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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 measure
9) ¼" (0.64cm) ID Teflon-lined polyethylene tubing. Confirm appropriate size tubing for O_2 meter connection for Short-Circuit test.
10) 100 % Liquid silicone
11) Oxygen (O_2) 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
20) Photoionization detector

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

PREPARATIONS FOR ACTIVE SOIL GAS SAMPLING:

1) Order 6 L summa® canisters and flow controllers from the laboratory for ½ hour sample time

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 $\pm$ 2 psi of the value recorded by the lab prior to shipment, it cannot be used (EPA, 1992).

PROCEDURES:

A. Vapor Point Installation

1) Install vapor point using a Geoprobe® direct-push sampling device or hand installed method. Pre-approval is needed from DNREC-SIRS for the hand installed method. The vapor point will be constructed of ¾-inch diameter PVC or stainless steel. 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).

2) 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 (except 100% liquid silicone) 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.

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

4) 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).

5) 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.

6) Liquid silicone (100% VOC free) must be applied to the connection of the PVC pipe and cap.

B. QA/QC Testing

1) 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 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) Connect the oxygen meter to the tubing to monitor the air being drawn out of the ground. The oxygen level (O_2) 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% O_2 or less, then short-circuiting is occurring and the vapor point will have to be resealed or possibly re-installed.

2) QA/QC testing of equipment - **Attachment 2** is a diagram of the QA/QC testing equipment. In order to confirm proper system seals, complete QA/QC test as described in **Attachment 3**.

3) 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. Another format containing this information is acceptable. Building information is not required for outdoor active soil gas sampling. Compare the vacuum pressure on the canister with the lab-recorded vacuum pressure, if it is different by more than $\pm$ 2 psi then don't sample with the canister (USEPA, 1992).

4) 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.

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

C. Sample Collection

1) A summa® canister sample valve will be opened to collect the sample for a 1/2 hour sample time.

2) The canister must be shut off while vacuum still remains in the canister. Note the remaining vacuum from the vacuum gauge on the sampling form. Samples are required to be received by

the analytical laboratory with a remaining vacuum ranging from a minimum five to ten inches of vacuum (Eurofins,2014).

Please contact DNREC as soon as possible regarding any sampling issues to discuss the data usability.

3) An ambient air summa canister sample and duplicate should be collected at the same time as the routine 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 per 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, Revised June 27, 2014. Guide to Air Sampling and Analysis, Section 3.2.4.

USEPA, 1992. OSWER Publication 9360.4-05- Compendium of ERI Air Sampling Procedures.

NJDEP, 2013. Vapor Intrusion Technical Guidance-March 2013, Section 3.3.1.4

New York State Department of Health, 2006 Guidance for Evaluating Soil Vapor Intrusion

Attachment 1- Bucket Shroud Construction

EQUIPMENT LIST

1 – Food-grade 5 gallon 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. The 5 gallon bucket is the primary component of the bucket shroud. Flip the bucket over so that the base of the bucket is now the top of the shroud.

b. Remove the handle from the bucket. Drill three holes in a plastic 5 gallon bucket.

    i. Two holes should be drilled on one side of the bucket (one higher and one lower) that are sufficiently large enough to accommodate a ⅜” hose barb fittings.

    ii. One hole should be drilled in the center of the top of the shroud. The hole should be sufficiently large enough to accommodate a ¼” diameter hose barb fitting.

