DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENTAL CONTROL
DIVISION OF WASTE & HAZARDOUS SUBSTANCES
SITE INVESTIGATION & RESTORATION SECTION

STANDARD OPERATING PROCEDURE

Active Soil Gas Sampling Procedure

GENERAL PROVISIONS:

This is the default procedure to be followed when installing and sampling active soil gas monitoring points. Alternative methods may be proposed and approved by DNREC-SIRS on a case by case basis.

EQUIPMENT LIST:

1) Pre-cleaned and individually certified summa canister*
2) ¾” PVC with 0.010-slot well screen
3) PVC cap to fit on ¾” PVC vapor point
4) 3/8 “ diameter Hose barb fitting with ¼” tip
5) #1 filter sand
6) Cement grout
7) Lockable expansion plug
8) Tape measurer
9) ¼” (0.64cm) ID Teflon-lined polyethylene tubing. Confirm appropriate size tubing for O2 meter connection for Short-Circuit test.
10) 100 % Liquid silicon
11) Oxygen (02) meter
12) Bucket Shroud-See Attachment 1
13) Helium tank or QA/QC gas
14) Helium meter or device capable of detecting QA/QC gas
15) Bentonite
16) Manual vacuum pump with pressure gauge
17) Electric vacuum pump
18) Tedlar bag.
19) Sampling form

* DNREC recommends, but does not require, that summa canister be pre-cleaned and individually certified.

PREPARATIONS FOR ACTIVE SOIL GAS SAMPLING:

1) Order summa® canisters from the laboratory for 8 hour sample time for commercial exposure scenario and 24 hour sample time for residential exposure scenario.
2) Personnel collecting the samples will avoid using permanent markers, or wearing perfume or cologne.

3) Do not collect samples if water is present in the vapor point. A vapor point is a hydraulically or hand-driven sub-surface boring that is meant to collect a sub-surface gas samples.

4) Soil gas samples should not be collected less than 24 hours after a heavy rain. A heavy rain is defined as greater than ½ “of rain in 1 hour.

5) The summa canister should be used within 24 hours of shipment to avoid cross-contamination. Canister can be stored longer with DNREC-SIRS permission. Record the vacuum pressure in each summa canister. If the value you just recorded is not within ± 2 psi of the value recorded by the lab prior to shipment, it can not be used (EPA, 1992).

PROCEDURE:

6) Vapor Probe Installation - Install using a Geoprobe® direct-push sampling device or handed installed method. Pre-approval is needed for the hand installed method. The vapor point will be constructed of 3/4 inch PVC or stainless steel riser. The top of the screen (PVC or stainless) will be 0.010-slot well screen to a minimum depth of 3 feet below ground surface (bgs). The screen length will be 1 foot long maximum. The vapor point will be completed to ground surface or a stick-up (requires DNREC pre-approval).

7) The annular space between each well screen and borehole will be filled with a sand pack consisting of #1 filter sand from the bottom of the borehole to 0.5 feet above the screened interval. A bentonite grout seal will be placed in the annular space above the sand pack to the surface. Alternatively, the vapor point may have a well vault constructed flush to the ground surface with the bentonite grout to the base of the well vault. A lockable expansion plug will be placed on top of each riser pipe. All connections must be threaded and no solvent or glue shall be used in the construction of the vapor point. With DNREC written pre-approval, the vapor point may also be completed as a stick-up on a case-by-case basis provided that proper QA/QC procedures can be implemented as described in this SOP.

8) Sampling will not take place until a minimum of 24 hours after construction completion of the vapor point.

9) Each vapor point will be gauged to verify its total depth, which will be used to calculate vapor point volume (total depth (ft) X 0.086L/ft).

10) A PVC cap fitted with a brass hose barb which is in turn connected to a length of Teflon-lined polyethylene tubing short enough to fit within a five-gallon bucket (as described in Attachment 2) will be placed on the vapor point head to allow
connection of the sample purge pump and sampling devices. When not conducting QA/QC tests or sampling, place the compression plug into the vapor point or put a cap over the top of the brass hose barb.

11) Liquid silicone (100%-no VOCs) must be applied to the connection of the PVC pipe and cap.

12) Short-Circuiting Test - In order to confirm proper construction of the vapor point, the following procedure should be followed:
   a) Connect the vapor point to the tubing.
   b) Purge 3 vapor point volumes (Step 9) out of the tubing using the electric vacuum pump into a tedlar bag. Empty and refill the bag until 3 vapor point volumes are purged.
   c) Monitor the air being drawn out of the ground. The oxygen level (O2) in the tubing must remain more than 2 percent less than atmospheric conditions (20.8%), or 18.8%. If levels do not stabilize at 18.8% O2 or less, then short-circuiting is occurring and the vapor point will have to be resealed or possibly re-installed.

