Illinois Environmental Protection Agency

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

ILLINOIS EPA RCRA CORRECTIVE ACTION CERTIFICATION

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

1.0 Facility Identification

Name: Equilon Enterprises LLC d/b/a Shell Oil Products US
County: Madison
Street Address: 900 South Central Avenue
Site No. (IEPA): 1191150002
City: Roxana
Site No. (USEPA): ILD080012305

2.0 Owner Information

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

3.0 Operator Information

Name: Equilon Enterprises LLC d/b/a SOPUS
Mail Address: 150 N. Dairy Ashford, Bldg A, 5th Fl
City: Houston
State: TX Zip Code: 77079
Contact Name: Dan Kirk
Contact Title: Principal Program Manager
Phone: 281-544-9796

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

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

IEPA Permit Log No. B-43R
Date of Last IEPA Letter on Project: December 20, 2019
Log No. of Last IEPA Letter on Project: M-21,26-30,35-36,38

Does this submittal include groundwater information: ☑ Yes ☐ No

Date of Submittal:

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

Routine Updates to Standard Operating Procedures Previously Submitted; SOPs 20 and 44R

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

Cover letter, Revised SOPs

7.0 Certification Statement

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

For: Equilon Enterprises LLCdba SOPUS

Date of Submission: ____________

7.1 Owner/Operator Certification

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

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

A person is a duly authorized representative only if:

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

Owner Signature: ____________ Date: ____________

Title: Not Applicable

Operator Signature: ____________ Date: 6/11/20

Title: Principal Program Manager

7.2 Professional Certification (if necessary)

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

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

Professional's Signature: ____________ Date: ____________

Professional's Name Not Applicable

Address ____________ Professional's Seal:

City ____________

State ____ Zip Code ____________

Phone ____________

7.3 Laboratory Certification (if necessary)

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

Name of Laboratory Not Applicable

____________ Date: ____________

Signature of Laboratory Responsible Officer

Mailing Address of Laboratory

Address ____________

City ____________

State ____ Zip Code ____________

____

Name and Title of Laboratory Responsible Officer

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

June 18, 2020

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

Routine Updates to Standard Operating Procedures - SOPs Nos. 3, 20, 44R and 52
Equilon Enterprises LLC dba Shell Oil Products US
Roxana, Illinois
1191150002 - Madison County
ILD080012305
Log B-43R

Dear Mr. Smith:

As part of AECOM Technical Services, Inc.'s (AECOM's) routine quality improvement process, we recently performed a review of some of the Standard Operating Procedures (SOPs) used by field staff performing activities at the investigation sites in Roxana, Illinois. Previously revised versions of SOPs have been submitted to the Illinois Environmental Protection Agency (IEPA), most recently on December 20, 2019. These procedures were originally submitted, as requested by various IEPA correspondences, within various reports and work plans related to the Investigation Site in Roxana, Illinois. We are submitting this package of updated SOPs for your reference and in accordance with revisions to Sections C.7.5 and C.8.4 of the RCRA Post-Closure Permit Application[1] for the Equilon Enterprises LLC d/b/a Shell Oil Products US (SOPUS) facility at the WRB Refining LP Wood River Refinery.

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

SOP No	SOP Title	Purpose of Revision
3	Calibration & Maintenance of Field Instruments	Add maintenance schedule for field screening laboratory instruments
20	Well Development or Redevelopment	Update procedures to include potential use of a surge collar
44R	Soil Vapor Purging & Sampling	Editorial and formatting related to canister filling time
52	Soil Vapor Field Laboratory Screening	Editorial and formatting related to Tedlar bag screening

[1] Class 1* Permit Modification – Section C Revision for SOP Reference (Log No. B-43R-CA-82, CA-88, CA-94 and CA-97) was submitted to IEPA on January 29, 2018. This modification was approved by an IEPA letter with modified Permit dated December 20, 2019.

