same laboratory (intralaboratory comparison). Field splits are typically used to assess sample handling procedures from field to laboratory and laboratory's comparability.
- Field Duplicate – Field duplicates should be samples collected side by side or by collecting one sample and immediately collecting the second sample. Field duplicates represent the precision of the whole method, site heterogeneity, field sampling and the laboratory analysis. When results for both duplicate and sample values are greater than 5 times the practical quantitation limit (PQL), satisfactory precision is indicated by a relative percent difference (RPD) less than or equal to 25% for aqueous samples, and 50% for non-aqueous samples. Where one or both of the results of a field duplicate pair are reported at less than 5 times the PQL, satisfactory precision is indicated if the field duplicate results agree within 2 times the quantitation limit for aqueous samples and within 5 times the quantitation limit for soil samples. Field duplicate results that do not meet these criteria may indicate unsatisfactory precision of the results.
- Trip Blanks – A sample, which is supplied by the laboratory, using analyte free and headspace free water prior to the sampling event and is stored with the investigative sample bottles and samples throughout the sampling event. They are then packaged for shipment with the other samples and submitted for analysis. At no time after their preparation are trip blanks to be opened before they reach the laboratory. Trip blanks are used to assess volatile organic compound (VOC) cross contamination of samples during storage and/or transportation back to the laboratory (a measure of sample handling variability resulting in positive bias in contaminant concentration). If VOC

samples are to be shipped, trip blanks are to be provided with each cooler containing VOC samples.

- Equipment Blanks – A sample collected using distilled or deionized water which has been collected using decontaminated investigative sample collection equipment in the same manner that investigative samples are collected (e.g. run over/through equipment). In the case of groundwater collection pumps, a new/clean section of tubing shall be attached to the pump and used to collect the equipment blank sample, in the same manner as the collection of investigative samples. The equipment blank sample identifies contamination resulting from the field equipment, sampling procedure, sample container, or preservative. Equipment blanks are often associated with collecting rinse blanks of equipment that has been field cleaned. Equipment blanks should be labelled with the ID of the next sample to be collected.
- Temperature Blanks – A container of water shipped with each cooler of samples requiring preservation by cooling to 4°C ± 2°C (ice). The temperatures of the blanks are measured at the time of sample receipt by the laboratory. No temperature blank is necessary for samples designated as “waste”.
- Field Blanks – A sample that is prepared in the field to evaluate the potential for contamination of a sample by site contaminants from a source not associated with the sample collected (for example air-borne dust or organic vapors which could contaminate a soil sample). Analyte-free water is taken to the field in sealed containers or generated on-site. The water is poured into the appropriate sample containers at pre-designated locations at the site. Field blanks should be collected in dusty environments and/or from areas where volatile organic contamination is present in the atmosphere and originating from a source other than the source being sampled.
- Material Blanks – Samples of sampling materials (e.g., material used to collect/wipe samples, etc.), construction materials (e.g., well construction materials), or reagents (e.g., organic/analyte free water generated in the field, water from local water supplies used to mix well grout, etc.) collected to measure any positive bias from sample handling variability. Commonly collected material blanks are listed below:
    - Wipe Sample Blanks – A sample of the material used for collecting wipe samples. The material is handled, packaged, and transported in the same manner as all other wipe samples with the exception that it is not exposed to actual contact with the sample medium.

- Grout Blanks – a sample of the material used to make seals around the annular space in monitoring wells.
- Filter Pack Blanks – a sample of the material used to create an interface around the screened interval of a monitoring well.
- Construction Water Blanks – a sample of the water used to mix or hydrate construction materials such as monitoring well grout.
- Organic/Analyte Free Water Blanks – a sample collected from a field organic/analyte free water generating system. The sample is normally collected at the end of sampling activities since the organic/analyte free water system is recharged prior to use on a study. On large studies, samples can be collected at intervals at the discretion of the project leader. The purpose of the organic/analyte free water blank is to measure positive bias from sample handling variability due to possible localized contamination of the organic/analyte free water generating system or contamination introduced to the sample containers during storage at the site. Organic/analyte free water blanks differ from field blanks in that the sample should be collected in as clean an area as possible (a usual location for the organic/analyte free water system) so that only the water generating system/containers are measured.

- Matrix Spike – A sample collected in the same manner as the investigative sample, with known concentrations of analytes added by the laboratory prior to laboratory analysis, which is introduced into a second aliquot. The spiked sample is processed through the entire analytical procedure. Analysis of the matrix spike is used to assess the accuracy and precision of the analytical process on an analytical sample in a particular matrix, and can be indicative of matrix effects/analyte recoveries. A group of up to 20 field samples of the same matrix (e.g., water, soil, sediment, waste) being analyzed for the same constituents may be associated with a single matrix spike (MS) sample of a matrix spike/matrix spike duplicate (MS/MSD) pair.
- Matrix Spike Duplicate – A sample collected in the same manner as the investigative sample, with known concentrations of analytes added by the laboratory prior to laboratory analysis (same concentrations of analytes as the matrix spike), which is introduced into a third sample aliquot. The spiked sample is processed through the entire analytical procedure. Analysis of the matrix spike duplicate is an additional measure of accuracy and precision.

## 4. Sample Containers

Certified commercially clean sample containers shall be supplied by the contract analytical laboratory. The lab shall indicate the type of sample to be collected in each bottle type, and the preservative (if applicable) of each bottle. A work plan or other project documentation may list the appropriate sample containers for the specific analyses require for each project/task.

## 5. Sample Preservation

Samples shall be preserved prior to, or at the time of the sample collection. Chemical preservatives, if necessary, are typically added to the sample containers by the laboratory prior to shipment to the field.

After QA/QC sample collection, the QA/QC sample shall be recorded on the chain of custody (COC) (see SOP No. 26 Sample Control and Custody Procedures for additional information). Each container shall be labeled and stored on ice at 4°C ± 2ºC in an insulated cooler until packed for shipment to the laboratory. The ice or the sample bottles shall be bagged in sealed storage bags, or as otherwise recommended by the laboratory. Freezing samples shall not be permitted. Any breakable sample bottles need to be wrapped in protective packing material (bubble wrap) to prevent breakage during shipping (see SOP No. 24 Sample Classification, Packaging and Shipping for additional information).

## 6. QA/QC Sample Collection Frequency

The table below outlines common frequencies for QA/QC sample collection. Refer to the project work plan or scope of work for a description of relevant QA/QC samples.

| QA/QC Sample | Frequency |
|---|---|
| Background Sample | Optional/Project or Task Specific |
| Split Sample | Optional/Project or Task Specific |
| Field Duplicate Sample | One per 10 samples collected per matrix; Project or Task Specific |
| Trip Blank | One per cooler containing VOC samples; Project or Task Specific |
| Equipment Blanks | One per 10 samples collected; Project or Task Specific |
| Temperature Blanks | Laboratory specific; One per cooler; Project or Task Specific |
| Field Blanks | Optional/Project or Task Specific; One per 20 samples collected per matrix |
| Material Blanks | Optional/Project or Task Specific; One per matrix |
| Matrix Spike | One per 20 samples collected per matrix; Project or Task Specific |
| Matrix Spike Duplicate | One per 20 samples collected per matrix; Project or Task Specific |

## 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to define the standard protocols for soil and groundwater sample identification, labeling, packaging, and shipping for Shell projects in Hartford and Roxana, Illinois. This SOP serves as a supplement to work plan, sampling and analysis plan or other project documentation, and is intended to be used together with several other SOPs.

## 3. Other SOPS referenced in this SOP

- SOP No. 8 Field Reporting and Documentation
- SOP No. 26 Sample Control and Custody Procedures
- SOP No. 51 Vapor Sampling Classification, Packaging and Shipping
- SOP No. 58 Westhollow LNAPL Sampling

## 2. Equipment

The following equipment is typically needed for sample identification, packaging and shipping:

- Chain of custody form
- Sample bottles (laboratory provided)
- Sample labels
- Water proof pen or similar
- Trash bag or similar for lining cooler
- Bubble wrap
- Ice
- Re-sealable storage bags
- Custody seal
- Clear packing tape
- Shipping label
- Waterproof cooler

## 3. Procedures

### Sample Identification

Samples collected during site activities shall have discrete and site-specific sample identification code (ID). These sample IDs are necessary to identify and track each of the many samples collected for analysis during the life of project. In addition, the sample IDs can be used in a database to identify and retrieve the analytical results received from the laboratory.

Each sample is identified by a unique code which indicates the specific project, site identification, sample location number, sample matrix identifier, sample depth, and/or date. If used, sample matrix identifiers may include the following:

GP - Geoprobe

GWP - Groundwater Profile

PZ - Piezometer

MW - Monitoring Well

CPT – Cone Penetrometer Testing

ROST - Rapid Optical Screening Tool

VMP - Vapor Monitoring Point

ROX – Roxana Site

WRR – Wood River Refinery

RAND – Rand Site

PM – Performance Monitoring

LNAPL – Light non-aqueous phase liquid

TB - Trip Blank

EB - Equipment Blank

DUP - Duplicate Sample

MS - Matrix Spike Sample

MSD - Matrix Spike Duplicate Sample

An example of the sample identification number codes for a groundwater monitoring well sample collected for field analysis for the Shell Sites will be:

MW13-PROJ-070713-EB.

Where "MW" indicates Monitoring Well, "13" indicates the well location, "PROJ" indicates the abbreviated project name (ROX, WRR, etc.), "070713" indicates the date, and "EB" indicates an equipment blank.

The project abbreviation, sample sequence, sampling locations, and sample type will be established prior to field activities for each sample to be collected. On-site personnel will obtain assistance from the Task or Project Manager in defining any special sampling requirements.

### ***Sample Labeling***

Sample labels will be filled out as completely as possible by a designated member of the sampling team prior to beginning field sampling activities each day. The date, time, sampler initials/signature should not be completed until the time of sample collection. All sample labels shall be filled out using waterproof ink, preferably black. Below is information typically included on a sample label:

- Sampler's company affiliation
- Project/Site location
- Sample identification code
- Date and time of sample collection
- Analyses required
- Method of preservation or preservative (if any)
- Sample matrix (i.e., soil, groundwater, surface water)
- Sampler's signature or initials.

The sample bottle will be wiped off to remove any dirt, moisture and/or contamination that may have become adhered to the outside of the bottle. Labels will be affixed to the sample bottle(s). Clear tape will be applied in order to keep the label attached to the sample and to keep the label legible. If waterproof or weatherproof labels are used to label sample bottles, clear tape is NOT required. If a sample bottle displays a tared weight from the laboratory, clear tape will NOT be used.

## Sample Packaging and Shipping

For packaging and shipping of air or soil vapor samples, refer to SOP No. 51 Vapor Sampling Classification, Packaging and Shipping. For packaging and shipping of LNAPL samples, refer to SOP No. 58 Westhollow LNAPL Sampling. Below describes packaging and shipping procedures for water and soil samples.

After sample collection, each container will be labeled as described above, and then stored on ice at ≤6°C in an insulated cooler until packed for shipment to the laboratory. Coolers will be lined with a trash bag or similar and either the ice or the sample bottles will be bagged in sealed storage bags, or as otherwise recommended by the laboratory.

Caps of sample bottles will be checked for proper tightness and to verify the lid of the sample bottle is not cross threaded. Sample bottles will be wiped off to remove any dirt, moisture and/or contamination that may have become adhered to the outside of the bottle. To the extent possible, the sample containers will be placed in re-sealable storage bags and wrapped in protective packing material (bubble wrap). Samples will then be placed right side up in a lined cooler with ice and a completed chain-of-custody (COC) form (placed in a separate zip-locked bag). The COC may be specific to the samples included within each shipping container or may be comprehensive of all samples collected during a particular day/sampling period, regardless of the number of shipping containers.

A custody seal will be placed over the lid and body of the cooler on the side from which the cooler is opened. The cooler will be wrapped with clear packing tape, including over the custody seal, for delivery to the laboratory. Samples will be hand delivered or shipped by overnight express carrier for delivery to the analytical laboratory. All samples must be shipped for laboratory receipt and analyses within specific holding times. This may require daily shipment of samples with short holding times. The temperature of all coolers will be measured upon receipt at the laboratory. A temperature blank may be included in each cooler for temperature measurement purposes, per laboratory specific requirements.

## Sample Documentation and Tracking

***Field Notes -*** Documentation of observations and data acquired in the field will recorded on field sampling sheets, in a bound field logbook and/or in a Toughbook/Toughpad to provide a permanent record of field activities. Refer to SOP No. 8 Field Reporting and Documentation for additional information.

***Sample Chain-of-Custody -*** During field sampling activities, traceability of the sample must be maintained from the time the samples are collected until laboratory data are issued. The sampling team member(s) will be responsible for initiating and filling out the COC form during sample collection. Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form. The COC should contain project and sample specific information. Sample labels should be checked against the COC to ensure everything intended for analysis is listed on the COC.

A member of the sampling crew will sign the COC form over to the person or party responsible for delivery of the samples to the laboratory, retain a copy of the COC form, document the method of shipment, and send the original COC form with the samples. Additionally, an electronic copy of the COC should be forwarded to applicable project contacts (e.g., task manager, project chemist, etc.). Each time custody of the samples is transferred, the COC should be signed by both parties. Refer to SOP No. 26 Sample Control and Custody Procedures for additional information about COCs.

### 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to define the standard protocols for sample containers, preservation and hold times for Shell projects in Hartford and Roxana, Illinois. This SOP is intended to be used together with several other SOPs.

### 2. Other SOPs referenced in this SOP

- SOP No. 24 Sample Classification, Packaging and Shipping

### 3. Equipment

The following equipment is typically required for this SOP:

- Waterproof coolers (hard plastic or metal)
- Custody seals
- Field forms such as Chain of Custody (COC) or sample collection sheet
- Field notebook
- Ice
- Bubble wrap
- Clear tape
- Duct tape
- Re-sealable bags
- Sample containers and labels
- Waterproof pen
- Permanent marker
- Nitrile gloves, or similar
- Trash bags

### 4. Sample Containers

Certified commercially clean sample containers will be obtained from the contract analytical laboratory. The lab will indicate the type of sample to be collected in each bottle type, and the preservative (if applicable) of each bottle. The work plan may list the appropriate sample containers for the specific analyses required for each project.

### 5. Sample Preservation

Samples will be preserved prior to, or at the time of the sample collection, if applicable. Chemical preservatives, if necessary, are typically added to the sample containers by the laboratory prior to shipment to the field. In some cases, preservatives may be added to the sample containers in the field by sampling personnel.

After sample collection, each container will be labeled and stored on ice at 4°C (+/- 2°C) in an insulated cooler until packed for shipment to the laboratory. The ice or samples will be bagged per laboratory specific requirements. Freezing samples will not be permitted. Any breakable sample bottles need to be wrapped in protective packing material (i.e., bubble wrap) to prevent breakage during shipping. Refer to SOP No. 24 Sample Classification, Packaging and Shipping for additional information.

### 6. Sample Hold Times

Samples will be hand delivered or shipped via overnight express carrier for delivery to the analytical laboratory. All samples must be shipped for laboratory receipt and analyses as soon as possible and within specific holding times. This may require daily shipment of samples with short holding times. The hold time varies for each type of analysis, and therefore, it will be necessary to check with the lab to verify the hold times to determine how frequently samples need to be sent to the lab. Typical hold times are provided in **Table 1**.

**Table 1 Typical Sample Holding Times & Preservation**

| Analysis | Holding Time | Preservation |
|---|---|---|
| Alkalinity | 14 days | Cool to ≤6°C |
| Ammonia NH3 | 28 days | Cool to ≤6°C - H2SO4 to pH<2 |
| Asbestos | 1 year | None |
| BOD 5 | 48 hours | Cool to ≤6°C |
| BOD 5 Inhibited | 48 hours | Cool to ≤6°C |
| BTEX | 14 days | Cool to≤6°C; HCl |
| Chloride | 28 days | Cool to ≤6°C |
| Chlorophyll | 24 hrs to filtration - 28 days after filtration | Freeze filters in 90% acetone |
| Chromium VI (Hexavalent) in water | 24 hours | Cool to ≤6°C |
| COD | 28 days | Cool to ≤6°C - H2SO4 to pH<2 |
| Conductivity | 28 days | Cool to ≤6°C |
| Cyanide in Soil | 14 days | Cool to ≤6°C |
| Cyanide in Water | 14 days | Cool to ≤6°C NaOH to pH>12; 0.6 g ascorbic acid |

**Table 1 Typical Sample Holding Times & Preservation**

| Analysis | Holding Time | Preservation |
|---|---|---|
| EDB/DBCP | 14 days | Cool to≤6°C; HCl |
| Fluoride in Soil | 28 days | Cool to ≤6°C |
| Fluoride in Water | 28 days | Cool to ≤6°C |
| Grain Size Sediment | 6 months | None required |
| Guaiacols/Catechols/Phenols | 30 days | Cool to≤6°C; H2SO4 to pH<2 |
| Halogenated Hydrocarbons HH | 7 days water/14 days soil | Cool to ≤6°C |
| Hardness | 6 months | HNO3 to pH<2 |
| Herbicides | 7 days water/14 days soil | Cool to ≤6°C |
| Hydrocarbon chlorinated | 7 days water/14 days soil | Cool to ≤6°C Ascorbic acid |
| Ignitability | None | Cool to ≤6°C |
| Iron and sulfur bacteria | 6 hours | Cool to≤6°C; 0.008% Sodium Thiosulfate |
| Mercury in Water | 28 days | Cool to≤6°C; HNO3 to pH<2 |
| Metals -- Except Cr(6) and Hg | 180 days | HNO3 to pH <2 |
| Metals, dissolved | 6 months | Filter - then add HNO3 to pH<2 |
| Nitrate NO3- | 48 hours | Cool to ≤6°C |
| Nitrate-Nitrite | 28 days | Cool to≤6°C; H2SO4 to pH<2 |
| Nitrite NO2- | 48 hours | Cool to ≤6°C |
| Nitrogen Pesticides | 7 days water/14 days soil | Cool to ≤6°C |
| NWTPH-Dx and NWTPH-HCID | 7 days water/14 days soil | Cool to ≤6°C HCl to pH<2 |
| NWTPH-Gx | 14/14 days | Cool to ≤6°C HCl to pH<2 |
| Oil & Grease in Water | 28 days | Cool to≤6°C; HCl to pH<2 |
| Oil and Grease in Soil | 28 days | Cool to ≤6°C |
| PAH Hazardous Waste Designation w/o HPLC | 7 days water/14 days soil | Cool to ≤6°C |
| PAH Polynuclear Aromatic Hydrocarbons | 7 days water/14 days soil | Cool to ≤6°C |
| PCBs only | 7 days water/14 days soil | Cool to ≤6°C |
| Percent Solids Soil/Tissue | 7 days | Cool to ≤6°C |

**Table 1 Typical Sample Holding Times & Preservation**

| Analysis | Holding Time | Preservation |
|---|---|---|
| Personal Monitors | None | None |
| Pesticides/PCBs | 7 days water/14 days soil | Cool to ≤6°C |
| pH | 24 hours | Cool to ≤6°C |
| Phenolics in Soil (4AAP) | 28 days | Cool to ≤6°C |
| Phenolics in Water (4AAP) | 28 days | Cool to≤6°C; H3PO4; FeSO4 and CuSO4 |
| Phosphorus, Total and Dissolved | 28 days | Cool to≤6°C; H2SO4 to pH<2 |
| PM10 | 1 year | Cool to ≤6°C |
| PM2.5 | 30 days | Cool to ≤6°C |
| Semivolatile Organics /SVOCs | 7 days water/14 days soil | Cool to ≤6°C |
| Settleable Solids(SS) | 48 hours | Cool to ≤6°C |
| Specific conductance | 28 days | Cool to ≤6°C |
| Sulfate | 28 days | Cool to ≤6°C |
| Sulfide | 7 days | Zinc acetate; NaOH to pH>9 |
| TOC in Soil | 28 days | Cool to ≤6°C |
| TOC in Water | 28 days | Cool to≤6°C; H2SO4 to pH<2 |
| Total Dissolved Solids(TDS) | 7 days | Cool to ≤6°C |
| Total Kjeldahl Nitrogen (TKN) | 28 days | Cool to≤6°C; H2SO4 to pH<2 |
| Total Non-Volatile Solids(TNVS) | 7 days | Cool to ≤6°C |
| Total Non-Volatile Suspended Solids(TNVSS) | 7 days | Cool to ≤6°C |
| Total Persulfate Nitrogen (TPN) | 28 days | Cool to≤6°C; H2SO4 to pH<2 |
| Total Solids(TS) | 7 days | Cool to ≤6°C |
| Total Suspended (TSS) | 7 days | Cool to ≤6°C |
| Total Volatile Solids(TVS) | 7 days | Cool to ≤6°C |
| Tributyl tin | 7 days water/14 days soil | Cool to ≤6°C |
| Turbidity | 48 hours | Cool to ≤6°C |
| Volatile Organics/VOCs | 7 days water/14 days soil | Cool to≤6°C; HCl |

### 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to define the standard procedure for the control and custody of environmental samples for Shell projects for Hartford and Roxana, Illinois. This SOP is intended to be used together with several other SOPs.

### 2. Other SOPs referenced in this SOP

- SOP No. 8 Field Reporting and Documentation
- SOP No. 24 Soil and Groundwater Sample Classification, Packaging and Shipping
- SOP No. 51 Vapor Sample Classification, Packaging and Shipping

### 3. Equipment

The following equipment is typically needed for sample control and custody procedures:

- Waterproof shipping container(s) (e.g., coolers)
- Custody seals
- Field forms such as a Chain of Custody (COC) or sample collection sheet
- Field notebook
- Re-sealable bags
- Waterproof pen
- Permanent markers
- Nitrile gloves, or similar

### 3. Sample Control and Custody

Once the samples are collected, they must remain in the custody of the sampler or another worker from the site. The samples can also remain unattended in a locked vehicle or jobsite trailer so that tampering with the samples will not be possible.

During field sampling activities, traceability of the samples must be maintained from the time the samples are collected until the laboratory data is issued. Initial information concerning the collection of the samples will be recorded on the COC and in the field log book as outlined in SOP No. 8 Field Reporting and Documentation.

COC forms will be used to document the transport and receipt of samples from the field to the lab. Information required on a COC includes the following:

- Samplers signature and company affiliation
- Company contact information (address, project contact, telephone, email)
- Project number/Project name
- Purchase Order (PO) number (typically same number as project number)
- Date and time of sample collection
- Sample IDs
- Sample matrix
- Analyses requested
- The total number of containers being sent to the lab for each sample
- The appropriate preservative used (where applicable), designating the number of containers to be analyzed with that preservative
- If any samples are to be placed on hold at the laboratory, this should be clearly indicated on the COC in the comments section
- Turnaround time (TAT) requested
- Deliverables requested
- Signature of person(s) relinquishing custody, dates, and times
- Signature of person(s) accepting custody, dates, and times
- Method of shipment
- Shipping air bill number (if appropriate)
- Custody seal number
- Appropriate project-specific Incident and SAP numbers (for Shell projects)
- Special instructions or field notes, if applicable
- Numerated pages (Page__of__)
    - Verify with the task manager and/or laboratory coordinator for potential maximum number of samples per sample delivery group (SDG).

The sampling team members will be responsible for initiating and filling out the COC form during sample collection. The COC will be signed by a sampling team member to relinquish custody of the samples to a shipping carrier, courier service, laboratory, or to another team member who is responsible for packing/shipping containers. If another team member is packing the shipping container (cooler, box, etc.), they will sign the COC to relinquish custody to the shipping carrier, courier service, or laboratory. Each time custody of the samples is transferred, the COC should be signed by both parties.

Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form. If the COC is not three-part (minimum) carbon-copy form, then photocopy the COC after initial signatures have been obtained, and before the samples and original copy leave the site (i.e., samples given to courier, delivery company or similar). One COC form will be included in each shipping container of samples and if samples are not hand delivered, the COC will be placed in a resealable bag and placed inside the shipping container(s).

- The COC may be specific to the samples included within each shipping container or may be comprehensive of all samples collected during a particular day/sampling period, regardless of the number of shipping containers.
- If there are multiple shipping containers in a shipment, then the COC included in each shipping container will designate the container number based on the total number of containers (e.g., cooler 2 of 6, box 1 of 4, etc.). In addition, the COC and/or logbook will indicate the custody seal number of each container. This designation can be made in the comments section or in the margins of the COC.

Additionally, an electronic copy of the COC will be forwarded to applicable project contacts (e.g., task manager, project chemist, etc.).

Refer to SOP No. 24 Soil and Groundwater Sample Classification, Packaging and Shipping for more information regarding packing and shipping of soil and groundwater samples. Refer to SOP No. 51 Vapor Sample Classification, Packaging and Shipping for more information regarding packing and shipping of vapor samples. Upon receipt at the laboratory, the person receiving the samples will sign the COC form. The original COC will remain with the samples until final disposition of the samples by the laboratory. The laboratory will dispose of the samples in an appropriate manner after data reporting (standard disposal times are laboratory dependent).

## 1. Objective

The purpose of this Standard Operating Procedures (SOP) is to define the standard procedure SOP and necessary equipment for collection of soil vapor samples from vapor monitoring points / sampling ports using stainless steel canisters for Shell projects in Hartford and Roxana, Illinois.

## 2. Other SOPs referenced in this SOP:

- SOP No. 4 Decontamination
- SOP No. 26 Sample Control and Custody Procedures
- SOP No. 51 Vapor Sampling Classification, Packaging and Shipping

## 3. Equipment

The following equipment is typically needed:

- Logbook
- Disposable nitrile gloves
- Cut resistant gloves
- Ultra-fine permanent marker
- Paper towels
- Decontamination equipment
- Soil vapor sampling field sheets and/or Panasonic® Toughpad, or similar electronic data entry device
- Small brush or broom
- Charcoal filter
- 15 mL hand pump
- 60 mL syringe or equivalent
- Peristaltic pump with battery
- Rotameter or equivalent
- Photoionization Detector (PID) (e.g., RAE Instruments MultiRAE or equivalent)
- Flame Ionization Detector (FID) (e.g., Thermo Scientific TVA-2020 or equivalent)

- Lower Explosive Limit (LEL) meter (e.g., RAE Instruments MultiRAE or equivalent)
- Landfill gas detector (e.g., Landtec GEM-2000 or equivalent)
- Stainless steel canisters with flow controllers (supplied by the laboratory)
- 1-Liter Tedlar® bags (new or decontaminated as outlined in SOP No. 4 Decontamination) – 2 per sample
- Black trash bag for storing Tedlar® bag samples
- Bentonite grout
- Foam padding
- Sample train assembly (configuration and parts shown on **Figure 1**)
- Vacuum gauge (0 – 30 inches Hg)
- Teflon® tubing (laboratory-grade) – 1/8" ID – ¼" OD
- Tygon® tubing (laboratory-grade) – 3/16" ID – 3/8" OD
- Tracer gas (e.g., Grade 5 helium)
- Tracer gas shroud (e.g., plastic tote)
- Tracer gas meter (e.g., Dielectric Technologies MGD-2002 or equivalent)
- Watch or timer
- Standard field tools (e.g., ratchet set, safety cutting tools, pry bar, etc.)
- Wrenches (7/16, ½, 9/16, 5/8)
- Shipping supplies (e.g., UN boxes, shipping labels, hazard labels, packing tape)

### *4. Vapor Port Development Purging*

If the port has been newly installed, the port must be developed by purging 3 volumes of the sampling assembly including 3 volumes of the sand pack. If development is not required, proceed to **Section 4** or **Section 5** below for the appropriate sampling procedures

1. Open vapor point vault to check integrity of individual soil vapor monitoring port(s) (VMP). Each port should have a hose barb connected to a 3-way polycarbonate stopcock (3-way) using silicone tubing. The 3-way should be in the "off" position.
2. Connect peristaltic pump and Tygon tubing connected to the 3-way.
3. Connect charcoal filter exhaust to the discharge end of the tubing assembly.

4. Calculate Purge volume:
   - Vapor Port tubing (1/8-in diameter): 2.41 mL/foot (single volume)
   - Sample train assembly / Tygon® tubing (1/4-in diameter): 9.65 mL/foot (single volume)
   - Sand Pack: 18,765 mL (4.95 gallons – single volume – assuming 18-inch-thick sand pack)
5. Open 3-way and begin purging port at a rate no greater than 2 L/min. Document time started.
6. Once 3 volumes are reached, stop pump and close 3-way. Document time stopped.
7. Move to next depth or replace vault cover and clean up at location.

### *5. Vapor Port Sampling – With No Tracer Gas*

To perform vapor port sampling with tracer gas shroud, proceed to **Section 5** below.

1. Set up at VMP. Turn off vehicle. If vehicle will be left running per health and safety procedures, prevent sample and sample media from being exposed to vehicle exhaust.
2. Open vapor point vault to check integrity of individual soil VMP(s). Each port should have a hose barb fitting connected to a 3-way valve using silicone tubing. The 3-way should be in the "off" position.
3. Perform stainless steel canister vacuum check, per the steps listed in **Section 6** of this SOP.
4. Remove hose barb fitting from port and set up the sample assembly using the configuration shown in **Figure 2**. The flow controller (one for each stainless-steel canister provided by the laboratory) shall be connected to the stainless-steel canister inlet. Do not re-use flow controllers between samples. Flow controllers can be set to different rates as specified by the project work plan, depending on size of container to be filled. For a 1-Liter stainless steel canister, approximately 5 minutes is a standard collection time (~167 ml/min).
5. Perform sample train leak check, per the steps listed in **Section 6** of this SOP.
6. Calculate Purge volume:
   - Vapor Port tubing (1/8-in diameter): 2.41 mL/foot (single volume)
   - Sample train assembly (1/4-in diameter): 9.65 mL/foot (single volume)

7. Purge the three volumes from the vapor monitoring port purge using the 60 mL syringe. If pullback is observed on the 60 mL syringe and the purge cannot be completed, the VMP screen may be saturated with water and will not yield a representative sample. If this happens, do not sample the VMP. Similarly, if water or LNAPL is observed in the syringe during the purge, do not sample the VMP. Record purge results in Toughpad and on sample sheets.
8. Remove the 3-way and connect the sample train to the VMP using Swagelok® fittings.
9. Open Port Valve and Valve #1. Use 60 mL syringe to purge 30 mL (approximately three times the volume of the sample train assembly).
10. Close Valve #1.
11. Open stainless-steel canister valve completely and record the time in the Toughpad or on sample sheets.
12. Allow the canister to fill until the vacuum gauge reads between -5 and -10 inches Hg; however, an ideal sample shall have approximately -5 inches Hg remaining after sampling is complete. When ambient temperatures are below freezing, close canister valve when the vacuum gauge reading is -8 inches Hg[1]. For a 1-Liter canister, filling shall take approximately 5 minutes but may require more or less time depending on formation materials[2]. If the vacuum gauge reading drops below -5 inches Hg before approximately 5 minutes, close the stainless-steel canister valve completely. Record the time in the Toughpad and on sample sheets.
13. Connect peristaltic pump to tubing connected to Valve #1 and open Valve #1 to collect a sample in a sample bag. The sample bag should be filled at a rate no greater than 200 ml/min. Use a rotameter to measure flow rate, and adjust pump speed to approximately 200 mL/min.
14. Disconnect the sample train from the VMP and reconnect the 3-way.
15. Disconnect flow controller, stainless steel canister, and used tubing from sample assembly.

[1]Sample will undergo thermal expansion (some loss of vacuum) when moved from a cold outdoor setting to a warmer indoor setting. By closing the canister valve at -8 inches Hg, the sample will be able to undergo thermal expansion without reaching 0 inches Hg. The larger the difference between outdoor and indoor temperatures, the greater the loss of vacuum.

[2] Other sized canisters will take different amounts of time to sufficiently fill.

16. From the soil vapor in the Tedlar® sample bag obtain readings for total volatile organics with a FID, PID and for $CO_2$, $CH_4$, LEL, and oxygen ($O_2$) with a landfill gas detector. Record readings in Toughpad and on sample sheets. If FID or PID is not on-site, label and retain bag for screening at field trailer.
17. Perform stainless steel canister vacuum check, per the steps listed in **Section 6** of this SOP.
18. Setup on the next port depth or replace vault cover and clean up at location.
19. Decontaminate any non-designated equipment (e.g., sample assembly) following procedures listed in **Section 7**.

### *6. Vapor Port Sampling – With Tracer Gas Shroud*

To perform vapor port sampling with no tracer gas shroud, proceed to **Section 4** above.

