PROPOSAL FOR SOIL-GAS SAMPLING AND ANALYTICAL SERVICES
Tecumseh Products
Tecumseh, MI

Background

Beacon Environmental Services, Inc. (BEACON), a small business concern (NAICS 541380), has been invited by RMT, Inc. to provide a Proposal and Cost Estimate for soil-gas services at the Tecumseh Products Site in Tecumseh, MI. The Proposal and Cost Estimate are based on information provided to BEACON by RMT.

Objective

Collection of passive soil-gas (PSG) samples from the shallow subsurface will provide data on the identity and relative concentrations of targeted volatile organic compounds (VOCs) which may be present, without generating waste from soil cuttings. This data will be used to identify source areas of chlorinated contamination that is present in the groundwater and to delineate the lateral extent of the contaminants.

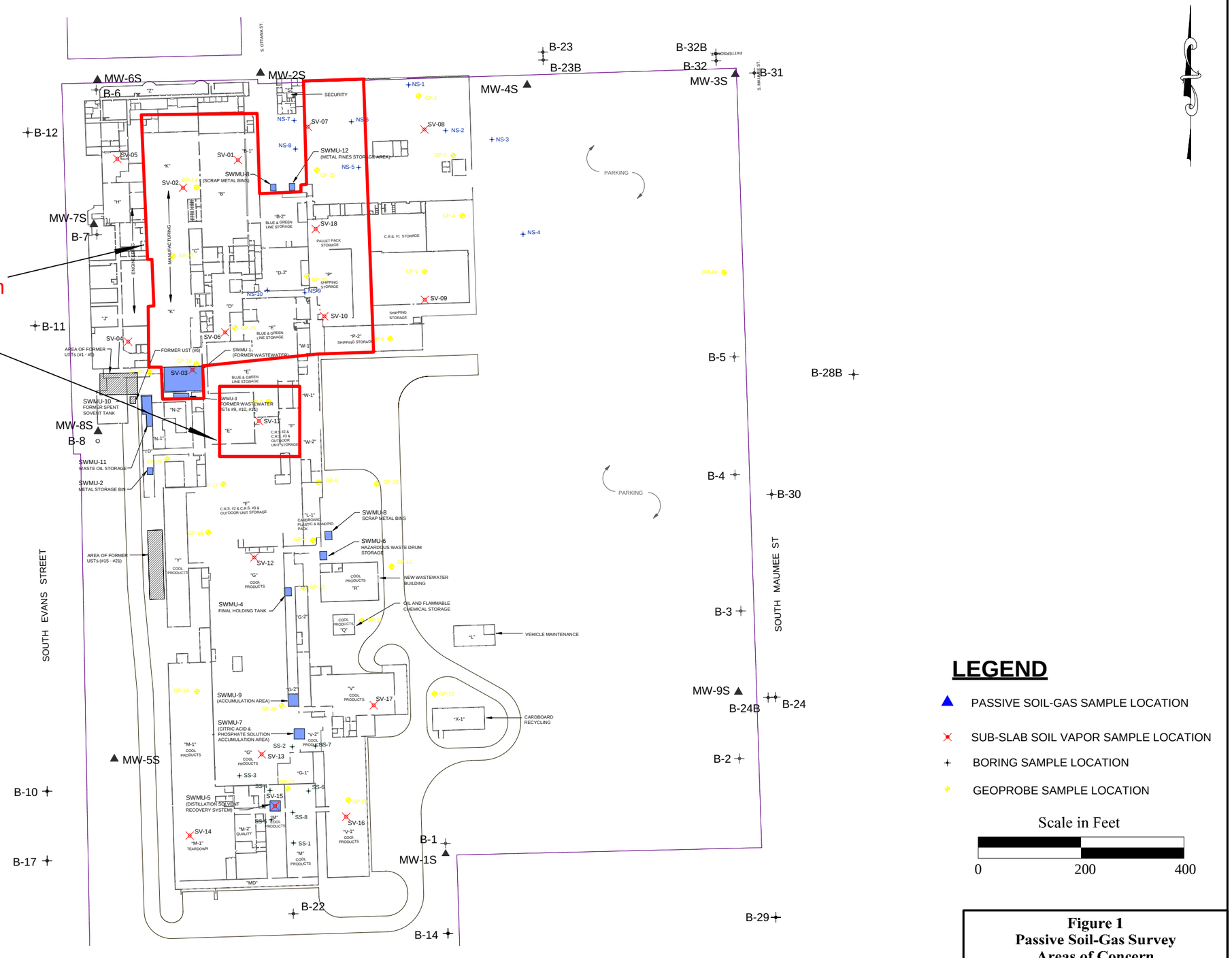
Survey Design

The focus of this investigation is to identify source areas in the northern portion of the site, as shown on **Figure 1**. Based on information provided by RMT and the objectives of the survey, BEACON recommends collecting samples across the areas of concern in a grid pattern with 40-foot spacing between sample locations. This results in a 148-point sampling plan (see **Figure 2**). Site access to the sample locations and the identification of site features that present possible contaminant release locations, may result in an adjustment to the number of samples collected. RMT will determine the final sampling locations.

Sampling Procedures

Small, easy-to-carry BESURE Sample Collection Kits™ containing sufficient equipment to collect at least 148 field samples will be provided to RMT personnel for collection of soil-gas samples following the protocols of BEACON's passive method. BEACON will ship the Field Kits via overnight delivery within two (2) business days following notice to proceed.

To install a PSG Sampler, an approximately 1" diameter hole is made to a depth of 12 inches using a hammer drill or comparable equipment. When applicable, this same equipment can be used to extend a smaller diameter hole to a two- to three-foot depth. In either case, the PSG Sampler (which contains ***two sets of hydrophobic adsorbent cartridges***) is installed in the top portion of the hole. For locations covered by asphalt or concrete surfacing, a 1 1/4" to 1 1/2" diameter hole is drilled through the surfacing to the underlying soils, a smaller diameter hole is then extended to a two- to three- foot depth, and the upper 12 inches of the hole is sleeved with a sanitized metal pipe provided in the Kit. After the Sampler is installed inside the metal pipe, the hole is patched with an aluminum foil plug and a thin concrete patch to protect the sampler. The samplers will be exposed to subsurface gas for approximately seven (7) days.



LEGEND

- PASSIVE SOIL-GAS SAMPLE LOCATION
- SUB-SLAB SOIL VAPOR SAMPLE LOCATION
- BORING SAMPLE LOCATION
- GEOPROBE SAMPLE LOCATION

Scale in Feet

0 200 400

Figure 1
Passive Soil-Gas Survey
Areas of Concern

Tecumseh Products
Tecumseh, MI

BEACON ENVIRONMENTAL SERVICES, INC.
323 Williams Street, Bel Air, MD, 800-878-5510
Beacon Project No. 2333, June 2010

LEGEND

- PROP0SED PSG SAMPLE LOCATION
- SUB-SLAB SOIL VAPOR SAMPLE LOCATION
- BORING SAMPLE LOCATION
- GEOPROBE SAMPLE LOCATION

Scale in Feet

0 100 200

Figure 2
Passive Soil-Gas Survey
Proposed Sample Locations

Tecumseh Products
Tecumseh, MI

BEACON ENVIRONMENTAL SERVICES, INC.
323 Williams Street, Bel Air, MD, 800-878-5510
Beacon Project No. 2333, June 2010

Each sampler is shipped to the site with a length of wire that is wrapped around the vial and twisted around the shoulder of the vial to expedite retrieval from the ground. Following the exposure period, the Samplers are retrieved and shipped to BEACON's laboratory for analysis. It is not necessary to use ice or preservatives during shipment; however, the samplers are sealed and shipped under strict chain-of-custody procedures. A trip blank, which will remain with the other PSG samples during preparation, shipment, and storage, will be included with each batch of up to 30 field samples.

BEACON provides in the BESURE Sample Collection Kit™ pre-cleaned metal sleeves when sampling through impermeable surfacing to protect the Samplers. These sleeves prevent any horizontal migration of vapors in the more porous substrate from influencing the soil-gas samplers. The metal sleeves are advanced below the substrate and tapped into the underlying soils so that the Samplers will only be adsorbing compounds in soil gas that is moving vertically through the soils beneath, and not in the vapors that may be migrating laterally through the more porous substrate. Other soil-gas vendors simply create a hole 2 to 3 feet deep, and leave their samplers unprotected to the horizontal migration of vapors in the substrate. This easy-to-perform but important procedure of using the metal sleeves is critical to an accurate and reliable soil gas survey (see **Attachment 1**).

Note: The adsorbent cartridges used by BEACON are hydrophobic, which allows the samplers to be effective even in water-saturated conditions. Extensive empirical evidence, which is supported by a government study, has proven that hydrophobic adsorbents work perfectly well in high moisture conditions and should not be encased by a hydrophobic membrane.[1] The use of surrogates and internal standards by BEACON during the analysis of samples verifies that moisture is not a problem during the analysis of the samples. Therefore, water does not adversely impact adsorption of compounds in the field or the analysis of the samplers at the laboratory. An analytical method that does not use internal standards or surrogates during the analysis of each sample cannot provide proof of performance that the system was functioning properly for each sample.

A two-person team can install approximately 50 to 100 samplers per day depending on the number of sample locations that are covered with asphalt, concrete, or gravel surfacing. For retrieval of the Samplers, one person can retrieve approximately 50 to 100 samplers per day and patch the holes through the surfacing. It is anticipated that two to three days will be required to install the samplers and one to two days will be required for retrieval.

Figure 3 — Installation of Samplers with BESURE Sample Collection Kit™

Sample Custody Procedures

A chain-of-custody accompanies the field samples at all times from the time the samples are collected until final analysis. Field kits are shipped with tug-tight custody seals to ensure that samplers are not tampered with during transport. Once samples are received at BEACON's laboratory, the sample custodian receives the samples and logs the samples into the laboratory's Sample Receipt Log per BEACON's *Quality Assurance Program Plan for the Analysis of Soil-Gas Samples*.

BEACON's laboratory is maintained in a safe and secure manner at all times. The facility is locked when not occupied and is monitored for fire and unauthorized access. BEACON personnel escort all visitors at all times while inside the facility.

Analytical Procedures

Soil gas samples will be analyzed by BEACON using gas chromatography/mass spectrometry (GC/MS) instrumentation, following modified EPA Method 8260C procedures. Samples will be analyzed for those compounds on the attached list. The laboratory will perform an ***initial five-point calibration***. In addition, a BFB tune is performed daily and a method blank is run following the daily calibration. ***Internal standards and surrogates*** are included with each sample analysis. The laboratory's reported quantitation level (RQL) for each of the targeted compounds is 25 nanograms (ng); however, the actual method detection limits range from 0.3 to 1.9 ng. Other specific analytes may be targeted, if requested prior to analysis. Two sets of adsorbent cartridges are included in each Sampler for duplicate or confirmatory analysis. At RMT's option, BEACON will analyze ***field sample duplicates*** from selected sample locations identified on the chain-of-custody.

BEACON provides the highest level of accuracy and quality assurance and quality control (QA/QC) procedures for the analysis of soil gas samples in the industry. The table below summarizes these analytical procedures.

Description	Included
Analysis by thermal desorption-gas chromatography/mass spectrometry (TD-GC/MS) following modified EPA Method 8260C	√
Analytical results based on 5-point initial calibration	√
MDLs are based on a seven replicate study with contiguous analyses at 5 nanograms -- the low-point on the five-point calibration curve	√
Internal standards and surrogates included with each run (100 nanograms per compound)	√
BFB tunes (5 to 50 nanograms through GC, per method)	√
Continuing calibration checks (50 nanograms per compound)	√
Method blanks	√

Notes: The low point on BEACON's initial calibration curve is 5 nanograms and the reporting limit for each of the compounds is 25 nanograms to assure that the low concentrations reported are accurate and defensible... as dictated by EPA Method 8260C. When high concentrations of contaminants are identified, the sample can be split or diluted to maintain an accurate quantification.

Lesser passive soil gas methods are known to base their results on an external calibration method and calibrate at quantities that are greater than an order of magnitude above their reporting limits, but refer to the process as being Method 8260 (*i.e.*, claim a reporting limit of 25 ng but have 250 ng or higher as the low-point of the calibration). These methods also do not include internal standards or surrogates with each analysis to provide proof of performance that the analytical system was functioning properly for each and every analysis and to provide consistent reference points for comparison of measured quantities.

