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Mr. Richard Nussbaum
Chief – Permits Section, Hazardous Waste Program
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, Missouri 65102

December 6, 2017

Subject: Sitewide Investigation Work Plan Addendum – Phase 2 (Passive Soil Gas Sampling and Short-Term Vapor Extraction Testing)

Dear Mr. Nussbaum:

On behalf of Modine Manufacturing Company, CH2M HILL Engineers, Inc. (CH2M) is submitting this addendum to the *Sitewide Investigation Work Plan* (Work Plan; CH2M 2016). This work plan addendum presents the objectives and approach for conducting passive gas sampling associated with the Phase 2 Sitewide Investigation at 221 Sunset Drive in Camdenton, Missouri (facility).

Phase 1 of the sitewide investigation, detailed in *Phase 1 Sitewide Soil Vapor Investigation Report* (CH2M 2017), included soil, groundwater, and soil vapor investigation around the northern and western perimeter of the facility. Phase 2 will include passive soil gas (PSG) sampling and short-term vapor extraction testing for evaluation of potential sources of contamination beneath the building.

PSG sampling has been used as a site characterization technique for over 20 years. It has been found to be useful for identifying areas with greater levels of volatile organic compound (VOC) contamination that may be associated with residual subsurface source zones or groundwater plumes. PSG generally involves placement of commercially available passive sampling devices that contain a sorbent material within the shallow subsurface for some time (typically 3 to 14 days) that are later retrieved and analyzed in a laboratory. The amount of contaminant sorbed to the material within the sampling device provides a qualitative indication of the amount of contaminant in the soil vapor near each sampling location. Maps showing the relative amounts of mass sorbed at different sampling points are then prepared, providing an indication of zones with the greatest amount of contamination, which can guide further intrusive activities such as drilling and soil sampling.

Short-term vapor extraction tests, also referred to as high-purge-volume sampling, can also be used to provide insight into the spatial distribution of vapors at a progressive distance from the point of extraction. These tests may reveal areas that are more likely to represent residual subsurface source zones compared to conventional subslab soil vapor sampling.

The Phase 2 passive soil sampling field activities are expected to provide a refined understanding of shallow subsurface conditions at the facility and assist in guiding future intrusive investigation activities within the building (drilling and soil sampling).

Sampling Program

This section summarizes the approach and methods that will be used as part of Phase 2 PSG activities. The following activities have been completed or will be conducted:

- A closed-circuit television (CCTV) investigation of the underground sewer lines was conducted from August 14 to 16, 2017. The purpose of this investigation was to evaluate the current condition of the sewers, aid in the understanding of the sewer line connectivity, and to identify compromised parts of the lines (such as cracks, breaks, or both), if any, to assist in guiding subsequent investigation activities beneath the facility building.
- PSG sampling will be conducted using Beacon BESURE Passive Sample Collection Kits to collect qualitative VOC data in subslab soil gas beneath the facility. Sixty-nine passive soil gas samples will be collected within the building. This includes 62 sampling locations as shown in Figure 1, as well as 7 quality control samples (6 field duplicates and 1 trip blank). Sampling locations were selected based on estimated locations of underground utilities as determined from the CCTV survey and other site information.
- A standard operating procedure (SOP) for installation and retrieval of the Beacon PSGs is provided in Attachment 1. Certain adaptations to the SOP may be made, depending on field conditions encountered during sampler installation.
- Up to four small-diameter, shallow test borings in different areas of the building will first be made to evaluate the general nature of the subbase material and shallow soil directly beneath the concrete floor to a depth of up to 2 to 3 feet. These borings are intended to identify the nature of the subslab base material and presence or absence of fill or clays beneath the slab. The preferred location for the PSG samplers is within subbase material if clays are present directly below the subbase, or slightly below the subbase material if more permeable fill is present in the shallow subsurface.
- Once installed, the PSG samplers will be left in place for approximately 7 days prior to retrieval. The PSG samplers will be shipped to Beacon's analytical laboratory for analysis by Method SW846 8260C. The length of time the samplers will be left in the subsurface is based on discussions with Beacon technical representatives.
- After receipt and evaluation of the analytical data and map showing relative VOC mass measured at different locations (approximately 3 to 4 weeks), short-term vapor extraction testing will be conducted at up to 6 locations inside the building. Locations will be chosen based on data from the PSG sampling. The short-term testing will follow the same technical approach previously used during the Phase 1 investigation, following the SOP defined in the *Sitewide Investigation Work Plan* (CH2M 2016). A landfill gas meter and ppbRae will be used to measure changes in VOC and bulk gas concentrations during the short-term test.