1. Set up at VMP. Turn off vehicle. If vehicle will be left running per health and safety procedures, prevent sample and sample media from being exposed to vehicle exhaust.
2. Open vapor point vault to check integrity of individual VMP(s). Each port should have a hose barb fitting connected to a 3-way valve using silicone tubing. The 3-way should be in the "off" position.
3. Perform stainless steel canister vacuum check, per the steps listed in **Section 6** of this SOP.
4. Remove hose barb fitting from port and set up the sample assembly using the configuration shown in **Figure 3**. The flow controller (one for each stainless-steel canister provided by the laboratory) shall be connected to the stainless steel canister inlet. Do not re-use flow controllers between samples. Flow controllers can be set to different rates as specified by the project work plan, depending on size of container to be filled. For a 1-Liter stainless steel canister, approximately 5 minutes is a standard collection time (~167 ml/min).
5. Perform sample train leak check, per the steps listed in **Section 6** of this SOP.
6. Calculate Purge volume:
    - Vapor Port tubing (1/8-in diameter): 2.41 mL/foot (single volume)
    - Sample train assembly (1/4-in diameter): 9.65 mL/foot (single volume)

7. Purge the three volumes from the vapor monitoring port purge using the 60 mL syringe. If pullback is observed on the 60 mL syringe and the purge cannot be completed, the VMP screen may be saturated with water and will not yield a representative sample. If this happens, do not sample the VMP. Similarly, if water or LNAPL is observed in the syringe during the purge, do not sample the VMP. Record purge results in Toughpad and on sample sheets.
8. Remove the 3-way and connect the sample train to the VMP using Swagelok® fittings.
9. Open Port Valve and Valve #1. Use 60 mL syringe to purge 30 mL (approximately three times the volume of the sample train assembly).
10. Close Valve #1.
11. Place an enclosure shroud over the VMP and assembled sample train as shown in **Figure 3**. The shroud should have openings for:
    - Introduction of tracer gas;
    - Pressure relief to the atmosphere and access of a tracer gas monitoring device;
    - Tygon tubing to connect to the peristaltic pump for Valve #1

    The shroud should have sufficient glove access to open or close all valves within. As shown in **Figure 3**, the shroud must also be sealed to the ground with hydrated bentonite (or equivalent) or foam padding.
12. Introduce tracer gas into the shroud at a known rate until the atmosphere within the shroud contains a sufficient quantity (typically 20% to 50%) of tracer gas.
13. Connect peristaltic pump to Valve #1 using Tygon tubing, open Valve #1, and collect sample bag #1. The sample bag should be filled at a rate no greater than 200 ml/min.
14. Close Valve #1.
15. From the soil vapor in Tedlar® sample bag #1, obtain readings for tracer gas with tracer gas detector. If tracer gas readings are elevated, analyze sample bag #1 using a landfill gas detector to obtain a direct methane reading. See **Section 6** for acceptance criteria.
16. Open stainless-steel canister valve completely and record the time in Toughpad or on sample sheets.
17. Allow the canister to fill until the vacuum gauge reads between -5 and -10 inches Hg; however, an ideal sample shall have approximately -5 inches Hg remaining after sampling is complete. When ambient temperatures are below freezing, close canister

valve when the vacuum gauge reading is -8 inches Hg[3]. For a 1-Liter canister, filling shall take approximately 5 minutes but may require more or less time depending on formation materials.[4] If the vacuum gauge reading drops below -5 inches Hg before approximately 5 minutes, close the stainless-steel canister valve completely. Record the time in the Toughpad and on sample sheets. Record the concentration of tracer gas within the shroud after closing the canister valve.

18. Connect peristaltic pump to tubing connected to Valve #1 and open Valve #1 to collect sample bag #2. The sample bag should be filled at a rate no greater than 200 ml/min.
19. Break seal on the shroud and disconnect flow controller, stainless steel canister, and used tubing from sample assembly.
20. From the soil vapor in sample bag #2 obtain readings for total volatile organics with a PID, for $CO_2$, $CH_4$, LEL, and oxygen ($O_2$) with a landfill gas detector, and for tracer gas concentration with the tracer gas detector. See **Section 6** for acceptance criteria. Record readings in Toughpad or on field sheets. If FID or PID is not on-site, label and retain Tedlar® sample bag #2 for reading at field trailer.
21. Perform stainless steel canister vacuum check, per the steps listed in **Section 6** of this SOP.
22. Disconnect the sample train from the VMP and reconnect the 3-way.
23. Move to next depth or replace vault cover and clean up at location.
24. Decontaminate any non-designated equipment (e.g., sample assembly) following procedures listed in **Section 7**.

## *7. Quality Control*

Quality control procedures have been developed to verify equipment integrity, sample quality, and sample repeatability.

In addition to the procedures listed below, the following items are also of concern:

- Care should be taken to keep all sampling equipment, especially the stainless-steel canisters, safe from damage.

[3]Sample will undergo thermal expansion (some loss of vacuum) when moved from a cold outdoor setting to a warmer indoor setting. By closing the canister valve at -8 inches Hg, the sample will be able to undergo thermal expansion without reaching 0 inches Hg. The larger the difference between outdoor and indoor temperatures, the greater the loss of vacuum.

[4]Other sized canisters will take different amounts of time to sufficiently fill.

- No samples are to be collected in an area where vehicle or other equipment exhaust is being discharged. Do not place samples or sample media directly on asphalt, gravel, or other ground surfaces.

**Field Duplicates**

A field duplicate shall be collected for 10% of the samples collected.

Field duplicates are collected by using a sample assembly with an additional 3-way union. A stainless-steel canister with a flow controller is attached to each of the 3-way unions on the assembly. For sampling, both stainless steel canister valves should be opened and closed simultaneously. Use the appropriate procedure described above to collect samples.

**Stainless Steel Canister Vacuum Check**

The stainless-steel canister vacuum check shall be performed for 100% of the stainless steel canisters.

*Prior to Sampling*

1. Remove brass cap from stainless steel canister. Brass cap will not be present if canister is configured with quick connect fitting.
2. Attach the pressure gauge provided by the laboratory to the stainless-steel canister inlet.
3. Open valve one-half turn, then close valve.
4. Record reading on the canister tag. If the canister does not show a vacuum or shows a vacuum of less than -26 inches Hg, then:
    - Label the canister tag with "Insufficient vacuum – No Sample";
    - Set canister aside for return to the laboratory; and
    - Contact task manager and lab coordinator if number of canister failures affect field work.
5. Make sure valve is closed tight, but not overtight.
6. Remove the pressure gauge.
7. If not immediately using the stainless-steel canister for sample, place and tighten brass cap on stainless steel canister (not applicable if canister is configured with quick connect fitting).

*After Sampling*

1. Attach the pressure gauge provided by the laboratory to the stainless-steel canister inlet.

2. Open valve one-half turn, then close valve.
3. Record reading. There should still be a vacuum in the stainless-steel canister. The final vacuum on the canister should be between -10 inches of Hg to -2 inches of Hg. If the final vacuum does not fall within this range, contact the task manager immediately to determine the value of using another stainless-steel canister to recollect the sample.
4. Make sure valve is closed tight, but not overtight.
5. Remove the pressure gauge.
6. Place and tighten brass cap on stainless steel canister (not applicable if canister is configured with quick connect fitting).

**Sample Train Vacuum Leak Check**

The sample train leak check shall be performed for 100% of the samples collected.

1. Assemble the sampling apparatus as shown in **Figure 1**.
2. Keep the stainless-steel canister closed, and Valve #1 in the "open" position.
3. Attach the 15 mL hand pump to sample train at Valve #1.
4. Withdraw air from the sampling apparatus until a vacuum between 20 and 25 inches Hg is achieved. Close Valve #1. Use flow controller's built-in vacuum gauge to observe the induced vacuum for at least five minutes. If the flow controller's vacuum gauge does not function properly, notify the task manager.
5. If the change in vacuum over five minutes is equal to or less than 0.5 inches Hg, the system leak rate is acceptable.
6. If the change in vacuum over five minutes is greater than 0.5 inches Hg, check, tighten or replace the fittings and connections and repeat the leak check.

**Tracer Gas Check**

An appropriate number of samples shall be collected using a tracer gas, as per the project work plan or activity plan.

1. Tracer gas should be introduced near the VMP to test the integrity of the probe seal and the above ground connections.
2. Collect the soil vapor sample per procedures in **Section 5**.
3. If the concentration of the tracer gas in a sample is $\leq$10% of the concentration of the tracer gas in the shroud:
    - Prior to stainless steel canister sampling: continue with sample collection.

- Following stainless steel canister sampling: the sample is acceptable.

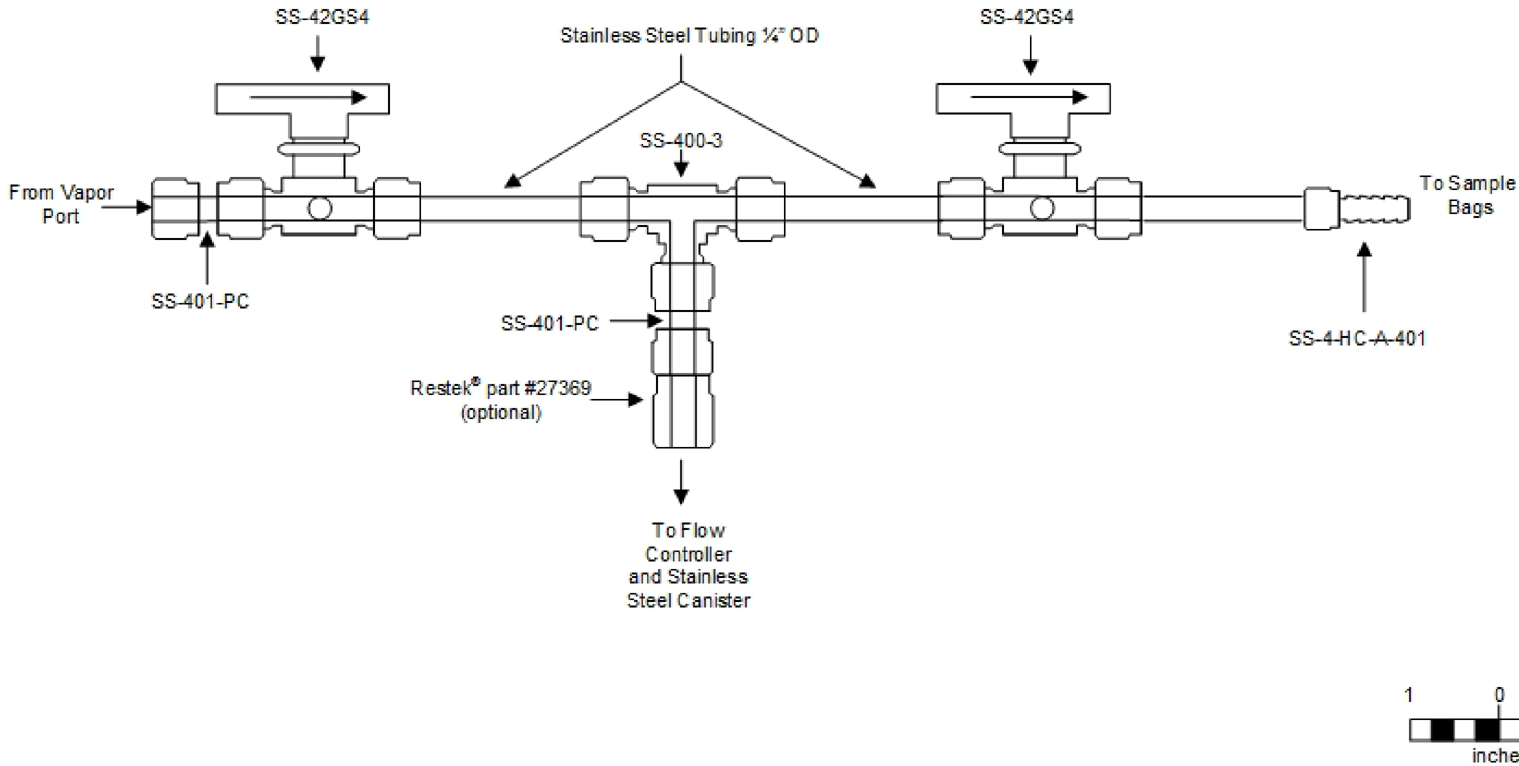
4. If the concentration of the tracer gas in the sample is >10% of the concentration of the tracer gas in the shroud:
   - Prior to stainless steel canister sampling: check methane levels.
     - If methane reading ≥2%, continue with sample collection.
     - If methane reading ≤2%, stop sample collection. Check fittings and valves before restarting sample collection.
   - Following stainless steel canister sampling: check methane levels.
     - If methane reading ≥2%, the results may be biased high by methane. Call task manager to discuss.
     - If methane reading <2%, sample likely compromised; do not use sample. Call task manager to inform of need for re-sample.
   - If a sample is found to be compromised, 2 additional attempts (3 attempts total) should be made to collect a sample.
     - With each additional attempt, check stainless-steel tubing and fittings for holes and loose connections, and place an additional layer of bentonite seal in the interior of the well vault.
     - After 3 attempts, if a successful sample has not been collected, the VMP shall not be sampled for that quarter.

### *8. Decontamination*

- Non-designated stainless-steel assemblies shall be thoroughly decontaminated by purging with at least half a liter of air (e.g., with hand pump or peristaltic pump).
- Should a stainless-steel assembly come into contact with groundwater, it shall be decontaminated using a Liquinox® detergent wash followed by a distilled water rinse. Discuss with task manager before re-using the assembly.
- If a stainless-steel assembly should come into contact with LNAPL, immediately call task manager and segregate the contaminated components from other sample media.
- Multiple stainless-steel assemblies shall be available to sample crews to allow for equipment to be cleaned and dried sufficiently before being reused.
- Tedlar® bags may be decontaminated if it meets the criteria listed in SOP No. 4 Decontamination.

## 9. Shipping

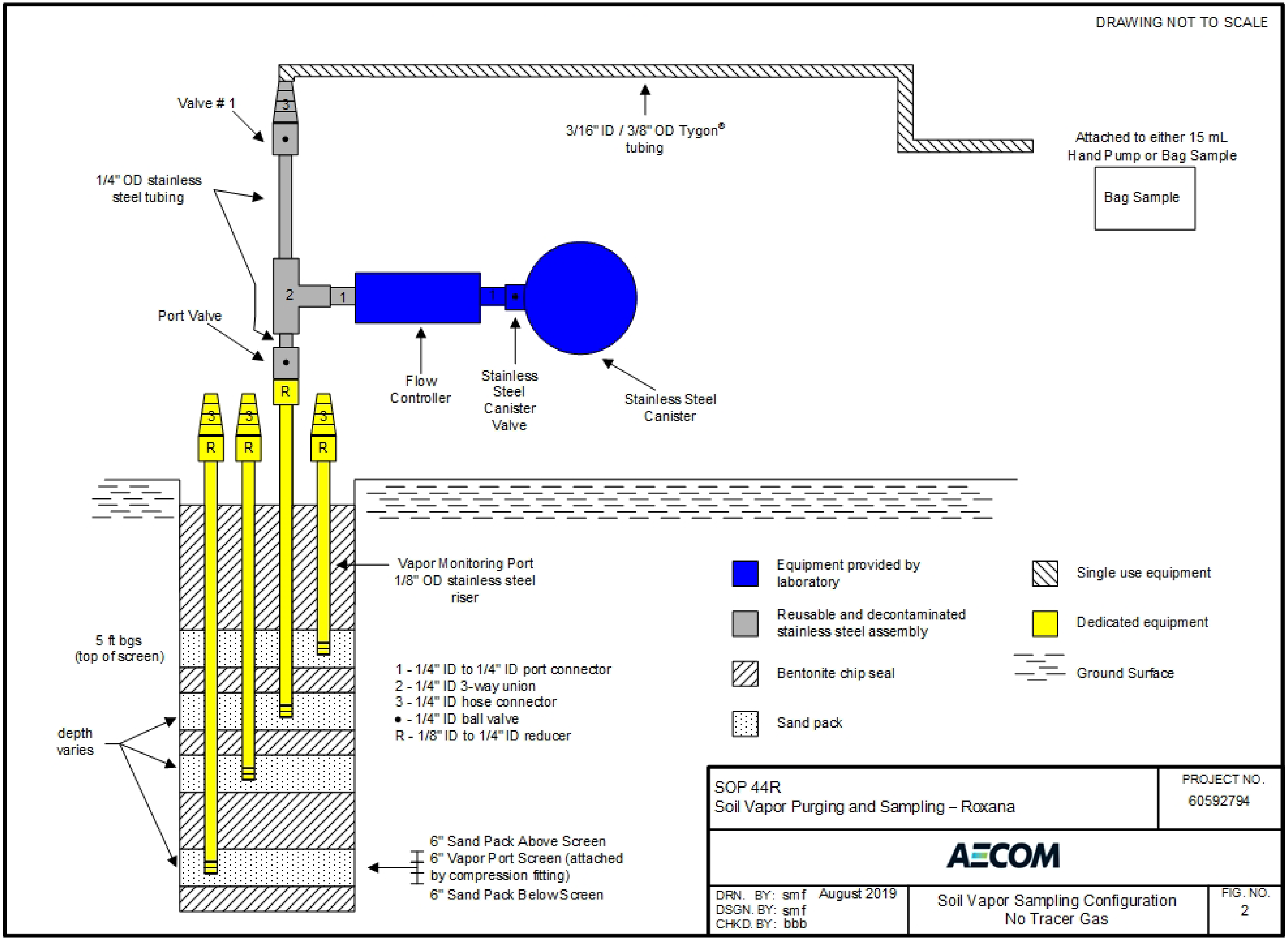
- Sample information shall be recorded on a chain of custody for the laboratory following procedures outlined in SOP No. 26 Sample Control and Custody Procedures.
- Samples shall be shipped to the laboratory following DOT regulations. If there is the possibility that samples may be classified as hazardous, samples must be shipped as such. For procedures, see SOP No. 51 Vapor Sampling Classification, Packaging and Shipping, and check with one of the office hazardous shipping personnel.

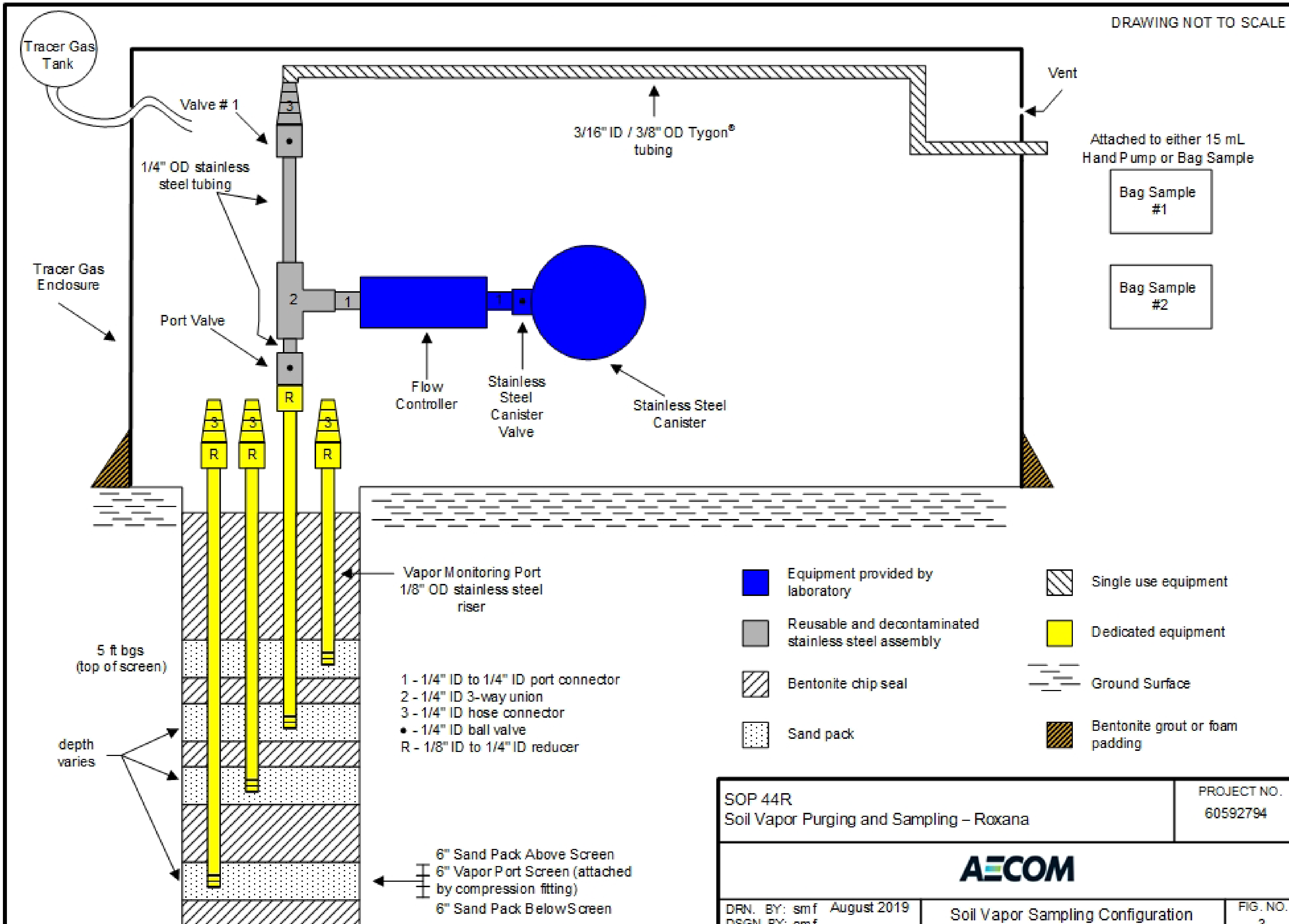



Notes:
1) All components listed with Swagelok® part numbers (if applicable).
2) All components made by Swagelok® unless otherwise noted.
3) Assembly shown for standard sample.
4) Duplicate assembly includes an additional 3-way union between the two shown.
5) All fittings shown are compression fittings with SS-400-Set ferules and SS-402-1 nuts.
6) Restek® part #27369 is a female quick connect fitting that may be used to connect sampling assembly to flow controller when flow controller is outfitted with accompanying Restek® part #27373 (male quick connect fitting).

Source: https://swagelok.com/products.aspx; Accessed June 13, 2019.
Source: https://www.restek.com/catalog/view/53581; Accessed June 13, 2019.

| | | |
|---|---|---|
| SOP 44R<br>Soil Vapor Purging and Sampling – Roxana | | PROJECT NO.<br>60592794 |
| AECOM | | |
| DRN. BY: smf August 2019<br>DSGN. BY: smf<br>CHKD. BY: bbb | Soil Vapor Sampling Assembly | FIG. NO.<br>1 |


DRAWING NOT TO SCALE
Valve # 1
3/16" ID / 3/8" OD Tygon® tubing
Attached to either 15 mL Hand Pump or Bag Sample
Bag Sample
1/4" OD stainless steel tubing
Port Valve
Flow Controller
Stainless Steel Canister Valve
Stainless Steel Canister
Vapor Monitoring Port 1/8" OD stainless steel riser
5 ft bgs (top of screen)
depth varies
1 - 1/4" ID to 1/4" ID port connector
2 - 1/4" ID 3-way union
3 - 1/4" ID hose connector
• - 1/4" ID ball valve
R - 1/8" ID to 1/4" ID reducer
6" Sand Pack Above Screen
6" Vapor Port Screen (attached by compression fitting)
6" Sand Pack Below Screen
Equipment provided by laboratory
Reusable and decontaminated stainless steel assembly
Bentonite chip seal
Sand pack
Single use equipment
Dedicated equipment
Ground Surface
SOP 44R
Soil Vapor Purging and Sampling – Roxana
PROJECT NO.
60592794
AECOM
DRN. BY: smf August 2019
DSGN. BY: smf
CHKD. BY: bbb
Soil Vapor Sampling Configuration
No Tracer Gas
FIG. NO.
2




| SOP 44R<br>Soil Vapor Purging and Sampling – Roxana | PROJECT NO.<br>60592794 |
|---|---|
| AECOM | |
| DRN. BY: smf August 2019<br>DSGN. BY: smf<br>CHKD. BY: bbb — Soil Vapor Sampling Configuration With Tracer Gas | FIG. NO.<br>3 |

## 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to provide a consistent methodology for the collection of soil vapor samples from vapor monitoring points related to the Shell Roxana Soil Vapor Extraction (SVE) system. This SOP details the necessary procedures to follow so that representative samples are collected. These procedures are applicable to any soil vapor sample collected at vapor monitoring points (VMPs). Important uses of these data include:

- SVE system performance evaluation
- Hydrocarbon plume definition

## 2. Other SOPs referenced in this SOP:

- SOP No. 4 – Decontamination
- SOP No. 52 Soil Vapor Field Laboratory Screening
- SOP No. 53 – Dwyer Digital Manometer

## 3. Equipment

The following equipment is typically used for sample collection.

- Dwyer Series 475 Mark III Digital manometer (or equivalent) (0-40 in. wc.)
- Rite-in-the-Rain logbook1-Liter Tedlar® bags (new or decontaminated as outlined in SOP No. 4 Decontamination)
- Tygon® or silicone tubing (or equivalent) - 3/16” ID x 3/8” OD
- Polyethylene tubing – 3/16” ID x 1/4” OD
- Peristaltic pump – 60-350 RPM
- Battery for peristaltic pump
- BIOS DC-LITE flow calibrator or calibrated rotameter (0-500 mL/min)
- 60-mL syringe
- Crescent wrench (or equivalent hand tools)
- Ratchet with ½, 9/16, ¾, 5/8, and 15/16-inch sockets
- Metal wire brush
- Circular brush for bolt holes
- Black collection bag (trash bag)

- String for Tedlar® bags that acts like a fish stringer and keeps samples organized
- Index cards for recording VMP vacuum, time, and any additional commentary
- Laminated map of VMP locations
- Dry erase marker
- Paper towels
- Broom
- Kneeling pads
- Extra traffic cones for VMPs when stabilizing
- Bilge pump for removing water from vault to access sample ports
- New or dedicated 3-way micro valves for purging and sampling
- Toughpad® with SVE Monitoring software

## 4. Procedures

### Initial Vacuum/Pressure Measurement

Using a Dwyer Series 475 Mark III digital manometer, the initial vacuum/pressure is measured. Basic manometer operation instructions can be found in SOP No. 53 Dwyer Digital Manometer.

At VMP monitoring locations the positive fitting of the manometer shall be connected to the VMP. The negative fitting on the manometer shall remain open to the atmosphere. The pressure and time are immediately read and recorded to the nearest hundredth of an inch (or tenth of an inch if using 0-40 manometer) of water column on the Toughbook/Toughpad with SVE Monitoring software. Immediately following the recording of the vacuum/pressure measurement, the VMP shall be closed to the atmosphere.

### VMP Purging

After obtaining the initial vacuum/pressure measurements and prior to soil vapor sample collection, each monitoring location shall be purged a predetermined amount based on the volume of the VMP riser and screen. The purge volume shall be equivalent to a minimum of three VMP volumes. The actual purge volume removed shall be recorded on the appropriate field forms (Toughbook and index card). If the VMP will not yield the purge volume or if water and/or light non-aqueous phase liquid (LNAPL) are encountered during purging, this observation shall be documented in the appropriate field forms (Toughbook and index cards). The VMP screen is presumed to be submerged when this condition is encountered. No sample is to be collected and no stabilized reading is required.

To purge VMP monitoring locations, a 60-mL plastic syringe is attached to the VMP to allow the removal of the required purge volume. The syringe plunger shall be drawn back to evacuate a purge volume.

**VMP Sampling**

Upon completion of VMP purging, soil vapor sample collection using Tedlar® bags may commence. If water and/or LNAPL are encountered during sample collection, this observation shall be documented on the appropriate field forms (Toughbook and index cards). Note that samples which indicate the presence of water and/or LNAPL shall not be analyzed.

*Tedlar® Bag Samples*

Air samples for on-site screening shall be collected using a Tedlar® bag and a peristaltic pump. For VMP monitoring locations, the inlet of the peristaltic pump tubing is attached to the VMP and the positive pressure (output) side of the peristaltic pump shall be attached to the inlet side of the flow calibrator (or rotameter) using designated tubing. Prior to flow-rate adjustment and sample collection, the sample identification, samplers' initials, date, time of initial vacuum reading, and initial vacuum/pressure reading (if applicable) shall be clearly marked on the Tedlar® bag.

*Flow Rate Adjustment*

The rotameter[1] shall be used to adjust the flow rate of the peristaltic pump to allow a flow rate of 200 mL/minute. For VMPs, this adjustment shall be performed by observing the flow rate indicated by the ball height and adjusting the peristaltic pump to allow a flow rate of 200 mL/minute. *Notes: The initial settings on the pump should be set to allow for the minimum flow possible. It is important to set the flow rate as quickly as possible in order to minimize the amount of additional sample purge.* After setting the sample flow, sample collection shall be immediately initiated. Care shall be taken at this time to avoid unintentionally adjusting (by bumping or handling) the pump speed control.

*Sample Collection*

After setting the sample flow, the rotameter shall be removed from the sample train and a new or decontaminated, pre-labeled one-liter Tedlar® bag shall be connected to the tubing exiting from the output side of the peristaltic pump. A wire tie shall be used, if necessary, to make the connection between the bag and the pump a leak-proof fitting. Immediately open the valve on the

[1] Rotameters are checked and calibrated on an annual basis.

Tedlar® bag approximately one turn. *Please note: The sample time is the same time as the acquisition of the initial vacuum/pressure reading. If a vacuum/pressure reading was not collected, the sample start time shall be documented on the appropriate field forms (Toughbook and index cards).* Based on the flow rate to collect a 1-liter vapor sample, the peristaltic pump shall be allowed approximately five (5) minutes to collect the sample. Total sample collection time, which may exceed five (5) minutes, is dependent on the soil characteristics of the stratum from which the sample is being collected. Upon retrieval of the one-liter sample volume, close the valve on the Tedlar® bag, turn off the peristaltic pump, and leave the VMP open to the atmosphere to allow for venting. Place the sample bag in a black trash bag or container that will minimize exposure to sunlight. These samples are taken to the field laboratory for screening throughout the day (refer to SOP No. 52 Soil Vapor Field Laboratory Screening).

Duplicate samples shall be collected by repeating the procedure detailed above. The duplicate sample shall be collected immediately after the first sample (original sample) has been collected. Due to the nature of the coarse-adjustment valves that are typically installed on Tedlar® bags, the use of a sample splitter is not recommended and will often result in the collection of unequal sample volumes. Duplicate samples shall be obtained at a frequency of one per every twenty original samples collected.

*Post-Sample Collection*

Dismantle the sample train, dispose of all non-dedicated lines used for sample collection. New sample lines at each sample location shall be used, except for dedicated equipment. Non-dedicated, reusable equipment shall be decontaminated according to SOP No 4 Decontamination.

***Venting***

Following sample collection, VMPs are vented (opened to atmosphere) for a minimum of 15 minutes. This allows for VMP stabilization to occur.

***Final (Stabilized) Vacuum/Pressure Measurement***

After venting, a final, stabilized vacuum/pressure measurement shall be recorded. A pressure is considered to be stabilized when it does not fluctuate more than 5% in one minute. The manometer shall be allowed a maximum of one (1) minute to stabilize before the vacuum/pressure is recorded. If the manometer does not stabilize within the 1-minute period, the range in which the vacuum/pressure fluctuates over an additional one (1) minute period shall be documented on the appropriate field forms (Toughbook and index cards). The highest reading observed within the observed range shall also be recorded on the appropriate field forms (Toughbook and index cards). (*Please note: If the manometer reading fluctuates between two vacuums, the lowest vacuum observed shall be recorded on the field forms (Toughbook and* *index cards). If the manometer reading fluctuates between a vacuum and a pressure, the highest pressure observed shall be recorded on the field forms (Toughbook and index cards). If the manometer reading fluctuates between two pressures, the highest/strongest pressure observed shall be recorded on the field forms (Toughbook and index cards). In all cases, the range in the manometer readings over the additional one-minute period shall be recorded on the field forms (Toughbook and index cards).*

At VMP monitoring locations, the manometer should be turned on, zeroed, and connected to the well as it was for the initial pressure. Once the pressure is stabilized the reading should be taken. The manometer can then be removed and the VMP can be closed to the atmosphere.

Note: Any monitoring location where water/LNAPL is encountered during purge or Tedlar® bag collection, where the requisite volume cannot be purged, or where the VMP screen is submerged will not have a stabilized pressure collected. If ports are found to be submerged, it is documented both in the Toughbook and index cards.