13) Attachment 2 is a diagram of the QA/QC testing equipment. Complete QA/QC test as described in Attachment 3.

14) Prior to completing the sampling, personnel will complete a sampling form by filling in the appropriate sections (Attachment 4) noting pertinent weather conditions, vacuum present in the canister when the sampling began, whether it passed QA/QC testing, etc. Building information is not required for outdoor active soil gas sampling. Compare the vacuum pressure on the canister with the lab vacuum pressure, if it is different by more than ± 2 psi then don’t sample with the canister (USEPA, 1992).

15) A small vacuum pump, limited to less than 0.2 liter per minute, will be connected to the tubing from the horizontal ball valve and allowed to purge 3 well volumes of air into a tedlar bag. Empty and refill the bag until 3 vapor point volumes are purged.

16) At the completion of the purge period, the horizontal ball valve will be turned to the off position and the pump disconnected.

17) A summa® canister sample valve will be opened to collect the sample for either 8 hour or 24 hour sample time depending on the appropriate exposure scenario.

18) The canister must be shut off while vacuum still remains the canister.

Note the remaining vacuum from the vacuum gauge on the sampling form. Summa canisters length of actual sample collection time must be within 10% of the required sampling time interval in order to be considered a valid sample and
have a minimum of 1 in of vacuum remaining in the canister (Eurofins). For example, 7 hours for 8 hour sample time or 22 hours for a 24 hour sample. Please contact DNREC as soon as possible regarding any sampling issues to discuss the data usability.

19) An ambient air summa canister sample and duplicate should be collected at the same time as the soil gas samples. The ambient air sample should be collected at the approximate height of an adult breathing zone. The work plan should specify the number and location for duplicates and ambient air samples. Typically one (1) duplicate is required for 20 samples. The number of outdoor ambient air samples should be based on Site specific conditions but each air sampling event should include at least one (1) ambient air sample.

APPLICABILITY:

This procedure applies to the collection of any samples on sites under the jurisdiction of the Hazardous Substance Cleanup Act (HSCA).

REFERENCES:

Eurofins. Guide to Air Sampling and Analysis, Section 3.2.4.


NJDEP, 2013. Vapor Intrusion Technical Guidance-March 2013, Section 3.3.1.4
Attachment 1- Bucket Shroud Construction

EQUIPMENT LIST

1 – Food-grade 5 gal plastic bucket
3 – ¼” Male Pipe Thread (MPT) X 3/8” diameter hose barb with ¼” tip
3- ¼” MPT x ¼” MPT nipples
2 – ¼” –turn ball valves, ¼” Female pipe thread (FPT) both ends
1 – ¼” x ¼” x ¼” FPT Tee fitting
3 – 1.5” fender washers to stabilize fittings as they pass through

Construction

a. Drill three holes in a plastic five gallon bucket-2 on sides (one higher and one lower) and 1 on top. This is the bucket shroud. The holes need to be sufficiently large to accommodate the hose barbs in Step b.

b. Place a 3/8 “diameter male-thread Hose barb fitting with ¼” tip in each of the side holes. Place a 1.5” washer on inside and outside of the side holes. Seal with silicon caulking (100%-no VOCs). The lower port will be used for Leak-Testing and the upper port for attaching the tracer gas.

c. Place tubing onto the outside tracer gas ports.

d. Thread a ¼’ hose barb with a male thread through a 1.5” washer, the top hole in the bucket, another washer, and finally thread into the vertical ball valve. Tighten this fitting and apply silicone sealant to the washers. Assemble the remainder of the manifold as shown on the diagram below.

e. Seal all threaded connections with Teflon tape, soap all connections and pressure test. Seal any leaks.
MANIFOLD X-SECTION

1/4" HOSE BARB

1/4" X 1/4" PIPE NIPPLE

1/4" X 1/4" X 1/4" TEE

1/4" X 1/4" PIPE NIPPLE

1/4" BALL VALVE

1/4" HOSE BARB

C THREADS THROUGH BUCKET

WASHERS #2 DIRECTLY INTO BALL VALVE

TOP OF BUCKET
**Attachment 3- QA/QC Steps**

Conduct a QA/QC test of the equipment. The vapor point must pass the QA/QC test in order to collect the samples in the canisters. Please review the October 2006 New York State Department of Health, “Guidance for Evaluating Soil Vapor Intrusion”, pages 26-28 for additional guidance on conducting QA/QC procedures. See Attachment 1 for an illustration of the QA/QC Procedures.

