REPORT

Soil Vapor Sampling Work Plan

Elmira (Madison Avenue) Former MGP Site
Elmira, New York

New York State Electric and Gas Corporation
Binghamton, New York

March 2006

Respectfully submitted,

BLASLAND, BOUCK & LEE, INC.

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1. Introduction

This document presents New York State Electric & Gas Corporation's (NYSEG's) Work Plan for soil vapor sampling at the Elmira (Madison Avenue) former MGP site located in Elmira, New York (Figure 1). This Work Plan has been prepared in response to the New York State Department of Environmental Conservation's (NYSDEC's) request for a soil vapor investigation as discussed in its July 7, 2005 comments on the May 2005 draft Supplemental Remedial Investigation (SRI) Report. NYSEG submitted a draft Soil Vapor Sampling (SVS) Work Plan on January 11, 2006, and NYSDEC and the NYS Department of Health (NYSDOH) provided comments on the draft SVS Work Plan in a letter dated February 16, 2006. NYSEG submitted a response to the NYSDEC's/NYSDOH's comments in a March 9, 2006 letter. NYSDEC provided written approval of NYSEG's responses in a March 9, 2006 e-mail. This SVS Work Plan formalizes the agreements made between NYSEG, NYSDEC, and NYSDOH as detailed in the documentation noted above. The soil vapor sampling activities described herein will be performed to assess whether site-related volatile organic compounds (VOCs) are present in soil vapor beneath select buildings on and in the vicinity of the site.

Relevant background information is presented below, followed by a discussion of the proposed sampling activities and anticipated schedule.

2. Background

The draft SRI Report provides a detailed discussion of the site conditions. The draft SRI Report includes the following information that is relevant for assembling the scope of the soil vapor sampling program discussed herein:

- Detected concentrations and extent of VOCs and polycyclic aromatic hydrocarbons (PAHs) in shallow groundwater at the site;
- Areas where non aqueous phase liquid (NAPL) has been observed above and below the water table; and
- Areas where PAHs were detected at concentrations greater than 500 parts per million (ppm) in soil above the water table.

We've included Figures 8 and 9 from the draft SRI Report in Attachment 1. These figures depict the information discussed in the above bullets.

The results presented in the draft SRI Report indicate that several VOCs have been detected in shallow groundwater beneath the site at concentrations above NYSDEC Class GA groundwater Standards. These VOCs include 1,1,1-trichloroethene, 1,1-dichloroethane, 1,1-dichloroethene, chloroethane, xylenes, benzene, ethylbenzene and toluene. As such, these VOCs are considered to be constituents of concern (COCs) for the soil vapor sampling program. In addition, naphthalene is also being considered as a COC because it is a volatile PAH that has been detected in groundwater beneath the site at concentrations higher than the respective Class GA groundwater Guidance Value.

Note that the chlorinated VOCs detected on site are not likely related to the MGP operations. These compounds are likely the result of activities conducted at or near the site after the MGP was dismantled.

3. Proposed Soil Vapor Sampling Program

Sub-slab soil vapor sampling will be performed to evaluate the potential presence and concentrations of COCs in sub-slab vapor. The six sub-slab sampling locations are shown on Figure 1. These locations were selected to provide a worst-case exposure scenario as the buildings considered for sampling are located near areas with COCs at levels above Class GA groundwater standards (which also generally coincide with areas of NAPL above and/or below the water table).

Sampling locations are discussed below.

- *SV-1 and SV-2:* Soil vapor sampling points SV-1 and SV-2 are located in the warehouse/storage building owned by I. D. Booth in the western portion of the site. These sampling points are located near shallow groundwater that contains concentrations of COCs above groundwater Standards (near monitoring wells NMW-0401S and MW-3S) and therefore are considered to represent a worst-case exposure scenario for this particular building. In addition, collecting these samples existing groundwater monitoring wells will allow for comparison of soil vapor and groundwater data.

- *SV-3, SV-4 and SV-5:* These soil vapor sampling locations are in the larger of the two Trayer buildings along the southern edge of the site. Given the relatively large size of this building, these three samples are positioned in areas that will provide adequate spatial coverage. As shown on Figure 1, SV-3 is near NAPL monitoring well NMW-0402S (which has COCs in groundwater above Standards). Location SV-4 is east of SV-3, just outside the extent of groundwater VOCs above Standards (Figure 1). This location is chosen to assess whether potential vapor issues exist in areas just outside the area identified as having groundwater concentrations above Standards. Sample location SV-5 is located near monitoring well MW-9S. Although concentrations in groundwater from this well do not exceed groundwater Standards, the extent of VOCs above groundwater Standards is nearby and immediately upgradient from this area.

- *SV-6:* This soil vapor sampling location is in the smaller and easternmost Trayer building (Figure 1). SV-6 is located adjacent to monitoring well MW-8S, which has VOCs in groundwater above Standards.

Final sampling locations will be selected in the field, and modified as necessary, based on a site reconnaissance and a building survey. The building survey will be conducted to:

- verify floor construction (e.g., slab-type);
- inspect foundations;
- locate sumps, floor drains, floor joints, and footers; and
- document the heating, ventilation, and air conditioning system (HVAC).

As discussed in NYSEG's March 9, 2006 letter, we have not been inside any of the three buildings proposed for sub-slab soil vapor sampling. As such, we are not sure if the areas we've proposed for sampling will be accessible due to possible obstructions (e.g., utilities, large machinery, etc.). Should any location be inaccessible, we will attempt to locate an alternate sub-slab sampling point inside of the building that is near our originally proposed location. The final locations of all soil vapor sampling points will be agreed upon with NYSDEC and/or NYSDOH during a building survey. The building survey will be conducted prior to performing the sampling work.

Should we be unsuccessful in locating a suitable alternate indoor sub-slab sampling location for potential inaccessible sub-slab sampling points, we will propose an outdoor subsurface sampling point that is near the original sub-slab sampling point. We may collect an indoor air sample as close as reasonably possible to the outdoor subsurface sampling point. The indoor air sample will be collected at the same time as the outdoor subsurface sample. NYSEG will consult with NYSDEC and/or NYSDOH during the building survey to determine the scope of any outdoor subsurface sampling and indoor air sampling, should this approach become necessary.

4. Soil Vapor Sampling Methodology

The methods for collecting sub-slab and subsurface soil vapor samples are detailed in the Standard Operating Procedures (SOPs) in Attachments 2 and 3. The NYSDOH's draft Guidance for Evaluating Soil Vapor Intrusion in the State of New York was considered in the development of these SOPs. For this program, each sub-slab soil vapor sampling point is proposed to be installed as a temporary sampling point. In addition to collecting sub-slab soil vapor samples, the outdoor air pressure, sub-slab air pressure, and air pressure inside the buildings will also be measured to assess pressure differentials.

Samples (including a single duplicate sample) are to be collected and analyzed using the United States Environmental Protection Agency (USEPA) Method TO-15, including n-alkanes and tentatively identified compounds (TICs). The complete list of analytes is provided in Table 1. Analyses will be conducted by a laboratory with current New York State Environmental Laboratory Approval Program (ELAP) certification in accordance with USEPA Compendium Method TO-15. The data report will be a Category B-equivalent data package to provide for completion of a Data Usability Summary Report (DUSR) of the data, if deemed necessary. The turnaround for analytical results will be 3 to 4 weeks after the laboratory receives the samples.

