



## Department of Energy

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October 10, 2023

Ms. April Webb  
Interim Federal Facility Agreement Manager  
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PPPO-02-10025727-24B

Mr. Victor Weeks  
Federal Facility Agreement Manager  
U.S. Environmental Protection Agency, Region 4  
61 Forsyth Street  
Atlanta, Georgia 30303

Dear Ms. Webb and Mr. Weeks:

**TRANSMITTAL OF THE ADDENDUM TO THE PLANT INDUSTRIAL AREA VAPOR INTRUSION PRELIMINARY RISK ASSESSMENT REPORT, PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY (DOE/LX/07-2471&D2/A1/R1)**

References:

1. Letter from A. Webb to A. Ladd, "KDWM Approval of the Addendum to the Plant Industrial Area Vapor Intrusion Preliminary Risk Assessment Report (DOE/LX/07-2471&D2/A1), Paducah Site, Paducah, McCracken County, Kentucky, #KY8-890-008-982," dated September 6, 2023
2. E-mail from S. Fountain to B. Schaffer, A. Webb, and V. Weeks, "RE: From the VI Addendum," dated September 5, 2023
3. Letter from V. Weeks to A. Ladd, "U.S. Environmental Protection Agency (EPA) Region 4 acknowledges receipt of, and provides a comment for the Department of Energy's (DOE's) Addendum to the Plant Industrial Area Vapor Intrusion Preliminary Risk Assessment Report, Paducah Gaseous Diffusion Plant, Paducah, Kentucky, DOE/LX/07-2471&D2/A1, transmittal date of July 17, 2023," dated July 25, 2023

Please find enclosed the *Addendum to the Plant Industrial Area Vapor Intrusion Preliminary Risk Assessment Report, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2471&D2/A1/R1. This addendum presents the results of the second round of sampling for the vapor intrusion study performed per the recommendations in the 2022 *Plant Industrial Area Vapor Intrusion Risk Assessment Report, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2471&D2, and incorporates revisions associated with the comment provided by the U.S. Environmental Protection Agency on July 25, 2023. The U.S.

Department of Energy appreciates the Kentucky Division of Waste Management approval of the document on September 6, 2023.

In accordance with Section XX of the Paducah Federal Facility Agreement, the U.S. Environmental Protection Agency and the Kentucky Department for Environmental Protection each have a 30-day review period. If the FFA Parties have no substantive comments, DOE requests a letter of concurrence. If you have any questions or require additional information, please contact Richard Bonczek at (859) 219-4051.

Sincerely,

**APRIL LADD** Digitally signed by APRIL LADD  
Date: 2023.10.10 14:21:20  
-05'00'

April Ladd  
Federal Facility Agreement Manager  
Portsmouth/Paducah Project Office

Enclosures:

1. *Addendum to the Plant Industrial Area Vapor Intrusion Preliminary Risk Assessment Report, Paducah Gaseous Diffusion Plant, Paducah, Kentucky, DOE/LX/07-2471&D2/A1/R1—Clean*
2. *Addendum to the Plant Industrial Area Vapor Intrusion Preliminary Risk Assessment Report, Paducah Gaseous Diffusion Plant, Paducah, Kentucky, DOE/LX/07-2471&D2/A1/R1—Redline*
3. Comment Response Summary

Administrative Record File—ARF ARR and GWARC

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DOE/LX/07-2471&D2/A1/R1  
Secondary Document

**Addendum to the Plant Industrial Area Vapor Intrusion  
Preliminary Risk Assessment Report,  
Paducah Gaseous Diffusion Plant,  
Paducah, Kentucky**



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**Addendum to the Plant Industrial Area Vapor Intrusion  
Preliminary Risk Assessment Report,  
Paducah Gaseous Diffusion Plant,  
Paducah, Kentucky**

Date Issued—September 2023

U.S. DEPARTMENT OF ENERGY  
Office of Environmental Management

Prepared by  
FOUR RIVERS NUCLEAR PARTNERSHIP, LLC,  
managing the  
Deactivation and Remediation Project at the  
Paducah Gaseous Diffusion Plant  
under Contract DE-EM0004895

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## ACRONYMS

DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
KDEP	Kentucky Department for Environmental Protection
MDL	method detection limit
PAL	project action limit
PGDP	Paducah Gaseous Diffusion Plant
PI	preliminary investigation
PQL	practical quantitation limit
PVC	polyvinyl chloride
QAPP	quality assurance project plan
RGA	Regional Gravel Aquifer
SIM	selective ion monitoring
UCRS	Upper Continental Recharge System
VI	vapor intrusion
VISL	vapor intrusion screening level

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## EXECUTIVE SUMMARY

This report is an addendum to the 2022 *Plant Industrial Area Vapor Intrusion Risk Assessment Report, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2471&D2 (2022 VI Report) (DOE 2022) and presents the results of the second round of sampling for the vapor intrusion (VI) study performed in response to the 2021 Sitewide VI Investigation [Preliminary Investigation (PI)] and in accordance with the *Paducah Gaseous Diffusion Plant Industrial Area Vapor Intrusion Preliminary Investigation Work Plan for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2447&D2/R1 (VI Work Plan) (DOE 2020). The VI Work Plan was developed in response to the March 2019 *Memorandum of Agreement for Resolution of Formal Dispute Concerning Kentucky Department for Environmental Protection Nonconurrence and U.S. Environmental Protection Agency Conditions Submitted on the Site Management Plan, Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Annual Revision-Fiscal Year 2018, DOE/LX/07-2418&D2* (2019 MOA) (DOE 2019). Summaries of the 2019 MOA, VI Work Plan, and site geologic and hydrogeologic settings can be found in Section 1 of the 2022 VI Report.

The objective of the VI study is to evaluate whether the subsurface-to-indoor air VI pathways are complete and whether they present an unacceptable risk to workers in the buildings within the Paducah Gaseous Diffusion Plant (PGDP) Industrial Area under current conditions. The results of the 2021 VI sampling event were evaluated to develop conclusions about the potential impact of VI on the indoor air of PI buildings at PGDP. Based on the comparison of results to the decision rules outlined in the VI Work Plan and in Section 4.3 of the 2022 VI Report, six locations within three buildings were recommended for additional sampling due to exceedances of U.S. Environmental Protection Agency (EPA) vapor intrusion screening levels (VISLs) for trichloroethene (TCE) (2.99 micrograms per cubic meter [ $\mu\text{g}/\text{m}^3$ ] in indoor air and  $99.7 \mu\text{g}/\text{m}^3$  in subslab vapor) and chloroform ( $0.533 \mu\text{g}/\text{m}^3$  in indoor air and  $17.8 \mu\text{g}/\text{m}^3$  in subslab vapor): (1) C-310 Location 2, (2) C-310 Location 3, and (3) C-720 Location 4 due to TCE VISL exceedances in subslab soil vapor; and (4) C-310 Location 4, (5) C-409 Location 1, and (6) C-409 Location 3 due to chloroform VISL exceedances in indoor air and subslab soil vapor. These locations were sampled during the March 2023 sampling event, with the exceptions noted in Sections 2.1.2 and 2.2.2.

During the March 2023 sampling event, chloroform was detected in one indoor air sample, with a concentration of  $2.2 \mu\text{g}/\text{m}^3$  and in three subslab samples, with concentrations ranging from  $0.63 \mu\text{g}/\text{m}^3$  to  $2 \mu\text{g}/\text{m}^3$ . TCE was detected in one indoor air sample at a concentration of  $4.4 \mu\text{g}/\text{m}^3$  and in five subslab samples, with concentrations ranging from  $1.2 \mu\text{g}/\text{m}^3$  to  $1,200 \mu\text{g}/\text{m}^3$ . 1,1,1-Trichloroethane (1,1,1-TCA) was detected in two indoor air samples at concentrations of  $1.1 \mu\text{g}/\text{m}^3$  and one subslab vapor sample at a concentration of  $1.3 \mu\text{g}/\text{m}^3$  within one building. Among the other analytes of concern identified in the 2021 sampling event, *cis*-1,2-dichloroethene (*cis*-1,2-DCE) was detected in one subslab vapor sample at a concentration of  $1.6 \mu\text{g}/\text{m}^3$ , and vinyl chloride (VC) and *trans*-1,2-dichloroethene (1,2-DCE) were not detected in any sample.

Of the three locations where TCE exceeded its subslab soil gas VISL during the 2021 sampling event—C-310 Location 2, C-310 Location 3, and C-720 Location 4—none of the paired indoor air samples collected from these locations had TCE concentrations greater than its VISL. During the March 2023 sampling event, TCE continued to exceed its subslab soil gas VISL at the C-310 locations. The paired indoor air samples collected from C-310 Location 2 and C-720 Location 4 did not have TCE concentrations greater than the TCE VISL for indoor air. As discussed in Section 4.3 and in the context of decision rules, this result is consistent with an incomplete VI pathway at these locations. At C-310 Location 3, the TCE concentration in indoor air exceeded the VISL, which indicates the potential for a complete VI pathway at

this location. The subslab to indoor air TCE attenuation factor<sup>1</sup> at this location is 0.004, which is typical of buildings with competent slabs; no background sources of contamination were identified. Therefore, although there may be a complete vapor intrusion pathway, there does not appear to be a preferential pathway from subslab to indoor air.

During the 2021 sampling event, chloroform exceeded its subslab VISL and was the only PI analyte with VISL exceedances in indoor air. Chloroform is a common background contaminant associated with the disinfection of water using chlorine, and Section 4.2.1 of the 2022 VI Report discusses lines of evidence used to conclude that chloroform is a background contaminant at the PI buildings. C-310 Location 4, C-409 Location 1, and C-409 Location 3 were the locations recommended for additional sampling based on prior chloroform exceedances in both subslab and indoor air; however, as described in Section 2.2.2, C-310 Location 4 was not sampled during the March 2023 sampling event due to flooding and standing water at the sampling location. Chloroform was detected at both C-409 Location 1 and C-409 Location 3, but neither location had chloroform VISL exceedances in subslab soil vapor or indoor air during the March 2023 sampling event. During the 2021 sampling event, chloroform had subslab concentrations of 56 µg/m<sup>3</sup> and 620 µg/m<sup>3</sup> at C-409 Locations 1 and 3, respectively. During the March 2023 sampling event, subslab chloroform concentrations were 0.63 J µg/m<sup>3</sup> and 2 µg/m<sup>3</sup> for C-409 Locations 1 and 3, respectively.

In buildings C-409 and C-720, no PI analytes were present in indoor air at concentrations equal to or greater than VISLs. Based on multiple lines of evidence, two rounds of evaluation of the VI pathways, and in consideration of the decision rules outlined in the VI Work Plan, the VI pathway is incomplete and there is no unacceptable risk to workers from the VI pathway under current conditions for these buildings. No additional actions are recommended at C-409 and C-720.

At C-310 Location 3, based on the presence of TCE in subslab soil gas above the EPA subslab soil gas VISL, periodic air monitoring, worker access restriction (or both) and/or increased ventilation may be appropriate steps to take if it is anticipated workers will spend substantial time in the building until the building is decommissioned. It should be noted that this building is currently undergoing deactivation, and it is occupied by workers engaged in deactivation activities. The results of this study have been communicated with and reviewed by the Department of Energy (DOE) Deactivation and Remediation Contractor's Safety and Health group (see Appendix G). The workers in this facility are protected under DOE health and safety requirements.

These conclusions and recommendations do not supersede the requirements in the risk methods document that if or when the use of an occupiable building on the DOE Paducah Site changes, a new building is constructed, or a parcel of land is transferred for a different use, DOE will evaluate the VI pathway to the building or the proposed building at that time (DOE 2021). Based on the results of this study, the analyte suite from this study [i.e., chloroform; *cis*-1,2-DCE; *trans*-1,2-DCE; mercury (elemental); 1,1,1-TCA; TCE; and VC] is recommended as a minimum analyte list for evaluation in future VI evaluations.

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<sup>1</sup> The attenuation factor is the ratio of the indoor air concentration to the subslab concentration and is calculated by dividing the indoor air concentration for a single analyte by the paired subslab concentration for the same analyte.

# 1. INTRODUCTION

This report is an addendum to the 2022 *Plant Industrial Area Vapor Intrusion Risk Assessment Report, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2471&D2 (2022 VI Report) (DOE 2022) and presents the results of the second round of sampling for the vapor intrusion (VI) study performed in response to the 2021 Sitewide VI Investigation [Preliminary Investigation (PI)] and in accordance with the *Paducah Gaseous Diffusion Plant Industrial Area Vapor Intrusion Investigation Work Plan for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2447&D2/R1 (VI Work Plan) (DOE 2020). The VI Work Plan was developed in response to the March 2019 *Memorandum of Agreement for Resolution of Formal Dispute Concerning Kentucky Department for Environmental Protection Nonconurrence and U.S. Environmental Protection Agency Conditions Submitted on the Site Management Plan, Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Annual Revision-Fiscal Year 2018*, DOE/LX/07-2418&D2 (2019 MOA) (DOE 2019). Summaries of the 2019 MOA, VI Work Plan, and site geologic and hydrogeologic settings can be found in Section 1 of the 2022 VI Report.

The objective of the VI study is to evaluate whether the subsurface-to-indoor air VI pathways are complete and whether they present an unacceptable risk to workers in the buildings within the Paducah Gaseous Diffusion Plant (PGDP) industrial area under current conditions. The results of the 2021 sampling event were evaluated to develop conclusions about the impact of VI on the indoor air of PI buildings at PGDP. PI results were evaluated against the U.S. Environmental Protection Agency (EPA) vapor intrusion screening levels (VISLs) outlined in Section 1.5 of the 2022 VI Report and are reproduced in Table 1.

**Table 1. VISLs for PI Analytes of Interest for PGDP Area—Commercial**

Chemical	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk via VI from Soil Source?	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk via VI from Groundwater Sources?	Indoor Air VISL ( $\mu\text{g}/\text{m}^3$ ) at TCR = $1\text{E}-06$ or THQ = $1^a$	Toxicity Basis	Soil Gas VISL ( $\mu\text{g}/\text{m}^3$ ) at TCR = $1\text{E}-06$ or THQ = $1^a$	Target Groundwater Concentration ( $\mu\text{g}/\text{L}$ ) at TCR = $1\text{E}-06$ or THQ = $1^a$
	Cvp > Cia, target?	Chc > Cia, target?	Min (Cia, C; Cia, NC)	C or NC	Csg	Chc
Chloroform	Yes	Yes	0.533	C	17.8	3.55
Dichloroethene, 1,2- <i>cis</i> - ( <i>cis</i> -1,2-DCE)	No Inhalation Toxicological Information	No Inhalation Toxicological Information	NVA*, 3,500	--, NC	--	--
Dichloroethene, 1,2- <i>trans</i> - ( <i>trans</i> -1,2-DCE) <sup>b</sup>	No Inhalation Toxicological Information	No Inhalation Toxicological Information	NVA*, 3,500	--, NC	--	--
Mercury (elemental) <sup>c</sup>	Yes	Yes	1.31	NC	43.8	3.73
Trichloroethane, 1,1,1- (1,1,1-TCA) <sup>d</sup>	Yes	Yes	21,900	NC	730,000	31,100
TCE	Yes	Yes	2.99	C	99.7	7.43
Vinyl Chloride (VC)	Yes	Yes	2.79	C	92.9	2.45

C = carcinogenic  
 Cia = concentration, indoor air  
 Chc = concentration, groundwater vapor  
 Csg = concentration, subslab and exterior soil gas concentration  
 Cvp = concentration, pure phase vapor

**Table 1. VISLs for PI Analytes of Interest for PGDP Area—Commercial (Continued)**

NVA\* = no VISL value available; provisional value provided by EPA, as documented in Appendix E (E.9) of the risk methods document (DOE 2021). Value for *cis*-1,2-DCE uses *trans*-1,2-DCE value as surrogate.

NC = noncarcinogenic

TCR = target risk for carcinogens

THQ = target hazard quotient for noncarcinogens

<sup>a</sup> The agreed upon VISLs laid out in the VI Work Plan were calculated at a hazard quotient of 1 because this was a preliminary assessment and was not intended to be used for human health risk assessment at this time. Reporting limits were targeted to meet the hazard quotient of 0.1 so that the data could still be used for future risk assessment.

<sup>b</sup> At the time of the VI Work Plan issuance, EPA did not have a VISL for *trans*-1,2-DCE. Using the most recent version of the EPA VISL calculator, accessed on June 9, 2021, the VISL for *trans*-1,2-DCE is 175 µg/m<sup>3</sup> and 5,840 µg/m<sup>3</sup> for indoor air and subslab vapor, respectively (EPA 2019). These VISLs are based on the EPA May 2021 Regional Screening Levels. The results of this study were evaluated against the new VISL for *trans*-1,2-DCE. Because the maximum concentrations of *trans*-1,2-DCE in this study were 0.77 µg/m<sup>3</sup> and 2 µg/m<sup>3</sup> (nondetect) for indoor air and subslab vapor, respectively, the new VISL does not change the interpretation of the results.

<sup>c</sup> For an analyte to be considered a contaminant of potential concern for VI, the analyte must be toxic and sufficiently volatile to migrate from a subsurface source into a building at a concentration greater than its indoor air VISL. Elemental mercury is toxic and can be sufficiently volatile to exist in vapors at levels potentially harmful to human receptors; therefore, mercury must be present in subsurface media in elemental form to pose a VI risk. The majority of mercury, which is a common industrial contaminant and by-product of coal combustion, detected in groundwater or soils at the Paducah Site is expected to be in the form of salts—not elemental mercury. Mercury has not been detected in site monitoring wells at concentrations greater than its groundwater VISL; therefore, mercury is not expected to be present in vapor form above trace concentrations. Indoor air in each building identified for PI sampling, however, was screened for mercury using a field meter as a protective measure based on its widespread detection in site soil.

<sup>d</sup> 1,1,1-TCA was included to be considered only when there is documented use within a facility. It was not considered in ranking PI facilities; however, it was sampled in each building identified for PI sampling.

Results and evaluations based on comparison to VISLs are presented in Sections 3 and 4 of the 2022 VI Report, respectively, and subsequent recommendations are proposed in Section 5. Based on comparison of results to the decision rules outlined in Section 10 of the VI Work Plan and in Section 4.3 of the 2022 VI Report, six locations within three buildings were recommended for additional sampling. Those locations and the rationale for recommending additional sampling are outlined in Table 2, and building locations are shown in Figure 1. Specific sample locations are included on Figures 2, 3, and 4.

**Table 2. March 2023 Additional Sampling Locations and Rationale**

Facility Number	Facility Description	Facility Walkdown Description	Inclusion Rationale	Paired Indoor Air and Subslab Locations to be Sampled	Additional Sampling Rationale*
C-310	Purge and Product Building	Former process building	Soil	Locations 2, 3, and 4	TCE exceeded VISL in subslab soil vapor at Locations 2 and 3; chloroform exceeded VISL in indoor air and subslab soil vapor at Location 4.
C-409	Stabilization Building	Big ovens/ laboratory	Regional Gravel Aquifer (RGA)/Upper Continental Recharge System (UCRS) Groundwater and Soil	Locations 1 and 3	Chloroform exceeded VISL in indoor air and subslab soil vapor at Locations 1 and 3.
C-720	Maintenance and Storage Building	Stores; maintenance shops. C-720 and C-720-C are connected; will be assessed together.	UCRS Groundwater and Soil	Location 4	TCE exceeded VISL in subslab soil vapor at Location 4.

\*VISL exceedances indicated by yellow highlighted results are included on Figures 2, 3, and 4.



These locations were sampled during the March 2023 sampling event. Sample identifications numbers for the March 2023 sampling event are as follows:

YYBBBBPP-XX-L (example: 23C310VI-IA-3)

where:

YY = year = 23 = 2023

BBBB = building = C310 = C-310 (can also be “C409” for C-409 or “C720” for C-720)

PP = project designation = VI

XX = sample type = IA = indoor air (can also be “OA” for outdoor air or “SS” for subslab)

L = location number within the building = 3

At the end of the sample identification number, “D” represents a duplicate sample and “R” represents a resample.

The samples were collected consistent with the VI Work Plan and associated quality assurance project plan (QAPP), with exceptions noted in Sections 2.1.2 and 2.2.2.