AECOM

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

SOP No.	SOP Title	Last Updated
3	Calibration & Maintenance of Field Instruments	6/16/2020
4	Decontamination	9/6/19
5	Utility Clearance Procedures	12/9/19
8	Field Reporting and Documentation	9/24/19
10	Well Gauging Measurements	9/13/19
11	Groundwater Sampling & Well Wizard Operation	12/9/19
12	Grouting Procedures	12/9/19
14	Headspace Soil Screening	12/9/19
17	Logging	12/9/19
18	Low Flow Groundwater Purging & Sampling	9/23/19
20	Well Development	6/17/2020
21	Monitoring Well Installation	7/24/2015
23	Quality Assurance Samples	9/13/19
24	Soil and Groundwater Sample Identification, Packaging & Shipping	9/13/19
25	Sample Containers, Preservation & Holding Times	9/20/19
26	Sample Control & Custody Procedures	9/20/19
28	Soil Sampling	12/9/19
29	Soil Probe Operation	12/9/19
42	Groundwater Profiling	12/9/19
44R	Soil Vapor Purging & Sampling	6/16/2020
46	Indoor Air Sampling with Canisters	7/23/2015
47	Sub-slab Soil Gas Installation & Sampling with Canisters	4/4/2017
48	SVE Well Data Collection and Sampling	12/9/19
49	SVE Effectiveness Monitoring at VMPs	8/28/19
51	Vapor Sample Classification, Packaging & Shipping	9/20/19
52	Soil Vapor Field Laboratory Screening	6/16/2020
53	Dwyer Digital Manometer	8/29/19
56	LNAPL Recovery	9/20/19

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

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

Sincerely,

Wendy Pennington
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encl: Revised SOPs 3, 20, 44R, and 52
RCRA Corrective Action Certification Form

cc: Paula Stine (IEPA - Springfield, IL)
Gina Search (IEPA - Collinsville, IL)
Dan Kirk (SOPUS)
Erika Reynolds (Greensfelder Hemker)
Project File
Repositories (Roxana Public L brary, website)

1. Objective

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

2. Other SOPs referenced in this SOP

- SOP No. 4 – Decontamination

3. Equipment

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

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

4. Types of Field Instruments Commonly used during Environmental Investigations

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

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

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

5. Maintenance

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

6. Calibration

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

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

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

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

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

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

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

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

Water Level Indicator and Petroleum/Water Interface Probe

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

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

7. Decontamination

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

8. Field Screening Laboratory Instrument Maintenance Schedule

Dedicated field screening laboratory FID and PID instruments (TVA-2020 FID/PID or equivalent) will be returned to equipment supplier approximately every 6 months so that manufacturer’s recommended maintenance may be performed. Equipment supplier will bring two replacement FID/PID units onsite and AECOM field lab manager will perform side-by-side calibrations with all four FID/PID units. This will be done to ensure that the two replacement FID/PID units can be calibrated with detector counts within manufacturer-recommended ranges for zero air and applicable span gas concentrations (consult instrument manual or call manufacturer technical support to determine recommended ranges for detector counts). After successfully calibrating the two replacement FID/PID units, the original two FID/PIDs may be returned to equipment supplier.

1. *Objective*

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

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

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

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

2. *Other SOPs referenced in this SOP:*

- SOP No. 4 Decontamination
- SOP No. 8 Field Reporting and Documentation
- SOP No. 10 Well Gauging Measurements

3. *Equipment*

Information and equipment typically used during well development includes:

- Well installation information
- Well keys
- Disposable latex or nitrile gloves
- Assorted tools (safety utility knife, screwdriver, tubing cutters, etc.)

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

- Pump and required accessories (check valve, surge collar, HDPE tubing, etc.) or air-lift equipment (typically provided by a subcontractor)
    - Waterra SS-19 standard flow check valve threads onto 1/2-inch inner diameter by 5/8-inch outer diameter HDPE tubing (may be used for wells up to 100 feet below ground surface)
    - Waterra SS-32 high flow check valve threads onto 3/4-inch inner diameter by 1-inch outer diameter HDPE tubing (recommended for wells deeper than 100 feet below ground surface)
- Power supply (battery, inverter, generator, or similar)
- Electronic water level indicator or oil/water interface probe with 0.01-foot increments
- Paper towels or Kimwipes (decontamination equipment)
- Calculator
- Bound field logbook and/or groundwater development sheet
- Waterproof pen or permanent marker
- Plastic Buckets or truck-mounted poly tank
- 55-gallon drums or portable tanks, if needed
- Appropriate health and safety equipment (e.g. photoionization detector (PID), etc.)

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

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

4. Procedure if no LNAPL present

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

1. Put on a new, unused pair of disposable latex or nitrile gloves.
2. Approached the well from upwind, unlock and remove the well cap , and monitor the air quality at the well head and in the breathing zone with a PID.