Decontamination

Nondisposable tooling and equipment that contacts potentially contaminated media will be decontaminated between sample intervals or locations using a non-phosphate detergent and clean potable water rise, as described in *SOP-Decontamination of Personnel and Equipment* (CH2M 2016b).

Investigation-Derived Waste

Investigation-derived waste (IDW) streams generated during Phase 2 will include the following: concrete and soil cuttings, decontamination water, and personal protective equipment and disposables that contact potentially contaminated media.

IDW will be containerized in new U.S. Department of Transportation-approved 55-gallon drums, labeled as "Investigation Derived Waste-Pending Analysis" and staged at the facility. Waste characterization samples will be collected as specified by the disposal facility. Following characterization, IDW was transported and disposed of at a waste disposal facility in accordance with applicable state and federal regulations.

Reporting

Once the Phase 2 PSG activities have been completed, a report describing the methods used, deviations from this work plan addendum (if any), and results will be prepared and submitted to the Missouri Department of Natural Resources. It is expected that preparation of the results report may take approximately 60 days after completion of all field activities. The report will include recommendations for collection of subsurface soil samples from beneath the building.

Addendum Approval

The Missouri Department of Natural Resources and the Missouri Department of Health and Senior Services approval for this work plan addendum will be documented by concurrence in an email or letter.

References

CH2M HILL Engineers, Inc. (CH2M). 2016. *Sitewide Investigation Work Plan. 221 Sunset Drive, Camdenton, Missouri.* August.

CH2M HILL Engineers, Inc. (CH2M). 2017. *Phase 1 Sitewide Soil Vapor Investigation Report. 221 Sunset Drive, Camdenton, Missouri.* August.

If you have questions regarding this work plan addendum, please contact me at 314.605.4616 or by email at Monica.Schneider@ch2m.com.

Sincerely,

CH2M HILL Engineers, Inc.

Monica Schneider

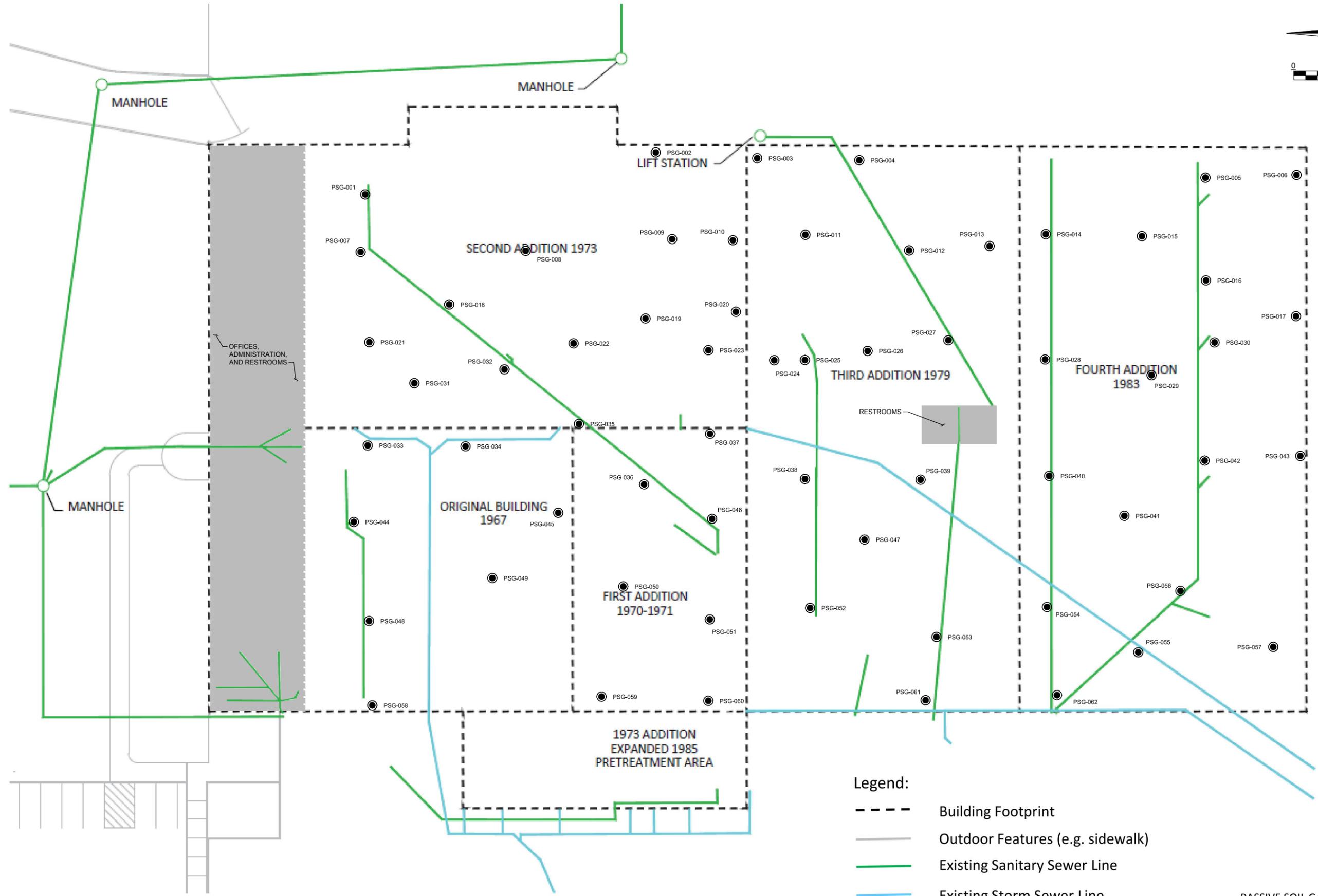
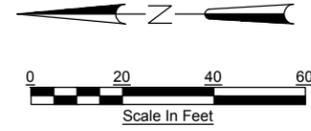