### 1. Purpose and Scope

The purpose of this Standard Operating Procedure is to define the standard protocols for sample classification, packaging and shipping of air and soil vapor samples for Shell projects in Hartford and Roxana, Illinois. This SOP is intended to be used together with several other SOPs.

### 2. Other SOPs referenced in this SOP

- SOP No. 8 Field Reporting and Documentation
- SOP No. 26 Sample Control and Custody Procedures

### 3. Equipment

The following equipment is typically used for sample classification, packaging and shipping:

- Chain of Custody (COC)
- Sample canisters
- Sample labels
- Waterproof pen
- Permanent marker
- UN-approved shipping box
- Shipping labels
- Packing materials
- Packing tape

### 4. Procedures

**Sample Identification**

Samples collected during site activities shall have discrete and site-specific sample identification numbers. These sample IDs are necessary to identify and track each of the many samples collected for analysis during the life of a project. In addition, the sample IDs can be used in a database to identify and retrieve the analytical results received from the laboratory.

Each sample is identified by a unique code which indicates the sample location type, sample location number, sample depth, and/or date collected. The sample locations will be numbered sequentially.

An example of the sample identification number codes for a vapor monitoring port collected for field analysis will be: VMP-1-5-090110.

Where “VMP” indicates a Vapor Monitoring Port sample, “1” indicates the site location number, “5” indicates the top of the sample depth interval, “090110” indicates the MMDDYY date the sample was collected.

The sampling locations and sample sequence identifiers will be established prior to field activities for each sample to be collected. On-site personnel will obtain assistance from the Task or Project Manager in defining any special sampling requirements. Other sample identification may be specified by the Task or Project Manager on an individual project basis.

***Sample Labeling***

Sample labels will be filled out as completely as possible by a designated member of the sampling team prior to beginning field sampling activities each day. The date, time, sampler initials/signature, and the last field of the sample identification number should not be completed until the time of sample collection. All sample labels shall be filled out using waterproof ink. At a minimum, each label shall contain the following information:

- Sampler's company affiliation
- Project/Site location
- Sample identification code
- Date and time of sample collection
- Analyses required
- Canister ID
- Initial and final vacuum readings
- Sampler's signature or initials.

***Sample Handling and Shipping***

After sample collection, each container will be labeled as described above, and then stored in a fashion which will protect the stems of the stainless-steel canisters. A determination will be made prior to sample shipment if the samples will be handled as hazardous materials for shipping and transportation purposes. If the samples are to be handled as hazardous material, a trained hazardous material shipper will be required to pack and ship samples.

When shipping samples designated as hazardous material, the sample containers will be placed right side up in a UN approved shipping box with a "This End Up" sticker, two "Cargo Aircraft Only" stickers (front and back of box), and a "Flammable Gas" placard. No more than the specified number of samples will be placed in an individual box for shipment (check regulations prior to packing). If the samples are designated non-hazardous, they do not require a UN approved shipping box or stickers/placards, and there is no limit to the number of canisters shipped in a box.

A chain-of-custody (COC) form will accompany each box. The COC may be specific to the samples included within each shipping container or may be comprehensive of all samples collected during a particular day/sampling period, regardless of the number of shipping containers. Applicable package tracking number(s) should be written on the COC.

A custody seal will be placed over both flaps on both the top and bottom of the box and covered in clear tape, so custody seals are visible. The box will then be taped closed for delivery to the laboratory. Samples will be hand delivered or shipped by overnight carrier for delivery to the analytical laboratory. All samples must be shipped for laboratory receipt and analyses within specific holding times.

## Sample Documentation and Tracking

### Field Notes

Documentation of observations and data acquired in the field will be recorded on field sampling sheets, in a bound field logbook and/or in a Toughbook/Toughpad to provide a permanent record of field activities. Refer to SOP No. 8 Field Reporting and Documentation for additional information.

### Sample Chain-of-Custody

During field sampling activities, traceability of the sample must be maintained from the time the samples are collected until laboratory data are issued. The sampling team member(s) will be responsible for initiating and filling out the COC form in the field during sample collection. Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form. The COC should contain project and sample specific information. Sample labels should be checked against the COC to ensure everything intended for analysis is listed on the COC.

A member of the sampling crew shall sign the COC form over to the person or party responsible for delivery of the samples to the laboratory, retain a copy of the COC form, document the method of shipment, and send the original COC form with the samples. Additionally, an electronic copy of the COC should be forwarded to applicable project contacts (e.g., task manager, project chemist, etc.). Each time custody of the samples is transferred, the COC should be signed by both parties. Each COC should be scanned and saved to the appropriate electronic location. Refer to SOP No. 26 Sample Control and Custody Procedures for additional information about COCs.

### 1. Introduction

The purpose of this Standard Operating Procedure (SOP) is to provide a consistent methodology for the screening of Tedlar® bag soil vapor samples from the Shell projects in Hartford and Roxana, Illinois. This SOP details the necessary procedures to follow in order to ensure that valid total vapor phase hydrocarbons, oxygen, methane and carbon dioxide concentration data is collected and adequately documented. These procedures are applicable to any vapor sample collected at the Roxana site, but are particularly useful for samples collected from vapor monitoring ports (VMPs), soil vapor extraction (SVE) wells, and sub-slab (SS) ports that are located throughout the Village. Important uses of these data include:

- Evaluation of indoor air or sub-slab methane concentrations
- Screening of indoor air or sub-slab petroleum hydrocarbon concentrations
- Evaluation of the performance of the Roxana Soil Vapor Extraction System.
- Evaluation of the performance of the Rand Avenue Remediation System
- Ambient air samples can either be collected and analyzed on-location using real-time instrumentation, or collected in Tedlar® bags and analyzed at a dedicated sample screening station.

### 2. Other SOPs referenced in this SOP

- SOP No. 4 - Decontamination

### 3. Equipment

The following materials are typically used to perform sample screening, either on-site or at a dedicated sample screening station:

- Thermo Scientific TVA-2020 (TVA-2020), RAE Instruments MiniRAE 3000 (MiniRAE), and Landtec GEM-2000 (GEM-2000) real-time monitors (or similar);
- Calibration gas cylinders, including;
  - Methane in air at concentrations of 50; 500; 5,000, and 32,500 ppmv
  - Isobutylene in air at concentrations of 50 and 1,000 ppmv
  - Hydrocarbon-free air (Ultra Pure zero air)
  - 50% by volume methane/35% by volume $CO_2$
- Regulators for calibration gas cylinders

- SKC sorbent tubes (part # 226-09) used for methane determination
- ¼-inch O.D. Teflon™ or Tygon™ tubing cut to length
- 10-to-1 dilution probe (Thermo Environmental Instruments Part #CR010MR)
- Disposable 3-way plastic valves (Qosina 3-way Stopcock, 2 Female Luer Locks, Male Luer Slip [Part # 13127]) used to switch the sample between methane and total hydrocarbon analyses.
- 1-liter Tedlar® bags (new or decontaminated as outlined in SOP No. 4 Decontamination)

## *4. Procedure*

The following instruments shall be used to screen soil vapor samples:

- TVA-2020 or performance equivalent for volatile organic compounds (VOCs) and methane by flame ionization detector (FID) and for VOCs by photoionization detector (PID)
- MiniRAE or performance equivalent for VOCs by PID for low-concentration samples
- Landtec GEM-2000 or performance equivalent for methane, lower explosive limit (LEL), oxygen and carbon dioxide.

Immediately prior to use, each instrument shall undergo a calibration check. In the event that instrument accuracy is not within 15% of the designated calibration check standard concentration, the instrument shall be recalibrated. Field personnel shall follow applicable instrument operation SOP's and/or manufacturer's recommended procedures for the calibration and operation of the instruments. Calibration data shall be documented on the appropriate calibration forms for each instrument.

### Calibration Procedures Applicable to All Field Screening Analyses

Instruments shall be calibrated in accordance with applicable SOPs and/or manufacturers recommended procedures immediately prior to sample screening. If the screening instruments are to be used throughout the work day, a mid-day and end-day calibration check shall be performed. Further, the TVA-2020 instrument detectors and associated dilution probe shall be bump checked (1-point accuracy check) approximately every two hours in order to document instrument stability. In the event that a bump check indicates a deviation greater than ± 15% from the designated bump-gas concentration, a full instrument calibration shall be performed. Due to negligible (<5%) instrument drift throughout the day, the GEM-2000 and MiniRAE shall not undergo bi-hourly bump checks. Instead, if the GEM-2000 is used throughout the work day, calibration accuracy checks shall be conducted at approximately midday, and again at the conclusion of the sample event.

As stated above, calibration of the GEM-2000, TVA-2020, and MiniRAE shall be performed in accordance with applicable SOPs and/or manufacturer recommended procedures. However, the wide range of petroleum hydrocarbons and methane concentrations present at the site (i.e., greater than four orders-of magnitude) may be outside of the linear range of the TVA-2020 FID. To meet a primary data quality objective of the project (i.e., to quickly and accurately determine whether a potentially explosive condition is present at a sampling location), the FID calibration shall be based on a calibration standard that is approximately 10% of the LEL for methane (5,000 ppmv). However, additional QC procedures shall be implemented to ensure quality data for both hydrocarbon and methane concentrations.

The linearity of instrument response shall be verified by using 50 ppmv, 500-ppmv methane standards. If significant non-linear response (i.e., greater than 15% relative root mean square error) is observed, a nonlinear calibration curve shall be developed. The relative response factor for isobutylene (which is used here as a surrogate for petroleum vapors) shall be determined by using a 1,000 ppmv (nominal) isobutylene calibration standard. (1,000 ppmv is approximately 10% of the LEL for gasoline.)

Calibration shall be considered adequate when check standards are within +/- 15%. If the calibration check standards are outside that range, a second check standard shall be run and if the check standard fails again, the instrument shall be recalibrated and data obtained since the last check standard was successfully run shall be flagged as estimated values.

**Screening of Concentrated Samples Utilizing a Dilution Probe**

Because samples will need to be analyzed which are above the measurement range of the FID or which may not have sufficient oxygen content to analyze reliably, dilution of some samples shall be required prior to screening. The 10:1 dilution probe shall be calibrated using the 32,500 ppmv methane standard. Calibration of the dilution probe is considered complete when the FID response to this standard is within ± 15% of 3,250 ppmv.

The critical orifice in the dilution probe is density-dependent. As it will be calibrated using a 3.25% methane standard that has a density of 98.6% that of air, samples that have a density significantly different from that shall be subject to some level of deterministic error. Samples that have extremely high hydrocarbon or methane concentrations have the potential to have significantly varying densities, which can introduce significant error when the screening relies on the dilution probe. For example, error in excess of 10% will be present at concentrations of methane above 40% (if significant concentrations of petroleum hydrocarbons are not present).

Because the average density of petroleum hydrocarbon vapors is variable, the error is not as readily quantified for elevated concentrations petroleum hydrocarbons. Assuming an average density of 2.5 times that of air (i.e., density equivalent to isopentane), error in excess of 10% will be present at concentrations of petroleum hydrocarbon above 17% (if significant concentrations of methane are not present).

The density error associated with methane and heavier hydrocarbons have the potential to offset each other. Because the average density of measured hydrocarbon will not be known, data associated with an estimated error greater than 10% due to the presence of hydrocarbon or methane shall be flagged as estimated, rather than corrected for an assumed density. As the concentrations at which significant error is introduced are well above project action levels, estimated concentrations at these ranges are considered adequate to meet project data quality objectives.

**Screening of Samples Utilizing a Charcoal Scrubber Tube to Filter Heavy Hydrocarbons**

Use of the sorbent tube to screen out hydrocarbons other than methane affects the function of the FID instrument by lessening the flow of air through the detector. Preliminary testing indicates that a 25% to 30% reduction in instrument response occurs over the linear calibration range of the instrument. To calibrate the instrument for use of the sorbent tube, the 50, 500 and 5,000-ppmv methane standards shall be run with the sorbent tube to determine the relative response of the instrument to methane passed through the sorbent tube. The relative response factor (RRF) for each calibration standard shall be calculated as:

$$RRF = \frac{FID_{sorb}}{FID_{raw}}$$

Where;

RRF = relative response factor;

$FID_{sorb}$ = Instrument response with sorbent tube; and

$FID_{raw}$ = Instrument response to calibration standard without sorbent tube

The average RRF shall be used as a correction factor for samples analyzed using the sorbent tube. It is not necessary to correct instrument response (other than multiplying the displayed value by 10) when using the 10:1 dilution probe in conjunction with the sorbent tube. When using the dilution probe, the majority (approximately 90%) of the sample that is analyzed is actually dilution air that does not pass through the sorbent tube.

### 5. Sample Screening

Whenever possible, the soil vapor samples collected for the various work tasks shall be screened on the same day of collection. If same-day screening is not possible due to time constraints, instrument problems, etc., the samples shall be screened within 24-hours of sample collection. If samples are stored overnight, they should be placed in a black trash bag or other opaque container to prevent light from reaching the samples. Most soil vapor samples collected in Tedlar® bags shall be screened at a fixed location using the instrumentation noted above. The fixed location facilitates the use of the instrumentation, allows for a more stable environment in which to screen the samples, and provides adequate space in which to perform the screening and complete the associated documentation. However, to allow rapid screening of indoor air and sub-slab soil vapor, such samples can be analyzed on site, using the same field instrumentation. The calibration of these instruments, as outlined in **Section 3.0**, shall be performed in such a way that instrument response is most accurate in the concentration range that corresponds to project action levels.

The TVA-2020 has been configured with a switching device (disposable 3-way valve) to allow sample to be passed through an SKC carbon sorbent tube to remove petroleum hydrocarbons (i.e., site data indicate that the remainder will be primarily methane).

**Procedures for Sample Screening On Site**

- Screen air sample with GEM-2000 landfill gas analyzer. Quickly document methane %, LEL %, oxygen and carbon dioxide concentrations on the appropriate sample screening data sheet;
- Screen sample with the TVA-2020 PID or MiniRAE PID instrument and quickly document the concentration on the appropriate data sheet; and
- Screen the sample with the TVA-2020 FID without the sorbent tube and quickly record the total hydrocarbon concentration (THC) on the appropriate data sheet.
    - If THC = zero, then screening of sample is complete and it is not necessary to screen through sorbent tube; record 0.0 ppm as methane value on the appropriate data sheet.
    - If THC > zero, proceed with steps below;
- Set the TVA-2020 to sample through the SKC sorbent tube used in conjunction with the FID.

Calculate the methane concentration as;

$$C_{meth} = \frac{\text{FID}}{\text{RRF}};$$

Where

$C_{meth}$ = methane concentration (ppmv); and

FID = FID reading (ppmv)

- The petroleum hydrocarbon concentration portion of the FID response should be calculated as;

$$PHC = C_{raw} - C_{meth};$$

Where

PHC = petroleum hydrocarbon concentration (ppmv); and

$C_{raw}$ = FID reading without sorbent tube (ppmv)

**Procedures for Sample Screening at a Dedicated Sample Screening Station**

The sampling instrumentation for the dedicated sample screening station has been configured such that the TVA-2020 can be operated with a 10:1 dilution valve, if concentrations are outside the operational range of the FID (i.e., if there is insufficient oxygen to support the FID flame or if the sample is above the linear range of the instrument).

- Open the valve on the Tedlar® bag sample approximately one turn and attach to the inlet of the GEM-2000 landfill gas analyzer. Quickly document methane %, LEL %, oxygen and carbon dioxide concentrations on the appropriate sample screening data sheet;
- Screen sample with the TVA-2020 PID or MiniRAE PID instrument and quickly document the concentration on the appropriate data sheet (MiniRAE PID should be used to confirm TVA-2020 PID results as needed in case of anomalous results, very low concentrations, etc.); and
- Screen the sample with the TVA-2020 FID without the sorbent tube and quickly record the total hydrocarbon concentration (THC) on the appropriate data sheet.
    - If THC = zero, then screening of the sample is complete and it is not necessary to screen through sorbent tube; record 0.0 ppm as methane value on the appropriate data sheet.
    - If THC > zero, proceed with steps below;

- Set the TVA-2020 to sample through the SKC sorbent tube used in conjunction with the FID.

  Calculate the methane concentration as;

  $$C_{meth} = \frac{FID}{RRF};$$

  Where

  $C_{meth}$ = methane concentration (ppmv); and

  FID = FID reading (ppmv)

- If the oxygen concentration in the sample is less than approximately 14%, configure the TVA-2020 for use with a 10-to-1 dilution probe. The dilution probe will allow for the sample to be screened by FID without flameout associated with low oxygen concentration samples. If the oxygen concentration is below 14%in a sample but a flameout does not occur on the TVA-2020, it should be screened without the 10-to-1 dilution probe. The dilution probe must be separately calibrated and should be used for sample screening by FID only. If the 10-to-1 dilution probe is used, the displayed concentrations must be multiplied by 10;

- Set the TVA-2020 to sample through the SKC sorbent tube. Record the reading as the methane concentration. If the 10-to-1 dilution probe is used, the displayed concentration (FID) must be multiplied by 10, and the RRF should not be used;

- The petroleum hydrocarbon (PHC) concentration portion of the FID response should be calculated as:

  $$PHC = C_{raw} - C_{meth}.$$

- After screening of the Tedlar® bag sample is complete, set aside the Tedlar® bag for cleaning according to SOP No. 04 Decontamination.

## Procedures Applicable to All Sample Screening

Because concentrations of hydrocarbons in some samples are elevated, the carbon in the sorbent tube can be saturated with hydrocarbon relatively quickly. If possible, use historical data to screen samples from low hydrocarbon concentration samples to high hydrocarbon concentration samples to avoid sorbent tube saturation. Therefore, the following protocols are in place to assure quality data:

- The sorbent tube shall be replaced after use with 20 samples (if THC in sample was zero and sorbent tube was not used on sample, don't count as a "use");
- The sorbent tube shall also be replaced if breakthrough is observed (readily apparent) or if concentrations do not go to zero after sample is removed from analyzer inlet; and associated sample lines (Teflon™ or Tygon™ tubing), valves, etc. shall be replaced if concentrations do not return to zero after sample is removed from analyzer inlet.
- TVA-2020 PID glass bulb should be cleaned according to manufacturer's instructions. Nothing but lens cleaning paper should ever make contact with glass bulb.

### *6. Conclusion*

The screening of soil gas samples must be conducted in an organized and precise manner. The resultant data will be valid only if proper procedure and associated QA/QC is followed. It is imperative that personnel conducting the sample screening strictly adhere to the protocol detailed above. Because the samples are collected in 1-liter bags, the samples must be removed from the instrument inlets as soon as a stable reading can be documented. Failure to do so will overly deplete sample volume and result in an inadequate amount of sample volume to complete all the screening parameters. Larger bags cannot be used due to time constraints during sample collection.

### 1. Introduction to the Dwyer Digital Manometer

The Dwyer Series 475 Mark III Digital Manometer is used by personnel in the field to measure vacuum/pressure at wells throughout the Shell projects in Hartford and Roxana, Illinois. Personnel responsible for using a manometer are required to read the manufacturer's instruction manual and be trained in the operation of the instrument.

### 2. Other SOPs referenced in this SOP

None.

### 3. Zeroing the Manometer

The manometer is zeroed before each measurement. Only zero the manometer when both fittings are open to atmosphere. This is done by either depressing the "zero" button located on the front of the manometer or adjusting the knob ("zero adjust knob") on the top of the manometer (depending on which model is being used) while both positive and negative connections are open to the atmosphere. The "zero" button will automatically zero the instrument. If manometer is zeroed using the knob, the knob must be turned either clockwise (more positive) or counterclockwise (more negative) depending upon whether the manometer is reading positive or negative.

### 4. Vacuum / Pressure Measurement

The manometer shall be set on the "inches of water column" unit setting which can be done by depressing the "E/M" button and scrolling until "in/H2O" is found.

The positive fitting of the manometer shall be connected to the appropriate vacuum measurement fitting located on the well. The negative fitting on the manometer shall remain open to the atmosphere. The vacuum/pressure is immediately read and recorded to the nearest hundredth of an inch (or tenth of an inch if using 0-200 manometer) of water. The manometer can then be removed from the vacuum measurement fitting.

### 5. Maintenance and Calibration

If the "low bat" indicator is lit on the manometer display, the battery needs to be replaced. A weak battery can cause improper operation or inaccurate measurements. The battery is changed by unscrewing the flathead screws located on the bottom of the manometer and removing the battery plate. The 9-volt alkaline battery will slide out and can then be unclipped from the wiring. Install a fresh battery and secure the battery plate. When replacing the cover, be sure the rubber sealing gasket is properly seated in the gasket channel of the endcap. Note the endcap will only fit one way.

If the manometer comes in contact with water or other conditions which cause the display to either not power on, or to read incorrectly, the manometer should be sent back to the manufacturer for calibration.

Exceeding the range of the manometer will not damage it or affect calibration if the maximum pressure is not exceeded. Exceeding the maximum pressure will cause permanent damage to the sensor and may rupture the housing and/or cause injury. The maximum pressure is shown on the rear label of the manometer.

Manometers should be sent back to the manufacturer or certified calibration agency every twelve (12) months for calibration following the "Manometer Calibration Schedule." Calibration and maintenance records as well as calibration certificates are maintained on site.

### 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to define the standard procedure for recovering Light Non-Aqueous Phase Liquid (LNAPL) from groundwater monitoring wells piezometers, soil vapor extraction (SVE) wells, etc. for the Shell projects in Hartford and Roxana, Illinois. This SOP serves as a supplement to information which might be in a project Work Plan and is intended to be used together with other SOPs. This SOP is not intended to be used for situations where a dedicated pump/removal system is warranted due to the amount of product.

### 2. Other SOPs referenced in this SOP

- SOP No. 4 Decontamination
- SOP No. 8 Field Reporting and Documentation
- SOP No. 10 Well Gauging Measurements

### 3. Equipment

The following equipment is typically needed:

- Oil/Water Interface probe with 0.01-foot increments;
- Well keys;
- Hand tools;
- Photo Ionization Detector (PID);
- Lower Explosive Limit (LEL) Monitor;
- Nitrile gloves;
- Site logbook;
- Field data sheets;
- Toughbook/Toughpad (optional);
- Appropriate NAPL recovery instruments (i.e. bailers, peristaltic pump, etc.);
- Container for collecting recovered LNAPL and to measure amount recovered;
- Appropriate decontamination equipment;
- Appropriate health and safety equipment; and
- Permanent ink pen.

### 4. Groundwater/LNAPL Level Measurement Procedures

Observations made during the fluid level measurement will be recorded in the field logbook, on appropriate field forms, and/or in the appropriate program in the Toughbook/Toughpad in accordance with the procedures defined in SOP No. 8 Field Reporting and Documentation.

Appropriate personal protective equipment (PPE), as described in the Health and Safety Plan (HASP), will be worn during well opening, fluid level measurement, LNAPL recovery and decontamination. Groundwater/LNAPL level measurement procedures shall be completed in accordance with SOP No. 10 Well Gauging Measurements.

### 5. LNAPL Recovery Procedures

When LNAPL is encountered while performing fluid level measurements, LNAPL presence will be confirmed by visual observations of the interface probe or by use of a clear plastic bailer or similar.

1. At SVE well locations, verify that the valve is closed so that the well is turned off and not under a vacuum from the SVE system.
2. Record static depth of LNAPL and groundwater and calculate the LNAPL thickness. Multiply the LNAPL thickness by the area of the inside diameter of the well casing to calculate the volume of LNAPL in the well.

| Well Diameter (in) | Gallons per Foot | Liters per Foot |
|---|---|---|
| 1 | 0.041 | 0.155 |
| 2 | 0.163 | 0.617 |
| 4 | 0.653 | 2.472 |
| 6 | 1.469 | 5.561 |

3. If the thickness of the LNAPL is measureable, but not practically recoverable (check with task manager regarding potential particular recovery thresholds), LNAPL recovery will not be attempted. If LNAPL is measureable and practically recoverable, LNAPL recovery shall be attempted.
   a. If LNAPL recovery will not be performed, perform decontamination procedures in accordance with SOP No. 4 Decontamination.
4. If LNAPL recovery is to be performed, determine the most effective and practical means of recovery by use of, but not limited to, any of the following equipment:
   a. Bailer (may be dedicated or designated to a particular well);

b. Peristaltic pump (tubing may be dedicated or designated to a particular well);

c. Spill Buddy™ pump, or similar;

d. Absorbent sock.

5. Use plastic sheeting, or similar, to minimize the potential for downhole equipment, LNAPL, or recovered water coming into contact with the ground. If the primary concern is with respect to recovered material, a tub or similar may suffice.

6. Recover LNAPL.

   a. If using a bailer:

      i. Slowly lower a bottom-filling bailer into the well until it reaches LNAPL/groundwater interface;

      ii. Pull bailer out of the well.

      iii. Discharge the collected LNAPL into a designated temporary storage container[1]).

         1. If the temporary storage container is a 5-gallon bucket or similar, the bailer contents may be discharged by carefully inverting the bailer to pour the contents from the top.

         2. If the temporary storage container is a metal gas can or similar, the bailer contents shall be discharged using a sample release device (typically included in the package with the bailer).

      iv. Repeat as necessary.

   b. If using a peristaltic pump, Spill Buddy™ pump, or similar:

      i. Lower the pump intake to the appropriate depth with the LNAPL thickness.

      ii. Begin recovering LNAPL from the well.

   c. If using an absorbent sock:

      i. Lower the sock into the well no deeper than the LNAPL/groundwater interface.

[1] The temporary storage container will typically be a 5-gallon bucket at the Rand Site or within the Wood River Refinery. The temporary storage container will typically be a metal gasoline can at the Roxana Site.

ii. Allow the absorbent sock to remain in the well for a predetermined amount of time, or as specified by the manufacturer.

iii. Pull the sock from the well, collect a LNAPL/groundwater interface reading.

iv. Dispose of the sock in an appropriate container or squeeze the sock out into a temporary storage container, and place the sock back in the well, as manufacturers specifications allow.

7. Periodically take another depth to groundwater and depth to LNAPL reading, removing the LNAPL recovery equipment, if necessary.
8. LNAPL recovery activities should cease when one of the following has occurred:
   a. Only a sheen of LNAPL is observed within the bailer;
   b. No more LNAPL is practically recoverable (i.e., too much water also being collected); or
   c. A maximum of 30 minutes has been reached (assuming that 30 minutes is sufficient time to remove about 1 volume of the LNAPL within the well).
9. Take a depth to groundwater and depth to LNAPL reading upon completion of LNAPL recovery activities.
10. Record all pertinent information on the LNAPL Recovery during Well Gauging field sheet (example attached). If something on the field form does not apply, that should be indicated using "NA". Include a comment regarding the reason recovery efforts were ceased (refer to Step 8 above for guidance).
11. Containerize disposable equipment for proper disposal. Decontamination of impacted equipment or PPE may be required prior to disposal. Check with the project IDW Coordinator or designee for additional information.
12. Transfer LNAPL into the designated storage container (e.g., drum, lube cube, or similar) for staging pending recycling/recovery.

### 6. Documentation

An LNAPL recovery sheet (attached) shall be completed for each well requiring LNAPL recovery. Field data sheets shall include field personnel, date, well ID, interface probe ID, Toughbook ID, initial and final fluid levels, height of LNAPL column, volume of LNAPL in well, volume of LNAPL recovered, and any additional field observations or comments. The appropriate information may also be entered into the Toughbook (as required) in the field during gauging activities. A field logbook shall also be kept during field activities describing, among other things, LNAPL recovery procedures, LNAPL recovery amounts, and other field observations. Both the data sheets and notebook shall be legibly completed using indelible ink, and shall be signed and dated by the person completing the page.

# LNAPL RECOVERY DURING WELL GAUGING

PROJECT NO: ____________________ WELL ID: ____________________

DATE: ____________________ INTERFACE PROBE ID: ____________________

PERSONNEL: ____________________ TOUGHBOOK ID: ____________________

DEPTH TO LNAPL: ____________ ft btoc

SCREEN SATURATED? Yes No

DEPTH TO WATER: ____________ ft btoc

HEIGHT OF LNAPL: ____________ ft

DEPTH TO TOP OF SCREEN: ____________ ft btoc

VOLUME OF LNAPL: ____________ gal
(ht * 0.041 for 1" well)
(ht * 0.163 for 2" well)
(ht * 0.653 for 4" well)

**DURING LNAPL RECOVERY:**

| Time | DTP (ft btoc) | DTW (ft btoc) | Ht of LNAPL (ft) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**NOTES:**

Gauge periodically during LNAPL recovery to monitor for recharge.

LNAPL recovery will continue until one of the following has occurred:
a) Only a sheen of LNAPL is observed wi hin the bailer
b) No more LNAPL is practically recoverable (i.e., too much water also being collected); or
c) A maximum of 30 minutes has been reached

VOLUME RECOVERED: ____________ gal
(if amount recovered is not measurable (i.e., <0.5 gal), record "TRACE" above)

DEDICATED BAILER ESTABLISHED AT WELL? Yes No

**COMMENTS:**

# Illinois Environmental Protection Agency

Bureau of Land • 1021 North Grand Avenue East • P.O. Box 19276 • Springfield • Illinois • 62794-9276

## ILLINOIS EPA RCRA CORRECTIVE ACTION CERTIFICATION

This certification must accompany any document submitted to Illinois EPA in accordance with the corrective action requirements set forth in a facility's RCRA permit. The original and two copies of all documents submitted must be provided.

### 1.0 Facility Identification

Name: Equilon Enterprises LLC d/b/a Shell Oil Products US
County: Madison
Street Address: 900 South Central Ave
Site No. (IEPA): 1191150002
City: Roxana
Site No. (USEPA): ILD 080 012 305

### 2.0 Owner Information

Name: Not Applicable
Mail Address:
City:
State: Zip Code:
Contact Name:
Contact Title:
Phone:

### 3.0 Operator Information

Name: Equilon Enterprises LLC d/b/a SOPUS
Mail Address: 17 Junction Drive, PMB #399
City: Glen Carbon
State: IL Zip Code: 62034
Contact Name: Kevin Dyer
Contact Title: Senior Principal Program Manager
Phone: 618-288-7237

### 4.0 Type of Submission (check applicable item and provide requested information, as applicable)

- ☐ RFI Phase I Workplan/Report
- ☐ RFI Phase II Workplan/Report
- ☐ CMP Report;
- ☑ Other (describe): Standard Operating Procedures update

IEPA Permit Log No. B-43R
Date of Last IEPA Letter on Project: October 10, 2017
Log No. of Last IEPA Letter on Project: B-43R-CA-82,88,94,97

Does this submittal include groundwater information: ☐ Yes ☑ No

Date of Submittal: 12/20/19

### 5.0 Description of Submittal: (briefly describe what is being submitted and its purpose)

Routine Standard Operating Procedure Revisions; SOPs 5, 11, 12, 14, 17, 28, 29, 42 and 48

### 6.0 Documents Submitted (identify all documents in submittal, including cover letter; give dates of all documents)

Cover Letter; Revised SOPs

### 7.0 Certification Statement

(This statement is part of the overall certification being provided by the owner/operator, professional and laboratory in Items 7.1, 7.2 and 7.3 below). The activities described in the subject submittals have been carried out in accordance with procedures approved by Illinois EPA. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

### 7.1 Owner/Operator Certification

(Must be completed for all submittals. Certification and signature requirements are set forth in 35 IAC 702.126.) All submittals pertaining to the corrective action requirements set forth in a RCRA Permit must be signed by the person designated below (or by a duly authorized representative of that person):

1. For a Corporation, by a principal executive officer of at least the level of vice president.
2. For a Partnership or Sole Proprietorship, by a general partner or the proprietor, respectively.
3. For a Governmental Entity, by either a principal executive officer or a ranking elected official.

A person is a duly authorized representative only if:

1. the authorization is made in writing by a person described above; and
2. the written authorization is provided with this submittal (a copy of a previously submitted authorization can be used).

Owner Signature: ______________________ Date: ____________

Title: Not Applicable

Operator Signature: Kevin Ellga Date: 12/19/19

Title: Senior Principal Program Manager

### 7.2 Professional Certification (if necessary)

Work carried out in this submittal or the regulations may also be subject to other laws governing professional services, such as the Illinois Professional Land Surveyor Act of 1989, the Professional Engineering Practice Act of 1989, the Professional Geologist Licensing Act, and the Structural Engineering Licensing Act of 1989. No one is relieved from compliance with these laws and the regulations adopted pursuant to these laws. All work that falls within the scope and definitions of these laws must be performed in compliance with them. The Illinois EPA may refer any discovered violation of these laws to the appropriate regulating authority.