3. Measure the depth to groundwater to the nearest hundredth of a foot (SOP No. 10 Well Gauging Measurements).
4. Measure the total depth of the well to the nearest hundredth of a foot (SOP No. 10 Well Gauging Measurements). Note whether the bottom of the well feels hard or soft (this may be easier to determine with a weighted tape measure).
5. Remove the water level indicator or interface probe from the well and decontaminate (refer to SOP No. 4 Decontamination).
6. Calculate the amount of water to be removed:

   installed depth – depth to water = height of water column

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

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

   - For Development of newly installed wells: Remove 1x the amount of water added within the screened and sand pack zone by drillers during installation, along with 5 well volumes of water.
   - For Redevelopment of existing wells: Remove 3 well volumes of water.
7. Thread check valve onto the appropriate sized HDPE tubing.
   - If using a surge collar, press it firmly from the threaded end of the check valve to about halfway down the check valve.
8. Lower check valve end of HDPE tubing into the well.
   - If using a surge collar lower to within the screened zone or just above the top of the sediment present within the bottom of the well.
   - If not using a surge collar, lower to the current bottom of the well to help agitate the sediment present.
9. Cut off the HDPE tubing leaving at least 6 feet and enough to extend into the development water collection vessel (drum, truck-mounted tank, etc.).

10. Hang the Waterra Hydrolift, or similar actuator, on the well protector, if possible, and secure with ratchet strap. If this is not possible, find some other way to mount and secure the actuator near and above the well pipe.
11. Ensure the actuator is resting at its lowest stroke position.
12. Install the actuator arm into the top slot of the actuator at the appropriate location for tubing placement within the center of the well pipe. Secure the clamp arm with the cotter pin.
13. Close the tubing clamp bracket with the tubing extending through the correct slot for its size (tight fit but tubing not crimped).
    - If the tubing is not a snug fit into one of the slots, hose clamps will be required above and below the actuator arm bracket.
14. Tighten tubing clamp bracket by screwing down the knob.
15. Secure the discharge end of the tubing into the development water collection vessel.
16. Plug the power cord for the actuator into a generator or inverter.
17. Begin pumping by turning on the tubing actuator to oscillate the tubing/check valve/surge collar assembly up and down.
    - Adjust the speed/pumping rate as possible/necessary to pump at a sufficient rate to allow the sediments to be removed.
    - The actuator and check valve surge the well screen and purge the groundwater at the same time.
18. (Re)Development is potentially completed when the following criteria have been achieved:
    - Water being purged is visually sediment free.
    - Required minimum volume of water has been removed (refer to **Step 6** above).
    - Installed depth is measured.
19. Once (re)development is thought to be completed, turn off the actuator and unplug the power cord.
20. Open the actuator arm bracket and free the tubing.
21. Remove the tubing from the well. Attempt to roll/coil tubing during removal. For disposal, tubing can be cut into manageable segments and containerized.

22. Re-measure the total well depth and calculate the percent of screen occlusion.

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

- If the measured depth indicates 10% or more occlusion for sampled well screens (or 75% or more occlusion for gauged well screens), repeat **Steps 8** through **21**.
- If the measured depth indicates less than 10% well screen occlusion for sampled wells (or less than 75% well screen occlusion for gauged wells) and sediment has been removed from the screen to the extent practicable, go to **Step 23**.

23. Remove (unthread) check valve and surge collar, if used, from end of tubing. Appropriately discard tubing (check with IDW Coordinator for further instruction).

24. Decontaminate check valve and surge collar, if used.

Note in the field logbook and on any field data sheets the approximate number of gallons of water removed during development of each well, well screen depth interval, depth to bottom prior to well development, depth to bottom after well development, and if the development water removed prior to completion was visually sediment free. For other information necessary to be recorded, refer to SOP No. 8 Field Reporting and Documentation.

5. Procedure if LNAPL is present

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

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

2. Calculate the amount of water to be removed:

   installed depth – depth to water = height of water column

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

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

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

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

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

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

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

Note in the field log book and on any field data sheets the amount of *NuWell 220*, or similar, dispersant polymer added to the well, the approximate number of gallons of water removed during development of each well, well screen depth interval, depth to bottom prior to well development, depth to bottom after well development, and if the development water removed prior to completion was visually sediment free. For other information necessary to be recorded, refer to SOP No. 8 Field Reporting and Documentation.

1. Objective

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

2. Other SOPs referenced in this SOP:

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

3. Equipment

The following equipment is typically needed:

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

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

4. Vapor Port Development Purging

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

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

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

5. Vapor Port Sampling – With No Tracer Gas

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

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

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

[1]Sample will undergo thermal expansion (some loss of vacuum) when moved from a cold outdoor setting to a warmer indoor setting. By closing the canister valve at -7 inches Hg, the sample will be able to undergo thermal expansion without reaching 0 inches Hg. The larger the difference between outdoor and indoor temperatures, the greater the loss of vacuum.
[2] Other sized canisters will take different amounts of time to sufficiently fill.