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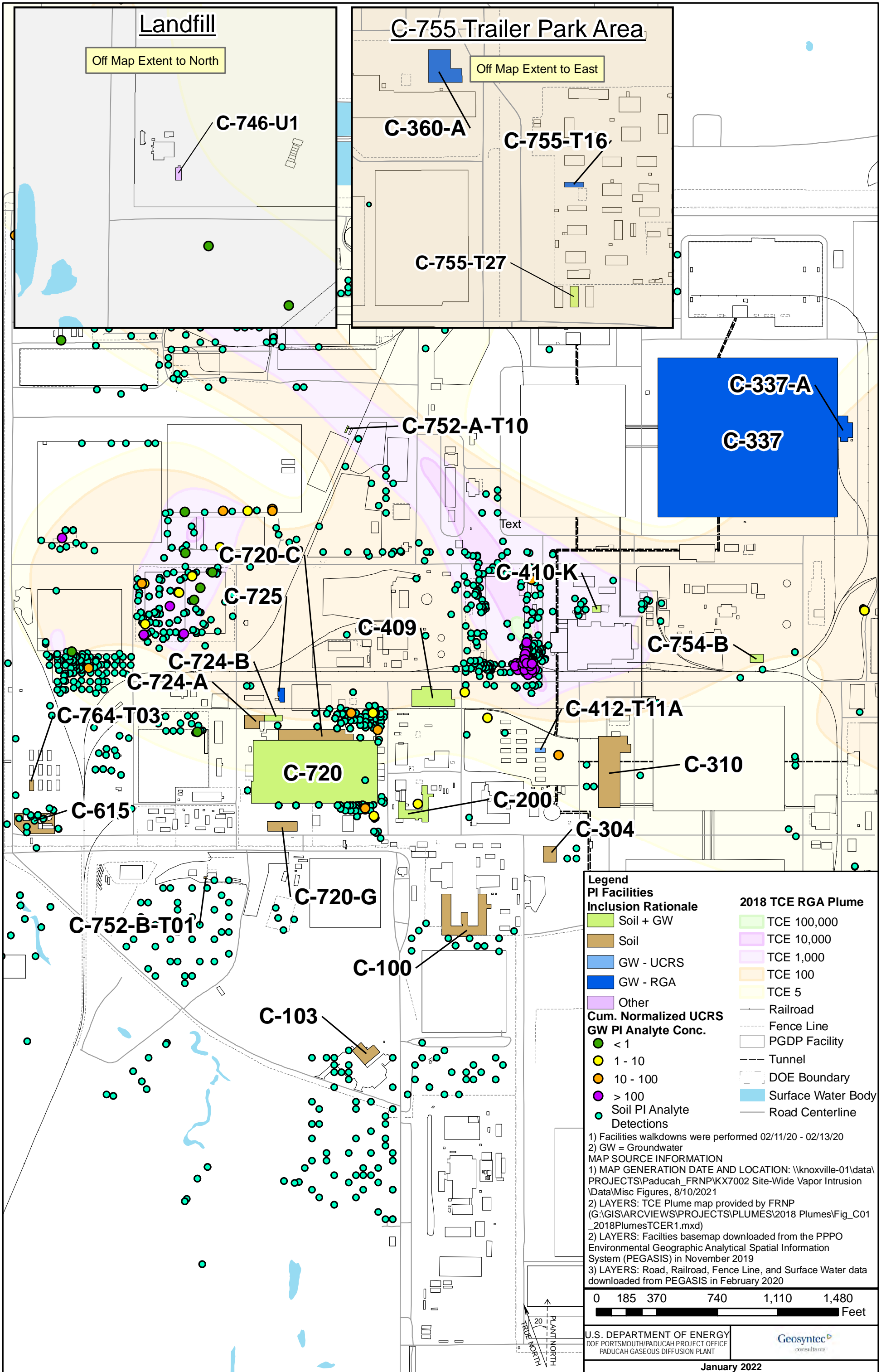
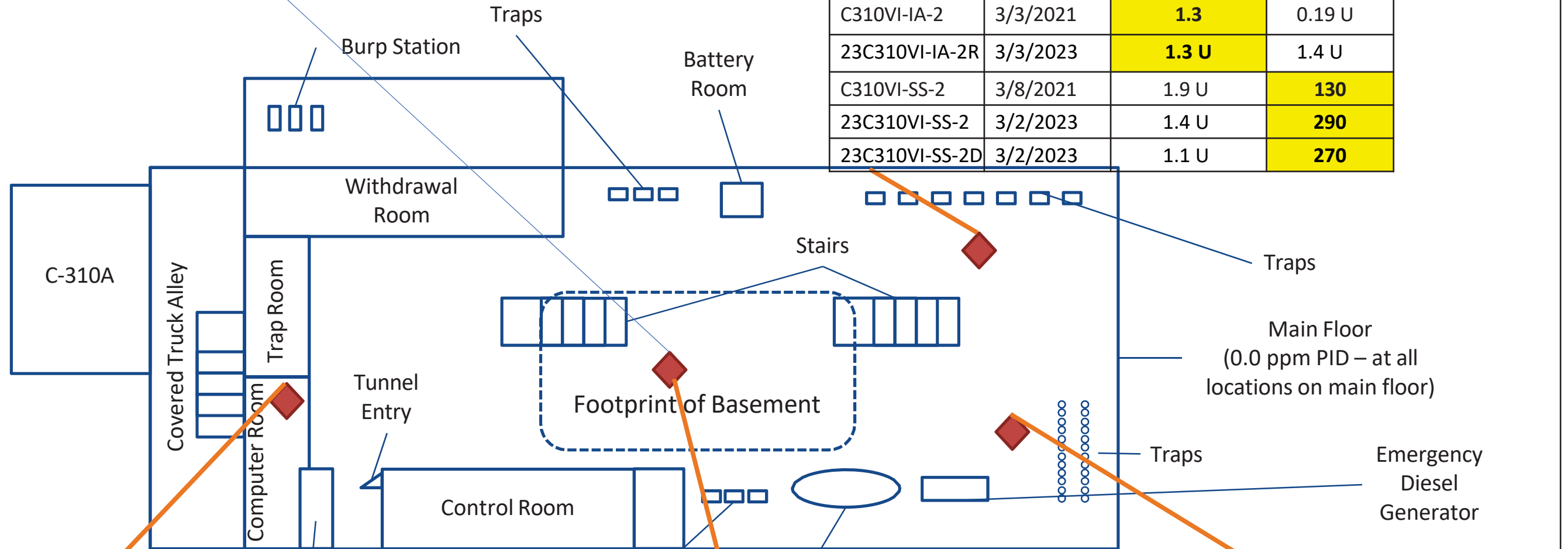


Figure 1. Preliminary Investigation Buildings Identified for Additional Sampling

Source: Soil

(Sample to be collected from basement level)



Location 2 Sample ID	Date	Compound (µg/m³)	
		Chloroform	TCE
C310VI-IA-2	3/3/2021	<b>1.3</b>	0.19 U
23C310VI-IA-2R	3/3/2023	<b>1.3 U</b>	1.4 U
C310VI-SS-2	3/8/2021	1.9 U	<b>130</b>
23C310VI-SS-2	3/2/2023	1.4 U	<b>290</b>
23C310VI-SS-2D	3/2/2023	1.1 U	<b>270</b>

Location 1 Sample ID	Date	Compound (µg/m³)	
		Chloroform	TCE
C310VI-IA-1	3/3/2021	<b>0.33 J</b>	0.19 U
C310VI-SS-1	3/5/2021	1.9 U	<b>46</b>

Location 4 Sample ID	Date	Compound (µg/m³)	
		Chloroform	TCE
C310VI-IA-4	3/4/2021	<b>1.6</b>	<b>0.28 J</b>
C310VI-SS-4	3/8/2021	<b>44</b>	<b>97</b>

Location 3 Sample ID	Date	Compound (µg/m³)	
		Chloroform	TCE
C310VI-IA-3	3/3/2021	<b>1.4</b>	0.19 U
23C310VI-IA-3	3/1/2023	<b>2.2</b>	<b>4.4</b>
C310VI-SS-3	3/8/2021	1.9 U	<b>750</b>
23C310VI-SS-3	3/2/2023	<b>0.99 J</b>	<b>1200 D</b>

**Legend**  
 Paired Sub-slab/Indoor Air Sampling Location (approximate)

**Notes**  
 Facility Size: 62,863 ft²  
 Basement Size: 2,100 ft²  
 \*All dimensions and locations are approximate unless otherwise noted.  
 \*Detections are bolded and results greater than their VISLs are highlighted in yellow.  
 \*Only chloroform and TCE results shown. There were no exceedances of VISLs for the other PI Analytes.

Not To Scale

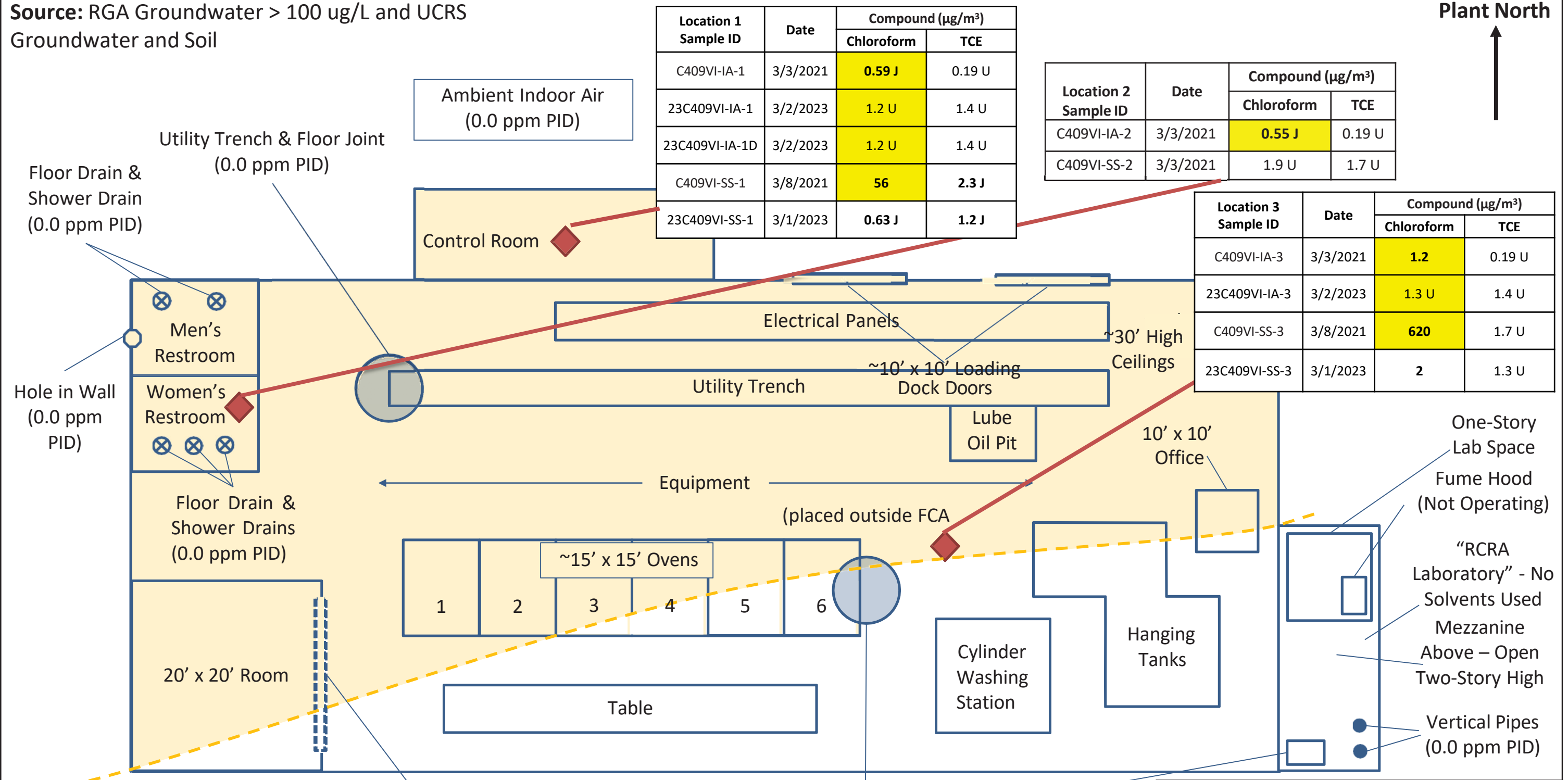
**Sampling Results: C-310**  
 Paducah Gaseous Diffusion Plant  
 McCracken County, Kentucky

U.S. DEPARTMENT OF ENERGY DOE/PORTSMOUTH/PADUCAH/PROJECT/OFFICE PADUCAHGASEOUSDIFFUSIONPLANT	<b>Geosyntec</b> consultants	<b>Figure</b>
May 2023		<b>2</b>

Figure 2. Sampling Results: C-310

**Source: RGA Groundwater > 100 ug/L and UCRS**  
Groundwater and Soil

**Plant North**



Location 1 Sample ID	Date	Compound (µg/m³)	
		Chloroform	TCE
C409VI-IA-1	3/3/2021	<b>0.59 J</b>	0.19 U
23C409VI-IA-1	3/2/2023	1.2 U	1.4 U
23C409VI-IA-1D	3/2/2023	1.2 U	1.4 U
C409VI-SS-1	3/8/2021	<b>56</b>	<b>2.3 J</b>
23C409VI-SS-1	3/1/2023	<b>0.63 J</b>	<b>1.2 J</b>

Location 2 Sample ID	Date	Compound (µg/m³)	
		Chloroform	TCE
C409VI-IA-2	3/3/2021	<b>0.55 J</b>	0.19 U
C409VI-SS-2	3/3/2021	1.9 U	1.7 U

Location 3 Sample ID	Date	Compound (µg/m³)	
		Chloroform	TCE
C409VI-IA-3	3/3/2021	<b>1.2</b>	0.19 U
23C409VI-IA-3	3/2/2023	1.3 U	1.4 U
C409VI-SS-3	3/8/2021	<b>620</b>	1.7 U
23C409VI-SS-3	3/1/2023	<b>2</b>	1.3 U

**Legend**

Paired Subslab/Indoor Air Sampling Location (approximate)

Inferred 100 ug/L TCE Contour in RGA Groundwater

**Notes**

Facility Size: 27,252 ft<sup>2</sup>

\*All dimensions and locations are approximate unless otherwise noted.  
 \*Detections are bolded and results greater than their VISLs are highlighted in yellow.  
 \*Only chloroform and TCE results shown. There were no exceedances of VISLs for the other PI Analytes.

Not To Scale

**Sampling Results: C-409**  
Paducah Gaseous Diffusion Plant  
McCracken County, Kentucky

U.S. DEPARTMENT OF ENERGY  
DOE/PORTSMOUTH/PADUCAH-PROJECT OFFICE  
PADUCAH-GASEOUS DIFFUSION PLANT

**Geosyntec**  
consultants

**Figure**

May 2023

3

Figure 3. Sampling Results: C-409

**Source: UCRS Groundwater and Soil**

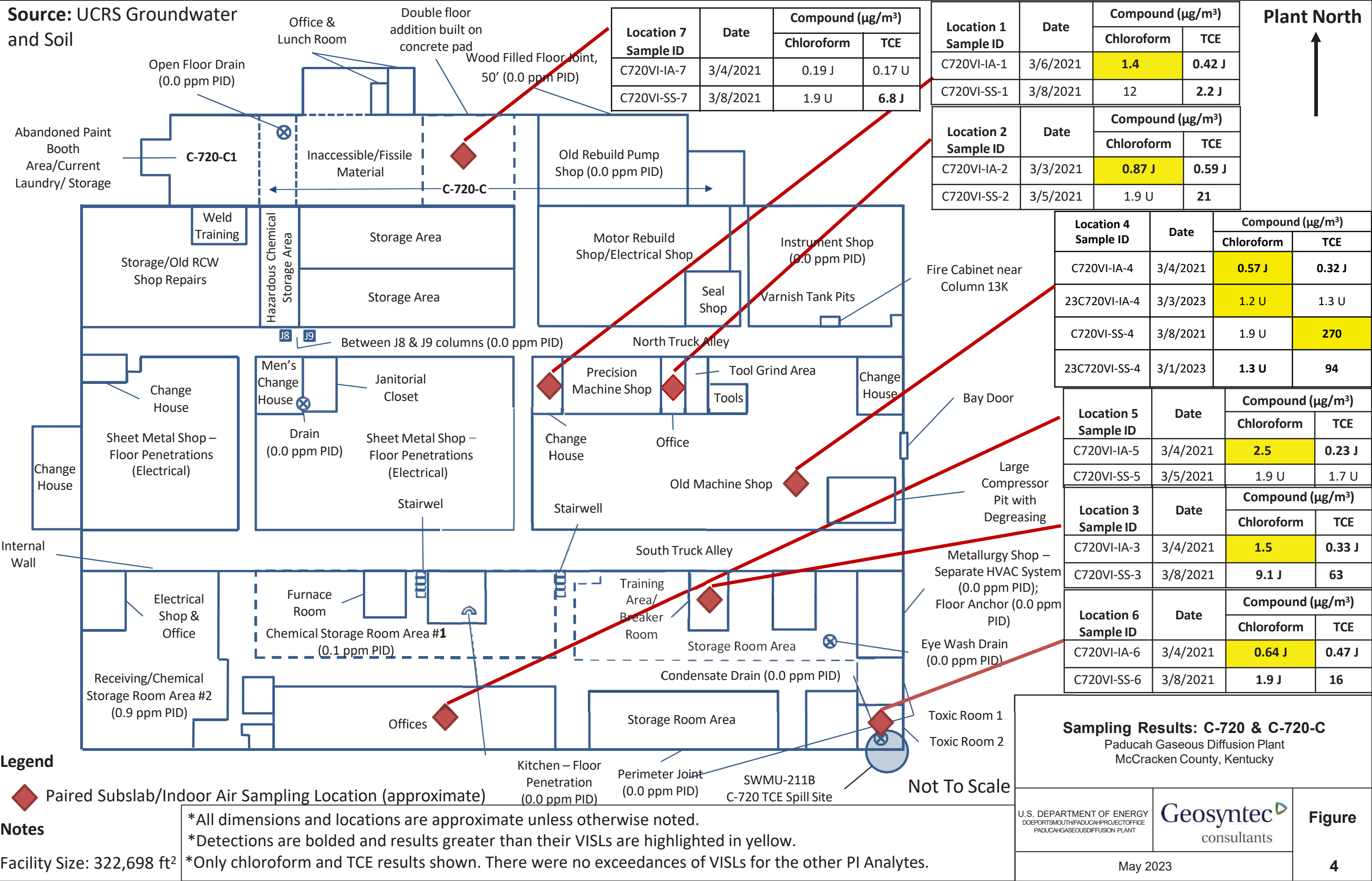


Figure 4. Sampling Results: C-720 and C-720-C

## 2. VAPOR INTRUSION STUDY APPROACH

This section describes the methods used to collect indoor air samples, subslab vapor samples, and outdoor air samples and to gather other relevant information, such as differential pressure readings, to support the March 2023 sampling event. Field activities were performed in accordance with the VI Work Plan and associated QAPP and deviations from the work plan are described in Sections 2.1.2 and 2.2.2 of this report. Representative photographs taken during sample collection are included in Appendix A, and field forms are included in Appendix B.

### 2.1 SUBSLAB VAPOR SAMPLING FIELD METHODS

The following subsections describe the subslab vapor sampling and any deviations from the VI Work Plan.

#### 2.1.1 Subslab Vapor Sampling

Mini Vapor Pin<sup>®</sup> subslab vapor monitoring probes were installed prior to the 2021 sampling event. For locations other than C-409 Location 1, the previously installed Mini Vapor Pins<sup>®</sup> were used for the collection of the March 2023 samples. As described in Section 2.1.2 below, the C-409 Location 1 Mini Vapor Pin<sup>®</sup> was reinstalled on January 26, 2023, following the protocol in the VI Work Plan.

Leak checks were performed prior to subslab sample collection at each location. After removing the Mini Vapor Pin<sup>®</sup> secure cover, screwing in the barbed fitting, and placing a piece of silicone tubing over the barbed fitting, each probe was subjected to a water dam check to ensure that the annular seal for the probe was not leaking. A circle of putty approximately 1 inch in diameter was pressed to the bottom edge of a 2-inch polyvinyl chloride (PVC) pipe coupling, and the PVC pipe coupling was placed around the probe (putty side down) and then pushed against the concrete to form a seal between the putty and the slab. Water was then poured into the PVC coupling and observed for bubbles or a drop in the water level that might indicate a leaky probe, and thus, not a secure seal. The water dam method is described in the *Standard Operating Procedure Leak Testing the VAPOR PIN<sup>®</sup> Sampling Device Via Water Dam* (Vapor Pin<sup>®</sup> 2021). All locations passed the water dam test.

After each probe passed a leak test,<sup>2</sup> a 6-liter (L), individually certified Summa<sup>®</sup> canister was connected to a tee-fitting, with a ball valve on each side to facilitate the transition from purging to sampling. The sampling tee was connected to the probe using ¼-inch Nylaflow<sup>®</sup> tubing with a compression fitting. A lung box equipped with a Tedlar<sup>®</sup> bag was attached to the other end of the sampling tee using ¼-inch Nylaflow<sup>®</sup> tubing and compression fitting. Prior to sample collection at each location, a shut-in vacuum test was performed and then a vacuum box equipped with a 1-L Tedlar<sup>®</sup> bag was used to purge 3 volumes of air, which were screened for total volatile organic compounds, oxygen, carbon dioxide, and methane using a photoionization detector and landfill gas meter.

Subslab vapor sampling was conducted on March 1, 2023, through March 3, 2023. For each 10-hour sample, the 6-L Summa<sup>®</sup> canister was opened and the canister vacuum was recorded at the start of sample collection. During sample collection, each canister vacuum was observed periodically to monitor whether the flow regulator was functioning as expected and if it would last for the full 10-hour sampling period.

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<sup>2</sup> A leak was identified during the leak check of the C-409 Location 3 subslab sample. All fittings were tightened and putty was added to the exterior of the fittings as an extra precaution, which is a standard VI troubleshooting approach. After tightening the fittings and adding putty, the location and equipment passed the leak tests. Additionally, there was no detection for any PI analyte in subslab vapor at this location, which reaffirms that there is no concern about cross-contamination or false positives.