5. Schedule and Reporting

NYSEG will discuss the soil vapor sampling program with the building owners once the NYSDEC/NYSDOH approves this Work Plan. Following these discussions, we will conduct a building survey and finalize the sampling locations. We request that the NYSDEC and/or the NYSDOH assist with the building survey so that we can mutually agree on the final soil vapor sampling locations. NYSEG is prepared to implement the soil vapor sampling program within approximately two to three weeks after the property owners have provided written authorization for the work.

A summary letter report will be prepared following receipt of the soil vapor sampling analytical results. The letter report will include:

- a summary of work performed and analytical results obtained during the soil vapor sampling program;
- an evaluation of the soil vapor results based on relevant guidance (as appropriate);
- data table(s) presenting analytical results; and
- figure(s) showing soil gas sampling locations and corresponding laboratory analytical results.

The summary letter report will be submitted to the NYSDEC/NYSDOH approximately one month after receipt of the analytical results. NYSEG will submit the letter report to the building owners after NYSDEC/NYSDOH have reviewed and approved the document.

Table

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TABLE 1
PROPOSED ANALYTE LIST AND REPORTING LIMITS

NEW YORK STATE ELECTRIC & GAS CORPORATION
MADISON AVENUE FORMER MGP SITE
ELMIRA, NEW YORK

I. Target Analytes

Compound	RL ppb(v/v)	RL (ug/m3)	Compound	RL ppb(v/v)	RL (ug/m3)
Benzene	0.2	0.63	1,1,2,2-Tetrachloroethane	0.2	1.37
Bromomethane	0.2	0.77	Tetrachloroethene	0.2	1.35
Carbon tetrachloride	0.2	1.25	Toluene	0.2	0.75
Chlorobenzene	0.2	0.92	1,2,4-Trichlorobenzene	1	7.42
Chloroethane	0.2	0.52	1,1,1-Trichloroethane	0.2	1.09
Chloroform	0.2	0.97	1,1,2-Trichloroethane	0.2	1.09
Chloromethane	0.5	1.03	Trichloroethene	0.2	1.07
1,2-Dibromoethane (EDB)	0.2	1.53	Trichlorofluoromethane	0.2	1.12
1,2-Dichlorobenzene	0.2	1.2	1,1,2-Trichloro-1,2,2-trifluoroethane	0.2	1.53
1,3-Dichlorobenzene	0.2	1.2	1,2,4-Trimethylbenzene	0.2	0.98
1,4-Dichlorobenzene	0.2	1.2	1,3,5-Trimethylbenzene	0.2	0.98
Dichlorodifluoromethane	0.2	0.98	Vinyl chloride	0.2	0.51
1,1-Dichloroethane	0.2	0.8	m-Xylene & p-Xylene	0.2	0.86
1,2-Dichloroethane	0.2	0.8	o-Xylene	0.2	0.86
1,1-Dichloroethene	0.2	0.79			
cis-1,2-Dichloroethene	0.2	0.79	**Alkanes:**		
1,2-Dichloropropane	0.2	0.92			
cis-1,3-Dichloropropene	0.2	0.9	n-Butane	0.4	0.95
trans-1,3-Dichloropropene	0.2	0.9	n-Decane	1	5.81
1,2-Dichloro-1,1,2,2-tetrafluoroethane	0.2	1.39	n-Dodecane	1	6.96
Ethylbenzene	0.2	0.86	n-Heptane	0.5	2.04
Hexachlorobutadiene	1	10.66	n-Hexane	0.5	1.76
Isopropylbenzene	0.4	1.96	Nonane	0.5	2.62
Methylene chloride	0.5	1.73	n-Octane	0.4	1.86
Methyl tert-butyl ether	1	3.6	Pentane	1	2.95
Naphthalene	0.5	2.62	n-Undecane	1	6.39
Styrene	0.2	0.85			

II. Tentatively Identified Compounds (TICs)

Branched Alkanes:

Butylcyclohexane
2,3-Dimethylheptane
2,3-Dimethylpentane
Isopentane
2,2,4-Trimethylpentane

Other:

Indane
Indene
Tetramethylbenzene isomers
Thiopenes
1,2,3-trimethylbenzene
1-Methylnaphthalene
2-Methylnaphthalene

Notes:
1. Analyses to be performed by Severn Trent Laboratories, Inc. (STL) of Knoxville, TN using United States Environmental Protection Agency (USEPA) Method TO-15.
2. RL = proposed reporting limit.
3. ppb (v/v) = parts per billion volumetric basis.
4. ug/m3 = micrograms per cubic meter.

Figure

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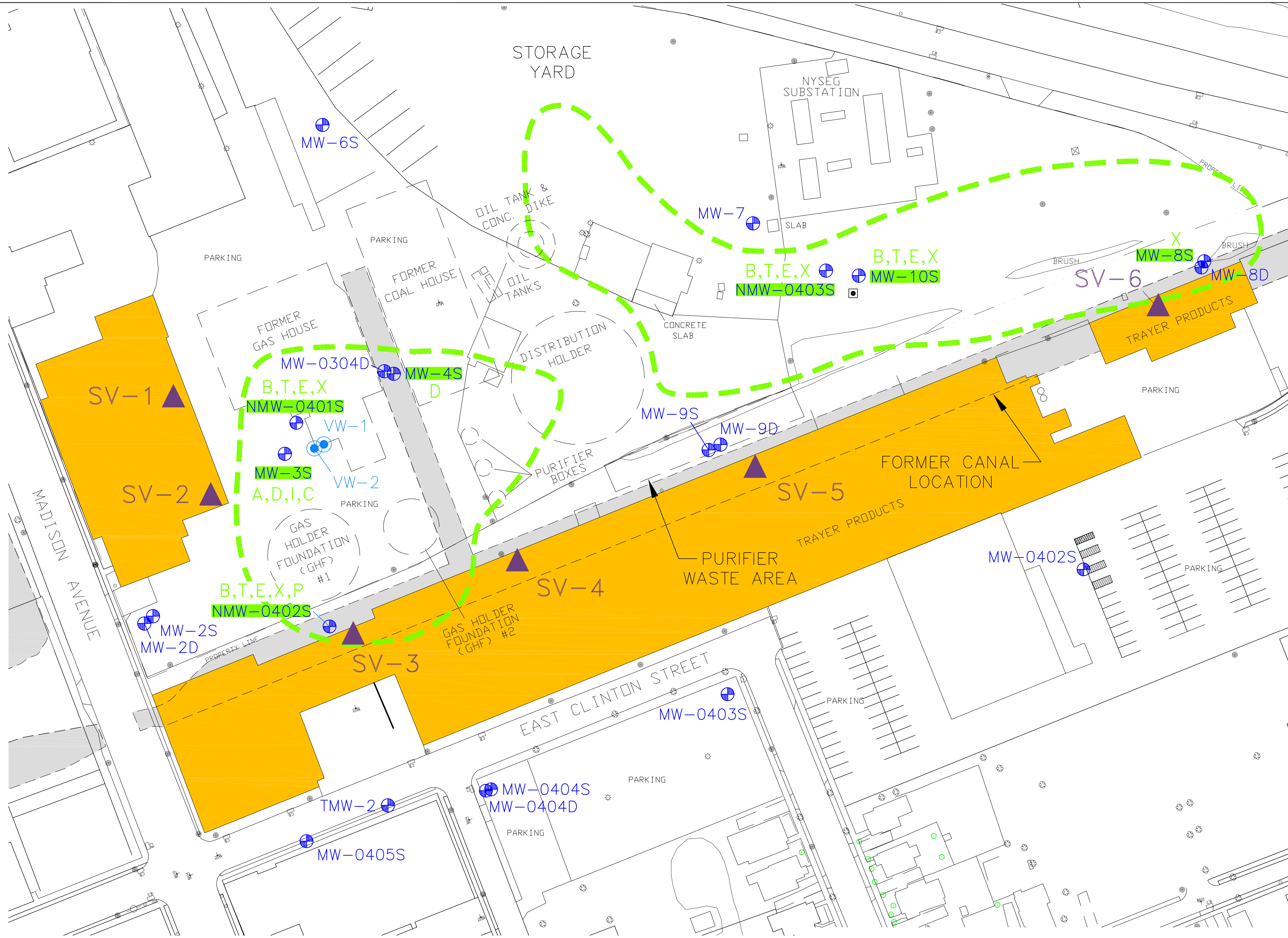

