STATE OF TENNESSEE

DEPARTMENT OF ENVIRONMENT AND CONSERVATION

DIVISION OF UNDERGROUND STORAGE TANKS

TECHNICAL GUIDANCE DOCUMENT - 018

EFFECTIVE DATE – January 1, 2008

RE: REQUIREMENTS FOR CONDUCTING SOIL GAS SURVEYS

I. General Guidance

A. Purpose

The purpose of this Technical Guidance Document (TGD) is to establish a standard for conducting soil gas sampling. The collection of soil gas data will aid in determining whether the measured subsurface soil gas vapor levels for each Chemical of Concern (COC) that exceeded the approved site-specific cleanup levels (SSCLs) pose an indoor air risk to the occupants of on-site structures.

B. Fund Eligibility/Coverage

An eligible owner or operator conducting UST corrective actions is entitled to coverage of reasonable costs from the Tennessee Petroleum Underground Storage Tank Fund, subject to rule 1200-1-15-.09(10)(a), which states:

> Upon confirmation of a release in accordance with rule 1200-1-15-.05(3) or after a release from the UST system is identified in any other manner, owners and/or operators or petroleum site owners shall comply with the requirements of rule 1200-1-15-.06 as necessary to investigate the release, characterize the site and control any hazards posed by the release in order to stabilize the site, prevent significant risk to human health and safety, and/or continuing damage to the environment.

Additionally, rule 1200-1-15-.06(5)(a)3 states:

> The Division may require the installation of more than four (4) soil borings and/or monitoring wells for site characterization and/or risk assessment. This may be done during the initial site characterization or at any time subsequent thereto.

Therefore, failure to comply with the requirements of this TGD may result in the loss of Fund coverage.

C. Applicability

The purpose of soil gas sampling is to evaluate the volatilization to indoor air pathway for sites that have completed a risk assessment, have SSCLs approved by the Division of Underground Storage Tanks (Division), and have soil and/or ground water contaminant concentrations that exceed the approved SSCLs. Soil gas sampling may be performed on other sites as directed by the Division. Soil gas sampling is not applicable if soil contamination that exceeds the SSCLs is shallower than three (3) feet from the ground surface or if the static ground water level is within three (3) feet of the ground surface at the time of the soil gas survey. This TGD may be used to satisfy the requirements of rule 1200-1-15-.06(8) regarding Interim Remediation and/or Risk Management.

Quantitative soil gas data is needed to evaluate risk to human health and the environment. Therefore, soil gas sampling shall be conducted in accordance with the protocol described in this TGD. If extenuating circumstances make application of this protocol impractical, then departures from this guidance must be specifically detailed in writing and may be implemented only with prior Division approval.

Rule 1200-1-15-.06(1)(b)1(i) requires one working day notice of routine field activity by owners/operators.

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Attachments

Soil Gas Survey Application
Soil Gas Sampling Report
Soil Gas Survey Field Log

Resources necessary to complete a Soil Gas Survey Application and Report

TN Soil Gas Cost Proposal (Excel spreadsheet)
TN Soil Gas Lookup Table (Excel spreadsheet)

Excel® spreadsheets are available for download at http://state.tn.us/environment/ust/

II. Definitions

For the purposes of this TGD only, the following definitions apply:

Expendable Probe Point – A non-recoverable nylon or metal tip that is connected to rigid tubing and is left in place after the soil gas sample is collected.

Probe – The subsurface portion of the vapor extraction device (including attached subsurface tubing) that is installed within the vadose zone for the primary purpose of obtaining a soil gas sample.

Retractable Probe Point – A recoverable metal tip that is connected to a drive rod and is removed after the soil gas sample is collected.

Sample Train – A device constructed of tubing, couplings, tees, and stopcocks that when assembled will connect the purge device and sample collection canister to the probe.

Tracer Compound – Isopropanol (2-Propanol, 70 % rubbing alcohol)

III. Preliminary Site Evaluation

A. Source Identification

Determine the location(s) where COC concentrations exceeded the approved SSCLs for soil and/or ground water. For the purpose of this TGD, these locations represent the source area(s). If soil and/or ground water contaminant concentrations exceed the approved SSCLs in distinct and separate areas, then each source area shall be treated as separate sources and evaluated with separate soil gas probes.

B. Receptor Identification

Identify on-site buildings and determine their foundation types. Most UST sites will have a slab-on-grade building; however, some sites will occasionally have basement or crawl space foundations. If no buildings are currently located on the site, then for the purpose of evaluating risk, assume that a slab-on-grade building will be constructed directly above the identified source area(s) as determined in Section III.A. Circumstances or facts that would affect the type and/or location of an assumed receptor that are not consistent with this protocol should be discussed with the Division case manager prior to soil gas sampling.

IV. Soil Gas Probe Location, Construction, and Installation

A. Location and Number of Soil Gas Probes (probes)

Prior to proposing soil gas probe location(s), local city and/or county zoning officials shall be contacted to delineate the site-specific building setback requirements pursuant to current zoning restrictions, utility easements, right-of-ways, access to or from the property, etc. Probes shall not be located within the building setback areas except when placing perimeter probes, where necessary, around an existing onsite structure located within these setback areas (i.e., grandfathered structure).

Probes should not be installed within forty-eight (48) hours of a significant precipitation event [e.g., one-half (0.5) inch or more of rain within a twenty-four (24) hour period]. If the proposed date of the soil gas survey changes, then the Division must be given adequate notification of the new date. Probe locations should be adequately distributed to allow accurate characterization of soil gas concentrations adjacent to receptors and in the source area(s). The actual number of probes necessary for a given site will depend upon the size and number of existing receptors/structures, and the location of the receptors/structures relative to the soil and/or ground water contamination. Up to eight (8) probes may be installed. If more than eight (8) probes and/or one-day of field work are proposed, then justification is required. Probe locations and number shall be based on the following criteria:

1. Source Area(s) – Up to four (4) probe(s) may be installed in the source area. Source area probes shall be located immediately adjacent to any sample location where maximum soil and/or ground water contaminant concentrations exceed the approved site-specific cleanup levels. The probe location(s) should also be at least five (5) feet outside any excavation area(s) that have been backfilled with gravel or sand.