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

6. Vapor Port Sampling – With Tracer Gas Shroud

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

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

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

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

valve when the vacuum gauge reading is -7 inches Hg[3]. For a 1-Liter canister, filling shall take approximately 5 minutes but may require more or less time depending on formation materials.[4] If the vacuum gauge reading drops below -5 inches Hg before approximately 5 minutes, close the stainless-steel canister valve completely. Record the time in the computer and on sample sheets. Record the concentration of tracer gas within the shroud after closing the canister valve. If canister fills in less than 5 minutes it is possible that there was a leak in the canister or flow controller, even if no helium is detected in sample bag #2. Call task manager to discuss any canisters that fill in less than 5 minutes; a re-sample may be necessary.

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

7. Quality Control

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

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

[3]Sample will undergo thermal expansion (some loss of vacuum) when moved from a cold outdoor setting to a warmer indoor setting. By closing the canister valve at -7 inches Hg, the sample will be able to undergo thermal expansion without reaching 0 inches Hg. The larger the difference between outdoor and indoor temperatures, the greater the loss of vacuum.

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

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

Field Duplicates

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

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

Stainless Steel Canister Vacuum Check

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

Prior to Sampling

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

After Sampling

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

Sample Train Vacuum Leak Check

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

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

Tracer Gas Check

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

1. Tracer gas should be introduced near the VMP to test the integrity of the probe seal and the above ground connections.
2. Collect the soil vapor sample per procedures in **Section 5**.