LEGEND:

- ▲ PROPOSED SUB-SLAB VAPOR SAMPLING LOCATIONS
- MONITORING WELL; SHALLOW (S), DEEP (D), TRAYER WELL (TMW)
- MGP VAULTED WELL
- RECHARGE PIT
- POWER POLE
- UTILITY POLE W/GUY
- LIGHT POLE
- POST, SIGN
- CATCH BASIN
- TRAFFIC LIGHT
- MANHOLE
- B,T,E,X,C — APRIL 2004 GROUNDWATER SAMPLE CONTAINED ONE OR MORE CONSTITUENTS OF CONCERN (BTEX AND PAHs) AT A CONCENTRATION GREATER THAN THE NYSDEC CLASS GA GROUNDWATER STANDARD (TOGS 1,1,1, JUNE 1998). THE LETTER GIVEN REPRESENTS THE COMPOUND(s) THAT EXCEED THEIR RESPECTIVE STANDARD, AS FOLLOWS:
  - A = 1,1,1-TRICHLOROETHANE
  - D = 1,1-DICHLOROETHANE
  - I = 1,1-DICHLOROETHENE
  - C = CHLOROETHANE
  - X = XYLENES
  - B = BENZENE
  - E = ETHYLBENZENE
  - T = TOLUENE
  - P = BENZO(A)PYRENE
- INFERRED EXTENT OF SHALLOW GROUNDWATER CONCENTRATIONS ABOVE NYSDEC CLASS GA GROUNDWATER STANDARDS, AS FOLLOWS:
- BUILDINGS TARGETED FOR SOIL VAPOR SAMPLING

NOTES:

1. BASE MAP SUPPLIED BY NYSEG, LATEST REVISION DATED APRIL 2004, AT A SCALE OF 1" = 60'.
2. ALL LOCATIONS ARE APPROXIMATE.

0 50' 100'
GRAPHIC SCALE

NEW YORK STATE ELECTRIC & GAS
ELMIRA MADISON AVENUE FORMER MGP SITE
SOIL VAPOR SAMPLING WORK PLAN

PROPOSED SUB-SLAB VAPOR SAMPLING LOCATIONS

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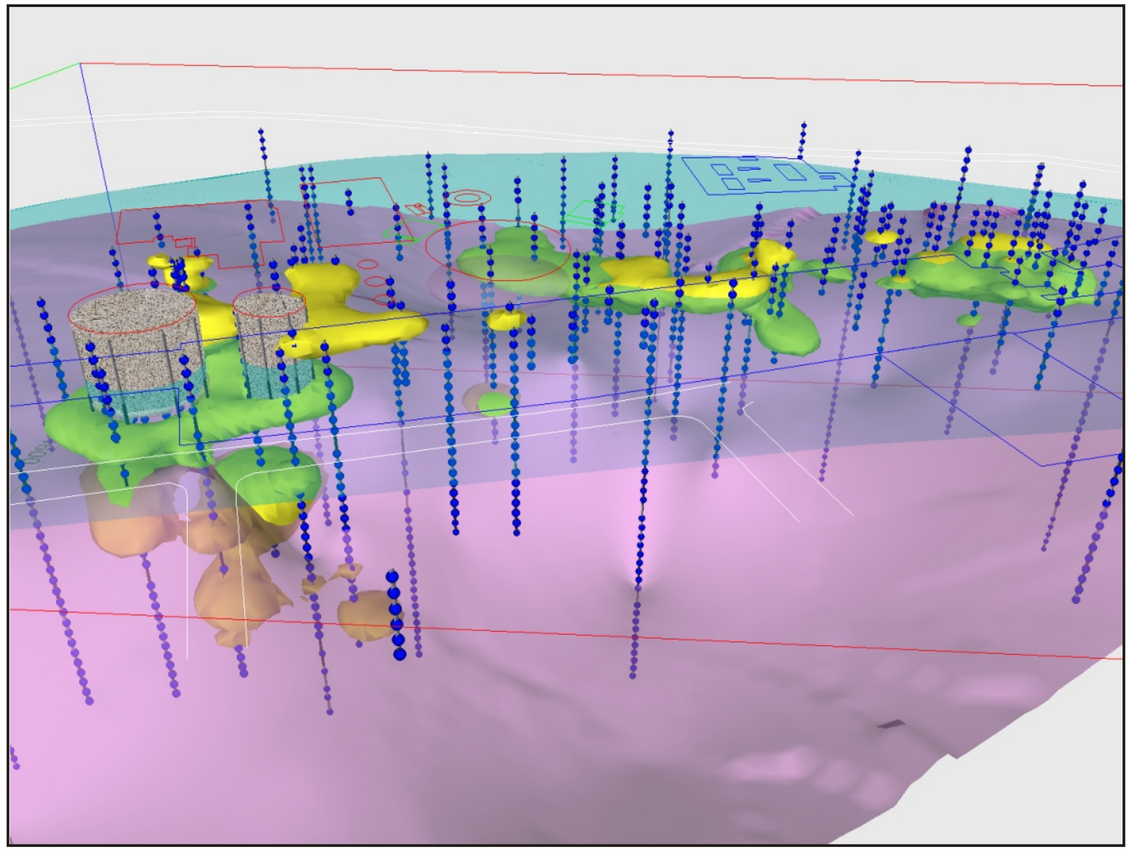
FIGURE 1