The Summa® canisters were closed and final canister vacuums were recorded after 10 hours, except at C-720 Location 4, which was collected as a grab sample with no flow controller due to a tight underlying soil formation and insufficient vacuum generated by the 10-hour flow controller to collect a sample, as is explained in detail in section 2.1.2.

### 2.1.2 Deviations from the VI Work Plan

Changed conditions for subslab sampling identified during project planning are shown in Table 3. Each of the conditions described was communicated to EPA and the Kentucky Department for Environmental Protection (KDEP) via e-mail, as appropriate (the correspondence is included in Appendix C).

**Table 3. Summary of Subslab Sampling Changed Conditions during Project Planning**

<b>Expected Condition</b>	<b>Changed Condition</b>	<b>Response</b>
A GEM 2000 Landfill Gas meter (or equivalent) to measure oxygen, carbon dioxide, and methane concentrations was to be used during purging of the subslab locations.	The GEM 2000 unit has been replaced by the manufacturer by the GEM 5000. With respect to this project and purpose, the GEM 5000 provides the same function as the GEM 2000, with slightly improved accuracy (0.5% versus 1.0%) at the methane and carbon dioxide levels FRNP anticipates during purging.	The GEM 5000 was used and considered as equivalent to the GEM 2000.
Subslab samples were to be collected in batch certified 1-L Summa® canisters.	The analytical laboratory was only able to provide 6-L Summa® canisters.	The new laboratory was only able to provide 6-L Summa® canisters; 6-L canisters were used for all samples rather than the 1-L canisters for the subslab sample collection. To avoid potential inventory issues, all canisters were individually certified, as opposed to batch certification for the subslab canisters.
Collect an additional round of paired subslab vapor and indoor air samples at C-310 Location 4 (i.e., basement) under conditions similar to conditions during the original sample collection.	During field planning, the C-310 basement was flooded with approximately 3 inches of standing water from a burst sanitary water pipe (i.e., chlorinated water). The presence of this water is a substantially different condition from the original sampling conditions, not only in terms of physical presence of the water but also the presence of chlorine and potential chlorine by-products. As noted in the VI Report, chloroform “is a common background contaminant associated with chlorinated drinking water.”	C-310 Location 4 was not sampled.

Changed conditions for subslab sampling identified during sampling are shown in Table 4.



**Table 4. Summary of Subslab Sampling Changed Conditions during Sampling**

<b>Expected Condition</b>	<b>Changed Condition</b>	<b>Response</b>
Per QAPP change approved during project planning (Table 3), all subslab samples were to be collected over 10 hours.	At C-720 Location 4, the canister vacuum was insufficient to pull a sample with the 10-hour flow controller installed due to a tight underlying soil formation.	There is no project requirement for duration of subslab samples (round 1 samples were collected as grab samples); a grab sample was manually collected at C-720 Location 4.
A duplicate sample was to be collected at C-310 Location 2.	At 10 hours, the analog gauge on the flow controller read -3.5 inHg; however, upon closing the canister, the gauge did not drop back to zero. After double-checking with a digital vacuum gauge, it was determined that the vacuum had reached zero.	In reviewing the QAPP, the frequency requirement for field duplicates is one duplicate per 20 samples. Unlike the round 1 sampling (where samples were analyzed using two methods), round 2 samples were all analyzed using the same method; therefore, the successfully collected duplicate at another location satisfies the QAPP frequency requirement for field duplicates. Although this sample canister had potentially failed in the field, the sample was analyzed by the laboratory. The data were verified as usable, so these results are included herein.
Subslab samples were intended to be “grab” samples.	The analytical laboratory was only able to provide Summa <sup>®</sup> canisters with 10-hour flow regulators.	All 6-L canisters provided by the laboratory had 10-hour flow controllers installed. The subslab samples were therefore collected over 10 hours. The VI Work Plan specifies that the subslab samples will be “allowed to fill until a vacuum of less than 5 inches of Hg remains,” and the plan did not specify a sample duration. The collection of the subslab sample over 10 hours meets data quality objectives.

## 2.2 INDOOR AND OUTDOOR AIR FIELD METHODS

The following subsections describe indoor air sampling, crawlspace air sampling, outdoor air sampling, and deviations from the VI Work Plan.

### 2.2.1 Indoor and Outdoor Air Sampling

The indoor and outdoor air samples were collected using 6-L, individually certified Summa<sup>®</sup> canisters. The morning of sample collection, canisters were positioned so that the intake was in the breathing zone 3–5 ft above the ground. This was achieved by placing the canister on a surface in the breathing zone or attaching the canister with zip ties to a tripod set to breathing zone height. In addition to being placed within the breathing zone, outdoor air canisters were placed on the upwind side of the PI building based on the wind direction at the time of setup.

Indoor and outdoor air samples were collected on March 1, 2023, through March 3, 2023. At the start of each day, Summa<sup>®</sup> canisters were placed and opened at indoor and outdoor air sampling locations, and the canister vacuums were recorded. For the duplicate sample, two Summa<sup>®</sup> canisters were placed adjacent to one another, and both canisters were opened simultaneously. During sample collection, the canister vacuum was observed for all samples to determine whether the flow regulator was functioning as expected and if it would last for the full 10-hour sampling period. After 10 hours, the Summa<sup>®</sup> canisters were closed, and final canister vacuums were recorded.

### 2.2.2 Deviations from the VI Work Plan

The submitted changed conditions for indoor and outdoor air sampling identified during project planning are shown in Table 5. The conditions described were also communicated to EPA and KDEP via e-mail at the time of sampling (the correspondence is included in Appendix C).

**Table 5. Summary of Indoor and Outdoor Air Sampling Changed Conditions during Project Planning**

Expected Condition	Changed Condition	Response
Indoor air and outdoor air samples were to be analyzed by method TO-15 and laboratory PQLs were set to meet project PALs.	The laboratory previously used for this project was not able to provide Summa <sup>®</sup> canisters to meet the project schedule. The new laboratory has TO-15 PQLs below PALs for the PI analytes, except chloroform, which has a PAL of 0.533 µg/m <sup>3</sup> and a TO-15 PQL of 2.44 µg/m <sup>3</sup> . While the new laboratory was not able to provide limits that meet the PALs, TO-15 SIM) is typically expected to have lower PQL/MDLs than TO-15.	All samples (subslab, indoor air, and outdoor air) were analyzed by method TO-15 SIM.
Collect an additional round of paired subslab vapor and indoor air samples at C-310 Location 4 (i.e., basement), under conditions similar to conditions during the original sample collection.	During field planning, the C-310 basement was flooded with approximately 3 inches of standing water from a burst sanitary water pipe (i.e., chlorinated water). The presence of this water is a substantially different condition from the original sampling conditions, not only in terms of physical presence of the water but also the presence of chlorine and potential chlorine by-products. As noted in the VI Report, chloroform “is a common background contaminant associated with chlorinated drinking water.”	C-310 Location 4 was not sampled.

Changed conditions for indoor and outdoor air sampling identified during sampling are shown in Table 6.

**Table 6. Summary of Indoor and Outdoor Air Sampling Changed Conditions during Sampling**

<b>Expected Condition</b>	<b>Changed Condition</b>	<b>Response</b>
<p>All indoor and outdoor air samples were to be collected over 10 hours.</p>	<p>The C-310 outdoor air sample was collected after 7 hours and 36 minutes due to the flow controller not lasting a full 10 hours.</p> <p>The C-310 Location 2 indoor air sample was collected after 4 hours and 53 minutes on March 1, 2023, due to the flow controller not lasting a full 10 hours.</p>	<p>The C-310 outdoor air sample collected after 7.5 hours is adequate for the purposes of the project (i.e., to reduce temporal variability uncertainty), and the pressure data will be used to augment this data.</p> <p>The C-310 Location 2 indoor air sample was re-collected on March 3, 2023. During re-collection, the sample was collected after 8 hours due to the flow controller not lasting a full 10 hours. The 8-hour sample duration is adequate for the purposes of this round of sampling (i.e., to reduce temporal variability uncertainty), and the pressure data will be used to augment this data</p> <p>The duration of these two samples is sufficiently close to 10 hours to be representative of conditions throughout the majority of the day and the sample results will be able to be compared to the round 1 results.</p>

**2.3 POST-MARCH 2023 SAMPLING EVENT ACTIVITIES**

After being closed and collected, Summa<sup>®</sup> canister labels were affixed, and the canisters were then released for radiological scanning and subsequent shipment to the laboratory under chain-of-custody control for analysis by EPA Method TO-15 SIM. At subslab sample locations, tubing was removed, the barbed fitting was removed, and a Mini Vapor Pin<sup>®</sup> secure cover was screwed onto the Mini Vapor Pin<sup>®</sup> surface port. For indoor and outdoor air locations where a tripod stand was used, the stand was disassembled and removed at the time of Summa<sup>®</sup> canister collection. All nonreusable materials (e.g., tubing, compression fittings) were appropriately dispositioned.

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## 3. RESULTS

This section presents laboratory analytical results from samples collected during the March 2023 PI fieldwork, field measurements, and relevant weather data.

### 3.1 ANALYTICAL RESULTS

Analytical results for the March 2021 and March 2023 PI samples are presented in Table 7. Results for chloroform and TCE are shown on the PI building maps in Figures 2, 3, and 4. Sumps, drains, and other features relevant to the study and identified during the walkdowns are also noted on the building maps included in Figures 2, 3, and 4. Laboratory analytical results are included in Appendix D. The results by medium are summarized in the following subsections.

#### 3.1.1 Indoor Air Analytical Results

Two indoor air samples were collected from C-310; three indoor air samples including one duplicate sample were collected from C-409; and one indoor air sample was collected from C-720, as shown in Table 7. TCE, chloroform, and 1,1,1-TCA were detected in indoor air samples. The March 2023 sample results included the following results.

- TCE was detected in one indoor air sample in building C-310, at a concentration of  $4.4 \mu\text{g}/\text{m}^3$ .
- 1,1,1-TCA was detected in one indoor air sample and the corresponding duplicate indoor air sample in building C-409, at a concentration of  $1.1 \mu\text{g}/\text{m}^3$ .
- Chloroform was detected in one indoor air sample in building C-310, at a concentration of  $2.2 \mu\text{g}/\text{m}^3$ .

Table 7. Analytical Results

		<i>Volatile Organic Compound</i>		1,1,1-TCA		Chloroform <sup>a</sup>		<i>cis</i> -1,2-DCE		<i>trans</i> -1,2-DCE		TCE		VC	
		<i>Target Indoor Air Concentration<sup>b</sup></i>		21,900		0.533		3,500		3,500		2.99		2.79	
		<i>Target Subslab Soil Gas Concentration</i>		730,000		17.8		--		--		99.7		92.9	
		<i>Unit</i>		µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>	
Building	Medium	Sample ID	Date												
C-310	Outdoor Air	C310VI-OA-1	3/3/2021	0.16	U	0.19	U	0.24	U	0.2	U	0.19	U	0.18	U,*,X
		23C310VI-OA	3/1/2023	1.6	U	1.4	U	1.1	U	1.1	U	1.6	U	0.74	U
	Indoor Air	C310VI-IA-2	3/3/2021	0.16	U	1.3		0.24	U	0.2	U	0.19	U	0.18	U,*,X
		23C310VI-IA-2R	3/3/2023	1.4	U	1.3	U	1	U	1	U	1.4	U	0.66	U
		C310VI-IA-3	3/3/2021	0.16	U	1.4		0.24	U	0.2	U	0.19	U	0.18	U,*,X
		23C310VI-IA-3	3/1/2023	1.3	U	2.2		0.96	U	0.96	U	4.4		0.62	U
	Subslab	C310VI-SS-2	3/8/2021	1.6	U	1.9	U	2.4	U	2	U	130		1.8	U
		23C310VI-SS-2	3/2/2023	1.5	U	1.4	U	1.6		1.1	U	290		0.71	U
		23C310VI-SS-2D <sup>c</sup>	3/2/2023	1.2	U	1.1	U	0.88	U	0.88	U	270		0.57	U
		C310VI-SS-3	3/8/2021	1.6	U	1.9	U	2.4	U	2	U	750		1.8	U
23C310VI-SS-3		3/2/2023	1.3	U	0.99	J	0.93	U	0.93	U	1200	D	0.6	U	
C-409	Outdoor Air	C409VI-OA-1R	3/8/2021	0.16	U	0.19	U	0.24	U	0.2	U	0.17	U	0.18	U
		23C409VI-OA	3/2/2023	1.4	U	1.2	U	1	U	1	U	1.4	U	0.65	U
	Indoor Air	C409VI-IA-1	3/3/2021	0.16	U	0.59	J	0.24	U	0.2	U	0.19	U	0.18	U,*,X
		23C409VI-IA-1	3/2/2023	1.1	J	1.2	U	1	U	1	U	1.4	U	0.65	U
		23C409VI-IA-1D	3/2/2023	1.1	J	1.2	U	1	U	1	U	1.4	U	0.65	U
		C409VI-IA-3	3/3/2021	0.16	U	1.2		0.24	U	0.2	U	0.19	U	0.18	U,*,X
		23C409VI-IA-3	3/2/2023	1.4	U	1.3	U	1	U	1	U	1.4	U	0.66	U
	Subslab	C409VI-SS-1	3/5/2021	1.6	U	56		2.4	U	2	U	2.3	J	1.8	U
		23C409VI-SS-1	3/1/2023	1.3	J	0.63	J	0.95	U	0.95	U	1.2	J	0.61	U
		C409VI-SS-3	3/8/2021	1.6	U	620		2.4	U	2	U	1.7	U	1.8	U
23C409VI-SS-3		3/1/2023	1.3	U	2		0.93	U	0.93	U	1.3	U	0.6	U	

Table 7. Analytical Results (Continued)

		<i>Volatile Organic Compound</i>		1,1,1-TCA		Chloroform <sup>a</sup>		<i>cis</i> -1,2-DCE		<i>trans</i> -1,2-DCE		TCE		VC	
		<i>Target Indoor Air Concentration<sup>b</sup></i>		21,900		0.533		3,500		3,500		2.99		2.79	
		<i>Target Subslab Soil Gas Concentration</i>		730,000		17.8		--		--		99.7		92.9	
		<i>Unit</i>		µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>		µg/m <sup>3</sup>	
Building	Medium	Sample ID	Date												
C-720	Outdoor Air	C720VI-OA-1	3/4/2021	0.16	U	0.19	U	0.24	U	0.2	U	0.17	U	0.18	U
		23C720VI-OA	3/3/2023	1.4	U	1.2	U	0.99	U	0.99	U	1.3	U	0.64	U
	Indoor Air	C720VI-IA-4	3/4/2021	0.16	U	0.57	J	0.24	U	0.2	U	0.32	J	0.18	U
		23C720VI-IA-4	3/3/2023	1.4	U	1.2	U	0.99	U	0.99	U	1.3	U	0.64	U
	Subslab	C720VI-SS-4	3/8/2021	1.6	U	1.9	U	2.4	U	2	U	270		1.8	U
		23C720VI-SS-4	3/1/2023	1.4	U	1.3	U	1.1	U	1.1	U	94		0.68	U

<sup>a</sup> For all indoor air and outdoor air chloroform results, reporting limit is greater than PAL.

<sup>b</sup> The EPA VISLs are the default commercial values for carcinogenic risk 1E-6 or hazard quotient = 1.0 for all chemicals except *cis*- and *trans*-1,2-DCE. The VISLs for *cis*- and *trans*-1,2-DCE are provided by EPA Region 4 and were derived based on the Agency for Toxic Substances and Disease Registry inhalation minimum risk level of 0.2 ppm (0.8 mg/m<sup>3</sup>).

<sup>c</sup> Sample was not intended to be analyzed since flow controller was noted to have lost pressure before Summa<sup>®</sup> canister was closed, and due to the QAPP change allowing for the same analytical method to be used for indoor air and subslab samples, this duplicate sample was not needed to comply with QAPP requirements. However, the sample was analyzed and since the data was validated, it is included in this analysis.

U = Less than laboratory reporting limit.

J = Compound detected below method quantitation limit; estimated value provided.

D = All compounds identified in the analysis at the secondary dilution factor.

\* = Duplicate analysis not within control limits.

X = Other specific flags and footnotes may be required to properly define the results.

Yellow-shaded values exceed indoor air target concentrations.

Orange-shaded values exceed subslab soil gas target concentrations.

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### 3.1.2 Subslab Vapor Analytical Results

Six subslab vapor samples, including one duplicate sample, were collected from three PI buildings in March 2023, as shown in Table 7. TCE, 1,1,1-TCA, *cis*-1,2-DCE, and chloroform were detected in subslab vapor samples.

- TCE was detected in five subslab vapor samples from three PI buildings—C-310, C-409, and C-720—at concentrations ranging from 1.2 J  $\mu\text{g}/\text{m}^3$  in C-409 to 1,200 D  $\mu\text{g}/\text{m}^3$  in C-310.
- 1,1,1-TCA was detected in one subslab vapor sample from the C-409 building, at a concentration of 1.3 J  $\mu\text{g}/\text{m}^3$ .
- *cis*-1,2-DCE was detected in one subslab vapor sample from the C-310 building, at a concentration of 1.6  $\mu\text{g}/\text{m}^3$ .
- Chloroform was detected in three subslab vapor samples from two PI buildings—C-310 and C-409—at concentrations ranging from 0.63 J  $\mu\text{g}/\text{m}^3$  to 2  $\mu\text{g}/\text{m}^3$ .

### 3.1.3 Outdoor Air Analytical Results

Three outdoor air samples were collected, one outside of each of the March 2023 sampling event PI buildings, as shown in Table 7. PI analytes were not detected in any outdoor air samples.

## 3.2 OTHER DATA

Field crews measured and recorded the differential pressure between subslab vapor and indoor air in each PI building where indoor air samples were collected in March 2023.

### 3.2.1 Pressure Monitoring Data

Differential pressure was recorded at 5-second intervals during the indoor air sample collection using data-logging field micromanometers.<sup>3</sup> These data were collected to assist with interpreting subslab vapor and indoor air analytical data. The results for each March 2023 sampling event PI building where differential pressure was recorded are presented in Table 8.

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<sup>3</sup> Differential pressure for C-310 was collected on a different day from the collection of the indoor air sample 23C310VI-IA-2R because this sample was re-collected due to the flow controller on the original sample not lasting a full 10 hours. While it is preferable to collect differential pressure data while indoor air samples are being collected, this data was collected over the same time of day and in the same season; therefore, it may be used as an approximation of pressure conditions.

**Table 8. Pressure Monitoring Summary**

<b>March 2023 Sampling Event PI Building</b>	<b>Date</b>	<b>Sample ID/ Location</b>	<b>Location Description</b>	<b>Average Differential Pressure (Pa)</b>	<b>Indoor Air with Respect to Subslab Vapor</b>
C-310	3/1/2023	23C310VI-SS-3	Near columns B-16 & B-17	-0.41	Slightly underpressurized
C-409	3/2/2023	23C409VI-SS-1	Control room	0.12	Slightly overpressurized
C-720	3/3/2023	23C720VI-SS-4	Old machine shop	1.83	Overpressurized

Temporal trends in differential pressure data varied across the March 2023 sampling event PI buildings. Pressure monitoring time series graphs that represent data during the time of sampling are presented in Appendix E.

- At C-409, fluctuation in differential pressure between the subslab and indoor air throughout the day was centered around 0 Pa.
- At C-310, differential pressure between subslab and indoor air was centered around 0 Pa at the start of the day was net negative between the hours of 1200 and 1600 and was net positive between the hours of 1600 and 1800.
- At C-720, differential pressure between subslab and indoor air had large fluctuations in differential pressure at the start of the day, but those fluctuations were centered around zero and then were negative between the hours of 1000 and 1100 and positive between the hours of 1100 and 1500.

### **3.2.2 Weather Data**

Throughout the sample collection period, weather data (e.g., temperature, barometric pressure, wind direction, wind speed) were recorded at an on-site weather station. Weather summary data are presented in Appendix F. Outdoor temperature at the weather station ranged from 42–77°F throughout the March 2023 sampling event, with an average temperature of 57°F. Barometric pressure ranged from approximately 29–30 inHg. Conditions were calm to moderately windy on March 1, 2023, and March 2, 2023, with sustained wind speeds from 0–15 miles per hour (mph) and some gusts up to 25 mph and light rain, with thunderstorms in the evenings after sample collection had been completed for the day. Conditions on March 3, 2023, were windy with sustained wind speeds from 0–26 mph and some gusts up to 56 mph, with heavy rain and thunderstorms throughout the day. Prevailing wind is generally from the southwest (DOE 2017); however, there was some variability noted during sample collection.

## 4. DISCUSSION

This section includes an evaluation of VI pathway completeness for each March 2023 sampling event PI building and comparison to results from the previous round of sampling. The evaluation includes the comparison of measured concentrations to regulatory screening levels, comparison of PI analyte concentrations between sampled media, a review of study decision rules, and a risk evaluation.

### 4.1 PROJECT ACTION LEVEL COMPARISON

In this section, laboratory analytical results are compared to PALs (i.e., VISLs; see Table 1). For each PI analyte, there is an indoor air VISL that is used to compare the sample results from indoor and outdoor air samples. Each PI analyte also has a soil gas VISL that is used to compare results from subslab vapor samples.