2. Receptors – Up to seven (7) probe(s) may be installed adjacent to existing or potential structures. Receptor probe location(s) shall be either three (3) feet from a slab-on-grade structure, or five (5) feet from a structure with a basement or crawl space foundation. Receptor probes should be located along the side of any existing structure that is adjacent to, and/or immediately hydraulically down gradient from, soil or ground water contamination. If any wall of a structure exceeds fifty (50) feet in length, then a minimum of two (2) sampling points are required along that wall.

   If no structure is present, then for the purpose of evaluating risk, assume that a slab-on-grade structure will be built above the source area. The future structure shall be evaluated by locating probes in accordance with Section IV.A.1. However, if a structure cannot be constructed above the source area because of existing zoning restrictions, utility easements, right-of-ways, access to or from the property, etc., then contact the Division case manager for guidance.

3. Subsurface Utilities – One (1) probe may be installed adjacent to each utility trench (e.g., water, sewer, electric, etc.) that crosses the source area(s) and then intersects a structure, thus providing a potential vapor pathway to the structure. The probe location shall be approximately three (3) feet from the utility trench **and** at least three (3) feet from a slab-on-grade structure or five (5) feet from a basement or crawl space foundation. The probe shall not be installed in the utility trench backfill. If no subsurface utilities provide a vapor pathway between the source area and a structure, then probes are not required near utility trenches.

B. Probe Installation – Maximum Depth

The depth of each soil gas probe shall be consistent between sampling locations. Probe depth shall be based on the type of receptor/structure that is present.

1. If the only receptors being evaluated are slab-on-grade or crawl space structures, or if no structure is currently present, then the probe depth at each sample location shall be three (3) feet.

2. If a receptor with a basement is being evaluated, then a probe shall be installed for each sample location at a depth of three (3) feet and ten (10) feet, respectively. If ground water is encountered at a depth between four (4) and ten (10) feet, then an additional probe shall be advanced to, and sampled at, a depth of two (2) feet above the ground water surface.

C. Probe Installation Specifications

1. Locating Utilities – Prior to probe advancement activities, utility clearance shall be obtained by contacting Tennessee One Call and all applicable utility companies.

2. Probe Construction Materials – The materials used shall not interact with petroleum vapors. Typical installation materials are steel or stainless steel. Probe tips are typically stainless steel and provide for a removable screen mesh that is inserted between the probe tip and drive rod prior to installation. For sites that have clay soils, the screen may not be necessary and if used, may interfere or prevent the drive rod and probe tip from separating when the drive rod is extracted.

3. Decontaminating Materials – Prior to probe installation, all metal portions of the soil gas probe shall be thoroughly cleaned in accordance with the decontamination protocol outlined in the Environmental Assessment Guidelines. All new metal probe components shall be cleaned prior to sampling to remove any residual oils that may have been used during the manufacturing process.

4. Tubing – Nylon tubing with an outside diameter no greater than 3/8-inch and no less than 1/8-inch shall be used to connect the probe point to the sample train. If necessary, reducer fittings may be used to connect the tubing to the sample train. The portion of tubing extruding from the top of the soil gas boring should be between one (1) and two (2) feet in length.

5. Surface Seal – A surface seal of clean, petroleum-free modeling clay, or hydrated bentonite with a consistency of modeling clay, shall be made between the ground surface (e.g., soil, asphalt, concrete, or gravel) and the tubing and/or drive rod.

6. Probe Advancement Technologies – Probes may be installed using either a direct push method or a hand-driven method such as a rotary hammer or a slide-hammer. Completion of the sampling point shall vary with the chosen installation technique as described below.

    a. Rotary Hammer Drill Kit – An electric powered rotary-hammer drill may be used to drive an expendable probe point to the target depth. Prior to advancing the probe, new rigid tubing shall be attached to the expendable point holder and threaded through the drive rod. The tubing will be advanced through the drive rod as the rod is advanced. The expendable probe point shall be a slightly larger diameter than the rod. All

connections shall be air-tight. After advancing the probe point to the target depth, the drive rod shall be retracted three (3) inches.

b. Direct Push Technology – Direct push may be used to push an expendable or retractable probe point to the target sampling depth. If expendable probe points are used, then the points shall be of similar diameter to the drive rod to prevent creation of a void space between the probe point and the wall of the soil boring. After advancing the probe point to the target depth, the drive rod shall be retracted three (3) inches. An adapter shall be connected to the rigid tubing and then advanced through the drive rod and securely threaded to the probe point. If the design utilizes o-rings, then all o-ring seals between the expendable probe point and the probe point holder, and/or between the probe point holder and probe point holder adaptor, shall be replaced between soil gas sampling locations. All connections shall be air-tight.

Retractable probe points may be used with direct push technology provided the probe point is not of a greater diameter than the drive rod, and provided the retractable point is thoroughly cleaned between probe installations.

c. Slide-hammer – Slide-hammer installation may be used in areas inaccessible by power driven techniques. A hammer drill may be used to drill through asphalt, concrete, or other impenetrable surface material prior to use of the slide-hammer.

A steel drive rod hammer is inserted into a 6-foot piece of clean, half (1/2)-inch diameter metal conduit. The referenced conduit should be constructed of thin walled galvanized steel instead of plastic, which may collapse during the driving process. The drive rod diameter shall be slightly smaller than the inside diameter of the conduit. The drive rod shall extend a minimum of three (3) inches below the bottom of the conduit so that when the conduit is advanced to the target depth, removal of the drive rod leaves at least a three (3) inch section of soil open for soil gas to migrate into the conduit. A short piece of flexible tubing should be clamped to the top of the conduit after the slide hammer drive rod is removed. The sample train should then be connected to the tubing using a reducer. All connections shall be air-tight.

d. Other methods as approved by the Division.

D. Sample and Purge Assembly

The configuration of sample trains, including the layout of the regulator, vacuum gauge, and purge equipment, shall conform to the photograph provided in Figure 1 using a SUMMA® canister or Figure 2 using a syringe and purge port. Additional figures are attached which show various types of equipment. Alternate configurations will require prior approval from the Division. Plastic quick connect fittings and new nylon tubing shall be connected in such a manner to insure a vacuum tight system. **A separate sample train is required for each probe location.** No above ground equipment, except the purging device, can be re-used between sample collection locations.

