FINAL MEMO

ARCADIS Design & Consultancy for natural and built assets

To:
Robert Morse, USEPA
Daniel Eaton, NYSDEC

Copies:
Wendy Kuehner, NYSDOH
David Farnsworth, Air Force
Sean Eldredge, Air Force Contractor

Arcadis of New York, Inc.
6723 Towpath Road
P.O. Box 66
Syracuse
New York 13214-0066
Tel 315 446 9120
Fax 315 449 0017

From:
Allison Nelan
Peter Milionis

Date:
April 19, 2017

Arcadis Project No.:
GP16BRAC.4019.CH000

Subject:
Soil Vapor Sampling Work Plan
SS028 – Building 508 Open Storage Area

On behalf of the Air Force, Arcadis has prepared this Soil Vapor Sampling Work Plan for Site SS028 - Building 508, Open Storage Area at Former Plattsburgh Air Force Base in Plattsburgh, New York to present the proposed scope of work associated with supplementary soil vapor sampling in the area of the former soil excavation. Site SS028 is associated with Building 508, which housed several base civil engineering shops, and is located adjacent to Site SS018 (Building 509, Auto Hobby Shop) near the intersection of Wisconsin Street and Ohio Street (Figure 1). The Site SS028 property, which is comprised of Building 508, Building 483 and "The New Building", is currently occupied by the Champlain Valley Transportation Museum (CVTM).

The objective of this sampling effort is to evaluate the current concentrations of contaminants of concern (COCs) in soil vapor in the area of the former soil excavation. COCs are tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride. The purpose of the investigation is to support decisions regarding the potential for soil vapor intrusion (SVI) and requirements for land use controls (LUCs).

SITE BACKGROUND

Site and Remedial Investigations conducted between 1994 and 1999 identified polynuclear aromatic hydrocarbons and metals in fill materials and volatile organic compounds (VOCs) in soils and groundwater due to past small spills of fuels and solvents. A time-critical removal action for the VOC source was conducted between December 1998 and June 1999 when approximately 112 cubic yards of soil

contaminated with VOCs were excavated to depths ranging from 2.5 to 4 feet below ground surface (bgs). As indicated through confirmation soil sampling, soil left in place were at concentrations less than current unrestricted use cleanup objectives. A groundwater monitoring program was established in 2000 and consisted of collecting samples for VOCs and/or methyl tertiary butyl ether (Tetra Tech 2013). In 2011, the New York State Department of Environmental Conservation (NYSDEC) and United States Environmental Protection Agency (USEPA) agreed that further groundwater monitoring was not required, as documented in the Remedial Action Completion Report (RACR; URS 2012).

The 2004 Finding of Suitability for Transfer for Parcel A2.9, which contained Site SS028, included a SVI LUC stating that prior to erection of a new structure or use of any existing structure within the specified restriction area, the potential for SVI would need to be evaluated. If it were determined that a potential human exposure was possible, then mitigation of the vapor intrusion would need to be included in the design/construction of the structure prior to occupancy. Following submission of the RACR, the NYSDEC and USEPA requested that soil vapor sampling be conducted to evaluate the possibility of SVI for future construction, with the potential of removing the LUC, if warranted.

In November 2012, the Air Force conducted a soil vapor investigation in and around the soil removal area which indicated that COCs were present in soil vapor in and around the Site SS028 soil removal area. PCE concentrations ranged from 38 to 6,000 micrograms per cubic meter ($\mu g/m^3$) and TCE concentrations ranged from less than the detection limit to 830 $\mu g/m^3$. The maximum PCE and TCE concentrations were both measured from SS028-SG-03D (16 feet bgs; Tetra Tech 2013).

Following the results of this investigation, a supplemental investigation that consisted of the collection of soil, groundwater, soil vapor, and indoor air samples was completed to evaluate the potential impact of soil vapor on the existing buildings (i.e., Building 483 and “New Building”). The investigation concluded that no further action was required with respect to the potential for SVI in the existing buildings (Tetra Tech 2016). New York State Department of Health (NYSDOH) commented that the portion of the site where the soil removal action occurred has in the past shown elevated levels of VOCs in soil vapor and represents a concern. In relation to the long term management of the site, NYSDOH recommends that an area associated with the location of the soil removal action be designated for an SVI restriction regarding future construction.

The stratigraphy in the SS028 area consists of four hydrogeologic units: an upper unconfined sand aquifer (approximately 30 feet thick), an underlying silty clay confining layer (approximately 20 feet thick), a confined glacial till water-bearing unit, and a confined thinly-bedded limestone bedrock aquifer. Fill material (approximately seven feet thick) overlies the upper sand aquifer and consists of sand with gravel, coal fragments and dust, cinders, ash, and debris. The direction of groundwater flow is to the east towards Lake Champlain. Depth to water has been measured at depths ranging from approximately 17 to 20 feet bgs.

SOIL VAPOR PROBE INSTALLATION AND SAMPLE COLLECTION

In order to complete this sampling effort, permanent multilevel soil vapor probes will be installed in four direct-push soil borings. Each vapor probe will contain two soil vapor screens set at depths of approximately 5 and 15 feet bgs. Samples for VOC analysis will be collected from each screen interval. The location of the soil vapor probes are shown on Figure 2. The planned samples are summarized in Table 1. Sampling will be conducted in accordance with the Standard Operating Procedure included as Attachment 1. Work will be completed in accordance with the Draft Quality Assurance Project Plan (Arcadis 2016).