#### 4.1.1 Indoor and Outdoor Air Samples

PI analytes were not detected in any outdoor air samples and *cis*-1,2-DCE, *trans*-1,2-DCE, 1,1,1-TCA, and VC were not detected above indoor air VISLs in any indoor air samples that were collected in March 2023. No PI analytes were detected above indoor air VISLs in buildings C-409 or C-720 in the March 2023 samples. TCE was detected above its indoor air VISL of 2.99  $\mu\text{g}/\text{m}^3$  in one indoor air sample in C-310 (4.4  $\mu\text{g}/\text{m}^3$  at Location 3), which is located near the traps and emergency diesel generator in the southwest corner of the building, as shown in Table 7 and Figure 2. Chloroform was also detected above its indoor air VISL of 0.533  $\mu\text{g}/\text{m}^3$  at C-310 Location 3, with a concentration of 2.2  $\mu\text{g}/\text{m}^3$ , as shown in Table 7 and Figure 2. Five chloroform results in indoor air samples were reported as not detected by the laboratory, but the results showed that chloroform was at a concentration above the chloroform PAL. As communicated to EPA and KDEP prior to the March 2023 sampling event, the laboratory was unable to achieve reporting limits for chloroform below the PAL for chloroform in indoor air. This deviation was approved by EPA and KDEP (as outlined in Section 2.2.2) because the PI results indicated chloroform is primarily a background contaminant and not driving the vapor intrusion risk at the Paducah Site; therefore, only samples with chloroform detections are discussed herein.

#### 4.1.2 Subslab Samples

PI analytes chloroform, *cis*-1,2-DCE, *trans*-1,2-DCE, 1,1,1-TCA, and VC were not detected above the subslab VISLs in any subslab vapor sample.

TCE exceeded its soil gas VISL of 99.7  $\mu\text{g}/\text{m}^3$  at two samples in C-310—290  $\mu\text{g}/\text{m}^3$  at 23C310VI-SS-2 and 270  $\mu\text{g}/\text{m}^3$  in the corresponding duplicate sample, 23C310VI-SS-2D, which is located near the traps in the southeast corner of the building and 1,200 D  $\mu\text{g}/\text{m}^3$  at 23C310VI-SS-3 near the traps and emergency diesel generator in the southwest corner of the building (Figure 2).

### 4.2 COMPARISON OF INDOOR AIR AND SUBSLAB VAPOR RESULTS

As discussed in the 2022 VI Report, a complete VI pathway results from a concentration gradient that decreases from source to receptor, which includes a much lower concentration of an analyte in indoor air than in the medium sampled below the floor (i.e., either subslab vapor or crawlspace air). Both chemical and physical results for all samples collected during the March 2023 sampling event are discussed in this section.

#### 4.2.1 Chemical Results

Of the three locations where TCE exceeded its subslab soil gas VISL during the 2021 sampling event—C-310 Location 2 and C-310 Location 3—neither of the paired indoor air samples collected from these locations had TCE concentrations greater than its VISL. During the March 2023 sampling event, TCE again exceeded its subslab soil gas VISL at the C-310 locations. The paired indoor air sample collected from C-310 Location 2 did not have TCE concentrations greater than the TCE VISL for indoor air. As discussed in Section 4.3 and in the context of decision rules, this result is consistent with an incomplete VI pathway at these locations. At C-310 Location 3, the TCE concentration in indoor air exceeded the VISL, which indicates a complete VI pathway at this location. The subslab to indoor air TCE attenuation factor<sup>4</sup> at this location is 0.004, which is typical of buildings with competent slabs. Paired samples with an attenuation factor greater than 0.03 (the EPA default) may be indicative of a background source; therefore, there does not appear to be an indoor source or preferential pathway contribution to the indoor air exceedance.

During the 2021 sampling event, the only PI analyte with VISL exceedances in indoor air was chloroform, which is a common background contaminant associated with the disinfection of water using chlorine. Section 4.2.1 of the 2022 VI Report discusses lines of evidence used to conclude that chloroform is a background contaminant at the PI buildings. C-310 Location 4, C-409 Location 1, and C-409 Location 3 were recommended for additional sampling based on chloroform exceedances in both subslab and indoor air. As described in Section 2.2.2, C-310 Location 4 was not sampled during the March 2023 sampling event due to flooding and standing water at the sampling location. Both C-409 Location 1 and C-409 Location 3 did not have chloroform exceedances in subslab soil vapor during the March 2023 sampling event, with concentrations of 0.63 J  $\mu\text{g}/\text{m}^3$  and 2  $\mu\text{g}/\text{m}^3$ , respectively. These concentrations are both approximately a factor of 100 lower than those detected during the 2021 sampling event; however, they fall within the range of subslab chloroform concentrations previously detected across the Paducah Site. This type of variability is consistent with the conceptual site model and the suspected nonenvironmental source of chloroform, as discussed in Section 4.2.1 of the 2022 VI Report.

#### 4.2.2 Physical Results

In building C-409, where chloroform previously exceeded its VISL in both subslab and indoor air, indoor air was slightly positively pressurized during the March 2023 sampling event, which indicated no driving force for vapor intrusion; however, since there were no chloroform exceedances in subslab during the 2023 event, regardless of building pressure, there is not currently a subsurface chloroform source at this location, which is one of the key conditions required for VI to occur.

In building C-720, where the TCE concentration for subslab vapor previously exceeded its VISL, the building was on average positively pressurized relative to beneath the slab. As shown in Appendix E, differential pressure fluctuated significantly throughout the day, ranging from  $> 50$  Pa to  $< -100$  Pa, which spans both extremes of differential pressure typically observed under natural conditions. This range is likely attributed to heavy winds and thunderstorms on the day that differential pressure was recorded. While differential pressure was positive on average, a condition indicating a lack of driving force for vapor intrusion, fluctuations included both negatively and positively pressurized swings. During the negative swings, conditions favorable for VI would have occurred and yet TCE was not detected in indoor air, which indicates that VI is not likely to occur at this location. Additionally, during the previous round of sampling, the building was slightly underpressurized—a condition favorable for VI—and TCE was not detected above

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<sup>4</sup> The attenuation factor is the ratio of the indoor air concentration to the subslab concentration and is calculated by dividing the indoor air concentration for a single analyte by the paired subslab concentration for the same analyte.

its VISL at the paired indoor air location, which indicates that VI is not likely to occur even in underpressurized conditions.

Building C-310, where TCE exceeded the VISLs for TCE in both indoor air and subsurface vapor at Location 3 and exceeded the TCE VISL in subsurface vapor but not indoor air at Location 2 during the March 2023 sampling event, was slightly underpressurized—a condition favorable for VI. At Location 2, because there were not indoor air exceedances under these conditions, exceedances would not be expected under most weather conditions.

#### **4.3 RISK EVALUATION**

In buildings C-409 and C-720, no PI analytes were present in indoor air at concentrations equal to or greater than VISLs. Based on two rounds of evaluation of the VI pathways, there is no unacceptable risk to workers from the VI pathway under current conditions for these buildings. Further context for the observed concentrations of PI analytes in the context of occupational thresholds is provided in Appendix G. Because there were no indoor air exceedances attributable to environmental sources from site-related contamination, therefore, there are no complete VI pathways under current conditions in these buildings.

In building C-310, TCE was present in both subsurface vapor and indoor air at concentrations greater than the VISL, which suggests a complete VI pathway under current conditions and potentially unacceptable risk to workers under default exposure scenarios.<sup>5</sup>

This conclusion applies to conditions encountered at the time of sampling. The investigation was conducted to evaluate whether there are complete VI pathways in a selection of facilities with the greatest potential to have a completed VI pathway based on the VI conceptual site model. Consistent with the requirements in the risk methods document, if or when the use of an occupiable building on the DOE Paducah Site changes, a new building is constructed, or a parcel of land is transferred for a different use, DOE will evaluate the VI pathway to the building or the proposed building at that time (DOE 2021).

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<sup>5</sup> This building is not currently used under default scenarios for commercial buildings. EPA VISL Calculator default scenarios include an averaging time of 365 days; an exposure frequency of 250 days/year; an exposure duration of 25 years; an exposure time of 8 hours; and a lifetime of 70 years.

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## 5. SUMMARY AND CONCLUSIONS

This section summarizes the VI pathway evaluations and provides conclusions and recommendations for additional actions.

### 5.1 SUMMARY

As described in the 2022 VI Report, the EPA 2015 VI Technical Guide states that a potential VI pathway should be considered complete when the following five key conditions are all present.

1. A subsurface source of vapor-forming chemicals exists.
2. There is a route for the vapors to migrate.
3. The building is susceptible to VI.
4. Vapors are present in the indoor environment.
5. People are in the indoor environment.

Based on an evaluation of multiple lines of evidence, the subsurface to indoor air VI pathway is incomplete in two out of the three buildings recommended for additional sampling (C-409 and C-720). In C-409, no PI analyte exceeded VISLs in either subslab or indoor air, which fails key conditions 1 and 4. In building C-720, TCE did not exceed the VISL for subslab vapor or indoor air, which fails key conditions 1 and 4. These buildings are considered to have incomplete VI pathways; therefore, there is no unacceptable risk to workers from the VI pathway under current conditions.

In building C-310, TCE exceeded its VISL in both subslab vapor and indoor air at paired Location 3. Under conditions encountered at the time of sampling, this building satisfies all five key conditions and appears to have a complete VI pathway.

Both PI buildings where TCE exceeded its VISL are consistent with proximity to known sources in groundwater or soil. C-310 is located within the 5-100 µg/L TCE RGA plume, and C-720 is located on the edge of the 5–100 µg/L TCE RGA plume and is proximal to soil PI analyte detections.

### 5.2 CONCLUSIONS

Based on multiple lines of evidence, interpretation of two rounds of VI investigation results, and in consideration of the decision rules outlined in the VI Work Plan, the VI pathway is incomplete within C-409 and C-720; therefore, there is no unacceptable risk to workers from the VI pathway under current conditions for these buildings, and because there is no unacceptable risk to workers, worker exposure to VI is under control. In C-409, no subsurface source of PI analytes was identified. In building C-720, TCE did not exceed the VISL for subslab vapor or indoor air.

In C-310, TCE exceeded its VISL in subslab vapor and in indoor air at Location 3, which is located near the southwestern corner on the main floor the building; therefore, there is a complete VI pathway under current conditions, and there is potentially unacceptable risk to workers from the VI pathway under current conditions. For chloroform, detections and exceedances are consistent with and attributed to background sources, though the possibility remains that some chloroform on-site may be derived from other sources, which includes materials currently used at PGDP or materials that were historically used during PGDP operations.

### 5.2.1 Recommendations

Based on the results of the two rounds of PI sampling, evaluation of the decision rules outlined in the VI Work Plan and the conclusion that chloroform is derived from background sources (i.e., not an environmental source from site-related contamination), no additional actions are recommended at C-409 and C-720. At C-310 Location 3, based on the presence of TCE in subslab soil gas above the EPA subslab soil gas VISL, periodic air monitoring, worker access restriction (or both) and/or increased ventilation may be appropriate steps to take if it is anticipated workers will spend substantial time in the building until the building is decommissioned. It should be noted that this building is currently undergoing deactivation, and it is occupied by workers engaged in deactivation activities. The results of this study have been communicated with and reviewed by DOE Deactivation and Remediation Contractor's Safety and Health group (see Appendix G). The workers in this facility are protected under DOE health and safety requirements.

These conclusions and recommendations do not supersede the requirements in the risk methods document that if or when the use of an occupiable building on the DOE Paducah Site changes, a new building is constructed, or a parcel of land is transferred for a different use, DOE will evaluate the VI pathway to the building or the proposed building at that time (DOE 2021). Based on the results of this study, the analyte suite from this study [i.e., chloroform; *cis*-1,2-DCE; *trans*-1,2-DCE; mercury (elemental); 1,1,1-TCA; TCE; and VC] is recommended as a minimum analyte list for evaluation in future VI evaluations.



## 6. REFERENCES

- DOE (U.S. Department of Energy) 2017. *C-400 Vapor Intrusion Study Work Plan to Support the Additional Actions for the CERCLA Five-Year Review at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2403&D2/R1, U.S. Department of Energy, Paducah, KY, July.
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- DOE 2020. *Paducah Gaseous Diffusion Plant Industrial Area Vapor Intrusion Preliminary Investigation Work Plan for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2447&D2/R1, U.S. Department of Energy, Paducah, KY, December.
- DOE 2021. *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant Paducah, Kentucky, Volume 1. Human Health*, DOE/LX/07-0107&D2/R12/V1, U.S. Department of Energy, Paducah, KY, June.
- DOE 2022. *Plant Industrial Area Vapor Intrusion Preliminary Risk Assessment Report, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2471&D2, U.S. Department of Energy, Paducah, KY, February.
- EPA (U.S. Environmental Protection Agency) 2019. *Vapor Intrusion Screening Level Calculator*, U.S. Environmental Protection Agency, November, [https://epa-visl.ornl.gov/cgi-bin/visl\\_search](https://epa-visl.ornl.gov/cgi-bin/visl_search) (accessed February 4, 2020).
- Vapor Pin<sup>®</sup> (Vapor Pin<sup>®</sup> Enterprises, Inc.) 2021. *Standard Operating Procedure Leak Testing the VAPOR PIN<sup>®</sup> Sampling Device Via Water Dam*, Vapor Pin<sup>®</sup> Enterprises, Inc., Plain City, OH, January 28.

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**APPENDIX A**  
**PHOTOGRAPHIC LOG**

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**GEOSYNTEC CONSULTANTS**  
**Photographic Record**



**Client: U.S. Department of Energy**

**Project Number: KX71110/09/10**

**Site Name: Paducah Gaseous Diffusion Plant  
Site-Wide Vapor Intrusion Study**

**Site Location: McCracken County, Kentucky**

**Photograph 1**

**Date: 1 March 2023**

**Direction: NA**

**Comments: Subslab  
sampling location for  
23C409-VI-SS-1**



**Photograph 2**

**Date: 1 March 2023**

**Direction: NA**

**Comments: Sampling  
location for 23C409-VI-  
SS-3**



**GEOSYNTEC CONSULTANTS**  
**Photographic Record**



**Client: U.S. Department of Energy**

**Project Number: KX71110/09/10**

**Site Name: Paducah Gaseous Diffusion Plant  
Site-Wide Vapor Intrusion Study**

**Site Location: McCracken County, Kentucky**

**Photograph 3**

**Date: 1 March 2023**

**Direction: NA**

**Comments: Outdoor Air  
sampling location for  
23C310-VI-OA on a  
tripod secured to a post  
on the south side of C-310  
building**

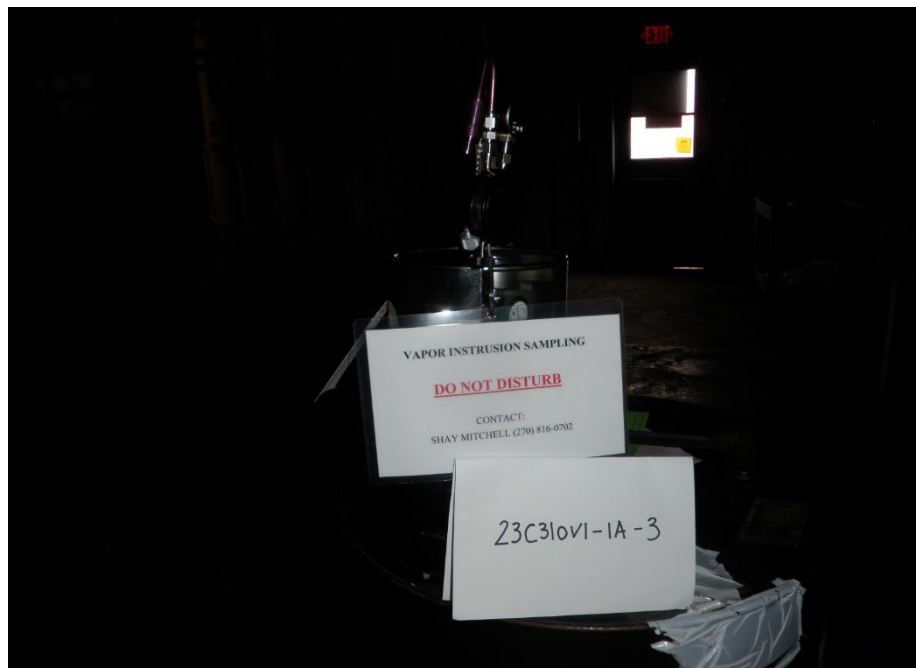


**Photograph 4**

**Date: 1 March 2023**

**Direction: NA**

**Comments: Indoor air  
sampling location for  
23C310-VI-IA-3**



**GEOSYNTEC CONSULTANTS**  
**Photographic Record**



**Client: U.S. Department of Energy**

**Project Number: KX71110/09/10**

**Site Name: Paducah Gaseous Diffusion Plant  
Site-Wide Vapor Intrusion Study**

**Site Location: McCracken County, Kentucky**

**Photograph 5**

**Date: 2 March 2023**

**Direction: NA**

**Comments: Subslab sampling location for 23C310-VI-SS-2 and duplicate. No sample for the duplicate due to loss of vacuum, however this duplicate is not needed to meet QAPP requirements**



**Photograph 6**

**Date: 2 March 2023**

**Direction: NA**

**Comments: Subslab sampling location for 23C310-VI-SS-3**



**GEOSYNTEC CONSULTANTS**  
**Photographic Record**



**Client: U.S. Department of Energy**

**Project Number: KX71110/09/10**

**Site Name: Paducah Gaseous Diffusion Plant  
Site-Wide Vapor Intrusion Study**

**Site Location: McCracken County, Kentucky**

**Photograph 7**

**Date: 2 March 2023**

**Direction: NA**

**Comments: Indoor air  
sampling location for  
23C409V1-1A-1 and  
duplicate**



**Photograph 8**

**Date: 2 March 2023**

**Direction: NA**

**Comments: Indoor air  
sampling location for  
23C409-VI-1A-3**





**GEOSYNTEC CONSULTANTS**  
**Photographic Record**



**Client: U.S. Department of Energy**

**Project Number: KX71110/09/10**

**Site Name: Paducah Gaseous Diffusion Plant  
Site-Wide Vapor Intrusion Study**

**Site Location: McCracken County, Kentucky**

**Photograph 9**

**Date: 2 March 2023**

**Direction: NA**

**Comments: Outdoor air  
sampling location for  
23C409-VI-OA on post  
near northwest corner of  
the C-409 building**

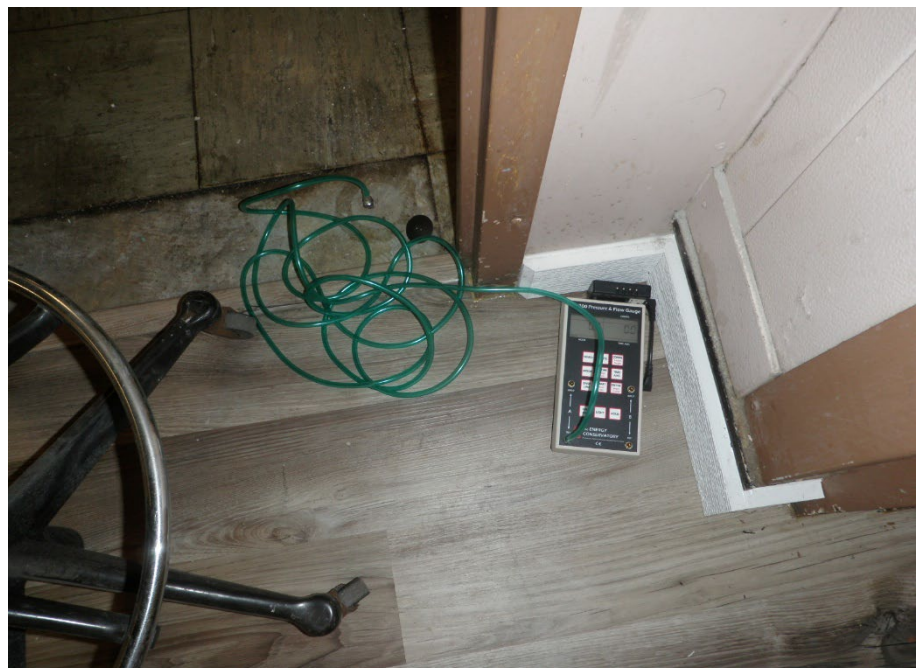


**Photograph 10**

**Date: 2 March 2023**

**Direction: NA**

**Comments: Cross-slab  
differential pressure  
monitoring location in C-  
409**



**GEOSYNTEC CONSULTANTS**  
**Photographic Record**



**Client: U.S. Department of Energy**

**Project Number: KX71110/09/10**

**Site Name: Paducah Gaseous Diffusion Plant  
Site-Wide Vapor Intrusion Study**

**Site Location: McCracken County, Kentucky**

**Photograph 11**

**Date: 3 March 2023**

**Direction: NA**

**Comments: Sampling  
location for 23C310-VI-  
IA-2R**



**Photograph 12**

**Date: 3 March 2023**

**Direction: NA**

**Comments: Indoor air  
sampling location for  
23C720-VI-IA-4**



**GEOSYNTEC CONSULTANTS**  
**Photographic Record**



**Client: U.S. Department of Energy**

**Project Number: KX71110/09/10**

**Site Name: Paducah Gaseous Diffusion Plant  
Site-Wide Vapor Intrusion Study**

**Site Location: McCracken County, Kentucky**

**Photograph 13**

**Date: 3 March 2023**

**Direction: NA**

**Comments: Sampling location for 23C720-VI-OA on picnic table on covered porch on south side of the C-720 building**



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**APPENDIX B**  
**FIELD FORMS**

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PROJECT: <u>Industrial Area Vapor Intrusion Study</u>		DATE: <u>2-28-23</u>	PAGE 1 of 1
PROJECT NO.: <u>KX71110/09/10</u>	CONTRACTOR: <u>Geosyntec</u>		
LOCATION: <u>PGDP</u>	DESCRIPTION: <u>VI Sampling</u>		
WEATHER: <u>Cool, calm, clear</u>			

600 PS on site to badging office

630 SM meets PS @ badging office, complete forms, get badge

645 mdo. to staging area, PS unpack/inventory equipment  
~~Geo~~ Geo intros help inventory equipment

740 tailgate safety

800 set up DG mobilize to C-409 to place

838 place <sup>connect</sup> DG-700 @ C-409 -SS1 (control room)

915 back to 233, assemble summas, organize equip.