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

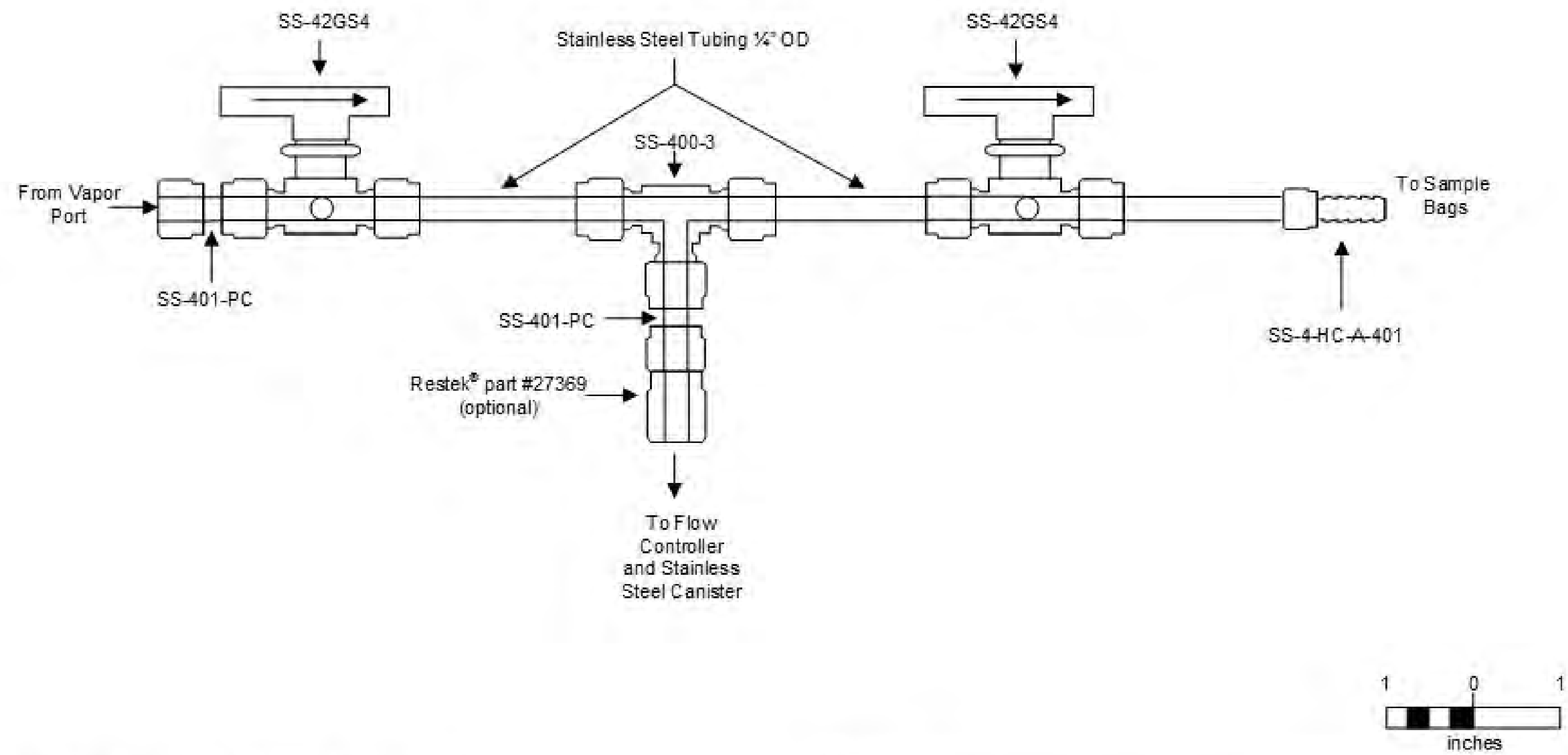
8. Decontamination

- Non-designated stainless-steel assemblies shall be thoroughly decontaminated by purging with at least half a liter of air (e.g., with hand pump or peristaltic pump).
- Should a stainless-steel assembly come into contact with groundwater, it shall be decontaminated using a Liquinox® detergent wash followed by a distilled water rinse. Discuss with task manager before re-using the assembly.
- If a stainless-steel assembly should come into contact with LNAPL, immediately call task manager and segregate the contaminated components from other sample media.