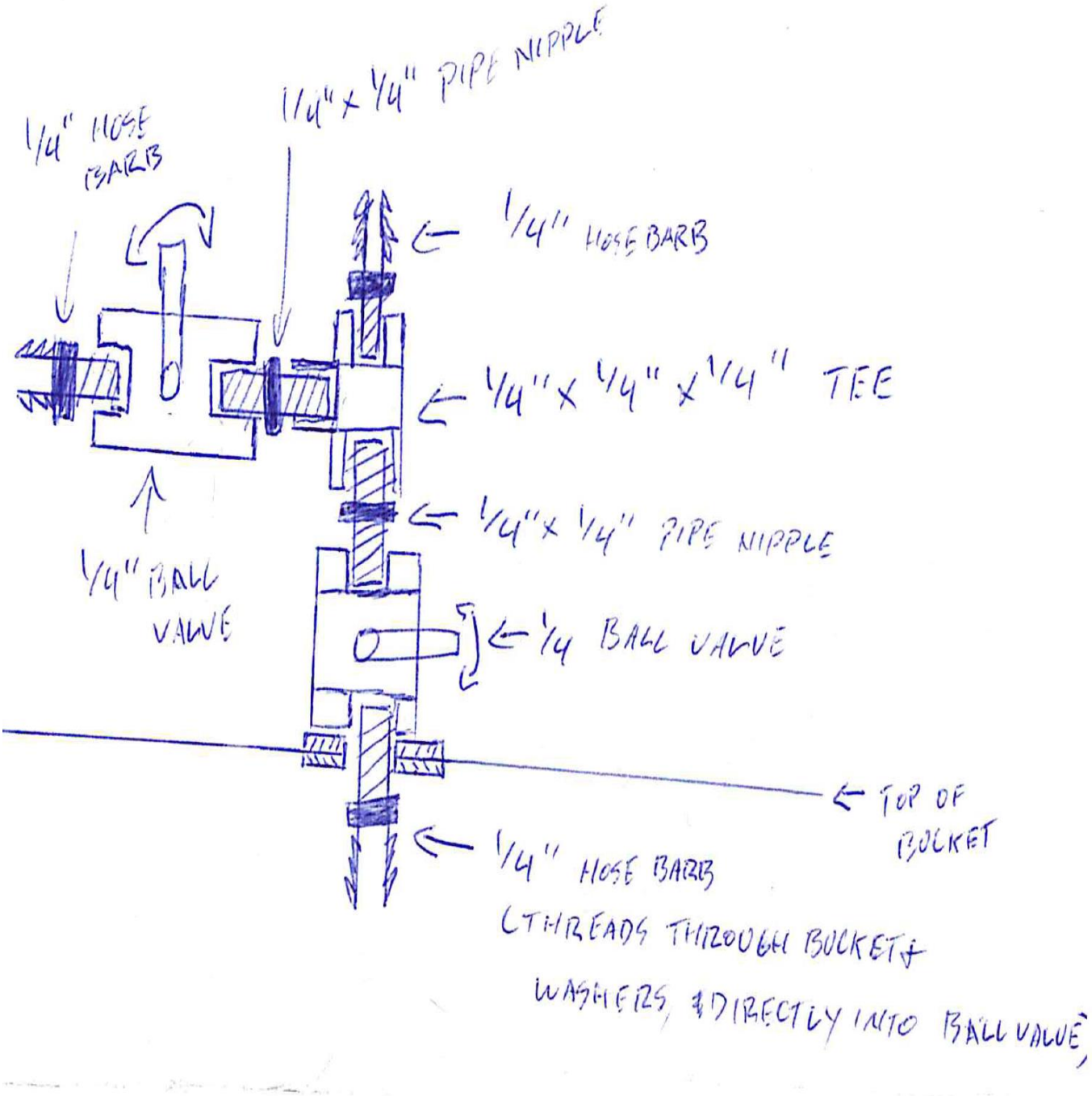
c. Place a 3/8” diameter male-thread Hose barb fitting with ¼” tip in each of the side holes. Place a 1.5” washer on inside and outside of the side holes. Seal with silicon caulking (100% VOC free). The lower port will be used for leak-testing and the upper port for attaching the tracer gas.

d. Place tubing onto the outside tracer gas ports.