Project Manager

c: Christine Kump-Mitchell/Missouri Department of Natural Resources
Michelle Hartman/Missouri Department of Health and Senior Services
Michael Stroh/Missouri Department of Natural Resources
Jesse Nickrand/Modine Manufacturing Company
File

Enclosures

- Figure 1
- Attachment 1—Beacon SOP for PSG Sampler Installation and Retrieval



- Legend:**
- Building Footprint
 - Outdoor Features (e.g. sidewalk)
 - Existing Sanitary Sewer Line
 - Existing Storm Sewer Line
 - PSG-001 Passive Soil Gas Sample Locations

FIGURE 1
 PASSIVE SOIL GAS SAMPLING LOCATIONS
 SITEWIDE INVESTIGATION WORKPLAN ADDENDUM
 221 SUNSET DRIVE
 CAMDENTON, MISSOURI



Attachment 1
Beacon SOP for PSG Sampler
Installation and Retrieval

FIELD KIT GUIDE
FOR
PASSIVE SOIL-GAS INVESTIGATIONS
[PLEASE READ ENTIRE GUIDE BEFORE STARTING SURVEY]

I. General Information

A. BEACON is furnishing this kit to **CLIENT** specifically for use on the **Project Site**. To meet the project objectives the Samplers will be retrieved **approximately 14 days after installation**. Please contact BEACON following installation of the samplers at 1-410-838-8780 with anticipated date when samples will arrive at BEACON's laboratory.

B. *Before going to the field* please inventory the contents of the Kit, checking them against the enclosed list to verify item counts and to become familiar with all components. The components are thoroughly cleaned prior to shipment, the inventory should be conducted without opening the plastic bags. Note that Trip Blanks are to remain sealed throughout the Survey.

C. Prior to returning the Kit to BEACON, verify that the caps are tight on the Passive Soil-Gas (PSG) Samplers and that the Samplers are sealed individually in the small Sampler Bags and also in the larger Return Shipment Bag, with an adsorbent pak.

D. Following completion of the survey, the Chain-of-Custody Form should be filled in with the following information: (i) Field Sample IDs, (ii) the name and contact phone number of the person submitting the samples, (iii) the unique number of the custody seal that will be used, and (iv) signature and date of person relinquishing samples. The Chain-of-Custody Form is to be returned with the Field Kit to BEACON. If possible, retain photocopies for your record. Next, pack the Samplers, containers, sampling caps, and requisite documentation in the Field Kit.

Note: Place the Return Shipment Bag, which contains the individually bagged PSG Samplers, in the upper tray and place the tools in the lower compartment of the Kit so they do not damage the Samplers. One trip blank should be included with the Return Shipment Bag.

Affix the tug-tight custody seal to the latch on the Field Kit, pack it in its original cardboard shipping container, and send the shipment via overnight courier (FedEx, UPS, DHL) to:

Beacon Environmental Services, Inc.
Attn: Sample Receiving
2203A Commerce Rd Suite 1
Forest Hill, MD 21050 USA
1-410-838-8780

NOTE: DO NOT PACK IN THE KIT OR SHIPPING BOX STYRENE PEANUTS, NEWSPAPER, OR OTHER MATERIALS THAT COULD CONTAMINATE THE SAMPLES. PLEASE AVOID SMOKING WHILE HANDLING SAMPLERS.

II. Contents

A. This Field Kit contains the components needed for a **50**-point soil-gas survey, plus sufficient additional cartridges for **2** trip blanks (labeled **Trip-1 and Trip-2**, not to be opened), and **2** extra Samplers for use in the event of breakage or accidental contamination. In addition, **2** extra transport vials are provided in case a Sampler Vial breaks during retrieval. **Do not open bags until deployment.**

<u>Code/Item</u>	<u>Quantity</u>
(1) PASSIVE SOIL-GAS SAMPLERS	54
(2) EXTRA TRANSPORT VIALS	2
(3) SAMPLING CAPS (in container)	54
(4) CAP STORAGE CONTAINERS	1
(5) GAUZE CLOTHS	54
(6) 3" x 4" PLASTIC SAMPLER BAGS (for return shipment of samples)	54
(7) 12" LENGTHS OF PIPE	52
(8) 12" x 12" PLASTIC RETURN SHIPMENT BAG	2
(9) WIRE CUTTERS	1
(10) PIPE CUTTER	1
(11) VISE GRIPS	1
(12) TAPPING DOWEL	1

B. In addition to the materials found in the kit, field teams will need:

- NITRILE GLOVES
- CLEAN TOWEL
- HAMMER
- ELECTRIC ROTARY HAMMER DRILL WITH:
 - ½"-DIAMETER BIT WITH AT LEAST 36 INCHES OF CUTTING LENGTH and
 - 1¼" to 1½" DIAMETER BIT WITH AT LEAST 12 INCHES OF CUTTING LENGTH
- PIPE WRENCH (to dislodge drill bits should they become stuck)
- BALL-POINT PEN and CLIPBOARD
- PIN FLAGS, WOODEN STAKES, or OTHER LOCATION MARKERS
- SMALL SCREWDRIVER or SCRATCH AWL
- FLAGGING TAPE
- BOX OF ALUMINUM FOIL

C. Additional materials necessary only for deployment through asphalt or concrete:

- DRY CONCRETE MORTAR MIX and ASSOCIATED EQUIPMENT (for temporary patching of the sample holes) including:
 - SMALL PAIL, WATER, SMALL PLASTIC PUTTY KNIFE
- CHISEL or SCREWDRIVER (to remove the temporary patch)
- ASPHALT COLD PATCH or CEMENT (for final repair of the sample holes)

III. Instructions

A. GENERAL:

Deployment and retrieval of Samplers requires only one person. Separate step-by-step procedures are detailed below for sampling through vegetation or bare soils and for sampling in areas covered by asphalt, concrete, or gravel. **Keep exposure of sample cartridges to ambient air to a minimum.**

Note: Do not deploy Samplers within 10 feet of a monitoring well, penetrometer, hydropunch shaft, or other intrusive sampling apparatus that potentially creates a preferential pathway for gases.

REMEMBER: TRIP BLANKS ARE NOT TO BE OPENED.

B. SAMPLER DEPLOYMENT:

Note: Each Sampler contains two sets of adsorbent cartridges. BEACON will analyze one set per Sampler; however, the second set in each Sampler can be analyzed as a field sample duplicate. Please note at which locations, if any, duplicates are to be analyzed by writing separate entries corresponding to the sample location followed by the letter "D" (*i.e.*, 3, 3-D, 4, 4-D) on the Chain-of-Custody Form. It is not necessary to alter the deployment pattern to have the duplicate samples analyzed. There is an additional per sample charge for analysis of any duplicates.