1045 lunch, discuss DG storage w/ TG

1145 begin pre-placing summa canisters in C-310, C-409, and C-720 and setting up <sup>for</sup> sub-slab sampling tomorrow morning at C-409 and C-720

disconnect DG-700 at C-409 since decision has been made that sampling will be extended through Friday in order to collect differential pressure data while IA is being collected

Attend Job Performance Measure at IH lab to be able to use FRNP Multi-Rae

1400 Troubleshoot lungbox ~~PS 2/25/23~~ seal issues

1800 PS off site

COPY TO: File \_\_\_\_\_ GEOSYNTEC REP.: PS HRS: 12  
 REVIEWED BY: \_\_\_\_\_

PROJECT: Industrial Area Vapor Intrusion Study	DATE: 3/1/23	PAGE 1 of 2 ③ 4/19/23
PROJECT NO.: KX71110/09/10	CONTRACTOR:	
LOCATION: PGDP	DESCRIPTION: VI Sampling	
WEATHER:		

0345 PS on site, test lung box  
 0400 M of Geo Con on site, pack ces  
 0415 mob. to limited area  
 0420 pick up PID from H  
 0430 mds. to C409, meet Shary, tailgate safety  
 0445 calibrate GEM  
 0500 setup on C409-SS-1; troubleshoot potential leak  
 0530 setup on C409-SS-3  
 0619 open 23C409VI-SS-1  
 0621 open 23C409VI-SS-3  
 0630 mob. to C-720  
 0659 open 23C720VI-SS-4  
 0700 mds. to C-310 meet rad con, briefing, suit up  
 0750 open 23C310VI-1A-2  
 0752 open 23C310VI-1A-3  
 0755 ext CA mds. to set OA sample  
 0811 open 23C310VI-OA-1, located on south side of bldg  
 0815 mds. to C-310 computer room attempt to find C310VI-SS-1 to connect DG-meter but cannot find. Call radcons to re-enter CA to place at 23C310VI-SS/A-2  
 0842 DG connected  
 0900 PS back to #233 to work on paperwork  
 1100 mid-day canister checks, 23C720<sup>VI</sup>-SS-4 still has same vacuum as initial (-30 inHg)  
 1215 23C310VI-1A-2 had only -5 inHg vacuum left. Wait for it to reach -3 inHg to close  
 1243 close 23C310VI-1A-2  
 1300 check C310-OA again; vacuum -11 @ 1300  
 1315 discuss plan for C720-SS-4 with TG and MW of Geosyntec. Based on previous grab sample duration (19 min.) and observations of strong vacuum required to purge, it is determined that location likely has tight soil formation and 10 in-flow controller

COPY TO: File \_\_\_\_\_ GEOSYNTEC REP.: \_\_\_\_\_ HRS: \_\_\_\_\_ likely will not be strong enough pull to pull air from the underlying soil. Proposed path forward is to remove flow controller and manually collect a grab sample



PROJECT: <u>Industrial Area Vapor Intrusion Study</u>	DATE: <u>3/1/2023</u>	PAGE <sup>2</sup> of <sup>2</sup>
PROJECT NO.: <u>KX71110/09/10</u>	CONTRACTOR: _____	
LOCATION: <u>PGDP</u>	DESCRIPTION: <u>VI Sampling</u>	
WEATHER: _____		

1500 mobilize to C-720  
1506 remove flow controller and begin collecting manual grab sample at 23C720 VI-SS-4  
1520 close 23C720 VI-SS-4  
1530 mobilize to C-310 for canister pressure checks  
1547 close 23C310 VI-0A  
1600 mobilize to C-409  
1619 close 23C409 VI-SS-1  
1621 close 23C409 VI-SS-3  
1700 mobilize to C-310, don PPE  
1752 close 23C310 VI-1A-3, collect differential pressure meter  
1900 depart site

COPY TO: File \_\_\_\_\_ GEOSYNTEC REP.: \_\_\_\_\_ HRS: \_\_\_\_\_  
REVIEWED BY: \_\_\_\_\_

PROJECT: Industrial Area Vapor Intrusion StudyDATE: 3/21/2023PAGE 1 of 2PROJECT NO.: KX71110/09/10CONTRACTOR: GeosyntecLOCATION: PGDPDESCRIPTION: VI SamplingWEATHER: Cool, breezy, overcast; rain in forecast for late afternoon

400	on site to C-233, calibrate GEM, load vehicle, start DG-700
410	mobilize to limited area, Pick up PID From IH
420	meet rad con. at C-310. tailgate safety meeting. Don PPE.
430	enter CA, set up at C310V1-SS-3.
505	open summa & begin sample collection @ C310V1-SS-3
507	mobilize to C310V1-SS-2 & set up
529	open summas & begin sample collection @ C310V1-SS-2 / C310V1-SS-2D
535	exit CA
550	mobilize to C-409
557	connect DG-700 & begin logging pressure @ C409-SS-1
601	open C409V1-1A-1 and C409V1-1A-1D
607	open C409V1-1A-3
619	open C409V1-0A; located on roof near the northwest corner of the building
630	return PID to IH
640	mobilize to C-233 complete paperwork
930	mobilize to limited area, meet Rad Con @ C-310 for mid-day canister checks
955	mid-day check - C310-SS-3 @ 16.5 intlg, C310-SS-2 @ 19. intlg, C310-SS-2D @ 16. intlg
1010	mobilize to C-410 for mid-day check
1015	mid day check - 409-1A-1 @ 17, 409-1A-1D @ 18.5, 1A-3 @ 22, 0A @ 21.5
1030	mobilize to C-233; lunch, paperwork
1230	PS mobilize to Geo trailer download weather station data
1415	mobilize to C-310, don PPE, enter CA, check canister vacuums and wait for 10-hr mark
1505	close 23C310V1-SS-3 clean up work area
1529	close 23C310V1-SS-2 and 23C310V1-SS-2D. Upon closing the duplicate, the flow controller gauge read -3.5 intlg, but the gauge did not drop any lower after closing the canister.
1535	clean work area, exit CA, mobilize to C-409.
1601	close 23C409V1-1A-1 and 23C409V1-1A-1D
1607	close 23C409V1-1A-3; retrieve DG-700
1619	close 23C409V1-0A

COPY TO: File \_\_\_\_\_ GEOSYNTEC REP.: PS HRS: 14

REVIEWED BY: \_\_\_\_\_

PROJECT: <u>Industrial Area Vapor Intrusion Study</u>	DATE: <u>3/21/2023</u>	PAGE # of <u>2</u>
PROJECT NO.: <u>KX71110/09/10</u>	CONTRACTOR: <u>Geosyntec</u>	<u>staz</u>
LOCATION: <u>PGDP</u>	DESCRIPTION: <u>VI Sampling</u>	
WEATHER: <u>cool, breezy, overcast</u>		

1625 mobilize back to C-233  
1700 check 23C310V1-SS-2D pressure with digital vacuum gauge, determine that the pressure had reached zero. Inform project team.  
1730 disassemble/pack summa's, download 06-700 data, organize  
1800 off site

COPY TO: File \_\_\_\_\_ GEOSYNTEC REP.: BS HRS: 14  
REVIEWED BY: \_\_\_\_\_

PROJECT: <u>Industrial Area Vapor Intrusion Study</u>	DATE: <u>3/31/2023</u>	PAGE 1 of <u>  </u>
PROJECT NO.: <u>KX71110/09/10</u>	CONTRACTOR: <u>Geosyntec</u>	
LOCATION: <u>PGDP</u>	DESCRIPTION: <u>VI Sampling</u>	
WEATHER: <u>Cool, windy, heavy rain</u>		

400 on site, organize equipment, start DG-700

415 mobilize to C-310

430 don PPE, enter CA

433 open 23C310VI-1A-2R

435 exit CA, mobilize to C-720

451 connect DG-700 @ C720VI-SS-4 and begin logging differential pressure

453 open 23C720VI-1A-4

455 decide on suitable location for 23C720VI-0A, remove dust cover on flow controller and before opening canister, flow controller fully drains

500 mobilize to C-233, retrieve new canister and flow controller, mobilize back to C-720

527 open 23C720VI-0A

530 mobilize back to C-233, breakfast, paperwork, organizing

915 mobilize to C-310 for mid-day check. 23C310VI-1A-2R is @ -7.2 in Hg. will come back to check in a couple hours

930 mobilize to C-720 for mid-day check. 23C720VI-1A-4 @ -17.5 in Hg; 23C720VI-0A @ -18 in Hg

945 mobilize back to C-233, paperwork, organizing equipment

1045 severe thunderstorm warning and shelter in place called; PS mobilizes to Geo lab to shelter in place

1145 shelter in place lifted; mobilize to C-720 to check OA sample, then to C-310 to check 23C310VI-1A-2R

1240 23C310VI-1A-2R closed after 8hr, 7min. with final pressure of -3 in Hg

1245 mobilize to C-233

1453 close 23C720VI-1A-4, disconnect DG-700

1527 close 23C720VI-0A

1530 mobilize to C-233, download DG-700 data, clean and organize

1618 download weather station data

1640 <sup>PS</sup> return badge

1645 off site

# METER CALIBRATION

Project Name: SAtewide V1 Date: 3/1/2023 Recorded By: PS Page 1 of 1  
 Project Number: K77110 Weather: cool, overcast, calm Primary Activities: SS sampling

Date: PIDs

Serial Number		Ambient Air (ppm)	Gas Concentration (ppm)	Meter Reading Initially / Meter Calibrated To
11882	Initial Time:			/
	Final Time:			/
	Initial Time:			/
	Final Time:			/
	Initial Time:			/
	Final Time:			/
	Initial Time:			/
	Final Time:			/

Note: FRNP- provided PID, calibrated by FRNP

## GEMs

Serial Number		Ambient Air			Calibration Gas Concentration			Meter Reading Initially / Meter Calibrated To		
		CH <sub>4</sub> (%)	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	CH <sub>4</sub> (%)	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	CH <sub>4</sub> : (%)	CO <sub>2</sub> : (%)	O <sub>2</sub> : (0%)
43636	Initial Time: 0439	0.2	6.1	22.5	50	35	0	496 / 50	365 / 350	0.2 / 0
	Final Time: N/A	-	-	-	-	-	-	-	-	-
	Initial Time:							/	/	/
	Final Time:							/	/	/
	Initial Time:							/	/	/
	Final Time:							/	/	/

NOTES: \_\_\_\_\_  
 \_\_\_\_\_

B-9

# METER CALIBRATION

Project Name: Sitewide Vapor Intrusion Date: 3/2/2023 Recorded By: PS Page 1 of 1  
 Project Number: KX71110 Weather: cool, calm clear Primary Activities: SS sampling

Date: PIDs

Serial Number		Ambient Air (ppm)	Gas Concentration (ppm)	Meter Reading Initially / Meter Calibrated To
4495	Initial Time:			/
	Final Time:			/
	Initial Time:	(PS) 3/2/23		/
	Final Time:			/
	Initial Time:			/
	Final Time:			/
	Initial Time:			/
	Final Time:			/

B-10

## GEMs

Serial Number		Ambient Air			Calibration Gas Concentration			Meter Reading Initially / Meter Calibrated To		
		CH <sub>4</sub> (%)	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	CH <sub>4</sub> (%)	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	CH <sub>4</sub> : (%)	CO <sub>2</sub> : (%)	O <sub>2</sub> : (0%)
43636	Initial Time: 0436	0	0	22.4	50	35	0	50.1 / 50.0	35.0 / 35.0	00 / 0.0
	Final Time: N/A	-	-	-	-	-	-	-	-	-
	Initial Time:							/	/	/
	Final Time:							/	/	/
	Initial Time:							/	/	/
	Final Time:							/	/	/

NOTES: PID provided by and calibrated by FRNP

Outdoor Air  
Monitoring Record C-310

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Project Name: **Industrial Area Vapor Intrusion Study** Date: 3/1/2023 Page 1 of 1  
Project Number: KX7110/09/10 Project Location: **Paducah Gaseous Diffusion Plant**  
Recorded By: PS  
Weather: Mild, breezy, clear

SUMMA Canister and Regulator Information  
SUMMA ID #: 15034 Regulator ID#: 02513

Sample ID: ~~CS10V-OA-1~~ <sup>(PS) 3/1/23</sup> Z3C310V1-OA-1 <sup>(PS) 4/12/23</sup>  
Sample Start Time: 0811 Sample Initial Vacuum: -2.6 inHg  
Sample End Time: 1547 Sample Completion Vacuum: -3.5 inHg

**Comments**

On south side of building, on tripod secured to a post

B-11

Outdoor Air  
Monitoring Record C-409

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Project Name: **Industrial Area Vapor Intrusion Study** Date: 3/2 /2023 Page 1 of 1  
Project Number: KX7110/09/10 Project Location: **Paducah Gaseous Diffusion Plant**  
Recorded By: PS  
Weather: cool, breezy, clear

SUMMA Canister and Regulator Information  
SUMMA ID #: 318 Regulator ID#: 06789

Sample ID: ~~C409VI-OA-1~~ <sup>23423</sup> 23C409VI-OA Sample Initial Vacuum: -30 in Hg  
Sample Start Time: 619 Sample Completion Vacuum: -65 in Hg  
Sample End Time: 1619

Comments  
on post near northwest corner of building

B-12



Outdoor Air  
Monitoring Record C-720

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Project Name: **Industrial Area Vapor Intrusion Study**

Date: 3/3 /2023

Page 1 of 1

Project Number: KX7110/09/10

Project Location: **Paducah Gaseous Diffusion Plant**

Recorded By: PS

Weather: Cool, windy, heavy rain

SUMMA Canister and Regulator Information

SUMMA ID #: 195

Regulator ID#: 06785

Sample ID: ~~C-720-VI-OA-1~~ 31523 23C720VI-OA

Sample Start Time: 527

Sample Initial Vacuum: -28.8 inHg

Sample End Time: 1527

Sample Completion Vacuum: -5 inHg

Comments

On picnic table on covered porch on south side of building.

B-13

# SOIL GAS VAPOR PIN MEASUREMENTS

① Project Name: Industrial Area Vapor Intrusion Study Location: C409VI-SS-1  Vapor Pin  Soil gas probe  
 Date: 3/1/2023 Project Number: KX7110/09/10 <sup>Multi Rae</sup> Mini Rae 2000 Serial No.: 11882 Lamp: (0.6) / 11.7 eV  
 Site Location: Paducah Gaseous Diffusion Plant <sup>PS 3/1/23</sup> Landtech GEM <sup>5000</sup> 2000 Landfill Gas Meter Serial No. M: 43636  
 Weather: cool, calm, overcast Specific Location within Facility: Control room; C-409  
 Field Personnel: PS, M.H. SM  
 Recorded By: PS

② Surface Type:  Asphalt  Concrete  Grass  Other \_\_\_\_\_ ③ 1 Casing Volume  
 Surface Thickness 8 inches centimeters  Unknown  Sub-slab <0.1 L  
 (i.e., asphalt or concrete) Soil gas probe \_\_\_\_\_ (L)

④ Initial Vacuum (prior to pumping) -30 in. H<sub>2</sub>O

⑤ Field tubing blank reading (ppm<sub>v</sub>) completed?  Yes  No PID Reading 0.0 ppm<sub>v</sub>

⑥ Shut in test prior to purging completed? Yes  No

⑦ Purging

Date	Start Time	End Time	Elapsed Time (min.)	Bag Volume (L)	Purge Rate (LPM)	CH <sub>4</sub> (%)	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	VOCs by PID (ppm <sub>v</sub> )
3/1/2023	507	509	2	1	0.5	0.0	0.1	22.8	0.0
↓	510	512	2	1	0.5	0.0	0.1	22.7	0.0
↓	512	514	2	1	0.5	0.0	0.1	22.7	0.0
<del>PS 3/1/23</del>									

⑧ Shut in test prior to sample collection completed? Yes  No

⑨ Sample Collection

Date	Time	Sample ID	Summa Canister ID	Flow Controller #	Vacuum Gauge #	Initial Vacuum (in. Hg)	Final Vacuum (in. Hg)
3/1/2023	1619	23C409VI-SS-1	173	02515		-30	-4.5
-	-	-	-	-		-	-
-	-	-	-	-		-	-

Comments: background PID 0.0 ppm  
opened @ 619

B-14

SGP measurement - pneumatic filling

# SOIL GAS VAPOR PIN MEASUREMENTS

① Project Name: Industrial Area Vapor Intrusion Study Location: C409VI-SS-3  Vapor Pin  Soil gas probe  
 Date: 3/1/2023 Project Number: KX7110/09/10 *Mylk Rae* Min-Rae 2000 Serial No.: 11882 Lamp: 10.6 / 11.7 eV  
 Site Location: Paducah Gaseous Diffusion Plant *3/1/23* Landtech GEM 5000 Landfill Gas Meter Serial No. M: 43636  
 Weather: Cool, calm, overcast Specific Location within Facility: C-409, column B10/11  
 Field Personnel: PS, MH, SM  
 Recorded By: PS

② Surface Type:  Asphalt  Concrete  Grass  Other \_\_\_\_\_  
 Surface Thickness 20 inches centimeters  Unknown  
 (i.e., asphalt or concrete)  Sub-slab <0.1 L  
 Soil gas probe \_\_\_\_\_ (L)

④ Initial Vacuum (prior to pumping) -30 in. H<sub>2</sub>O

⑤ Field tubing blank reading (ppm<sub>v</sub>) completed?  Yes  No PID Reading \_\_\_\_\_ ppm<sub>v</sub>

⑥ Shut in test prior to purging completed? Yes  No

⑦ Purging

Date	Start Time	End Time	Elapsed Time (min.)	Bag Volume (L)	Purge Rate (LPM)	CH <sub>4</sub> (%)	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	VOCs by PID (ppm <sub>v</sub> )
3/1/2023	546	548	2	1	0.5	0.0	0.3	22.3	0.0
↓	548	550	2	1	0.5	0.0	0.3	22.2	0.0
↓	550	552	2	1	0.5	0.0	0.3	22.2	0.0
<del>_____ 3/1/23 _____</del>									

⑧ Shut in test prior to sample collection completed? Yes  No

⑨ Sample Collection

Date	Time	Sample ID	Summa Canister ID	Flow Controller #	Vacuum Gauge #	Initial Vacuum (in. Hg)	Final Vacuum (in. Hg)
3/1/2023	1621	23C409VI-SS-3	53	06782		-30	-2.5
-	-	-	-	-		-	-
-	-	-	-	-		-	-

Comments: background PID 0.0; summa opened @ 621

B-15

SGP measurement - pneumatic testing

# SOIL GAS VAPOR PIN MEASUREMENTS

① Project Name: Industrial Area Vapor Intrusion Study Location: C720V1-SS-4  Vapor Pin  Soil gas probe  
 Date: 3/1/2023 Project Number: KX7110/09/10 Multi-Rate Mini-Rate 2000 Serial No.: 11882 Lamp: 10.6 / 11.7 eV  
 Site Location: Paducah Gaseous Diffusion Plant Landtech GEM-2000 Landfill Gas Meter Serial No. M: 43636  
 Weather: cool, calm overcast Specific Location within Facility: C-720; old machine shop area column F-18  
 Field Personnel: PS, MH, SM  
 Recorded By: PS

② Surface Type:  Asphalt  Concrete  Grass  Other \_\_\_\_\_  
 Surface Thickness \_\_\_\_\_ inches centimeters  Unknown  
 (i.e., asphalt or concrete)

③ 1 Casing Volume  
 Sub-slab <0.1 L  
 Soil gas probe \_\_\_\_\_ (L)

④ Initial Vacuum (prior to pumping) -30 in. H<sub>2</sub>O

⑤ Field tubing blank reading (ppm<sub>v</sub>) completed?  Yes  No PID Reading 0.0 ppm<sub>v</sub>