Analyses of the samples will be performed at BEACON's laboratory using state-of-the-art instruments that are listed below. The Markes thermal desorption instruments outperform older thermal desorption equipment used by other vendors, which cannot target as broad a range of compounds with as much sensitivity or accuracy.

- Agilent 6890-5973 Gas Chromatograph/Mass Spectrometer,
- Markes Unity thermal desorber,
- Markes UltrA autosampler, and
- Markes Mass Flow Controller Module.

Report

Preliminary laboratory data can be provided to RMT typically within five business days following the laboratory's receipt of samples. Within 10 business days of the laboratory's receipt of samples, a final report will be provided that will contain:

project objectives,
the investigation plan,
the QA/QC program and findings,
laboratory data (in nanograms),
a base map,
up to three color isopleth maps,
field procedures,
laboratory procedures,
Field Deployment Reports, and
Chain-of-Custody documentation.

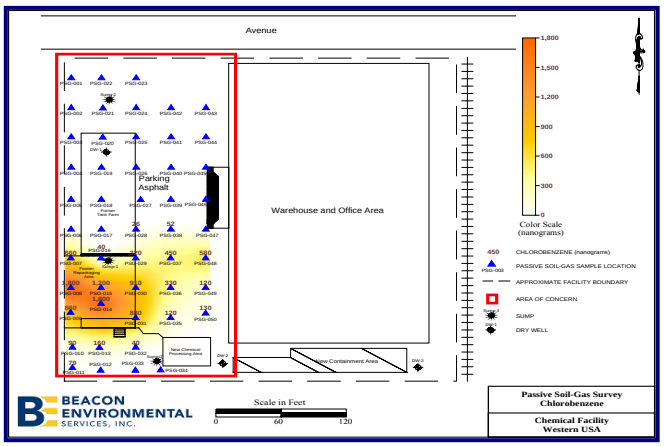


Figure 4 – Example Color Isopleth Map

BEACON requests that RMT provide electronically a CAD drawing of the site. BEACON can also incorporate GPS or GIS informational data into the maps. If requested, BEACON will provide the color isopleth maps as layers for use with CAD software or provide data files of the contours for use with GIS software. BEACON will provide post survey support to assist in interpreting the data.

Key Personnel and Relevant Experience

The principals of BEACON have many years of experience in characterizing sites for organic contaminants using innovative soil-gas sampling technologies. BEACON was founded in 1999 by Mr. Harry O'Neill, who is the company president and has managed and reviewed data from 1,000s of soil gas surveys. Prior to forming BEACON, Mr. O'Neill managed the soil-gas sampling program for Quadrel Services, Inc., an innovative company that lead the acceptance of passive soil-gas sampling at the national and international level. Mr. Steve Thornley is the company's Laboratory Director, who is responsible for sample analyses and ensures that all project samples are analyzed and reported following the highest level of quality assurance procedures in the industry. Mr. Thornley has analyzed and reported data from more than 50,000 soil-gas samples and follows established analytical procedures that allow BEACON to provide accurate, reliable, and defensible data. Dr. Joe Odencrantz is the company's Technical Director and Western Region Manager, who is responsible for ensuring projects are executed under the direction of a licensed, professional civil & environmental engineer. Dr. Odencrantz has written numerous applied research articles on applications of BEACON's technology which are published in conference proceedings and peer-reviewed journals.

Following are a few references from clients who have applied BEACON's passive soil-gas services.

Multiple Superfund Sites

EPA Region VI
Mr. Vince Malott
Dallas, TX
Phone: 214-665-8313
Number of samples: 900
Completion Date: October 2007 to September 2009

Passive soil gas samples were collected from Superfund sites and analyzed for petroleum and chlorinated compounds to identify source areas and delineate the lateral extent of the contamination. Samplers were installed in one-foot deep holes and were exposed for seven days. Survey results clearly defined areas of releases and contaminant migration pathways.