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44 (h))

Professional's Signature: ______________________ Date: ____________

Professional's Name Not Applicable

Address ______________________ Professional's Seal:

City ______________________

State ______ Zip Code ____________

Phone ______________________

### 7.3 Laboratory Certification (if necessary)

The sample collection, handling, preservation, preparation and analysis efforts for which this laboratory was responsible were carried out in accordance with procedures approved by Illinois EPA.

Name of Laboratory Not Applicable

______________________ Date: ____________

Signature of Laboratory Responsible Officer

Mailing Address of Laboratory

Address ______________________

City ______________________ ______________________

Name and Title of Laboratory Responsible Officer

State ______ Zip Code ____________

AECOM
100 North Broadway
20th Floor
St. Louis, MO 63110
USA
aecom.com

December 20, 2019

Mr. Kenneth E. Smith, PE
Manager, Permit Section
Illinois Environmental Protection Agency
Division of Land Pollution Control
Bureau of Land
1021 North Grand Avenue East
Springfield, Illinois 62794

**Routine Standard Operating Procedure Revisions**
**SOPs Nos. 5, 11, 12, 14, 17, 28, 29, 42 and 48**
**Equilon Enterprises LLC dba Shell Oil Products US**
**Roxana, Illinois**
**1191150002 - Madison County**
**ILD080012305**
**Log B-43R**

Dear Mr. Smith:

As part of AECOM Technical Services, Inc.'s (AECOM's) routine quality improvement process, we recently performed a review of some of the Standard Operating Procedures (SOPs) used by field staff performing activities at the investigation sites in Roxana, Illinois. Previously revised versions of SOPs have been submitted to the Illinois Environmental Protection Agency (IEPA), most recently on February 12, 2019. These procedures were originally submitted, as requested by various IEPA correspondences, within various reports and work plans related to the Investigation Site in Roxana, Illinois. We are submitting this package of updated SOPs for your reference and in accordance with proposed revisions to Sections C.7.5 and C.8.4 of the RCRA Post-Closure Permit Application[1] for the Equilon Enterprises LLC d/b/a Shell Oil Products US (SOPUS) facility at the WRB Refining LP Wood River Refinery.

The SOPs included with this submittal are listed below. The SOPs listed below were revised as indicated.

| SOP No | SOP Title | Purpose of Revision |
|---|---|---|
| 5 | Utility Clearance Procedures | Editorial and formatting |
| 11 | Groundwater Sampling & Well Wizard Operation | Editorial and formatting |
| 12 | Grouting Procedures | Editorial and formatting |
| 14 | Headspace Soil Screening | Editorial and formatting |
| 17 | Logging | Editorial and formatting |
| 28 | Soil Sampling | Editorial and formatting |

[1] Class 1* Permit Modification – Section C Revision for SOP Reference (Log No. B-43R-CA-82, CA-88, CA-94 and CA-97) was submitted to IEPA on January 29, 2018. A response to this submittal is still pending as of the date of this submittal.

| SOP No | SOP Title | Purpose of Revision |
|---|---|---|
| 29 | Soil Probe Operation | Editorial and formatting |
| 42 | Groundwater Profiling | Editorial and formatting |
| 48 | SVE Well Data Collection and Sampling | Editorial and formatting; Revision due to use of quick connect fittings |

Below is an SOP summary table, which indicates the most recent revision date for each SOP for your reference.

| SOP No. | SOP Title | Last Updated |
|---|---|---|
| 3 | Calibration & Maintenance of Field Instruments | 9/6/19 |
| 4 | Decontamination | 9/6/19 |
| 5 | Utility Clearance Procedures | 12/9/19 |
| 8 | Field Reporting and Documentation | 9/24/19 |
| 10 | Well Gauging Measurements | 9/13/19 |
| 11 | Groundwater Sampling & Well Wizard Operation | 12/9/19 |
| 12 | Grouting Procedures | 12/9/19 |
| 14 | Headspace Soil Screening | 12/9/19 |
| 17 | Logging | 12/9/19 |
| 18 | Low Flow Groundwater Purging & Sampling | 9/23/19 |
| 20 | Well Development | 8/28/19 |
| 21 | Monitoring Well Installation | 7/24/2015 |
| 23 | Quality Assurance Samples | 9/13/19 |
| 24 | Soil and Groundwater Sample Identification, Packaging & Shipping | 9/13/19 |
| 25 | Sample Containers, Preservation & Holding Times | 9/20/19 |
| 26 | Sample Control & Custody Procedures | 9/20/19 |
| 28 | Soil Sampling | 12/9/19 |
| 29 | Soil Probe Operation | 12/9/19 |
| 42 | Groundwater Profiling | 12/9/19 |
| 44R | Soil Vapor Purging & Sampling | 9/23/19 |
| 46 | Indoor Air Sampling with Canisters | 7/23/2015 |
| 47 | Sub-slab Soil Gas Installation & Sampling with Canisters | 4/4/2017 |
| 48 | SVE Well Data Collection and Sampling | 12/9/19 |
| 49 | SVE Effectiveness Monitoring at VMPs | 8/28/19 |
| 51 | Vapor Sample Classification, Packaging & Shipping | 9/20/19 |
| 52 | Soil Vapor Field Laboratory Screening | 8/29/19 |
| 53 | Dwyer Digital Manometer | 8/29/19 |
| 56 | LNAPL Recovery | 9/20/19 |

Copies of this submittal are being sent separately directly to Amy Butler (IEPA, Springfield) and Gina Search (IEPA, Collinsville).

If you have any questions, please contact Wendy Pennington at wendy.pennington@aecom.com (314-802-1196) or Bob Billman at bob.billman@aecom.com (314-802-1122).

Sincerely,

Wendy Pennington
Project Engineer
AECOM
T: 314-802-1196
M: 314-452-8929
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Robert B. Billman
Senior Project Manager
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T: 314-802-1122
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**encl:** Revised SOPs 5, 11, 12, 14, 17, 28, 29, 42 and 48
RCRA Corrective Action Certification Form

**cc:** Amy Butler (IEPA - Springfield, IL)
Gina Search (IEPA - Collinsville, IL)
Kevin Dyer (SOPUS)
Dan Kirk (SOPUS)
Erika Reynolds (Greensfelder Hemker)
Project File
Repositories (Roxana Public L brary, website)

## 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to define the standard procedures for subsurface utility clearance that will allow staff to work safely and prevent damage to utility systems. This procedure provides descriptions of equipment and procedures necessary to properly clear utilities prior to beginning subsurface field activities for Shell projects in Hartford and Roxana, Illinois.

This document also defines the procedure for contacting the applicable "one-call" service for locating underground utilities. One-call, Joint Utility Locating Information for Excavators (JULIE), is a public service provided by individual states as a single point of contact for requesting a utility locate from a majority of underground utilities. This service is primarily for locating utilities on public properties and right-of ways.

Utility clearances should be completed prior to the start of any work in the area that could feasibly result in contact with or damage to that utility. Additional information and a checklist can be found in AECOM Procedure No. S3AM-331-PR1 Underground Utilities. Please use S3AM-331-PR1 in conjunction with this SOP.

Utility clearances are supposed to be completed/submitted by the company doing the drilling/excavating but they will likely require information from us. We should also confirm, in the field, that utilities have been marked. We should also get locate ticket number and information from subcontractor once it's available.

## 2. Other SOPs Referenced in this SOP

- SOP No. 8 – Field Reporting and Documentation

## 3. Equipment

Equipment typically used during utility clearance procedures:

- Project map
- Known utility map
- Marking paint
- Stakes or flags
- Permanent marker
- Coloring pencils or permanent marker in different colors

- Measuring tape and/or wheel
- Other related field paperwork, as needed.
- Camera
- Surveyors, as needed

### *4. Location Marking*

Prior to utility clearance, locations to be drilled or excavated should be marked by the task manager, field personnel scheduled to complete the work, or a knowledgeable assigned designee. Per one-call guidelines excavation areas should be marked either a) with stakes or flags with the necessary radius to be cleared marked on the stake or flag or b) with white marking paint (black paint may be substituted when necessary). When using paint, the extent of the area to be cleared should be marked, if possible.

As a note, fluorescent paint should not be used when DyeLIF technology is to be used.

When marking locations, initial adjustments to locations should be made based on visible utilities such as overhead power lines, sewers and other utility corridors. As a general rule drill rig masts and excavating equipment must stay at least 50 horizontal feet away from overhead utilities unless/until the voltage and height of the system has been determined. Depending on the voltage of the overhead lines or site/client requirements, a lesser distance may be used. The table below summarizes the typical minimum distances from overhead power lines. Additional information can be found in AECOM Procedure No. S3AM-302-PR1 Electrical Safety. Please use S3AM-302-PR1 in conjunction with this SOP.

| **Minimum Distances from Power Lines** | |
|---|---|
| **Nominal System (kV)** | **Minimum Required Distance (feet)** |
| 0-50 | 10 |
| 51-100 | 12 |
| 101-200 | 15 |
| 201-300 | 20 |
| 301-500 | 25 |
| 501-750 | 35 |
| 751-1,000 | 45 |

Operations adjacent to overhead power lines are prohibited unless the power has been shut off (such as lockout/tagout), the minimum distance above has been observed, or the power lines have been isolated (such as using insulating blankets) by the owner of the lines.

### 5. One-Call

The purpose of the one-call system is to alert member utility companies to a planned drilling or excavating project. The one-call system will inform the person making the utility call which member companies will be notified. Additional contacts may be necessary if suspected utility providers in the area of the proposed work are not members of the public one-call system. Illinois has their own one-call number Illinois: 1-800-892-0123). Illinois requires the subcontractor actually performing the drilling or excavating to make the initial call (e.g., Illinois), and each drilling subcontractor needs to have their own locating (in this case JULIE) ticket number.

Once a one-call notification has been placed the utility companies typically have 48-hours (2 business days) to respond. The time does not include weekends or observed holidays. Once a one-call has been placed work should be ready to start within 10 working days. Once work has begun, renewal of utility locates is determined by an individual state’s regulations. If the markings of utility locations are destroyed or removed before excavation/drilling commences or is completed, the one-call ticket must be renewed.

A joint meet may also be requested if the area of the proposed work is large and/or complicated. Member utilities must be given 48-hours prior to the joint meet to schedule a representative to attend. Following the joint meet, an additional 48 hours must be allowed for the utility companies to mark their utilities.

The following information should be provided when making a one-call:

- Identification of who is conducting the work as well as any subcontractor such as a drilling or excavating firm. The contact information for the person responsible along with a phone number where they can be easily reached is a minimum.
- Type of work being conducted (e.g. drilling or excavating).
- Location of work being conducted described as best as possible. Addresses in conjunction with relation to buildings or other property features when possible should be used. Other forms of locating include distances and directions from intersections.
- Whether or not a joint meet is required.
- The time frame expected for work to begin.

The following information should be recorded and kept available after the one-call has been made:

- Ticket serial number
- Utilities one-call will notify
- Time and location of joint meet (if applicable)
- Time and date by which utilities are to be cleared
- Log of utilities which have been cleared, either from markings on ground at the location or locator calling to confirm.
- Re-notification date when activities extend beyond 28 days.

Industrial facilities often are responsible for utility locates on their own property and will not be covered by a one-call. Field personnel should coordinate with their contact at such a facility in order to check for known utilities under control of the facility and for any additional clearance efforts which may be required.

When possible, identify the size of underground utilities being marked. The general rule is that the accuracy of marking, from the center of the utility, is the width of the utility plus 1.5-feet. Certain utility companies may require a greater distance from their lines.

The following are the colors from the uniform color code and marking guidelines:

- White (or Black) – Proposed excavations
- Pink – Temporary survey markings
- Red – Electric power lines, cables, conduit and lighting cables
- Yellow – Gas, oil, steam, petroleum or gaseous materials
- Orange – Communication, alarm or signal lines, cables or conduit
- Blue – Potable water
- Purple – Reclaimed water, irrigation and slurry lines
- Green – Sewers and drain lines

These colors shall be used by both the company requesting the utility locate and the member companies marking underground utilities.

### 6. Private Utility Clearance

Private utility clearance involves using ground penetrating radar (GPR) and/or electromagnetic (EM) technologies to check for utilities prior to beginning secondary utility clearance and excavation or drilling activities. GPR and EM should be performed by a trained and qualified subcontractor.

### 7. Secondary Utility Clearance

Secondary utility clearance involves using an air knife, a hand auger, a post-hole digger and/or a shovel to check for utilities prior to beginning the excavation or boring.

*Air Knife/Vacuum Excavation*

Air Knife/Vacuum Excavation operations involve air/water jetting combined with a high suction vacuum to create a boring or trench of specified dimensions. Single point borings need to have the hole cleared to below the depth of known utilities in the area and to a diameter 3 inches greater than the diameter of the tools penetrating the ground surface (per Shell guidelines). If the depth of utilities in the area is not known, a minimum depth of 5 to 10 feet can be used, depending on client/property owner requirements.

As an alternative, a “V-trench” or a triangle configuration of air-knife holes can also be used to clear a location. If the air-knife is to be completed in a triangle formation, the air knife holes should be completed in sets of three in as tight a triangle as the boring size will allow, with the center of the boring to be completed at the center of the triangle. Whichever method is selected, the air knife boring(s) must be located so that the absence of underground utilities can be confirmed. Once the location is confirmed as being clear, the air knife hole(s) or trench should be backfilled with air knife spoils or an inert material, such as silica sand or flowable fills, unless drilling is to commence right away. Refer to the scope of work or other project documentation for other backfill options.

*Hand Auger*

Due to access, availability or other reasons, air knifing/vacuum excavation may not be an option. If this is the case, hand augers may be used to clear a location. Due to the size of the hand auger bucket, multiple hand auger holes may be necessary to clear a location for a single boring. If multiple hand augers are necessary, the best option is to complete hand auger holes in sets of three in as tight a triangle as the boring size will allow, with the center of the boring to be completed at the center of the triangle. The same depth requirement for clearance applies to hand auger holes as it does for air knifing/vacuum excavation. Once the location is confirmed as being clear, the hand auger hole(s) should be backfilled with hand auger spoils or an inert material, as described for air knifing/vacuum excavation holes.

*Post-hole digger / Hand Shovel*

As a last choice, conventional means such as a post-hole digger or hand shovel may be used to clear a location. This option is generally best only when any known utilities are very shallow, or the surface material is extremely coarse (large gravels and rocks). Hand shovels and post-hole diggers have a higher chance of damaging weaker utilities, so caution should be taken when used. If deeper clearance than a foot or two is necessary, either an air knife or hand auger should be used for utility clearance. Other procedures/protocols mentioned above still apply.

### 8. *Final Boring Placement*

To the extent possible, excavation or drilling work should not be performed within 5 feet of a confirmed or suspected utility or other subsurface structure. The minimum distance to perform work from any utility may vary and should be confirmed with the utility company. If drilling will be performed within 5 feet of a confirmed or suspected utility, contact the utility company/companies to discuss any potential precautions that should be taken. Shell projects require the secondary utility clearance hole be cased if within 10 feet of a gas line. Casing may also be used if the sidewall caves in or water fills in the secondary utility clearance hole. If an unmarked utility is encountered during secondary utility clearance, contact the project/task manager and/or site contact/property owner for further guidance and information.

### 9. *Documentation*

Once private utility locating personnel and one-call personnel have marked any utility lines in the vicinity of the work to be performed, document the markings for the project file. Documentation can include, but is not limited to:

- Photographs showing the markings and surrounding area,
- Field sketch of the vicinity including work locations and utility lines marked,
- Updating the area basemap (AutoCAD) with utility information, if necessary/possible,
- Private utility clearance report from the trained and licensed subcontractor,
- One-call ticket printout documenting the utilities contacted, etc.
- Shell Borehole Clearance form
- AECOM Procedure S3AM-331-PR1 Underground Utilities Checklist
- AECOM Procedure S3AM-302-PR1 Electrical Safety Checklist

Refer to SOP No. 8 Field Reporting and Documentation for further guidance. Documentation should be kept with the project file for future reference.

## 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to describe equipment and field procedures necessary to collect groundwater samples and operate the dedicated Well Wizard pumps for monitoring wells in the Shell Wood River Refinery (WRR) groundwater monitoring program.

## 2. Other SOPs Referenced in this SOP

- SOP No. 3 – Calibration and Maintenance of Field Instruments
- SOP No. 4 – Decontamination
- SOP No. 8 – Field Reporting and Documentation
- SOP No. 23 – Quality Assurance Samples
- SOP No. 24 – Soil and Groundwater Sample Identification, Packaging and Shipping
- SOP No. 25 – Sample Containers, Preservation and Holding Times
- SOP No. 26 – Sample Control and Custody Procedures

## 3. Equipment

Equipment typically used during well purging and sampling:

- Well keys
- Air monitoring equipment
- Water level indicator or water/product interface probe with 0.01-foot increments
- Assorted tools (safety knife, screwdriver, etc.)
- Water quality parameter meter(s) with appropriate sensors (Hanna/Lamotte or similar)
- Calibration fluids
- Paper towels or Kimwipes
- Calculator
- Field Logbook
- Waterproof permanent marker or pen
- Field data paperwork
- Panasonic Toughbook/Toughpad, or similar electronic data entry device

- Plastic buckets
- 55-gallon drums or truck-mounted tank for holding purged water
- Plastic sheeting, plastic tote or other means of secondary containment to use during purging and sampling
- Compressor
- Controller for the QED Well Wizard pumps (MP10 or similar)
- Air hoses and connections/splitters
- Appropriate health and safety equipment
- Well construction information sheet
- Appropriate decontamination equipment
- Cooler with ice
- Sample jars and labels. Sample bottles with preservatives added will be obtained from the analytical laboratory. Several extra sample bottles will be obtained in case of breakage or other problems.
- Plastic sheeting, plastic tote or other means of keeping sample bottles off the ground and clean.

### *4. Sampling Procedures*

This section provides the step-by-step procedures for collecting groundwater samples in the field via dedicated Well Wizard pumps. Observations made during groundwater sample collection should be recorded in the field notebook, on field data sheets and/or in the Toughbook/Toughpad in accordance with procedures described in SOP No. 8 Field Reporting and Documentation.

1. Before any purging or sampling begins, all reusable well probes, and other sampling devices shall be decontaminated. Mobile decontamination supplies will be provided so that equipment can be decontaminated in the field (SOP No. 4 Decontamination).
2. Electronic equipment used during sampling includes water quality parameter meter(s), and a water level or water/product interface measurement probe. Before going into the field, the sampler shall verify that these instruments are operating properly. The water quality parameter meter(s) require calibration prior to use every day. Calibration times and readings will be recorded in the field notebook and/or on daily calibration sheets to be kept in the project file. Specific instructions for calibrating the field instruments are

provided in SOP No. 3 Calibration and Maintenance of Field Instruments and the instrument manuals.

3. Before well purging begins, the following procedures will be performed at each well:
    - The condition of the outer well casing, concrete well pad, protective posts (if present), and any unusual conditions of the area around the well will be noted on the field sheets and/or in the Toughbook/Toughpad.
    - The presence of a working lock and its condition (e.g., locked) will be verified.
    - Clean plastic sheeting or other form of secondary containment for purgewater collection will be placed around the well.
    - The well will be opened.
    - Appropriate readings will be taken in the breathing zone with a flame ionization detector (FID) or photoionization detector (PID) according to the Health and Safety Plan. The reading will be recorded on the field sheets and/or in the Toughbook/Toughpad.
    - The condition of the inner well cap, tubing connections, and casing will also be noted.
4. Groundwater elevations will be measured to the nearest 1/100 foot at each monitoring well using an electronic water level or interface probe. The groundwater measurements, screened intervals, and total monitoring well depth will be recorded on the field data sheet and/or in the Toughbook/Toughpad. A detailed description of monitoring well gauging activities, including well head vapor readings, is provided in SOP No. 10 Well Gauging Measurements.
5. The presence of nonaqueous-phase liquids (NAPL), dense or light, will be determined using an oil-water interface probe and confirmed by observation on the probe or via clear bailer. If NAPL is identified, its thickness will be measured. The presence of light or dense NAPLs will preclude sampling of the groundwater itself. Note it, close the well and continue to the next well.
6. Following measurement of the static water levels, the monitoring wells will be purged of at least three (3) well volumes. The well purge volume is calculated with one of the following equations:

**If a packer is present to isolate the water column around the screened interval**:

[(TD of well) – (bottom of packer)] x (ft to gal conversion[1]) x 3 = __________ gallons
(ft btoc) (ft btoc) (see footnote) # Vols Calculated Purge Volume

**If no packer is present and the full water column height is to be considered**:

[(TD of well) – (WL)] x (ft to gal conversion[1]) x 3 = __________ gallons
(ft btoc) (ft btoc) (see footnote) # Vols Calculated Purge Volume

If work is being performed at a group of wells, perform this calculation for all wells in the group prior to proceeding to the next step.

7. Set up the compressor and connections as follows to maximize groundwater flow and minimize sampling time:

   a. If a packer is present in the well, attached the pressure gauge (black hose with gauge attached) to the smaller quick-connect fitting at the well head. If no packer is present, skip this step. Attach one end of the air hose to the pressure gauge hose, if present, or the larger quick-connect fitting at the well head. If only one well is being sampled, use the vented air hose, with the vent at the well head. If multiple wells are being sampled at a time, do not use the vented air hose for either well.

   b. Attach the other end of the air hose to the "out" connection of the control box. If multiple wells are being sampled at a time, connect the "+" splitter to the "out" connection of the control box and connect the air line from each well to the splitter.

      - If you use the splitter to sample multiple wells at a time at a cluster of 4 wells (e.g., P-89A, P-89B, P-89C, P-89D), the sequence is typically as follows but will vary from well cluster to cluster depending on operational packers and purge volume calculations:

        i. Purge "B" and "C" well first. Typically, the volume required to be removed from "A" is twice that to be removed from "C".

        ii. Sample "C" well first.

        iii. Once "C" well is sampled, disconnect the air hose from the "C" well and move to "D" well

iv. Begin purging “D” well.

v. Sample “D” well.

vi. Once “D” well is sampled, disconnect the air hose from the “A” well and move to “A” well.

vii. Begin purging “B” well.

viii. Sample “A” well.

ix. Once “D” well is sampled, disconnect both ends of the air hose connected to “D” well.

x. Sample “B” well.

- Typically, using the splitter to sample multiple wells at a time can make for fast paced work. Make sure to keep watch of the 5-gallon buckets used to collect/measure purged water to prevent overflow.

8. Verify the compressor has enough gasoline in its tank to perform the sampling to be done. Connect the compressor air hose to the “in” connection of the control box.
9. Verify the compression ring in the open end of the elbow joint for the tubing at the well head is in good condition. Replace if necessary.
10. Place the elbow joint and accompanying rigid tubing to the water tubing at the well head and tighten the fitting for a secure fit.
11. Place secondary containment (shallow totes or plastic sheeting) on the ground and place the 5-gallons buckets to collect the purged water within the secondary containment.
12. Prepare the sample bottles and labels for each sample to be collected.
13. Start the compressor, turn the control box on (MP-10 or similar), and begin purging the well(s).
14. Purging will continue until the required volume of water has been removed (minimum 3 well volumes). If the well is pumped dry during purging, consult the Task Manager.
15. Once the appropriate amount of water has been purged from the well, collect a sample for groundwater quality parameters:

[1] For a 1-inch diameter well, use 0.0408 gal/ft; For a 1.5-inch diameter well, use 0.0918 gal/ft; For a 2-inch diameter well, use 0.163 gal/ft; For a 4-inch diameter well, use 0.652 gal/ft; For a 6-inch diameter well, use 1.468 gal/ft.

- Rinse the sample cup with distilled water and fill with sample water.
- Immerse the probes in the sample and swirl gently, keeping the probes in the sample until the display stops flashing or readings have generally stabilized.
- Record the water quality parameters of the sample.
- Repeat previous steps if additional readings are to be collected.
- When finished, decontaminate the sample cup and sonde as described in SOP No. 4 Decontamination.

16. Samples for chemical analysis will be collected within 24 hours after purging is completed. For quickly recovering wells, a sample may be collected immediately after purging is completed.

    The following sampling procedure is to be used:

    a) Identification labels for sample bottles will be filled out for each well.
    b) Bottles will be kept clean and off the ground using plastic sheeting, plastic tote or similar.
    c) If collecting a sample for VOC analysis, attempt to obtain the ideal flow rate of 200-300 mL/minute. VOC sample vials should be completely filled so the water forms a convex meniscus at the top, then capped so that no air space exists in the vial. Turn the vial over and tap it to check for bubbles in the vial which indicate air space. If air bubbles are observed in the sample vial, repeat the procedure until no air bubbles appear (reattempting zero headspace within a sample vial may be performed up to 3 times prior to a new sample vial being required).
    d) After VOC sample bottles are filled, sample bottles for additional analysis should be filled in the order given below:
        - Gas sensitive parameters (e.g., ferrous iron, methane, alkalinity)
        - Semivolatiles organic compounds
        - Petroleum hydrocarbons
        - Total metals
        - Any filtered analytes (use in-line filters if possible) – about 100-1000 mL should be purged through the filter prior to sample collection.

e) Fill bottles for metals and general minerals almost full.

f) Time of sampling will be recorded in the field book, Toughbook/Toughpad and/or on the groundwater sampling data sheet.

g) Replace "L" tubing within well

h) The well cap will be replaced and well locked.

i) Field documentation will be completed, including the chain-of-custody (SOP No. 26 Sample Control and Custody Procedures).

j) Place the sample containers on ice in a cooler to maintain the samples at approximately 4ºC as described in SOP No. 25 Sample Containers, Preservation and Holding Times.

k) Begin chain-of-custody procedures. A sample chain-of-custody form is included in SOP No. 26 Sample Control and Custody Procedures. Ship the cooler to the laboratory for analysis within 24-48 hours of sample collection in accordance with the procedures described in SOP No. 24 Sample Classification, Packaging and Shipping.

l) Decontaminate the sample equipment as summarized below and described in detail in SOP No. 4 Decontamination.

m) If a field sampling data sheet for groundwater samples will be completed with information from each sampling location, the data sheet will be completely filled in. If items on the sheet do not apply to a specific location, the item will be labeled as not applicable (NA).

n) Field notes shall be kept in a bound field book and/or the Toughbook/Toughpad. Refer to SOP No. 8 Field Reporting and Documentation for additional information.

17. Once purging and sampling is completed, either turn off the compressor, or move the air hose connection to the next well to be sampled (refer to **Step 7** above for clarification).

The well sampling order will be dependent on expected levels of contamination in each well, if known, and will be determined prior to sampling. Sampling will typically progress from lesser contaminated wells to more contaminated wells. Quality assurance/quality control (QA/QC) samples will be collected during groundwater sampling (SOP No. 23 Quality Assurance Samples).

*5. Decontamination*

Decontamination of any reusable field/sampling equipment will be performed as described in SOP No. 4 Decontamination.

## *1. Objective*

The purpose of this Standard Operating Procedure (SOP) is to define the procedures and equipment for the grouting of borings following their completion for Shell projects in Hartford and Roxana, Illinois. If a monitoring well or piezometer is to be installed in the boring refer to the procedure outlined in SOP No. 21 Monitoring Well Installation. If a soil vapor monitoring point is to be installed in the boring, refer to the procedure outlined in SOP No. 57 Soil Vapor Monitoring Point Installation.

## *2. Other SOPs Referenced in this SOP*

- SOP No. 8 – Field Reporting and Documentation

## *3. Equipment*

The following is the typical equipment for grouting a borehole:

- Portland Type I or II Cement
- Powdered bentonite
- Potable water
- Appropriate health and safety equipment as specified in the project/task Health and Safety Plan (HASP)
- Log book and/or boring log sheets
- Drums or other suitable container for mixing of grout

## *4. Procedures*

A standard mixture of cement-bentonite grout will consist of the following ratio:

- 1 (94 lb) sack of Portland cement,
- Powdered bentonite (as permitted by state regulations), and
- 7 to 15 gallons of potable water.

A standard mixture of high-solids bentonite grout will consist of the following:

- Powdered bentonite (as permitted by state regulations), and
- 7 to 15 gallons of potable water.

The allowable grouting compound should be confirmed with the regulatory agency or permit, if applicable.

The grouting procedures for either type of grout consist of the following:

1. Mix the bentonite and water first to a creamy consistency.
2. Slowly add the Portland Cement (if used). The amount of bentonite or water can be varied to control the consistency and pumpability of the mix.
3. Pump the mixture through tremie pipe or drill rods placed down the boring to displace any water or drilling fluids.
4. Withdraw rods or piping when grout has reached surface.
5. Repeat steps 1 – 4 as augers/drill pipe are removed.
6. Grout the remaining open boring to the surface after the augers are removed. The grout will be tremied into the borehole until it is completely filled.
7. After the grout sets for 24 hours it will be checked for settlement. If necessary, additional grout will be added to top off. Hydrated bentonite chips, or similar, may also be used to top off.
8. Add surface seal (asphalt or concrete) as necessary.

### *5. Documentation*

Documentation will be written in the field book according to SOP No. 8 Field Reporting and Documentation and may include, but is not limited to, the following:

- Date
- Time
- Personnel
- Weather
- Subcontractors
- Health and Safety monitoring equipment and readings
- Portland and bentonite bag counts
- The quantity and composition of the grout
- Start and completion dates and times
- Discussion of all procedures and any problems encountered during drilling/grouting.

## *1. Objective*

The purpose of this Standard Operating Procedure (SOP) is to define the standard procedure for preforming field headspace screenings. Volatile Organic Compound (VOC) field headspace screenings will be performed on selected soil samples to obtain preliminary estimates of VOC concentrations. This qualitative data will be used as criteria in selecting soil samples from locations where collection depths have not been predetermined. This document defines the standard procedure for headspace soil screening for Shell projects in Hartford and Roxana, Illinois.

## *2. Other SOPs Referenced within this SOP*

None.

## *3. Equipment*

The following equipment is typically required.

- Resealable zipper bag, or glass jars with plastic lids.
- Photoionization detector (PID)
- Permanent Marker
- Watch (or similar to keep time)

## *4. Procedure*

The following general procedure is to be followed:

1. Obtain approximately 1/2 qt of soil and place in clean resealable zipper bag or glass jar with plastic lid. Immediately seal the zipper bag or jar. Record the boring location and sample depth on the bag or jar. **Note:** The selected drilling technology and/or defined sampling plan may limit volume of soil available for field headspace screening.
2. Break soil into about 1 in. sized particles by squeezing the bag/shaking the jar, taking care not to compromise the seal.
3. Place sample in a location where it can be left undisturbed for a minimum of 5 minutes. If the temperature is less than $35^{o}$F, place the sample sample in a heated vehicle or other location for a minimum of 5 minutes.
4. Measure ambient air background VOC concentrations.

5. After at least 5 minutes has elapsed, obtain PID reading from bag or jar headspace by opening a space in the seal just large enough to allow the PID probe to enter unobstructed. Continue monitoring until PID readings drop to background concentrations or stabilize. **Note:** Soil with high water content or significant contamination may require frequent replacement of moisture/dust trap on PID or use of other types of filters for PID readings.
6. Record highest PID reading measured on the field boring log and/or in the field logbook.
7. Archive or dispose of soil per site field sampling plan, work plan or outlined scope of work.

## *1. Objective*

The purpose of this Standard Operating Procedure (SOP) is to define the standard procedure for logging of soil and rock samples both for environmental and geotechnical characterization purposes for Shell projects in Hartford and Roxana, Illinois. This procedure provides descriptions of equipment and field procedures necessary to log soil and rock samples.

## *2. Other SOPs Referenced within this SOP*

- SOP No. 8 – Field Reporting and Documentation

## *3. Equipment*

The following equipment is typically used during soil and rock sample logging:

1. USCS Chart
2. Boring logs
3. Tape measure
4. Pocket Penetrometer, if available
5. Field data sheets/bound field logbook
6. Waterproof pen and/or permanent marker
7. Munsell Color Chart
8. Water and clean VOA
9. HCL

## *4. Sample Descriptions*

This section provides an approach for describing (logging) soil samples in the field. General observations made before, during, and after field activities should be recorded in a bound field logbook in accordance with the procedures defined in SOP No. 8 on Field Reporting and Documentation:

### *Soil*

The soil's description should include as a minimum:

1. Apparent strength (for fine-grained soils) or density (for coarse-grained soil) adjective
2. Water content condition adjective
3. Color description (using Munsell soil chart when available)

4. Descriptive adjective for main soil type
    - Particle-size distribution adjective for gravel and sand
    - Plasticity adjective and soil texture (silty or clayey) for inorganic and organic silts or clays
5. Minor soil type name with "y" added (if ≥ 30 percent)
6. Main soil type's name (all capital letters)
7. Geologic name, if known (in parenthesis or in notes column)
8. Descriptive adjective, some or trace, for minor soil type if ≤ 30 percent. See page 9 of 20 for more information on when to use, "some", "trace", or "with".
9. Minor soil type(s)
10. Inclusions
11. The Unified Soil Classification System (USCS) Group Name and Symbol appropriate for the soil type in accordance with ASTM D 2487, with few exceptions, and (symbol in parenthesis)

The various elements of the soil's description should be stated in the order listed above.

Examples:

| | |
|---|---|
| Fine-grained soils: | Soft, wet, gray, high plasticity CLAY, trace f. sand – Fat CLAY (CH); (Alluvium) |
| Coarse-grained soils: | Dense, moist, brown, medium to fine grained silty SAND, trace fine gravel to coarse sand – Silty SAND (SM); (Alluvium) |

When changes occur within the same soil layer, such as change in apparent density, then this change must be indicated ("Becomes XYZ"). Note that only those aspects of the soil description that are different from the description of the overlying soil are mentioned. Note also the depth at which some characteristic is no longer present must be noted ("XYZ grades out").

*Apparent Strength and Density*

Strength and density descriptive terms are related to blow count resistance using a 2-inch OD, 24-inch long split barrel sampler and standard penetration tests (a 140-pound hammer dropped 30-inches) (ASTM D 1586-84). Strength can also be related to pocket penetrometer resistance. Use the values and descriptions in the table presented below to determine the strength or density.

**Strength & Density**

| Cohesive Clays (clays & silts) | | | Non-cohesive Granular Soils (sands & gravels) | |
|---|---|---|---|---|
| **Blow Count** | **Pocket Penetrometer (tsf)** | **Strength** | **Blow Count** | **Density** |
| 0-2 | <0.25 | Very soft | 0-4 | Very loose |
| 3-4 | 0.25-0.50 | Soft | 4-10 | Loose |
| 5-8 | 0.50-1.0 | Medium stiff | 11-30 | Medium dense |
| 9-15 | 1.0-2.0 | Stiff | 31-50 | Dense |
| 16-30 | 2.0-4.0 | Very stiff | >50 | Very dense |
| >30 | >4.0 | Hard | | |

A blow count of >50 for a 12-inch interval[1] constitutes spoon refusal and the sample should be terminated at that time.

The strength of the soil can be determined without blow counts using the following guide:

H Hard Soil – Brittle or tough, may be broken in the hand with difficulty. Can be peeled with a pocketknife.

VST Very Stiff – Soil can barely be imprinted by pressure from the fingers or indented by thumbnail.

ST Stiff – Soil can be imprinted with considerable pressure from fingers or indented by thumbnail.

M Medium Stiff – Soil can be imprinted easily with fingers; remolded by strong finger pressure.

So Soft – Soil can be pinched in two between the thumb and forefinger; remolded by light finger pressure.

Vso Very Soft – Soil exudes between fingers when squeezed; specimen (height = 2 x diameter) sags under its own weight.

[1] Blow counts are recorded for four separate 6-inch sections when driving a 2-foot long split spoon sampler. The blow counts for the second and third 6-inch section should be used to assist with the strength/density determination. The blow counts for the first section should NOT be used due to possible disturbed soil from the augers. The blow counts for the fourth section should NOT be used due to potential compaction from the split spoon.

*Water Content*

The amount of water present in the soil sample or its water content adjective should be described as dry, moist, or wet as follows:

**Descriptors for Water Content (moisture)**

| Description | Condition |
|---|---|
| Dry | No sign of water and soil is dry to the touch |
| Moist | Signs of water and soil is relatively dry to the touch |
| Wet | Signs of water and the soil definitely wet to the touch; granular soil exhibits some free water when densified |

The descriptor "damp" should not be used (use "moist"). The descriptor "saturated" should not be used (use "wet").

*Color*

The colors should be assigned consistent with a Munsell Color Chart and should be described when the sample is first retrieved at the soil's as-sampled water content (the color will change with water content). A Munsell Color Chart is provided as Appendix A. When the soil is marked with spots of color, the term mottled can be applied with the following descriptors:

**Descriptors for Mottling**

| Abundance | Size | Contract |
|---|---|---|
| f: few (<2%) | fine (<5 mm) | faint |
| c: common (2%-20%) | medium (5-15 mm) | distinct |
| m: many (>20%) | coarse (>15 mm) | prominent |

Soils with a homogeneous texture but having color patterns, which change and are not considered mottled, can be described as streaked.

*Soil Types*

The constituent parts of a given soil type are defined on the basis of texture in accordance with particle-size designators separating the soil into coarse-grained, fine-grained, and highly organic designations.

*Coarse-grained (gravel and sand)*

Soils with more than 50% of the particles larger than No. 200 sieve (0.074 mm). The soil components are described on the basis of particle size as follows:

**Grade Limits and Grade Standards**

| Grade Names | |
|---|---|
| **Name** | **Grain Size** |
| Sand | |
| Fine | #200 to #40 sieve |
| Medium | #40 to #10 sieve |
| Coarse | #10 to #4 sieve |
| Gravel | |
| Fine | #4 sieve to ¾-inch |
| Coarse | ¾-inch to 3-inches |
| Cobbles | 3-inches to 12-inches |
| Boulders | >12-inches |

The particle-size distribution is identified as well graded or poorly graded. Well-graded coarse-grained soil contains a good representation of all particle sizes from largest to smallest, with ≤12 percent fines. Poorly graded coarse-grained soil is uniformly graded with most particles about the same size or lacking one or more intermediate sizes, with ≤12 percent fines. A table of USC symbols and names for coarse-grained soils is presented below.

**USCS Symbols and Names for Coarse-grained Soils**

| USCS Symbol | Typical Names |
|---|---|
| GW | Well graded gravels, gravel-sand mixtures, little or no fines |
| GP | Poorly graded gravels, gravel-sand mixtures, little or no fines |
| GM | Silty gravels, gravel-sand-silt mixtures |
| GC | Clayey gravels, gravel-sand-clay mixtures |
| SW | Well graded sands, gravelly sands, little or no fines |
| SP | Poorly graded sands, gravelly sands, little or no fines |
| SM | Silty sand, sand-silt mixtures |
| SC | Clayey sands, sand-clay mixtures |

The following field identification tests can be used to estimate the grain size distribution of coarse-grained soils:

<u>Feel and Smear Tests</u> – A pinch of soil is handled lightly between the thumb and fingers to obtain an impression of the grittiness or of the softness of the constituent particles. Thereafter, a pinch of soil is smeared with considerable pressure between the thumb and forefinger to determine the degrees of roughness and grittiness, or the softness and smoothness of the soil.

| | |
|---|---|
| Coarse- to medium-grained sand: | Typically exhibits a very harsh and gritty feel and smear. |
| Coarse- to fine-grained sand: | Has a less harsh feel, but exhibits a very gritty smear. |
| Medium- to fine-grained sand: | Exhibits a less gritty feel and smear which becomes softer and less gritty with an increase in the fine sand fraction. |
| Fine-grained sand: | Exhibits a relatively soft feel and a much less gritty smear than the coarser sand components. |
| Silt: | Components less than about 10 percent of the total weight can be identified by a slight discoloration of the fingers after smear of a moist sample. Increasing silt increases discoloration and softens the smear. |

Sedimentation Test – A small sample of soil is shaken in a test tube filled with water and allowed to settle. The time required for the particles to fall to a distance of 4 inches is about ½ minute for particle sizes coarser than silt. About 50 minutes would be required for particles of 0.005 mm or smaller (often defined as "clay size") to settle out.

Visual Characteristics – Sand and gravel particles can be readily identified visually, however, silt particles are generally indistinguishable to the eye. With an increasing silt component, individual sand grains become obscured, and when silt exceeds about 12 percent, it masks almost entirely the sand component from visual separation. Note that gray fine-grained sand visually appears siltier than the actual silt content.

*Fine-grained (clay and silt)*

Soils with more than 50% of the particles finer than the No. 200 sieve (0.074 mm) and the fines are silts and clays.

A table of USC symbols and names for fine-grained soils is presented here.

**USCS Symbols and Names for Fine-grained Soils**

| USCS Symbol | Typical Names |
|---|---|
| ML | Inorganic silts and very fine sands, rock flour, silty, or clayey fine sands, or clayey silts with slight plasticity |
| CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays |
| OL | Organic silts and organic silty clays of low plasticity |
| MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts |
| CH | Inorganic clays or high plasticity (residual clays), fat clays |
| OH | Organic clays of medium to high plasticity, organic silts |
| Pt | Peat and other highly organic soils |

The following field identification tests can be used to estimate the degree of plasticity and size distribution of fine-grained soils:

Shaking (Dilatency) Test: Water is dropped or sprayed on a part of basically fine-grained soil mixed and held in the palm of the hand until it shows a wet surface appearance when shaken or bounced lightly in the hand or a sticky nature when touched. The test involves lightly squeezing the soil pat between the thumb and forefinger and releasing it alternatively to observe its reaction and the speed of the response. Soils which are predominantly silty (nonplastic to low plasticity) will show a dull dry surface upon squeezing and a glassy wet surface immediately upon releasing of the pressure. With increasing fineness (plasticity) and the related decreasing dilatency, this phenomenon becomes less and less pronounced.

Dry Strength Test: A portion of the sample is allowed to dry out and a fragment of the dried soil is pressed between the fingers. Fragments which cannot be crumbled or broken are characteristic of clays with high plasticity. Fragments which can be disintegrated with gentle finger pressure are characteristic of silty materials of low plasticity. Thus, materials with great dry strength are clays of high plasticity and those with little dry strength are predominantly silts.

Thread Test: Moisture is added or worked out of a small ball (approximately 1 ½-inch diameter) and the ball kneaded until its consistency approaches medium stiff to stiff, it breaks, or crumbles. A thread is then rolled out to the smallest diameter possible before disintegration. The smaller the thread achieved, the higher the plasticity of the soil. Fine-grained soils of high plasticity will have threads smaller than 1/32 inch in diameter. Soils with low plasticity will have threads larger than 1/8 inch in diameter.

<u>Smear Test:</u> A fragment of soil smeared between the thumb and forefinger or drawn across the thumbnail will, by the smoothness and sheen of the smear surface, indicate the plasticity of the soil. A soil of low plasticity will exhibit a rough textured, dull smear while a soil of high plasticity will exhibit a slick, waxy smear surface.

The following table presents the terms used to denote the various degrees of plasticity of soil that passes the No. 200 sieve.

**Degrees of Plasticity**

| Descriptive Term | Degree of Plasticity | Plasticity Index Range |
|---|---|---|
| SILT | none | non-plastic |
| Clayey SILT | slight | 1-5 |
| SILT & CLAY | low | 5-10 |
| CLAY & SILT | medium | 10-20 |
| Silty CLAY | high | 20-40 |
| CLAY | very high | over 40 |

*Highly-organic*

Soils that primarily consist of organic matter. Identification markers are:

1. Dark and black and sometimes dark brown colors, although not all dark colored soils are organic.
2. Moist organic soils will oxidize when exposed to air and change from a gray/black color to a lighter brown, i.e. The exposed surface is brownish, but when the sample is pulled apart the freshly exposed surface is dark gray/black.
3. Fresh organic soils usually have a characteristic odor which can be recognized, particularly when the soil is heated.
4. Compared to non-organic soils, less effort is typically required to pull the material apart and a friable break is usually formed with a fine granular or silty texture and appearance.
5. Their workability at the plastic limit is weaker and spongier than an equivalent non-organic soil.
6. The smear, although generally smooth, is usually duller and appears siltier.

*Minor Soil Types*

In many soils two or more soil types are present in the soil. When the percentage of the minor soil type is ≥ 50% of the total sample, the minor soil type is given prior to the major soil type and is indicated by adding a "y" to its name; i.e. silty CLAY.

When the minor soil type percentage is between 1 and 49% of the total sample, the minor soil type is given after the major soil type is given along with an adjective term:

1. Trace – When the soil type's percentage is between 1 and 5% of the total sample.
2. Some – When the soil type's percentage is between 5 and 12% of the total sample.
3. With – When the soil type's percentage is between 13% and 49% of the total sample.

A table of soil descriptors is presented below.

**Soil Descriptors**

| | | |
|---|---|---|
| Calcareous: | Containing appreciable quantities of calcium carbonate | |
| Fissured: | Containing shrinkage cracks, often filled with fine sand or silt, usually more less vertical | |
| Interbedded: | Containing alternating layers of different soil types | |
| Intermixed: | Containing appreciable, random, and disoriented quantities of varying color, texture, or constituency | |
| Laminated: | Containing thin layers of varying color, texture, or constituency | |
| Layer: | Thickness greater than 3 inches | |
| Mottled: | Containing appreciable random speckles or pockets of varying color, texture, or constituency | |
| Parting: | Paper thin | |
| Poorly graded (well sorted): | Primarily one grain size, or having a range of sizes with some intermediate size missing | |
| Slickensided: | Having inclined planes of weakness that are slick and glossy in appearance and often result in lower unconfined compression cohesion | |
| Split graded: | Containing two predominant grain sizes with intermediate sizes missing | |
| Varved: | Sanded or layered with silt or very fine sand (cyclic sedimentary couplet) | |
| Well graded (poorly sorted): | Containing wide range of grain sizes and substantial amounts of all intermediate particle sizes | |
| Modifiers: | Predominant type - | ≥ 50% |
| | With - | 13% to 49% |
| | Some - | 6% to 12% |
| | Trace - | 1% to 5% |

*Inclusions*

Additional inclusions or characteristics of the sample can be described by using "with" and the descriptions described above. Examples are given below:

1. With petroleum odor
2. With organic matter
3. With shell fragments
4. With mica.

*Layered Soils*

Soils of different types can be found in repeating layers of various thicknesses. It is important that all such formations and their thicknesses are noted. Each layer is described as if it is a nonlayered soil using the sequence for soil descriptions discussed above. The thickness and shape of layers and the geological type of layering are noted using the following descriptive terms:

| Type of Layer | Thickness | Occurrence |
|---|---|---|
| Parting | < 1/16 inch | |
| Seam | 1/16 inch to 0.5 inches | |
| Layer | 0.5 inches to 12 inches | |
| Stratum | > 12 inches | |
| Pocket | | Small erratic deposit |
| Lens | | Lenticular deposit |
| Varved (also layered) | | Alternating seams or layers of silt and/or clay and sometimes fine sand |
| Occasional | | One or less per foot of thickness of laboratory sample inspected |
| Frequent | | More than one per foot of thickness of laboratory sample inspected |

Place the thickness designation before the type of layer, or at the end of each description and in parentheses, whichever is appropriate.

An example of a description of layered soils is:

> Medium stiff, moist to wet ¼" – ¾" interbedded seams and layers of: gray, medium plastic, silty CLAY (CL); and lt. gray, low plasticity SILT (ML); (Alluvium).

*Geologic Name*

The soil description should include the Field Representative's assessment of the origin of the soil unit and the geologic name, if known, placed in parentheses at the end of the soil description or in the field notes column of the boring log.

*Rock*

The rock's description should include as a minimum:

1. Rock type
2. Color
3. Grain size and shape
4. Texture (stratification/foliation)
5. Mineral composition
6. Weathering and alteration
7. Strength
8. Other relevant notes.

The various elements of the rock's description should be stated in the order listed above.

Example:

Limestone, light gray, very fine-grained, thin-bedded, unweathered, strong

The rock description should include identification of discontinuities and fractures. The description should include a drawing of the naturally occurring fractures and mechanical breaks.

*Rock Type*

Rocks are classified according to origin into three major divisions: igneous, sedimentary, and metamorphic. These three groups are subdivided into types according to mineral and chemical composition, texture, and internal structure. Engineering classifications of rocks can be based on ASTM Method C 294.

<table>
<tr><th>Division</th><th>Class</th><th>Type</th></tr>
<tr><td rowspan="2">Igneous</td><td>Coarse-grained (Intrusive)</td><td>Granite<br>Syenite<br>Diorite<br>Gabbro<br>Peridotite<br>Pegmatite</td></tr>
<tr><td>Fine-grained (Extrusive)</td><td>Volcanic Glass<br>Delsite<br>Basalt</td></tr>
<tr><td rowspan="2">Sedimentary</td><td>Calcareous</td><td>Limestone<br>Dolomite</td></tr>
<tr><td>Siliceous</td><td>Conglomerate<br>Sandstone<br>Quartizite<br>Claystone<br>Siltstone<br>Argillite<br>Shale<br>Chert</td></tr>
<tr><td rowspan="2">Metamorphic</td><td>Foliated</td><td>Slate<br>Phyllite<br>Schist<br>Amphibolite<br>Hornfels<br>Unfixes</td></tr>
<tr><td>Nonfoliated</td><td>Marble<br>Metaquartzite<br>Serpentinite</td></tr>
</table>

*Color*

Colors should be assigned consistent with a Munsell Color Chart and recorded for both wet and dry conditions as appropriate.

*Grain Size and Shape*

The grain size description should be classified using the following terms:

| | |
|---|---|
| Very Coarse-Grained: | Diameter greater than 0.187 inches (4.76 mm). |
| Coarse-Grained: | Diameter 0.187 inches to 0.0787 inches (4.76 mm to 2.00 mm). Individual grains can be easily distinguished by the naked eye. |
| Medium-Grained: | Diameter 0.0787 inches to 0.0165 inches (2.00 mm to 0.420 mm). Individual grains can be distinguished with the naked eye. |
| Fine-Grained: | Diameter 0.0165 inches to 0.0029 inches (0.420 mm to 0.074 mm). Individual grains can be distinguished by the naked eye with difficulty. |
| Very Fine-grained: | Diameter less than 0.0029 inches (0.074 mm). Individual grains cannot be distinguished by the naked eye. |

The grain shape description should be classified using the following terms:

| | |
|---|---|
| Angular: | Showing very little evidence of wear. Grain edges and corners are sharp. Secondary corners are numerous and sharp. |
| Subangular: | Showing definite effects of wear. Grain edges and corners are slightly rounded off. Secondary corners are slightly less numerous and slightly less sharp than in angular grains. |
| Subrounded: | Showing considerable wear. Grain edges and corners are rounded to smooth curves. Secondary corners are reduced greatly in number and highly rounded. |
| Rounded: | Showing extreme wear. Grain edges and corners are smoother off to broad curves. Secondary corners are few in number and rounded. |
| Well-Rounded: | Completely worn. Grain edges or corners are not present. No secondary edges or corners are present. |

*Texture (stratification/foliation)*

Significant nonfracture structural features should be described. The thickness should be described using the following terms:

| Type of Layer | Thickness | |
|---|---|---|
| | English | Metric |
| Thinly laminated | 0.1 inches | 2.5 millimeters |
| Laminated | 0.1 to 0.5 inches | 2.5 to 10 millimeters |
| Very thinly bedded | 0.5 to 2.0 inches | 1 to 5 centimeters |
| Thinly bedded | 2.0 inches to 2 feet | 5 to 50 centimeters |
| Thickly bedded | 2 to 3 feet | 0.5 to 1 meters |
| Very thickly bedded | 3 feet | 1 meter |

The orientation of the bedding/foliation should be measured from the horizontal with a protractor.

*Mineral Composition*

A geologist, based on experience and the use of appropriate references, should identify the mineral composition. The most abundant mineral should be listed first, followed by minerals in decreasing order of abundance. For some common rock types, mineral composition need not be specified (i.e. dolomite, limestone).

*Weathering and Alteration*

Weathering as defined here is due to physical disintegration of the minerals in the rock by atmospheric processes while alteration is defined here as due to geothermal processes. Terms and abbreviations used to describe weathering or alteration are:

RS Residual Soil – The original minerals of the rock have been entirely weathered to secondary minerals, and the original rock fabric is not apparent. The material can be easily broken.

C Completely Altered or Weathered – The original minerals of the rock have been almost entirely changed to secondary minerals, even though the original fabric may be intact. The material can be easily broken.

H Highly Altered or Weathered – The rock is weakened to such an extent that a sample with a 2-inch minimum diameter can be broken readily by hand across the rock fabric. More than half the rock material is decomposed or altered. Fresh rock is present in a discontinuous framework or as corestones.

M Moderately Altered or Weathered – rock is discolored and noticeably weakened, but sample with a 2-inch minimum diameter cannot usually be broken by hand, across the rock fabric. Less than half of the rock material is decomposed or altered. Fresh or discolored rock is present either as a continuous framework or as corestones.

S Slightly Altered or Weathered – Rock is slightly discolored, but not noticeably lower in strength than fresh rock.

F Fresh – Rock shows no discoloration, no loss of strength, or any other effect of weathering.

*Rock Strength*

A common qualitative assessment of strength can be used while logging of rock core during drilling. Terms and abbreviations used to describe weathering or alteration are:

ES Extremely Strong – Specimen can only be chipped with geological hammer.

VS Very Strong – Specimen requires many blows of geologic hammer to fracture it.

S Strong – Specimen requires more than one blow of geological hammer to fracture it.

MS Medium Strong – Cannot be scraped or peeled with a pocketknife. Specimen can be fractured with a single firm blow of geological hammer.

W Weak – material crumbles under firm blows with the sharp end of a geological hammer. Can be peeled by a pocketknife with difficulty.

VW Very Weak Rock – Brittle or tough, may be broken in the hand with difficulty. Can be peeled with a pocketknife.

Descriptors and abbreviations used to describe rock hardness are:

| | |
|---|---|
| S | Soft - Reserved for plastic material alone. |
| F | Friable - Easily crumbled by hand, pulverized or reduced to powder and is too soft to be cut with a pocketknife. |
| LH | Low Hardness - Can be gouged deeply or carved with a pocketknife. |
| MH | Moderately Hard - Can be readily scratched by a knife blade; scratch leaves heavy trace of dust and scratch is readily visible after the powder has been blown away. |
| H | Hard - Can be scratched with difficulty; scratch produces little powder and is often faintly visible; traces of the knife steel may be visible. |
| VH | Very Hard - Cannot be scratched with pocketknife. Leaves knife steel marks on surface. |

*Rock Discontinuity*

Discontinuity is the general term for any mechanical discontinuity in a rock mass having zero or low tensile strength. It is the collective term for most types of joints, weak bedding planes, weak schistocity planes, weakness zones, and faults. The following symbols are recommended for the type of rock mass discontinuities.

F Fault

J Joint

Sh Shear

Fo Foliation

V Vein

B Bedding

The spacing of discontinuities is the perpendicular distance between adjacent discontinuities. The spacing should be measured in feet to the nearest tenth, perpendicular to the planes in the set.

| | | |
|---|---|---|
| EC | Extremely close spacing | <0.07 ft |
| VC | Very close spacing | 0.07 – 0.2 ft |
| C | Close spacing | 0.2 – 0.66 ft |
| M | Moderate spacing | 0.7 – 2 ft |
| W | Wide spacing | >2 – 6.6 ft |
| EW | Extremely wide spacing | >6.6 ft |

The discontinuities should be described as closed, open, or filled. Aperture is used to describe the perpendicular distance separating the adjacent rock walls of an open discontinuity in which the intervening space is air or water filled. Width is used to describe the distance separating the adjacent rock walls of filled discontinuities. The following terms should be used to describe apertures:

| Aperture | Description | |
|---|---|---|
| <0.1 mm<br>0.1 – 0.25 mm<br>0.2 0.25 – 0.5 mm | Very tight<br>Tight<br>Partly open | "Closed Features" |
| 0.5 – 2.5 mm<br>2.5 – 10 mm<br>>10 mm | Open<br>Moderately open<br>Wide | "Gapped Features" |
| 1 10 cm<br>1 10 – 100 cm<br>>1 m | Very wide<br>Extremely wide<br>Cavernous | "Open Features" |

The following terms are recommended to describe the width of discontinuities such as thickness of veins, fault gouge filling, or joints openings.

| | | |
|---|---|---|
| W | Wide | 0.5 – 2.0 inches |
| MW | Moderately wide | 0.1 – 0.5 inches |
| N | Narrow | 0.05 – 0.1 inches |
| VN | Very narrow | <0.05 |
| T | Tight | 0 |

For the thickness of faults or shears that are not thick enough to be represented on the boring log and are greater than 2-inches thick, record the measured thickness numerically in feet to the nearest tenth of a foot.

The following terms should be used to describe the planarity of discontinuities:

Wa Wavy

Pl Planar

St Stepped

Amplitude = A

Wavelength = γ

Measured in feet.

The following terms should be used to describe the surface roughness of discontinuities:

| | |
|---|---|
| VR | Very Rough – Near right-angle steps and ridges occur on the discontinuity surface. |
| R | Rough – Some ridges and side- angle steps are evident; asperities are clearly visible; and discontinuity surface feels very abrasive. |
| Sr | Slightly Rough – Asperities on the discontinuity surfaces are distinguishable and can be felt. |
| S | Smooth – Surface appears smooth and feels so to the touch. |
| Slk | Slickensides – Visual evidence of striations or a smooth glassy appearing finish. |

Filling is the term for material separating the adjacent rock walls of discontinuities. The perpendicular distance between the adjacent rock walls is termed the width of the filled discontinuity. The type of discontinuity infilling should be described using the following terms:

| | | | |
|---|---|---|---|
| C | Clay | Fe | Iron Oxide |
| Sd | Sand | g | Gypsum/Talc |
| H | Healed | q | Quartz |
| Ch | Chlorite | N | None |
| Ca | Calcite | O | Other (describe) |

The amount of infilling in discontinuities should be described using the following terms:

| | |
|---|---|
| St | Surface stain |
| Sp | Spotty |
| P | Partially filled half surface or opening is filled |
| F | Filled |
| N | None |

*Fracture Description*

The location of each naturally occurring fracture and mechanical break is shown in the fracture column of the rock core log. The naturally occurring fractures are numbered and described using the terminology described above for discontinuities.

The naturally occurring fracture and mechanical breaks are sketched in the drawing column.

Dip angles of fractures should be measured using a protractor and marked on the log. For nonvertical borings, the angle should be measured and marked as if the boring was vertical. If the rock is broken into many pieces less than ½ inch to 1-inch long, the log may be crosshatched in that interval or the fracture may be shown schematically.

The number of naturally occurring fractures observed in each foot of core should be recorded in the fracture frequency column. Mechanical breaks, thought to have occurred due to drilling, are not counted. The following criteria can be used to identify natural breaks:

1. A rough brittle surface with fresh cleavage planes in individual rock minerals indicates an artificial fracture.
2. A generally smooth or somewhat weathered surface with soft coating or infilling materials, such as talc, gypsum, chlorite, mica, or calcite obviously indicates a natural discontinuity.
3. In rocks showing foliation, cleavage or bedding it may be difficult to distinguish between natural discontinuities and artificial fractures when these are parallel with the incipient weakness planes. If drilling has been carried out carefully then the questionable breaks should be counted as natural features, to be on the conservative side.
4. Depending upon the drilling equipment, part of the length of core being drilled may occasionally rotate with the inner barrels in such a way that grinding of the surfaces of discontinuities and fractures occurs. In weak rock types it may be very difficult to decide if the resulting rounded surfaces represent natural or artificial features. When in doubt, the conservative assumption should be made; i.e., assume that they are natural.
5. It may be useful to keep a separate record of the frequency of artificial fractures (and associated lower RQD) for assessing the possible influence of blasting on the weaker sedimentary and foliated or schistose metamorphic rocks.

The results of core logging (frequency and RQD) can be strongly time dependent and moisture content dependent in the case of certain varieties of shales and mudstones having relatively weakly developed digenetic bonds. A not infrequent problem is "discing," in which an initially intact core separates into discs on incipient planes, the process becoming noticeable perhaps within minutes of core recovery. The phenomena are experienced in several different forms:

1. Stress relief cracking (and swelling) by the initially rapid release of strain energy in cores recovered from areas of high stress, especially in the case of shaley rock.

2. Dehydration cracking experienced in the weaker mudstones and shales which may reduce RQD from 100 to 0 percent in a matter of minutes, the initial integrity possibly being due to negative pore pressure.
3. Slaking cracking experienced by some of the weaker mudstones and shales when subjected to wetting.

All these phenomena make core logging of *frequency* and RQD unreliable. Whenever such conditions are anticipated, an engineering geologist should log core as it is recovered and at subsequent intervals until the phenomenon is predictable. An added advantage is that the engineering geologist can perform mechanical index tests, such as the point load or Schmidt hammer test, while the core is still in a saturated state.

*5. Drilling information:*

- Drill rig manufacturer, model, and driller (if applicable)
- Geologist or geotechnical engineer
- Project name, sample point identification, and location
- Date samples obtained (and times if required)
- Type of sampler (e.g., split spoon, Shelby, California), measurements or method of advancing boring or equipment, method of driving sampler, and weight of hammer
- Drill fluids (if applicable)
- Ground surface or grade elevation (if known)
- Depth penetrated and blow counts/6-inch interval of penetration for ASTM 1586-84 and sample number (if applicable)
- Closed hole intervals and advancement (if applicable)
- Recovery
- Strata changes and changes within samples
- Sampling tool behavior
- Drill string behavior
- Use(s) of borehole
- Disposition(s) of residual soil or cuttings
- Signature or sampling of log (as required).

## 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to define the standard procedure for collection of soil samples for environmental characterization purposes for Shell projects in Hartford and Roxana, Illinois. This procedure provides general descriptions of typical equipment and field procedures necessary to collect soil samples.

## 2. Other SOPs Referenced within this SOP

- SOP No. 4 – Decontamination
- SOP No. 8 – Field Reporting and Documentation
- SOP No. 24 – Soil and Groundwater Sample Identification, Packaging and Shipping
- SOP No. 25 – Sample Containers, Preservation and Holding Times
- SOP No. 26 – Sample Control and Custody Procedures
- SOP No. 38 – Methanol Preservation Sampling (Terracore)

## 3. Equipment

The following equipment is typically used to collect soil samples:

- Hand Auger (if required to collect sample)
- Labels
- Latex/Nitrile gloves
- Photoionization detector (PID)
- Portable field table
- Stainless steel spoon or scoop, if needed
- Stainless steel bowl, if needed
- Resealable Zipper bags, if needed
- Sample containers
- Decontamination equipment
- Plastic Sheeting, if necessary
- Field data sheets/bound field logbook
- Health & Safety equipment

- Cooler with ice.

## *4. Soil Sample Collection Procedures*

This section provides step-by-step procedures for collecting soil samples in the field. Observations made during soil sample collection should be recorded on applicable field sheets and/or in a bound field logbook in accordance with the procedures defined in SOP No. 8 Field Reporting and Documentation:

A. Remove appropriate sample containers from the transport container (i.e., cooler), and prepare the sample containers for receiving samples.

B. Fill out a self-adhesive label with the appropriate information and affix it to the appropriate sample container or fill out the sample label attached by the laboratory. Secure label with clear tape, unless a waterproof/weatherproof label is use. If a tare weight has been recorded by the laboratory on the container, do not use clear tape to secure label. Sample labels can be prepared prior to sample collection except for sample time and date, and depth, if necessary. Labels can be filled in with the date and time of sample collection just prior to collecting the sample. Sample containers will be kept cool with their caps on until they are ready to receive samples.

C. Place labeled sample containers near the sampling location.

D. Place clean plastic sheeting on the ground surface or the field table at the sampling area as needed.

E. Put on a pair of new nitrile or latex gloves.

F. Decontaminate the reusable sampling equipment as described in detail in SOP No. 4 Decontamination prior to beginning sampling activities.

G. Advance the sampler (direct push sampler, hand auger, split-spoon, etc.) to the desired sample depth and retrieve the sample.

H. VOC samples cannot be composited without losing volatiles. Therefore, collect a discrete VOC sample prior to compositing the remaining soil (if doing so). Collect the VOC sample with a Terra Core sampler or equivalent (SOP No. 38 Methanol Preservation Sampling (Terracore)), or by placing it directly into an appropriate sample container. If the sample is transferred to a jar, the entire jar must be filled without any voids and the top surface of the soil should be smeared to prevent VOCs from escaping when opening the jar. After collecting the sample at the desired location within the sample interval, place the remainder of the sample into a stainless-steel bowl/zipper bag, break up large chunks and mix the soil, if a composite sample is to be collected. Fill the remaining sample containers from the steel bowl.

I. Place the sample containers on ice in a cooler to maintain the samples at approximately 4ºC as described in SOP No. 25 Sample Container, Preservation and Holding Times.

J. Begin chain-of-custody procedures as described in SOP No. 26 Sample Control and Custody Procedures. Ship the cooler to the laboratory for analysis within 24-48 hours of sample collection in accordance with the procedures described in SOP No. 24 Sample Classification, Packaging and Shipping.