- Multiple stainless-steel assemblies shall be available to sample crews to allow for equipment to be cleaned and dried sufficiently before being reused.
- Tedlar® bags may be decontaminated if it meets the criteria listed in SOP No. 4 Decontamination.

9. Shipping

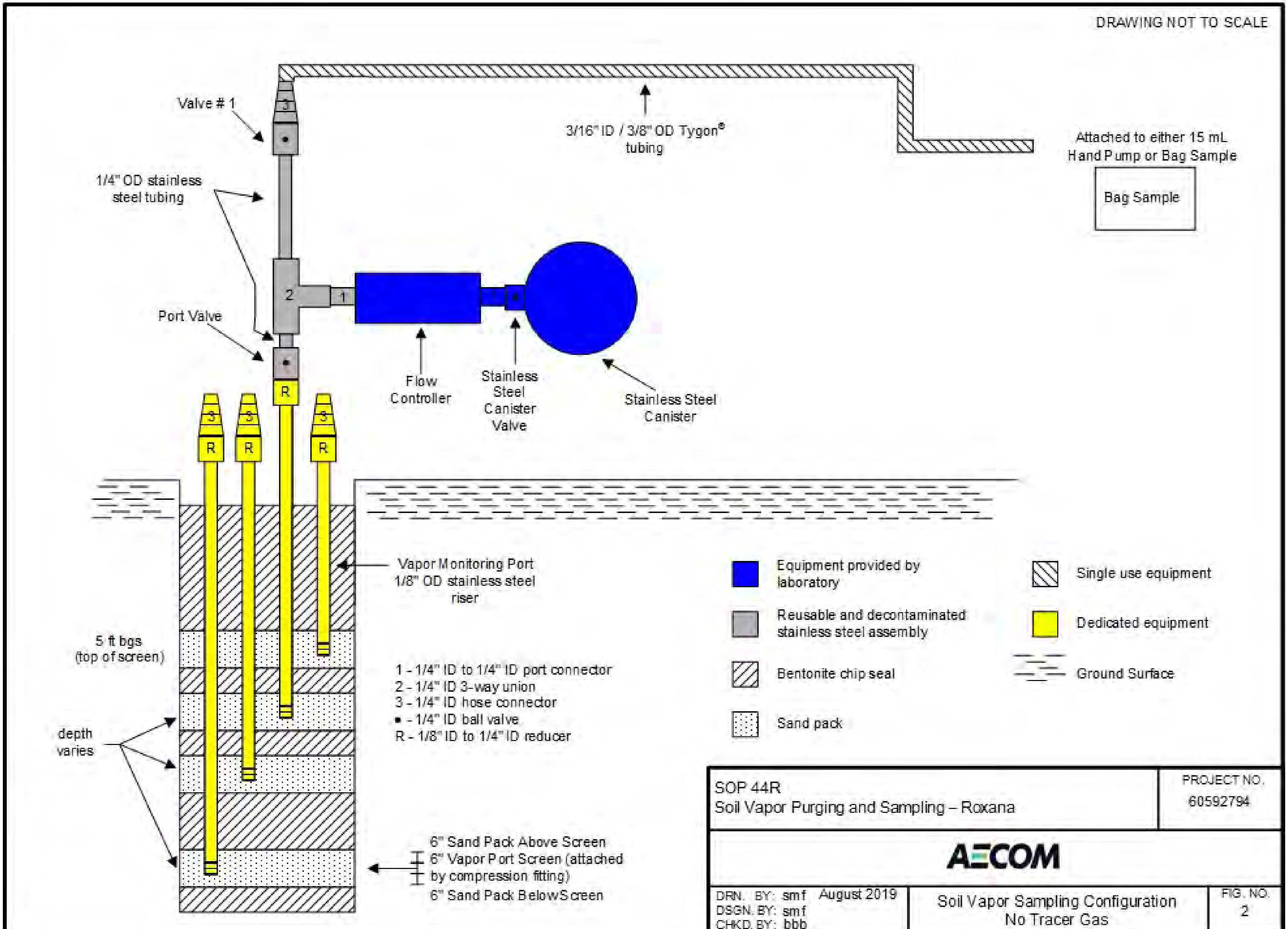
- Sample information shall be recorded on a chain of custody for the laboratory following procedures outlined in SOP No. 26 Sample Control and Custody Procedures.
- Samples shall be shipped to the laboratory following DOT regulations. If there is the possibility that samples may be classified as hazardous,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