X: (NONE)
L: ON=*, OFF=REF*
P: PAGESET/PLT-DL
1/9/06 SYR-85-RCA AMS RCA
13043002/13043W07.DWG

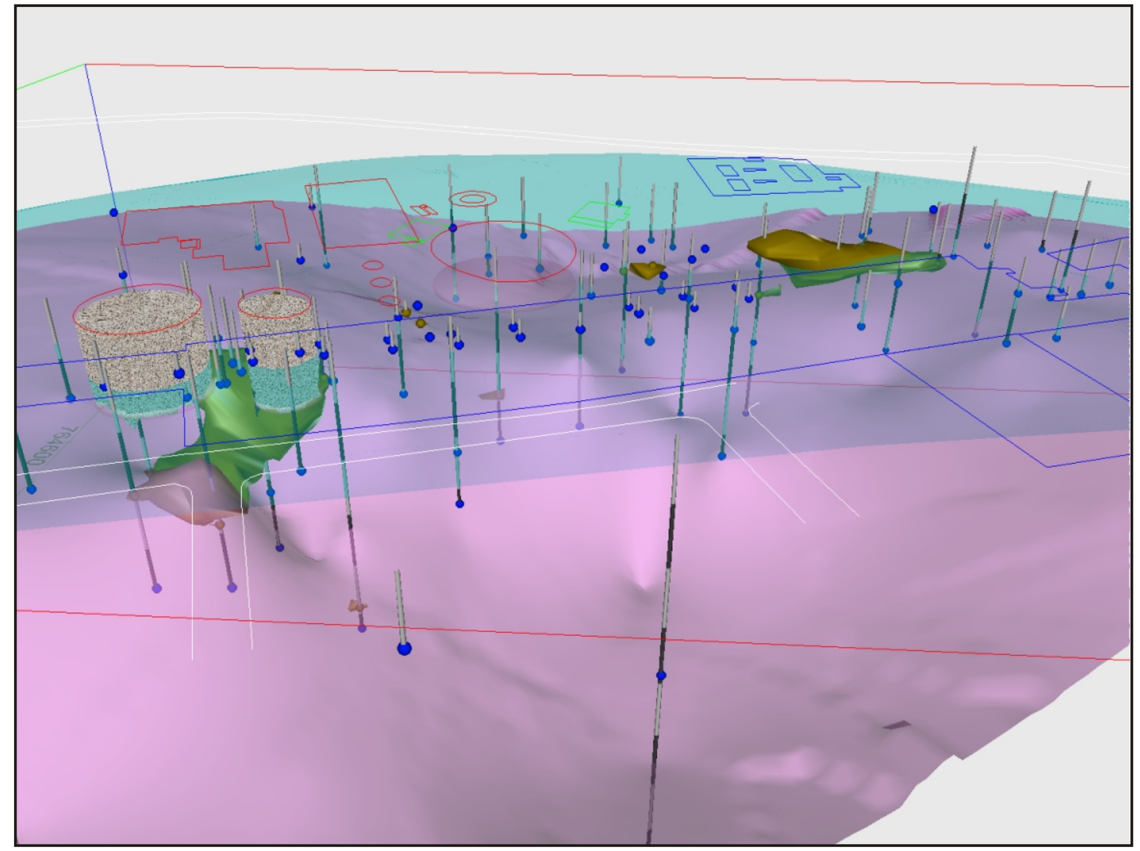
Attachments

Attachment 1

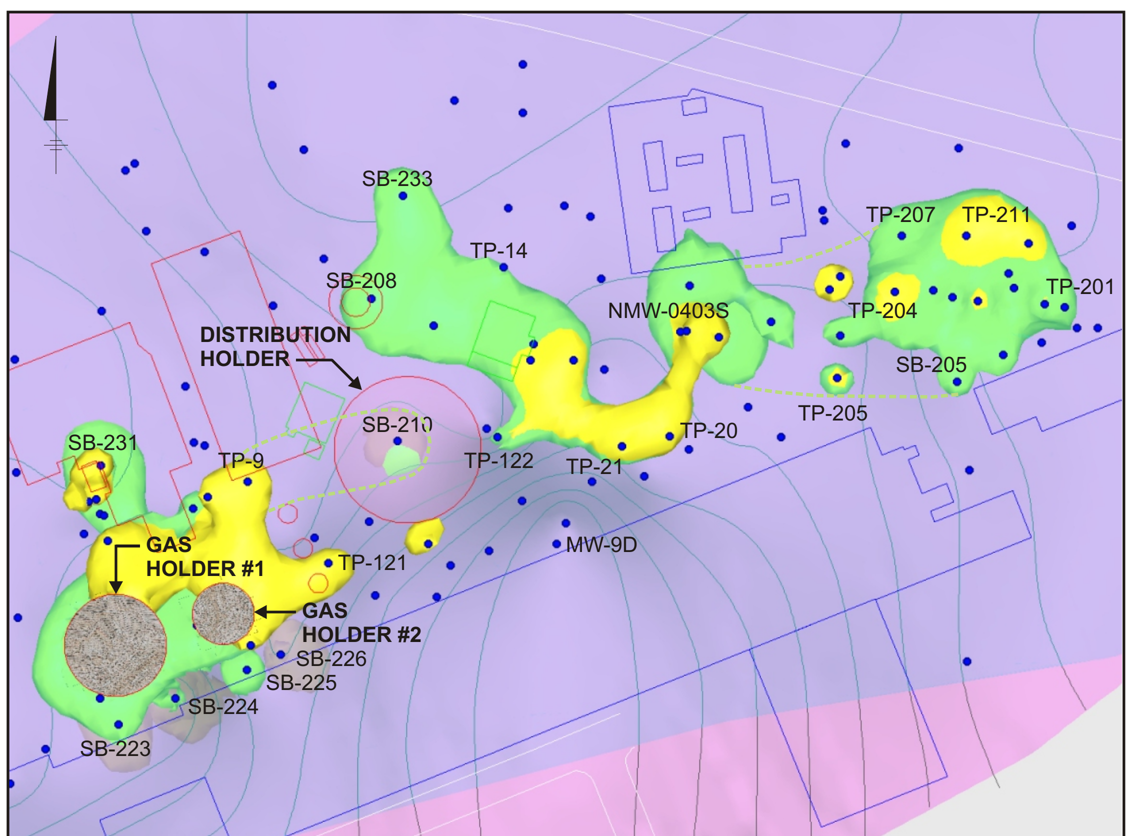
Figures 8 and 9 from Draft SRI Report



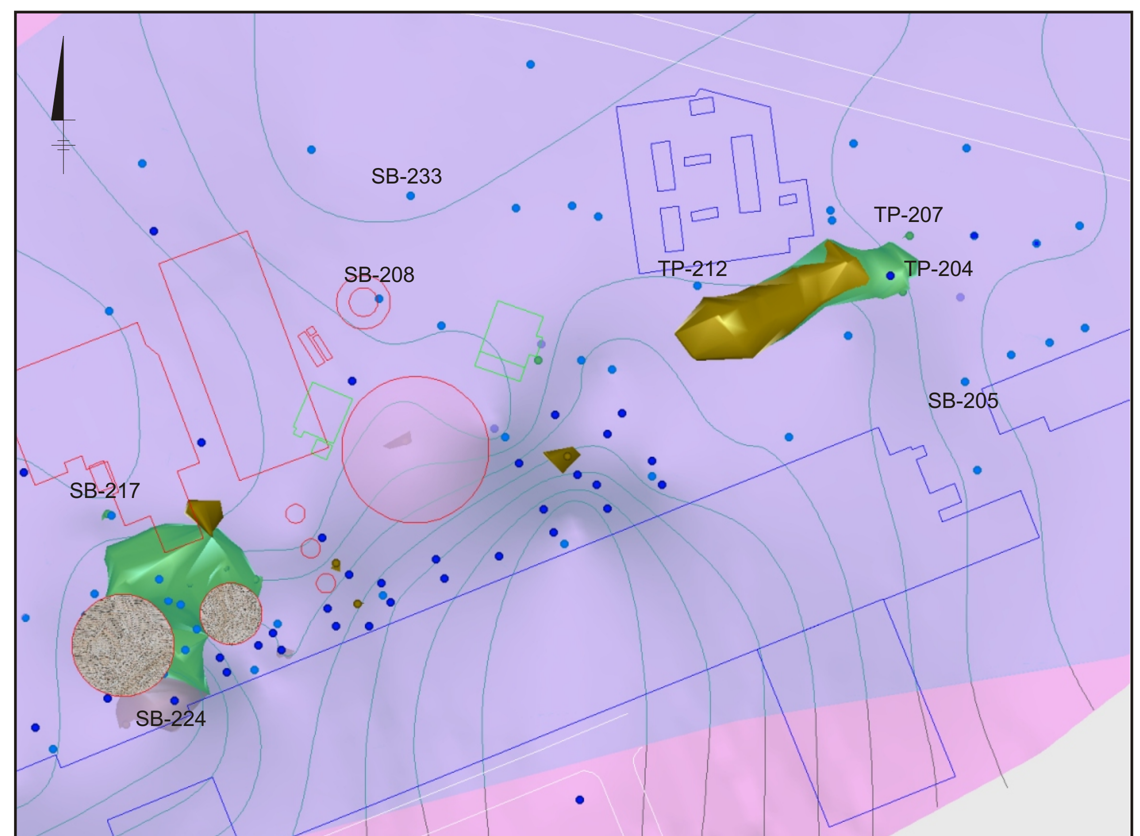
MODELED NAPL DISTRIBUTION (INCLUDING SHEEN) OBLIQUE VIEW FACING NORTHEAST



MODELED PAH DISTRIBUTION (≥ 500 PPM) OBLIQUE VIEW FACING NORTHEAST



MODELED NAPL DISTRIBUTION (INCLUDING SHEEN) - PLAN VIEW



MODELED PAH DISTRIBUTION (≥ 500 ppm) - PLAN VIEW

LEGEND:

- PAHs (≥ 500 PPM) ABOVE THE WATER TABLE
- PAHs (≥ 500 PPM) BELOW THE WATER TABLE
- NAPL ABOVE WATER TABLE
- NAPL BELOW WATER TABLE
- NAPL BELOW TILL SURFACE
- WATER TABLE
- IRM BACKFILL
- INFERRED NAPL LIMITS
- 832 TOP OF SILT AND FINE SAND TOPOGRAPHIC CONTOUR (REFER TO FIGURE 3 FOR DETAILS)
- BOREHOLE TRACE
- SAMPLE LOCATION

NOTE:
THE MAJORITY OF DATA POINTS USED TO GENERATE THE REGION OF PAHS SHOWN ARE LOCATED INSIDE THE REGION ITSELF AND ARE THEREFORE NOT VISIBLE. ALL AVAILABLE SOIL PAH DATA WERE USED TO GENERATE THE REGION.

Area Location

NEW YORK STATE ELECTRIC & GAS
ELMIRA MADISON AVENUE FORMER MGP SITE
SUPPLEMENTAL REMEDIAL INVESTIGATION

MODELED DISTRIBUTION OF NAPL (INCLUDING SHEEN) AND PAHS ≥ 500 PPM IN SOIL

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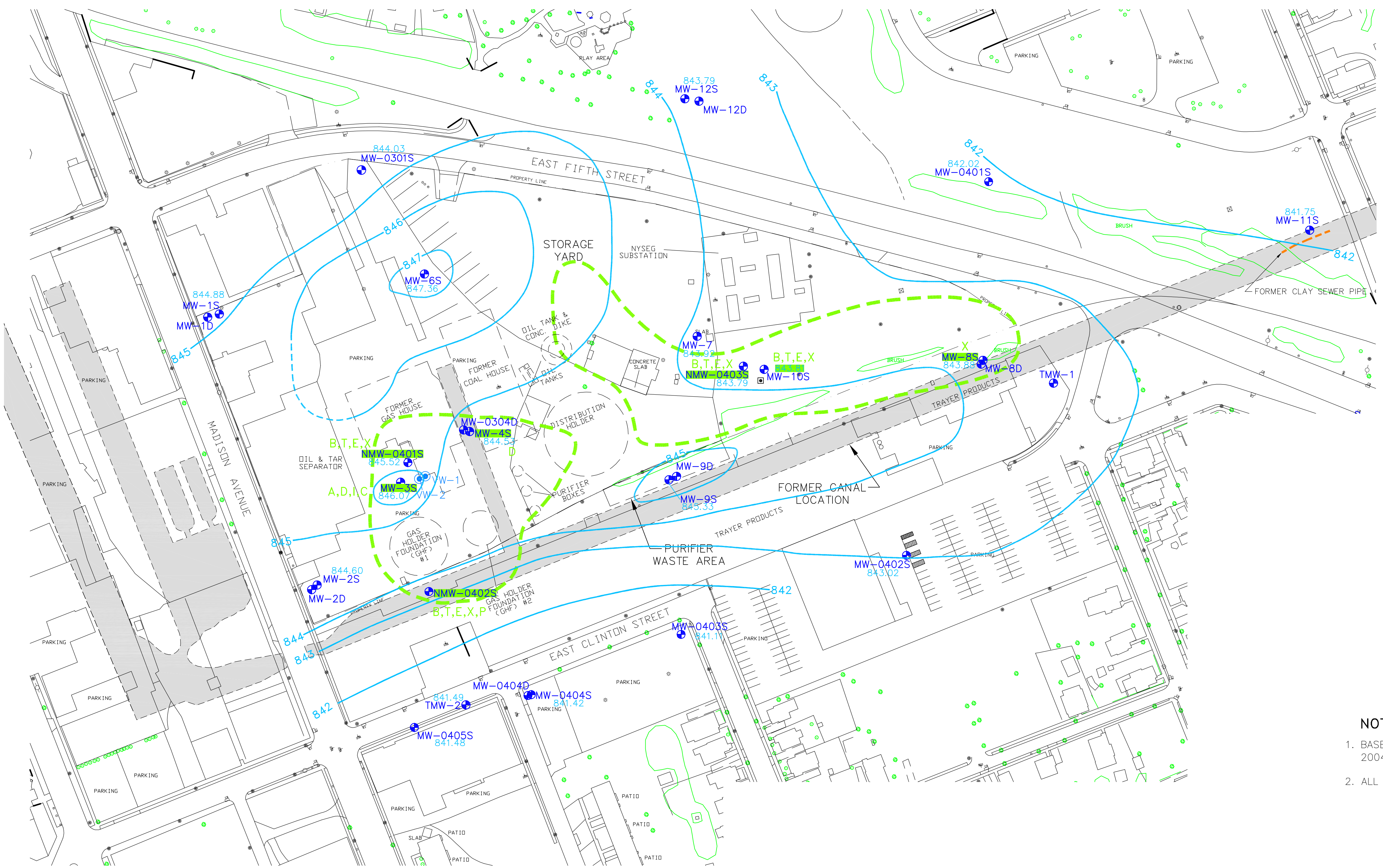
FIGURE **8**

05/23/05 SYR-D85-DJH
13043003/13043n04.cdr



LEGEND:

- MONITORING WELL; SHALLOW (S), DEEP (D), TRAYER WELL (TMW)
- MGP VAULTED WELL
- RECHARGE PIT
- POWER POLE
- UTILITY POLE W/GUY
- LIGHT POLE
- POST, SIGN
- CATCH BASIN
- TRAFFIC LIGHT
- MANHOLE
- 842 — INFERRED GROUNDWATER ELEVATION CONTOUR
- 841.75 GROUNDWATER ELEVATION
- B,T,E,X,C APRIL 2004 GROUNDWATER SAMPLE CONTAINED ONE OR MORE CONSTITUENTS OF CONCERN (BTEX AND PAHs) AT A CONCENTRATION GREATER THAN THE NYSDEC CLASS GA GROUNDWATER STANDARD (TOGS 1,1,1, JUNE 1998). THE LETTER GIVEN REPRESENTS THE COMPOUND(S) THAT EXCEED THEIR RESPECTIVE STANDARD, AS FOLLOWS:

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  D = 1,1-DICHLOROETHANE
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  X = XYLENES
  B = BENZENE
  E = ETHYLBENZENE
  T = TOLUENE
  P = BENZO(A)PYRENE

- INFERRED EXTENT OF SHALLOW GROUNDWATER CONCENTRATIONS ABOVE NYSDEC CLASS GA GROUNDWATER STANDARDS, AS FOLLOWS:

NOTES:

1. BASE MAP SUPPLIED BY NYSEG, LATEST REVISION DATED APRIL 2004, AT A SCALE OF 1"= 60'.
2. ALL LOCATIONS ARE APPROXIMATE.