K. Decontaminate the sample equipment as described in SOP No. 4 Decontamination.

L. Field notes shall be kept on applicable field sheets and/or in a bound field logbook (refer to SOP No. 8 Field Reporting and Documentation)

### *5. Possible Soil Sample Collection Methods*

- Geoprobe (micro or macro samplers)
- Backhoe Bucket
- Split Spoon sampler using a conventional drill rig
- Hand Auger
- Surface Sampling with a stainless-steel spoon or scoop.

## 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to define the standard procedure and typical equipment for sampling with the use a hydraulically advanced direct push GeoProbe® (or similar) to obtain representative subsurface soil samples for geologic logging and physical and chemical laboratory testing for Shell projects in Hartford and Roxana, Illinois.

## 2. Other SOPs Referenced within this SOP

- SOP No. 4 – Decontamination
- SOP No. 5 – Utility Clearance Procedures
- SOP No. 8 – Field Reporting and Documentation
- SOP No. 12 – Grouting Procedures
- SOP No. 17 – Logging
- SOP No. 28 – Soil Sampling

## 3. Equipment

The following equipment is typically used:

- Hydraulic percussion hammer Geoprobe® or similar rig
- Probe/sample rods (macro core or dual-tube)
- Acetate liners
- Liner caps
- Disposable sample retainers
- Photoionization detector (PID)
- Surveyor's stakes, pin flags, spray paint or similar
- Stainless steel knife and resealable plastic bags
- Sample containers
- Decontamination equipment
- Health and safety equipment
- Field data sheets

- Field logbook
- Water proof or permanent ink pen

*4. Procedure*

The general procedure for using the Geoprobe® equipment for sampling is as follows. Prior to sampling crews will begin monitoring breathing zone according to requirements in the project Health and Safety Plan (HASP). The specific soil probe operation procedures may vary slightly based on individual drilling subcontractors' procedures for soil probe operation.

A. Locate boring using facility drawings and/or site base map to check utilities. Refer to SOP No. 5 Utility Clearance Procedures.

B. Hydraulically push or drive probe rods with acetate sample liner, or dual tube system with acetate liner to the first sample depth.

C. Remove probe/inner rods and retrieve acetate liner. Visually log and classify the soil (SOP No. 17 Logging), select sample specimen, if necessary, for physical and/or chemical testing (SOP No. 28 Soil Sampling). Record information on field data sheets and/or in field logbook.

D. Decon the sampler

E. Replace sampler acetate liner with a new/clean liner.

F. Insert acetate sample liner and attached rods in exiting probe hole and push or drive sampler to the next sample depth, repeat sampling procedure.

G. Repeat Geoprobe® sampling until the target depth is reached.

H. Record total depth.

I. Retrieve probe rods.

J. Backfill probe hole with bentonite grout or similar as required by the work plan unless a monitoring well, piezometer, soil vapor port or similar installation is to be completed (refer to appropriate SOP for an installed feature or SOP No.12 Grouting Procedures).

K. Place survey stake, pin flag, or similar at boring location.

L. Record data collected on boring log, or other field paperwork, and in log book (refer to SOP No 8. Field Reporting and Documentation).

M. Decontaminate equipment (SOP No. 4 Decontamination).

N. Perform equipment blank (EB) as needed

## *5. Decontamination*

Refer to the HASP for exclusion zone setup and personnel decontamination guidance; refer to SOP No. 4 Decontamination for equipment decontamination procedures.

## 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to define the standard procedure and typical equipment for collection of groundwater profiling samples within hydraulically advanced GeoProbe® (or similar) hollow drill rods and well screens using a peristaltic pump or ball and check valve for Shell projects in Hartford and Roxana, Illinois.

During groundwater profiling activities, groundwater samples are collected at predetermined intervals. Sampling intervals are specified in the scope of work for a specific project/task. In order to lessen drawdown within the hollow drill rods, a pump that minimizes disturbance to the groundwater is operated at the lowest possible flow rate. Purging is performed until specific parameters have stabilized over three consecutive flow-through cell volumes or until one hour of purge time has elapsed, whichever occurs first. Therefore, the groundwater samples collected are representative of the water bearing formation and hydraulically isolated from the water in the casing.

## 2. Other SOPs Referenced within this SOP

- SOP No. 3 – Calibration and Maintenance of Field Instruments
- SOP No. 4 – Decontamination
- SOP No. 5 – Utility Clearance Procedures
- SOP No. 8 – Field Reporting and Documentation
- SOP No. 10 – Well Gauging Measurements
- SOP No. 12 – Grouting Procedures
- SOP No. 18 – Low Flow Groundwater Purging and Sampling
- SOP No. 26 - Sample

## 3. Equipment

Equipment typically used during well purging and sampling:

- Polyethylene tubing
- Ball and check valve
- Disposable latex or nitrile gloves
- Assorted tools (knife, screwdriver, etc.)
- Pump and required accessories (described in more detail in following section)

- Water level indicator and/or water/product interface probe with 0.01-foot increments
- Graduated cylinder, measuring cup or similar
- Water quality parameter instrument with necessary sensors
- Flow-through cell
- Calibration fluids
- Paper towels or Kimwipes
- Calculator
- Bound field logbook (logbook) and/or Groundwater Sampling Form
- Waterproof pen or permanent marker
- Plastic buckets with lids
- 55-gallon drums or truck-mounted tank
- Plastic sheeting
- Appropriate decontamination equipment (see SOP No. 4)
- Cooler with ice
- Sample containers and labels
- Chain-of-Custody form
- Appropriate health and safety equipment (e.g., photoionization detector (PID)).

## *4. Sampling Procedure*

This section provides the step-by-step procedure for collecting groundwater profile samples in the field. Observations made during groundwater purging and sampling should be recorded in a logbook in accordance with procedures described in SOP No. 8 Field Reporting and Documentation, and/or on field paper work

A. Any reusable equipment used in the profile sampling procedure that could contact groundwater should be properly decontaminated before each use (see SOP No.4 Decontamination).

B. Equipment should be calibrated based on the manufacturers' instructions. Refer to SOP No. 3 Calibration and Maintenance of Field Instruments for more information.

C. Underground utilities at the location of each soil probe will be cleared prior to commencement of probing activities (SOP No. 5 Utility Clearance Procedures).

D. Following utility clearance, the sampler will be advanced to the predetermined depth and opened. A groundwater measurement of the water within the screen and rods will be collected to the nearest 1/100th of a foot (SOP No. 10 Well Gauging Measurements). Measurements will be recorded in the logbook and on any pertinent field forms. The volume of water within the screen and rods will then be calculated.
(DTB - DTW) = WH (feet); (WH)*($\pi$ $r^2$) * 1gal/0.134cf=x gallons with in screen/rods

E. Following measurement of the static groundwater elevation, the appropriate equipment will be slowly and carefully placed in the rods. If the rods have light or dense non-aqueous-phase liquids (LNAPLs or DNAPLs) care should be taken to place sampling equipment below or above the NAPL respectively. When placing the tubing in the rods, the water intake (i.e., ball and check valve assembly) should be set near the middle or slightly above the middle of the screened interval. If the screen length allows, the water intake should be at least two feet from the bottom of the screen.[1]

F. Tubing should be connected from the pump to a flow-through cell. New tubing should be used for each profiling interval.

G. The pump should be started at a low flow rate, approximately 100 mL/min or the lowest flow rate possible. Refer to SOP No. 18 Low Flow Groundwater Purging and Sampling for additional low flow procedure information. The diameter of the rods and of the water level/interface probe may preclude the ability to check water levels during purging and sampling activities.

H. Allow water to flow through the flow-through cell. Parameter readings should be documented on the groundwater sampling form and/or in the logbook. The time between parameter measurements is calculated as follows.

$$T = \frac{V}{Q}$$ , where

$T$ = time between measurements (minutes)

$V$ = volume of the flow-through cell (liters)

[1] Placing the water intake near the top of the water column can cause stagnant water from the casing to be purged but placing the water intake near to the bottom of the well can cause mobilization and entrainment of settled solids from the bottom of the well.

$Q$ = purge flow rate (liters per minute)

I. In most cases, purging will continue until specific parameters have stabilized over three consecutive flow-through cell volumes. **Table 1** provides guidelines that may be used for parameter stabilization as specified by USEPA, ASTM, and in the Nielsen and Nielsen Technical Guidance on Low-Flow Purging and Sampling and Minimum-Purge Sampling (Nielsen and Nielsen, 2002). These guidelines are to be used in combination with professional judgment. **Table 2** provides the guidelines to be used for Roxana, WRR and Rand groundwater profiling activities. **Table 2** combines relevant stabilization guidelines from **Table 1** in combination with limitations in accuracy for readings collected by the YSI Pro DSS (typical low flow and groundwater profiling equipment used on the Rand and Roxana groundwater projects).

**Table 1. Stabilization Guidelines for Low-Flow Sampling**

| **Parameter** | **Stabilization Guidelines** | | |
|---|---|---|---|
| | **EPA** | **ASTM** | **Nielsen & Nielsen** |
| DO | +/- 10% | +/- 10% or +/-0.2 mg/L, whichever is greatest | +/- 10% or +/-0.2 mg/L, whichever is greatest |
| ORP | +/- 10 mV | +/- 20 mV | +/- 20 mV |
| PH | +/- 0.1 units | +/- 0.2 units | +/- 0.2 units |
| Conductivity | +/- 3% | +/- 3% | +/- 3% |
| Temperature | Not Specified | Not Specified | +/- 0.2 ºC |
| Turbidity | +/- 10% | Not Specified | Not Specified |

**Table 2. Stabilization Guidelines used for Rand, WRR and Roxana GW Sampling**

| **Parameter** | **Stabilization Guidelines (using above standards combined with YSI Pro DSS accuracies)** |
|---|---|
| DO | +/- 10% or +/-0.2 mg/L, whichever is greatest |
| ORP | +/- 20 mV |
| PH | +/- 0.2 units |
| Specific Conductivity | +/- 5% or +/-2µs/cm |
| Temperature | Not Specified; Monitor and record |
| Turbidity | Visually Sediment Free, when practical; Monitor and record |

J. After the relevant parameters have stabilized or the required purging time has elapsed, the flow-through cell should be disconnected or bypassed for sampling. A new pair of disposable latex or nitrile gloves should be put on immediately before sampling. Samples will be collected by allowing the groundwater to flow from the tubing directly into the laboratory supplied containers. Do NOT allow the sample tubing to come into contact with the sample bottles, and do NOT place sample bottles on the ground (e.g., place bottles in a plastic tub or similar).

K. The constituents should be sampled for in the order given below:

- VOCs – Vials should be filled completely so that the water forms a convex meniscus then capped so that no air space exists in the vial. Turn the vial over and tap it to check for bubbles. If air bubbles are observed in the sample vial, remove the lid and attempt to fill the vial two more times, (being careful not to dump out any groundwater currently in the vial). If air bubbles are present twice more, discard the sample vial and repeat the procedure with a new vial. If, after three attempts, air bubbles are still in the vial, make a note of this and place the vial in the cooler.
- Gas sensitive parameters (e.g., ferrous iron, methane, alkalinity)
- Semivolatile organic compounds
- Petroleum hydrocarbons
- Metals (unfiltered)
- Any filtered analytes (use in-line filters if possible).

L. Place all samples on ice inside a cooler immediately.

M. Each sample should be identified with the Sample ID, location, analysis number, preservatives, date and time of sampling event, and sampler.

N. The sample time and constituents to be analyzed for should be recorded in the logbook and/or on the groundwater sampling form.

O. Chain-of-custody procedures should be started (SOP No. 26 Sample Control and Custody Procedures).

P. Sample equipment should be decontaminated (SOP No. 4 Decontamination) or replaced as applicable.

Q. The rods/screen should then be advanced to the next predetermined profiling depth and the process of purging and sampling repeated.

R. Upon completion of each boring, the hole will be sealed with bentonite grout from the bottom up using the GeoProbe® rods as a tremie pipe and the surface will be returned to the original condition (SOP No. 12 Grouting Procedures). Purge water will be placed in 55-gallon drums (or similar) that are labeled, sealed, and staged at a pre-determined location on-site (refer to the IDW Coordinator for more information). The drill rig unit and rods will be decontaminated between profiling holes using a steam pressure washer or similar (SOP No. 4 Decontamination). Decontamination water will be containerized in 55-gallon drums (or similar) that are labeled, sealed, and staged at a predetermined location on-site (refer to the IDW Coordinator for more information).

## 1. Objective

The purpose of this Standard Operating Procedure (SOP) is to provide a consistent methodology for data and soil vapor sample collection related to the Shell Roxana soil vapor extraction (SVE) remediation system. This SOP is applicable to:

- Collecting data from and sampling Roxana Soil Vapor Extraction (SVE) wells
- Collecting data from and sampling the West Fenceline and Public Works header lines and/or the RTO exhaust stack.

## 2. Other SOPs referenced in this SOP

- SOP No. 4 Decontamination
- SOP No. 10 Well Gauging Measurements
- SOP No. 51 Vapor Sample Classification, Packaging and Shipping
- SOP No. 52 Soil Vapor Field Laboratory Screening
- SOP No. 53 Dwyer Digital Manometer

## 3. Equipment

The following equipment is typically used for SVE well data collection and sampling:

- Pry bars (2) (if needed)
- Extension cord (if needed)
- SVE Data Collection sheets and Toughbook with SVE Monitoring software
- Impact driver (or socket set) with 3/4 and 9/16 sockets, or adjustable wrench (if needed)
- Oil/Water Interface probe
- Isopropyl alcohol
- Dwyer Series 475 Mark III Digital manometer (measuring appropriate range(s)), or equivalent
- Nut driver – 5/16 (if needed)
- Paper towels
- PPE
    - ANSI Class II safety vest

  - Hardhat
  - Nitrile gloves
  - Cut Resistant gloves
  - Safety glasses
  - Safety goggles (when working within Wood River Refinery (WRR))
  - Steel-toe boots
  - FRC Clothing (when working within WRR)
- Power inverter (if needed)
- Sump pump (if needed)
- Geotech® peristaltic pump (or equivalent)
- 1- Liter Tedlar® bags (new or decontaminated as outlined in SOP No. 4 Decontamination)
- Traffic barricades (orange cones)
- Tygon® tubing – 3/16” ID x 3/8” OD
- Teflon® tubing – 3/16” ID x 1/4” OD
- Black collection bag (trash bag) and collection string

The following equipment is typically used for the West Fenceline and Public Works header line and RTO exhaust stack data collection and sampling:

- Combination wrench 1/2 and 9/16 inch
- Extension cord
- GAST® high flow vacuum pump
- Geotech® peristaltic pump
- Dwyer Series 475 Mark III Digital manometer (measuring appropriate range(s)), or equivalent
- PPE
  - ANSI Class II safety vest
  - Hardhat

- Nitrile gloves
- Safety glasses
- Safety goggles
- Steel-toe boots
- FRC Clothing
- Summa canister
- Pressure gauge
- Regulators (flow controllers)
- Calibrated rotameter (or equivalent)
- Sample train
- 1- Liter Tedlar® bags (new or decontaminated as outlined in SOP No. 4 Decontamination)
- Tygon® tubing – 3/16” ID x 3/8” OD
- Teflon® tubing – 1/8” ID x 1/4” OD
- Black collection bag (trash bag) and collection string

## *4. Procedures for SVE Wells*

This section provides step-by-step procedures for data collection and soil vapor sampling of SVE wells. The field data sheet (attached) or the appropriate fields in the SVE Monitoring software should be filled out completely with the appropriate observations and data collected during sampling. All applicable components of the Health and Safety Plan, including completion of Job Safety Analysis (JSA) forms, shall be followed while performing the activities described in this SOP.

### Upon Arrival at Well

1. Position truck between the well to be sampled (work zone) and on-coming traffic, turn on hazard lights available with the truck in use.
2. Place traffic cones in front of and behind the truck. Place wheel chocks around one of the tires of the truck.
3. Unlock the well vault, remove well vault bolts, use pry bars (if needed) to release vault latch, and pry open vault lid for underground wells or open above ground well

vault to access well. Engage safety latch, weight and/or chain (if present) to secure vault lid in open position. Record position of main SVE valve.

4. Use a sump pump to drain rain water from the vault, if present.
    - If water in vault has **NO** evidence of sheen water can be pumped to the surrounding ground/road surface.
    - If water in vault has evidence of sheen water must be pumped into 5–gallon containers Containerized water from wells located within the refinery is transported to Site 9 in WRR for proper management. Containerized water from wells located outside the refinery is transported to Tannery property for proper management.

Sample Collection

1. Connect manometer to sample port and record the vacuum on the SVE well by connecting the appropriate digital manometer (SOP No. 53 Dwyer Digital Manometer) to the sample port of the well and turning the sample port lever to the open position. If the vacuum reading fluctuates, record the most consistent reading.
2. Write the well ID, date, sample time, vacuum, and sampler's initials on the Tedlar® bag.
3. Connect a clean piece of disposable Tygon® tubing to the sample port of the SVE well, or use dedicated tubing if present.
4. Insert Tygon® tubing into the peristaltic pump head.
5. Connect power cord to peristaltic pump and plug into battery, vehicle cigarette lighter, or other available power source (car battery adapter).
6. Inset hard plastic (e.g. Teflon) reducer on end of Tedlar® bag which shall later connect to Tygon® tubing.
7. Turn on the peristaltic pump with sample port open to purge Tygon® tubing for approximately 10 seconds.
8. Connect Tedlar® bag to Tygon® tubing.
9. Once the Tedlar® bag is full, close valve on Tedlar® bag, turn peristaltic pump off, close sample port, remove Tygon® tubing from Tedlar® bag and sample port.
10. Place Tedlar® bag sample in black collection bag to minimize exposure to sunlight while other samples are being collected and transported to on-site screening lab.

Fluid Level Measurement

1. If necessary, close the valve a little to completely if the reading is not clear or difficult to obtain.
2. Remove the sample plug from the well cap.
3. Turn the interface probe on and lower probe into the SVE well. Record fluid levels and total depth as described in SOP No. 10 Well Gauging Measurements. If water in SVE well is splashing and an accurate reading cannot be obtained, reduce well vacuum by partially closing the well valve and collect reading as quickly as possible. Additionally, record if the bottom surface of the well is hard or soft. Decontaminate the probe and tape as described in SOP No. 4 Decontamination.
4. Record the condition of the probe and tape upon removal (e.g. clean, visual or olfactory evidence of petroleum hydrocarbon, sludge, foam, silt) and any well defects or maintenance issues.
5. Replace the sample plug into the well cap.
6. Return the main SVE valve to its original position, if adjusted in Step 1 and/or 3 above.
7. Disengage safety latch, weight and/or lower vault lid. Replace well vault bolts (if needed) and lock the well vault.
8. Load traffic cones and other equipment and move to next well location.

## *5. Procedures for the Header Lines and Exhaust Stack*

This section provides step-by-step procedures for data collection and soil vapor sampling of the Public Works and West Fenceline Headers located immediately upstream of the VLS units and the RTO Exhaust stack.

### 5.1. Data/Sample Collection at the Regenerative Thermal Oxidizer (RTO) Unit – PW and WFL Header Lines

1. Connect appropriate manometer to sample port on the header line and record the vacuum (SOP No. 53 Dwyer Digital Manometer). Write the sample ID, date, sample time, vacuum, and sampler's initials on the Tedlar® bag.
2. Connect one end of a clean piece of disposable Tygon® tubing, or dedicated tubing if present,to the header sample port and the other end to the inlet port of the GAST® high flow sample pump.

3. Connect clean section of Tygon® tubing to the outlet port of the GAST® high flow sample pump.
4. Connect power cord to GAST® high flow pump and plug into ac power source, (extension cord with GFI plugged into wall outlet)
5. Inset hard plastic reducer on end of Tedlar® bag which shall later connect to Tygon® tubing.
6. Turn on the GAST® high flow pump with sample port open and allow pump to run for approximately 10 seconds to purge the tubing.
7. Connect Tedlar® bag to Tygon® tubing on the outlet port of the GAST® high flow sample pump.
8. Once the Tedlar® bag is full, close valve on Tedlar® bag.
9. Turn GAST® high flow pump off, close sample port, and remove/dispose of Tygon® tubing from Tedlar® bag and sample port.
10. Place Tedlar® bag with sample in black collection bag on sample collection string to minimize exposure to sunlight while other samples are being collected and transported to on-site screening lab.

### 5.2. Summa Canister Sample Collections - PW and WFL Header Lines

<u>*Prior to Sampling - PW and WFL Header Lines*</u>

1. Attach the vacuum gauge provided by the laboratory to the stainless-steel canister inlet.
2. Open valve completely.
3. Record the vacuum reading on the canister tag. If the canister does not show a vacuum or shows a vacuum of less than -26 inches of Hg, then:

    - Label the canister tag with “Insufficient vacuum – No Sample”;
    - Set canister aside for return to the laboratory; and
    - Contact task manager and lab coordinator if canister failures affect field work.

4. Close valve completely.
5. Remove the vacuum gauge.

*Sampling - PW and WFL Header Lines*

1. Collect a Tedlar® bag sample using steps 1 through 9 from Section 4.1 above.
2. Thread the sample train to the particulate filter and then quick-connect the setup to the canister.
3. Using a clean piece of disposable silicone tubing, connect the hose barb attached to the sample train to the exhaust port on the GAST® pump.
4. Open the sample canister. Allow sample to enter the canister until the vacuum reads approximately between -5 and -10 inches of Hg. **The vacuum gauge should reach less than -10 inches Hg, but should not be allowed to drop below -2 inches of Hg.**
5. Close valve to sample port and turn off GAST® pump.
6. Close the sample canister valve completely and remove the sample train.
7. Close the sample port on the exhaust/header line..

*After Sampling - PW and WFL Header Lines*

1. Attach the vacuum gauge provided by the laboratory to the stainless-steel canister inlet using quick connect fittings.
2. Open valve completely.
3. Record reading. There should still be a vacuum in the stainless-steel canister. If the final vacuum reading is not between -10 and -2 inches Hg, contact the task manager or project manager immediately to determine the value of using another stainless steel canister to recollect the sample.
4. Close valve completely.
5. Remove the vacuum gauge.

### 5.3. Data/Sample Collection at the Regenerative Oxidizer Unit – Exhaust Stack

1. Connect appropriate manometer to sample port on the exhaust stack and record the vacuum (SOP No. 53 Dwyer Digital Manometer). Write the sample ID, date, sample time, vacuum, differential pressure, and sampler's initials on the Tedlar® bag.
2. Connect the piece of dedicated disposable Tygon® tubing connected to the sample port of the exhaust stack and insert into peristaltic pump.
3. Inset hard plastic reducer on end of Tedlar® bag which shall later connect to Tygon® tubing.

4. Attach pump head to the lower RPM shaft on the Geotech® peristaltic pump. Turn on peristaltic pump with sample port open. Allow pump to run for at least 60 seconds to purge the sample line.
5. Use a calibrated rotameter or equivalent to set the speed of the peristaltic pump at approximately 125mL/min to 140mL/min.
6. At the beginning of poppet valve switch, connect Tedlar® bag to Tygon® tubing.
7. After 2 cycles of poppet valve switching, close valve on Tedlar® bag,
8. Turn peristaltic pump off, close sample port, and remove/dispose of Tygon® tubing from Tedlar® bag and sample port.
9. Place Tedlar® bag with sample in black collection bag on the sample collection string to minimize exposure to sunlight while other samples are being collected and transported to on-site screening lab.

### 5.4. Summa Canister Sample Collection – Exhaust Stack

*Prior to Sampling - Exhaust Stack*

1. Attach the vacuum gauge provided by the laboratory to the stainless-steel canister inlet using quick connect fittings.
2. Open valve completely.
3. Record reading on the canister tag. If the canister does not show a vacuum or shows a vacuum of less than -26 inches of Hg, then:
    - Label the canister tag with “Insufficient vacuum – No Sample”;
    - Set canister aside for return to the laboratory; and
    - Contact task manager and lab coordinator if canister failures affect field work.
4. Close valve completely.
5. Remove the vacuum gauge.

*Sampling - Exhaust Stack*

1. Collect a Tedlar® bag sample using steps 1 through 7 from **Section 5.3** above.
2. Thread the sample train to the particulate filter, which is then threaded to the regulator. Quick-connect the setup to the canister.

3. Using a clean piece of disposable silicone tubing, connect the hose barb attached to the sample train to the sample port on the exhaust stack.
4. 10 seconds after hearing the poppet valve switch, open the sample canister. Allow sample to enter the canister though 2 cycles of poppet valve switching and the vacuum reads approximately between -5 and -10 inches of Hg. Sample collection should end approximately 10 seconds after two additional poppet valve switches (total sample collection time should be approximately 6 minutes. **The vacuum gauge should reach less than -10 inches Hg, but should not be allowed to drop below -2 inches of Hg.**
5. Close the sample canister valve completely and remove the sample train.
6. Close the sample port on the exhaust line.

*After Sampling - Exhaust Stack*

1. Attach the vacuum gauge provided by the laboratory to the stainless-steel canister inlet using quick connect fittings.
2. Open valve completely.
3. Record reading. There should still be a vacuum in the stainless-steel canister. If the final vacuum reading is not between -10 and -2 inches Hg, contact the task manager or project manager immediately to determine the value of using another stainless steel canister to recollect the sample.
4. Close valve completely.
5. Remove the vacuum gauge.

## 5. *Sample Screening, Classification, Packaging and Shipping*

Refer to SOP No. 51 Vapor Sample Classification, Packaging and Shipping for information related to packing and shipping samples to the laboratory for analysis, if necessary. Refer to SOP No. 52 Soil Vapor Field Laboratory Screening for information related to on-site field laboratory screening of samples collected.

## SVE Monthly Effectiveness

| Well ID | Date | Tech | Time Arrived | Valve Position Arrival | % Open | Vacuum (In H2O) | Tedlar Sample Time | DTP | DTW | DTB | Hard/Soft Bottom | Tape Condition | Valve Position Departure | % Open | Time Left | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SVE-3R | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-4 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-5 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-6 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-7 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-8 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-9 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-10 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE 11 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-12 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-13 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-14 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-15 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-16 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-17 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-18 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-19 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-20 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-21 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-22 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-23 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-24 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-25 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-26 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-27 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-28 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-29 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |

SVE Monthly Effectiveness

| Well ID | Date | Tech | Time Arrived | Valve Position Arrival | % Open | Vacuum (in H2O) | Tedlar Sample Time | DTP | DTW | DTB | Hard/Soft Bottom | Tape Condition | Valve Position Departure | % Open | Time Left | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SVE-30 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-31 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-32 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-33 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-34 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-35 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-36 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-37 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-38 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-39 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-40 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-41 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-42 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-43 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-44 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-45 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-46 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |
| SVE-47 | | | | Open / Closed | | | | | | | | | Open / Closed | | | |

# Illinois Environmental Protection Agency

Bureau of Land • 1021 North Grand Avenue East • P.O. Box 19276 • Springfield • Illinois • 62794-9276

## ILLINOIS EPA RCRA CORRECTIVE ACTION CERTIFICATION

This certification must accompany any document submitted to Illinois EPA in accordance with the corrective action requirements set forth in a facility's RCRA permit. The original and two copies of all documents submitted must be provided.

### 1.0 Facility Identification

Name: Equilon Enterprises LLC d/b/a Shell Oil Products US
County: Madison
Street Address: 900 South Central Avenue
Site No. (IEPA): 1191150002
City: Roxana
Site No. (USEPA): ILD080012305

### 2.0 Owner Information

Name: Not Applicable
Mail Address:
City:
State: Zip Code:
Contact Name:
Contact Title:
Phone:

### 3.0 Operator Information

Name: Equilon Enterprises LLC d/b/a SOPUS
Mail Address: 150 N. Dairy Ashford, Bldg A, 5th Fl
City: Houston
State: TX Zip Code: 77079
Contact Name: Dan Kirk
Contact Title: Principal Program Manager
Phone: 281-544-9796

### 4.0 Type of Submission (check applicable item and provide requested information, as applicable)

- ☐ RFI Phase I Workplan/Report
- ☐ RFI Phase II Workplan/Report
- ☐ CMP Report;
- ☑ Other (describe): Standard Operating Procedures update

IEPA Permit Log No. B-43R
Date of Last IEPA Letter on Project: December 20, 2019
Log No. of Last IEPA Letter on Project: M-21,26-30,35-36,38

Does this submittal include groundwater information: ☑ Yes ☐ No

Date of Submittal: 

### 5.0 Description of Submittal: (briefly describe what is being submitted and its purpose)

Routine Updates to Standard Operating Procedures Previously Submitted; SOPs 20 and 44R

### 6.0 Documents Submitted (identify all documents in submittal, including cover letter; give dates of all documents)

Cover letter, Revised SOPs

### 7.0 Certification Statement

(This statement is part of the overall certification being provided by the owner/operator, professional and laboratory in Items 7.1, 7.2 and 7.3 below). The activities described in the subject submittals have been carried out in accordance with procedures approved by Illinois EPA. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

## 7.1 Owner/Operator Certification

(Must be completed for all submittals. Certification and signature requirements are set forth in 35 IAC 702.126.) All submittals pertaining to the corrective action requirements set forth in a RCRA Permit must be signed by the person designated below (or by a duly authorized representative of that person):

1. For a Corporation, by a principal executive officer of at least the level of vice president.
2. For a Partnership or Sole Proprietorship, by a general partner or the proprietor, respectively.
3. For a Governmental Entity, by either a principal executive officer or a ranking elected official.

A person is a duly authorized representative only if:

1. the authorization is made in writing by a person described above; and
2. the written authorization is provided with this submittal (a copy of a previously submitted authorization can be used).

Owner Signature: ______________________ Date: ____________

Title: Not Applicable

Operator Signature: D. T. Kirk Date: 6/11/20

Title: Principal Program Manager

## 7.2 Professional Certification (if necessary)

Work carried out in this submittal or the regulations may also be subject to other laws governing professional services, such as the Illinois Professional Land Surveyor Act of 1989, the Professional Engineering Practice Act of 1989, the Professional Geologist Licensing Act, and the Structural Engineering Licensing Act of 1989. No one is relieved from compliance with these laws and the regulations adopted pursuant to these laws. All work that falls within the scope and definitions of these laws must be performed in compliance with them. The Illinois EPA may refer any discovered violation of these laws to the appropriate regulating authority.

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44 (h))

Professional's Signature: ______________________ Date: ____________

Professional's Name Not Applicable

Address ______________________ Professional's Seal:

City ______________________

State _____ Zip Code ____________

Phone ______________________

## 7.3 Laboratory Certification (if necessary)

The sample collection, handling, preservation, preparation and analysis efforts for which this laboratory was responsible were carried out in accordance with procedures approved by Illinois EPA.

Name of Laboratory Not Applicable

______________________ Date: ____________

Signature of Laboratory Responsible Officer

Mailing Address of Laboratory

Address ______________________

City ______________________ ______________________

Name and Title of Laboratory Responsible Officer

State _____ Zip Code ____________

AECOM
100 North Broadway
20th Floor
St. Louis, MO 63110
USA
aecom.com

June 18, 2020

Mr. Kenneth E. Smith, PE
Manager, Permit Section
Illinois Environmental Protection Agency
Division of Land Pollution Control
Bureau of Land
1021 North Grand Avenue East
Springfield, Illinois 62794

**Routine Updates to Standard Operating Procedures - SOPs Nos. 3, 20, 44R and 52**
**Equilon Enterprises LLC dba Shell Oil Products US**
**Roxana, Illinois**
**1191150002 - Madison County**
**ILD080012305**
**Log B-43R**

Dear Mr. Smith:

As part of AECOM Technical Services, Inc.'s (AECOM's) routine quality improvement process, we recently performed a review of some of the Standard Operating Procedures (SOPs) used by field staff performing activities at the investigation sites in Roxana, Illinois. Previously revised versions of SOPs have been submitted to the Illinois Environmental Protection Agency (IEPA), most recently on December 20, 2019. These procedures were originally submitted, as requested by various IEPA correspondences, within various reports and work plans related to the Investigation Site in Roxana, Illinois. We are submitting this package of updated SOPs for your reference and in accordance with revisions to Sections C.7.5 and C.8.4 of the RCRA Post-Closure Permit Application[1] for the Equilon Enterprises LLC d/b/a Shell Oil Products US (SOPUS) facility at the WRB Refining LP Wood River Refinery.