1. Sample Train – A separate, one-time use, tubing train, constructed of rigid 1/4-inch outside diameter nylon tubing and plastic quick connect fittings, shall be provided for each probe location. Swagelok® fittings can be used to connect the purge and/or sample collection device to the rigid tubing. Alternatively, flexible tubing segments may be used and should be no longer than two (2) inches so as to reduce the possibility of collapsing the flexible tubing during purging and sample collection. A shorter piece of flexible tubing will also reduce the likelihood of the tracer compound permeating the flexible tubing. If possible, the components that are inserted into the flexible tubing should be inserted so that the components are almost touching. It is recommended that all sample trains be assembled prior to arrival at the site to avoid potential cross contamination. All tubing trains shall be discarded between sampling locations to prevent cross contamination. Vinyl tubing shall not be used.

2. Purge System – The purge system, which is connected to the sample train, shall consist of a vacuum pump, vacuum regulator (if necessary), and a vacuum gauge. The vacuum pump may be either a hand pump that can be manually regulated or an electric pump that requires a regulator. The regulator for the vacuum pump shall not be the same regulator that is attached to the sampling device. The purging flow rate shall not exceed 200 mL/minute.

3. If a syringe, complete with a stopcock and purge port, is used in conjunction with on-site analysis, then 1/8-inch outside diameter tubing may be connected to the probe using an appropriate reducer fitting. If a syringe is used, then the sampling train and purge system detailed in Section IV D. 1. and 2., above, are not applicable.

4. Sample Collection Equipment – A dedicated, lab supplied, sample collection container **and** regulator shall be used for **each** sample location. The sample collection container is typically a 1-Liter SUMMA® canister. **The laboratory shall supply a minimum of 2 additional sample collection containers and regulators in case a malfunction with a sample collection container or component occurs.** Examples of specific equipment failure are SUMMA® canisters that have lost vacuum, regulators that malfunction, and/or vacuum gauges that are not functioning properly. If a malfunction is suspected after initiating sample collection, then continue to collect the sample for a maximum of 30-minutes and then repeat the sample collection process with a new sample train and sample collection container.

E. Surface Completion for Subsequent Sampling Events

In most applications, soil gas probes will be abandoned the same day they are installed; however, in some instances subsequent sampling events may be required. In these instances, with prior Division approval, the probes may be properly secured, capped, and completed to prevent infiltration of water or ambient air into the subsurface and to prevent accidental damage or vandalism. If applicable, the following components shall be installed:

1. Plastic quick connect stopcock for capping the vapor tubing; and

2. Protective flush mounted or aboveground well vaults.

F. Probe Abandonment

After obtaining the soil gas sample at each sampling location, all equipment that can be removed from each sample location shall be removed. If the tubing cannot be removed, then it shall be cut flush with the surface and plugged to prevent surface water infiltration. The probe boring shall be filled with powdered bentonite to the maximum extent practicable and then hydrated. If the probe is installed through asphalt or concrete, then asphalt or cement grout may be used to finish the upper six (6) inches of the probe boring.

V. Purging, Vacuum Testing, Tracer Application, and Sample Collection

A. Probe and Sample Train Purging

Prior to obtaining a soil gas sample, the probe and sample train shall be purged to ensure that the collected soil gas samples are representative of subsurface conditions. The following purge procedure shall be followed:

1. Use a pair of new disposable latex gloves before handling any equipment, tubing, etc.

2. Complete all above ground connections from the probe and sample train to the vacuum system, regulator, and sample container.

3. Calculate the volume of the sample train by summing the volume from the probe tip to the purge and sampling device.

4. Purge the system until a minimum of three system volumes have been evacuated. Purging should be conducted at low flow rates (i.e., 200 mL/minute or less) and be under vacuum conditions similar to those used during sample collection. A purging flow rate of 200 mL/minute or less, will reduce the potential of stripping volatiles from the soil and/or ground water and will reduce the likelihood of drawing ambient air into the sample train.

B. Vacuum Testing

Leakage resulting from loose fittings, etc., during soil gas sampling may decrease or increase sample analytical concentrations. A decrease in sample concentrations can occur when ambient air enters the sample system, whereas an increase can occur when external contaminants enter the sample system. Therefore, to insure the integrity of the sample results, a vacuum test shall be performed <u>each time</u> a soil gas sample is collected. The procedures required to perform a vacuum test are listed below.

1. Complete system purging in accordance with Section V.A.

2. With the stopcock closest to the probe closed, perform a vacuum test on the sample train. Apply a minimum of ten (10) inches of mercury vacuum on the sample train. A passing vacuum test occurs if no vacuum loss is observed after two (2) minutes.

3. If the test fails, then check/repair connections, re-purge the system, and retest the system until a passing vacuum test result is obtained. Replace the sample train if repeated vacuum tests fail.

C. Tracer Application

In addition to the vacuum test specified in Section V.B., the application of a tracer shall be performed each time a soil gas sample is collected to help insure the integrity of the sample results. The procedures required to apply a tracer are listed below.

1. Isopropanol (70 % rubbing alcohol) shall be used as a tracer to determine if leaks are present in the soil gas sampling system.

2. After performing the vacuum test described in Section V.B. and immediately before obtaining the sample, loosely apply a new paper towel around the tubing where it exits the ground surface.

3. Lightly dampen the paper towel with the tracer. Do **not** saturate the paper towel. Use a small spray bottle or syringe to apply a minimal amount of liquid tracer. Do not pour the tracer directly from the bottle onto the paper towel.

4. Replace the latex gloves used to apply the tracer with a new pair of latex gloves, before proceeding with sample collection.

D. Sample Collection

1. If the soil gas samples are analyzed using an off-site fixed laboratory, then samples shall be collected in a 1-liter or smaller sample canister (e.g., a SUMMA® canister or other approved, metal sample collection device). The laboratory providing the sample containers shall certify that the sample containers and flow regulators are free of contaminants.

   If the samples are analyzed using an on-site mobile laboratory, then samples shall be collected in gas-tight 300-cc syringes equipped with stopcocks. Syringes shall not be used if the samples are to be analyzed using an off-site fixed laboratory.