⑥ Shut in test prior to purging completed? Yes  No

⑦ Purging

Date	Start Time	End Time	Elapsed Time (min.)	Bag Volume (L)	Purge Rate (LPM)	CH <sub>4</sub> (%)	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	VOCs by PID (ppm <sub>v</sub> )
3/1/2023	640	644	4	1	0.25	0.0	0.0	20.4	0.1
↓	645	650	5	1	0.2	0.0	0.2	20.5	0.1
↓	650	654	4	1	0.25	0.0	0.0	20.0	0.1
<del>_____</del>						<del>(PS) 3/1/23</del>			

⑧ Shut in test prior to sample collection completed? Yes  No

⑨ Sample Collection

Date	Time	Sample ID	Summa Canister ID	Flow Controller #	Vacuum Gauge #	Initial Vacuum (in. Hg)	Final Vacuum (in. Hg)
3/1/2023	1520	23C720V1-SS-4	1119g	06791	<del>_____</del>	-30	approx. -5
-	-	-	-	-	<del>_____</del>	-	-
-	-	-	-	-	<del>_____</del>	-	-

Comments: Background PID 0.0 ppm; opened @ 659; vacuum still -30 inHg @ 1130; collected as grab sample w/ no Flow controller b/c tight soil formation; grab sample start @ 1506; used gauge built into summa canister as rough guide for final pressure; closed @ -5 inHg

B-10

SGF measurement - pneumatic testing

# SOIL GAS VAPOR PIN MEASUREMENTS

① Project Name: Industrial Area Vapor Intrusion Study Location: C310VI-SS-3  Vapor Pin  Soil gas probe  
 Date: 3/2/2023 Project Number: KX7110/09/10 Multi-Rae 2000 Serial No.: 4495 Lamp: 10.6 / 11.7 eV  
 Site Location: Paducah Gaseous Diffusion Plant Landtech GEM 2000 Landfill Gas Meter Serial No. M: 43636  
 Weather: cool, calm, clear Specific Location within Facility: C-310 columns B-16 & B-17  
 Field Personnel: PS, MH  
 Recorded By: PS

② Surface Type:  Asphalt  Concrete  Grass  Other \_\_\_\_\_  
 Surface Thickness 12 inches centimeters  Unknown  
 (i.e., asphalt or concrete)

③ 1 Casing Volume  
 Sub-slab <0.1 L  
 Soil gas probe \_\_\_\_\_ (L)

④ Initial Vacuum (prior to pumping) -27 in. H<sub>2</sub>O

⑤ Field tubing blank reading (ppm<sub>v</sub>) completed?  Yes  No PID Reading 0.0 ppm<sub>v</sub>

⑥ Shut in test prior to purging completed? Yes  No

⑦ Purging

Date	Start Time	End Time	Elapsed Time (min.)	Bag Volume (L)	Purge Rate (LPM)	CH <sub>4</sub> (%)	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	VOCs by PID (ppm <sub>v</sub> )
3/2/2023	453	455	2	1	0.5	0.0	1.6	19.6	0.1
↓	456	458	2	1	0.5	0.0	1.6	19.6	0.1
↓	459	501	2	1	0.5	0.0	1.5	19.7	0.1
<del>PS 3/2/23</del>									

⑧ Shut in test prior to sample collection completed? Yes  No

⑨ Sample Collection

Date	Time	Sample ID	Summa Canister ID	Flow Controller #	Vacuum Gauge #	Initial Vacuum (in. Hg)	Final Vacuum (in. Hg)
3/2/2023	1505	23C310VI-SS-3	168	05057		-27	-3.5
-	-	-	-	-		-	-
-	-	-	-	-		-	-

Comments: background PID 0.0 ; summa opened @ 505

B-17

# SOIL GAS VAPOR PIN MEASUREMENTS

① Project Name: Industrial Area Vapor Intrusion Study Location: C310VI-SS-2  Vapor Pin  Soil gas probe  
 Date: 3/2/2023 Project Number: KX7110/09/10 Multi-Pass 2000 Serial No.: 4495 Lamp: 10.6 / 11.7 eV  
 Site Location: Paducah Gaseous Diffusion Plant Landtech GEM 2000 Serial No.: 500  
 Weather: Cool, calm, clear Landtech GEM 2000 Landfill Gas Meter Serial No. M: 43636  
 Field Personnel: PS, MH Specific Location within Facility: C-310; columns D-153D-16  
 Recorded By: PS

② Surface Type:  Asphalt  Concrete  Grass  Other \_\_\_\_\_  
 Surface Thickness 12 inches centimeters  Unknown  
 (i.e., asphalt or concrete)

③ 1 Casing Volume  
 Sub-slab <0.1 L  
 Soil gas probe \_\_\_\_\_ (L)

④ Initial Vacuum (prior to pumping) -27.5 in. H<sub>2</sub>O

⑤ Field tubing blank reading (ppm<sub>v</sub>) completed?  Yes  No PID Reading 0.0 ppm<sub>v</sub>

⑥ Shut in test prior to purging completed? Yes  No

⑦ Purging

Date	Start Time	End Time	Elapsed Time (min.)	Bag Volume (L)	Purge Rate (LPM)	CH <sub>4</sub> (%)	CO <sub>2</sub> (%)	O <sub>2</sub> (%)	VOCs by PID (ppm <sub>v</sub> )
<u>3/2/2023</u>	<u>518</u>	<u>520</u>	<u>2</u>	<u>1</u>	<u>0.5</u>	<u>0.0</u>	<u>1.1</u>	<u>21.8</u>	<u>0.1</u>
	<u>521</u>	<u>523</u>	<u>2</u>	<u>1</u>	<u>0.5</u>	<u>0.0</u>	<u>1.0</u>	<u>22.0</u>	<u>0.0</u>
	<u>524</u>	<u>526</u>	<u>2</u>	<u>1</u>	<u>0.5</u>	<u>0.0</u>	<u>1.1</u>	<u>21.9</u>	<u>0.0</u>
<u>(PS) 3/2/23</u>									

⑧ Shut in test prior to sample collection completed? Yes  No

⑨ Sample Collection

Date	Time	Sample ID	Summa Canister ID	Flow Controller #	Vacuum Gauge #	Initial Vacuum (in. Hg)	Final Vacuum (in. Hg)
<u>3/2/2023</u>	<u>1529</u>	<u>23C310VI-SS-2</u>	<u>230</u>	<u>04949</u>	<u>-27.5</u>	<u>-7</u>	
<u>3/2/2023</u>	<u>1529</u>	<u>23C310VI-SS-2D</u>	<u>152</u>	<u>02512</u>	<u>-30</u>	<u>-3.5</u>	

Comments: background PID 0.0; sample and duplicate summas opened @ 529; for duplicate - at 10 hrs flow controller read -3.5 in Hg but gauge did not drop any further upon closing. After checking canister pressure with a digital vacuum gauge it was determined that the vacuum was at zero. 23C310VI-SS-2D WILL NOT BE ANALYZED (PS) 4/12/23

B-18

SGP measurements - pneumatic testing of

Indoor Air Monitoring Record C-310  
Location: Near Columns D-15 & D-16

Project Name: Industrial Area Vapor Intrusion Study Date: 3/1/2023 Page 1 of 1  
Project Number: KX7110/09/10 Project Location: Paducah Gaseous Diffusion Plant  
Recorded By: PS  
Weather: mild, breezy, clear

Jerome Mercury Vapor Analyzer  
Serial No.: \_\_\_\_\_ Field Screening Result: PS 3/1/23

SUMMA Canister and Regulator Information  
SUMMA ID #: 161 Regulator ID#: 06781

Sample ID: ~~CS10VI-1A-2~~ 23C310VI-1A-2  
Sample Start Time: 0750 Sample Initial Vacuum: -30 in Hg  
Sample End Time: 1243 Sample Completion Vacuum: -3 in Hg

Comments  
closed after 4hr. 57min.  
Sample not analyzed; re-collected on 3/3/23.

B-19

Indoor Air Monitoring Record C-310

Location: near columns B-16 and B-17

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Project Name: Industrial Area Vapor Intrusion Study

Date: 3/1/2023

Page 1 of 1

Project Number: KX7110/09/10

Project Location: Paducah Gaseous Diffusion Plant

Recorded By: PS

Weather: mild breezy clear

~~JEROME Mercury Vapor Analyzer~~

~~Serial No.:~~

~~Field Screening Result: (PS) 3/1/23~~

SUMMA Canister and Regulator Information

SUMMA ID #: 80531

Regulator ID#: 06738

Sample ID: 23C310VI-1A-3

Sample Start Time: 0752

Sample Initial Vacuum: -30 inHg

Sample End Time: 1752

Sample Completion Vacuum: -5 inHg

Comments

B-20



Indoor Air Monitoring Record C-409

Location: Near Column B-10/B-11

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Project Name: **Industrial Area Vapor Intrusion Study**

Date: 3/2/2023

Page 1 of 1

Project Number: KX7110/09/10

Project Location: **Paducah Gaseous Diffusion Plant**

Recorded By: PS

Weather: cool, calm, clear

~~Jerome Mercury Vapor Analyzer~~

PS 3/2/23

~~Serial No.:~~

~~Field Screening Result:~~

SUMMA Canister and Regulator Information

SUMMA ID #: 325

Regulator ID#: 06788

Sample ID: ~~C109VI-1A-3~~ 3/2/23 23C409VI-1A-3

Sample Start Time: 607

Sample Initial Vacuum: -30 inHg

Sample End Time: 1607

Sample Completion Vacuum: -7 inHg

Comments

B-21

Indoor Air Monitoring Record C-409

Location: Control Room

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Project Name: **Industrial Area Vapor Intrusion Study**

Date: 3/2/2023

Page 1 of 1

Project Number: KX7110/09/10

Project Location: **Paducah Gaseous Diffusion Plant**

Recorded By: PS

Weather: Cool, calm, clear

~~Jerome Mercury Vapor Analyzer~~

~~Serial No.:~~

~~Field Screening Result:~~

B 3/2/23

SUMMA Canister and Regulator Information

DUP: 330

DUP: 05088

SUMMA ID #: 02815

Regulator ID#: 06740

Sample ID: ~~23C409VI-1A-1~~ 23C409VI-1A-1 / 23C409VI-1A-1D

Sample Start Time: 601 / DUP 601

Sample Initial Vacuum: -27 inHg / DUP -30 inHg

Sample End Time: 1601 / DUP 1601

Sample Completion Vacuum: -2 inHg / DUP -3 inHg

Comments

B-22

Indoor Air Monitoring Record C-310

Location: Near Columns D15 & D16

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Project Name: Industrial Area Vapor Intrusion Study

Date: 3/3/2023

Page 1 of 1

Project Number: KX7110/09/10

Project Location: Paducah Gaseous Diffusion Plant

Recorded By: PS

Weather: cool, windy, heavy rain and thunder

~~Jerome Mercury Vapor Analyzer~~

~~(PS) 3/3/23~~

~~Serial No.:~~

~~Field Screening Result:~~

SUMMA Canister and Regulator Information

SUMMA ID #: 236

Regulator ID#: 02514

Sample ID: ~~PS~~ (PS) 3/3/23 236310v1-1A-2R

Sample Start Time: 433

Sample Initial Vacuum: -28 inHg

Sample End Time: 1240

Sample Completion Vacuum: -3 inHg

Comments

8 hr. 7 min. sample

B-23

Indoor Air Monitoring Record C-720

Location: old machine shop; column F-18

Project Name: Industrial Area Vapor Intrusion Study

Date: 3/3/2023

Page 1 of 1

Project Number: KX7110/09/10

Project Location: Paducah Gaseous Diffusion Plant

Recorded By: PS

Weather: cool, windy, heavy rain

Jerome Mercury Vapor Analyzer

PS 3/3/23

Serial No.:

Field Screening Result:

SUMMA Canister and Regulator Information

SUMMA ID #: 14815

Regulator ID#: 06786

Sample ID: ~~C720V1A4~~ 23720V1-1A-4

Sample Start Time: 453

Sample Initial Vacuum: -30 in Hg

Sample End Time: 1453

Sample Completion Vacuum: -5 in Hg

Comments

B-24

Differential Pressure Monitoring Record C-310

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Project Name: **Industrial Area Vapor Intrusion Study**

Date: 3 / 1 / 2023

Page 1 of 1

Project Number: KX7110/09/10

Project Location: **Paducah Gaseous Diffusion Plant**

Recorded By: PS

Weather: mild, breezy, clear

DG-700 Pressure Gauge Information

Serial #: 02620

Monitoring Location ID: C310-VI-IA-3 near columns B-16 & B-17

Start Time: 0842

End Time: 1752

Comments

logging started ~1hr after IA samples opened

logging stopped when last IA sample was closed

B-25

Differential Pressure Monitoring Record C-409

Project Name: **Industrial Area Vapor Intrusion Study** Date: 3/12/2023 Page 1 of 1  
Project Number: KX7110/09/10 Project Location: **Paducah Gaseous Diffusion Plant**  
Recorded By: RS  
Weather: cool, calm, clear

DG-700 Pressure Gauge Information  
Serial #: 62620

Monitoring Location ID: 3C409-SS-1  
Start Time: 557  
End Time: 1610

Comments
<u>control room</u>

B-26

Differential Pressure Monitoring Record 720

Geosyntec<sup>®</sup>  
consultants

180A Market Place Boulevard

Knoxville, TN 37922

Phone: (865) 330-0037

Project Name: **Industrial Area Vapor Intrusion Study**

Date: 3 / 3 / 2023

Page 1 of 1

Project Number: KX7110/09/10

Project Location: **Paducah Gaseous Diffusion Plant**

Recorded By: PS

Weather: Cool, windy, heavy rain

DG-700 Pressure Gauge Information

Serial #: \_\_\_\_\_

Monitoring Location ID: 23C720V1-SS-4

Start Time: 451

End Time: 1453

Comments

B-27

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**APPENDIX C**

**FIELD CHANGE CORRESPONDENCE**

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## Perri Silverhart

---

**From:** Weeks, Victor <weeks.victor@epa.gov>  
**Sent:** Friday, January 13, 2023 4:20 PM  
**To:** Begley, Brian (EEC); Fountain, Stefanie; Bonczek, Richard  
**Subject:** [ EXTERNAL SENDER ] RE: Vapor Intrusion - C-310 Basement

EPA agrees that the C-310 Location 4 should not be sampled.

Victor L. Weeks

U.S. EPA Region 4  
Superfund and Emergency Management Division  
Superfund Restoration and Site Evaluation Branch  
Restoration & DOE Coordination Section  
Atlanta Federal Center  
61 Forsyth ST  
Atlanta, Georgia 30303

Direct: 404-562-9189  
Cell: 770-363-8201

---

**From:** Begley, Brian (EEC) <Brian.Begley@ky.gov>  
**Sent:** Friday, January 13, 2023 3:36 PM  
**To:** Fountain, Stefanie <Stefanie.Fountain@pad.pppo.gov>; Bonczek, Richard <richard.bonczek@pppo.gov>  
**Cc:** Weeks, Victor <weeks.victor@epa.gov>  
**Subject:** Re: Vapor Intrusion - C-310 Basement

Stefanie and Rich,

I have reviewed the proposal to not collect 2<sup>nd</sup> round vapor intrusion samples from the C-310 Basement (Location 4) and agree that due to the chlorinated water leak, the intended purpose would not be met.

*Brian Begley, PG*

**Registered Geologist Supervisor**

**KY Federal Facilities Agreement Manager**

Energy and Environment Cabinet

Division of Waste Management

Hazardous Waste Branch

Paducah Gaseous Diffusion Plant Section

300 Sower Blvd., Frankfort, KY 40601

[Brian.Begley@KY.GOV](mailto:Brian.Begley@KY.GOV)

office: (502) 782-6317

mobile: (502) 229-4703

---

**From:** Fountain, Stefanie <[Stefanie.Fountain@pad.pppo.gov](mailto:Stefanie.Fountain@pad.pppo.gov)>  
**Sent:** Friday, January 13, 2023 2:31 PM  
**To:** Weeks, Victor <[weeks.victor@epa.gov](mailto:weeks.victor@epa.gov)>; Begley, Brian (EEC) <[Brian.Begley@ky.gov](mailto:Brian.Begley@ky.gov)>  
**Cc:** Bonczek, Richard <[richard.bonczek@pppo.gov](mailto:richard.bonczek@pppo.gov)>  
**Subject:** Vapor Intrusion - C-310 Basement

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---

Good afternoon Brian and Victor-

You may recall that the Sitewide VI report included a recommendation to recollect an additional round of samples from a subset of the facilities/locations as to confirm those results. As such, the intent was that the samples would be collected under conditions similar to conditions during the original sample collection. The recommended additional round of sampling included three locations in C-310:

second sampling event is recommended for PI buildings where TCE concentrations in subslab vapor exceeded VISLs or chloroform concentrations exceeded VISLs in both subslab vapor and indoor air to reduce this temporal uncertainty. The following additional actions are recommended as the VI pathway evaluation is continued to satisfy the question of potential threat to human health from VI.

- Conduct an additional round of paired subslab vapor/indoor air sampling at paired locations 2, 3, and 4 in C-310. During the PI, TCE exceeded its VISL in subslab sample locations 2 and 3; however, it did not exceed its VISL in the paired indoor air samples. During the PI, chloroform exceeded its VISL in both subslab and indoor air samples at paired location 4.

Additionally, the C-310 location 4 (in the basement-see attached figure from the report) was selected based on its exceedance of the chloroform VISL. The C-310 basement is currently flooded with approximately 3 inches of standing water from a burst sanitary water pipe (i.e., chlorinated water). The presence of this water is a substantially different condition from the original sampling conditions, not only in terms of physical presence of the water, but also the presence of chlorine and potentially chlorine byproducts. As noted in the VI Report, chloroform "is a common background contaminant associated with chlorinated drinking water."

For consideration with respect to the C-310 Location 4:

- A schedule for dewatering is not available as the basement sump pumps are not functional.
- Access to this area is currently restricted by H&S and RadCon.
- Even were access permitted, entrainment of water into the Summa canister or the differential pressure meter would be detrimental to the equipment and render the sample unanalyzable.
- The sampling was planned for February so as to capture winter conditions consistent with the original sampling event. Notwithstanding our current unseasonably warm winter, it is reasonable to assume that February will have winter conditions whereas pushing into March or April become much more uncertain in this regard.

- C-310 is designated as “Occupiable” and “Almost Never” occupied. During the walkdown of this facility in 2020, several penetrations in the basement floor were noted, including a crack, sump, and floor drain (see the Work Plan Appendix C for walkdown forms).
- The presence of chlorinated water in the basement is a confounding condition in being able to understand the VI pathway for chloroform. Due to the presence of the floor penetrations in the basement, chlorinated water may also have infiltrated below the floor. This makes interpretation of the sample results very difficult and it may not be possible to use either the sub-slab and indoor air results from this location to evaluate the completeness of the VI pathway.

Because of the inability to reasonably replicate the original sampling conditions, the samples from this location are not able to meet the intended purpose of the second sampling event (confirming the original results). Additionally, postponing the sampling to a time when the standing water is removed is not recommended due to seasonality concerns and the potential prolonged impacts from the standing water infiltrating below the floor. Therefore, we recommend that the C-310 Location 4 not be sampled. We intend to collect samples at C-310 Locations 2 and 3 as planned.

Thank you,  
Stefanie

**Stefanie A. Fountain, Ph.D., P.E.\*, PMP**

\*Licensed in GA, ID, IL, KY, NC, NV, OH, SC, TN, and WV

**Environmental Services | Subject Matter Expert**

**Four Rivers Nuclear Partnership, LLC | Geosyntec Consultants, Inc.**

Office: **(865) 291-4689**

Mobile: **(865) 361-1699**



## Perri Silverhart

---

**From:** Weeks, Victor <weeks.victor@epa.gov>  
**Sent:** Monday, January 23, 2023 12:28 PM  
**To:** Fountain, Stefanie; Bonczek, Richard; Begley, Brian (EEC)  
**Subject:** [ EXTERNAL SENDER ] RE: Vapor Intrusion Laboratory Item

Looks ok to me, if KDEP also concurs.

Victor L. Weeks

U.S. EPA Region 4  
Superfund and Emergency Management Division  
Superfund Restoration and Site Evaluation Branch  
Restoration & DOE Coordination Section  
Atlanta Federal Center  
61 Forsyth ST  
Atlanta, Georgia 30303

Direct: 404-562-9189  
Cell: 770-363-8201

---

**From:** Fountain, Stefanie <Stefanie.Fountain@pad.pppo.gov>  
**Sent:** Monday, January 23, 2023 8:23 AM  
**To:** Bonczek, Richard <richard.bonczek@pppo.gov>; Weeks, Victor <weeks.victor@epa.gov>; Begley, Brian (EEC) <Brian.Begley@ky.gov>  
**Subject:** Vapor Intrusion Laboratory Item

Good morning –

In contracting the laboratory for the February vapor intrusion sampling, we have been notified that the laboratory previously used for this project is not able to provide the Summa canisters to meet our schedule. We have contacted an alternative laboratory for this work and there are a few QAPP specifications to consider:

- The new lab has slightly different PQLs from the prior laboratory. The new lab PQLs are below the PALs (see table below and worksheet from QAPP attached).
- TO-15 would be used for all samples. The QAPP listed TO-15 SIM for the subslab samples. The new lab does not have a TO-15 SIM method for the subslab samples, but they are able to meet the PALs for the subslab samples using TO-15.