2) Helium or propylene may be used as a tracer gas.

3) The QA/QC set-up is as follows:

   a. Hook up the tubing from the PVC cap on the top of the vapor point to the brass hose barb at the top of the inside of the bucket.

   b. Connect Teflon-lined tubing between the top of the stainless steel manifold and the summa canister. This is known as the “sample train.”

   c. Seal the bucket to the ground with bentonite.

   d. Connect the tracer gas meter to the tracer gas relief port on the side of the bucket shroud using Teflon-lined tubing.

   e. Connect tracer gas tank to a tracer gas fill port on the side of the bucket shroud using Teflon-lined tubing and then fill the bucket with tracer gas.

   f. Measure the tracer gas concentration with a meter capable of detecting the tracer gas. Note the concentration. This represents the concentration in the bucket.

   g. Remove the tracer gas meter and crimp or place a plastic cap on the end of the tubing.

   h. The concentration measured from the ball valve should be less than 10% of concentration measured from the tracer gas relief port. This indicates a good seal.

   i. If it is greater than 10%, recheck all fittings and seal fitting on the vapor point until it meets this 10% rule.

   j. Shut-in Test: Close the ball valve (located directly above the bucket) while attaching a vacuum pump with a pressure gauge to the horizontal ball valve with Teflon-lined tubing. Open the horizontal ball valve and using the vacuum pump lower the pressure within the sample train to -7” Hg (NJDEP, 2013). If after 5 minutes there is less than +2 psig change in the vacuum, then proceed with the sampling otherwise tighten fittings until this is achieved.
Attachment 4- DNREC-SIRS Sampling Form

DNREC SIRS Vapor Intrusion Policy

Field Sampling Form

Project #: __________________________ Sample #: __________________________
(Attach Sample Map)

Project Name: __________________________
Sampled By: __________________________
Date Sampled: __________________________ Time: __________________________

General Site Conditions:

Atmospheric Data:
Source of Data
Precipitation during sampling
Amount of Precipitation
Barometric Pressure
Temperature
Wind Speed
Wind Direction

Sampling System
(check one)

Whole-Air active approach
Whole-Air passive approach
Sorbed contaminants-active approach
Sorbed contaminants-passive approach
Headspace or extraction approach
soil pore liquid headspace approach

Sample Type
Direct Field Sample Field
Blank
Travel Blank
Sample Container Blank
Sample Probe Blank
Sample Replicate Blank

Spiked _________ with ________ cc of _________

Potential reaction products due to spiking:

System Purge Volume: _________ Volumes Purged: _________ Volumes Sample Volume: _________
Sorbent Device: Installed: ______________ Date/time
Recovered: ______________ Date/time

Sample Container Type: ______________ Sample Container #: ______________

Analytical Method: ______________ (Chain of Custody Attached)
<table>
<thead>
<tr>
<th>Integral Analyzer:</th>
<th>Detector:</th>
<th>(attach equipment calibration, detections to this form)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzer Result:</td>
<td>Surface cover:</td>
<td>Sample Depth:</td>
</tr>
<tr>
<td>Sample Horizon data visual estimates:</td>
<td>Vadose Zone Make-up:</td>
<td>Native soil+rock</td>
</tr>
<tr>
<td>Soil Composition:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay</td>
<td>Soil Organic matter</td>
<td>Fine Granular Material</td>
</tr>
<tr>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Moisture Content:</td>
<td>Other characteristics:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>free water present</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Free product</td>
</tr>
<tr>
<td></td>
<td></td>
<td>contaminant odors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>poor perm. To vapor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>near slope or vent</td>
</tr>
</tbody>
</table>
INDOOR AIR BUILDING SURVEY & SAMPLING FORM

Survey Completed by: ________________________________ Date: ______________

Site Name: ________________________________________
DE#: ____________________

Part I - Occupants

Building Address:
________________________________________________________________________

Property Contact: ________________________________________________
Owner/Renter/Other: _________________________________________

Contact’s Phone: home (    )________________ work (    )______________
cell (    )________________

Contact’s Email: __________________________

Building occupants: Children under age 13 _____ Children age 13-18 ______ Adults _____

Special Health Conditions (respiratory, cardiovascular; partially able or homebound?)
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Allergies_____________________________________ Other (describe) ____________________

Part II – Building Characteristics

Building type: single-family residential / trailer or mobile / multi-family residential (duplex, row, apartment?) / office / strip mall / commercial / industrial

Describe building:
1) age
2) construction frame / masonry / steel / other;
3) type of insulation;
4) type of roof
5) general condition and air tightness
6) fireplace or chimney (serviced recently?)