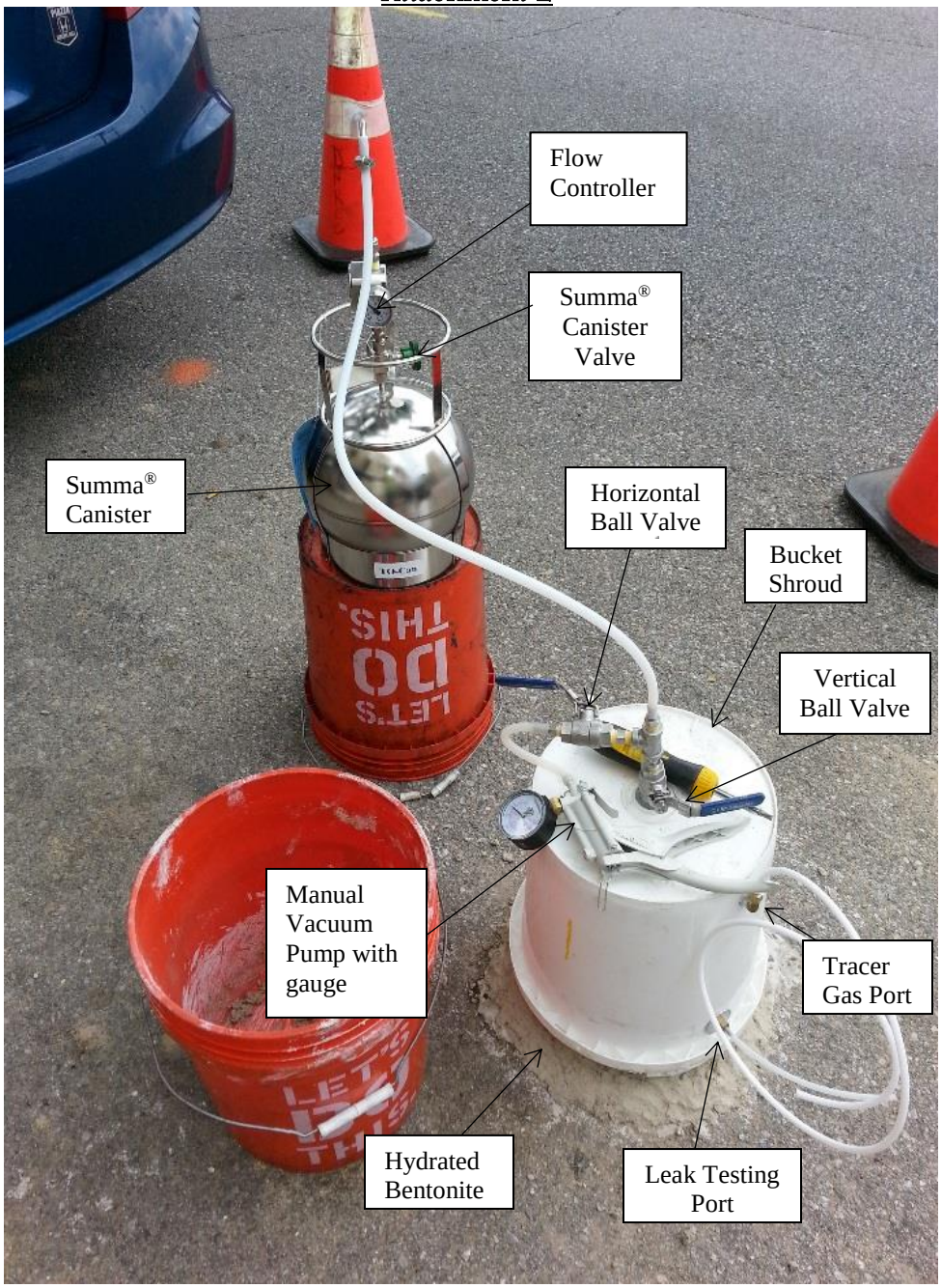
e. Thread a ¼” hose barb with a male thread through a 1.5” washer, the top hole in the bucket, another washer, and finally thread into the vertical ball valve. Tighten this fitting and apply silicone sealant to the washers. Assemble the remainder of the manifold as shown on the diagram below.

f. Seal all threaded connections with Teflon tape, soap all connections and pressure test. Seal any leaks.

MANIFOLD X-SECTION



Attachment 2



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.

1) 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.

Helium or propylene may be used as a tracer gas.

2) 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 Press.(Outside/Inside))

_____ Temp(Outside/Inside)

_____ Wind Speed

_____ Wind Direction

Sampling System (check one)

( ) Whole-Air active approach (summa)

( ) Whole-Air passive approach

( ) Sorbed contaminants-active approach

( ) Sorbed contaminants-passive approach

( ) Headspace or extraction approach

( ) soil pore liquid headspace approach

Sample Type

( ) Field Blank

( ) TravelBlank

( ) Sample Replicate

_____ _____ _____

System Purge Volume (0.086 L/ft) * Depth (ft): _____ Volumes Purged (3): _____ Sample Volume: _____

Sorbent Device: Installed: _____ Date/time

Recovered _____ Date/time

Sample Container Type: _____ Sample Container #: _____

Analytical Method: _____ (Chain of Custody Attached)

Analyzer Result: _____

Surface cover: _____

Concrete Thickness: _____

Condition Of Concrete Floor near Sample: _____

Sample Depth: _____ Sampling rate: _____

Soil Composition:	Clay	_____	%
	Soil Organic matter	_____	%
	Fine Granular Material	_____	%
	Coarse Granular Material	_____	%

Moisture Content: _____

Other characteristics:	_____	free water present	_____ indurated
	_____	Free product	_____ discoloration
			probable connection to surface macropores
	_____	contaminant odors	_____

QA/QC Testing Results

Note- Each vapor point must pass all the QA\QC Tests below before sampling. Reseal and Retest until the vapor point passes the test.