2. Sample Collection Flow Rate – If sample canisters are used to obtain the soil gas samples, then a separate laboratory-supplied regulated flow meter shall be utilized to control sample flow rates. A different laboratory supplied flow regulator shall be used for each sample location. The flow regulator shall be placed in accordance with Figure 1 and the sample collection flow rate shall not exceed 200 mL/min for each sample location. The lab will specify the sample collection time necessary to fill the sample container. **The minimum draw time preset by the laboratory for this procedure shall not be less than five (5) minutes. The maximum draw time preset by the laboratory for this procedure shall not exceed thirty (30) minutes.**

3. Sample Collection Order – Soil gas samples shall be collected in the following order. Start at the location assumed to have the lowest soil gas contaminant levels, followed by the location assumed to have the second lowest

concentrations, and so forth, ending with the sample location assumed to have the highest soil gas contaminant concentrations based on in-situ concentrations.

4. Sample Collection Procedure

   a. Open the probe and vacuum stopcock and perform purging as described in Section V.A. After purging, close the probe stopcock.

   b. If water droplets are observed inside the sample train during the purging or sampling process, then stop sample collection and note the presence of water. Sample locations with water are not acceptable.

   c. Complete vacuum testing in accordance with Section V.B.

   d. Apply paper towel and tracer in accordance with Section V.C

   e. Replace the latex gloves used to apply the tracer with a new pair of latex gloves, before proceeding with sample collection.

   f. For sample syringes, open the probe stopcock to extract the sample. Once the sample has been collected, close the same stopcock. Immediately label the syringe with sample identification information. Use a ballpoint pen for labeling. Do not use a pen or marker that contains alcohol or other volatile chemicals.

   g. For sample canisters, open the probe stopcock and then open the sample valve on the canister to allow the soil gas sample to be collected. After the sample collection time provided by the lab has lapsed, close the sample valve and disconnect the sample canister. Immediately label the canister with sample identification information. Clearly identify samples collected from source areas or any other sample location where indication of high concentrations are suspected and/or known. Use a ballpoint pen for labeling. Do not use a pen or marker that contains alcohol or other volatile chemicals.

   h. Store all sample containers out of direct sunlight and do not chill.

   i. All personnel are to use new disposable gloves for each sample collection location to prevent possible cross-contamination.

   j. Proceed to the next sample location and repeat Section V.

   k. One field duplicate sample is required for each sampling event. Following the same sampling protocol detailed above, the duplicate sample shall be collected at the sample location presumed to have the highest soil gas contaminant concentrations.

VI. Laboratory Analysis

A. On-site and Off-site Sample Analysis

Soil gas samples may be analyzed either off-site at a fixed laboratory, or on-site in a mobile laboratory. If the samples are transported to an off-site laboratory, then the samples shall be transported via ground carrier and **not** shipped on ice or in a refrigerated container.

B. Sample Parameters

The following parameters will be analyzed for all samples collected during the survey.

1. Chemicals of Concern (COCs): Benzene, Toluene, Ethylbenzene, Xylenes, MtBE, and Naphthalene. **Only analyze for those COCs that exceeded the approved site-specific standard.**

2. Leak Tracer Compound: Isopropanol (2-Propanol, 70% rubbing alcohol)

3. Biological Parameters: Oxygen and Carbon Dioxide

C. Analytical Methods

1. Fixed laboratory analysis**:** The COC analysis using gas chromatography shall follow Method TO-15.

   On-site laboratory analysis**:** The laboratory shall use the Test Methods for Evaluating Solid Waste, SW-846. The COC analysis using gas chromatography shall follow Method 8260.

   All method detection limits must be below the applicable residential and/or commercial target concentrations listed in Table 1 Analytical Results of the Soil Gas Sampling Report.

   Other laboratory methods may be used only if prior approval from the Division is obtained. Regardless of the selected laboratory method used, the laboratory detection limits for each COC must be lower than the applicable residential and/or commercial target concentrations listed in Table 1 Analytical Results of the Soil Gas Sampling Report.

2. The laboratory shall provide adequate and complete Quality Assurance and Quality Control (QA/QC) data for each analysis. QA/QC data shall be developed in accordance with the provisions of the analytical method used.