VOC	New Lab PQL (ug/m3)	Former Lab PQL (ug/m3)	PAL (ug/m3)
1,1,1-Trichloroethane	2.73	4.37	21,900
<i>cis</i> -1,2-Dichloroethene	1.98	3.17	N/A, 3500
Chloroform	2.44	3.91	0.533
<i>trans</i> -1,2-Dichloroethene	1.98	3.17	N/A, 3500
Trichloroethene	2.69	2.15	2.99
Vinyl chloride	1.28	1.02	2.79

- The new laboratory only has 6-L Summa canisters, so we propose to use the 6-L canisters rather than the 1-L canisters for the subslab sample collection. To avoid potential inventory issues, all canisters will be individually

certified (the QAPP specified batch certification for the subslab canisters). As described in the QAPP, 10-hr regulators will be used for the indoor and outdoor air samples.

Please let me know if you have any questions or if the use of the new laboratory with changes to the QAPP noted above is acceptable. To stay on schedule for February sampling, we will need to confirm the laboratory in the next few days. We appreciate the quick review.

Thank you for your attention to this process as we continue to work through logistics for this sampling. We are also working through equipment rental and have learned that some equipment models may not be available (some newer models have been brought to market). I will advise if there are any substantive changes in the equipment or equipment performance that would deviate from the QAPP.

Thank you,  
Stefanie

**Stefanie A. Fountain, Ph.D., P.E.\*, PMP**

\*Licensed in GA, ID, IL, KY, NC, NV, OH, SC, TN, and WV

**Environmental Services | Subject Matter Expert**

**Four Rivers Nuclear Partnership, LLC | Geosyntec Consultants, Inc.**

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Mobile: **(865) 361-1699**



## Perri Silverhart

---

**From:** Begley, Brian (EEC) <Brian.Begley@ky.gov>  
**Sent:** Tuesday, January 24, 2023 12:32 PM  
**To:** Fountain, Stefanie; Bonczek, Richard  
**Cc:** Weeks, Victor; Williamson, Leo (EEC)  
**Subject:** [ EXTERNAL SENDER ] Re: Vapor Intrusion Laboratory Item (KY acceptance of new lab and QAPP changes)

Stefanie and Rich,  
KY has reviewed the new Lab PQLs and proposed changes to the QAPP and finds them all acceptable.

### Brian Begley, PG

Registered Geologist Supervisor  
KY Federal Facilities Agreement Manager

Energy and Environment Cabinet  
Division of Waste Management  
Hazardous Waste Branch  
Paducah Gaseous Diffusion Plant Section  
300 Sower Blvd., Frankfort, KY 40601

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[Brian.Begley@KY.GOV](mailto:Brian.Begley@KY.GOV)

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---

**From:** Fountain, Stefanie <Stefanie.Fountain@pad.pppo.gov>  
**Sent:** Monday, January 23, 2023 8:22 AM  
**To:** Bonczek, Richard <richard.bonczek@pppo.gov>; Weeks, Victor <weeks.victor@epa.gov>; Begley, Brian (EEC) <Brian.Begley@ky.gov>  
**Subject:** Vapor Intrusion Laboratory Item

**\*\*CAUTION\*\* PDF attachments may contain links to malicious sites. Please contact the COT Service Desk [ServiceCorrespondence@ky.gov](mailto:ServiceCorrespondence@ky.gov) for any assistance.**

Good morning –

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The new lab has slightly different PQLs from the prior laboratory. The new lab PQLs are below the PALs (see table below and worksheet from QAPP attached).

TO-15 would be used for all samples. The QAPP listed TO-15 SIM for the subslab samples. The new lab does not have a TO-15 SIM method for the subslab samples, but they are able to meet the PALs for the subslab samples using TO-15.

VOC	New Lab PQL (ug/m3)	Former Lab PQL (ug/m3)	PAL (ug/m3)
1,1,1-Trichloroethane	2.73	4.37	21,900
cis-1,2-Dichloroethene	1.98	3.17	N/A, 3500



Chloroform	2.44	3.91	0.533
<i>trans</i> -1,2-Dichloroethene	1.98	3.17	N/A, 3500
Trichloroethene	2.69	2.15	2.99
Vinyl chloride	1.28	1.02	2.79

The new laboratory only has 6-L Summa canisters, so we propose to use the 6-L canisters rather than the 1-L canisters for the subslab sample collection. To avoid potential inventory issues, all canisters will be individually certified (the QAPP specified batch certification for the subslab canisters). As described in the QAPP, 10-hr regulators will be used for the indoor and outdoor air samples.

Please let me know if you have any questions or if the use of the new laboratory with changes to the QAPP noted above is acceptable. To stay on schedule for February sampling, we will need to confirm the laboratory in the next few days. We appreciate the quick review.

Thank you for your attention to this process as we continue to work through logistics for this sampling. We are also working through equipment rental and have learned that some equipment models may not be available (some newer models have been brought to market). I will advise if there are any substantive changes in the equipment or equipment performance that would deviate from the QAPP.

Thank you,  
Stefanie

**Stefanie A. Fountain, Ph.D., P.E.\*, PMP**

\*Licensed in GA, ID, IL, KY, NC, NV, OH, SC, TN, and WV

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## Perri Silverhart

---

**From:** Weeks, Victor <weeks.victor@epa.gov>  
**Sent:** Thursday, January 26, 2023 2:31 PM  
**To:** Fountain, Stefanie; Bonczek, Richard; Begley, Brian (EEC)  
**Subject:** [ EXTERNAL SENDER ] RE: VI Sampling Equipment

I agree to the suggested approach.

Victor L. Weeks

U.S. EPA Region 4  
Superfund and Emergency Management Division  
Superfund Restoration and Site Evaluation Branch  
Restoration & DOE Coordination Section  
Atlanta Federal Center  
61 Forsyth ST  
Atlanta, Georgia 30303

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---

**From:** Fountain, Stefanie <Stefanie.Fountain@pad.pppo.gov>  
**Sent:** Thursday, January 26, 2023 2:02 PM  
**To:** Bonczek, Richard <richard.bonczek@pppo.gov>; Weeks, Victor <weeks.victor@epa.gov>; Begley, Brian (EEC) <Brian.Begley@ky.gov>  
**Subject:** VI Sampling Equipment

Good afternoon –

The Vapor Intrusion work plan states that a “GEM 2000 Landfill Gas meter (or equivalent) to measure oxygen, carbon dioxide and methane concentrations” will be used during purging of the subslab locations. The GEM 2000 unit has been replaced by the manufacturer by the GEM 5000. With respect to this project and purpose, the GEM 5000 provides the same function as the GEM 2000, with slightly improved accuracy (0.5% versus 1.0%) at the methane and carbon dioxide levels we anticipate during purging. We propose to use the GEM 5000 “as equivalent” to the GEM 2000.

Thank you,  
Stefanie

**Stefanie A. Fountain, Ph.D., P.E.\*, PMP**  
\*Licensed in GA, ID, IL, KY, NC, NV, OH, SC, TN, and WV  
**Environmental Services | Subject Matter Expert**  
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## Perri Silverhart

---

**From:** Begley, Brian (EEC) <Brian.Begley@ky.gov>  
**Sent:** Thursday, January 26, 2023 2:50 PM  
**To:** Fountain, Stefanie; Bonczek, Richard; 'Weeks, Victor'  
**Subject:** [ EXTERNAL SENDER ] Re: VI Sampling Equipment

Stefanie,  
The change is acceptable to KY.  
Thanks,  
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---

**From:** Fountain, Stefanie <Stefanie.Fountain@pad.pppo.gov>  
**Sent:** Thursday, January 26, 2023 2:04 PM  
**To:** Bonczek, Richard <richard.bonczek@pppo.gov>; 'Weeks, Victor' <weeks.victor@epa.gov>; Begley, Brian (EEC) <Brian.Begley@ky.gov>  
**Subject:** VI Sampling Equipment

Good afternoon –

The Vapor Intrusion work plan states that a “GEM 2000 Landfill Gas meter (or equivalent) to measure oxygen, carbon dioxide and methane concentrations” will be used during purging of the subslab locations. The GEM 2000 unit has been replaced by the manufacturer by the GEM 5000. With respect to this project and purpose, the GEM 5000 provides the same function as the GEM 2000, with slightly improved accuracy (0.5% versus 1.0%) at the methane and carbon dioxide levels we anticipate during purging. We propose to use the GEM 5000 “as equivalent” to the GEM 2000.

Thank you,

Stefanie

**Stefanie A. Fountain, Ph.D., P.E.\*, PMP**

\*Licensed in GA, ID, IL, KY, NC, NV, OH, SC, TN, and WV

**Environmental Services | Subject Matter Expert**

**Four Rivers Nuclear Partnership, LLC | Geosyntec Consultants, Inc.**

Office: (865) 291-4689

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## Perri Silverhart

---

**From:** Weeks, Victor <weeks.victor@epa.gov>  
**Sent:** Wednesday, February 8, 2023 11:46 AM  
**To:** Fountain, Stefanie; Begley, Brian (EEC)  
**Cc:** Bonczek, Richard; Ford, Bruce  
**Subject:** [ EXTERNAL SENDER ] RE: Vapor Intrusion Laboratory Item

Thank you for the clarifications. Looks good to me.

Victor L. Weeks

U.S. EPA Region 4  
Superfund and Emergency Management Division  
Superfund Restoration and Site Evaluation Branch  
Restoration & DOE Coordination Section  
Atlanta Federal Center  
61 Forsyth ST  
Atlanta, Georgia 30303

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---

**From:** Fountain, Stefanie <Stefanie.Fountain@pad.pppo.gov>  
**Sent:** Wednesday, February 8, 2023 11:08 AM  
**To:** Begley, Brian (EEC) <Brian.Begley@ky.gov>; Weeks, Victor <weeks.victor@epa.gov>  
**Cc:** Bonczek, Richard <richard.bonczek@pppo.gov>; bruce.ford@pad.pppo.gov  
**Subject:** RE: Vapor Intrusion Laboratory Item

Good morning–

Thank you for your prior review of this matter and response. I wanted to provide a follow-up to this topic. (Recall from prior discussion, that the prior lab was not able to provide sampling containers and we were looking at this new lab with the goal of being able to start the sampling in February.)

The new laboratory has clarified this week that they are able to run the TO-15 SIM method on the samples, which should result in lower PQLs than I included in my prior email. As indicated in the table in the prior email, the new TO-15 PQL for chloroform (2.44 ug/m3) was above the PAL (0.533 ug/m3). The primary difference in this round is that the new lab TO-15 chloroform MDL (0.693 ug/m3) is also above the PAL. Typically, TO-15 SIM is expected to have lower PQL/MDLs than TO-15, although the lab is not able to provide these limits. The PQL/MDL for TO-15 (and thus TO-15 SIM) is below the PAL for the other analytes. We are now proposing to run TO-15 SIM on all the samples collected (indoor air, outdoor air, and subslab). We are still planning to use 6-L Summa canisters for all the samples, as discussed prior.

From the VI report, the rationale for this round of samples:

- Conduct an additional round of paired subslab vapor/indoor air sampling at paired locations 2, 3, and 4 in C-310. During the PI, TCE exceeded its VISL in subslab sample locations 2 and 3; however, it did not exceed its VISL in the paired indoor air samples. During the PI, chloroform exceeded its VISL in both subslab and indoor air samples at paired location 4.

- Conduct an additional round of paired subslab vapor/indoor air sampling at paired locations 1 and 3 in C-409. During the PI, chloroform exceeded its VISL in both subslab and indoor air samples at these two paired locations.
- Conduct an additional round of paired subslab vapor/indoor air sampling at paired location 4 in C-720. During the PI, TCE exceeded its VISL in this subslab sample; however, it did not exceed its VISL in the paired indoor air sample.

For context on chloroform:

- Of the locations selected for resampling based on chloroform results, C-310 Location 4 has been removed from the sampling event per the emails on January 13, 2023.
- The prior round results for chloroform at C-409 at locations 1 and 3 ranged from 0.55 J to 1.2 ug/m3 in the indoor air samples and 56 ug/m3 to 620 ug/m3 in the subslab samples.

I also corrected a couple text items in the original email in red below.

Please advise if there are any questions or concerns. We will also plan to discuss this Thursday during the Routine Groundwater Update call.

Thank you,  
Stefanie

**Stefanie A. Fountain**  
Mobile: (865) 361-1699

---

**From:** Fountain, Stefanie <[Stefanie.Fountain@pad.pppo.gov](mailto:Stefanie.Fountain@pad.pppo.gov)>  
**Sent:** Monday, January 23, 2023 8:22 AM  
**To:** Bonczek, Richard <[richard.bonczek@pppo.gov](mailto:richard.bonczek@pppo.gov)>; Weeks, Victor <[weeks.victor@epa.gov](mailto:weeks.victor@epa.gov)>; Begley, Brian (EEC) <[Brian.Begley@ky.gov](mailto:Brian.Begley@ky.gov)>  
**Subject:** Vapor Intrusion Laboratory Item

Good morning –

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The new lab has slightly different PQLs from the prior laboratory. The new lab PQLs are below the PALs (see table below and worksheet from QAPP attached), **with the exception of chloroform (similar to the prior laboratory)**. TO-15 would be used for all samples. The QAPP listed TO-15 SIM for the **indoor air** samples. The new lab does not have a TO-15 SIM method for the subslab samples, but they are able to meet the PALs for the **indoor air** samples using TO-15.

VOC	New Lab TO-15 PQL/MDL (ug/m3)	Former Lab PQL (ug/m3)	PAL (ug/m3)
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cis-1,2-Dichloroethene	1.98/0.341	3.17	N/A, 3500
Chloroform	2.44/0.693	3.91	0.533
trans-1,2-Dichloroethene	1.98/0.979	3.17	N/A, 3500
Trichloroethene	2.69/1.34	2.15	2.99
Vinyl chloride	1.28/1.04	1.02	2.79

The new laboratory only has 6-L Summa canisters, so we propose to use the 6-L canisters rather than the 1-L canisters for the subslab sample collection. To avoid potential inventory issues, all canisters will be individually

certified (the QAPP specified batch certification for the subslab canisters). As described in the QAPP, 10-hr regulators will be used for the indoor and outdoor air samples.

Please let me know if you have any questions or if the use of the new laboratory with changes to the QAPP noted above is acceptable. To stay on schedule for February sampling, we will need to confirm the laboratory in the next few days. We appreciate the quick review.

Thank you for your attention to this process as we continue to work through logistics for this sampling. We are also working through equipment rental and have learned that some equipment models may not be available (some newer models have been brought to market). I will advise if there are any substantive changes in the equipment or equipment performance that would deviate from the QAPP.

Thank you,  
Stefanie

**Stefanie A. Fountain, Ph.D., P.E.\*, PMP**

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**Environmental Services | Subject Matter Expert**

**Four Rivers Nuclear Partnership, LLC | Geosyntec Consultants, Inc.**

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## Perri Silverhart

---

**From:** Begley, Brian (EEC) <Brian.Begley@ky.gov>  
**Sent:** Thursday, February 9, 2023 12:53 PM  
**To:** Fountain, Stefanie  
**Cc:** Bonczek, Richard; Ford, Bruce; Weeks, Victor  
**Subject:** [ EXTERNAL SENDER ] Re: Vapor Intrusion Laboratory Item

Stefanie,  
KY has reviewed the changes and does not have any questions or concerns on the new lab changes.  
Thanks,

*Brian Begley, PG*

**Registered Geologist Supervisor**  
**KY Federal Facilities Agreement Manager**

Energy and Environment Cabinet  
Division of Waste Management  
Hazardous Waste Branch  
Paducah Gaseous Diffusion Plant Section  
300 Sower Blvd., Frankfort, KY 40601

[KY Paducah Site Section Web Page](#)

[Brian.Begley@KY.GOV](mailto:Brian.Begley@KY.GOV)

office: (502) 782-6317

mobile: (502) 229-4703

---

**From:** Fountain, Stefanie <Stefanie.Fountain@pad.pppo.gov>  
**Sent:** Wednesday, February 8, 2023 11:07 AM  
**To:** Begley, Brian (EEC) <Brian.Begley@ky.gov>; 'Weeks, Victor' <weeks.victor@epa.gov>  
**Cc:** Bonczek, Richard <richard.bonczek@pppo.gov>; Ford, Bruce <Bruce.Ford@pad.pppo.gov>  
**Subject:** RE: Vapor Intrusion Laboratory Item

Good morning—

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From the VI report, the rationale for this round of samples:

Conduct an additional round of paired subslab vapor/indoor air sampling at paired locations 2, 3, and 4 in C-310.

During the PI, TCE exceeded its VISL in subslab sample locations 2 and 3; however, it did not exceed its VISL in the paired indoor air samples. During the PI, chloroform exceeded its VISL in both subslab and indoor air samples at paired location 4.

Conduct an additional round of paired subslab vapor/indoor air sampling at paired locations 1 and 3 in C-409. During the PI, chloroform exceeded its VISL in both subslab and indoor air samples at these two paired locations.

Conduct an additional round of paired subslab vapor/indoor air sampling at paired location 4 in C-720. During the PI, TCE exceeded its VISL in this subslab sample; however, it did not exceed its VISL in the paired indoor air sample. For context on chloroform:

Of the locations selected for resampling based on chloroform results, C-310 Location 4 has been removed from the sampling event per the emails on January 13, 2023.

The prior round results for chloroform at C-409 at locations 1 and 3 ranged from 0.55 J to 1.2 ug/m3 in the indoor air samples and 56 ug/m3 to 620 ug/m3 in the subslab samples.

I also corrected a couple text items in the original email in red below.

Please advise if there are any questions or concerns. We will also plan to discuss this Thursday during the Routine Groundwater Update call.

Thank you,

Stefanie

**Stefanie A. Fountain**

Mobile: (865) 361-1699

---

**From:** Fountain, Stefanie <[Stefanie.Fountain@pad.pppo.gov](mailto:Stefanie.Fountain@pad.pppo.gov)>

**Sent:** Monday, January 23, 2023 8:22 AM

**To:** Bonczek, Richard <[richard.bonczek@pppo.gov](mailto:richard.bonczek@pppo.gov)>; Weeks, Victor <[weeks.victor@epa.gov](mailto:weeks.victor@epa.gov)>; Begley, Brian (EEC) <[Brian.Begley@ky.gov](mailto:Brian.Begley@ky.gov)>

**Subject:** Vapor Intrusion Laboratory Item

Good morning –

In contracting the laboratory for the February vapor intrusion sampling, we have been notified that the laboratory previously used for this project is not able to provide the Summa canisters to meet our schedule. We have contacted an alternative laboratory for this work and there are a few QAPP specifications to consider:

The new lab has slightly different PQLs from the prior laboratory. The new lab PQLs are below the PALs (see table below and worksheet from QAPP attached), **with the exception of chloroform (similar to the prior laboratory).**

TO-15 would be used for all samples. The QAPP listed TO-15 SIM for the **indoor air** samples. The new lab does not have a TO-15 SIM method for the subslab samples, but they are able to meet the PALs for the **indoor air** samples using TO-15.

VOC	New Lab TO-15 PQL/MDL (ug/m3)	Former Lab PQL (ug/m3)	PAL (ug/m3)
1,1,1-Trichloroethane	2.73/0.605	4.37	21,900
cis-1,2-Dichloroethene	1.98/0.341	3.17	N/A, 3500
Chloroform	2.44/0.693	3.91	0.533
trans-1,2-Dichloroethene	1.98/0.979	3.17	N/A, 3500
Trichloroethene	2.69/1.34	2.15	2.99
Vinyl chloride	1.28/1.04	1.02	2.79

The new laboratory only has 6-L Summa canisters, so we propose to use the 6-L canisters rather than the 1-L canisters for the subslab sample collection. To avoid potential inventory issues, all canisters will be individually certified (the QAPP specified batch certification for the subslab canisters). As described in the QAPP, 10-hr regulators will be used for the indoor and outdoor air samples.

Please let me know if you have any questions or if the use of the new laboratory with changes to the QAPP noted above is acceptable. To stay on schedule for February sampling, we will need to confirm the laboratory in the next few days.

We appreciate the quick review.

Thank you for your attention to this process as we continue to work through logistics for this sampling. We are also working through equipment rental and have learned that some equipment models may not be available (some newer models have been brought to market). I will advise if there are any substantive changes in the equipment or equipment performance that would deviate from the QAPP.