Table 1. Planned Sampling Table

Sample ID	Sample Depth (feet bgs)	Analysis
SS028-SG-13S(MMDDYY)	5	USEPA Method TO-15 (PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride)
SS028-SG-13D(MMDDYY)	15	
SS028-SG-14S(MMDDYY)	5	
SS028-SG-14D(MMDDYY)	15	
SS028-SG-15S(MMDDYY)	5	
SS028-SG-15D(MMDDYY)	15	
SS028-SG-16S(MMDDYY)	5	
SS028-SG-16D(MMDDYY)	15	

Note:
MMDDYY- Month/Day/Year

Property Access and Utility Clearance:

Access to the property will be coordinated with the Air Force, the City of Plattsburgh, and the CVTM.

Prior to performing intrusive activities, the proposed boring locations will be cleared of potential conflict with existing underground utilities. The Dig Safely New York One Call System will be notified to have any utilities in the area marked. A private utility locator will conduct a geophysical survey using ground penetrating radar technology and will mark underground lines identified. The locations of the soil vapor probes may be adjusted in the field depending on the results of the utility clearance.

Soil Vapor Probe Installation:

Four permanent multilevel soil vapor probes will be installed as shown on Figure 2. Each vapor probe will contain two soil vapor screens set at depths of approximately 5 and 15 feet bgs which will assist in establishing a soil vapor concentration gradient. The soil vapor probe depths may be adjusted in the field based on soil properties and the observed subsurface conditions including presence/absence of wet formation materials, ambient air short circuiting, and photoionization detector (PID) measurements.

Each probe will be constructed with a 6-inch-long, ½-inch-diameter, wrapped stainless steel soil vapor screen implant. Soil vapor probes will be centered in a 1-foot-long interval of sand pack, allowing approximately 3 inches of sand above and below the screen. Teflon tubing (or equivalent) will be connected to the soil vapor screen and capped with a vapor-tight 2-way valve or cap at the surface to eliminate the potential for barometric pressure fluctuations and to induce vapor transport between the subsurface and the atmosphere. The 2-way valve will be installed in the closed position to allow equilibration of soil vapor concentrations to commence immediately after installation. A 1-foot interval of dry granular bentonite will be placed above the sand pack. Hydrated granular bentonite will be placed above the dry granular bentonite to the next vapor probe depth. The installation process will be repeated for the 5-foot vapor probe with hydrated granular bentonite to approximately 1 foot bgs. Following the hydrated granular bentonite, the borehole will be grouted to approximately 1 foot bgs with a neat cement grout mixture. At the surface, the probe location will be fitted with a concrete cap and a flush-mounted, traffic-rated well box.

Due to the introduction of atmospheric oxygen into the vadose zone during soil vapor probe installation, an equilibration time is required to allow the sand pack and tubing to equilibrate with the subsurface. A minimum of 48 hours will be allowed for equilibration before purging and sampling of the soil vapor probes. In addition, soil vapor sampling will only occur after 5 days without a significant rain event (i.e., more than 0.5-inch of precipitation in 24 hours).

Soil Vapor Probe Shut-in, Leak, and Purge Volume Tests:

To assure sampling train integrity, a shut-in leak detection test will be implemented at each soil vapor probe. One vapor tight two-way ball valve will be installed closest to the soil vapor port (port valve) and another vapor tight two-way ball valve will be installed on the opposite end of the sampling train as a purge valve (purge valve). While the port valve is left in the closed position, a laboratory provided syringe will be utilized to remove approximately 30 milliliters from the purge port inducing a vacuum of at least -7.5 inches of mercury (inches Hg; approximately -102 inches of water) within the sampling train. A vacuum gauge will be utilized to monitor pressure within the sampling train. The purge valve will be closed and the vacuum within the sampling train will be monitored for a minimum of 2 minutes. If there is any observable loss in the vacuum within the sampling train after 2 minutes, fittings will be adjusted and the test repeated until the vacuum in the sampling train does not dissipate.

Leak testing will also be conducted concurrently with the purge volume testing and soil vapor sampling to test the integrity of the sampling system. The well head and entire sampling train (valves, tubing, fittings, gauges, and Summa® canister) will be placed in a sampling shroud. High-purity helium will be used as the tracer compound for the leak test. The tracer compound will be released into the shroud in a controlled quantity and will be monitored for concentration stability using a helium detector. Approximately 10 to 20 percent helium will be maintained in the enclosure using a portable helium detector. Leakage will be calculated using the following equation:

$$\%\ Leakage = \left(\frac{Helium\ Concentration\ in\ Sample\ (\%)}{Helium\ Concentration\ in\ Shroud\ (\%)}\right) \times 100\ (\%)$$

If leakage calculated during purge volume testing is greater than 5 percent, fittings will be adjusted and the purge volume test step will be repeated. If leakage is detected greater than 5 percent at a single soil vapor probe depth in purged air after three attempts, Arcadis will consider abandoning the soil vapor probe.

A purge volume test will be conducted after the shut-in and concurrently with leak testing. The purpose of a purge volume test is to ensure that stagnant air is removed from the sampling system and to ensure that samples are representative of subsurface conditions. Purging will consist of removing approximately three volumes of soil vapor using a two-way valve and a personal sample pump at a flow rate of approximately 100 milliliters per minute (ml/min). The purge volume will be calculated using the dimensions of aboveground gauges, tubing, sampling equipment, belowground tubing, and sand pack pore space. A Tedlar® bag will be collected after each volume step is completed and field measured for total VOCs using a parts per billion PID. As soon as the VOC measurements stabilize, assuming ~10% variance, soil vapor sample collection will begin. If the total VOC concentrations do not stabilize, additional volumes will be purged until it stabilizes or until 10 purge volumes are reached, whichever comes first. To avoid extensive purging for soil vapor samples collected at less than 5 feet bgs, a default of three purge volumes will be extracted prior to sampling. If VOCs are not detected by a PID in any of the step purge tests, a default of three purge volumes will be used. This method allows for collection of accurate subsurface soil vapor measurements and stable subsurface conditions. The ideal purge volumes established are expected to be used in subsequent soil vapor sampling, if necessary.

Soil Vapor Sample Collection:

After the completion of the shut-in, purge volume, and pre-sample leak testing, soil vapor samples will be collected using certified SUMMA™ canisters at a flow rate of approximately 100 ml/min. A vacuum of less than 10 inches Hg will be maintained throughout sampling. Soil vapor sampling will be stopped when the canister vacuum has dropped to no less than 5 inches Hg. Initial and final vacuum gauge readings will be

taken for each sample and recorded in soil vapor sample collection field logs. Analysis for the tracer compound (helium) in the soil vapor sample will be used to assess if leakage occurred.

One duplicate sample will be collected in-line with its respective parent sample via a laboratory supplied duplicate tee fitting. In addition to the duplicate sample, an equipment blank sample collected using a laboratory supplied air source for each day of sampling will also be submitted to the laboratory for quality assurance purposes.

DATA ANALYSIS

As stated in The Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (guidance document; NYSDOH 2006), the State of New York does not have any standards, criteria, or guidance values for concentrations of VOCs in subsurface soils vapor. In lieu of specified soil vapor screening criteria, the NYSDOH requested consideration of this guidance document and subsequent updates.

As per the second paragraph of Section 3.3.1 of the guidance document, “New York State currently does not have any standards, criteria or guidance values for concentrations of compounds in soil vapor. Additionally, there are currently no databases available of background levels of volatile chemicals in soil vapor. In the absence of this information, soil vapor sampling results are reviewed "as a whole," in conjunction with the results of other environmental sampling and the site conceptual model, to identify trends and spatial variations in the data [Section 3.2.1]. To put some perspective on the data, soil vapor results might be compared to background outdoor air levels [Section 3.2.4], site related outdoor air sampling results, or the NYSDOH's guidelines for volatile chemicals in air [Table 3.1] (NYSDOH 2006).” Note that there are updates to the values originally presented in Table 3.1.

There are no concentrations of volatile chemicals in soil vapor that automatically trigger action or no further action. Therefore, No Further Action will be considered based on a review of the soil vapor data in conjunction with the other environmental data and site conceptual model.

SCHEDULE AND REPORTING

Sampling will be completed upon concurrence of the proposed scope of work from USEPA, NYSDEC, and NYSDOH. It is anticipated the work will occur in the second quarter of 2017. Results of the sampling will be presented in a technical memorandum, or similar.

REFERENCES

Arcadis. 2016. Draft Quality Assurance Project Plan, Former Plattsburgh Air Force Base, Plattsburgh, New York. November.

New York State Department of Health. 2006. Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York. October.

Tetra Tech, Inc. (Tetra Tech). 2013. Soil Gas Investigation Data Report, Installation Program Site SS-028, Open Storage Area, Former Plattsburgh Air Force Base, Plattsburgh, New York. May

Tetra Tech. 2016. Draft Report of Findings, Supplemental Investigation at Installation Program Site SS-028, Open Storage Area, Former Plattsburgh Air Force Base, Plattsburgh, New York. July.

URS Group, Inc. 2012. Remedial Action Completion Report for Site SS-018 (Auto Hobby Shop) and Site SS-028 (Open Storage Area), Former Plattsburgh Air Force Base, Plattsburgh, New York. January.

Figures

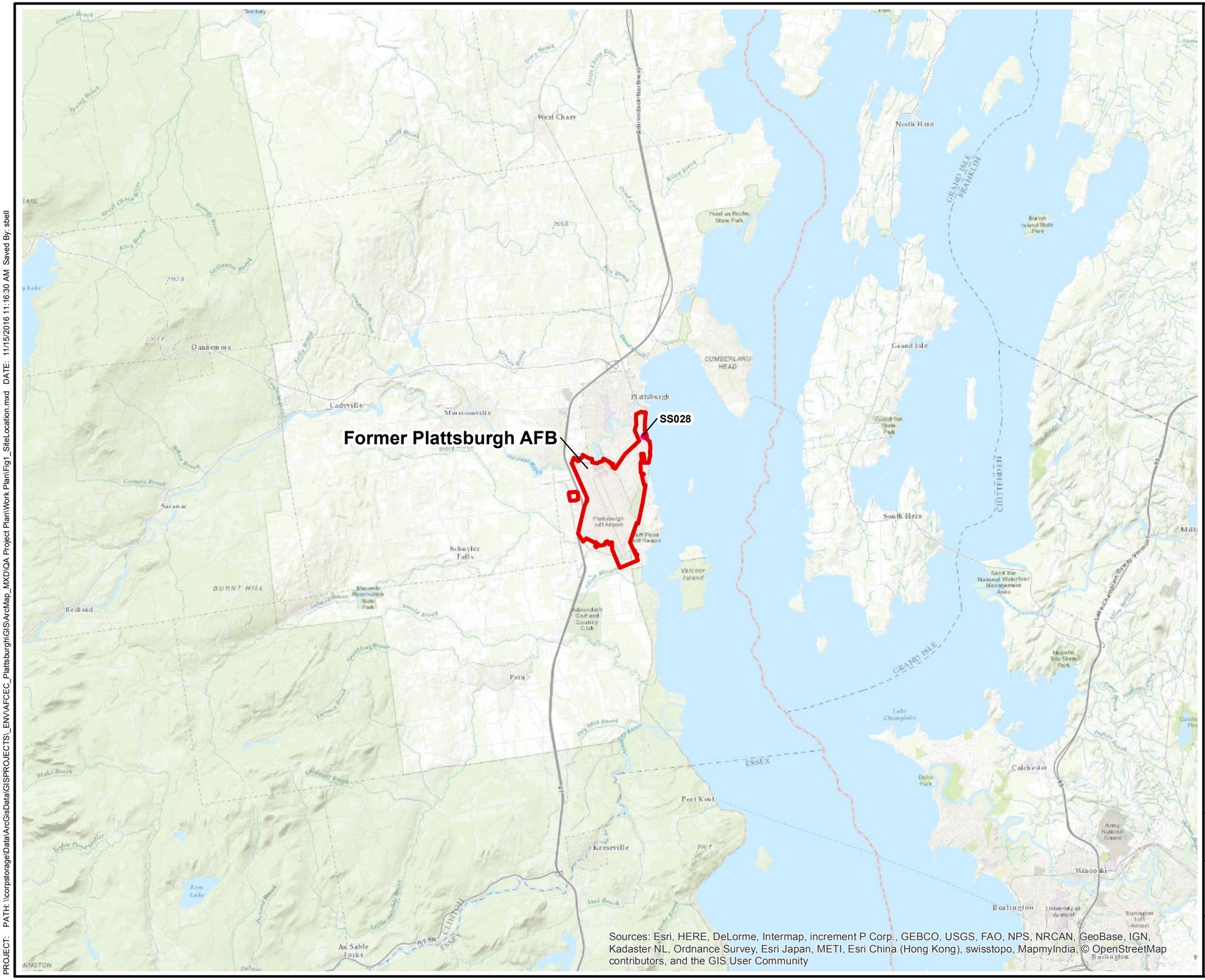
1 – Site Location

2 – Proposed Soil Vapor Sample Locations

Attachments

1 – Standard Operating Procedure – Soil Gas Sampling Using Single of Nested Ports

FIGURES



LEGEND:

- Base Boundary
- SS028 Site Boundary

0 15,000 30,000

SCALE IN FEET

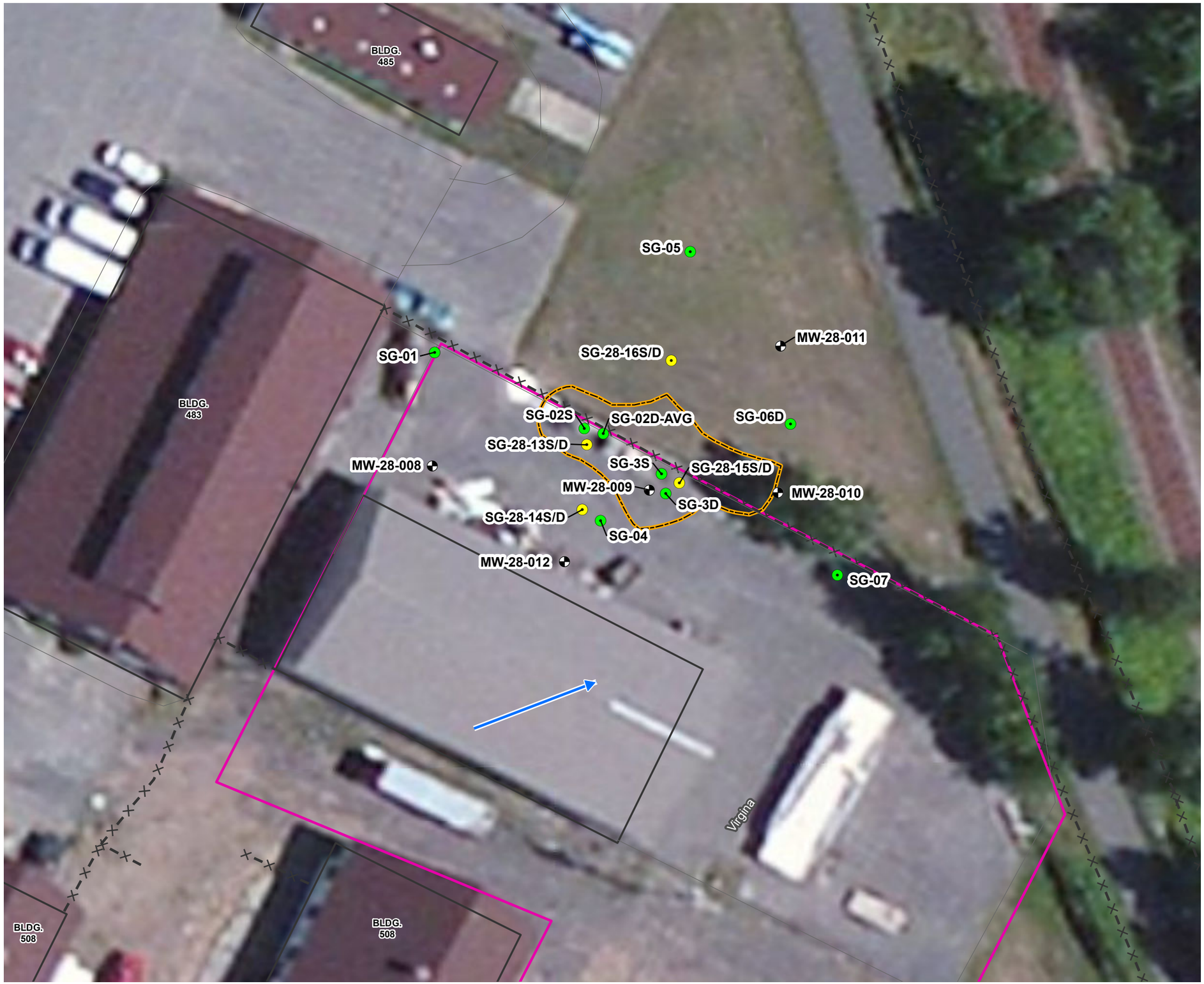
FORMER PLATTSBURGH AFB,
PLATTSBURGH, NEW YORK

SS028 SAMPLING WORKPLAN

SITE LOCATION

ARCADIS

FIGURE
1



LEGEND:

- Monitoring Well
- 2012 Soil Vapor Sample
- Proposed Soil Vapor Sample Locations
- Groundwater Flow Direction
- Fence Line
- Excavation Area (1998-1999)
- Site Boundary

0 25 50

SCALE IN FEET

FORMER PLATTSBURGH AIR FORCE BASE
PLATTSBURGH, NEW YORK

SS028 SAMPLING WORK PLAN

PROPOSED SOIL VAPOR SAMPLE LOCATIONS

ARCADIS

FIGURE
2

Citrix DIV/GROUP: ENV/IMDV DB: LD: PIC: PM: TM:
PROJECT: PATH: \\corpstorage\Data\ArcGisData\GISPROJECTS_ENVAFCEC_Plattsburgh\GIS\ArcMap_MXD\QA Project Plan\Work Plan\Fig2_SS028_SiteLayout.mxd DATE: 11/15/2016 1:04:15 PM Saved By: sbell

ATTACHMENT 1

Standard Operating Procedure – Soil Gas Sampling Using Single of Nested Ports

ARCADIS
Infrastructure, environment, facilities

Imagine the result

Soil Gas Sampling Using Single or Nested Ports

SOP # 428199

Rev. #: 4

Rev Date: July 9, 2010

Approval Signatures

Prepared by: _____ Date: 07/09/2010
Mitch Wacksman and Andrew Gutherz

Approved by: _____ Date: 07/09/2010
Christopher Lutes and Nadine Weinberg

I. Scope and Application

This document describes the procedures for installing semi-permanent or permanent single or nested soil-gas ports and collecting soil-gas samples. Nested soil-gas ports allow for the generation of discrete data as a function of depth and time. Samples are collected for the analysis of volatile organic compounds (VOCs) by United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). Method TO-15 uses a 1-liter, 3-liter of 6-liter SUMMA® passivated stainless steel canister. An evacuated SUMMA canister (less than 28 inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5 liters when allowed to fill to a vacuum of 6 inches of Hg. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide compound detection limits of 0.5 parts per billion volume (ppbv). Optionally, the whole air sample can also be analyzed for permanent gasses such as oxygen and carbon dioxide.

The following sections list the necessary equipment and provide detailed instructions for the installation of semi-permanent or permanent single or nested soil-gas ports (using direct-push technology or a hollow stem auger) and the collection of soil-gas samples for VOC analysis.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training, including 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training. Site supervisor training, site-specific training, first-aid, and cardiopulmonary resuscitation (CPR), may be appropriate at some sites. ARCADIS field sampling personnel will be well versed in the relevant standard operating procedures (SOPs) and possess the required skills and experience necessary to successfully complete the desired field work. ARCADIS personnel responsible for leading soil-gas sample collection activities must have previous soil-gas sampling experience.

III. Health and Safety Considerations

All sampling personnel should review the appropriate health and safety plan (HASP) and job loss analysis (JLA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific installation. Field sampling equipment must be carefully handled to minimize the potential for injury and the spread of hazardous substances. For vapor port installation, drilling with a direct-push drilling rig

or hollow stem auger rig should be done only by personnel with prior experience using such of equipment.

IV. Equipment List

The equipment required to install single or nested soil vapor ports is presented below:

- Appropriate personal protective equipment (PPE ; as required by the HASP and JLA);
- Appropriate drill rig to reach necessary sample depth (hollow stem auger, direct-push rig, etc)
    - Hollow stem auger rig with interconnecting augers. The inner diameter of typical augers ranges from 2.25-inches to 7.75-inches; the auger size should be chosen should be large enough to accommodate the number of nested ports that will be installed inside the boring.
    - Direct-push rig (e.g., -Geoprobe) equipped with interconnecting 4-foot lengths of steel drive rods (2.25-inch-diameter, or 3.25-inch diameter depending on the number of ports to be installed).
- 1/4-inch outside diameter (OD) x 1/8-inch inside diameter (ID) tubing (Teflon, Teflon lined, or nylon). Note that Nylaflow tubing has a somewhat higher background level of BTEX and much poorer recovery of trichlorobenzene and naphthalene then Teflon, so it should not be used on site where these compounds are a concern (Hayes, 2006)
- Stainless steel sample screens with sacrificial point (one per sample depth to weight sample screen, available from Geoprobe). Typically 6” long for sized for 1/4-inch OD tubing.
- Stainless steel, or Teflon ball valve or needle valve (one per sample depth to match sample tubing) for sample line termination.
- Commercially available clean sand filter pack or glass beads having a grain size larger than 0.0057-inch (pore diameter of screen)

- Granular and powdered bentonite (Benseal®, Volclay® Crumbles, or equivalent)
- Down hole measuring device
- Distilled or Deionized water for hydration of bentonite
- Plastic or aluminum tags for permanently labeling port with sample depth, and port identification number. It is no recommended to write on or affix adhesive tape to tubing as these methods fail over time.
- Well cover for permanent installation, This should be a traffic rated road box for exterior installations or an appropriate clean-out cover for interior installations.
- Photoionization Detector (PID) (with a lamp of 11.7 eV).

The equipment required for soil-gas sample collection from single or nested ports is presented below:

- 1,3, or 6 – liter stainless steel SUMMA® canisters (order at least one extra, if feasible) (batch certified canisters or individual certified canisters as required by the project)
- Flow controllers with in-line particulate filters and vacuum gauges; flow controllers are pre-calibrated to specified sample duration (e.g., 30 minutes, 8 hours, 24 hours) or flow rate (e.g., 200 milliliters per minute [mL/min]); confirm with the laboratory that the flow controller comes with an in-line particulate filter and pressure gauge (order at least one extra, if feasible). Flow rate should be selected based on expected soil type (see below)
- Decontaminated stainless steel1/4-inch Swagelok (or equivalent) fittings (e.g., nuts, ferrules and backers)
- Decontaminated stainless steel Swagelok or comparable “T” fitting and needle valve for isolation of purge pump.
- Stainless steel or brass “T” fitting (if collecting duplicate [i.e., split] samples). Swage-lok or comparable

- Portable vacuum pump capable of producing very low flow rates (e.g., 100 to 200 mL/min) with vacuum gauge. Purging flow rate should also be selected based on expected soil type (see below).
- Rotameter or an electric flow sensor if vacuum pump does not have an accurate flow gauge (Bios DryCal or equivalent).
- Tracer gas testing supplies if applicable (refer to tracer SOP)
- Photoionization Detector (PID) (with a lamp of 11.7 eV)
- Appropriate-sized open-end wrench (typically 9/16-inch, 1/2-inch, and 3/4-inch)
- Down hole measuring device (e.g., water level probe, tape measure)
- Portable weather meter, if appropriate
- Chain-of-custody (COC) forms
- Sample collection logs (attached)
- Field Book

V. Cautions

The following cautions and field tips should be reviewed and considered prior to installing or collecting a single or nested soil-gas sample.

- When drilling to install sampling ports , be mindful of utilities that may be in the area. Follow ARCADIS utility location procedure. If the driller is concerned about a particular location, consult the project manager about moving it to another location. Do not hesitate to use Stop Work Authority; if something doesn't seem right stop and remedy the situation.
- Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens (sharpies), wear/apply fragrances, or smoke cigarettes/cigars before and/or during the sampling event.

- Ensure that the flow controller is pre-calibrated to the proper sample collection duration (confirm with laboratory). Sample integrity can be compromised if sample collection is extended to the point that the canister reaches atmospheric pressure. Sample integrity is maintained if sample collection is terminated prior to the target duration and a measurable vacuum (e.g., 3-7–inches Hg) remains in the canister when sample collection is terminated. Do not let sample canister reach atmospheric pressure (e.g., 0-inches Hg).

- Care should be taken to ensure that nested ports are installed at the target sample depths within the sand filer pack.. Sampling personnel should work closely with the driller to accomplish this.

- When introducing granular bentonite to the boring, the material should be introduced slowly and hydrated properly. Consult the bentonite manufacturer's instructions on the bag to determine the proper amount of to be used. When hydrated properly bentonite forms a thick clay mass that remains moist. The hydration step is crucial in the installation process and if not done properly the integrity of the bentonite seal can be compromised.

- Using prehydrated bentonite is best and should be discussed with drilling subcontractor.

- The purge flow rate of 100 ml/min should be suitable for a variety of silt and sand conditions but will not be achievable in some clays without excessive vacuum. Thus lower flow rates may be necessary in clay. A low vacuum (<10" of mercury) should be maintained. Record the measured flow rate and vacuum pressure during sample collection.

  The cutoff value for vacuum differs in the literature from 10" of water column (ITRC 2007) to 136" of water column or 10" of mercury (http://www.dtsc.ca.gov/lawsregspolicies/policies/SiteCleanup/upload/SMBR_ADV_activesoilgasinvst.pdf). A detailed discussion of the achievable flow rates in various permeability materials can be found in Nicholson 2007. Related issues of contaminant partitioning are summarized in ASTM D5314-92. Passive sampling approaches can be considered as an alternative for clay soils although most passive methods for soil gas do not yield a quantitative concentration in soil gas.

- It is important to record the canister pressure, start and stop times and ID on a proper field sampling form. You should observe and record the

time/pressure at a mid-point in the sample duration. It is a good practice to lightly tap the pressure gauge with your finger before reading it to make sure it isn't stuck.

- Ensure that there is still measureable vacuum in the SUMMA® after sampling. Sometimes the gauges sent from labs have offset errors, or they stick.

- When sampling carefully consider elevation. If your site is over 2,000' above sea level or the difference in elevation between your site and your lab is more than 2,000' then pressure effects will be significant. If you take your samples at a high elevation they will contain less air for a given ending pressure reading. High elevation samples analyzed at low elevation will result in more dilution at the lab, which could affect reporting limits. Conversely low elevation samples when received at high elevation may appear to not have much vacuum left in them. http://www.uigi.com/Atmos_pressure.html.

- If possible, have equipment shipped a two or three days before the sampling date so that all materials can be checked. Order replacements if needed.

- Requesting extra canisters from the laboratory should also be considered to ensure that you have enough equipment on site in case of an equipment failure.

- Soil-gas sampling should not proceed within 5 days following a significant rain event (1/2-inch of rainfall or more). Exceptions to this requirement may be appropriate depending on site climatic conditions, soil gas point depth and soil drainage characteristics. However since this requirement is frequently contained in regulatory documents, any exception to this requirement must be discussed with client and/or regulatory representatives. ITRC (2007) discussed the conditions when this requirement may not be necessary: "*Infiltration from rainfall can potentially impact soil gas concentrations by displacing the soil gas, dissolving VOCs, and by creating a "cap" above the soil gas. In many settings, infiltration from large storms penetrates into only the uppermost vadose zone. In general, soil gas samples collected at depths greater than about 3–5 feet bgs or under foundations or areas with surface cover are unlikely to be significantly affected. Soil gas samples collected closer to the surface (<3 feet) with no surface cover may be affected. If the moisture has penetrated to the*

sampling zone, it typically can be recognized by difficulty in collecting soil gas samples. "

VI. Procedure

Single or Nested Soil-Gas Monitoring Point Installation

The procedure used to install semi-permanent or permanent single or nested soil-gas ports will vary based upon the method of boring installation. In most situations a temporary well casing well need to be installed to keep the down hole formation from collapsing during port installation. The following steps will detail installing nested soil-gas ports through a temporary well casing.

If the nested ports will be installed at shallow depths, or the formation is thought to be stable enough to not collapse, a temporary well casing may not be necessary to facilitate the installation of the sample ports. Either way, the steps for installing the sample ports are nearly identical. These following steps should be discussed with the drilling subcontractor and altered based on the methods chosen for a given project.

1. Advance boring to bottom of deepest sampling interval and install a temporary well casing. Care should be taken to ensure that the terminal depth of the boring does not reach groundwater or the capillary fringe. Soil-gas probes should not be installed in groundwater or the capillary fringe. Moisture conditions and/or other observations (such as depth to water in nearby monitoring wells) should be recorded on the soil-gas collection log, as indicated.

2. Cut a length of 1/4-inch tubing slightly longer (e.g., 4 to 5 feet) than the collection depth. Attach a stainless steel sample screen and sacrificial point to the tubing and lower the screen and attached tubing through the boring.

3. Assure that the sample screen has reached the bottom of the boring and record this depth.

4. Begin simultaneously filling in the area around the sample screen with sand filter pack and retracting the temporary well casing. The casing should be lowered back down onto the sand every few inches to compact the sand around the screen. Sand should be introduced 3-inches below the screen, to cover the 6-inch sample screen and extend 3-inches inches above the screen for a total of 12 inches of sand. Closely monitor the amount of sand added to the borehole with a tape measure or water level probe.

5. With the proper sand pack in place begin slowly introducing 6-inches of dry granular bentonite into the boring. This dry Bentonite will prevent water from entering the sand filter pack during hydration.

6. A slurry of hydrated bentonite should be placed above the dry granular bentonite to the next sample depth (for nested ports) or to the ground surface (for single ports).

7. Properly label the sample tubing with a permanent label to designate the sample number and screen depth.

8. Affix a Swagelok fitting and valve to the end of the tubing.

9. Add an inch or two of dry granular Bentonite over the bentonite slurry prior to installing the subsequent sand filter pack and screen.

10. Repeat steps 2-8 until all the sample depths are installed.

11. With all semi-permanent or permanent single or nested ports installed and labeled, a well cover may be installed.

    a. For permanent installations, the well cover should be rated for whatever type of traffic it may encounter in the future. For interior installations a brass clean-out cover available from a plumbing supply store may provide adequate protection. For exterior installations in high traffic areas a heavy duty groundwater well cover may be appropriate.

    b. For a semi-permanent installation, a well cover is generally not necessary as the tubing will be removed within several days.

12. All soil-gas points should be allowed to sit and equilibrate for a minimum of 24-hours before proceeding to soil-gas sample collection.

Soil-Gas Sample Collection

The following steps should be used to collect a soil-gas sample from each of the single or nested probes installed using the above procedure.

1. Record the following information on the sample log, if appropriate (contact the local airport or other suitable information source [e.g., site-specific measurements, weatherunderground.com] to obtain the information):

    a. wind speed and direction;

    b. ambient temperature;

    c. barometric pressure; and

    d. relative humidity.

2. Assemble the sample train by removing the cap from the SUMMA canister and connecting the Swagelok T-fitting to the can using a short length of 1/4-inch OD Teflon tubing. The flow controller with in-line particulate filter and vacuum gauge is then attached to the T-fitting. The Swagelok (or similar) two-way valve is connected to the free end of the T-fitting using a short length of ¼-inch OD Teflon tubing (precleaned stainless steel tubing could also be used)..

3. When collecting duplicate or other quality assurance/quality control (QA/QC) samples as required by applicable regulations and guidance, couple two SUMMA canisters using stainless steel Swagelok duplicate sample T-fitting supplied by the laboratory. Attach flow controller with in-line particulate filter and vacuum gauge to duplicate sample T-fitting provided by the laboratory.

4. Attach Teflon sample tubing to the flow controller using Swagelok fittings.

5. Remove the flush Swagelok cap from the sample port and install a Swagelok nut, ferrules, and sample tubing into the sub-slab port.

6. Connect the two-way valve and the portable purge pump using a length of Teflon sample tubing.

7. Record on the sample log and COC form the flow controller number with the appropriate SUMMA® canister number.

    a. Perform a leak-down-test by replacing the nut which secures sample tubing with the cap from the canister or closing the valve on the sample port. This will create a closed system. Open the canister

valve and quickly close it; the vacuum should increase approaching 30" Hg. If there are no leaks in the system this vacuum should be held. If vacuum holds proceed with sample collection; if not attempt to rectify the situation by tightening fittings.

8. The seal around the soil-gas sampling port and the numerous connections comprising the sampling train will be evaluated for leaks using helium as a tracer gas. The helium tracer gas will be administered according to the methods established in the appropriate guidance documents and SOP: Administering Tracer Gas.