Figure 1 – Example Sample Train with 1-Liter SUMMA® Canister

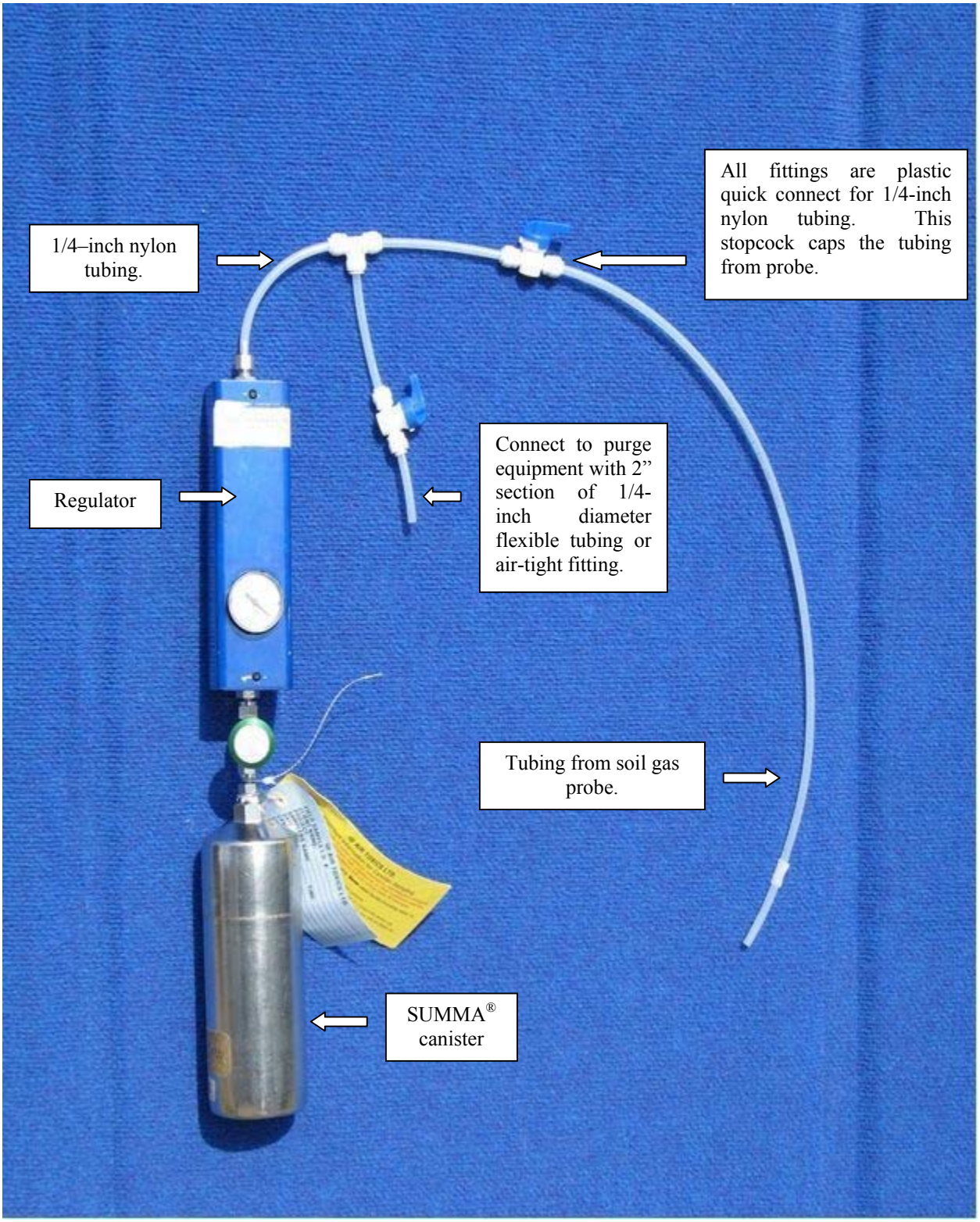


Figure 2 – Example Sample Train with 300-cc Syringe and Purge Port

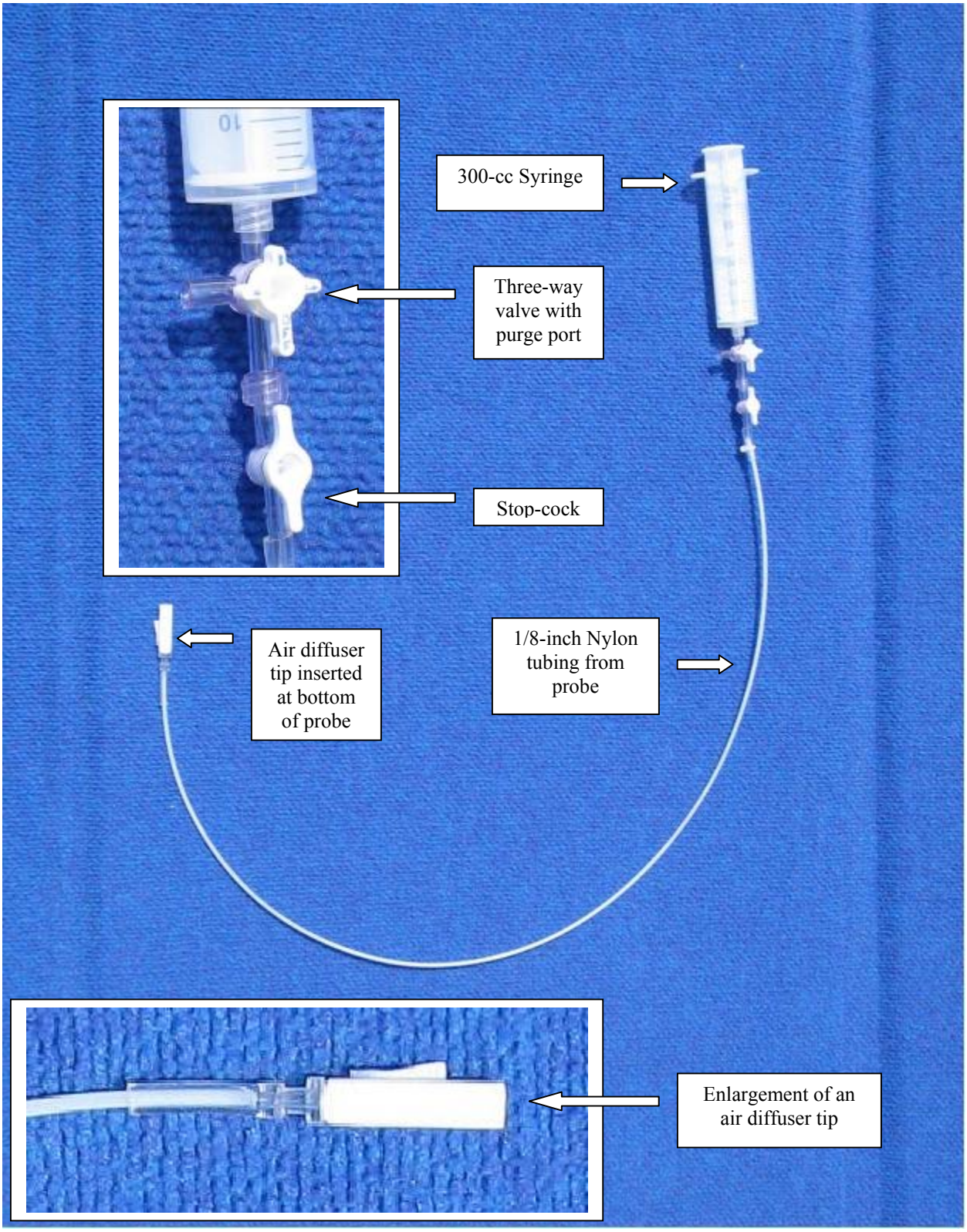
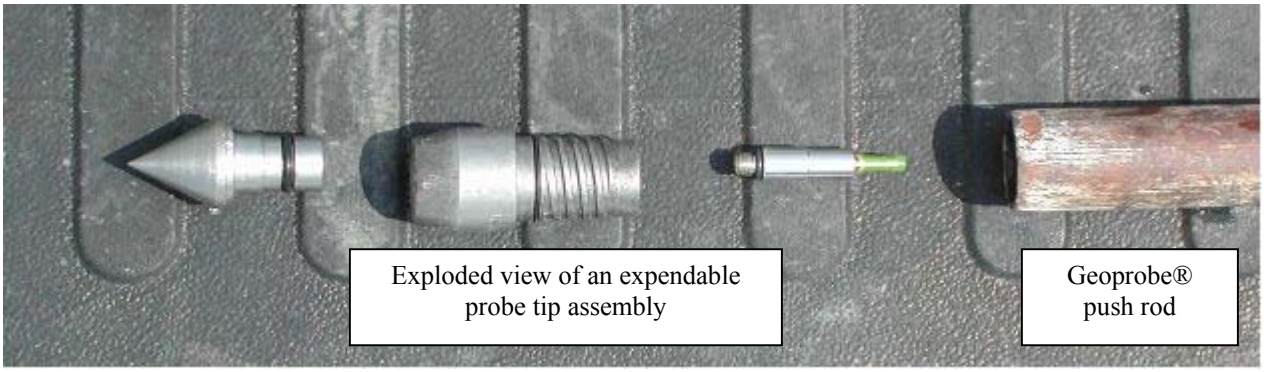
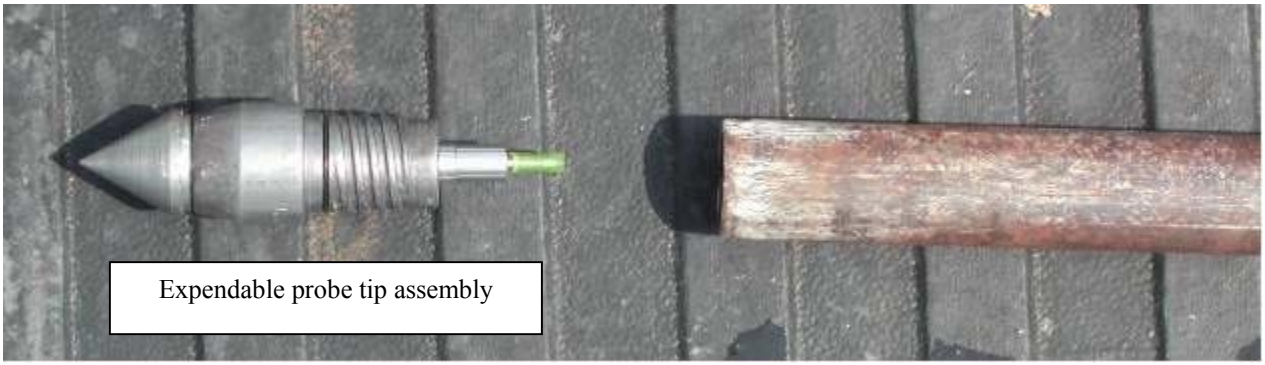


