



April 13, 2026

Batson, Himes, Norvell & Poe
4334 Papermill Drive
Knoxville, TN 37909

Attention: Mr. David Harbin
harbin@bhn-p.com

Subject: Limited Soil Gas Sampling
1155 & 1161 Copperwood Lane
Knoxville, Tennessee
UES Project No. A25109.01368.000

Dear Mr. Harbin:

UES Professional Solutions 19, LLC (UES) has completed the requested limited soil gas sampling at the property located at 1155 & 1161 Copperwood Lane in Knoxville, Tennessee. The sampling was performed in accordance with UES Proposal No. A25109.01368.000 dated December 1, 2025 to determine the presence/absence of constituents of concern from the offsite REC.

INTRODUCTION

The project area consists of approximately 3.39 acres of wooded land that has had abandoned structures and miscellaneous debris removed. UES conducted a Phase I Environmental Site Assessment (ESA) for the subject property (Project No. A25109.00789.000). According to the Phase I for the subject property, an adjacent property (Remediation Site at 9053 Middlebrook Pike) located north of the subject property was a former fuel station and dry cleaner with land use restrictions. A recognized environmental condition (REC) was called out due to the location and possible migration of impacts associated with the nearby remediation site.

Based on discussions with the client, UES has performed the following scope of work:

Soil Gas Sampling

On April 1, 2026, UES personnel arrived at the site to conduct the proposed soil gas sampling activities. A total of four soil gas samples were collected (SG-1 through SG-4) along the northern property boundary that abuts Middlebrook Pike. A site plan was not provided, therefore the scope of work consisted of sampling along the property line located down gradient to the REC identified in Phase I ESA. Approximate locations of the sampling points are presented in **Appendix A, Figure 2**.

A one-inch diameter hole was placed in the soil using the hammer drill and gas vapor probe kit. The sampling train consisted of fluoropolymer tubing, stainless steel sacrificial gas vapor tip, and air flow regulator connected to a one-liter summa canister. A 60mL syringe was used to purge a minimum of three volumes of air from the tubing and void space. The one-liter summa canister was used to collect the soil gas from the sampling point. The air flow regulator was used to only allow a maximum of 200 mL of air per minute to enter the summa canister. Bentonite chips were hydrated to a paste-like consistency and then placed around all openings to prevent ambient air from entering the sample point. Sample trains and summa canisters were 'vacuum tested' before each sampling event to ensure that no leaks in the system were present.

After completion of the sampling, the summa canisters were sent to Pace Analytical Laboratory and were analyzed for VOCs by the EPA method TO-15. Proper chain-of-custody procedures were maintained from sample collection until delivery to the laboratory to protect sample integrity.

The analytical results of the samples were compared to the Environmental Protection Agency (EPA) Regional Screening Levels (RSLs) for residential use as well as the EPA's Vapor Intrusion Screening Level (VISL) Calculator. The analytical results for the detected constituents, along with the comparison to EPA's VISL Calculator are provided in **Table 1** and **Table 2** below. Only detections above laboratory detection limits are shown in all tables for clarity. **Table 3** provides the cumulative sum of the Target Risk for Carcinogens (TRC) and Target Hazard Quotient for Non-Carcinogens (THQ). **Table 4** provides the parameters utilized in the VISIL calculator A complete laboratory report is provided in **Appendix B** of this report.



Table 1: Ambient Air Sampling Results
(Only detections above laboratory detection limits shown for clarity)

Project Sample ID		SG-1	SG-2	SG-3	SG-4	Target Indoor Air Concentrations for Residential Structures (µg/m ³)
Analyte	CAS	Results	Results	Results	Results	
ACETONE	67-64-1	13.9	36.1	75.3	34.2	NC
BENZENE	71-43-2	15.4	62.3	65.2	12.2	12
1,3-BUTADIENE	106-99-0	15.3	35.8	34.5	21.1	3.12
CARBON DISULFIDE	75-15-0	8.93	11.3	9.87	18.6	2430
CHLOROMETHANE	74-87-3	0.865	1.48	2.38	0.905	10400
CYCLOHEXANE	110-82-7	24.2	194	197	11.4	62600
ETHANOL	64-17-5	9.22	ND	5.84	13.0	NC
ETHYLBENZENE	100-41-4	2.45	9.88	6.42	2.51	37.4
4-ETHYLTOLUENE	622-96-8	ND	2.28	ND	ND	NC
TRICHLOROFLUOROMETHANE	75-69-4	2.17	1.18	1.34	1.30	3480
DICHLORODIFLUOROMETHANE	75-71-8	1.69	1.25	1.36	1.45	3480
1,1,2-TRICHLOROTRIFLUOROETHANE	76-13-1	1.82	ND	ND	ND	174000
HEPTANE	142-82-5	30.2	234	302	15.8	13900
N-HEXANE	110-54-3	50.4	328	423	26.2	6950
ISOPROPYLBENZENE	98-82-8	ND	2.52	1.60	1.14	313
METHYLENE CHLORIDE	75-09-2	ND	ND	ND	4.93	3380
2-BUTANONE (MEK)	78-93-3	ND	11.5	20.0	11.1	3480
2-PROPANOL	67-63-0	ND	ND	3.32	11.0	24300
PROPENE	115-07-1	ND	ND	ND	379	10400
TOLUENE	108-88-3	23.7	101	78.0	14.2	17400
TRICHLOROETHENE	79-01-6	ND	ND	1.63	ND	7.47
1,2,4-TRIMETHYLBENZENE	95-63-6	3.46	15.9	7.85	1.04	695
1,3,5-TRIMETHYLBENZENE	108-67-8	1.90	8.59	4.64	ND	695
2,2,4-TRIMETHYLPENTANE	540-84-1	ND	ND	ND	37.7	NC
XYLENES, TOTAL	1330-20-7	18.4	73.4	44.3	8.03	1390
M&P-XYLENE		13.5	55.1	33.8	6.24	NC
O-XYLENE	95-47-6	4.90	18.0	10.2	1.79	348

Notes:

- Shaded results indicate an exceedance above the relevant screening limits.
- ND - indicates below reportable detection limits.
- NC - No Criteria
- All results are µg/m³



Table 2: VI THQ and TRC Results for Highest Detections

Project Sample ID		Sample ID	Site Indoor Air Concentrations (µg/m ³)	VI Carcinogenic Risk CR (TCR)	VI Hazard HQ (THQ)
Analyte	CAS				
Benzene	71-43-2	SG-1	15.4	1.28E-06	1.48E-02
Benzene	71-43-2	SG-2	62.3	5.19E-06	5.97E-02
Benzene	71-43-2	SG-3	65.2	5.43E-06	6.25E-02
Benzene	71-43-2	SG-4	12.2	1.02E-06	1.17E-02

- RED results indicate an exceedance above VI Carcinogenic Risk
- BLUE results indicate an exceedance above VI Hazard HQ
- All results are µg/m³
- NC – No Criteria

Table 3: VISL Cumulative Sum of the Hazard Quotient Index for Target Organs and VI Carcinogenic Risk

Target Organs (COC)	VI Hazard HQ (SUM) (THQ)	VI Carcinogenic Risk CR (TCR)
Blood (Benzene)	<1.00E+00	5.43E-06
Cumulative VI Carcinogenic Risk		5.43E-06

The concentrations detected values of the soil gas samples were input into the on-line VISL calculator. The VISL calculator is used to determine if a VI Carcinogenic Risk or VI Vapor Hazard exists based on the soil gas samples collected. The Residential exposure scenario with a Target Risk for Carcinogens (TCR) of 1.00E-06 and a Target Hazard Quotient (THQ) for non-carcinogens of 0.1 for soil gas analyses was utilized in the calculator. **Table 4** below identifies the parameters utilized in the on-line VISL Calculator.

Table 4: VISL Calculator Parameters Utilized

Parameter	Symbol	Value
Exposure Scenario	Scenario	Residential
Target Risk for Carcinogens	TCR	1.00E-06
Target Hazard Quotient for Non-Carcinogens	THQ	0.1

Conclusions

UES uses TDEC’s Vapor Mitigation Guidance to develop recommendations for the proposed project and considers it the standard of care. Vapor intrusion has two components **Target Risk of Carcinogens (TCR)**



and **Target Hazard Quotient (THQ)**, which identifies carcinogenic (TCR) and non-carcinogenic (THQ) vapor intrusion hazards. Each category is developed with specific criteria to determine potential health risks from vapor intrusion.

Benzene and 1,3-Butadiene were found to exceed VISL Sub-Slab and Near-source Soil Gas Concentrations Target for residential structures. The soil gas samples results for Benzene were input into the EPA's VISL on-line calculator to determine the potential indoor air concentrations. A target risk of carcinogens (TCR) value of 1.00E-06 as well as a target hazard quotient (THQ) value of 0.1 were utilized in the VISL calculator as part of the calculated indoor air concentration. The TCR and THQ are conservative values that are utilized initially to screen for a vapor intrusion hazard.

1,3-Butadiene is also not considered a constituent of concern. 1,3-Butadiene often arises as a false positive due to drilling/testing procedures, slightly exceeds the default residential standards in four samples.

- "1,3-butadiene sometimes is detected in soil vapor samples initially collected after probe installation through tight soil formations using direct-push approaches. It is believed that heating due to friction during the probe installation process produces the 1,3-butadiene. Subsequent sampling invariably shows that the 1,3-butadiene does not persist. In this scenario, 1,3-butadiene is formed as a result of the sampling process and is therefore a sampling artifact; its steady-state concentration in soil vapor is essentially zero." [Haley & Aldrich, White Paper: Steady-State Concentrations in Vapor Intrusion Study Design at 12.](#)
- It is well established that 1,3-butadiene is formed as a product of incomplete combustion of organic matter, including biomass present during sub-surface sampling. [National Institute of Health, 1,3-Butadiene: A Ubiquitous Environmental Mutagen and Its Associations with Diseases](#) ("1,3-Butadiene (BD) . . . is a ubiquitously environmental pollutant because it is formed as a product of incomplete combustion of fossil fuels and biomass.").
- The Interstate Technology Regulatory Council ("ITRC") acknowledges the potential for 1,3-butadiene to be a by-product of combustion, which can lead to false positives when the compound is assigned ultra-low screening levels by regulators. The ITRC also acknowledges the



potential for 1,3-butadiene detections to actually reflect the presence of isobutylene, a gas produced through biogenetic processes. [ITRC, Petroleum Vapor Intrusion – Fundamentals of Screening, Investigation, and Management at 234-235 \(Oct. 2014\)](#).

TCR

Benzene was found to be below EPA's VISL Calculator concentrations for residential. Additionally, the cumulative TCR was calculated to be less than 1.00E-05 for Benzene.

THQ

Benzene was calculated to be below the TDEC Vapor Mitigation Guidance action level THQ value of 1.0E+00.

Summary

Soil gas analysis shows levels of certain constituents in each of the soil gas samples. When the vapor intrusion sample results were input into the VISL calculator and compared to TDEC's Vapor Mitigation Guidance, the results indicate Benzene was below TDEC's New Construction Mitigation Risk Criteria.

Because of the 1,3-Butadiene being a product of the soil gas sampling procedure it should be removed from the constituent of concern. Based on the analytical results from this sampling event, the soil gas intrusion anticipated level of indoor concentrations appears to be below the TDEC recommended vapor mitigation levels. The analytical results do not indicate a vapor barrier is required for the constituents of concern from the offsite REC based on this sampling event.

UES does not suggest additional sampling currently however, if a site plan is developed with structures additional sampling may be necessary to determine if the constituents of concern can be found within the building footprint. It should be noted that radon is not included in the constituents analyzed for, therefore this report does not include recommendation for radon gas.



CLOSURE

UES appreciates the opportunity to provide our services to you. If you have any questions or would like to discuss the findings, please feel free to call us.

Sincerely,

UES Professional Solutions



Byron L. Barton, P.G.
Senior Geologist



Scott Goan, RLS
Environmental Professional

Attachments: Sample Location and Laboratory Results





Note:
 Site boundary and features shown are approximate only.
 Drawing composed from field notes and observations only.

- Approximate Location of Soil Gas Samples.
- Subject Property.

SCALE:	NTS
CHECKED BY:	MCP
DRAWN BY:	SG
DATE:	04-13-2026



2651 Willow Point Way
 Knoxville, Tennessee 37931

Phone: (865) 539-8242
 Fax: (865) 539-8252

SITE PLAN
 COPPERWOOD LANE PHASE II
 1155 COPPERWOOD LANE
 KNOXVILLE, TENNESSEE

JOB NO: A25109.01368.000