Vegetation or Bare Soils:

1. At each survey point, clear vegetation as necessary and, using a hammer drill and drill bit, create a 1¼"- to 1½"-diameter hole approximately 12-14 inches deep. Then, using the ½" drill bit, extend the hole to a three foot depth. **Note:** In areas of very organic topsoil or landscaped areas (ie, mulched areas, gardens, etc.) it is important to get beneath the organic soil layer to the underlying soil below.
2. When the holes have been drilled, take a 12-inch length of 1"-diameter metal pipe and lower it into the sample hole, being careful not to touch the inside of the pipe. Any portion of pipe above grade is cut flush with the ground surface, using the pipe cutter. With the tapping dowel and a hammer, push or tap the pipe one inch into the base of the drilled hole (see **attached figure**).
3. Remove one of the Samplers (a glass vial containing *two sets of hydrophobic* adsorbent cartridges) and unwind the retrieval wire wrapped around it. Holding the capped end of the vial in one hand, pull the wire tight (to straighten it) with the other hand. Remove the solid cap on the Sampler Vial and replace it with a Sampling Cap (a one-hole cap with a screen meshing insert). Place the solid cap in the Field Kit.

Note: At each sampling location, verify that the (black) sampling cap is on the vial before installing the Sampler.

4. Lower the Sampler, open-end down, into the metal pipe approximately four inches so that the retrieval wire sticks out of the hole. Cover the open end of the pipe with a balled up **wad** of aluminum foil, pressing it tightly on top of the pipe with the tapping dowel. Next, cover the hole to grade with local soils or sand, leaving the end of the wire exposed above the surface of the ground. Using the hammer, collapse the soils above the Sampler. **Coil the wire and lay it**

flat on the ground surface. Place the solid cap in the Cap Storage Container. Clearly mark the sample location with a pin flag or wooden stake.

5. Close the Field Kit, and on the Chain-of-Custody record: (a) sample-point number; (b) date/time of emplacement (to nearest minute); and (c) other relevant information (*e.g.*, soil type, vegetation, proximity to potential source areas). Mark the sample location and take detailed notes (*i.e.*, compass bearings and distances from fixed reference points).
6. Move to next location.
7. After installing all field samples place the Trip Blank in a 3" x 4" Sampler Bag. Store the bagged Trip Blank in the "Return Shipment" bags until retrieval, with one (1) Trip Blank in each Return Shipment bag.

Concrete, Asphalt, or Gravel Covered Areas:

1. At each survey point, drill a 1¼"- to 1½"-diameter hole through the asphalt/concrete/gravel to bare soil using a rotary hammer drill or comparable equipment. This hole should be approximately 12-14 inches deep. **Note:** When one person is performing fieldwork, it is often more efficient to drill all sample-point holes before beginning Sampler deployment.
2. When the hole through concrete/asphalt/gravel has been completed, using the ½" drill bit, extend the hole to a three foot depth. Next, take a 12-inch length of 1"-diameter metal pipe and lower it into the sample hole, being careful not to touch the inside of the pipe. Any portion of pipe above grade is cut flush with the ground surface, using the pipe cutter. With the tapping dowel and a hammer, push or tap the pipe one inch into the base of the drilled hole (see **attached figure**).
3. Remove one of the Samplers (a glass vial containing *two sets of hydrophobic* adsorbent cartridges) and unwind the retrieval wire wrapped around it. Holding the capped end of the vial in one hand, pull the wire tight (to straighten it) with the other hand. Remove the solid cap on the Sampler Vial and replace it with a Sampling Cap (a one-hole cap with a screen meshing insert). Place the solid cap in the Field Kit.

Note: At each sampling location, verify that the (black) sampling cap is on the vial before installing the Sampler.

4. Lower the Sampler, open-end down, into the metal pipe approximately four inches.

If sampling through asphalt or concrete, bend the end of the wire over the top of the pipe so that the coil of wire hangs over the top and outside of the pipe. Next, plug the top of the hole with a wad of aluminum foil. Using the tapping dowel, push down the aluminum foil so it forms a seal on the metal pipe and rests ¼" below the surfacing. Cover the hole to grade with a ¼" **thick** concrete patch. [**Note:** A ¼" thick patch is all that is required. If it is thicker it will be difficult to remove during retrieval.] Next, place the solid cap in the Cap Storage Container.

If sampling through gravel, extend the retrieval wire out of the pipe and plug the pipe with a wad of aluminum foil. Using the tapping dowel, push down the aluminum foil so it forms a seal on the metal pipe. Bend the wire over the aluminum foil plug and while the wire is extended out of the hole, cover the aluminum foil with local soil or sand. **Coil the wire and lay it flat on the ground surface.** Next, place the solid cap in the Cap Storage Container.

If a hole deeper than 12 inches is created, it will be necessary to use more than one wad of aluminum foil. In these situations, extend the wire out of the pipe. While holding onto the wire, plug the top of the pipe and hole loosely with as many wads as needed. Before inserting the last wad of foil, bend the wire so it rests below the uppermost wad of foil. This will make it easy to retrieve the Sampler during retrieval.

5. Close the Field Kit, and on the Chain-of-Custody record: (a) sample-point number; (b) date and time of emplacement (to nearest minute); (c) type of surfacing and approximate thickness; and (d) other relevant information (*e.g.*, surfacing material, proximity to potential source areas). Be sure to mark the sample location and take detailed notes (*i.e.*, compass bearings and distances from fixed reference points).
6. Move to next location.
7. After installing all field samples place the Trip Blank in a 3" x 4" Sampler Bag. Store the bagged Trip Blank in the "Return Shipment" bags until retrieval, with one (1) Trip Blank in each Return Shipment bag.

C. SAMPLER RETRIEVAL:

Prior to retrieving samples, seal each Trip Blank in a 3"x4" Sampler Bag, and place the bagged Trip Blank in a separate larger bag marked "Return Shipment Bag." One trip blank should be included with each Return Shipment Bag. Stow the sampler blocks, with the Transport vials and extra samplers, in the lower compartment of the kit. The sampler blocks are to be returned to BEACON's lab along with the samples.

Note: Each Sampler contains two sets of adsorbent cartridges. BEACON will analyze one set per Sampler; however, the second set in each Sampler can be analyzed as a field sample duplicate. Please note at which locations, if any, duplicates are to be analyzed by writing separate entries corresponding to the sample location followed by the letter "D" (*i.e.*, 3, 3-D, 4, 4-D) on the Chain-of-Custody Form. It is not necessary to alter the deployment pattern to have the duplicate samples analyzed. There is an additional per sample charge for analysis of any duplicates.

Vegetation or Bare Soils:

1. At each sample location open the Field Kit and place it and the wire cutters within easy reach. Remove a square of gauze cloth and place it and a clean towel on the open Kit. Remove a solid cap from the Cap Storage Container and place it on the Kit, also.
2. Remove the aluminum foil plug, using vise grips and the scratch awl or small screwdriver, if necessary, and retrieve the Sampler from the hole.
3. Holding the Sampler upright, clean the sides of the vial with the clean towel (especially close to the Sampling Cap). Remove the Sampling Cap, cut the wire from the vial with the wire cutters, and clean the vial threads completely with the gauze cloth.
[Note: **Completely remove the wire to ensure the cap fits tight on the vial and no soil is returned in the field kit.**]

4. Firmly screw the solid cap on the Sampler Vial and clean the vial completely with the gauze cloth. With a **ballpoint pen** record the sample number, corresponding to the sample location, on the cap's label. [**Note:** Do not use a Sharpie marker.]
5. Place the sealed and labeled Sampler Vial in the smaller 3" x 4" plastic Sampler Bag and record the sample number on the white block using a ballpoint pen. Then place the individually bagged and labeled sampler into the larger bag labeled "Return Shipment Bag."

Note: Each Sampler must be individually bagged and placed in a Return Shipment Bag with the trip blank. If you know or suspect some sample(s) collected unusually high levels of contaminants, please place these sample(s) in the provided extra bag.