Figure 3 – Examples of Specific Equipment





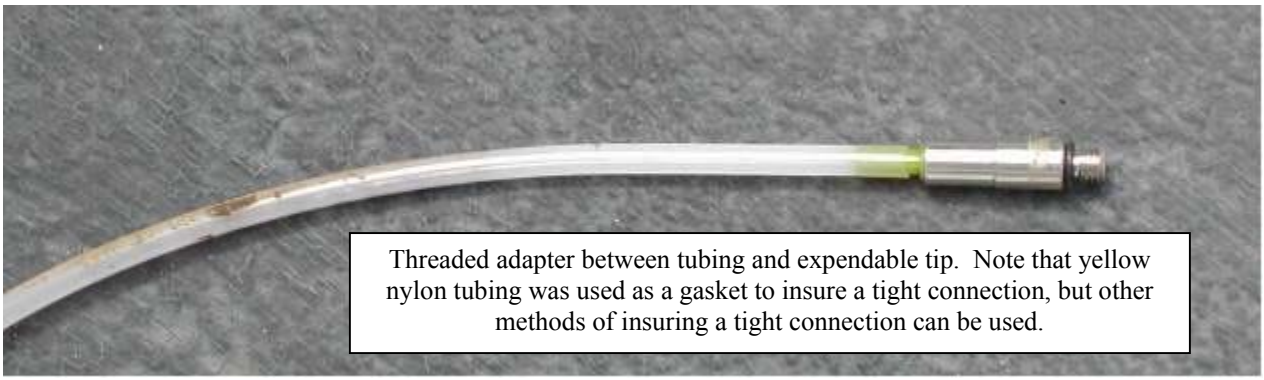


Figure 4 – Examples of Specific Equipment

Mechanical vacuum pump

Spray bottle containing 70% isopropyl alcohol

Ready-to-use SUMMA® canisters, regulators, and sample trains

References

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U.S. Environmental Protection Agency, 2002, *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway From Groundwater and Soils (Subsurface Vapor Intrusion Guidance)*, November 2002.

STATE OF TENNESSEE

DEPARTMENT OF ENVIRONMENT AND CONSERVATION

DIVISION OF UNDERGROUND STORAGE TANKS

SOIL GAS SURVEY APPLICATION

Effective January 1, 2008

The underground storage tank owner/operator shall complete and submit an original Soil Gas Survey Application to the appropriate Environmental Field Office for approval thirty (30) days prior to performing the soil gas survey. A duplicate copy of the application shall be sent to the Nashville Central Office. Any proposed changes that deviate from the requirements set forth in TGD-018, should be discussed with the Division case manager prior to submittal of the application. No activities associated with performing the soil gas survey shall be conducted **before** the application is Division approved.

THIS APPLICATION IS NOT COMPLETE UNLESS THE FOLLOWING DOCUMENTS ARE ATTACHED TO THE APPLICATION OR IN AN APPENDIX:

Attached

A. **Properly completed signature page** (attach to the application) _____

B. **Scaled site map with proposed soil gas probe locations** _____

Site Map: Provide a contoured scaled site map that, at a minimum, depicts the location of tanks, product and vent lines, dispensers, buildings, subsurface structures, underground utilities, and soil borings/monitoring wells. Indicate former UST systems with a dashed line. The site map shall include a North arrow and shall identify the nearest intersecting roads. The site map shall also depict the most recent soil and ground water COC concentrations that exceed the approved site-specific standards. Proposed soil gas sample locations shall be depicted. All Setback boundaries shall be depicted on the site map (in accordance with Section IV.A.) and distances provided in a legend.

C. **Cost proposal** (Excel® format available on the Division's webpage) _____

Costs shall not exceed those identified in the current Reimbursement Guidance Document – 001, available on the Division's webpage. Justification shall be provided if the soil gas survey and report costs are expected to exceed $4,500.00 for a half-day

soil gas survey (four or less samples collected) or $8,000.00 for a full day soil gas survey (five or more samples collected).