Test #1A- Short Circuit Test

Oxygen reading in % O_2 : _____ Did the vapor points pass the test (<=18.8%): Y/N (circle one)

Notes: _____

Test #1B- Short Circuit Test

Oxygen reading in % O_2 : _____ Did the vapor points pass the test (<=18.8%): Y/N (circle one)

Notes: _____

Test #2- Helium Test (Please see Attachment 3- Active Soil Gas or Sub-Slab Air Sampling SOP for details)

Test #2A- Helium Concentration within the Shroud: _____

Helium Concentration within tubing: _____
Did the vapor points pass the test (tubing<10% of the shroud): Y/N (circle one)

Test #2B- Helium Concentration within the Shroud: _____
Helium Concentration within tubing: _____
Did the vapor points pass the test (tubing<10% of the shroud): Y/N (circle one)
Notes:

_____

Test #3- Shut-in Test (Please see Attachment 3- Active Soil Gas or Sub-Slab Air Sampling SOP for details)

Test 3A# Pass Shut in test by maintaining -7 in. Hg in tubing from the shroud to the summa canister for 5 minutes: Y/N (circle one)
Notes:

_____

Test 3B# Pass Shut in test by maintaining -7 in. Hg in tubing from the shroud to the summa canister for 5 minutes: Y/N (circle one)
Notes:

_____

Test 3C# Pass Shut in test by maintaining -7 in. Hg in tubing from the shroud to the summa canister for 5 minutes: Y/N (circle one)
Notes:

_____

Sampling Information

Laboratory: _____

Sample #	**Floor**	**Room**	**Canister / Tube #**	**Pump ID #** (if applicable)	**Sample Start** Date / Time	**Sample End** Date / Time

Sample location(s):

Provide Drawing of Sample Location(s) in Building

Sample # _____ - _____

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

If so, describe modifications: _____

General Observations

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

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

INDOOR AIR BUILDING SURVEY

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: _____ ft^2 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 hot water radiation	wood	steam radiation
kerosene heater	electric baseboard	heat pump	
other (specify): _____			
solar/air	solar/glycol or other heat transfer fluid		
solar/water			

If air, when were filters changed last?

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:

Gas stations	Emission stacks	Refineries/chemical plants	
Waste disposal facilities (LFS & WWTPs)		Hot-mix plants	Fuel oil tanks
Dry cleaners	Beauty shops	Auto repair/body shops	Road or roof Repair w/hot tar

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

_____

_____

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.

Potential Sources	**Location(s)**	**Removed Prior to Sampling? (Yes / No / NA)**
Gasoline storage cans		
Gas-powered equipment		
Kerosene storage cans		
Paints / thinners / strippers / glues / caulks		
Cleaning solvents		
Oven cleaners		
Carpet / upholstery cleaners		
Other house cleaning products/laundry products		
Moth balls		
Polishes / waxes		
Insecticides		
Furniture / floor polish		
Nail polish / polish remover		
Hairspray		
Cologne / perfume / after-shave, etc.		
Air fresheners		
Fuel tank (inside building) (outside)		NA
Wood stove or fireplace		NA
New furniture / upholstery		
New carpeting / flooring /paneling		NA
Recent painting in building? Roof repair?		NA
Hobbies - glues, paints, etc.		
Toilet or septic additives		

Dry drain traps, plugged drains, toilets won't flush		
Garbage/spoiled food		
Standing water/tire piles/recent flooding		
Sewage/septage		
Dead animals (including unusual numbers of insects)?		
Mold/mildew		
Wet sheetrock/paneling/flooring		
Neighbors making drugs/Explosives		
Mercury-containing switches or instruments		
Alcohol/bleach/disinfectants		
Recent concrete/masonry work		
Flowers		
Pets (specify); scented kitty litter		
Compost/manure		

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? _____
Connected to house or separate?_____ 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
_____

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):
_____
_____