The SOPs included with this submittal are listed below. The SOPs listed below were revised as indicated.

| SOP No | SOP Title | Purpose of Revision |
|---|---|---|
| 3 | Calibration & Maintenance of Field Instruments | Add maintenance schedule for field screening laboratory instruments |
| 20 | Well Development or Redevelopment | Update procedures to include potential use of a surge collar |
| 44R | Soil Vapor Purging & Sampling | Editorial and formatting related to canister filling time |
| 52 | Soil Vapor Field Laboratory Screening | Editorial and formatting related to Tedlar bag screening |

[1] Class 1* Permit Modification – Section C Revision for SOP Reference (Log No. B-43R-CA-82, CA-88, CA-94 and CA-97) was submitted to IEPA on January 29, 2018. This modification was approved by an IEPA letter with modified Permit dated December 20, 2019.

AECOM

Below is an SOP summary table, which indicates the most recent revision date for each SOP for your reference.

| SOP No. | SOP Title | Last Updated |
|---|---|---|
| 3 | Calibration & Maintenance of Field Instruments | 6/16/2020 |
| 4 | Decontamination | 9/6/19 |
| 5 | Utility Clearance Procedures | 12/9/19 |
| 8 | Field Reporting and Documentation | 9/24/19 |
| 10 | Well Gauging Measurements | 9/13/19 |
| 11 | Groundwater Sampling & Well Wizard Operation | 12/9/19 |
| 12 | Grouting Procedures | 12/9/19 |
| 14 | Headspace Soil Screening | 12/9/19 |
| 17 | Logging | 12/9/19 |
| 18 | Low Flow Groundwater Purging & Sampling | 9/23/19 |
| 20 | Well Development | 6/17/2020 |
| 21 | Monitoring Well Installation | 7/24/2015 |
| 23 | Quality Assurance Samples | 9/13/19 |
| 24 | Soil and Groundwater Sample Identification, Packaging & Shipping | 9/13/19 |
| 25 | Sample Containers, Preservation & Holding Times | 9/20/19 |
| 26 | Sample Control & Custody Procedures | 9/20/19 |
| 28 | Soil Sampling | 12/9/19 |
| 29 | Soil Probe Operation | 12/9/19 |
| 42 | Groundwater Profiling | 12/9/19 |
| 44R | Soil Vapor Purging & Sampling | 6/16/2020 |
| 46 | Indoor Air Sampling with Canisters | 7/23/2015 |
| 47 | Sub-slab Soil Gas Installation & Sampling with Canisters | 4/4/2017 |
| 48 | SVE Well Data Collection and Sampling | 12/9/19 |
| 49 | SVE Effectiveness Monitoring at VMPs | 8/28/19 |
| 51 | Vapor Sample Classification, Packaging & Shipping | 9/20/19 |
| 52 | Soil Vapor Field Laboratory Screening | 6/16/2020 |
| 53 | Dwyer Digital Manometer | 8/29/19 |
| 56 | LNAPL Recovery | 9/20/19 |

Copies of this submittal are being sent separately directly to Paula Stine (IEPA, Springfield) and Gina Search (IEPA, Collinsville).

AECOM

If you have any questions, please contact Wendy Pennington at wendy.pennington@aecom.com (314-802-1196) or Bob Billman at bob.billman@aecom.com (314-802-1122).

Sincerely,


Wendy Pennington
Project Engineer
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**encl:** Revised SOPs 3, 20, 44R, and 52
RCRA Corrective Action Certification Form

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Project File
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## *1. Objective*

The purpose of this Standard Operating Procedure (SOP) is to define the procedure for calibration and maintenance of field instruments frequently used during environmental field activities for the Shell projects in Hartford and Roxana, Illinois. This SOP gives descriptions of the most commonly used of these instruments and field procedures to calibrate and maintain these field instruments. Calibration and maintenance records are maintained with the project file.

## *2. Other SOPs referenced in this SOP*

- SOP No. 4 – Decontamination

## *3. Equipment*

The following equipment is typically required during field instrument calibration and maintenance activities.

- Nitrile gloves
- Site logbook
- Field data sheets
- Equipment Calibration Record forms
- Distilled or deionized water
- Decontamination equipment
- Health and Safety Equipment
- Field Instrument Operations Manual
- Calibration gases for Air Monitoring Equipment
- Calibration solutions for Water Monitoring Equipment.

## *4. Types of Field Instruments Commonly used during Environmental Investigations*

The following are some of the more commonly used instruments during environmental investigations.

- Photoionization Detector (PID)
- Flame Ionization Detector (FID)

- Multi-gas Meter (usually includes Explosimeter, Hydrogen Sulfide detector, Oxygen sensor, and Carbon Monoxide meter)
- Single-gas Meter (usually Benzene or Hydrogen Sulfide meters)
- Groundwater Level Indicator
- Petroleum/Groundwater Interface Probe
- Groundwater pH, Temperature, Conductivity, Dissolved Oxygen, Oxidation-Reduction Potential and/or Turbidity Meter(s).

### *5. Maintenance*

Each instrument has specific maintenance requirements, which are described in the instrument's manufacturer's manual. These maintenance requirements should be followed. General maintenance such as regular cleaning of the instrument, battery checks and replacement, and ensuring the instrument is handled and stored properly can be performed by AECOM employees. Other maintenance items such as sensor repair, annual calibrations and repair of a malfunctioning piece of equipment should be performed by the instrument manufacturer or licensed dealer and should NOT be performed by AECOM employees, unless specifically directed by the equipment supplier. Contact the manufacturer or licensed dealer to determine where the instrument should be submitted for maintenance tasks, if necessary.

### *6. Calibration*

Due to the wide variety of field instruments available, various parameters potentially monitored, and the wide range of functions potentially performed by each instrument, a description of the calibration of every type of instrument available is not feasible. However, a generalized SOP for general types of field equipment calibration is presented here. Refer to the manufacturer's manual for specific calibration instructions for the instrument being used.

The appropriate calibration field form for the equipment being calibrated should be completed in its entirety, including the equipment model and serial/ID number. If something on the calibration field form does not apply, fill in the space on the form with "NA".

*Air Monitoring Instruments (PID, FID, Multi-gas Meters, Single-gas meters, etc.)*

1. Turn the instrument on. The on/off switch may be a toggle switch, knob, or button to be depressed depending on the type and brand of instrument being used.
2. Allow the instrument to "warm up" and progress through the startup diagnostic routine.

3. Perform a "fresh air" calibration, if possible, for the air meter. This fresh air calibration should be performed using a zero-air filter provided with the air monitor or using a zero-air calibration gas.
4. Record the initial reading on the proper equipment calibration field form. Also record the fresh air calibration standard on the field form.
5. Apply the proper calibration gas and proceed with calibration as directed in the manufacturer's manual.
6. Record the final calibrated reading on the field equipment calibration forms.
7. Verify a moisture and dust filter is in place on the air meter intake nozzle, when applicable.
8. If directed in the manufacturer's manual, at periodic intervals throughout the day, the calibration of the instrument should be checked and re-evaluated as directed in the manufacturer's manual.

*Groundwater Parameter Instruments (YSI ProDSS, pH-Con 10, turbidimeters, etc.)*

Frequently one instrument will have multiple sensors for measuring various parameters in water. With the exception of temperature, each of these parameters can generally be field calibrated.

1. Turn the instrument on. The on/off switch may be a toggle switch, knob, or button to be depressed depending on the type and brand of instrument being used.
2. Allow the instrument to "warm up" and progress through the startup diagnostic routine.
3. Apply calibration solution(s) as instructed by the instrument prompts and/or the manufacturer's manual. Reseal calibration solution containers for future use.
4. Adjust the reading of the instrument, if necessary, to correlate to the corresponding calibration solution being applied.
5. Record calibration reading(s) on the proper field calibration form(s).
6. Dispose of used calibration solution.

*Water Level Indicator and Petroleum/Water Interface Probe*

Field calibration of this instrument is not required. Rather a series of field checks to ensure the instrument is in proper working order are described.

1. Turn the instrument on. The on/off switch is usually a knob located on the side of the reel which the measuring tape is rolled onto.
2. Push the "test" button to ensure that the batteries are in working order. If the batteries are working, an audible tone will be heard and a visible light located on the side of the real will illuminate.
3. Immerse the sensor probe in distilled water to ensure the audible tone is heard and visible light illuminates when the probe enters the water and make an observation of where the water level is at on the probe. Repeat this step several times to familiarize yourself with this contact point. If sensor probe does not react when immersed, contact the manufacturer or licensed dealer for troubleshooting or replacement.
4. Immerse the sensor probe (for interface probes only) in pure phase product (such as vegetable oil) to ensure the audible tone is heard and visible light illuminates when the probe enters the product. Make an observation of where the product level is at on the probe. Perform decontamination on the probe as outlined in SOP No. 4 Decontamination after this step. If sensor probe does not react when immersed, contact the manufacturer or licensed dealer for troubleshooting or replacement

## *7. Decontamination*

Small instruments and equipment that comes into contact with environmental media shall be cleaned according to SOP No. 4 – Decontamination between each use and shall be stored in such a way as to prevent contamination.

## *8. Field Screening Laboratory Instrument Maintenance Schedule*

Dedicated field screening laboratory FID and PID instruments (TVA-2020 FID/PID or equivalent) will be returned to equipment supplier approximately every 6 months so that manufacturer's recommended maintenance may be performed. Equipment supplier will bring two replacement FID/PID units onsite and AECOM field lab manager will perform side-by-side calibrations with all four FID/PID units. This will be done to ensure that the two replacement FID/PID units can be calibrated with detector counts within manufacturer-recommended ranges for zero air and applicable span gas concentrations (consult instrument manual or call manufacturer technical support to determine recommended ranges for detector counts). After successfully calibrating the two replacement FID/PID units, the original two FID/PIDs may be returned to equipment supplier.

## 1. Objective

The purpose of this SOP is to the standard procedure for developing or redeveloping a groundwater monitoring well. The objective of groundwater monitoring well development or redevelopment is to clear the well of accumulated sediments so that representative groundwater samples and water quality measurements and/or water levels may be collected for Shell projects in Hartford and Roxana, Illinois. Development activities are typically performed when a well, intended for sampling, is installed. Redevelopment activities are typically performed based on the following criteria[1]:

- If the well is sampled as part of a routine groundwater sampling program, when 10% or more of a well screen has been occluded by sediment; or
- If the well in only gauged (and not sampled) as part of a routine groundwater sampling program, when 75% or more of a well screen has been occluded by sediment.

Accumulated sediments are typically suspended in the water column in order to be removed. This procedure discusses the use of a check valve with an actuator pump to suspend and remove sediments. Other methods to suspend sediments, some of which may require a subcontractor, include:

- using a surge block,
- injecting air into the water column of the well, or
- using a submersible pump, an air bladder pump, air-lift, or a bailer.

## 2. Other SOPs referenced in this SOP:

- SOP No. 4 Decontamination
- SOP No. 8 Field Reporting and Documentation
- SOP No. 10 Well Gauging Measurements

## 3. Equipment

Information and equipment typically used during well development includes:

- Well installation information
- Well keys
- Disposable latex or nitrile gloves
- Assorted tools (safety utility knife, screwdriver, tubing cutters, etc.)

[1] Redevelopment criteria presented are guidelines based on site knowledge and experience and are not a formal or regulatory requirement.

- Pump and required accessories (check valve, surge collar, HDPE tubing, etc.) or air-lift equipment (typically provided by a subcontractor)
    - Waterra SS-19 standard flow check valve threads onto 1/2-inch inner diameter by 5/8-inch outer diameter HDPE tubing (may be used for wells up to 100 feet below ground surface)
    - Waterra SS-32 high flow check valve threads onto 3/4-inch inner diameter by 1-inch outer diameter HDPE tubing (recommended for wells deeper than 100 feet below ground surface)
- Power supply (battery, inverter, generator, or similar)
- Electronic water level indicator or oil/water interface probe with 0.01-foot increments
- Paper towels or Kimwipes (decontamination equipment)
- Calculator
- Bound field logbook and/or groundwater development sheet
- Waterproof pen or permanent marker
- Plastic Buckets or truck-mounted poly tank
- 55-gallon drums or portable tanks, if needed
- Appropriate health and safety equipment (e.g. photoionization detector (PID), etc.)

Additional equipment typically used during well (re)development for wells with LNAPL includes:

- Water/product interface probe with 0.01-foot
- *NuWell 220* dispersant polymer

## *4. Procedure if no LNAPL present*

The following procedures will be used when using a check valve with an actuator pump (such as the Waterra Hydrolift II) to develop a new well or redevelop an existing well which does NOT contain LNAPL.

1. Put on a new, unused pair of disposable latex or nitrile gloves.
2. Approached the well from upwind, unlock and remove the well cap , and monitor the air quality at the well head and in the breathing zone with a PID.

3. Measure the depth to groundwater to the nearest hundredth of a foot (SOP No. 10 Well Gauging Measurements).

4. Measure the total depth of the well to the nearest hundredth of a foot (SOP No. 10 Well Gauging Measurements). Note whether the bottom of the well feels hard or soft (this may be easier to determine with a weighted tape measure).

5. Remove the water level indicator or interface probe from the well and decontaminate (refer to SOP No. 4 Decontamination).

6. Calculate the amount of water to be removed:

   installed depth – depth to water = height of water column

   height of water column * gallons/foot conversion = 1 well volume

| Well Diameter | Gal/ft Conversion |
|---|---|
| 0.75 inch | 0.0229 |
| 1 inch | 0.0408 |
| 1.5 inches | 0.0918 |
| 2 inches | 0.163 |
| 4 inches | 0.652 |
| 6 inches | 1.468 |

   - For Development of newly installed wells: Remove 1x the amount of water added within the screened and sand pack zone by drillers during installation, along with 5 well volumes of water.
   - For Redevelopment of existing wells: Remove 3 well volumes of water.

7. Thread check valve onto the appropriate sized HDPE tubing.

   - If using a surge collar, press it firmly from the threaded end of the check valve to about halfway down the check valve.

8. Lower check valve end of HDPE tubing into the well.

   - If using a surge collar lower to within the screened zone or just above the top of the sediment present within the bottom of the well.
   - If not using a surge collar, lower to the current bottom of the well to help agitate the sediment present.

9. Cut off the HDPE tubing leaving at least 6 feet and enough to extend into the development water collection vessel (drum, truck-mounted tank, etc.).

10. Hang the Waterra Hydrolift, or similar actuator, on the well protector, if possible, and secure with ratchet strap. If this is not possible, find some other way to mount and secure the actuator near and above the well pipe.
11. Ensure the actuator is resting at its lowest stroke position.
12. Install the actuator arm into the top slot of the actuator at the appropriate location for tubing placement within the center of the well pipe. Secure the clamp arm with the cotter pin.
13. Close the tubing clamp bracket with the tubing extending through the correct slot for its size (tight fit but tubing not crimped).
    - If the tubing is not a snug fit into one of the slots, hose clamps will be required above and below the actuator arm bracket.
14. Tighten tubing clamp bracket by screwing down the knob.
15. Secure the discharge end of the tubing into the development water collection vessel.
16. Plug the power cord for the actuator into a generator or inverter.
17. Begin pumping by turning on the tubing actuator to oscillate the tubing/check valve/surge collar assembly up and down.
    - Adjust the speed/pumping rate as possible/necessary to pump at a sufficient rate to allow the sediments to be removed.
        - The actuator and check valve surge the well screen and purge the groundwater at the same time.
18. (Re)Development is potentially completed when the following criteria have been achieved:
    - Water being purged is visually sediment free.
    - Required minimum volume of water has been removed (refer to **Step 6** above).
    - Installed depth is measured.
19. Once (re)development is thought to be completed, turn off the actuator and unplug the power cord.
20. Open the actuator arm bracket and free the tubing.
21. Remove the tubing from the well. Attempt to roll/coil tubing during removal. For disposal, tubing can be cut into manageable segments and containerized.

22. Re-measure the total well depth and calculate the percent of screen occlusion.

$$\frac{\text{installed total well depth} - \text{sump length} - \text{measured total well depth}}{\text{screen length}}(100\%) = \%\ \text{occlusion}$$

- If the measured depth indicates 10% or more occlusion for sampled well screens (or 75% or more occlusion for gauged well screens), repeat **Steps 8** through **21**.
- If the measured depth indicates less than 10% well screen occlusion for sampled wells (or less than 75% well screen occlusion for gauged wells) and sediment has been removed from the screen to the extent practicable, go to **Step 23**.

23. Remove (unthread) check valve and surge collar, if used, from end of tubing. Appropriately discard tubing (check with IDW Coordinator for further instruction).

24. Decontaminate check valve and surge collar, if used.

Note in the field logbook and on any field data sheets the approximate number of gallons of water removed during development of each well, well screen depth interval, depth to bottom prior to well development, depth to bottom after well development, and if the development water removed prior to completion was visually sediment free. For other information necessary to be recorded, refer to SOP No. 8 Field Reporting and Documentation.

## *5. Procedure if LNAPL is present*

The following procedures will be used when using a check valve with an actuator pump (such as the Waterra Hydrolift II) to develop a new well or redevelop a submersible pump to develop a new well or redevelop an existing well in which LNAPL is observed. The procedures below assume that **Steps 1** and **2** in **Section 4** above have been completed

1. Measure the total depth of the well to the nearest hundredth of a foot. Note whether the bottom of the well feels hard or soft.

2. Calculate the amount of water to be removed:

   installed depth – depth to water = height of water column

   height of water column * gallons/foot conversion = 1 well volume

| Well Diameter | Gal/ft Conversion |
|---|---|
| 0.75 inch | 0.0229 |
| 1 inch | 0.0408 |
| 1.5 inches | 0.0918 |
| 2 inches | 0.163 |
| 4 inches | 0.652 |
| 6 inches | 1.468 |

6. Add *NuWell 220*, or similar, dispersant polymer into the well in accordance with the dosage guide below or the manufacturer's dosage recommendations

    - 2" monitoring well – add 0.12 ounces per foot of water within the well (Example: 20-foot deep 2" monitoring well, DTW = 7 feet;

      13 feet of water * 0.12 ounces per foot = 1.56 oz of *NuWell 220*)

    - 4" monitoring well – add 0.46 ounces per foot of water within the well.

7. Complete **Steps 7** through **24** in **Section 4** above.

Note in the field log book and on any field data sheets the amount of *NuWell 220*, or similar, dispersant polymer added to the well, the approximate number of gallons of water removed during development of each well, well screen depth interval, depth to bottom prior to well development, depth to bottom after well development, and if the development water removed prior to completion was visually sediment free. For other information necessary to be recorded, refer to SOP No. 8 Field Reporting and Documentation.

## 1. Objective

The purpose of this Standard Operating Procedures (SOP) is to define the standard procedure SOP and necessary equipment for collection of soil vapor samples from vapor monitoring points / sampling ports using stainless steel canisters for Shell projects in Hartford and Roxana, Illinois.

## 2. Other SOPs referenced in this SOP:

- SOP No. 4 Decontamination
- SOP No. 26 Sample Control and Custody Procedures
- SOP No. 51 Vapor Sampling Classification, Packaging and Shipping

## 3. Equipment

The following equipment is typically needed:

- Logbook
- Disposable nitrile gloves
- Cut resistant gloves
- Ultra-fine permanent marker
- Paper towels
- Decontamination equipment
- Soil vapor sampling field sheets and computer, or similar electronic data entry device
- Small brush or broom
- Charcoal filter
- 15 mL hand pump
- 60 mL syringe or equivalent
- Peristaltic pump with battery
- Rotameter or equivalent
- Photoionization Detector (PID) (e.g., RAE Instruments MultiRAE or equivalent)
- Flame Ionization Detector (FID) (e.g., Thermo Scientific TVA-2020 or equivalent)

- Lower Explosive Limit (LEL) meter (e.g., RAE Instruments MultiRAE or equivalent)
- Landfill gas detector (e.g., Landtec GEM-2000 or equivalent)
- Stainless steel canisters with flow controllers (supplied by the laboratory)
- 1-Liter Tedlar® bags (new or decontaminated as outlined in SOP No. 4 Decontamination) – 2 per sample
- Black trash bag for storing Tedlar® bag samples
- Bentonite grout
- Foam padding
- Sample train assembly (configuration and parts shown on **Figure 1**)
- Vacuum gauge (0 – 30 inches Hg)
- Teflon® tubing (laboratory-grade) – 1/8" ID – ¼" OD
- Tygon® tubing (laboratory-grade) – 3/16" ID – 3/8" OD
- Tracer gas (e.g., Grade 5 helium)
- Tracer gas shroud (e.g., plastic tote)
- Tracer gas meter (e.g., Dielectric Technologies MGD-2002 or equivalent)
- Watch or timer
- Standard field tools (e.g., ratchet set, safety cutting tools, pry bar, etc.)
- Wrenches (7/16, ½, 9/16, 5/8)
- Shipping supplies (e.g., UN boxes, shipping labels, hazard labels, packing tape)

### *4. Vapor Port Development Purging*

If the port has been newly installed, the port must be developed by purging 3 volumes of the sampling assembly including 3 volumes of the sand pack. If development is not required, proceed to **Section 4** or **Section 5** below for the appropriate sampling procedures

1. Open vapor point vault to check integrity of individual soil vapor monitoring port(s) (VMP). Each port should have a hose barb connected to a 3-way polycarbonate stopcock (3-way) using silicone tubing. The 3-way should be in the "off" position.
2. Connect peristaltic pump and Tygon tubing connected to the 3-way.
3. Connect charcoal filter exhaust to the discharge end of the tubing assembly.

4. Calculate Purge volume:

    - Vapor Port tubing (1/8-in diameter): 2.41 mL/foot (single volume)
    - Sample train assembly / Tygon® tubing (1/4-in diameter): 9.65 mL/foot (single volume)
    - Sand Pack: 18,765 mL (4.95 gallons – single volume – assuming 18-inch-thick sand pack)

5. Open 3-way and begin purging port at a rate no greater than 2 L/min. Document time started.
6. Once 3 volumes are reached, stop pump and close 3-way. Document time stopped.
7. Move to next depth or replace vault cover and clean up at location.

*5. Vapor Port Sampling – With No Tracer Gas*

To perform vapor port sampling with tracer gas shroud, proceed to **Section 5** below.

1. Set up at VMP. Turn off vehicle. If vehicle will be left running per health and safety procedures, prevent sample and sample media from being exposed to vehicle exhaust.
2. Open vapor point vault to check integrity of individual soil VMP(s). Each port should have a hose barb fitting connected to a 3-way valve using silicone tubing. The 3-way should be in the "off" position.
3. Perform stainless steel canister vacuum check, per the steps listed in **Section 6** of this SOP.
4. Remove hose barb fitting from port and set up the sample assembly using the configuration shown in **Figure 2**. The flow controller (one for each stainless-steel canister provided by the laboratory) shall be connected to the stainless-steel canister inlet. Do not re-use flow controllers between samples. Flow controllers can be set to different rates as specified by the project work plan, depending on size of container to be filled. For a 1-Liter stainless steel canister, approximately 5 minutes is a standard collection time (~167 ml/min).
5. Perform sample train leak check, per the steps listed in **Section 6** of this SOP.
6. Calculate Purge volume:

    - Vapor Port tubing (1/8-in diameter): 2.41 mL/foot (single volume)
    - Sample train assembly (1/4-in diameter): 9.65 mL/foot (single volume)

7. Purge the three volumes from the vapor monitoring port purge using the 60 mL syringe. If pullback is observed on the 60 mL syringe and the purge cannot be completed, the VMP screen may be saturated with water and will not yield a representative sample. If this happens, do not sample the VMP. Similarly, if water or LNAPL is observed in the syringe during the purge, do not sample the VMP. Record purge results in computer and on sample sheets.
8. Remove the 3-way and connect the sample train to the VMP using Swagelok® fittings.
9. Open Port Valve and Valve #1. Use 60 mL syringe to purge 30 mL (approximately three times the volume of the sample train assembly).
10. Close Valve #1.
11. Open stainless-steel canister valve completely and record the time in the computer or on sample sheets.
12. Allow the canister to fill until the vacuum gauge reads between -5 and -10 inches Hg; however, an ideal sample shall have approximately -5 inches Hg remaining after sampling is complete. When ambient temperatures are below freezing, close canister valve when the vacuum gauge reading is -7 inches Hg[1]. For a 1-Liter canister, filling shall take approximately 5 minutes but may require more or less time depending on formation materials[2]. If the vacuum gauge reading drops below -5 inches Hg before approximately 5 minutes, close the stainless-steel canister valve completely. If canister fills in less than 5 minutes it is possible that there was a leak in the canister or flow controller, even if no helium is detected in the final Tedlar® bag. Call task manager to discuss any canisters that fill in less than 5 minutes; a re-sample may be necessary. Record the time in the computer and on sample sheets.
13. Connect peristaltic pump to tubing connected to Valve #1 and open Valve #1 to collect a sample in a sample bag. The sample bag should be filled at a rate no greater than 200 ml/min. Use a rotameter to measure flow rate, and adjust pump speed to approximately 200 mL/min.
14. Disconnect the sample train from the VMP and reconnect the 3-way.
15. Disconnect flow controller, stainless steel canister, and used tubing from sample assembly.

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[1]Sample will undergo thermal expansion (some loss of vacuum) when moved from a cold outdoor setting to a warmer indoor setting. By closing the canister valve at -7 inches Hg, the sample will be able to undergo thermal expansion without reaching 0 inches Hg. The larger the difference between outdoor and indoor temperatures, the greater the loss of vacuum.
[2] Other sized canisters will take different amounts of time to sufficiently fill.

16. From the soil vapor in the Tedlar® sample bag obtain readings for total volatile organics with a FID, PID and for $CO_2$, $CH_4$, LEL, and oxygen ($O_2$) with a landfill gas detector. Record readings in computer and on sample sheets. If FID or PID is not on-site, label and retain bag for screening at field trailer.
17. Perform stainless steel canister vacuum check, per the steps listed in **Section 6** of this SOP.
18. Setup on the next port depth or replace vault cover and clean up at location.
19. Decontaminate any non-designated equipment (e.g., sample assembly) following procedures listed in **Section 7**.

### *6. Vapor Port Sampling – With Tracer Gas Shroud*

To perform vapor port sampling with no tracer gas shroud, proceed to **Section 4** above.

1. Set up at VMP. Turn off vehicle. If vehicle will be left running per health and safety procedures, prevent sample and sample media from being exposed to vehicle exhaust.
2. Open vapor point vault to check integrity of individual VMP(s). Each port should have a hose barb fitting connected to a 3-way valve using silicone tubing. The 3-way should be in the "off" position.
3. Perform stainless steel canister vacuum check, per the steps listed in **Section 6** of this SOP.
4. Remove hose barb fitting from port and set up the sample assembly using the configuration shown in **Figure 3**. The flow controller (one for each stainless-steel canister provided by the laboratory) shall be connected to the stainless steel canister inlet. Do not re-use flow controllers between samples. Flow controllers can be set to different rates as specified by the project work plan, depending on size of container to be filled. For a 1-Liter stainless steel canister, approximately 5 minutes is a standard collection time (~167 ml/min).
5. Perform sample train leak check, per the steps listed in **Section 6** of this SOP.
6. Calculate Purge volume:
    - Vapor Port tubing (1/8-in diameter): 2.41 mL/foot (single volume)
    - Sample train assembly (1/4-in diameter): 9.65 mL/foot (single volume)

7. Purge the three volumes from the vapor monitoring port purge using the 60 mL syringe. If pullback is observed on the 60 mL syringe and the purge cannot be completed, the VMP screen may be saturated with water and will not yield a representative sample. If this happens, do not sample the VMP. Similarly, if water or LNAPL is observed in the syringe during the purge, do not sample the VMP. Record purge results in computer and on sample sheets.
8. Remove the 3-way and connect the sample train to the VMP using Swagelok® fittings.
9. Open Port Valve and Valve #1. Use 60 mL syringe to purge 30 mL (approximately three times the volume of the sample train assembly).
10. Close Valve #1.
11. Place an enclosure shroud over the VMP and assembled sample train as shown in **Figure 3**. The shroud should have openings for:
    - Introduction of tracer gas;
    - Pressure relief to the atmosphere and access of a tracer gas monitoring device;
    - Tygon tubing to connect to the peristaltic pump for Valve #1

    The shroud should have sufficient glove access to open or close all valves within. As shown in **Figure 3**, the shroud must also be sealed to the ground with hydrated bentonite (or equivalent) or foam padding.
12. Introduce tracer gas into the shroud at a known rate until the atmosphere within the shroud contains a sufficient quantity (typically 20% to 50%) of tracer gas.
13. Connect peristaltic pump to Valve #1 using Tygon tubing, open Valve #1, and collect sample bag #1. The sample bag should be filled at a rate no greater than 200 ml/min.
14. Close Valve #1.
15. From the soil vapor in Tedlar® sample bag #1, obtain readings for tracer gas with tracer gas detector. If tracer gas readings are elevated, analyze sample bag #1 using a landfill gas detector to obtain a direct methane reading. See **Section 6** for acceptance criteria.
16. Open stainless-steel canister valve completely and record the time in computer or on sample sheets.
17. Allow the canister to fill until the vacuum gauge reads between -5 and -10 inches Hg; however, an ideal sample shall have approximately -5 inches Hg remaining after sampling is complete. When ambient temperatures are below freezing, close canister

valve when the vacuum gauge reading is -7 inches Hg[3]. For a 1-Liter canister, filling shall take approximately 5 minutes but may require more or less time depending on formation materials.[4] If the vacuum gauge reading drops below -5 inches Hg before approximately 5 minutes, close the stainless-steel canister valve completely. Record the time in the computer and on sample sheets. Record the concentration of tracer gas within the shroud after closing the canister valve. If canister fills in less than 5 minutes it is possible that there was a leak in the canister or flow controller, even if no helium is detected in sample bag #2. Call task manager to discuss any canisters that fill in less than 5 minutes; a re-sample may be necessary.

18. Connect peristaltic pump to tubing connected to Valve #1 and open Valve #1 to collect sample bag #2. The sample bag should be filled at a rate no greater than 200 ml/min.
19. Break seal on the shroud and disconnect flow controller, stainless steel canister, and used tubing from sample assembly.
20. From the soil vapor in sample bag #2 obtain readings for total volatile organics with a PID, for $CO_2$, $CH_4$, LEL, and oxygen ($O_2$) with a landfill gas detector, and for tracer gas concentration with the tracer gas detector. See **Section 6** for acceptance criteria. Record readings in computer or on field sheets. If FID or PID is not on-site, label and retain Tedlar® sample bag #2 for reading at field trailer.
21. Perform stainless steel canister vacuum check, per the steps listed in **Section 6** of this SOP.
22. Disconnect the sample train from the VMP and reconnect the 3-way.
23. Move to next depth or replace vault cover and clean up at location.
24. Decontaminate any non-designated equipment (e.g., sample assembly) following procedures listed in **Section 7**.

## *7. Quality Control*

Quality control procedures have been developed to verify equipment integrity, sample quality, and sample repeatability.

In addition to the procedures listed below, the following items are also of concern:

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[3]Sample will undergo thermal expansion (some loss of vacuum) when moved from a cold outdoor setting to a warmer indoor setting. By closing the canister valve at -7 inches Hg, the sample will be able to undergo thermal expansion without reaching 0 inches Hg. The larger the difference between outdoor and indoor temperatures, the greater the loss of vacuum.

[4]Other sized canisters will take different amounts of time to sufficiently fill.

- Care should be taken to keep all sampling equipment, especially the stainless-steel canisters, safe from damage.
- No samples are to be collected in an area where vehicle or other equipment exhaust is being discharged. Do not place samples or sample media directly on asphalt, gravel, or other ground surfaces.

**Field Duplicates**

A field duplicate shall be collected for 10% of the samples collected.

Field duplicates are collected by using a sample assembly with an additional 3-way union. A stainless-steel canister with a flow controller is attached to each of the 3-way unions on the assembly. For sampling, both stainless steel canister valves should be opened and closed simultaneously. Use the appropriate procedure described above to collect samples.

**Stainless Steel Canister Vacuum Check**

The stainless-steel canister vacuum check shall be performed for 100% of the stainless steel canisters.

*Prior to Sampling*

1. Remove brass cap from stainless steel canister. Brass cap will not be present if canister is configured with quick connect fitting.
2. Attach the pressure gauge provided by the laboratory to the stainless-steel canister inlet.
3. Open valve one-half turn, then close valve.
4. Record reading on the canister tag. If the canister does not show a vacuum or shows a vacuum of less than -26 inches Hg, then:
    - Label the canister tag with “Insufficient vacuum – No Sample”;
    - Set canister aside for return to the laboratory; and
    - Contact task manager and lab coordinator if number of canister failures affect field work.
5. Make sure valve is closed tight, but not overtight.
6. Remove the pressure gauge.
7. If not immediately using the stainless-steel canister for sample, place and tighten brass cap on stainless steel canister (not applicable if canister is configured with quick connect fitting).