9. Open the two-way valve and purge the soil-gas sampling port and tubing with the portable sampling pump. Purge approximately three volumes of air from the soil-gas sampling port and sampling line using a flow rate of 200 mL/min. Purge volume is calculated by the following equation "purge volume = 3 x Pi x inner radius of tubing^2 x length of tubing. Purge air should be vented away from personnel and sampling equipment, a length of tubing or Tedlar bag can be used for this purpose. Measure organic vapor levels and tracer gas within the Tedlar bag, as appropriate.

10. Close the two-way valve to isolate the purge pump.

11. Open the SUMMA® canister valve to initiate sample collection. Record on the sample log (attached) the time sampling began and the canister pressure.

If the initial vacuum pressure registers less than -25 inches of Hg, then the SUMMA® canister is not appropriate for use and another canister should be used.

12. Take a photograph of the SUMMA® canister and surrounding area unless prohibited by the property owner.

13. Check the SUMMA canister pressure approximately half way through the sample duration and note progress on sample logs.

14. Steps 2-10 should be repeated for each of the nested soil-gas ports; samples can be collected concurrently.

Termination of Sample Collection

1. Arrive at the SUMMA® canister location at least 1-2 hours prior to the end of the required sampling interval (e.g., 8, 24-hours)..

2. Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valves. The canister should have a minimum amount of vacuum (approximately 6 inches of Hg or slightly greater).

3. Record the date and time of valve closing on the sample log and COC form.

4. Close the valve on the nested soil-gas sample tubing or replace Swagelok cap.

5. Once all the nested samples have been collected, be sure the well cover (if applicable) is properly re-installed and secured.

6. Remove the particulate filters and flow controllers from the SUMMA® canisters, re-install the brass plugs on the canister fittings, and tighten with the appropriate wrench.

7. Package the canisters and flow controllers in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canisters should not be preserved with ice or refrigeration during shipment.

8. Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with a string).

9. Complete the COC form and place the requisite copies in a shipping container. Close the shipping container and affix a custody seal to the container closure. Ship the container to the laboratory via overnight carrier (e.g., Federal Express) for analysis.

VII. Soil-Gas Monitoring Point Abandonment

If the single or nested soil-gas ports were installed in a semi-permanent manner, and the soil-gas samples have been collected, the soil-gas monitoring points will be abandoned by pulling up the sample tubing. Since the boring is filled with bentonite and sand, no additional abandonment steps are necessary. Ensure that the boring location and surrounding area are returned to as close to their original appearance as possible.

VIII. Waste Management

The waste materials generated by these activities should be minimal. Personal protective equipment, such as gloves and other disposable equipment (i.e., tubing) should be collected by field personnel for proper disposal. Any soils brought up from the borehole should be disposed of in a manner consistent with the project workplan.

IX. Data Recording and Management

Measurements will be recorded on the sample log at the time of measurement with notations of the project name, sample date, sample start and finish time, sample location (e.g., GPS coordinates, distance from permanent structure), canister serial number, flow controller serial number, initial vacuum reading, and final pressure reading. Field sampling logs and COC records will be transmitted to the Project Manager.

X. Quality Assurance

Duplicate samples should be collected in the field as a quality assurance step. Generally, duplicates are taken of 10% of samples, but project specific requirements should take precedence.

Soil-gas sample analysis will generally be performed using USEPA TO-15 methodology or a project specific constituent list. Method TO-15 uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits (typically 0.5-ppbv for most VOCs). A trip blank sample will accompany each shipment of soil-gas samples to the laboratory for analysis. Trip blanks assess potential sample contamination resulting from the transportation and storing of samples.

Duplicate soil gas samples should be collected via a split sample train, allowing the primary and duplicate sample to be collected from the soil-gas probe simultaneously.

XI. References

ASTM – “Standard Guide for Soil Gas Monitoring in the Vadose Zone”, D5314-92.

ITRC “Vapor Intrusion Pathway: A Practical Guide”, January 2007, Appendix F: “regulators Checklist for Reviewing Soil Gas Data”

New York State Department of Health (NYSDOH). 2005. DRAFT "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" February 23, 2005.

Nicholson, P, D. Bertrand and T. McAlary. "Soil Gas Sampling in Low-Permeability Materials" Presented at AWMA Specialty Conference on Vapor Intrusion, Providence RI, Sept 200

Hayes, H. C., D. J. Benton and N. Khan "Impact of Sampling Media on Soil Gas Measurements" Presented with short paper at AWMA Vapor Intrusion Conference, January2006, Philadelphia, PA.

Sub-slab Soil Vapor Sample Collection Log

		Sample ID:	
Client:		**Boring Equipment:**	
Project:		**Sealant:**	
Location:		**Tubing Information:**	
Project #:		**Miscellaneous Equipment:**	
Samplers:		**Subcontractor:**	
`		**Equipment:**	
Sampling Depth:		**Moisture Content of Sampling Zone):**	
Time and Date of Installation:		**Approximate Purge Volume:**	

Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)

(a) Record canister information at a minimum at the beginning and end of sampling

SUMMA Canister Information:

Size (circle one):	**1 L 6 L**
Canister ID:	
Flow Controller ID:	
Notes:	

Tracer Test Information (if applicable):

Initial Helium Shroud:	
Final Helium Shroud:	
Tracer Test Passed:	**Yes No**
Notes:	

General Observations/Notes:

Approximating One-Well Volume (for purging):

When using 1¼-inch "Dummy Point" and a 6-inch sampling interval, the sampling space will have a volume of approximately 150 mL. Each foot of ¼-inch tubing will have a volume of approximately 10 mL.