Hanford Reservation, WA

Vista Engineering Technologies
Dr. Wes Bratton
Kennewick, WA
Phone: 509-737-1377

Number of samples: 400+
Completion date: August 2000 to August 2006

Passive soil-gas surveys have been performed at the Hanford Reservation to delineate the extent of chlorinated and petroleum-related contaminants, primarily carbon tetrachloride (CTC). BEACON identified carbon tetrachloride contamination in soils at a 60-foot depth, with the passive soil gas samplers installed to a four-inch depth and the samplers remaining in the field for only three days.

Edwards AFB, CA

Earth Tech, Inc.
Mr. Robert Kohlhardt
Sacramento, CA
Phone: 916-929-4143
Number of samples: 1,000+
Completion date: January 2001 to March 2004

BEACON has analyzed more than 1,000 passive soil-gas samples collected at various sites on Edwards Air Force Base. Sample delivery groups ranged from 82 to 416 samples to target a full range of volatile organic compounds (VOCs) and lighter semivolatile organic compounds (SVOCs). The objectives of the surveys were to identify source areas and migration pathways of targeted contaminants, with chlorinated solvents being the primary compounds of concern.

Oak Ridge National Laboratory, TN

Formerly with NFT Incorporated
Mr. Steve Short
Oak Ridge, TN 37830
Phone: 865-482-1056
Number of samples scoped: 200
Completion date: July 2004

Passive soil-gas samples were analyzed to delineate the lateral extent of chlorinated contaminants. Data deliverables require CLP data packages and project specific electronic data deliverables (EDDs) uploaded to the client's site. The client visited BEACON's laboratory and other soil-gas vendors prior to selecting BEACON.

1 The Marines Project: A Laboratory Study of Diffusive Sampling/Thermal Desorption/Mass Spectrometry Techniques for Monitoring Personal Exposure to Toxic Industrial Chemicals, April 2002, Warren Hendricks, Methods Developments Team, Industrial Hygiene Chemistry Division, OSHA Salt Lake Technical Center, Salt Lake City, UT 84115-1802.

Beacon Project No. 2333
Target Compound List
Analysis by EPA Method 8260C

Analytes	Method Detection Limits (ng)
Vinyl Chloride	1.5
Trichlorofluoromethane (Freon 11)	1.5
1,1-Dichloroethene	0.7
Methylene Chloride	1.1
1,1,2-Trichlorotrifluoroethane (Freon 113)	1.9
trans-1,2-Dichloroethene	0.8
1,1-Dichloroethane	0.4
cis-1,2-Dichloroethene	0.5
Chloroform	0.3
1,2-Dichloroethane	0.3
1,1,1-Trichloroethane	0.7
Carbon Tetrachloride	0.7
Trichloroethene (TCE)	0.5
1,1,2-Trichloroethane	0.7
Tetrachloroethene (PCE)	0.6
1,1,1,2-Tetrachloroethane	0.8
Chlorobenzene	0.3
1,1,2,2-Tetrachloroethane	0.5

Note: Additional compounds may be added to meet project specific requirements.

The reporting quantitation level (RQL) for each compound is 25 nanograms (ng); however, the actual analyte method detection limits (MDLs) range from 0.3 to 1.9 ng.

The MDL study was performed May 17, 2010, and is based on a seven replicate study with contiguous analyses at 5 nanograms, which is the low-point on the initial calibration curve.

