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: 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: Kevin Eldyer 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
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St. Louis
MO, 63110
USA
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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.

AECOM

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

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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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".

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 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:

   $$[(\underset{\text{(ft btoc)}}{\text{TD of well}}) - (\underset{\text{(ft btoc)}}{\text{bottom of packer}})] \times (\underset{\text{(see footnote)}}{\text{ft to gal conversion}}^{1}) \times \underset{\text{\# Vols}}{3} = \underline{\qquad\qquad}_{\text{Calculated Purge Volume}} \text{ gallons}$$

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

   $$[(\underset{\text{(ft btoc)}}{\text{TD of well}}) - (\underset{\text{(ft btoc)}}{\text{WL}})] \times (\underset{\text{(see footnote)}}{\text{ft to gal conversion}}^{1}) \times \underset{\text{\# Vols}}{3} = \underline{\qquad\qquad}_{\text{Calculated Purge Volume}} \text{ gallons}$$

   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 ≤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.
        - 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

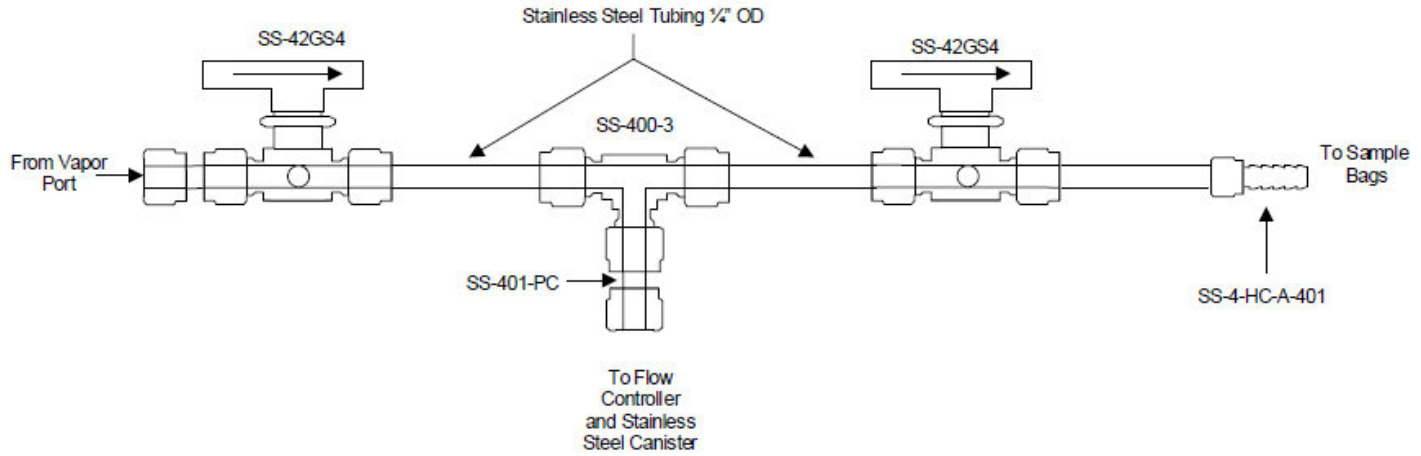
- Non-designated stainless steel assemblies shall be thoroughly decontaminated by purging with at least half a liter of air (e.g., with hand pump or peristaltic pump).
- Should a stainless steel assembly come into contact with groundwater, it shall be decontaminated using a Liquinox® detergent wash followed 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.

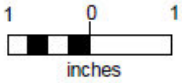
- Tedlar® bags may be decontaminated if it meets the criteria listed in Section 3.9 of SOP No. 4 Decontamination.

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.