1. Date of application: _____

2. Facility I.D. number: _____

3. Facility name: _____

   Facility address: _____
   _____

   Facility telephone number: (_____)_____

4. Name of UST system owner: _____

   Owner address: _____
   _____

   Owner telephone number: (_____)_____

5. Name of Corrective Action Contractor (CAC): _____

   CAC Address: _____
   _____

   CAC Mobile Phone Number: (_____)_____

6. Name of subcontractor (if applicable): _____

   Subcontractor address: _____
   _____

   Subcontractor mobile phone number: (_____) _____

7. Date the soil gas survey will be conducted: _____

8. Existing onsite building(s): ☐ Commercial ☐ Residential ☐ N/A

9. Existing foundation type(s): ☐ Slab-on-grade ☐ Basement/Crawl ☐ N/A

10. Reasonably expected future property usage: ☐ Commercial ☐ Residential

11. Number of proposed soil gas sample locations: _____

    If more than eight (8) locations are proposed, then justification shall be provided for each location:

    _____
    _____

12. List the borings/well numbers that have soil and/or ground water contaminant concentrations that exceed the approved SSCLs:

Sample Location † (B-1, MW-1, etc.)	Sample Depth (feet)	Chemical of Concern	Concentration (ppm)	Approved SSCL (ppm)

† These sample locations shall be depicted on the site map

13. Proposed probe installation method: ☐ Rotary hammer drill kit ☐ Slide hammer
☐ Direct push technology (specify equipment brand name): _____
☐ Other explain: _____

14. Soil gas sample collection depth(s) based on the answer(s) to question # 9. (Mark all that apply)

☐ Three (3) feet; Identify the proposed sample locations: _____
☐ Ten (10) feet; Identify the proposed sample locations: _____

15. Probe tubing type: ☐ Nylon ☐ Metal conduit (slide-hammer)
☐ Other explain: _____

16. Probe tubing outside diameter: ☐ 1/4-inch ☐ 3/8-inch
☐ 1/2-inch (conduit – slide hammer) ☐ Other explain: _____

17. Sample train tubing type: ☐ Nylon ☐ Other explain: _____

18. Sample train outside tubing diameter: ☐ 1/8-inch ☐ 1/4-inch
☐ Other explain: _____

19. Type of tubing connections: ☐ 1/4-inch, quick-connect plastic
☐ Other explain: _____

20. Probe surface seal material: ☐ Petroleum free modeling clay ☐ Hydrated bentonite
☐ Other explain: _____

21. Type of tracer: ☐ Isopropanol(70% rubbing alcohol)
☐ Other explain: _____

22. Name of analytical laboratory: _____

23. Type of laboratory analysis:
- ☐ Method TO-15 (off-site analysis)
- ☐ GC using Method 8260B (on-site portable GC analysis)
- ☐ Other explain: _____

24. Sample container type:
- ☐ 1-Liter SUMMA® Canisters (off-site analysis only)
- ☐ 300-cc syringe with stopcock (on-site analysis only)
- ☐ Other explain: _____

25. The selected laboratory has been notified that in addition to the requested petroleum constituents, Isopropanol, (%) Oxygen, and (%) Carbon Dioxide are required to be analyzed:

☐ Yes ☐ No

26. Purge equipment: ☐ Hand vacuum pump ☐ Electric vacuum pump & regulator
☐ Other explain: _____

27. Probe abandonment:
- ☐ To be abandoned at the conclusion of the sampling event
- ☐ To be surface completed for future sampling event(s)

Signature Page

A signature page, as shown below shall be attached to the Soil Gas Survey Application. The page shall be signed by the owner/operator (or authorized representative within the organization), and either a registered professional geologist under the Tennessee Geologist Act (*T.C.A. §62-36-101 et seq*.) or a registered professional engineer under the Tennessee Architects, Engineers, Landscape Architects and Interior Designer Law and Rules (*T.C.A. §62-2-101 et seq*.).

We, the undersigned, certify under penalty of law, including but not limited to penalties for perjury, that the information contained in this report form and on any attachments, is true, accurate and complete to the best of our knowledge, information, and belief. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for intentional violations.

_____	_____	_____
Owner/Operator (Print name)	Signature	Date
	_____	
	Title (Print)	
_____	_____	_____
P.E. or P.G. (Print name)	Signature	Date
	_____	
	Tennessee Registration #	

Note: Each of the above signatures shall be notarized separately with the following statement.

STATE OF _____ COUNTY OF _____

Sworn to and subscribed before me by _____on this date

_____. My commission expires _____.

_____	_____	_____
Notary Public (Print name)	Signature	Date

Stamp/Seal

STATE OF TENNESSEE

DEPARTMENT OF ENVIRONMENT AND CONSERVATION

DIVISION OF UNDERGROUND STORAGE TANKS

SOIL GAS SAMPLING REPORT

Effective January 1, 2008

The following information shall be provided in the format specified below.

Date of report: _____

Facility ID # ___-___ ___ ___ ___ ___ ___ ___

Facility name: _____

Facility address: _____

_____

THIS REPORT IS NOT COMPLETE UNLESS THE FOLLOWING DOCUMENTS ARE ATTACHED TO THE REPORT OR IN AN APPENDIX:

		Attached (Yes/No)
A.	**Properly completed signature page** (attach to the report)	_____
B.	**Scaled site map with soil gas analytical data and tracer data** (update the site map submitted with the application)	_____
C.	**Table 1 - Analytical Results**	_____
D.	**Original laboratory certificates of analysis**	_____
	Chain of Custody sheet(s)	_____
	Sample shipment documentation	_____
E.	**Field Log**	_____
F.	**TN Soil Gas Lookup Table printout(s)**	_____

1. The Executive Summary shall include all relevant facts and developments that occurred during the soil gas sampling event, including, but not limited to a discussion of the field operations, any deviations from the work plan specified in TGD-018 and/or approved application, any data inconsistencies, and any other significant procedural and/or analytical details.

2. Describe the weather conditions (e.g., temperature, precipitation, etc.) during the soil gas survey event. Also describe the precipitation conditions during the forty-eight (48) hour period immediately preceding the survey.

3. Identify and discuss the contaminant source areas (i.e., those areas that have analytical concentrations that exceed the SSCLs approved by the Division).