6. On the Chain-of-Custody, record: (a) date and time of retrieval (to nearest minute); and (b) any other relevant information.
7. After all samples have been retrieved, verify that the caps on each Sampler are sealed tightly and that the seals on the Sampler Bags are closed. Verify that all Samplers are stored in the Return Shipment Bag, which contains an adsorbent pak. Seal the Return Shipment Bag and place it in the upper tray of the Field Kit, and place the provided tools and materials in the lower compartment of the Field Kit.

Note: Please do not return the sampling caps, used pipe, or the wire with the Field Kit as they could bias the samplers. Return *all* the other materials and equipment (blocks, extra samplers, tools, containers, etc.).

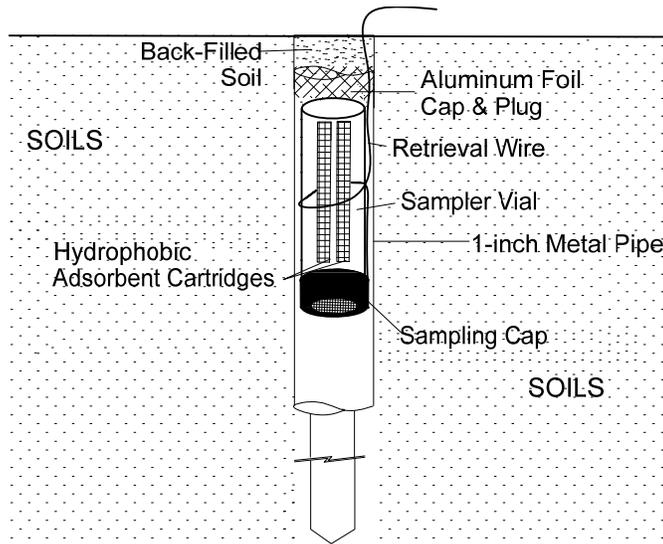
Asphalt, Concrete, or Gravel:

1. At each sample point covered by gravel, clear away the soil or sand to expose the aluminum-foil plug. For those locations covered by asphalt or concrete, use a small chisel and hammer to remove the concrete patch to expose the aluminum foil.
2. Next, open the Field Kit and place it and the wire cutters within easy reach. Remove a square of gauze cloth and place it and a clean towel on the open Kit. Remove a solid cap from the Cap Storage Container and place it on the Kit, also.
3. While securely holding onto the retrieval wire, remove the aluminum-foil plug, using the scratch awl or small screwdriver, as necessary. Holding the Sampler upright, clean the sides of the vial with the clean towel (especially close to the Sampling Cap). Remove the Sampling Cap, cut all the wire from the vial with the wire cutters, and clean the vial threads completely with gauze cloth.
[Note: Completely remove the wire to ensure the cap fits tight on the vial and no soil is returned in the field kit.]
4. Firmly screw the solid cap on the Sampler Vial and clean the vial completely with the gauze cloth. With a **ballpoint pen** record the sample number, corresponding to the sample location, on the cap's label. [**Note:** Do not use a Sharpie marker.]

5. Place the sealed and labeled Sampler Vial in the smaller 3" x 4" plastic Sampler Bag and record the sample number on the white block using a ballpoint pen. Then place the individually bagged and labeled sampler into the larger bag labeled "Return Shipment Bag."
- Note:** Each Sampler must be individually bagged and placed in a Return Shipment Bag with the trip blank. If you know or suspect some sample(s) collected unusually high levels of contaminants, please place these sample(s) in the provided extra bag.
6. On the Chain-of-Custody, record: (a) date and time of retrieval (to nearest minute); and (b) any other relevant information.
7. After all samples have been retrieved, verify that the caps on each Sampler are sealed tightly and that the seals on the Sampler Bags are closed. Verify that all Samplers are stored in the Return Shipment Bag, which contains an adsorbent pak. Seal the Return Shipment Bag and place it in the upper tray of the Field Kit, and place the provided tools and materials in the lower compartment of the Field Kit.
8. **Note:** Please do not return the sampling caps, used pipe, or the wire with the Field Kit as they could bias the samplers. Return *all* the other materials and equipment (blocks, extra samplers, tools, containers, etc.).
9. Fill sampling holes to grade with an asphalt cold patch or cement.

BEACON'S PASSIVE SOIL-GAS SAMPLER

DEPLOYMENT THROUGH SOILS



DEPLOYMENT THROUGH AN ASPHALT/CONCRETE CAP