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

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

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



SOP 44R
Soil Vapor Purging and Sampling – Roxana

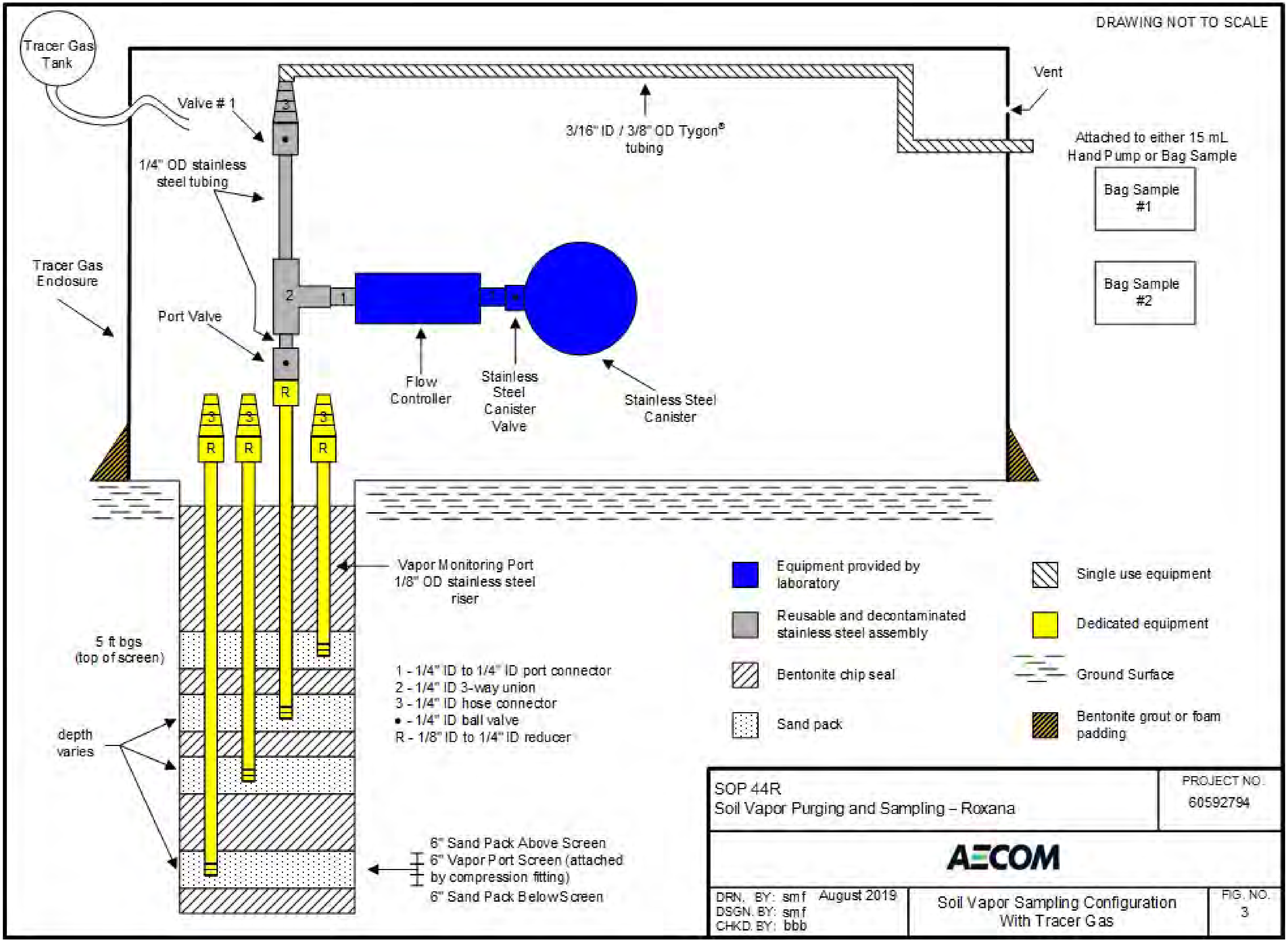
PROJECT NO. 60592794

AECOM

DRN. BY: smf August 2019
DSGN. BY: smf
CHKD. BY: bbb

Soil Vapor Sampling Configuration
No Tracer Gas

FIG. NO. 2


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

1. Introduction

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

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

2. Other SOPs referenced in this SOP

- SOP No. 4 - Decontamination

3. Equipment

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

- Thermo Scientific TVA-2020 (TVA-2020) and Landtec GEM-2000 (GEM-2000) real-time monitors (or similar);
- Calibration gas cylinders, including;
  - Methane in air at concentrations of 50; 500; 5,000, and 32,500 ppmv
  - Isobutylene in air at concentrations of 50 and 1,000 ppmv
  - Hydrocarbon-free air (Ultra Pure zero air)
  - 50% by volume methane/35% by volume CO2
- Regulators for calibration gas cylinders

- SKC sorbent tubes (part # 226-09) used for methane determination
- ¼-inch O.D. Teflon™ or Tygon™ tubing cut to length
- 10-to-1 dilution probe (Thermo Environmental Instruments Part #CR010MR)
- Disposable 3-way plastic valves (Qosina 3-way Stopcock, 2 Female Luer Locks, Male Luer Slip [Part # 13127]) used to switch the sample between methane and total hydrocarbon analyses.
- 1-liter Tedlar® bags (new or decontaminated as outlined in SOP No. 4 Decontamination)
- Nitrile gloves

4. Procedure

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

- TVA-2020 or performance equivalent for volatile organic compounds (VOCs) and methane by flame ionization detector (FID) and for VOCs by photoionization detector (PID)
- Landtec GEM-2000 or performance equivalent for methane, lower explosive limit (LEL), oxygen and carbon dioxide.

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

Calibration Procedures Applicable to All Field Screening Analyses

Instruments shall be calibrated in accordance with applicable SOPs and/or manufacturers recommended procedures immediately prior to sample screening. If the screening instruments are to be used throughout the work day, a mid-day and end-day calibration check shall be performed. Further, the TVA-2020 instrument detectors and associated dilution probe shall be bump checked (1-point accuracy check) approximately every two hours in order to document instrument stability. In the event that a bump check indicates a deviation greater than ± 15% from the designated bump-gas concentration, a full instrument calibration shall be performed. Due to negligible (<5%) instrument drift throughout the day, the GEM-2000 shall not undergo a bi-hourly bump check. Instead, if the GEM-2000 is used throughout the work day, calibration accuracy checks shall be conducted at approximately midday, and again at the conclusion of the sample event.

As stated above, calibration of the GEM-2000 and TVA-2020 shall be performed in accordance with applicable SOPs and/or manufacturer recommended procedures. However, the wide range of petroleum hydrocarbons and methane concentrations present at the site (i.e., greater than four orders-of magnitude) may be outside of the linear range of the TVA-2020 FID. To meet a primary data quality objective of the project (i.e., to quickly and accurately determine whether a potentially explosive condition is present at a sampling location), the FID calibration shall be based on a calibration standard that is approximately 10% of the LEL for methane (5,000 ppmv). However, additional QC procedures shall be implemented to ensure quality data for both hydrocarbon and methane concentrations.

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

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

Screening of Concentrated Samples Utilizing a Dilution Probe

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

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

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

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

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

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

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

Where;

RRF = relative response factor;

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

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

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

5. Sample Screening

Whenever possible, the soil vapor samples collected for the various work tasks shall be screened on the same day of collection. If same-day screening is not possible due to time constraints, instrument problems, etc., the samples shall be screened within 24-hours of sample collection. If samples are stored overnight, they should be placed in a black trash bag or other opaque container to prevent light from reaching the samples. Most soil vapor samples collected in Tedlar® bags shall be screened at a fixed location using the instrumentation noted above. The fixed location facilitates the use of the instrumentation, allows for a more stable environment in which to screen the samples, and provides adequate space in which to perform the screening and complete the associated documentation. However, to allow rapid screening of indoor air and sub-slab soil vapor, such samples can be analyzed on site, using the same field instrumentation. The calibration of these instruments, as outlined in **Section 3.0**, shall be performed in such a way that instrument response is most accurate in the concentration range that corresponds to project action levels.

The TVA-2020 has been configured with a switching device (disposable 3-way valve) to allow sample to be passed through an SKC carbon sorbent tube to remove petroleum hydrocarbons (i.e., site data indicate that the remainder will be primarily methane).