P:\Projects\Environmental\SHELL\01-MGMT SPT\SOPs\SOP No 44R Figure 1 - SV Assembly_updated.vsd 3/23/2018 10:15 AM



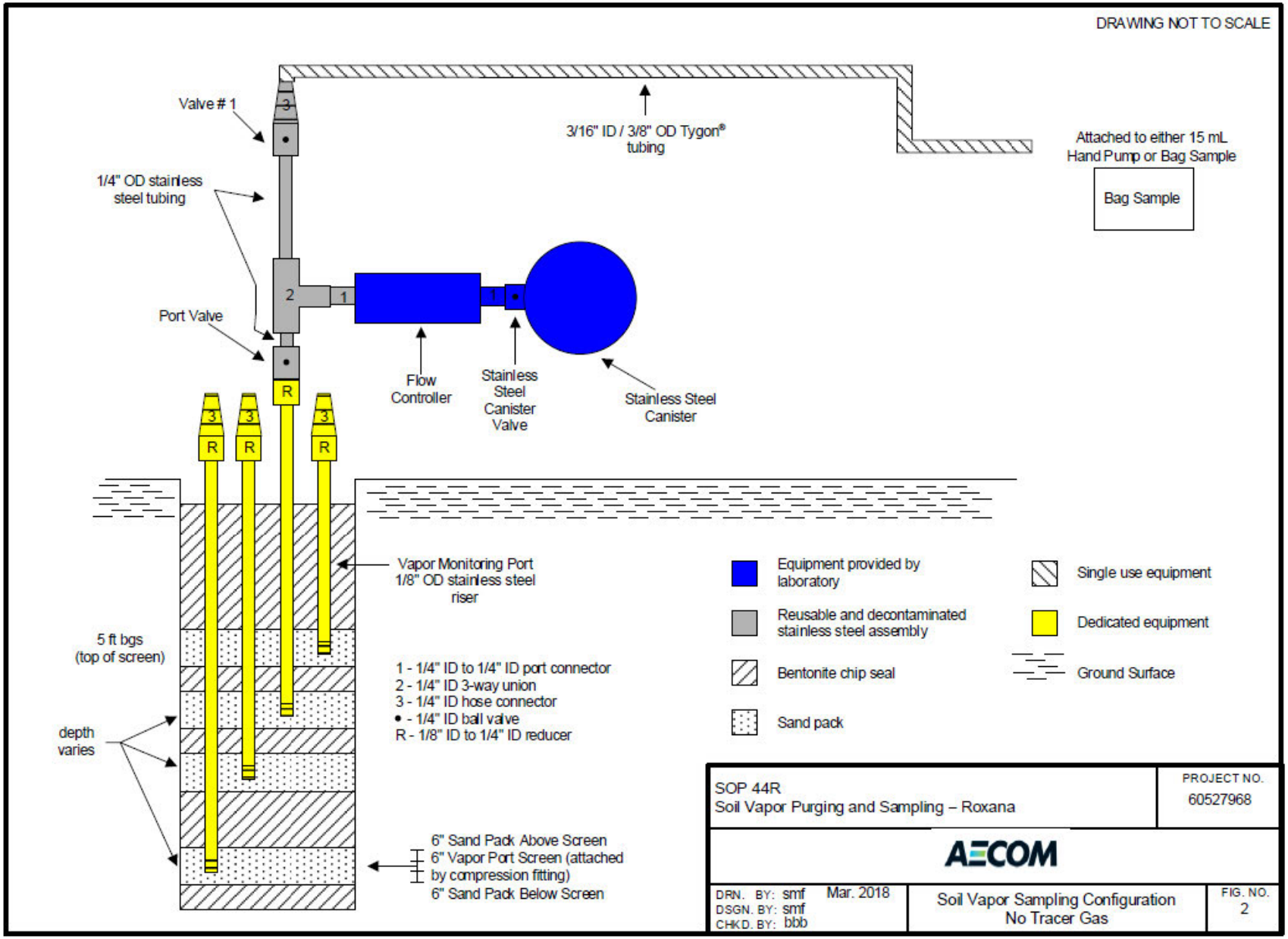


Notes:
1) All components listed with Swagelok part numbers.
2) Assembly shown for standard sample.
3) Duplicate assembly includes an additional 3-way union between the two shown.
4) All fittings shown are compression fittings with SS-400-Set ferules and SS-402-1 nuts.