4. Identify and discuss all the applicable site receptors (residential and/or commercial).

5. Describe the probe advancement methodology.

6. Describe the sample collection methodology.

7. List the field-sampling instrument(s) used for the survey. Provide a description of the sampling instrument(s). The descriptions shall include, but not be limited to, the make and model(s), detection limits, sample parameters, and calibration procedure and dates.

8. Describe any problems encountered (e.g., utility lines encountered, water encountered in samples, free product encountered, equipment malfunctions, etc.).

9. List the Corrective Action Contractor personnel that were on-site, their billing title(s), and total time at the site:

Name	Billing Title	Time On-site (hrs)

10. If applicable, list subcontractor personnel that were on-site, their billing title(s), and total time at the site:

Name	Billing Title	Time On-site (hrs)

11. Based on the analytical results listed in Table 1, state your conclusions and recommendations.

Signature Page

A signature page, as shown below shall be attached to the Soil Gas Survey Report. The page shall be signed by the owner/operator (or authorized representative within the organization), and either a registered professional geologist under the Tennessee Geologist Act (*T.C.A. §62-36-101 et seq*.) or a registered professional engineer under the Tennessee Architects, Engineers, Landscape Architects and Interior Designer Law and Rules (*T.C.A. §62-2-101 et seq*.).

We, the undersigned, certify under penalty of law, including but not limited to penalties for perjury, that the information contained in this report form and on any attachments, is true, accurate and complete to the best of our knowledge, information, and belief. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for intentional violations.

_____	_____	_____
Owner/Operator (Print name)	Signature	Date
	_____	
	Title (Print)	
_____	_____	_____
P.E. or P.G. (Print name)	Signature	Date
	_____	
	Tennessee Registration #	

Note: Each of the above signatures shall be notarized separately with the following statement.

STATE OF _____ COUNTY OF _____

Sworn to and subscribed before me by _____on this date

_____. My commission expires _____.

_____	_____	_____
Notary Public (Print name)	Signature	Date

Stamp/Seal

Instructions to complete Table 1 - Analytical Results

Complete the following steps in sequence:		Check if complete
A	Check the applicable receptor and foundation	
B	Delete any rows containing COCs that did not exceed the SSCLs in the Risk Analysis Report	
C	Enter the depth each sample was collected	
D	Select and enter the units (µg/m^3, ppbv, or ppmv) used by the laboratory. The analytical results and lookup value units must be identical for all data	
E	Based on the analytical units selected in D above, record the corresponding valid tracer concentration (10,000,000 µg/m, 4,000,000 ppbv, or 4,000 ppmv) in columns one through eight	
F	Enter the analytical results	
G	Using the TN Soil Gas Lookup Table (available from the Division's website), enter the depth for each sample and record the lookup value results for the applicable COCs in the appropriate row	
H	Print the TN Soil Gas Lookup Table for each depth entered. Attach a copy to the Soil Gas Sampling Report in an appendix (Do not print the Data and Equations table)	
I	Compare the analytical results to the corresponding lookup value. Highlight, shade, and/or bold any analytical result concentration(s) that are equal to or exceed the lookup value concentrations	
J	Enter the biological parameters laboratory results (%) for each sample location	
K	Enter the vacuum test field log data (in. of Hg) for each sample location	

Table 1 Analytical Results

Check applicable receptor & foundation:		Receptor: ☐ Commercial ☐ Residential							
		Foundation: ☐ Slab-on-grade ☐ Basement/Crawlspace ☐ Basement/Slab							
		Analytical results/lookup values							
COC parameter†	Sample location	1	2	3	4	5	6	7	8
	Sample depth (feet)								
	Units†† (µg/m³, ppbv, ppmv)								
Benzene	Analytical Result								
	Lookup Value								
Toluene	Analytical Result								
	Lookup Value								
Ethylbenzene	Analytical Result								
	Lookup Value								
Xylenes	Analytical Result								
	Lookup Value								
MtBE	Analytical Result								
	Lookup Value								
Naphthalene	Analytical Result								
	Lookup Value								
Isopropanol	Analytical Result								
	Valid Conc.*								
Biological parameters		**Percent**							
Oxygen									
Carbon Dioxide									
		Inches of Hg							
Sample train test vacuum									
2-min. vacuum test passed? (Y/N)									
Initial SUMMA® canister vacuum									
Final SUMMA® canister vacuum									

† Only include analytical results for COCs that exceed the approved SSCLs. Delete rows and COCs from the table, which were below the SSCL in the Risk Analysis Report.

†† Specify the correct units in columns 1 through 8. Units for all columns must be identical.

* Based on the analytical units selected for COCs, record the corresponding valid tracer concentration (10,000,000 µg/m³, 4,000,000 ppbv, or 4,000 ppmv) in columns 1 through 8

Soil Gas Survey Field Log

Effective January 1, 2008

The following information shall be completed during the soil gas survey event provided in the format specified below. The original field log shall be submitted.

Facility name: _____ Facility ID # ___-___ ___ ___ ___ ___ ___ ___

Date of collection: _____ CAC project # _____

1. List the Corrective Action Contractor personnel and if applicable, subcontractor personnel that are on-site, their billing title(s), and total time at the site:

CAC/Subcontractor Company Name	Name	Billing Title	Time On-site (hrs)

2. Purge volume calculations Tubing size (OD): ☐ 1/8-inch ☐ 1/4-inch ☐ 3/8-inch
Show purge volume calculations. If both 3 and 10 foot depth probes are installed, then show both calculations.

Total purge vol. per 3 ft probe: _____ mL; per 10 ft probe (if applicable): _____ mL

3. Complete the following tables:

Table 1 – Field Log

Parameter	Units	Value							
Boring #		1	2	3	4	5	6	7	8
Canister/syringe #									
Total purge volume	mL								
Vacuum test - initial	Inches Hg								
Vacuum test - final	Inches Hg								
Vacuum test - loss	Inches Hg								
Vacuum test start time	Military								
Vacuum test stop time	Military								
Total vacuum test time	Min/sec								
Initial SUMMA® vac	Inches Hg								
Sample start time	Military								
Sample stop time	Military								
Total sample time	Min/sec								
Final SUMMA® vac	Inches Hg								

Table 2 – Comments from Table 1

Boring #	Comments
1	
2	
3	
4	
5	
6	
7	
8	

4. Weather conditions: _____

5. Field log completed by: _____

   Date completed: _____