Number of floors - below grade: ______  (full basement / crawl space / slab) at or above grade:
______________________________________________________________________________
______________________________________________________________________________
Number of rooms _____________  Do windows open? ________________________________
Basement size: _______ ft² Basement floor: concrete / dirt / floating / other (specify): ____
______________________________________________________________________________
Foundation type: poured concrete / cinder blocks (hollow?) / stone / other (specify):
______________________________________________________________________________
Type of ground cover around outside of building: grass / concrete / asphalt / other (specify):
______________________________________________________________________________
If vegetation, does it appear stressed? _____________  French drain? _____________  Flooding experienced? _____________
Floor drains present? ________  If yes, trap present? _____________  Water in trap? _____________
Connected to a:  a) sanitary sewer  b) storm sewer  c) septic system
d) surface discharge  e) unknown
Basement sump present? Yes / No  Sump pump? Yes / No
Type of heating system (circle all that apply):

hot air circulation  hot air radiation  wood  steam radiation
kerosene heater  hot water radiation  electric baseboard  heat pump
other (specify):  solar/air  solar/glycol or other heat transfer fluid
solar/water

If air, when were filters changed last?

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Type of ventilation system (circle all that apply):
- central air conditioning
- mechanical fans
- bathroom ventilation fans
- individual air conditioning units
- kitchen range hood fan
- other (specify): ___________________________

Type of fuel utilized (circle all that apply):
- Natural gas
- electric
- fuel oil
- wood-wood pellets
- coal
- solar
- kerosene
- waste oil
- outside (fresh) air intake

Septic system?  Yes / Yes (but not used) / No  Irrigation/private well?
Yes / Yes (but not used) / No

Public or private well  Yes / No  If public, name of company ___________________________

Existing subsurface depressurization (radon) system in place? Yes / No
and running? Yes / No

**Part III - Outside Contaminant Sources**

DNREC  DEN/Marplot/Brownfields lists (1000-ft. radius):

Previous land use in area:
______________________________________________________________________________

Other stationary sources nearby:

<table>
<thead>
<tr>
<th>Gas stations</th>
<th>Emission stacks</th>
<th>Refineries/chemical plants</th>
<th>Fuel oil tanks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste disposal facilities (LFS &amp; WWTPs)</td>
<td>Beauty shops</td>
<td>Hot-mix plants</td>
<td>Road or roof</td>
</tr>
<tr>
<td>Dry cleaners</td>
<td>Auto repair/body shops</td>
<td>Auto repair/body shops</td>
<td>Repair w/ hot tar</td>
</tr>
</tbody>
</table>

Wetlands nearby? (distance and direction)
______________________________________________________________________________

Heavy vehicular traffic nearby (or other mobile sources):
______________________________________________________________________________

Known groundwater or soil contamination within 1000 feet
______________________________________________________________________________
Physical parameters of unsaturated zone (summarize or attach)

Sinkholes or Debris Pits

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**Part IV – Indoor Contaminant Sources**

Identify all potential indoor sources found in the building (including attached garages), the location of the source (floor & room), and whether the item was removed from the building 48 hours prior to indoor air sampling event.

<table>
<thead>
<tr>
<th>Potential Sources</th>
<th>Location(s)</th>
<th>Removed Prior to Sampling? (Yes / No / NA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline storage cans</td>
<td></td>
<td></td>
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<tr>
<td>Gas-powered equipment</td>
<td></td>
<td></td>
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<tr>
<td>Kerosene storage cans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paints / thinners / strippers / glues / caulks</td>
<td></td>
<td></td>
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<tr>
<td>Cleaning solvents</td>
<td></td>
<td></td>
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<tr>
<td>Oven cleaners</td>
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<td></td>
</tr>
<tr>
<td>Carpet / upholstery cleaners</td>
<td></td>
<td></td>
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<tr>
<td>Other house cleaning products / laundry products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moth balls</td>
<td></td>
<td></td>
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<tr>
<td>Polishes / waxes</td>
<td></td>
<td></td>
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<tr>
<td>Insecticides</td>
<td></td>
<td></td>
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<tr>
<td>Furniture / floor polish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nail polish / polish remover</td>
<td></td>
<td></td>
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<tr>
<td>Hairspray</td>
<td></td>
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<tr>
<td>Cologne / perfume / after-shave, etc.</td>
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<td></td>
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<tr>
<td>Air fresheners</td>
<td></td>
<td></td>
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<tr>
<td>Fuel tank (inside building) (outside)</td>
<td></td>
<td></td>
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<tr>
<td>Wood stove or fireplace</td>
<td></td>
<td></td>
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<tr>
<td>New furniture / upholstery</td>
<td></td>
<td></td>
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<tr>
<td>New carpeting / flooring / paneling</td>
<td></td>
<td></td>
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<tr>
<td>Recent painting in building? Roof repair?</td>
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<tr>
<td>Hobbies - glues, paints, etc.</td>
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<td></td>
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<tr>
<td>Toilet or septic additives</td>
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<td></td>
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<tr>
<td><strong>Dry drain traps, plugged drains, toilets won’t flush</strong></td>
<td></td>
<td></td>
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<tr>
<td>-------------------------------------------------------</td>
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<tr>
<td><strong>Garbage/spoiled food</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Standing water/tire piles/recent flooding</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Sewage/septage</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Dead animals (including unusual numbers of insects)</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Mold/mildew</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Wet sheetrock/paneling/flooring</strong></td>
<td></td>
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<tr>
<td><strong>Neighbors making drugs/Explosives</strong></td>
<td></td>
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<tr>
<td><strong>Mercury-containing switches or instruments</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Alcohol/bleach/disinfectants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Recent concrete/masonry work</strong></td>
<td></td>
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<tr>
<td><strong>Flowers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pets (specify); scented kitty litter</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Compost/manure</strong></td>
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</tbody>
</table>

**Part V – Miscellaneous Items**

Do any occupants of the building smoke?  Yes / No  How often?  _____________

Any chronic health problems?  Yes / No

Has anyone smoked within the building within the last 48 hours?  Yes / No

Does the building have an attached garage?  Yes / No
If yes, does garage have heat/ventilation?  Yes / No
Connected to house or separate?  Yes / No  Windows?  Yes / No

If so, is a car usually parked in the garage?  Yes / No

Do the occupants of the building have their clothes dry-cleaned?  Yes / No
If yes, name of dry cleaner  ___________________________________________________________________

When were dry-cleaned clothes last brought into the building?
_____________________________________________________________________________________

Have the occupants ever noticed any unusual odors in the building?  Yes / No

Describe (with location):  Date  _______________  Amount
_____________________________________________________________________________________

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Any known spills of a chemical, fuel or sewage immediately outside or inside the building?  
Yes  /  No  Fires? Yes  / No

Describe (with location):_____________________________________________________
______________________________________________________________________________

Have any pesticides/herbicides been applied around the building foundation or in the yard/gardens? Yes  / No

Have any pesticides been applied regionally, e.g. by Mosquito Control or DSWC?  Yes  / No

If so, when and which chemicals?
______________________________________________________________________________
______________________________________________________________________________

Are odors more noticeable under certain weather conditions?  Describe (wind direction/speed/precipitation/temperature/humidity):
______________________________________________________________________________
______________________________________________________________________________

Part VI – Sampling Information

Sample Technician: ________________________ Phone number: (____) _______ - _________

Sampler Type:  Tedlar  /  Sorbent  /  Canister
Analytical Method:  TO-15  /  TO-17  /  other:  _______________________________________

Laboratory:  _________________________________    NJ Certified Lab?  Yes  /  No

<table>
<thead>
<tr>
<th>Sample #</th>
<th>Floor</th>
<th>Room</th>
<th>Canister / Tube #</th>
<th>Pump ID # (if applicable)</th>
<th>Sample Start Date / Time</th>
<th>Sample End Date / Time</th>
</tr>
</thead>
</table>

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Sample location(s):  
Location(s) in Building

<table>
<thead>
<tr>
<th>Sample #</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Provide Drawing of Sample

Did the occupants **not** follow any of the “Instructions for Residents” directions?  Yes / No

If so, describe modifications: __________________________________________________________

**Part VII - Weather Conditions**

Outside temperature at time of sampling: _____ °F

Expected high temperature: _____ °F  Expected low temperature: _____ °F

Humidity: ___________  Barometric pressure: _________________  Ozone: Red/Orange alert?

Was there significant precipitation within 12 hours of (or during) the sampling event?  Yes / No

Wind direction and speed

___________________________________________________________
Describe the general weather conditions:

---

*Fill out and attach DNREC SIRB Vapor Intrusion Guidance Document Field Sampling Form 1 to this form.*

**Part VIII – General Observations**

Provide any information that may be pertinent to the sampling event and may assist in the data interpretation process.

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