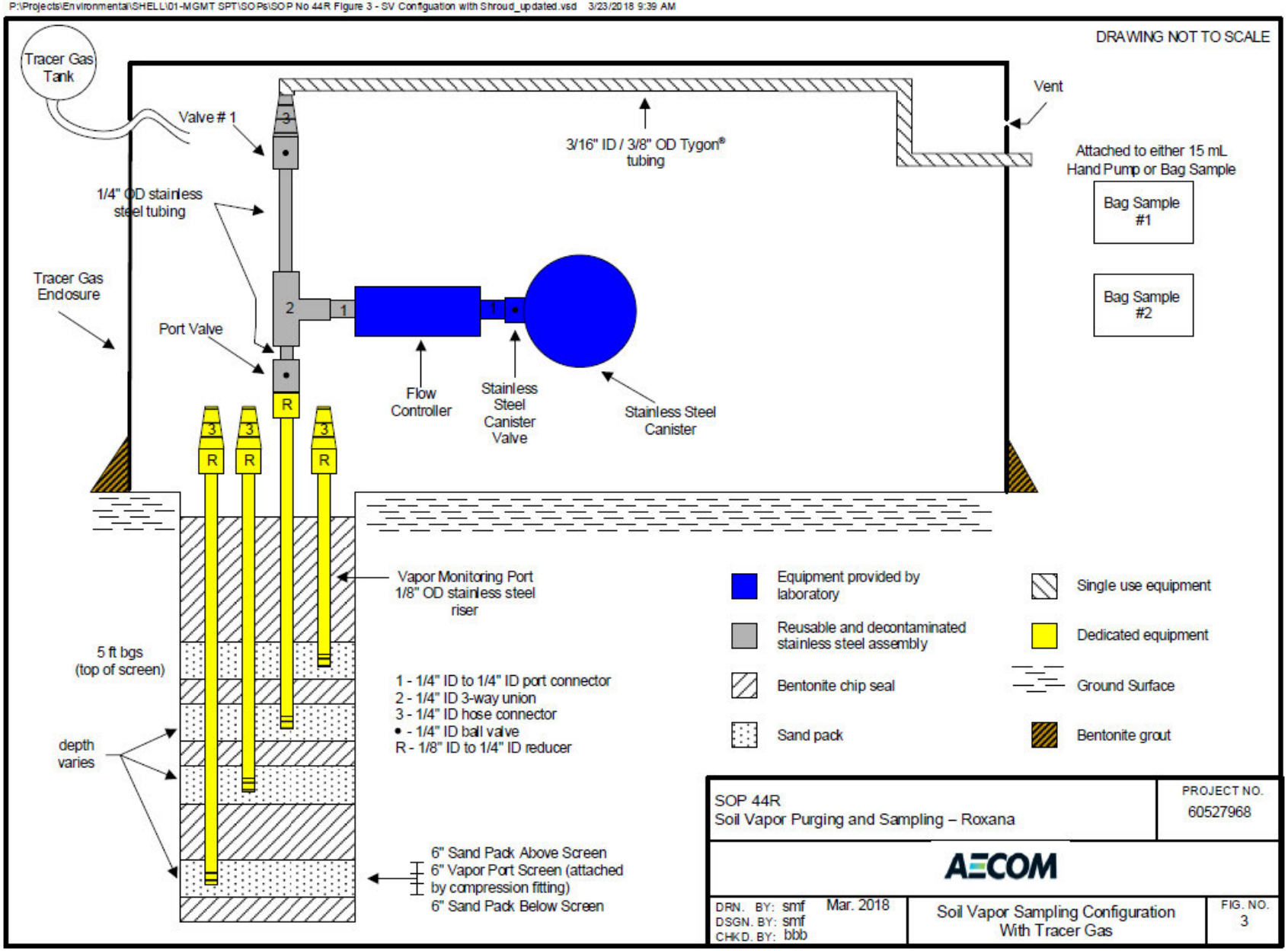
Source: http://swagelok.com/products.aspx; Accessed March 23, 2018.

SOP 44R Soil Vapor Purging and Sampling – Roxana	PROJECT NO. 60527968
AECOM	
DRN. BY: smf Mar. 2018 DSGN. BY: smf CHK'D. BY: bbb	Soil Vapor Sampling Assembly FIG. NO. 1

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



P:\Projects\Environmental\SHELL\D1-MGMT SPT\SOPs\SOP No 44R Figure 3 - SV Configuation with Shroud_updated.vsd 3/23/2018 9:39 AM



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			

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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			

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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;

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

  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: _____

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 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: