Soil Gas and Ambient Air Sampling Work Plan Addendum, Former Communications Site (Taku Gardens) Fort Wainwright, Alaska

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This technical memorandum has been developed by CH2M HILL, under contract to Jacobs Engineering, to assist in planning and guiding additional soil gas sampling activities at the Former Communications Site (FCS) at Fort Wainwright, Alaska.

The purpose of these activities is to collect additional subslab soil gas and indoor data that will supplement data presented in the *Draft Final Remedial Investigation Report* (Draft Final RI Report) (CH2M HILL, 2010).

The soil gas sampling activities presented in this technical memorandum include the following:

- Additional subslab soil gas sampling for volatile organic compounds (VOCs) and radon
- Additional indoor ambient air sampling for VOCs and radon
- Additional outdoor ambient air sampling for VOCs and radon

The sample locations identified in this work plan addendum represent the locations of the highest exceedances of Alaska Department of Environmental Conservation (ADEC) target levels during the December 2008 and August 2009 subslab soil gas sampling events. During review of the draft version of this work plan addendum, ADEC also requested sampling of at Building 13. It is anticipated that, if a meaningful migration pathway from subslab sources can be demonstrated to be absent from these units, then the same would be true for other units where lower subslab VOC concentrations have been observed.

The purpose and details associated with these activities are discussed in subsequent sections of this addendum. This addendum is a supplement to the *Interim Draft Remedial Investigation Management Plan* (Remedial Investigation [RI] Management Plan) (CH2M HILL, 2008), which includes the Risk Assessment Work Plan, Quality Assurance Program Plan (QAPP), Field Sampling Plan (FSP), Work Plan Addendum 3, and Health and Safety Plan (HASP) already developed for the remedial investigation at the FCS.

1.0 Background Information

Potential sources of contaminant release at the FCS include chemical spills from past maintenance practices; leaks from tanks, pipelines, and transformers; and burial of drums and other debris. Soil gas and vapor intrusion investigation activities were conducted from 2006 to 2009 and reported in the *Preliminary Source Evaluation Phase II Report, Taku Gardens, Fort Wainwright, Alaska (Final)* (North Wind, 2007) and the Draft Final RI Report (CH2M HILL, 2010). As part of the RI, a human health risk assessment was conducted to assess, in part, whether VOC exposure through vapor intrusion could pose a potential for unacceptable risk to human health. The vapor intrusion risk estimates and additional information on exposure pathways were included in the Draft RI Report, Section 7.5.4 (CH2M HILL, 2009).

ADEC has requested that additional sampling be conducted to confirm that specific VOCs have not significantly migrated indoors at locations where subslab concentrations were previously found to exceed target screening levels. The sampling described herein is intended to address this request, and will be supplemented with additional ambient air sampling for VOCs and radon sampling to support interpretation of the results. The overall goals are (1) to strengthen the database in support of the site-specific attenuation factor using radon as a surrogate, and (2) to provide added confidence in the conclusions of the RI risk assessment.

2.0 Additional Soil Gas/Indoor Air Sampling for VOCs and Radon

The purpose of additional VOC sampling is to gather supplemental VOC concentration data in support of the RI and baseline risk assessment, by collecting soil gas data from beneath and within selected housing units, at ADEC request. The validated and reviewed analytical data will be incorporated into the RI project geo-database, and analytical results will be incorporated as an addendum to the Draft Final RI Report.

The purpose of additional subslab/indoor air sampling for radon is to demonstrate that radon attenuation is consistent with the site-specific attenuation factor data reported in the Draft Final RI Report and baseline risk assessment. Radon is a radioactive noble gas that emanates from naturally occurring uranium found in the earth's surface and various soils all over the world. Radon usually migrates freely through faults and porous soils and can accumulate in buildings, especially in confined areas such as basements and building foundations. In addition, radon is not expected as a byproduct of any known sources of contamination at the FCS. For these reasons, radon provides an excellent naturally occurring "tracer" for effectively evaluating subslab-indoor air attenuation factors specific to the FCS.

2.1 Subslab Soil Gas Sampling Activities

The sampling team will ensure that the heat recovery ventilators within each unit to be sampled have been operating as designed at least 48 hours prior to sample collection and that indoor ambient air temperatures range between 65 and 75 degrees Fahrenheit (°F).

Subslab soil gas samples will be collected for VOCs and radon from 12 housing units located at the FCS. The sample locations were identified at selected units where previous subslab

VOC concentrations were highest and were found to exceed PSLs to the greatest degree. It is anticipated that, if a meaningful migration pathway from subslab sources can be demonstrated to be absent from these units, then the same would be true for other units where lower subslab VOC concentrations have been observed. Table 1 lists the proposed sampling locations and sampling rationale. The sample locations are shown in Figure 1.

Each subslab soil gas sample will be collected from subslab soil gas sample points installed within the garage floors of each housing unit in 2007. Subslab samples will be collected in accordance with CH2M HILL's Standard Operating Procedures (SOP) (Attachments 1 through 4). All subslab sampling points will be inspected and helium-leak-tested prior to sampling.

Table 2 lists the types of containers and sample collection times for each type of sample collected.

Sample points will be resealed if necessary and retested prior to sampling. If acceptable resealing and leak-testing cannot be achieved, these sampling points will be avoided and the sample will be collected from the adjoining housing unit within the same building. Otherwise, all subslab soil gas samples will be collected according to the sampling locations and scheme summarized in Table 1.

One subslab soil gas field duplicate sample will be collected representing a field duplicate frequency of 10 percent.

2.2 Ambient Air Sampling Activities

2.2.1 Indoor Ambient Air Sampling

The sampling team will ensure that the heat recovery ventilators within each unit to be samples have been operating as designed at least 48 hours prior to sample collection and that indoor ambient air temperatures range between 65°F and 75°F.

Indoor ambient air samples will be collected for VOCs and radon from 12 housing units located at the FCS. The sample locations were identified at selected units where previous subslab VOC concentrations were highest and had been found to exceed PSLs to the greatest degree. It is anticipated that, if a meaningful migration pathway from subslab sources can be demonstrated to be absent from these units, then the same would be true for other units where lower subslab VOC concentrations have been observed. Table 1 lists the proposed sampling locations and sampling rationale. The sample locations are shown in Figure 1.

Table 2 lists the types of containers and sample collection times for each type of sample collected. Standard operating procedures for the collection of ambient air samples for VOCs and radon are provided as Attachments 2 and 4, respectively, to this work plan addendum.

Two indoor ambient air duplicate samples will be collected, as presented in Table 1, representing a field duplicate frequency greater than 10 percent.

TABLE 1
June 2010 Vapor Intrusion Sampling Scheme
Former Communications Site (Taku Gardens), Fort Wainwright, Alaska

Physical House Number	Building Number	Location ID	Primary Sample ID	VOC Subslab Sample[a]	VOC Ambient Air Sample	Radon Subslab Sample[b]	Radon Ambient Air Sample[b]	Sample Rationale
4716-2	08-R	SG008-R	10FWBSG008-1R	X	X	X	X	Housing unit with highest PSL exceedance for carbon tetrachloride and PSL exceedance for TCE in subslab soil gas. Also previously sampled for radon.
4712-1	12-L	SG012-L	10FWASG012-1L	X (Duplicate)[c]	X (Duplicate)[c]	X (Duplicate)[c]	X (Duplicate)[c]	Housing unit with highest PSL exceedance for TCE in subslab soil gas. Also previously sampled for radon.
4711-1	13-L	SG013-L	10FWASG013-1L	X (Duplicate)[c]	X (Duplicate)[c]	X (Duplicate)[c]	X (Duplicate)[c]	ADEC-requested because of earlier indications of soil with elevated PID readings documented during construction.
4711-2	13-R	SG013-R	10FWASG013-2L	X	X	X	X	ADEC-requested because of earlier indications of soil with elevated PID readings documented during construction.
4708-1	16-L	SG016-L	10FWASG016-1L	X	X	X	X	Housing unit with PSL exceedance for TCE in subslab soil gas. Also previously sampled for radon.
4704-1	20-L	SG020-L	10FWASG020-1L	X	X	X	X	Housing unit with PSL exceedance for TCE in subslab soil gas. Also previously sampled for radon.
4744-1	22-L	SG022-L	10FWASG022-1L	X	X	X	X	Housing unit with PSL exceedance for TCE in subslab soil gas.
4738-1	29-L	SG029-L	10FWASG029-1L	X	X	X	X	Housing unit with PSL exceedance for TCE in subslab soil gas.
4736-2	32-R	SG032-R	10FWASG032-1R	X	X	X	X	Housing unit with PSL exceedance for TCE in subslab soil gas.

TABLE 1
June 2010 Vapor Intrusion Sampling Scheme
Former Communications Site (Taku Gardens), Fort Wainwright, Alaska

Physical House Number	Building Number	Location ID	Primary Sample ID	VOC Subslab Sample[a]	VOC Ambient Air Sample	Radon Subslab Sample[b]	Radon Ambient Air Sample[b]	Sample Rationale
4735-1	34-L	SG034-L	10FWASG034-1L	X	X	X	X	Housing unit with highest PSL exceedances for 1,2,4-trimethylbenzene and naphthalene in subslab soil gas. Also previously sampled for radon.
4728-1	42-L	SG042-L	10FWFSG042-1L	X	X	X	X	Housing unit with PSL exceedance for chloroform in subslab soil gas. Also previously sampled for radon.
4725-1	47-L	SG047-L	10FWASG047-1L	X	X	X	X	Housing unit with highest PSL exceedance for chloroform in subslab soil gas. Also previously sampled for radon.
OAW	N/A	OAW	10FWOAW1-1		X (Duplicate)[c]		X (Duplicate)[c]	Ambient background sample to distinguish subslab from ambient sources.
OAE	N/A	OAE	10FWOAE1-1		X		X	Ambient background sample to distinguish subslab from ambient sources.
			Total Samples	**12**	**14**	**12**	**12**	
			Total Duplicates	**2**	**2**	**2**	**2**	

[a]VOC sample by U.S. Environmental Protection Agency Method TO-15I
[b]Radon sample by scintillation cell counting method
[c]Proposed location of field duplicate
N/A = not applicable
PSL = project screening level
TCE = trichloroethylene
VOC = volatile organic compound

2.2.2 Outdoor Ambient Air Sampling

Two outdoor ambient air samples and one field duplicate sample for VOCs and radon will be taken to determine the contribution from sitewide background sources (for example, airport, power plant, gas station, and natural). One outdoor air sample will be collected on both the western and the eastern fencelines of the FCS at the locations of previous outdoor air sampling (Figure 1). A field duplicate will be collected at the western fenceline location, as summarized in Table 1.

Table 2 lists the types of containers and sample collection times for each type of sample collected. Standard operating procedures for the collection of ambient air samples for VOCs and radon are provided as Attachments 2 and 4, respectively.

2.3 Analytical Methods

All subslab soil gas, indoor air, and outdoor air samples will be analyzed for VOCs by U.S. Environmental Protection Agency Method TO-15, using a mass spectrometer in both low-level scan and selective ion monitoring (SIM) modes to achieve the reporting limits listed in the RI Management Plan (CH2M HILL, 2008). Modifications to the method may be made by using a solvent delay or other similar techniques to help mitigate potential interference by other non-target analytes such as freon. All subslab samples will be submitted to AirToxics Ltd. (AirToxics) in Folsom, California, for analysis.

All subslab soil gas, indoor air, and outdoor air samples will also be analyzed for radon by the scintillation cell counting method.

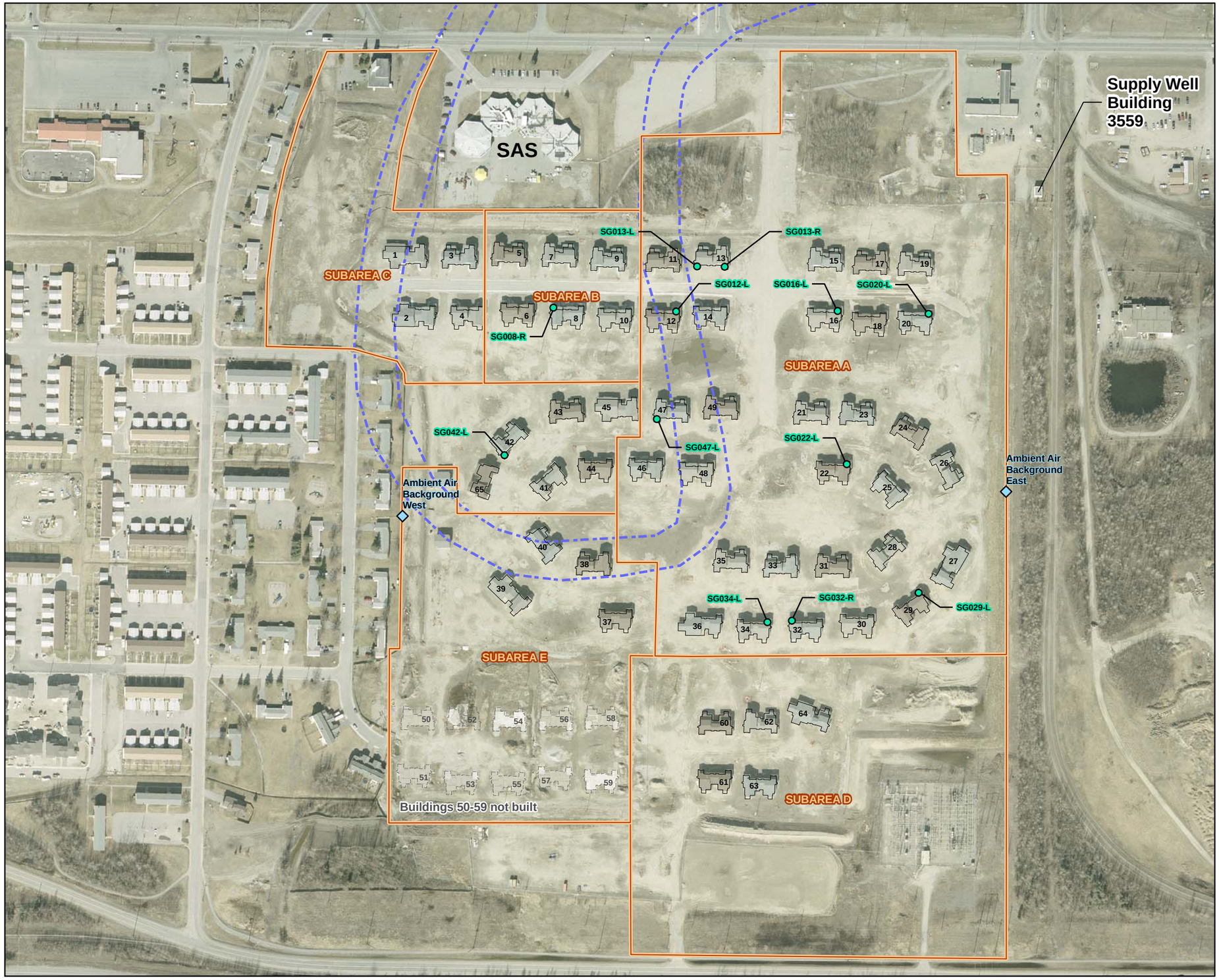
TABLE 2

Sample Containers and Collection Rates

Former Communications Site (Taku Gardens), Fort Wainwright, Alaska

Type of Sample	Type and Volume of Sample Container	Sample Flow Rate	Duration of Sample Collection
VOC subslab	6-liter SUMMA™	100 - 200 ml/min	30 - 60 minutes
VOC ambient air	6-liter SUMMA™	3 - 5 ml/min	20 - 28 hours
Radon subslab	1-liter Tedlar	100 - 200 ml/min	3 - 6 minutes
Radon ambient air	1-liter Tedlar	100 - 200 ml/min	3 - 6 minutes

ml/min = milliliter per minute
VOC = volatile organic compound



Legend

- Paired Subslab Soil Gas and Indoor Air Sample Location - VOC and Radon
- Outdoor Ambient Air Sample Location - VOC and Radon
- Former Hoppe's Slough
- Historical Feature Subarea

0 275
Feet

FIGURE 1
June 2010 Soil Gas and Ambient Air Sampling Locations
Former Communications Site
Fort Wainwright, Alaska

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4.0 Sample Management, Quality Assurance, and Reporting

4.1 Sample Identification

Subslab soil gas and ambient air samples will be uniquely identified according to the established sample identification scheme:

- 10 for 2010
- FW for Fort Wainwright
- A, B, C, D, E, or F for the historical subarea designation ("F" is for undesignated areas)
- SG or IA for soil gas or indoor air
- ### for house number – generally 0##
- -2L or -2R for left or right side of unit (2 = 2nd sampling event of year)
- B for duplicates only

Example: indoor air from the left side of Building 42 would be labeled "10FWFIA042-2L," and, if a duplicate were collected at that location, it would be labeled "10FWFIA042-2LB."

The outdoor air samples will be uniquely identified according to the following sample identification scheme:

- 10 for 2010
- FW for Fort Wainwright
- OA for outdoor air
- W or E for west or east fenceline sample location
- # number of sample collected this year (first sample of 2010 is 1, second is 2)
- -2 designated second sampling event of 2010
- B for duplicate only

Example: outdoor air from the west fenceline of the FCS would be labeled "10FWOAW1-2," and, if a duplicate were collected at that location, it would be labeled "10FWOAW1-2B."

All proposed samples and their proposed sample identification numbers are listed in the field sampling scheme in Table 1.

4.2 Sample Handling and Shipping

Each collected subslab soil gas, indoor air, and outdoor air sample will be handled and prepared for shipment in accordance with Attachments 1 through 4. As soil gas and air samples are collected, samples will be shipped to the project laboratories daily or as frequently as practical. All collected VOC samples shipped to AirToxics will be delivered by FedEx 2Day Air. All collected radon samples will be shipped to the University of Southern California Earth Sciences Laboratory by FedEx Overnight because of the relatively short holding time of radon (half-life of 3.8 days).

4.3 Quality Assurance

Sample analysis and data management will be accomplished in accordance with the RI Management Plan (CH2M HILL, 2008).

4.4 Reporting

Following completion of the June 2010 vapor intrusion sampling activities, the final validated data will be evaluated and incorporated into a technical memorandum for inclusion as an addendum to the Draft Final RI Report.

5.0 References

CH2M HILL. 2009. *Draft Remedial Investigation Report*. Prepared for the Department of the Army, U.S. Army Corps of Engineers, Alaska District, Elmendorf Air Force Base, Alaska. June.

CH2M HILL. 2008. *Interim Draft Remedial Investigation Management Plan*. Prepared for the Department of the Army, U.S. Army Corps of Engineers, Alaska District, Elmendorf Air Force Base, Alaska. January.

North Wind. 2007. *Preliminary Source Evaluation Phase II Report, Taku Gardens, Fort Wainwright, Alaska (Final)*. Prepared for the Department of the Army, U.S. Army Corps of Engineers, Alaska District, Elmendorf Air Force Base, Alaska. May.

Attachment 1
Standard Operating Procedure: Collection of Subslab Vapor Samples Using SUMMA™ Canisters

Attachment 1

Standard Operating Procedure for the Collection of Sub-Slab Vapor Samples Using SUMMA™ Canisters

This procedure describes the approach for the collection of subslab soil vapor samples in Summa canisters. It includes instruction on probe installation, leak checking, gas sampling, and probe abandonment. This SOP should be used in conjunction with project data quality objectives. Only persons trained in the collection of soil gas samples should attempt this procedure

1.0 Materials

1.1 Probe Installation

- Hammer drill and 7/8″ or 1″ and 5/16″ or 3/8″ bits
- Vacuum cleaner ('shop vac' type or hand held)
- Probe (1/4″ stainless steel tube with Swagelock or equivalent nut and ferrule)
- Probe seal (1/8″ NPT internal wrenching plug)
- Probe union (1/4″ male Swagelock or equivalent to 1/8″ female NPT)
- Nuts and ferrules (1/4″ stainless steel Swagelock or equivalent)
- Hack saw
- Mortar consisting of Portland Cement mix, Fix-it-All, or similar
- Large Q-tips or paper towels and water
- Tongue depressor, putty knife, or similar tool
- Tape measure

1.2 Leak check

- Leak check enclosure
- Compressed helium tank (balloon grade), helium regulator, flow meter (0-500 ml/min)
- Helium detector, or equal
- (alternative) Isopropyl alcohol and paper towels

1.3 Sampling

- Sampling union (1/4″ male Swagelock or equivalent to 1/4″ male NPT)
- Vacuum pump, sampling manifold
- ¼″ Teflon tubing, rubber tubing
- Flow controller
- Summa canister (sized appropriately for sampling requirements)
- Miscellaneous fitting to connect tubing to sampling union and Summa canister)

1.4 Probe Abandonment

- Probe removal fitting
- Crowbar

1.5 Miscellaneous

- Teflon tape
- 9/16″, ½″, crescent wrench, screw driver
- Extension cord
- Timer/watch
- Tools required to cut carpet, and/or tools needed for removal of other floor coverings

2.0 Probe Installation

2.1 Locate the sampling locations in accordance with the work plan. Check with local utility companies to identify utilities coming into the building from outside. If possible, look for known or suspected utility conduits and note their location on a map or in the field log.

Be sure to confirm that the sample locations will not interfere with the known underground utilities. Also note the location of the probe, locations of significant features (walls, cracks, sumps, drains, etc), and conditions of the slab and soil.

2.2 If needed, expose the concrete by cutting the carpet or other loose floor coverings (Note: Carpet need not be removed, but rather a 'L' shape cut to expose the concrete for drilling and the leak check enclosure). Drill a 7/8" or 1" diameter hole to a depth of 1-3/4" (measured to the center of the hole) to allow room for the installation of the probe nut and probe union (See Figure 2). Remove the cuttings using a vacuum cleaner. Be careful to not compromise the integrity of the slab during drilling (i.e., cracking it), although note if this occurs. It is important that the slab and the probe hole remain airtight for sampling and that cracks are noted.

2.3 Drill a 5/16" or 3/8" diameter hole through the remainder of the slab and approx. 3" down into the sub-slab material (See Figure 3). Drilling into the sub slab material creates a void that is free of obstructions that might plug the probe during sampling. Record the total depth of the slab and the depth drilled into the sub slab material.

2.4 Once the total depth of the slab is known, be sure that the probe (1/4" stainless steel tube with Swagelock or equivalent nut and ferrule) is cut with a hacksaw so that it does not extend beyond the bottom of the slab. Attach the probe union (1/4" male Swagelock to 1/8" female NPT) to the probe and tighten. Wrap the probe seal with Teflon tape and tighten into the union. See Figure 8 for an expanded view of the probe parts.

2.5 Wet the walls of the hole using the Q-tip or moistened paper towel. This helps the mortar bond to the drilled concrete. Prepare the mortar in accordance with manufacturer's directions to a stiff consistency. Make sure that the consistency is such that the mixture will not run down the sides of the hole and potentially clog the probe or hole. Place sample probe and sample union part way into the hole as shown in Figure 4. The probe tip should be at least one inch into the smaller diameter hole, but not so far that mortar cannot be easily placed in the large diameter hole around the probe fittings. It is critical that the mortar mixture does not get into either end of the probe and cause a plug. Using the tongue depressor or similar tool, apply mortar around the base of the sampling probe and sampling union such that it will be sealed once it is in place.

2.6 Fill the hole with mortar, and press the probe further into the hole until its top is flush with the floor. In doing so, slightly wiggle the probe to create good 'wetting' contact between the probe and the mortar as well as the mortar and the drilled concrete. Scrape off excess and make sure there is clear access to the probe. See Figure 5.

2.7 Let dry for 24 hours

2.8 Be sure to never leave the probe hole open to atmosphere for extended periods to minimize the effects of surface infiltration.

3.0 Manifold Assembly and leak check

3.1 Make sure the sampling system is assembled (as shown in Figure 1 or 10) by connecting the sampling manifold to the soil gas probe and the purge system. <u>Do not connect the flow controller or canister at this time</u>.

3.2 Make sure the gas probe valve (valve #1) is closed.

3.3 Open the sample valve (valve #2) and the purge valve (valve #3) and turn the vacuum pump on. Make sure that the flow meter on the vacuum pump exhaust is reading 200 ml/min. Let the pump run for 1 minute to allow purging of potential contaminants from the manifold

3.4 Now close valve #2 to achieve a vacuum gauge reading of 10 inches of mercury or to a vacuum that will be encountered during sampling, whichever is greater. Close the purge valve #3 and shut the vacuum pump off.

3.5 If the pressure in the manifold has not changed after a minute, then the manifold is considered leak free. If not, repair any leaks prior to use and re-check the manifold.

3.6 Record the leak check date and time on the field sampling log.

4.0 Probe Leak Check and Probe Purging

4.1 The sampling system needs to be leak-checked and purged before sampling. Two different methods supported by the available literature/guidance are presented. One method uses helium gas as a tracer and allows for the assessment of potential probe leak prior to sample collection. The other method uses isopropyl alcohol as a tracer and allows for the assessment of potential probe leak after sample collection and analysis. Both of these methods are acceptable and are detailed below.

4.1.1 Helium leak checking technique and purge

4.1.1.1 Remove the probe seal insert, wrap the sampling union fitting threads (1/8″ male NPT to ¼″ male Swagelock or equivalent) with Teflon tape (wrap the NPT threads only), and tighten into the exposed probe fitting. Thread the Teflon sample tubing through the rubber grommet in the leak check enclosure from the outside, and attach the tube to the sampling union using a nut and ferrule. Slide the enclosure down so it seals on the concrete slab. Attach the other end of the sample tube to the sampling manifold. See Figure 6 and 7.

4.1.1.2 Attach tubing to the flow meter on the helium tank regulator and the other end to the enclosure. Attach the exhaust tube to the enclosure and position the other end as far away as possible to avoid detection by the helium leak detector. See figure 9.

4.1.1.3 Put the helium detector on the exhaust line from the sample pump. Make sure valve 1 is closed. Open valves 2 and 3. Turn on the sample pump and helium detector.

4.1.1.4 Open the helium tank and set the flow meter for approximately 200 ml/min. Allow it to flow for 1 minute to fill the leak check enclosure before starting the purge. Make sure that the detector is not reading any helium before starting the purge.

4.1.1.5 A minimum of 3 dead volumes should be purged before sample collection. Dead volumes (or the volume of the sampling train) include the probe's annular space, tubing volume, and manifold volume, and typically range from 20 to 100 ml, depending on probe and tubing dimensions. Close valve #2 and open valve #1 simultaneously and start timing for the minimum purge volume. During the purge, observe the helium detector for indication of probe leakage (e.g. infiltration of room air into the probe). If a reading of >5% is observed, then the probe leak check has failed, and corrective action is required. This includes first checking the fittings and trying another purge and leak check. But may result in removing the probe and re-cementing it.

4.1.1.6 At the end of the purge time, close valves #1 and #3 and turn the pump off. If the detector reads < 5%, then the system is leak free and ready for sampling. If >5% was observed, then check the fittings and try again. If <5% cannot be achieved, then the probe should be repaired or replaced. Be sure to record the helium leak check value on the field sheet.

4.1.1.7 Close the helium tank valve.

4.1.2 Isopropyl alcohol leak checking technique and purge

4.1.2.1 Moisten a paper towel with isopropyl alcohol. Wrap the isopropyl alcohol moistened paper towel around probe fittings at the slab surface. Note: It is important to keep the isopropyl alcohol completely away from the sample equipment and SUMMA Canister during the set up phase. The sampler must also change nitrile gloves between setting up the sample equipment and conducting the leak detection test. It is also important to instruct the laboratory to analyze for isopropyl alcohol. If isopropyl alcohol is detected by the laboratory at a concentration greater than 5% (50,000 ppmv) then the sample is deemed invalid due to a leak.

4.1.2.2 Two liters of sub slab gas need to be purged before sampling. The purge time is 10 minutes at a flow rate of 200 ml/min. Close valve #2 and open valve #1 simultaneously and start timing for the purge volume.

4.1.2.3 At the end of the purge time, close valves #1 and #3 and turn the pump off.

5.0 Sampling

5.1 The Summa canister has been evacuated to near absolute zero pressure. Care should be used at all times to prevent inadvertent loss of canister vacuum. Never open the valve affixed to the canister unless the intent is to collect sample or check the pressure. Use only a canister that has been certified to be clean.

5.2 Remove the canister valve cap, attach the vacuum gauge to the canister, and open the canister valve. Record the pressure reading and close and remove the valve. The pressure in the canister should be between 28″ and 30″ of mercury. If not, then the canister has leaked and should not be used for sampling.

5.3 Connect the flow controller to the manifold (at valve #2) and the Summa canister to the flow controller. The port on the flow controller that reads 'HP' or 'In' should be attached to the manifold. The port that reads 'LP' or 'Out' should be attached to the canister. Use only a flow controller that has been cleaned and properly adjusted.

5.4 To take the sample, confirm valve #3 is closed, and open valves #1 and #2. Slowly open the canister valve approximately one (1) full turn, and start timing. Record the start time on the field sampling log. During the sampling period, record the lowest pressure from the manifold gauge on the field log.

5.5 There are different sample time and flow rate protocols. These are subject to project requirements.

5.5.1 5 minute sample period, 850 ml canister: The flow controller is set for 150 ml/min. For an 850 cc Summa canister, it will take 5 minutes to collect a sample.

5.5.2 24 hour sample period, 6 liter canister: The flow controller is set for 3.75 ml/min. For a 6 liter Summa canister, it will take 24 hours to collect a sample.

5.6 At the end of the time, close the sample valve (valve #2) and the valve affixed to the canister. Remove the canister from the apparatus.

5.7 Re-attach the vacuum gauge and record the final pressure. Final pressures should range between negative 0.5 and 10″ of mercury. Record the sampling date, time, canister ID, flow controller ID, and any other observation pertinent to the sampling event on the field sampling log.

5.8 Remove the gauge from the can and tighten the cap back on with a wrench. Verify that canister valve is closed.

5.9 Fill out all appropriate documentation (sampling forms, sample labels, chain of custody, sample tags, etc.).

5.10 Disconnect the sample tubing from the probe, and remove the sampling union.

6.0 Probe Abandonment

6.1 After sampling, it is critical that the probe either be removed or plugged to prevent the creation of a new pathway for vapor intrusion.

6.2 If the probe is to be used again in the future, wrap the probe seal insert with Teflon tape, and tighten it into the probe opening using a hex key until it is tight and flush with the concrete floor.

6.3 If the probe is to be removed, insert the removal fitting into the probe. Using a crow bar, remove the entire probe assembly. If the probe cannot be removed in this manner, then over drill the probe with the drill and 1″ bit. Fill the hole with cement mix.

Figure 1 – Sub slab
Sampling

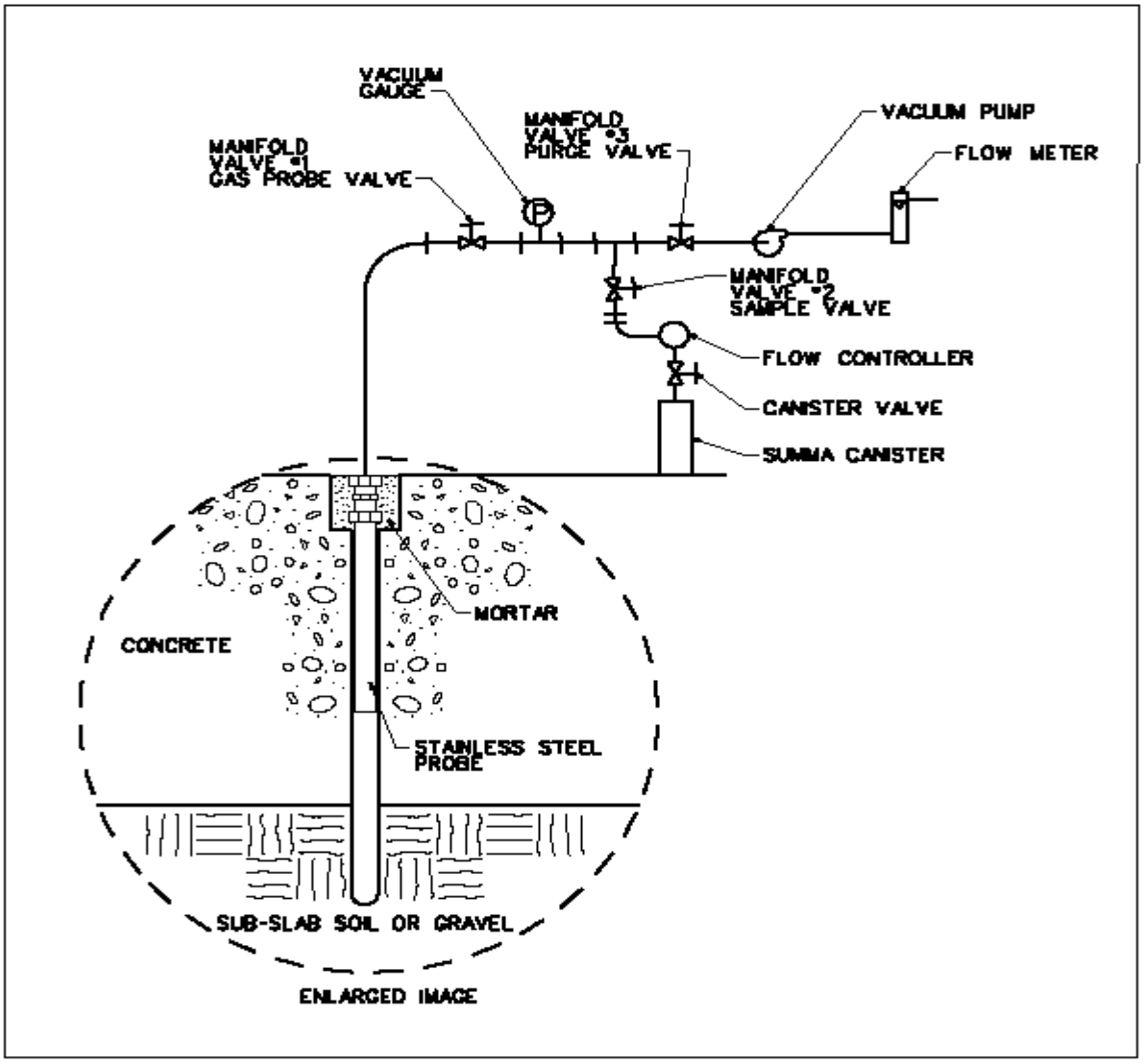


Figure 2 – Drilling 1″ mortar hole to a depth of 1 ¾″

Figure 3 – Drilling 3/8″ probe hole

Figure 4 – Installing Probe with mortar

Figure 5 – Installed probe, flush with slab

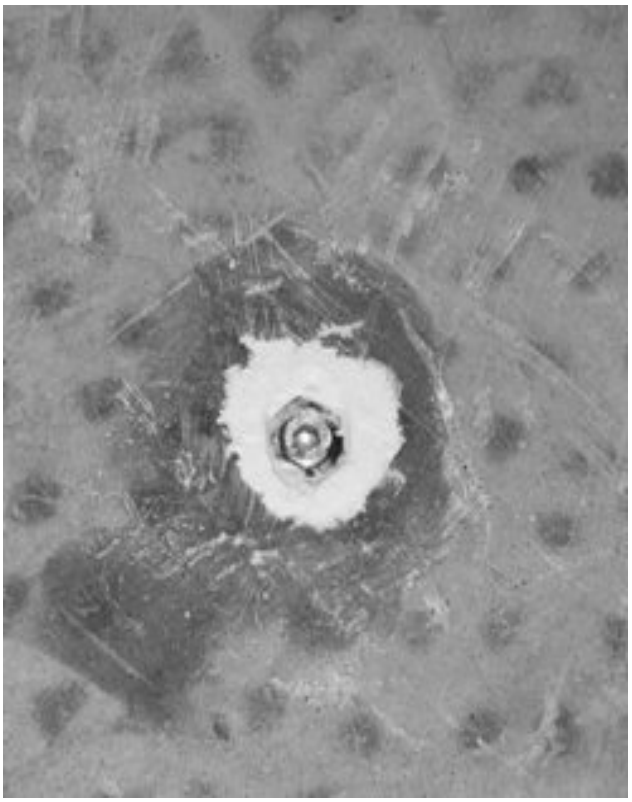


Figure 6 – Installed probe with sample tube assembly

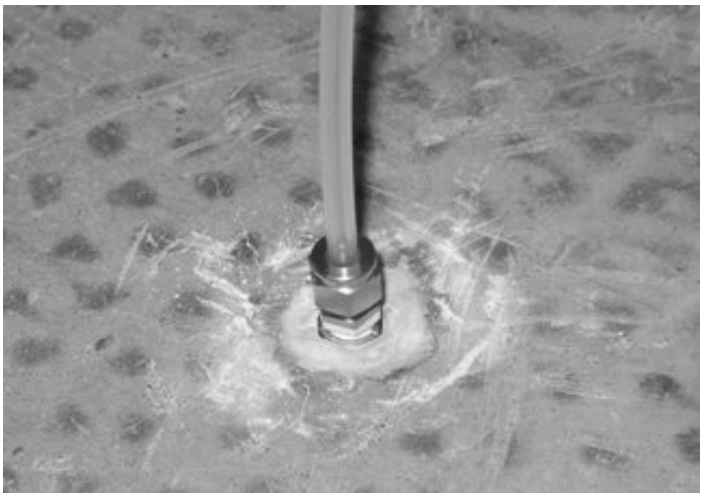


Figure 7 - Installing the helium leak check

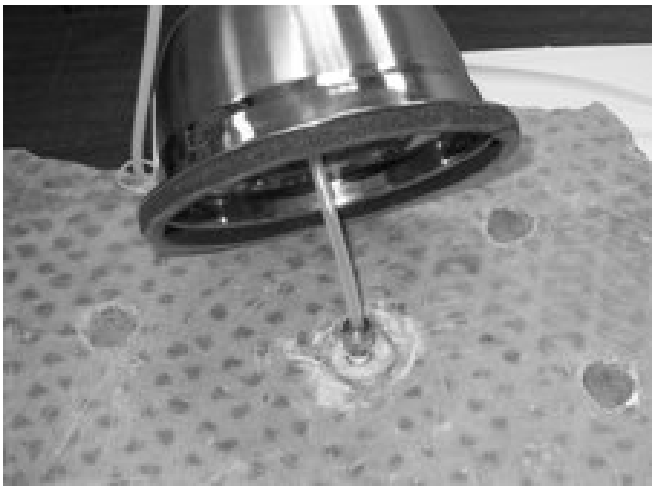


Figure 8 – Probe Parts

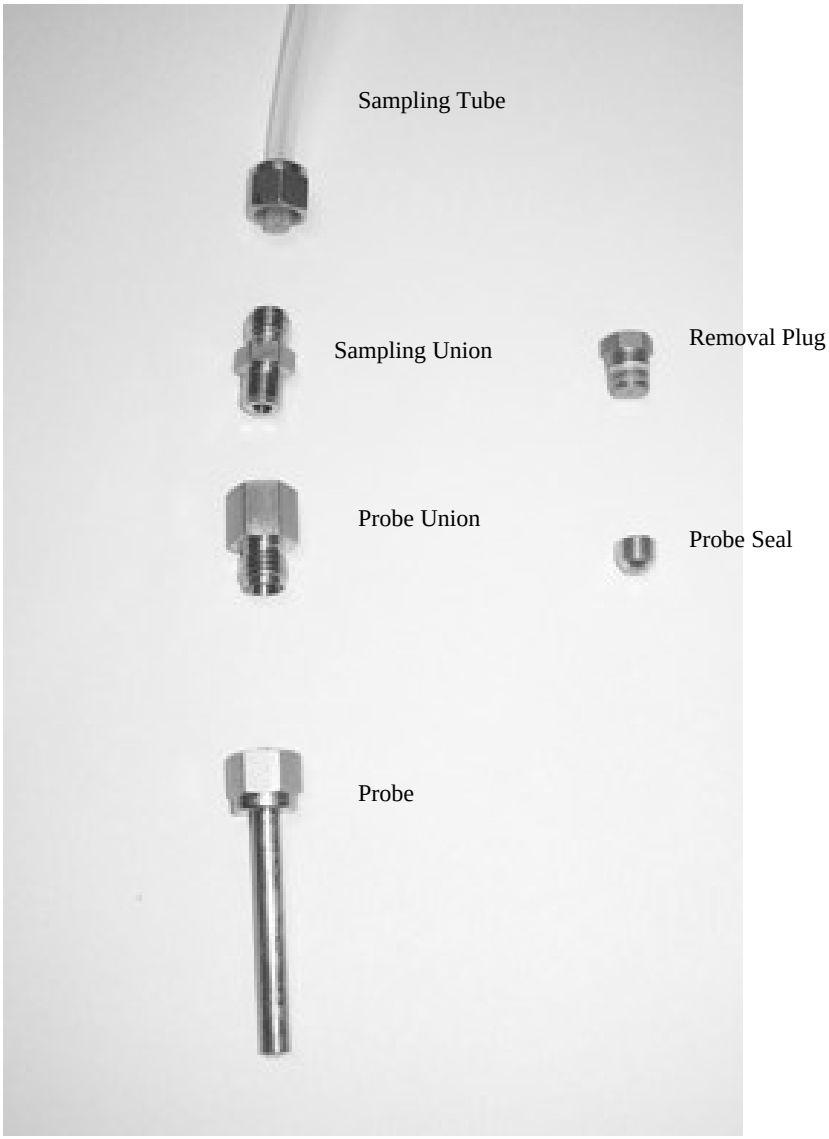


Figure 9 –Helium Leak Check Assembly

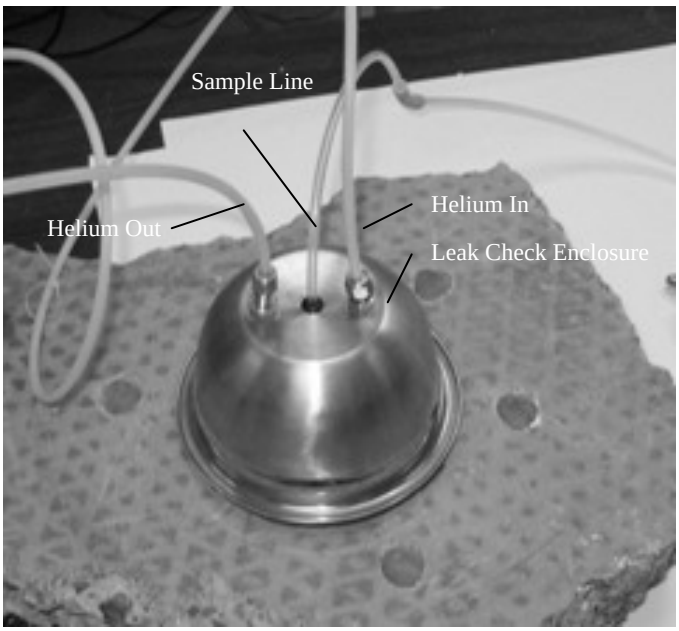
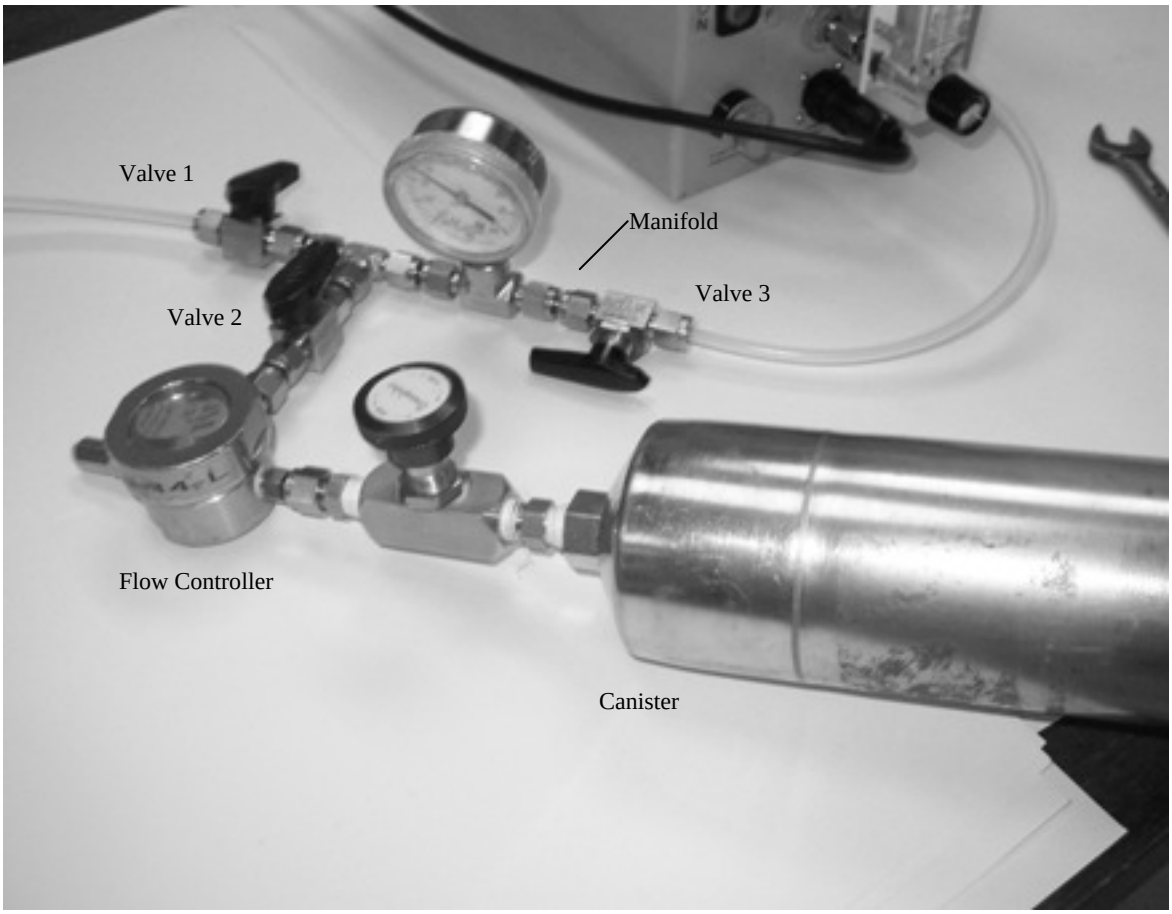


Figure 10 – Sampling Manifold



Attachment 2
Standard Operating Procedure: Integrated Ambient Indoor, Outdoor, and Crawl Space Air Sampling Method for Trace VOCs Using SUMMA™ Canisters

ANC/GS124/101400020
ES052010223303ANC

Attachment 2

Integrated Ambient Indoor, Outdoor, and Crawl Space Air Sampling Method for Trace VOCs Using SUMMA Canisters

1. Scope and Application

This sampling method describes the procedure for collecting ambient air samples for targeted volatile organic compounds (VOCs). Reporting limits for these samples are usually very low and extremely prone to positive bias from interfering VOC sources. The method presented here is based on 'clean' sampling techniques. The requirements of 'clean' sampling dictate that sampling and sample handling are done by trained personnel. A building survey must be performed before sample collection. It is the responsibility of the project team to make sure this procedure meets all applicable regulatory standards and receives approval/concurrence from the leading regulatory agency for the project.

2. Summary of Method

A sample of air is withdrawn, using clean technique, into a certified clean and evacuated SUMMA canister using a certified clean flow controller. Sample collection can be integrated over time by adjusting the flow controller. Project-specific sample periods as short as 10 minutes to as long as 24 hours can be achieved based on the size of canister used and the sampling rate selected (see Table 1). Generally, 6-liter canisters are used for ambient air sampling. In cases where the crawl space is most conveniently sampled by access through crawl space vents, a sampling probe (sample delivery line made of Teflon or stainless steel) of sufficient length is attached to the inlet of the flow controller.

3. Apparatus and Materials

3.1. Canister, SUMMA polished, certified clean and evacuated. (Canisters are typically provided by the laboratory.)

3.2. Flow controller, certified clean and set at desired sampling rate. (Flow controllers are typically provided and set by the laboratory.)

3.3. Shipping container suitable for protection of canister during shipping. Typically, strong cardboard boxes are used for canister shipment. The canisters should be shipped back to the laboratory in the same shipping container in which they were received.

3.4. Wrenches and screw driver (clean and free of contaminants), various sizes as needed for connecting fittings and making adjustment to the flow controller A 9/16-inch wrench fits the ¼-inch Swagelok® fittings, which most canisters and flow controllers have.

3.5. Negative pressure gauge, oil-free and clean, to check canister pressure. (The pressure gauges are typically provided by the laboratory.) The laboratory may either provide one pressure gauge to be used with all of the canisters, or a pressure gauge for each canister to be left on during sample collection. Sometimes the canisters are fitted with built-in pressure gauges that are not removable.

3.6. Sampling probe, new Teflon or stainless steel tubing, fitted with compression fittings. (For crawl space samples)

4. Sample Collection

4.1. 'Clean' sampling protocols must be followed when handling and collecting samples. This requires care in the shipping, storage, and use of sampling equipment. Cleanliness of personnel who come in contact with the sampling equipment is also important: no smoking, no eating, no drinking, no perfumes, no deodorants, no dry cleaned clothing, etc. Canisters should not be transported in vehicles with gas-powered equipment or gasoline cans. Sharpie markers should not be used for labeling or note- taking during sampling.

4.2. The SUMMA canisters are certified clean and evacuated by the laboratory to near absolute zero pressure. Care should be used at all times to prevent inadvertent loss of canister vacuum. ***Never open the canister's valve unless the intent is to collect a sample or check the canister pressure.***

4.3. Prior to taking indoor air samples, be sure to complete an indoor air building survey [see the vapor intrusion standard operating procedure (SOP) on Building Surveys]. When taking outdoor or crawl space samples, be sure to note on the field log any items that might bias analytical results (such as gasoline cans, garbage, fresh paint, etc.)

4.4. Inspect the canister for damage and do not use a canister that has visible damage.

4.5. Verify that the vacuum pressure of the canister is between 28 – 30 inches mercury(Hg). Do not use a canister that has an initial pressure less than 28 inches Hg because that canister likely leaked during shipment.

4.5.1. Remove the protective cap from the valve on the canister.

4.5.2. If using an external gauge, attach the gauge to the canister and open the valve. If the pressure gauge has two openings, make sure that the other opening is closed; the canister cap can be used for this. After taking the reading, close the canister and remove the gauge.

4.5.3. If using assigned pressure gauges, attach the pressure gauge to the canister, then attach the flow controller. When sample collection begins, record the initial pressure.

4.6. Flow controllers (if used) should come pre-set by the laboratory to sample at a pre-determined rate based on specific project requirements (see Table 1 for the most common options). In some cases [that is, project-specific quality assurance (QA)], the flow rate will need to be verified in the field prior to use. This is accomplished with a bubble meter, vacuum source, and instructions supplied by the laboratory.

4.7. In the field log record the canister identification (ID), flow controller ID, initial vacuum, desired flow rate, sample location information, and all other information pertinent to the sampling effort. The indoor and outdoor temperature and barometric pressure should be recorded when sampling is begun and completed.

4.8. Connect the flow controller to the canister.

4.8.1. The flow controller fitting denoted "LP" or "OUT" is connected to the canister. Tighten the fitting to be leak free but <u>do not over-tighten</u> (a ¼ turn past snug is usually enough.) When tightening the fitting, be sure that the valve assembly does not rotate by using your other hand to hold the valve steady.

4.8.2. If an assigned pressure gauge is used for each canister, the pressure gauge should be attached to the canister first and then the flow controller should be attached to the pressure gauge.

4.8.3. When the flow controller and pressure gauge are attached correctly they will not move separately from the canister (they will not spin around).

4.9. For outdoor samples, be sure that the inlet to the flow controller is protected from precipitation. Either place the canister and flow controller under a shelter/enclosure, or use a clean piece of aluminum foil to build a tent over the flow controller inlet.

4.10. For sampling in public areas, outdoor air sample canisters should be secured to an immovable structure to ensure security. A bicycle lock or piece of chain and Master lock can be used. It may be a good idea to attach a label to the canister explaining that it is an environmental sample and should not be tampered with. The label can also include contact information.

4.11. If crawl spaces are being sampled remotely through a crawl space vent, adjust the length of the sampling probe to achieve the desired sampling location and place an inert spacer

near the end of the probe to keep the probe tip opening suspended ~ 3 inches above the ground level. Now connect the sampling probe to the inlet of the flow controller.

4.12. Remove all work articles from the sampling area.

4.13. To begin sampling, slowly open the canister valve one full turn.

4.14. For canisters with built-in or assigned pressure gauges, monitor the vacuum pressure change several times during the course of the selected sample period to ensure the canister is filling at the desired rate.

4.15. At the end of the sample period, close the canister valve finger tight.

4.16. Remove the flow controller (and assigned pressure gauge) and replace the protective cap on the canister valve fitting.

4.17. If using an external vacuum gauge, re-attach it, open the canister valve, and record the final pressure. Then close the valve, remove the vacuum gauge, and replace the protective cap. Ideal pressure in the canister is between 2 - 10 inches Hg. More than 10 inches Hg can greatly increase reporting limits. No measurable vacuum can invalidate the sample. Immediately consult with the project team if either one of these conditions is encountered.

4.18. If the flow controller is going to be used for more than one sample collection, be sure to purge it between uses. To do this, attach the flow controller to a vacuum source and draw clean air or gas (ultra-high purity) through it for several minutes before attaching it to the canister.

5. Sample Handling and Shipping

5.1. Fill out all appropriate documentation (chain of custody, sample tags) and return canisters and equipment to the laboratory.

5.2. The canisters should be shipped back to the laboratory in the same shipping container in which they were received. The samples do not need to be cooled during shipment. DO NOT put ice in the shipping container.

5.3. When packing the canisters for shipment, verify that the valve (just past finger tight) and valve caps are snug (1/4 turn past finger tight), and use sufficient clean packing to prevent the valves from rubbing against any hard surfaces. Never pack the cans with other objects or materials that could cause them to be punctured or damaged.

5.4. **Do not place sticky labels or tape on any surface of the canister!**

5.5. Place a custody seal over the openings to the shipping container.

5.6. Make sure to insure the package for the value of the sample containers and flow controllers.

5.7. Ship canisters for overnight delivery.

6. Quality Control

6.1. Canisters supplied by the laboratory must follow the performance criteria and quality assurance prescribed in U.S. Environmental Protection Agency (EPA) Method TO-14/15 for canister cleaning, certification of cleanliness, and leak checking. SOPs are required.

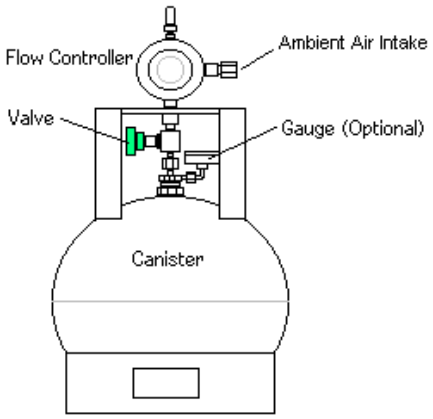
6.2. Flow controllers supplied by the laboratory must follow the performance criteria and QA prescribed in EPA Method TO-14/15 for flow controller cleaning and adjustment. SOPs are required.

Table 1 – Common Sampling Rates for Ambient Air Sampling

Can Size	Length of sampling time	Sampling Flow Rate (ml/min)
6 Liter	1 hour	90
6 Liter	8 hours	11.25
6 Liter	24 hours	3.75
1 Liter	5 minutes	180
1 Liter	1 hour	15
850 ml	5 minutes	150
850 ml	1 hour	12

FIGURE 1

Assembled Canister Sampler for Integrated Sample Collection



CH2M HILL **Applied Sciences Laboratory**

Sheet 1 of __

Ambient Air, Outdoor Air & Crawl Space Air Sampling Log (Summa Canister)

Project Information

Project Name: ..... Project # : .....

By: ..... Date: .....

Sampling Data Log

Sample Location	Field ID	Canister ID	Flow Controller ID	Initial Canister Pressure ("Hg)	Initial Flow Controller Rate (ml/min)	Start Date & Time	End Data & Time	Final Pressure ("Hg)	Final Flow Controller Rate (ml/min)

Sample Location Diagram

N

Note:

Draw in outline the structure's foundation and interior walls, identify rooms, and note other defining features. Show location of canister relative to physical objects, etc.

Other Observations and Comments (note any unique circumstances): .....

.....

Attachment 3
Standard Operating Procedure: Analysis and Collection of Subslab Soil Gas Samples for Radon Using Tedlar® Bags

Attachment 3

Procedure for the Analysis and Collection of Sub-Slab Soil Gas Samples for Radon using Tedlar Bags

This procedure offers a practical approach for the collection of subslab soil vapor samples into Tedlar bags using CH2M HILL's Air Sampler Box for field and laboratory analysis. Soil gas sample integrity is verified by using a real time helium leak checking procedure. When Tedlar Bag samples are collected in coordination with Summa Canister, this SOP should be used in conjunction with CH2M HILL's SOP: "Standard Operating Procedure for the Collection of Sub-Slab Vapor Samples Using Summa™ Canisters" and consistent with the projects data quality objectives. It is the responsibility of the project team to make sure this procedure meets all applicable regulatory standards and receives approval/concurrence from the leading regulatory agency for the project. Only persons trained in the collection of soil gas samples should attempt this procedure.

Note: For this entire process to work, the vacuum in the system must not exceed 5" Hg. Both the Gem 2000 and the Tedlar bag inside the Air Sampler Box will not operate properly at a vacuum greater than 5" Hg.

1. System Set-up

1.1 Acquire all the necessary hardware and sampling equipment.

1.2 Assemble or obtain the necessary fittings and vacuum gauge to create a soil gas probe (see CH2M HILL's SOP: "Standard Operating Procedure for the Collection of Sub-Slab Vapor Samples Using Summa™ Canisters") and sampling manifold. This manifold must be clean, free of oils, and flushed free of VOCs prior to use. Note: use only gas tight fittings such as Swagelok or equivalent. Be sure to place the helium leak check enclosure over the probe, and push the sample tubing through the hole in the cap before attaching the sampling manifold. It is critical that all **sample tubing have a ¼" outside diameter**.

1.3 Adjust the purge system evacuation pump sampling rate to achieve the desired flow rate of 200 milliliters /min.

2. System Leak Checking & Purging

2.1 Make sure the sampling system is assembled. The leak check enclosure is placed over the sample probe prior to connection of the sample line to the sampling manifold and the purge system.

2.2 ***System Purge and Helium Leak Check*** -A purge of the soil gas probe and sampling manifold system is required. The helium leak check procedure is also performed during this step. This is accomplished by:

2.2.1 Where the ground surface is soft, the helium leak check enclosure is pressed down slightly into the ground surface. In situations where the ground surface is hard (e.g. asphalt), apply a slight downward pressure to achieve a build up of helium in the leak check enclosure.

2.2.2 Start the flow of helium into the side of the leak check enclosure at 200 ml/min. Let the helium fill the enclosure for a couple of minutes.

2.2.3 Turn the helium leak detector on and make sure that the detector is not giving a helium reading before starting the purge. Place the probe of the helium detector in the exhaust port of the flow meter.

2.2.4 Purging is carried out by pulling soil gas through the system at a rate of 200 milliliters /min for a time period sufficient to achieve a purge volume that equals

at least 3-5 dead volumes (internal volume of the in ground annular space, sample line, and sampling manifold system).

2.2.5 Open the Teflon valve and start the purge pump. Verify that the flow rate is still 200 ml/min. Record the start time.

2.2.6 During the purge, observe the helium detector for indication of soil gas probe leakage (e.g. infiltration of ambient air into the probe). If a helium reading of >1% is observed, then the probe leak check has failed and corrective action should be taken. This includes first checking the fittings and connections and trying another purge and leak check. It may also result in removing the soil gas probe and re-installing it in a nearby location.

2.2.7 If the vacuum gauge reads >5" Hg during the purge, then the vacuum will be too great for the Gem 2000 or the bomb box sampling. There are three things to consider before continuing.

2.2.7.1 The soil formation is too 'tight' (i.e. high clay or moisture content). Try a different depth or location

2.2.7.2 With a GeoProbe style probe system, the expendable tip may not have released when the probe was retracted. Try retracting the probe a little further, or using a long thin rod to poke the tip loose.

2.2.7.3 If water is visible in the flexible soil gas tubing, stop the purging immediately. It is not possible to take a soil gas sample at that depth or location.

2.2.7.4 When in doubt, consult with the project manager/team to determine the appropriate course of action.

2.2.8 At the end of the pre-determined purge time (usually around a couple minutes) and after the system is verified to be leak free, close the Teflon valve. Do not open it again. Doing so will result in loss of the purge integrity and requires re-purging. Turn off the pump and the helium leak detector.

2.2.9 Record the purge time, purge rate, leak check result, and purge volume on the field sampling log.

2.2.10 Immediately move on to the sampling phase. Little to no delay should occur between purging and sampling.

3 Radon Sampling via Air Sampler Box

3.1 Open the Air Sampler Box and attach a Tedlar bag to the flexible hose in the Air Sampler Box.

3.2 Attach the 'Sample In' port on the Air Sampler Box to the manifold valve. Attach the pump and flow meter to the 'To Vacuum' port of the Air Sampler Box. Be sure to use 2 wrenches to tighten the fittings so that bulkhead fitting does not rotate on Air Sampler Box resulting in a leak.

3.3 Open the valve on the Tedlar bag one turn. Then close and latch the Air Sampler Box.

3.4 Open the manifold valve and start the pump. The 1 liter bag should take approximately 5 minutes to fill at 200 ml/min

3.5 Record the start time. During sampling, be sure to watch the flow meter on the pump to make sure the flow rate remains consistent at 200 ml/min. Adjust the flow if necessary.

3.6 When the bag appears to be full (around 5 minutes), close the manifold valve and turn the pump off. Record the final time an average flow rate of the sampling.

3.7 Disconnect the 'To Vacuum' fitting to allow the pressure to return to ambient in the Air Sampler Box.

3.8 Open the Air Sampler Box and close the valve on Tedlar bag. Remove the Tedlar bag from the Air Sampler Box

4 Sample Handling and Shipping

4.1 Pack the Tedlar Bag samples in a rigid wall shipping container such as a cooler or heavy duty cardboard box (ice is not required). Never pack the bags with other objects or materials that could cause them to be punctured or damaged.

4.2 Make sure the bags are 50-75% full. Too low, and there may not be enough volume for analysis. Too high, and the bag may rupture due to reduced cabin pressure in a cargo aircraft.

4.3 Place a custody seal over the openings to the shipping container.

4.4 Ship immediately to the laboratory for analysis.

4.5 Call the laboratory and notify them of the number of samples that are coming.

CH2M HILL Air Sampling Contacts:

Ben Thompson 541-760-9738 (Cell)
John Dollhausen 541-768-3149 CH2M HILL ASL Lab Number

Attachment 4
Standard Operating Procedure: Collection of Indoor Air and Outdoor Ambient Air Samples for Radon Using Tedlar® Bags

Attachment 4

Procedure for Collection of Indoor Air and Outdoor Ambient Air Samples for Radon using Tedlar Bags

This procedure offers a practical approach for the collection of Indoor Air and Outdoor Ambient Air samples into Tedlar bags using CH2M HILL's Air Sampler Box for field and laboratory analysis. It is the responsibility of the project team to make sure this procedure meets all applicable regulatory standards and receives approval/concurrence from the leading regulatory agency for the project. Only persons trained in the collection of air radon samples should attempt this procedure.

Note: For this entire process to work, the vacuum in the system must not exceed 5" Hg. The Tedlar bag inside the Air Sampler Box will not operate properly at a vacuum greater than 5" Hg.

1. Radon Sampling via Air Sampler Box

1.1. Open the Air Sampler Box and attach a Tedlar bag to the "Sample in" flexible hose in the Air Sampler Box.

1.2. Turn the Air Sampler Box pump on and set the pump timer to approximately 5 minutes.

1.3. Open the valve on the Tedlar bag one turn. Then close and latch the Air Sampler Box.

1.4. Record the sample start time. During sampling, be sure to periodily check to make sure that the air is flowing into the Tedlar bag and that the bag is filling.

1.5. When the bag appears to be 75% full (around 5 minutes), open the Air Sampler Box, close the Tedlar bag valve, and turn the pump off if still running. Record the sample stop time.

1.6. Disconnect the Tedlar Bag sample from the Air Sampler Box and remove the Tedlar bag sample.

2. Sample Handling and Shipping

2.1. Pack the Tedlar Bag samples in a rigid wall shipping container such as a cooler or heavy duty cardboard box (ice is not required). Never pack the bags with other objects or materials that could cause them to be punctured or damaged.

2.2. Make sure the bags are 50-75% full. Too low, and there may not be enough volume for analysis. Too high, and the bag may rupture due to reduced cabin pressure in a cargo aircraft.

2.3. Place a custody seal over the openings to the shipping container.

2.4. Ship immediately to the laboratory for analysis.

2.5. Call the laboratory and notify them of the number of samples that are coming.

CH2M HILL Air Sampling Contacts:
Ben Thompson 541-760-9738 (Cell)
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