*After Sampling*

1. Attach the pressure gauge provided by the laboratory to the stainless-steel canister inlet.
2. Open valve one-half turn, then close valve.
3. Record reading. There should still be a vacuum in the stainless-steel canister. The final vacuum on the canister should be between -10 inches of Hg to -2 inches of Hg. If the final vacuum does not fall within this range, contact the task manager immediately to determine the value of using another stainless-steel canister to recollect the sample.
4. Make sure valve is closed tight, but not overtight.
5. Remove the pressure gauge.
6. Place and tighten brass cap on stainless steel canister (not applicable if canister is configured with quick connect fitting).

**Sample Train Vacuum Leak Check**

The sample train leak check shall be performed for 100% of the samples collected.

1. Assemble the sampling apparatus as shown in **Figure 1**.
2. Keep the stainless-steel canister closed, and Valve #1 in the "open" position.
3. Attach the 15 mL hand pump to sample train at Valve #1.
4. Withdraw air from the sampling apparatus until a vacuum between 20 and 25 inches Hg is achieved. Close Valve #1. Use flow controller's built-in vacuum gauge to observe the induced vacuum for at least five minutes. If the flow controller's vacuum gauge does not function properly, notify the task manager.
5. If the change in vacuum over five minutes is equal to or less than 0.5 inches Hg, the system leak rate is acceptable.
6. If the change in vacuum over five minutes is greater than 0.5 inches Hg, check, tighten or replace the fittings and connections and repeat the leak check.

**Tracer Gas Check**

An appropriate number of samples shall be collected using a tracer gas, as per the project work plan or activity plan.

1. Tracer gas should be introduced near the VMP to test the integrity of the probe seal and the above ground connections.
2. Collect the soil vapor sample per procedures in **Section 5**.

3. If the concentration of the tracer gas in a sample is ≤10% of the concentration of the tracer gas in the shroud:
   - Prior to stainless steel canister sampling: continue with sample collection.
   - Following stainless steel canister sampling: the sample is acceptable.
4. If the concentration of the tracer gas in the sample is >10% of the concentration of the tracer gas in the shroud:
   - Prior to stainless steel canister sampling: check methane levels.
     - If methane reading ≥2%, continue with sample collection.
     - If methane reading ≤2%, stop sample collection. Check fittings and valves before restarting sample collection.
   - Following stainless steel canister sampling: check methane levels.
     - If methane reading ≥2%, the results may be biased high by methane. Call task manager to discuss.
     - If methane reading <2%, sample likely compromised; do not use sample. Call task manager to inform of need for re-sample.
   - If a sample is found to be compromised, 2 additional attempts (3 attempts total) should be made to collect a sample.
     - With each additional attempt, check stainless-steel tubing and fittings for holes and loose connections, and place an additional layer of bentonite seal in the interior of the well vault.
     - After 3 attempts, if a successful sample has not been collected, the VMP shall not be sampled for that quarter.

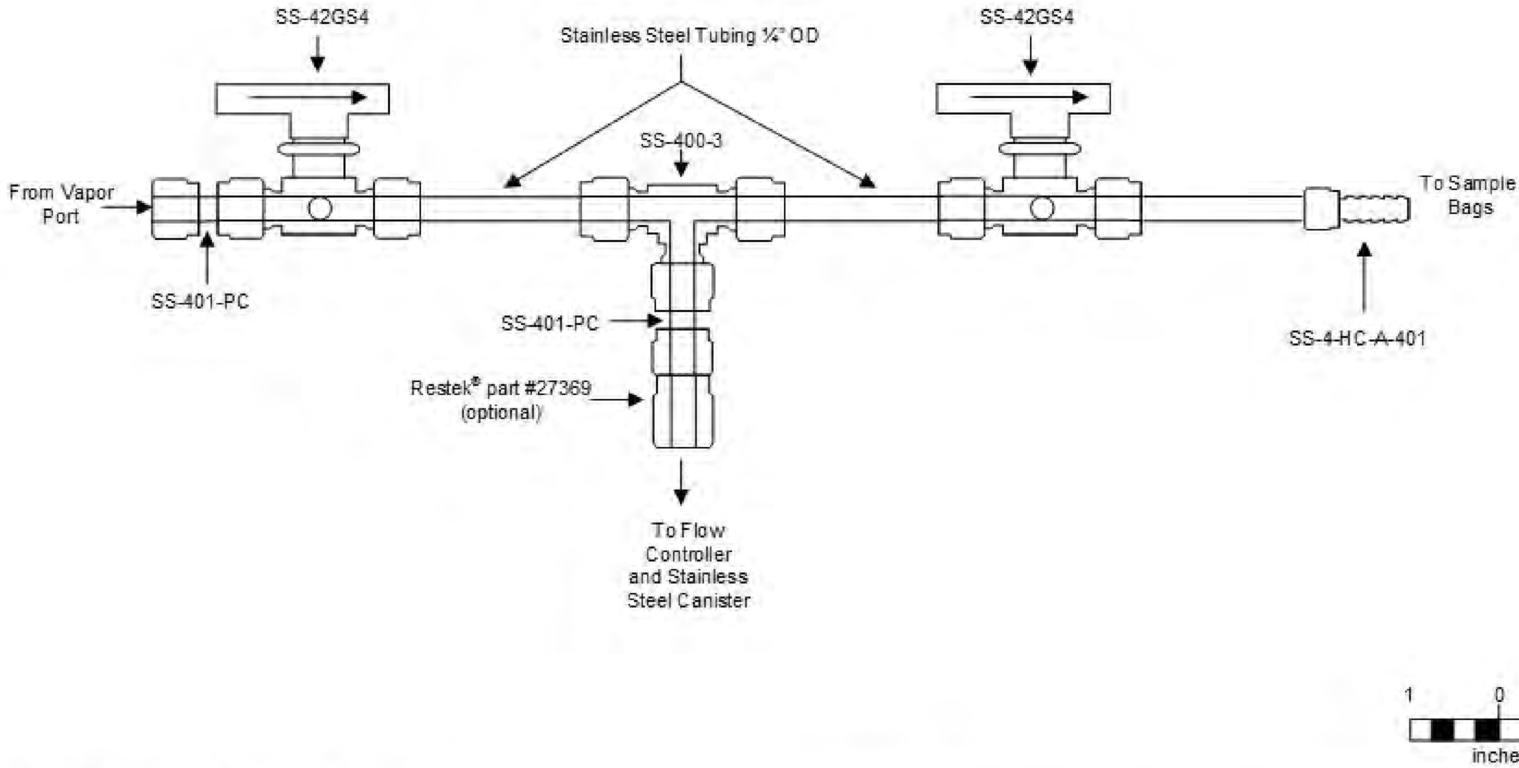
## *8. Decontamination*

- Non-designated stainless-steel assemblies shall be thoroughly decontaminated by purging with at least half a liter of air (e.g., with hand pump or peristaltic pump).
- Should a stainless-steel assembly come into contact with groundwater, it shall be decontaminated using a Liquinox® detergent wash followed by a distilled water rinse. Discuss with task manager before re-using the assembly.
- If a stainless-steel assembly should come into contact with LNAPL, immediately call task manager and segregate the contaminated components from other sample media.

- Multiple stainless-steel assemblies shall be available to sample crews to allow for equipment to be cleaned and dried sufficiently before being reused.
- Tedlar® bags may be decontaminated if it meets the criteria listed in SOP No. 4 Decontamination.

*9. Shipping*

- Sample information shall be recorded on a chain of custody for the laboratory following procedures outlined in SOP No. 26 Sample Control and Custody Procedures.
- Samples shall be shipped to the laboratory following DOT regulations. If there is the possibility that samples may be classified as hazardous, samples must be shipped as such. For procedures, see SOP No. 51 Vapor Sampling Classification, Packaging and Shipping, and check with one of the office hazardous shipping personnel.




Notes:
1) All components listed with Swagelok® part numbers (if applicable).
2) All components made by Swagelok® unless otherwise noted.
3) Assembly shown for standard sample.
4) Duplicate assembly includes an additional 3-way union between the two shown.
5) All fittings shown are compression fittings with SS-400-Set ferules and SS-402-1 nuts.
6) Restek® part #27369 is a female quick connect fitting that may be used to connect sampling assembly to flow controller when flow controller is outfitted with accompanying Restek® part #27373 (male quick connect fitting).

Source: https://swagelok.com/products.aspx; Accessed June 13, 2019.
Source: https://www.restek.com/catalog/view/53581; Accessed June 13, 2019.

SOP 44R
Soil Vapor Purging and Sampling – Roxana

PROJECT NO. 60592794

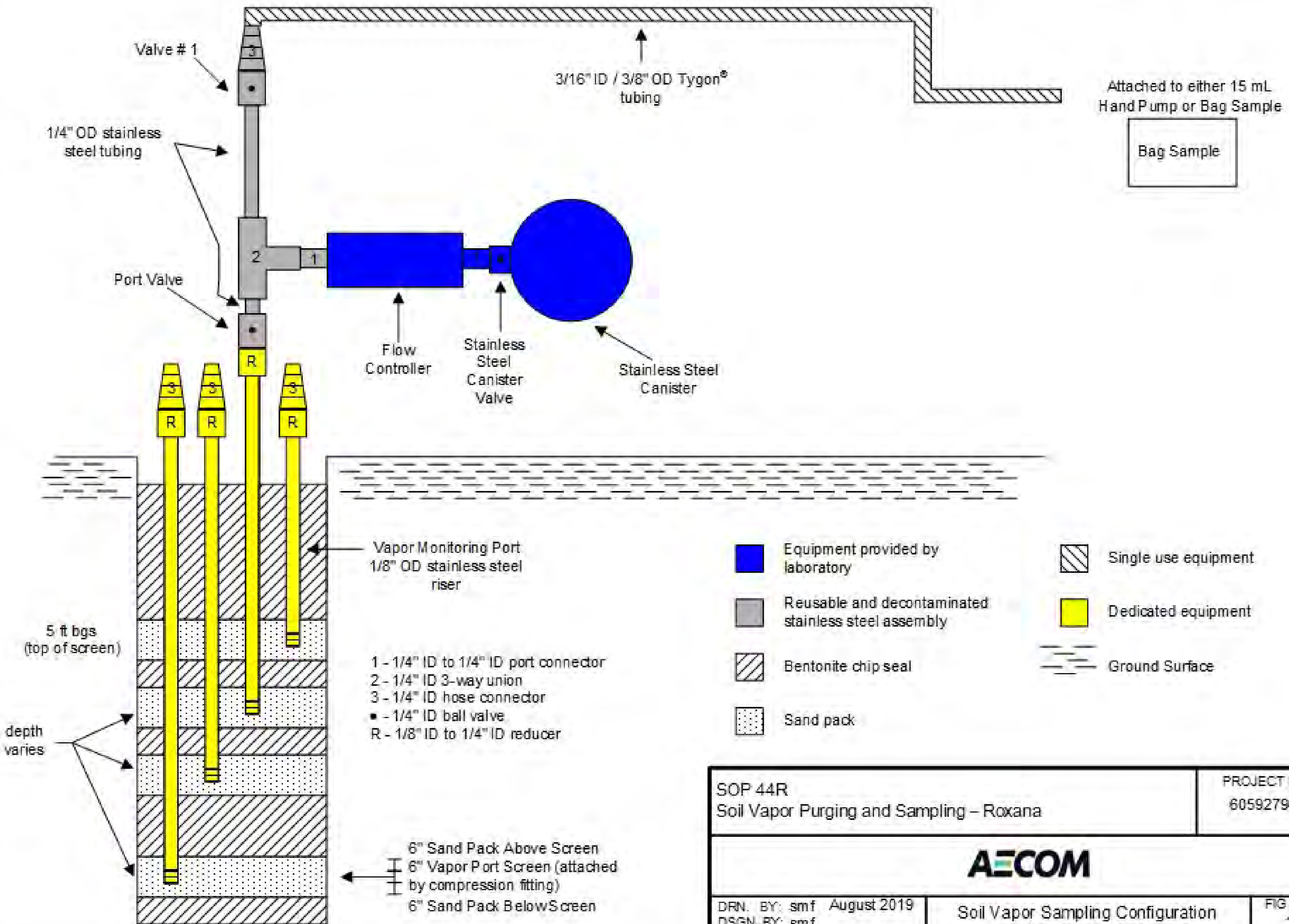
AECOM

DRN. BY: smf August 2019
DSGN. BY: smf
CHKD. BY: bbb

Soil Vapor Sampling Assembly

FIG. NO. 1

DRAWING NOT TO SCALE

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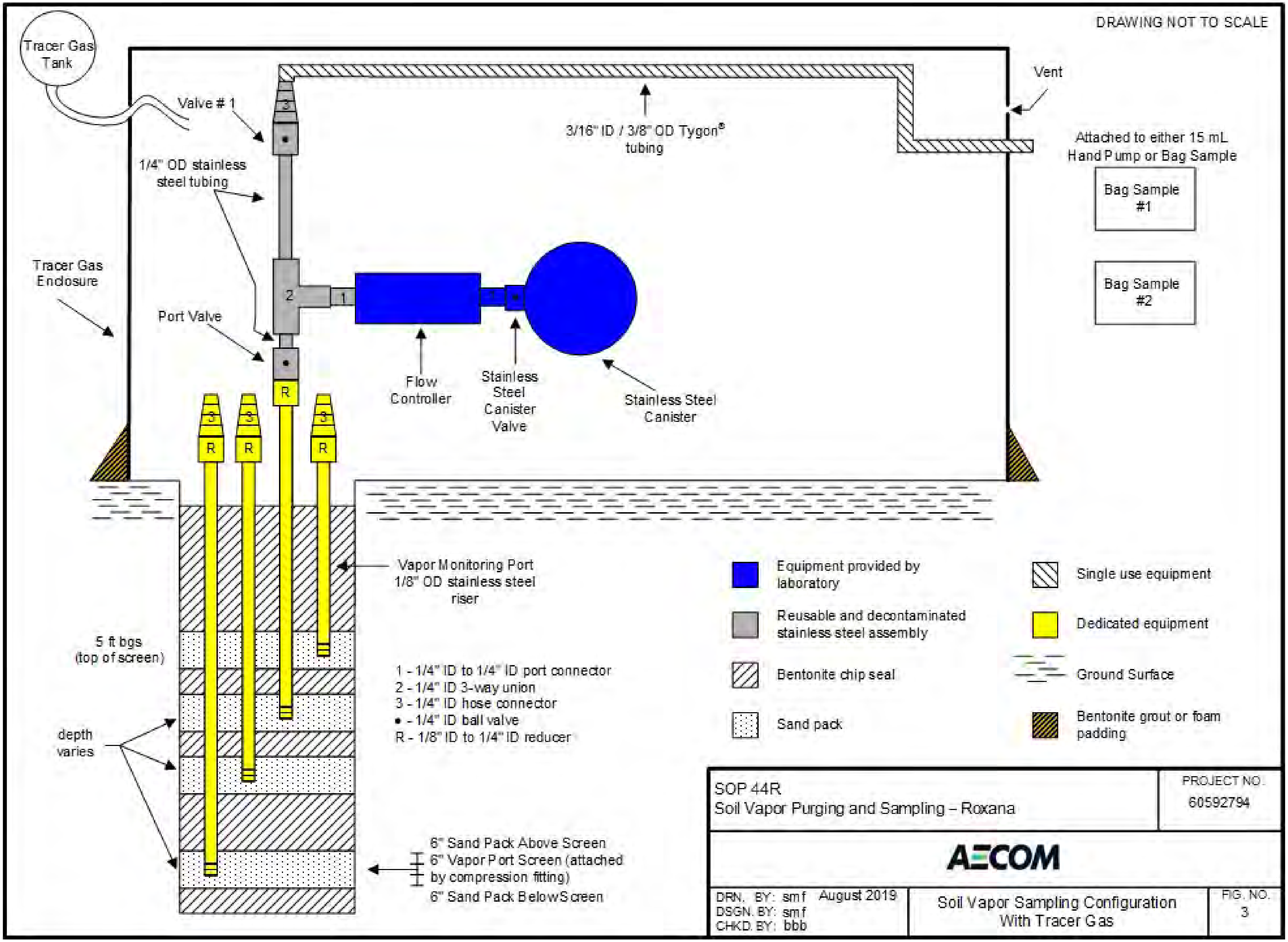
| SOP 44R<br>Soil Vapor Purging and Sampling – Roxana | PROJECT NO.<br>60592794 |

AECOM

| | | |
|---|---|---|
| DRN. BY: smf August 2019<br>DSGN. BY: smf<br>CHKD. BY: bbb | Soil Vapor Sampling Configuration<br>No Tracer Gas | FIG. NO.<br>2 |


DRAWING NOT TO SCALE
Tracer Gas Tank
Valve # 1
3/16" ID / 3/8" OD Tygon®
tubing
Vent
Attached to either 15 mL Hand Pump or Bag Sample
Bag Sample #1
Bag Sample #2
1/4" OD stainless steel tubing
Tracer Gas Enclosure
Port Valve
Flow Controller
Stainless Steel Canister Valve
Stainless Steel Canister
Vapor Monitoring Port 1/8" OD stainless steel riser
5 ft bgs (top of screen)
depth varies
1 - 1/4" ID to 1/4" ID port connector
2 - 1/4" ID 3-way union
3 - 1/4" ID hose connector
• - 1/4" ID ball valve
R - 1/8" ID to 1/4" ID reducer
6" Sand Pack Above Screen
6" Vapor Port Screen (attached by compression fitting)
6" Sand Pack Below Screen
Equipment provided by laboratory
Reusable and decontaminated stainless steel assembly
Bentonite chip seal
Sand pack
Single use equipment
Dedicated equipment
Ground Surface
Bentonite grout or foam padding
SOP 44R
Soil Vapor Purging and Sampling – Roxana
PROJECT NO.
60592794
AECOM
DRN. BY: smf August 2019
DSGN. BY: smf
CHKD. BY: bbb
Soil Vapor Sampling Configuration With Tracer Gas
FIG. NO.
3

## *1. Introduction*

The purpose of this Standard Operating Procedure (SOP) is to provide a consistent methodology for the screening of Tedlar® bag soil vapor samples from the Shell projects in Hartford and Roxana, Illinois. This SOP details the necessary procedures to follow in order to ensure that valid total vapor phase hydrocarbons, oxygen, methane and carbon dioxide concentration data is collected and adequately documented. These procedures are applicable to any vapor sample collected at the Roxana site, but are particularly useful for samples collected from vapor monitoring ports (VMPs), soil vapor extraction (SVE) wells, and sub-slab (SS) ports that are located throughout the Village. Important uses of these data include:

- Evaluation of indoor air or sub-slab methane concentrations
- Screening of indoor air or sub-slab petroleum hydrocarbon concentrations
- Evaluation of the performance of the Roxana Soil Vapor Extraction System.
- Evaluation of the performance of the Rand Avenue Remediation System
- Ambient air samples can either be collected and analyzed on-location using real-time instrumentation, or collected in Tedlar® bags and analyzed at a dedicated sample screening station.

## *2. Other SOPs referenced in this SOP*

- SOP No. 4 - Decontamination

## *3. Equipment*

The following materials are typically used to perform sample screening, either on-site or at a dedicated sample screening station:

- Thermo Scientific TVA-2020 (TVA-2020) and Landtec GEM-2000 (GEM-2000) real-time monitors (or similar);
- Calibration gas cylinders, including;
  - Methane in air at concentrations of 50; 500; 5,000, and 32,500 ppmv
  - Isobutylene in air at concentrations of 50 and 1,000 ppmv
  - Hydrocarbon-free air (Ultra Pure zero air)
  - 50% by volume methane/35% by volume CO2
- Regulators for calibration gas cylinders

- SKC sorbent tubes (part # 226-09) used for methane determination
- ¼-inch O.D. Teflon™ or Tygon™ tubing cut to length
- 10-to-1 dilution probe (Thermo Environmental Instruments Part #CR010MR)
- Disposable 3-way plastic valves (Qosina 3-way Stopcock, 2 Female Luer Locks, Male Luer Slip [Part # 13127]) used to switch the sample between methane and total hydrocarbon analyses.
- 1-liter Tedlar® bags (new or decontaminated as outlined in SOP No. 4 Decontamination)
- Nitrile gloves

### *4. Procedure*

The following instruments shall be used to screen soil vapor samples:

- TVA-2020 or performance equivalent for volatile organic compounds (VOCs) and methane by flame ionization detector (FID) and for VOCs by photoionization detector (PID)
- Landtec GEM-2000 or performance equivalent for methane, lower explosive limit (LEL), oxygen and carbon dioxide.

Immediately prior to use, each instrument shall undergo a calibration check. In the event that instrument accuracy is not within 15% of the designated calibration check standard concentration, the instrument shall be recalibrated. Field personnel shall follow applicable instrument operation SOP's and/or manufacturer's recommended procedures for the calibration and operation of the instruments. Calibration data shall be documented on the appropriate calibration forms for each instrument.

Calibration Procedures Applicable to All Field Screening Analyses

Instruments shall be calibrated in accordance with applicable SOPs and/or manufacturers recommended procedures immediately prior to sample screening. If the screening instruments are to be used throughout the work day, a mid-day and end-day calibration check shall be performed. Further, the TVA-2020 instrument detectors and associated dilution probe shall be bump checked (1-point accuracy check) approximately every two hours in order to document instrument stability. In the event that a bump check indicates a deviation greater than ± 15% from the designated bump-gas concentration, a full instrument calibration shall be performed. Due to negligible (<5%) instrument drift throughout the day, the GEM-2000 shall not undergo a bi-hourly bump check. Instead, if the GEM-2000 is used throughout the work day, calibration accuracy checks shall be conducted at approximately midday, and again at the conclusion of the sample event.

As stated above, calibration of the GEM-2000 and TVA-2020 shall be performed in accordance with applicable SOPs and/or manufacturer recommended procedures. However, the wide range of petroleum hydrocarbons and methane concentrations present at the site (i.e., greater than four orders-of magnitude) may be outside of the linear range of the TVA-2020 FID. To meet a primary data quality objective of the project (i.e., to quickly and accurately determine whether a potentially explosive condition is present at a sampling location), the FID calibration shall be based on a calibration standard that is approximately 10% of the LEL for methane (5,000 ppmv). However, additional QC procedures shall be implemented to ensure quality data for both hydrocarbon and methane concentrations.

The linearity of instrument response shall be verified by using 50 ppmv, 500-ppmv methane standards. If significant non-linear response (i.e., greater than 15% relative root mean square error) is observed, a nonlinear calibration curve shall be developed. The relative response factor for isobutylene (which is used here as a surrogate for petroleum vapors) shall be determined by using a 1,000 ppmv (nominal) isobutylene calibration standard. (1,000 ppmv is approximately 10% of the LEL for gasoline.)

Calibration shall be considered adequate when check standards are within +/- 15%. If the calibration check standards are outside that range, a second check standard shall be run and if the check standard fails again, the instrument shall be recalibrated and data obtained since the last check standard was successfully run shall be flagged as estimated values.

Screening of Concentrated Samples Utilizing a Dilution Probe

Because samples will need to be analyzed which are above the measurement range of the FID or which may not have sufficient oxygen content to analyze reliably, dilution of some samples shall be required prior to screening. The 10:1 dilution probe shall be calibrated using the 32,500 ppmv methane standard. Calibration of the dilution probe is considered complete when the FID response to this standard is within ± 15% of 3,250 ppmv.

The critical orifice in the dilution probe is density-dependent. As it will be calibrated using a 3.25% methane standard that has a density of 98.6% that of air, samples that have a density significantly different from that shall be subject to some level of deterministic error. Samples that have extremely high hydrocarbon or methane concentrations have the potential to have significantly varying densities, which can introduce significant error when the screening relies on the dilution probe. For example, error in excess of 10% will be present at concentrations of methane above 40% (if significant concentrations of petroleum hydrocarbons are not present).

Because the average density of petroleum hydrocarbon vapors is variable, the error is not as readily quantified for elevated concentrations petroleum hydrocarbons. Assuming an average density of 2.5 times that of air (i.e., density equivalent to isopentane), error in excess of 10% will be present at concentrations of petroleum hydrocarbon above 17% (if significant concentrations of methane are not present).

The density error associated with methane and heavier hydrocarbons have the potential to offset each other. Because the average density of measured hydrocarbon will not be known, data associated with an estimated error greater than 10% due to the presence of hydrocarbon or methane shall be flagged as estimated, rather than corrected for an assumed density. As the concentrations at which significant error is introduced are well above project action levels, estimated concentrations at these ranges are considered adequate to meet project data quality objectives.

Screening of Samples Utilizing a Charcoal Scrubber Tube to Filter Heavy Hydrocarbons

Use of the sorbent tube to screen out hydrocarbons other than methane affects the function of the FID instrument by lessening the flow of air through the detector. Preliminary testing indicates that a 25% to 30% reduction in instrument response occurs over the linear calibration range of the instrument. To calibrate the instrument for use of the sorbent tube, the 50, 500 and 5,000-ppmv methane standards shall be run with the sorbent tube to determine the relative response of the instrument to methane passed through the sorbent tube. The relative response factor (RRF) for each calibration standard shall be calculated as:

$$RRF = \frac{FID_{sorb}}{FID_{raw}}$$

Where;

RRF = relative response factor;

$FID_{sorb}$ = Instrument response with sorbent tube; and

$FID_{raw}$ = Instrument response to calibration standard without sorbent tube

The average RRF shall be used as a correction factor for samples analyzed using the sorbent tube. It is not necessary to correct instrument response (other than multiplying the displayed value by 10) when using the 10:1 dilution probe in conjunction with the sorbent tube. When using the dilution probe, the majority (approximately 90%) of the sample that is analyzed is actually dilution air that does not pass through the sorbent tube.

*5. Sample Screening*

Whenever possible, the soil vapor samples collected for the various work tasks shall be screened on the same day of collection. If same-day screening is not possible due to time constraints, instrument problems, etc., the samples shall be screened within 24-hours of sample collection. If samples are stored overnight, they should be placed in a black trash bag or other opaque container to prevent light from reaching the samples. Most soil vapor samples collected in Tedlar® bags shall be screened at a fixed location using the instrumentation noted above. The fixed location facilitates the use of the instrumentation, allows for a more stable environment in which to screen the samples, and provides adequate space in which to perform the screening and complete the associated documentation. However, to allow rapid screening of indoor air and sub-slab soil vapor, such samples can be analyzed on site, using the same field instrumentation. The calibration of these instruments, as outlined in **Section 3.0**, shall be performed in such a way that instrument response is most accurate in the concentration range that corresponds to project action levels.

The TVA-2020 has been configured with a switching device (disposable 3-way valve) to allow sample to be passed through an SKC carbon sorbent tube to remove petroleum hydrocarbons (i.e., site data indicate that the remainder will be primarily methane).

Procedures for Sample Screening On Site

- Screen air sample with GEM-2000 landfill gas analyzer. Quickly document methane %, LEL %, oxygen and carbon dioxide concentrations on the appropriate sample screening data sheet;
- Screen sample with the TVA-2020 PID instrument and quickly document the concentration on the appropriate data sheet; and
- Screen the sample with the TVA-2020 FID without the sorbent tube and quickly record the total hydrocarbon concentration (THC) on the appropriate data sheet.
    - If THC = zero, then screening of sample is complete and it is not necessary to screen through sorbent tube; record 0.0 ppm as methane value on the appropriate data sheet.
    - If THC > zero, proceed with steps below;
- Set the TVA-2020 to sample through the SKC sorbent tube used in conjunction with the FID.

Calculate the methane concentration as;

$$C_{meth} = \frac{FID}{RRF};$$

Where

$C_{meth}$ = methane concentration (ppmv); and

FID = FID reading (ppmv)

- The petroleum hydrocarbon concentration portion of the FID response should be calculated as;

$$PHC = C_{raw} - C_{meth};$$

Where

PHC = petroleum hydrocarbon concentration (ppmv); and

$C_{raw}$ = FID reading without sorbent tube (ppmv)

Procedures for Sample Screening at a Dedicated Sample Screening Station

The sampling instrumentation for the dedicated sample screening station has been configured such that the TVA-2020 can be operated with a 10:1 dilution valve, if concentrations are outside the operational range of the FID (i.e., if there is insufficient oxygen to support the FID flame or if the sample is above the linear range of the instrument).

- Note: Do not attach Tedlar® bag to inlet of instrument when Tedlar® bag valve is closed. This will put stress on the instrument fan and potentially cause damage.
- Note: When screening Tedlar® bag samples, take care to prevent release of sample gas by either keeping your finger over the Tedlar® bag opening when moving between instruments, or by keeping Tedlar® bag valve closed for longer pauses.
- Open the valve on the Tedlar® bag sample approximately one turn and attach to the inlet of the GEM-2000 landfill gas analyzer. Allow about 20 seconds for readings to stabilize. Quickly document methane %, LEL %, oxygen and carbon dioxide concentrations on the appropriate sample screening data sheet;
- Screen sample with the TVA-2020 PID instrument and allow 5-10 seconds for reading to stabilize. Quickly document the concentration on the appropriate data sheet (second TVA-2020 PID should be used to confirm TVA-2020 PID results as needed in case of anomalous results, very low concentrations, etc.); and

- Screen the sample with the TVA-2020 FID without the sorbent tube and allow 5-10 seconds for reading to stabilize. Quickly record the total hydrocarbon concentration (THC) on the appropriate data sheet.
  - If THC = zero, then screening of the sample is complete and it is not necessary to screen through sorbent tube; record 0.0 ppm as methane value on the appropriate data sheet.
  - If THC > zero, proceed with steps below;
- Set the TVA-2020 to sample through the SKC sorbent tube used in conjunction with the FID and allow 10 seconds for reading to stabilize.

  Calculate the methane concentration as;

$$C_{meth} = \frac{\text{FID}}{\text{RRF}};$$

Where

$C_{meth}$ = methane concentration (ppmv); and

FID = FID reading (ppmv)

- If the oxygen concentration in the sample is less than approximately 14%, configure the TVA-2020 for use with a 10-to-1 dilution probe. The dilution probe will allow for the sample to be screened by FID without flameout associated with low oxygen concentration samples. If the oxygen concentration is below 14% in a sample but a flameout does not occur on the TVA-2020, it should be screened without the 10-to-1 dilution probe. The dilution probe must be separately calibrated and should be used for sample screening by FID only. If the 10-to-1 dilution probe is used, the displayed concentrations must be multiplied by 10. When using the FID in conjunction with 10:1 dilution probe, allow at least 20 seconds for readings to stabilize;
- Set the TVA-2020 to sample through the SKC sorbent tube. Record the reading as the methane concentration. If the 10-to-1 dilution probe is used, the displayed concentration (FID) must be multiplied by 10, and the RRF should not be used;
- The petroleum hydrocarbon (PHC) concentration portion of the FID response should be calculated as:

$$PHC = C_{raw} - C_{meth}.$$

- After screening of the Tedlar® bag sample is complete, set aside the Tedlar® bag for cleaning according to SOP No. 04 Decontamination.

Procedures Applicable to All Sample Screening

Because concentrations of hydrocarbons in some samples are elevated, the carbon in the sorbent tube can be saturated with hydrocarbon relatively quickly. If possible, use historical data to screen samples from low hydrocarbon concentration samples to high hydrocarbon concentration samples to avoid sorbent tube saturation. Therefore, the following protocols are in place to assure quality data:

The sorbent tube shall be replaced after use with 20 samples (if THC in sample was zero and sorbent tube was not used on sample, don't count as a "use");

- The sorbent tube shall also be replaced if breakthrough is observed (readily apparent) or if concentrations do not go to zero after sample is removed from analyzer inlet; and associated sample lines (Teflon™ or Tygon™ tubing), valves, etc. shall be replaced if concentrations do not return to zero after sample is removed from analyzer inlet.
- TVA-2020 PID glass bulb should be cleaned according to manufacturer's instructions. Nothing but lens cleaning paper should ever make contact with glass bulb.

## *6. Conclusion*

The screening of soil gas samples must be conducted in an organized and precise manner. The resultant data will be valid only if proper procedure and associated QA/QC is followed. It is imperative that personnel conducting the sample screening strictly adhere to the protocol detailed above. Because the samples are collected in 1-liter bags, the samples must be removed from the instrument inlets as soon as a stable reading can be documented. Failure to do so will overly deplete sample volume and result in an inadequate amount of sample volume to complete all the screening parameters. Larger bags cannot be used due to time constraints during sample collection.