Procedures for Sample Screening On Site

- Screen air sample with GEM-2000 landfill gas analyzer. Quickly document methane %, LEL %, oxygen and carbon dioxide concentrations on the appropriate sample screening data sheet;
- Screen sample with the TVA-2020 PID instrument and quickly document the concentration on the appropriate data sheet; and
- Screen the sample with the TVA-2020 FID without the sorbent tube and quickly record the total hydrocarbon concentration (THC) on the appropriate data sheet.
    - If THC = zero, then screening of sample is complete and it is not necessary to screen through sorbent tube; record 0.0 ppm as methane value on the appropriate data sheet.
    - If THC > zero, proceed with steps below;
- Set the TVA-2020 to sample through the SKC sorbent tube used in conjunction with the FID.

Calculate the methane concentration as;

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

Where

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

FID = FID reading (ppmv)

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

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

Where

PHC = petroleum hydrocarbon concentration (ppmv); and

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

Procedures for Sample Screening at a Dedicated Sample Screening Station

The sampling instrumentation for the dedicated sample screening station has been configured such that the TVA-2020 can be operated with a 10:1 dilution valve, if concentrations are outside the operational range of the FID (i.e., if there is insufficient oxygen to support the FID flame or if the sample is above the linear range of the instrument).

- Note: Do not attach Tedlar® bag to inlet of instrument when Tedlar® bag valve is closed. This will put stress on the instrument fan and potentially cause damage.
- Note: When screening Tedlar® bag samples, take care to prevent release of sample gas by either keeping your finger over the Tedlar® bag opening when moving between instruments, or by keeping Tedlar® bag valve closed for longer pauses.
- Open the valve on the Tedlar® bag sample approximately one turn and attach to the inlet of the GEM-2000 landfill gas analyzer. Allow about 20 seconds for readings to stabilize. Quickly document methane %, LEL %, oxygen and carbon dioxide concentrations on the appropriate sample screening data sheet;
- Screen sample with the TVA-2020 PID instrument and allow 5-10 seconds for reading to stabilize. Quickly document the concentration on the appropriate data sheet (second TVA-2020 PID should be used to confirm TVA-2020 PID results as needed in case of anomalous results, very low concentrations, etc.); and

- Screen the sample with the TVA-2020 FID without the sorbent tube and allow 5-10 seconds for reading to stabilize. Quickly record the total hydrocarbon concentration (THC) on the appropriate data sheet.
    - If THC = zero, then screening of the sample is complete and it is not necessary to screen through sorbent tube; record 0.0 ppm as methane value on the appropriate data sheet.
    - If THC > zero, proceed with steps below;
- Set the TVA-2020 to sample through the SKC sorbent tube used in conjunction with the FID and allow 10 seconds for reading to stabilize.

  Calculate the methane concentration as;

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

Where

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

FID = FID reading (ppmv)

- If the oxygen concentration in the sample is less than approximately 14%, configure the TVA-2020 for use with a 10-to-1 dilution probe. The dilution probe will allow for the sample to be screened by FID without flameout associated with low oxygen concentration samples. If the oxygen concentration is below 14% in a sample but a flameout does not occur on the TVA-2020, it should be screened without the 10-to-1 dilution probe. The dilution probe must be separately calibrated and should be used for sample screening by FID only. If the 10-to-1 dilution probe is used, the displayed concentrations must be multiplied by 10. When using the FID in conjunction with 10:1 dilution probe, allow at least 20 seconds for readings to stabilize;
- Set the TVA-2020 to sample through the SKC sorbent tube. Record the reading as the methane concentration. If the 10-to-1 dilution probe is used, the displayed concentration (FID) must be multiplied by 10, and the RRF should not be used;
- The petroleum hydrocarbon (PHC) concentration portion of the FID response should be calculated as:

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

- After screening of the Tedlar® bag sample is complete, set aside the Tedlar® bag for cleaning according to SOP No. 04 Decontamination.

Procedures Applicable to All Sample Screening

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

The sorbent tube shall be replaced after use with 20 samples (if THC in sample was zero and sorbent tube was not used on sample, don't count as a "use");

- The sorbent tube shall also be replaced if breakthrough is observed (readily apparent) or if concentrations do not go to zero after sample is removed from analyzer inlet; and associated sample lines (Teflon™ or Tygon™ tubing), valves, etc. shall be replaced if concentrations do not return to zero after sample is removed from analyzer inlet.
- TVA-2020 PID glass bulb should be cleaned according to manufacturer's instructions. Nothing but lens cleaning paper should ever make contact with glass bulb.

6. Conclusion

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