0 80' 160'
GRAPHIC SCALE

NEW YORK STATE ELECTRIC & GAS
ELMIRA MADISON AVENUE FORMER MGP SITE
SUPPLEMENTAL REMEDIAL INVESTIGATION

ESTIMATED EXTENT OF VOCs AND SVOCs EXCEEDING CLASS GA GROUNDWATER STANDARDS

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FIGURE
9

L: ON=*, OFF=REF*
P: PAGESET/PLT-DL
5/23/05 SYR-85-RCA NJR RCA
13043003/13043W05.DWG

Attachment 2

Sub-Slab Soil-Gas Sampling and Analysis

Sub-Slab Soil-Gas Sampling and Analysis

I. Scope and Application

This document describes the procedures to install a sub-slab sampling port and then to collect sub-slab soil-gas samples for the analysis of volatile organic compounds (VOCs) by United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). The TO-15 method uses a 6-liter SUMMA® passivated stainless-steel canister. An evacuated SUMMA canister (less than 28 inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5.5 liters when allowed to fill to a vacuum of 2 inches of Hg. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide compound detection limits of 0.5 parts per billion volume (ppbv).

The following sections list the necessary equipment and provide detailed instructions for installing sub-slab soil-gas probes and collecting soil-gas samples for VOC analysis.

II. Personnel Qualifications

BBL field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first-aid, and cardiopulmonary resuscitation (CPR), as needed. BBL field sampling personnel will be well versed in the relevant standard operating procedures (SOPs) and possess the required skills and experience necessary to successfully complete the desired field work. BBL personnel responsible for leading sub-slab soil-gas sample collection activities must have previous sub-slab soil-gas sampling experience.

III. Equipment List

The equipment required to <u>install a permanent sub-slab vapor probe</u> is presented below:

- Electric impact drill;
- 5/8-inch- and 1-inch-diameter concrete drill bits for impact drill;
- Stainless steel vapor probe (typically 3/8-inch outside diameter [OD], 2 to 2.5-inch long (length will ultimately depend on slab thickness), 1/8-inch inside diameter [ID], pipe stainless steel pipe nipples with 0.5-inch OD stainless steel coupling and recessed stainless steel plugs per DiGiulio et. al., 2003);
- Photoionization detector (PID);
- Polyethylene tubing; and
- Quick-setting hydraulic cement powder.

The equipment required to <u>install a temporary sub-slab vapor probe</u> is presented below:

- Electric impact drill;
- 5/8-inch-diameter concrete drill bit for impact drill;
- 3/8-inch tubing (Teflon®, polyethylene, or similar);
- PID;

- Hydrated bentonite; and
- Teflon® tape.

The equipment required for soil-gas sample collection is presented below:

- Stainless steel SUMMA® canisters (order at least one extra, if feasible) certified clean by the analytical laboratory;
- Flow controllers with in-line particulate filters and vacuum gauges; flow controllers are pre-calibrated to specified sample duration (e.g., 30 minutes, 8 hours, 24 hours) or flow rate (e.g., 200 milliliters per minute [mL/min]); confirm with the laboratory that the flow controller comes with an in-line particulate filter and pressure gauge (order at least one extra, if feasible);
- 1/4-inch I.D. tubing (Teflon®, polyethylene, or similar);
- Twist-to-lock fittings;
- Stainless steel "T" fitting (if collecting duplicate [i.e., split] samples);
- Portable vacuum pump capable of producing very low flow rates (e.g., 100 to 200 mL/min);
- Rotameter or an electric flow sensor if vacuum pump does not have a flow gauge;
- Tracer gas source (e.g., helium);
- PID;
- Appropriate-sized open-end wrench (typically 9/16-inch);
- Chain-of-custody form (COC);
- Sampling summary form; and
- Field notebook.

IV. Cautions

Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens, or smoke cigarettes before and/or during the sampling event.

Care should also be taken to ensure that the flow controller is pre-calibrated to the proper sample collection time (confirm with laboratory). Sample integrity is maintained if the sampling event is shorter than the target duration, but sample integrity can be compromised if the event is extended to the point that the canister reaches atmospheric pressure.

Care must be taken to properly seal around the vapor probe at slab surface to prevent leakage of atmosphere into the soil vapor probe during purging and sampling. Temporary points are fit snug into the pre-drilled hole using Teflon® tape and a hydrated bentonite seal at the surface. Permanent points are fit snug using quick-setting hydraulic cement powder.

V. Health and Safety Considerations

Field sampling equipment must be carefully handled to minimize the potential for injury and the spread of hazardous substances. For sub-slab vapor probe installation, drilling with an electric concrete impact drill should be done only by personnel with prior experience using such a piece of equipment.

VI. Procedures

Permanent Vapor Probe Installation

Permanent sub-slab soil vapor probes are installed using an electric drill and manual placement of the probe. Drill a 1-inch-diameter hole, approximately 1-inch deep, in the concrete then use the 5/8-inch-diameter drill to advance the hole to approximately 3 inches below the base of the floor slab. The vapor probe is inserted into the hole and grouted with a quick-setting hydraulic cement powder. The vapor probe is equipped with a recessed threaded cap and stainless steel threaded fitting or compression fitting to allow collection of a soil gas sample through the stainless steel tubing. The vapor probe and tubing will be purged with a portable sampling pump prior to collecting the soil gas sample.

1. Remove, only to the extent necessary, any covering on top of the slab (e.g., carpet).

2. Drill a 5/8-inch-diameter hole through the slab using the electric drill. (Optional: Although not required, use a source of dust control/suppressant during drilling operations.)

3. Advance the hole to approximately 3 inches beneath the bottom of the slab.

4. Overdrill the upper 1 inch of slab to a hole diameter of 1 inch.

5. Insert the vapor probe so that it sits flush with the top of the slab.

6. Use a quick-setting hydraulic cement to grout the probe in place and allow the grout to set.

7. Purge the soil vapor probe and tubing with a portable sampling pump prior to collecting the soil-gas sample (see sample collection section below).

8. Proceed to soil-gas sample collection.

9. When sub-slab soil-gas sampling is complete, plug the soil vapor probe opening with a stainless steel plug.

Temporary Vapor Probe Installation

Temporary sub-slab soil vapor probes are installed using an electric drill and manual placement of tubing. The drill will be advanced to approximately 3 inches beneath the bottom of the slab. A 3/8-inch inside-diameter (ID) hole is installed through the slab. The tubing, wrapped in Teflon® tape, is inserted into the hole. The tubing is purged prior to collection of a soil gas sample. Probe locations are resealed after sampling is complete.

1. Remove, only to the extent necessary, any covering on top of the slab (e.g., carpet).

2. Drill a 3/8-inch-diameter hole through the concrete slab using the electric drill.

3. Advance the drill bit approximately 3 inches into the sub-slab material to create an open cavity.

4. Wrap the tubing with Teflon® tape, to the extent necessary, for a snug fit of tubing and hole.

5. Insert the tubing approximately 1.5 inches into the sub-slab material.

6. Prepare a hydrated bentonite mixture using granular bentonite or use melted beeswax. Apply bentonite or beeswax at slab surface around the tubing. If using bentonite, proceed to Step 7 immediately. If using beeswax, allow beeswax to harden then proceed to Step 7.