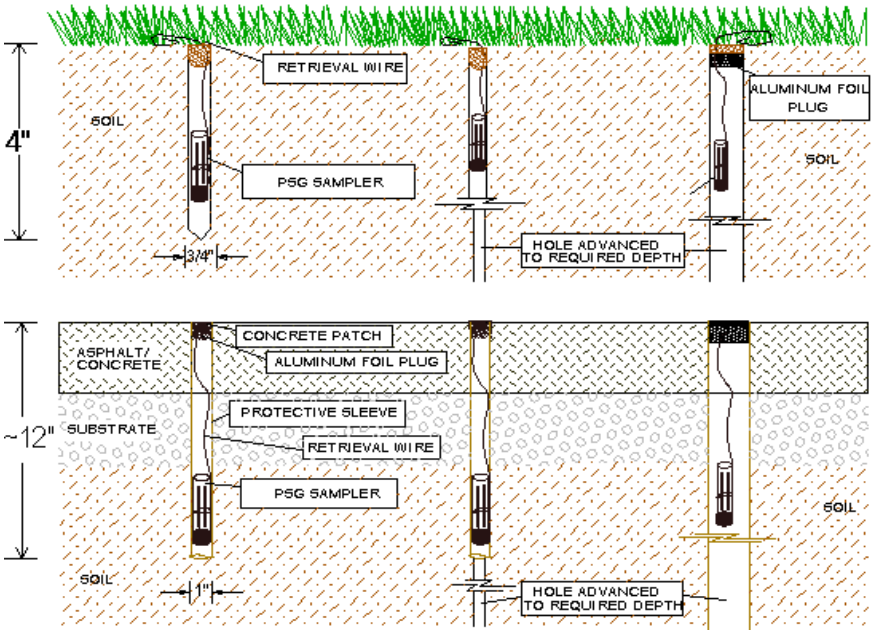
Attachment 1

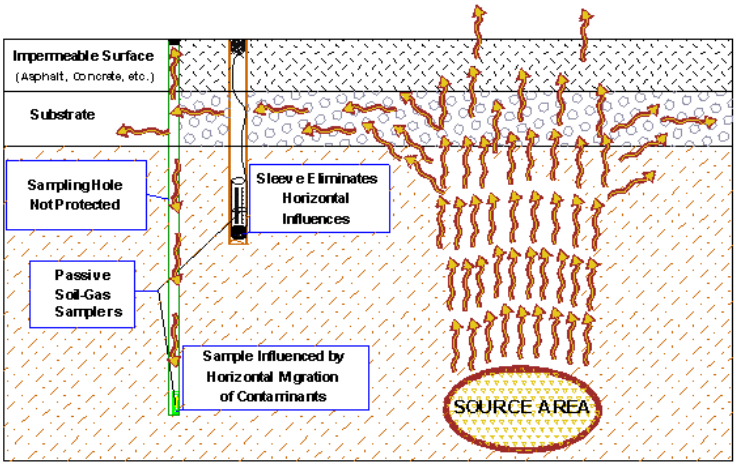
EFFECTIVE PASSIVE SOIL-GAS SAMPLING PROCEDURES

PSG Samplers need only be **installed to a 4-inch depth** because of the sensitivity of the method. However, the method is extremely versatile and installation procedures can be adapted to meet project objectives or client requirements.

When a PSG Sampler is installed in the ground, the top of the hole is completely sealed by collapsing the soils above the Sampler or patching the drilled hole through the surfacing. Other vendors use a permeable cork to plug their installation hole, which allows subsurface gases to escape before the adsorbent captures the organic compounds (reducing sensitivity) *and* permits vapors from above the surface, as well as surface water, to enter the hole (false positives). BEACON's PSG Samplers are not susceptible to these influences because they are effectively sealed in the subsurface.

As mentioned above, BEACON's Samplers are versatile and for some projects a higher sensitivity is required because contaminants are present at low concentrations or soils are fairly impermeable. In these situations, the sampling hole is advanced to a greater depth using a hammer drill, slide hammer, or direct push equipment. *Because the soil vapors that enter the hole will migrate upwards in this newly created preferential pathway, it is not necessary to push the Sampler to the bottom of the hole.* Therefore, the Sampler can still be installed in the upper 4-inches of the hole





Samplers installed through an impermeable surface are sleeved in pre-cleaned protective metal sleeves (provided by BEACON). These sleeves prevent any horizontal migration of vapors in the more porous substrate from influencing the soil-gas Samplers. As the accompanying diagram shows, the metal sleeves are advanced below the substrate and tapped into the underlying soils so that the Samplers will only be adsorbing compounds in soil gas that are moving vertically through the soils beneath, and not in the vapors that may be migrating laterally through the more porous substrate. Other soil-gas vendors simply create a hole 2 to 3 feet deep, and leave their samplers unprotected to the horizontal migration of vapors in the substrate. This easy-to-perform but important procedure is yet another reason why BEACON's method has achieved the reputation as being the most accurate and reliable soil gas technology available.

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