7. Purge the soil vapor probe and tubing with a portable sampling pump prior to collecting the soil-gas sample (see sample collection section below).

8. Proceed to soil gas sample collection.

9. When the sub-slab soil-gas sampling is complete, remove the tubing and grout the hole in the slab with quick-setting hydraulic cement powder or other material similar to the slab.

Sub-Slab Soil-Gas Sample Collection

<u>Preparation of SUMMA®-Type Canister and Collection of Sample</u>

1. Record the following information in the field notebook, if appropriate (contact the local airport or other suitable information source [e.g., site-specific measurements, weatherunderground.com] to obtain the information):

   - Wind speed and direction;
   - Ambient temperature;
   - Barometric pressure; and
   - Relative humidity.

2. Connect a short piece of polyethylene tubing to the sub-slab sampling port using a twist-to-lock fitting.

3. Connect a portable vacuum pump to the sample tubing. Purge 1 to 2 (target 1.5) volumes of air from the vapor probe and sampling line using a portable pump [purge volume = 1.5 Pi r^2h] at a rate of approximately 100 mL/min. Measure organic vapor levels with the PID.

4. Check the seal established around the soil vapor probe by using a tracer gas (e.g., helium) or other method established in the state guidance documents. [Note: Refer to Attachment 5, adapted from NYSDOH 2005, for how to use a tracer gas.]

5. Remove the brass plug from the SUMMA® canister and connect the flow controller with in-line particulate filter and vacuum gauge to the SUMMA® canister. Do not open the valve on the SUMMA® canister. Record in the field notebook and the COC the flow controller number with the appropriate SUMMA® canister number.

6. Connect the polyethylene sample collection tubing to the flow controller and the SUMMA® canister valve. Record in the field notebook the time sampling began and the canister pressure.

7. Connect the other end of the polyethylene tubing to the sub-slab sampling port.

8. Open the SUMMA® canister valves. Record in the field notebook the time sampling began and the canister pressure.

9. Take a photograph of the SUMMA® canister and surrounding area.

Termination of Sample Collection

1. Arrive at the SUMMA® canister location at least 10 to 15 minutes prior to the end of the required sampling interval (i.e., 2 hours).

2. Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valves. The canister should have a minimum amount of vacuum (approximately 2 inches of Hg or slightly greater).

3. Record the date and local time (24-hour basis) of valve closing in the field notebook, sampling summary form, and COC.

4. Remove the particulate filter and flow controller from the SUMMA® canister, re-install the brass plug on the canister fitting, and tighten with the appropriate wrench.

5. Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canister does not require preservation with ice or refrigeration during shipment.

6. Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with a string).

7. Complete the COC and place the requisite copies in a shipping container. Close the shipping container and affix a custody seal to the container closure. Ship the container to the laboratory (via overnight carrier [e.g., Federal Express]) for analysis.

Soil Gas Monitoring Point Abandonment

Once the soil-gas samples have been collected, a temporary soil-gas monitoring point will be abandoned by removing the sampling materials and filling the resulting hole with concrete. Replace the surface covering (e.g., carpet) to the extent practicable.

VII. Waste Management

No specific waste management procedures are required.

VIII. Data Recording and Management

Measurements will be recorded in the field notebook at the time of measurement with notations of the project name, sample date, sample start and finish time, sample location (e.g., GPS coordinates, distance from permanent structure [e.g., two walls, corner of room]), canister serial number, flow controller serial number, initial vacuum reading, and final pressure reading. Field sampling logs and COC records will be transmitted to the Project Manager.

IX. Quality Assurance

Soil-gas sample analysis will be performed using USEPA TO-15 methodology. This method uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits. The GC/MS system requires a 1-liter gas sample (which can easily be recovered from a 6-liter canister) to provide a 0.5-ppbv detection limit. The 6-liter canister also provides several additional 1-liter samples in case subsequent re-analyses or dilutions are required. This system also offers the advantage of the GC/MS detector, which confirms the identity of detected compounds by evaluating their mass spectra in either the SCAN or SIM mode.

X. References

DiGiulio et. al. 2003. Draft Standard Operating Procedure (SOP) for Installation of Sub-Slab Vapor Probes and Sampling Using EPA TO-15 to Support Vapor Intrusion Investigations. http://www.cdphe.state.co.us/hm/indoorair.pdf (Attachment C)

New York State Department of Health (NYSDOH). 2005. DRAFT "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" February 23, 2005.

Attachment 3

Subsurface Soil Gas Sampling

Subsurface Soil Gas Sampling and Analysis

I. Scope and Application

This document describes the procedures to subsurface soil-gas samples for the analysis of volatile organic compounds (VOCs) by United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). The TO-15 method uses a 6-liter SUMMA® passivated stainless-steel canister. An evacuated 6-liter SUMMA® canister (<28 inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5.5 liters when allowed to fill to a vacuum of 2 inches of Hg. The whole-air sample will be analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GC/MS) system to provide compound detection limits of 0.5 parts per billion volume (ppbv).

The following sections list the necessary equipment and provide detailed instructions for the installation of soil-gas probes (using direct-push technology and steel rods) and the collection of soil-gas samples for VOC analysis.

II. Personnel Qualifications

BBL field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first-aid, and cardiopulmonary resuscitation (CPR), as needed. BBL field sampling personnel will be well versed in the relevant standard operating procedures (SOPs) and possess the required skills and experience necessary to successfully complete the desired field work. BBL personnel responsible for leading subsurface soil-gas sample collection activities must have previous subsurface soil-gas sampling experience.

III. Equipment List

The equipment required to install a soil vapor probe is presented below:

- Appropriate PPE (as required by the Health and Safety Plan);
- Direct-push rig (e.g., PowerProbe™) equipped with interconnecting 4-foot lengths of 1.25-inch-diameter steel rods;
- Expendable points (one per sample);
- Expendable point holder, and appropriate twist-to-lock connector;
- Photoionization Detector (with a lamp of 11.7 eV);
- ¼-inch I.D. tubing (Teflon®, polyethylene, or similar);
- Commercially available clean sand or play sand; and
- Non-coated bentonite.

The equipment required for <u>soil-gas sample collection</u> is presented below:

- Stainless steel SUMMA® canisters (order at least one extra, if feasible) certified clean by the analytical laboratory;

- Flow controllers with in-line particulate filters and vacuum gauges; flow controllers are pre-calibrated to specified sample duration (e.g., 30 minutes, 8 hours, 24 hours) or flow rate (e.g., 200 milliliters per minute [mL/min]); confirm with the laboratory that the flow controller comes with an in-line particulate filter and pressure gauge (order at least one extra, if feasible);
- 1/4-inch I.D. tubing (Teflon®, polyethylene, or similar);
- Twist-to-lock fittings;
- Stainless steel "T" fitting (if collecting duplicate [i.e., split] samples);
- Portable vacuum pump capable of producing very low flow rates (e.g., 100 to 200 mL/min);
- Rotameter or an electric flow sensor if vacuum pump does not have a flow gauge;
- Tracer gas source (e.g., helium);
- PID;
- Appropriate-sized open-end wrench (typically 9/16-inch);
- Chain-of-custody form (COC);
- Sampling summary form; and
- Field notebook.

IV. Cautions

Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens, or smoke cigarettes before and/or during the sampling event.

Care should also be taken to ensure that the flow controller is pre-calibrated to the proper sample collection time (confirm with laboratory). Sample integrity is maintained if the sampling event is shorter than the target duration, but sample integrity can be compromised if the event is extended to the point that the canister reaches atmospheric pressure.

Care must be taken to properly seal around the vapor probe at ground surface to prevent leakage of atmosphere into the soil vapor probe during purging and sampling. Temporary sampling points are to be sealed at the surface using hydrated bentonite. Permanent points are sealed at the surface using quick-setting hydraulic cement powder.

V. Health and Safety Considerations

Field sampling equipment must be carefully handled to minimize the potential for injury and the spread of hazardous substances. For subsurface vapor probe installation, drilling with a direct-push drilling rig should be done only by personnel with prior experience using such a piece of equipment.

VI. Procedure

Soil Gas Steel Rod Monitoring Point Installation

1. Advance an assembly consisting of interconnected lengths of decontaminated 1.25-inch-diameter steel drive rods, affixed with an expendable point holder and expendable point at the downhole end, to the bottom of the desired sampling interval.

2. Cut a length of sample collection tubing slightly longer (e.g., 1 to 2 feet) than the collection depth. Attach a twist-to-lock connector to one end of the sample collection tubing and lower the twist-to-lock connector and attached tubing through the drive rods. Thread the twist-to-lock connector into the expendable point holder, by twisting counterclockwise.

3. Hydraulically retract the sampling assembly approximately 6 inches or more if needed, allowing the expendable point to fall off, and creating a void in the subsurface for soil gas sample collection.

4. Fill annular space between the steel drive rod and the borehole wall (if any) with a mixture of bentonite and water. Typically only a bentonite surface seal is needed since there is no annular space between the steel drive rods and the borehole wall.

5. Proceed to soil gas sample collection.

Soil-Gas Sample Collection

<u>Preparation of SUMMA®-Type Canister and Collection of Sample</u>

1. Record the following information in the field notebook, if appropriate (contact the local airport or other suitable information source [e.g., site-specific measurements, weatherunderground.com] to obtain the information):

    a. Wind speed and direction;
    b. Ambient temperature;
    c. Barometric pressure; and
    d. Relative humidity.

2. Connect a short piece of polyethylene tubing to the sub-slab sampling port using a twist-to-lock fitting.

3. Connect a portable vacuum pump to the sample tubing. Purge 1 to 2 (target 1.5) volumes of air from the vapor probe and sampling line using a portable pump [purge volume = 1.5 Pi r^2h] at a rate of approximately 100 mL/min. Measure organic vapor levels with the PID.

4. Check the seal established around the soil vapor probe by using a tracer gas (e.g., helium) or other method established in the state guidance documents. [Note: Refer to Attachment 5, adapted from NYSDOH 2005, for how to use a tracer gas.]

5. Remove the brass plug from the SUMMA® canister and connect the flow controller with in-line particulate filter and vacuum gauge to the SUMMA® canister. Do not open the valve on the SUMMA® canister. Record in the field notebook and the COC the flow controller number with the appropriate SUMMA® canister number.

6. Connect the polyethylene sample collection tubing to the flow controller and the SUMMA® canister valve. Record in the field notebook the time sampling began and the canister pressure.

7. Connect the other end of the polyethylene tubing to the sub-slab sampling port.

8. Open the SUMMA® canister valves. Record in the field notebook the time sampling began and the canister pressure.

9. Take a photograph of the SUMMA® canister and surrounding area.

Termination of Sample Collection

1. Arrive at the SUMMA® canister location at least 10 to 15 minutes prior to the end of the required sampling interval (i.e., 2 hours).

2. Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valves. The canister should have a minimum amount of vacuum (approximately 2 inches of Hg or slightly greater).

3. Record the date and local time (24-hour basis) of valve closing in the field notebook, sampling summary form, and COC.

4. Remove the particulate filter and flow controller from the SUMMA® canister, re-install the brass plug on the canister fitting, and tighten with the appropriate wrench.

5. Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canister does not require preservation with ice or refrigeration during shipment.

6. Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with a string).

Complete the COC and place the requisite copies in a shipping container. Close the shipping container and affix a custody seal to the container closure. Ship the container to the laboratory (via overnight carrier [e.g., Federal Express]) for analysis.

Soil Gas Monitoring Point Abandonment

Once the soil-gas samples have been collected, the soil-gas monitoring points will be abandoned by removing the drive rods, and filling the resulting hole with bentonite.

VII. Waste Management

Field personnel will collect and remove all investigation-derived waste materials (including disposable equipment) for proper disposal.

VIII. Data Recording and Management

Measurements will be recorded in the field notebook at the time of measurement with notations of the project name, sample date, sample start and finish time, sample location (e.g., GPS coordinates, distance from permanent structure, canister serial number, flow controller serial number, initial vacuum reading, and final pressure reading. Field sampling logs and COC records will be transmitted to the Project Manager.

IX. Quality Assurance

Soil-gas sample analysis will be performed using USEPA TO-15 methodology. This method uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits. The GC/MS system requires a 1-liter gas sample (which can easily be recovered from a 6-liter canister) to provide a 0.5-ppbv detection limit. The 6-liter canister also provides several additional 1-liter samples in case subsequent re-analyses or dilutions are required. This system also offers the advantage of the GC/MS detector, which confirms the identity of detected compounds by evaluating their mass spectra.

All analytical results will be reported in units of $\mu g/m^3$.

Attachment 4

Administering Tracer Gas

Administering Tracer Gas

When collecting subsurface vapor samples as part of a vapor intrusion evaluation, a tracer gas serves as a quality assurance/quality control device to verify the integrity of the vapor probe seal. Without the use of a tracer, verification that a soil vapor sample has not been diluted by surface air is difficult.

Depending on the nature of the contaminants of concern, a number of different compounds can be used as a tracer. Typically, sulfur hexafluoride (SF6) or helium are used as tracers because they are readily available, have low toxicity, and can be monitored with portable measurement devices. Butane and propane (or other gases) could also be used as a tracer in some situations. The protocol for using a tracer gas is straightforward: simply enrich the atmosphere in the immediate vicinity of the area where the probe intersects the surface with the tracer gas, and measure a vapor sample from the probe for the presence of high concentrations (> 20%) of the tracer. A cardboard box, plastic pail, or even a plastic bag can serve to keep the tracer gas in contact with the probe during the testing.

There are two basic approaches to testing for the tracer gas:

1. Include the tracer gas in the list of target analytes reported by the laboratory; or

2. Use a portable monitoring device to analyze a sample of soil vapor for the tracer prior to and after sampling for the compounds of concern. (Note that the tracer gas samples can be collected via syringe, Tedlar bag, etc. They need not be collected in SUMMA® canisters or minicans.)

The advantage of the second approach is that the real time tracer sampling results can be used to confirm the integrity of the probe seals prior to formal sample collection.

Because minor leakage around the probe seal should not materially affect the usability of the soil vapor sampling results, the mere presence of the tracer gas in the sample should not be a cause for alarm. Consequently, portable field monitoring devices with detection limits in the low ppm range are more than adequate for screening samples for the tracer. If high concentrations (> 20%) of tracer gas are observed in a sample, the probe seal should be enhanced to reduce the infiltration of ambient air.

During the initial stages of a subsurface vapor sampling program, tracer gas samples should be collected at each of the sampling probes. If the results of the initial samples indicate that the probe seals are adequate, the project manager can consider reducing the number of locations at which tracer gas samples are used. At a minimum, at least 10% of the subsequent samples should be supported with tracer gas analyses. When using permanent soil vapor probes as part of a long-term monitoring program, annual testing of the probe integrity is recommended.