Thank you,

Stefanie



**Stefanie A. Fountain, Ph.D., P.E.\*, PMP**

\*Licensed in GA, ID, IL, KY, NC, NV, OH, SC, TN, and WV

**Environmental Services | Subject Matter Expert**

**Four Rivers Nuclear Partnership, LLC | Geosyntec Consultants, Inc.**

Office: **(865) 291-4689**

Mobile: **(865) 361-1699**



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**APPENDIX D**  
**ANALYTICAL RESULTS**

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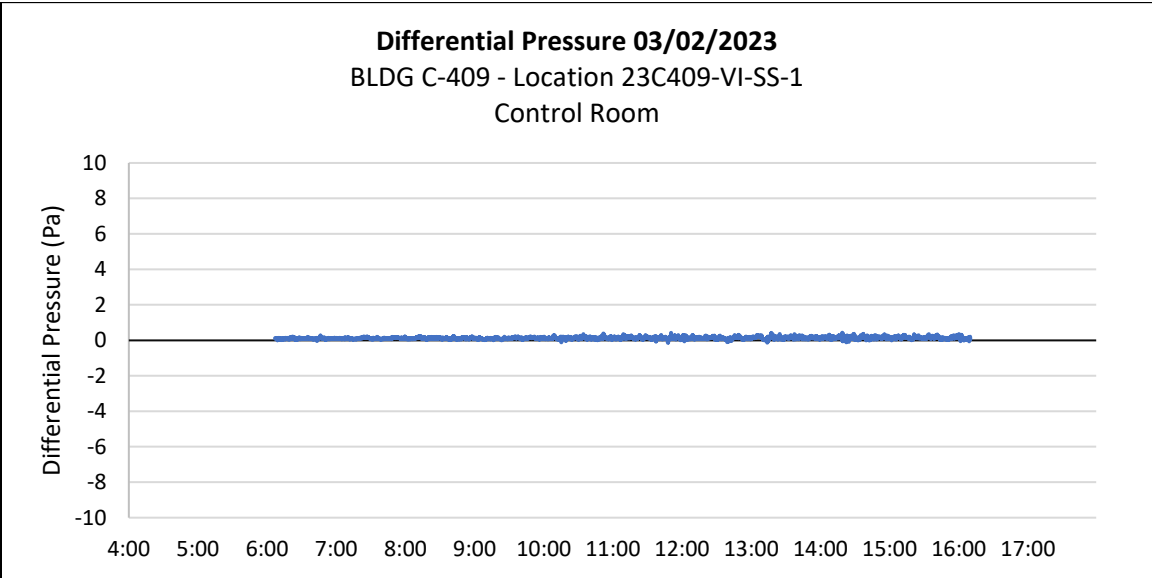
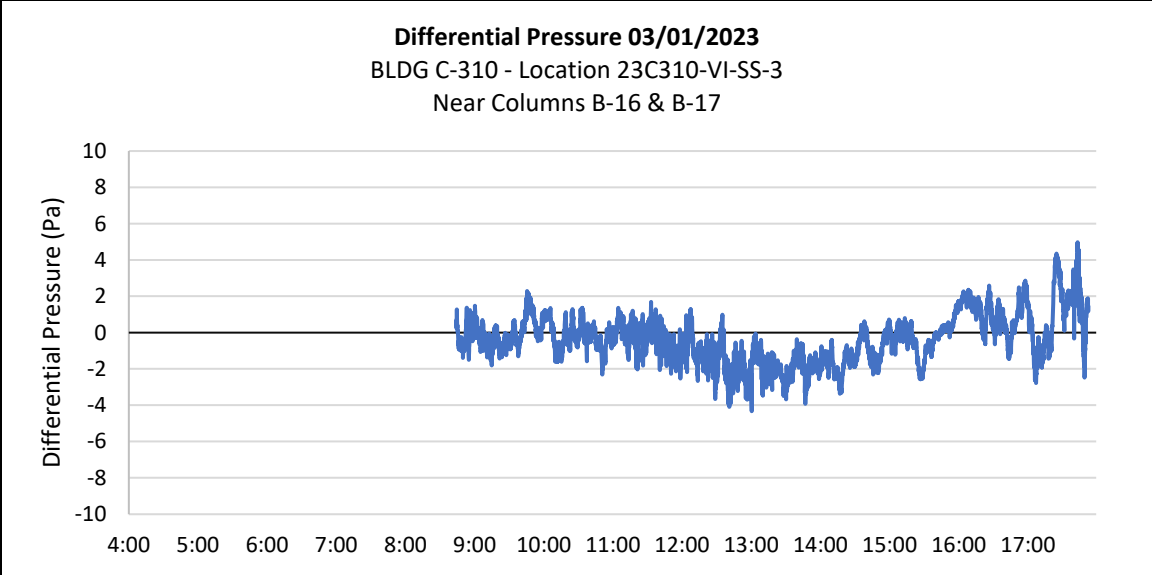


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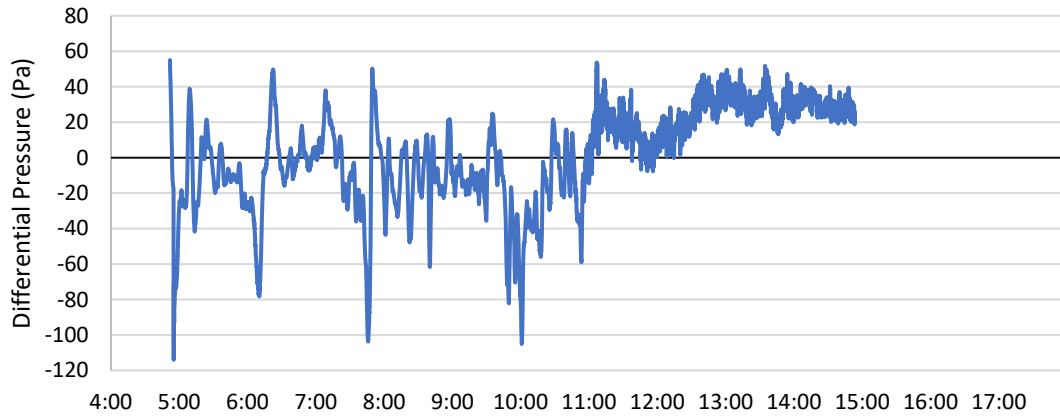
**APPENDIX E**  
**PRESSURE MONITORING DATA**

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**Differential Pressure 03/03/2023**  
BLDG C-720 - Location 23C720-VI-SS-4  
Old Machine Shop



**APPENDIX F**  
**WEATHER DATA**

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**Weather Data**

Date	Time	Temperature (°F)		Wind		Barometric Pressure (in Hg)
		High	Low	Speed (mph)	Direction	
2/28/2023	11:15:00 PM	69.2	68.9	0	---	29.484
2/28/2023	11:30:00 PM	68.9	68.7	0	---	29.487
2/28/2023	11:45:00 PM	68.8	68.7	0	---	29.493
2/28/2023	12:00:00 AM	68.8	68.7	0	---	29.494
2/28/2023	12:15:00 AM	68.8	68.7	0	---	29.505
2/28/2023	12:30:00 AM	68.7	68.6	0	---	29.509
2/28/2023	12:45:00 AM	68.6	68.4	0	---	29.512
2/28/2023	1:00:00 AM	68.4	68.2	0	---	29.519
2/28/2023	1:15:00 AM	68.3	68	0	---	29.523
2/28/2023	1:30:00 AM	68.1	67.9	0	---	29.528
2/28/2023	1:45:00 AM	68.1	67.9	0	---	29.534
2/28/2023	2:00:00 AM	68.1	68	0	---	29.538
2/28/2023	2:15:00 AM	68.1	68	0	---	29.542
2/28/2023	2:30:00 AM	68	67.9	0	---	29.546
2/28/2023	2:45:00 AM	68	67.7	0	---	29.555
2/28/2023	3:00:00 AM	67.8	67.5	0	---	29.56
2/28/2023	3:15:00 AM	67.6	67.5	0	---	29.571
2/28/2023	3:30:00 AM	67.7	67.5	0	---	29.578
2/28/2023	3:45:00 AM	67.7	67.6	0	---	29.586
2/28/2023	4:00:00 AM	67.7	67.6	0	---	29.591
2/28/2023	4:15:00 AM	67.6	67.4	0	---	29.593
2/28/2023	4:30:00 AM	67.5	67.3	0	---	29.588
2/28/2023	4:45:00 AM	67.4	67.2	0	---	29.585
2/28/2023	5:00:00 AM	67.4	67.2	0	---	29.591
2/28/2023	5:15:00 AM	67.5	67.3	0	---	29.59
2/28/2023	5:30:00 AM	67.6	67.4	0	---	29.597
2/28/2023	5:45:00 AM	67.7	67.6	0	---	29.603
2/28/2023	6:00:00 AM	67.8	67.7	0	---	29.607
2/28/2023	6:15:00 AM	67.9	67.8	0	---	29.608
2/28/2023	6:30:00 AM	68	67.8	0	---	29.607
2/28/2023	6:45:00 AM	68.1	67.9	0	---	29.608
2/28/2023	7:00:00 AM	68.1	68	0	SSW	29.604
2/28/2023	7:15:00 AM	68	67.8	0	ENE	29.607
2/28/2023	7:30:00 AM	68	58.6	3	SE	29.608
2/28/2023	7:45:00 AM	58.4	57.1	3	SSE	29.61
2/28/2023	8:00:00 AM	57.1	57	2	E	29.624
2/28/2023	8:15:00 AM	---	---	0	---	29.633
2/28/2023	8:30:00 AM	---	---	0	---	29.633
2/28/2023	8:45:00 AM	---	---	0	---	29.63
2/28/2023	9:00:00 AM	---	---	0	---	29.622
2/28/2023	9:15:00 AM	---	---	0	---	29.62
2/28/2023	9:30:00 AM	---	---	0	---	29.62
2/28/2023	9:45:00 AM	---	---	0	---	29.61
2/28/2023	10:00:00 AM	---	---	0	---	29.601
2/28/2023	10:15:00 AM	---	---	0	---	29.598

**Weather Data (Continued)**

Date	Time	Temperature (°F)		Wind		Barometric Pressure (in Hg)
		High	Low	Speed (mph)	Direction	
2/28/2023	10:30:00 AM	---	---	0	---	29.587
2/28/2023	10:45:00 AM	---	---	0	---	29.579
2/28/2023	11:00:00 AM	---	---	0	---	29.574
2/28/2023	11:15:00 AM	---	---	0	---	29.566
2/28/2023	11:30:00 AM	---	---	0	---	29.559
2/28/2023	11:45:00 AM	---	---	0	---	29.554
2/28/2023	12:00:00 PM	---	---	0	---	29.55
2/28/2023	12:15:00 PM	---	---	0	---	29.541
2/28/2023	12:30:00 PM	68.4	68.2	4	S	29.527
2/28/2023	12:45:00 PM	69.1	68.5	4	SE	29.517
2/28/2023	1:00:00 PM	69.5	69	4	S	29.502
2/28/2023	1:15:00 PM	70	69.2	7	SW	29.494
2/28/2023	1:30:00 PM	70.8	69.9	5	SW	29.489
2/28/2023	1:45:00 PM	70.9	70.6	7	SW	29.481
2/28/2023	2:00:00 PM	71.2	70.9	6	SW	29.471
2/28/2023	2:15:00 PM	71.1	70.6	6	SW	29.465
2/28/2023	2:30:00 PM	71	70.3	4	SW	29.464
2/28/2023	2:45:00 PM	70.6	70.2	6	SW	29.46
2/28/2023	3:00:00 PM	70.7	70.2	6	SW	29.458
2/28/2023	3:15:00 PM	70.4	69.6	4	SW	29.46
2/28/2023	3:30:00 PM	69.6	68.8	3	SW	29.459
2/28/2023	3:45:00 PM	68.8	67.2	2	SW	29.461
2/28/2023	4:00:00 PM	67.2	66.2	1	SW	29.468
2/28/2023	4:15:00 PM	66.2	65	0	SW	29.468
2/28/2023	4:30:00 PM	65	63.6	1	SW	29.469
2/28/2023	4:45:00 PM	63.6	62.1	0	SW	29.469
2/28/2023	5:00:00 PM	62.1	60.6	0	SW	29.466
2/28/2023	5:15:00 PM	60.6	59.4	1	SW	29.467
2/28/2023	5:30:00 PM	59.4	57.8	0	SW	29.465
2/28/2023	5:45:00 PM	57.8	57.5	2	SW	29.464
2/28/2023	6:00:00 PM	57.8	57.2	1	SW	29.464
2/28/2023	6:15:00 PM	57.5	57	0	SW	29.463
2/28/2023	6:30:00 PM	57	56.3	0	SW	29.465
2/28/2023	6:45:00 PM	56.3	55.3	0	WSW	29.465
2/28/2023	7:00:00 PM	55.3	55	0	WSW	29.462
2/28/2023	7:15:00 PM	57.9	55.3	1	WSW	29.462
2/28/2023	7:30:00 PM	60.4	57.9	2	SW	29.457
2/28/2023	7:45:00 PM	60.9	60.4	2	SW	29.458
2/28/2023	8:00:00 PM	60.9	60.4	2	WSW	29.459
2/28/2023	8:15:00 PM	61.1	60.5	2	WSW	29.456
2/28/2023	8:30:00 PM	60.6	60.3	2	SW	29.454
2/28/2023	8:45:00 PM	61.1	60.3	2	SW	29.454
2/28/2023	9:00:00 PM	62.3	61.1	4	WSW	29.455
2/28/2023	9:15:00 PM	62.3	61.7	3	WSW	29.456
2/28/2023	9:30:00 PM	62.3	61.8	4	WSW	29.457

**Weather Data (Continued)**

Date	Time	Temperature (°F)		Wind		Barometric Pressure (in Hg)
		High	Low	Speed (mph)	Direction	
2/28/2023	9:45:00 PM	62.2	62	4	WSW	29.46
2/28/2023	10:00:00 PM	62.1	61.8	4	WSW	29.465
2/28/2023	10:15:00 PM	62	61.7	4	WSW	29.467
2/28/2023	10:30:00 PM	62.4	61.9	5	WSW	29.467
2/28/2023	10:45:00 PM	62.1	61.6	4	WSW	29.47
3/1/2023	11:00:00 PM	61.9	61.6	5	W	29.475
3/1/2023	11:15:00 PM	61.8	61.3	5	WSW	29.474
3/1/2023	11:30:00 PM	61.5	60.8	4	W	29.471
3/1/2023	11:45:00 PM	61	60.7	5	WSW	29.469
3/1/2023	12:00:00 AM	61.2	60.9	5	W	29.47
3/1/2023	12:15:00 AM	61.4	61.2	6	W	29.467
3/1/2023	12:30:00 AM	61.2	60.3	4	W	29.47
3/1/2023	12:45:00 AM	60.4	60.1	3	W	29.476
3/1/2023	1:00:00 AM	60.1	59.3	1	W	29.479
3/1/2023	1:15:00 AM	59.3	58.7	1	W	29.48
3/1/2023	1:30:00 AM	58.7	57.1	0	W	29.477
3/1/2023	1:45:00 AM	57.1	54.9	0	W	29.476
3/1/2023	2:00:00 AM	54.8	52.5	0	W	29.476
3/1/2023	2:15:00 AM	52.5	51.5	0	W	29.471
3/1/2023	2:30:00 AM	51.5	50.6	0	W	29.474
3/1/2023	2:45:00 AM	50.6	49.5	0	W	29.482
3/1/2023	3:00:00 AM	49.5	48.8	0	W	29.487
3/1/2023	3:15:00 AM	50.1	48.7	1	W	29.488
3/1/2023	3:30:00 AM	53.2	50.1	2	W	29.495
3/1/2023	3:45:00 AM	54.3	53.2	2	WSW	29.487
3/1/2023	4:00:00 AM	54.3	53.7	1	WSW	29.496
3/1/2023	4:15:00 AM	54	53.6	2	WSW	29.494
3/1/2023	4:30:00 AM	54.1	53.1	1	WSW	29.492
3/1/2023	4:45:00 AM	54.3	53	2	WSW	29.493
3/1/2023	5:00:00 AM	56.1	54.3	2	WSW	29.497
3/1/2023	5:15:00 AM	58.3	56.1	4	WSW	29.502
3/1/2023	5:30:00 AM	59.8	58.3	4	WSW	29.503
3/1/2023	5:45:00 AM	61.3	59.8	4	WSW	29.504
3/1/2023	6:00:00 AM	62.9	61.3	5	WSW	29.497
3/1/2023	6:15:00 AM	64.3	62.9	5	WSW	29.502
3/1/2023	6:30:00 AM	66.3	64.3	5	WSW	29.502
3/1/2023	6:45:00 AM	67.5	66.3	6	W	29.501
3/1/2023	7:00:00 AM	69	67.5	6	WSW	29.501
3/1/2023	7:15:00 AM	70.3	69	7	W	29.493
3/1/2023	7:30:00 AM	70.9	70.3	7	W	29.493
3/1/2023	7:45:00 AM	71.5	70.8	7	W	29.494
3/1/2023	8:00:00 AM	71.7	71.4	7	W	29.501
3/1/2023	8:15:00 AM	74.3	71.7	6	W	29.493
3/1/2023	8:30:00 AM	75.3	74.3	6	W	29.493
3/1/2023	8:45:00 AM	75.5	74.9	5	W	29.496

**Weather Data (Continued)**

Date	Time	Temperature (°F)		Wind		Barometric Pressure (in Hg)
		High	Low	Speed (mph)	Direction	
3/1/2023	9:00:00 AM	75.6	74.7	5	W	29.491
3/1/2023	9:15:00 AM	75.7	75.3	6	W	29.493
3/1/2023	9:30:00 AM	76.1	75.3	8	W	29.495
3/1/2023	9:45:00 AM	76.1	75.5	8	W	29.495
3/1/2023	10:00:00 AM	75.9	75.5	7	W	29.486
3/1/2023	10:15:00 AM	76.3	75.7	6	W	29.485
3/1/2023	10:30:00 AM	75.7	75.4	6	W	29.478
3/1/2023	10:45:00 AM	77.6	75.8	5	W	29.469
3/1/2023	11:00:00 AM	77.3	76.4	6	W	29.461
3/1/2023	11:15:00 AM	76.7	76.3	8	W	29.462
3/1/2023	11:30:00 AM	76.9	76.5	6	W	29.455
3/1/2023	11:45:00 AM	77.3	76.9	5	W	29.454
3/1/2023	12:00:00 PM	77.2	76.6	5	W	29.447
3/1/2023	12:15:00 PM	78.6	77	4	W	29.443
3/1/2023	12:30:00 PM	78.2	76.7	4	W	29.441
3/1/2023	12:45:00 PM	76.8	75.6	3	W	29.443
3/1/2023	1:00:00 PM	75.5	74.6	3	W	29.447
3/1/2023	1:15:00 PM	74.6	74.1	4	W	29.452
3/1/2023	1:30:00 PM	74.1	74	3	W	29.44
3/1/2023	1:45:00 PM	74.2	73.8	3	W	29.446
3/1/2023	2:00:00 PM	73.9	73.4	3	W	29.458
3/1/2023	2:15:00 PM	73.5	73.1	3	W	29.469
3/1/2023	2:30:00 PM	73.1	72.5	5	W	29.474
3/1/2023	2:45:00 PM	72.5	72.1	4	W	29.466
3/1/2023	3:00:00 PM	72.1	71.7	3	W	29.482
3/1/2023	3:15:00 PM	71.7	71.1	4	W	29.466
3/1/2023	3:30:00 PM	71.2	70.8	4	W	29.489
3/1/2023	3:45:00 PM	70.8	67.7	6	N	29.501
3/1/2023	4:00:00 PM	67.5	62.7	5	N	29.517
3/1/2023	4:15:00 PM	62.7	62.4	5	N	29.502
3/1/2023	4:30:00 PM	62.8	62.5	2	NNW	29.512
3/1/2023	4:45:00 PM	62.6	62.4	1	NNW	29.497
3/1/2023	5:00:00 PM	62.5	62.4	1	NNW	29.498
3/1/2023	5:15:00 PM	62.4	62.1	2	NNW	29.53
3/1/2023	5:30:00 PM	62.5	62.2	4	W	29.508
3/1/2023	5:45:00 PM	62.5	62.2	2	W	29.514
3/1/2023	6:00:00 PM	62.3	62	1	W	29.51
3/1/2023	6:15:00 PM	62.1	61.7	1	NNE	29.535
3/1/2023	6:30:00 PM	61.7	61	2	NNW	29.546
3/1/2023	6:45:00 PM	61.2	60.9	2	ENE	29.523
3/1/2023	7:00:00 PM	61.2	60.9	1	SE	29.519
3/1/2023	7:15:00 PM	60.9	60.6	1	SE	29.506
3/1/2023	7:30:00 PM	60.6	60	3	NNE	29.51
3/1/2023	7:45:00 PM	60	59.7	1	NE	29.513
3/1/2023	8:00:00 PM	59.8	59.6	1	NE	29.513



**Weather Data (Continued)**

Date	Time	Temperature (°F)		Wind		Barometric Pressure (in Hg)
		High	Low	Speed (mph)	Direction	
3/1/2023	8:15:00 PM	59.6	59	0	NE	29.534
3/1/2023	8:30:00 PM	59	58.1	1	NE	29.543
3/1/2023	8:45:00 PM	58.2	57.9	1	E	29.538
3/1/2023	9:00:00 PM	59.5	58.1	2	ESE	29.523
3/1/2023	9:15:00 PM	59.6	59.5	2	ESE	29.522
3/1/2023	9:30:00 PM	59.5	59.3	2	E	29.513
3/1/2023	9:45:00 PM	59.6	59.5	2	E	29.523
3/1/2023	10:00:00 PM	59.7	59.5	3	NNE	29.541
3/1/2023	10:15:00 PM	59.7	59.6	3	NNE	29.549
3/1/2023	10:30:00 PM	59.6	59.3	2	NNE	29.555
3/1/2023	10:45:00 PM	59.3	59	2	NE	29.568
3/2/2023	11:00:00 PM	59.2	59.1	3	NE	29.566
3/2/2023	11:15:00 PM	59.1	58.5	3	NNE	29.569
3/2/2023	11:30:00 PM	58.6	58.3	3	NNE	29.571
3/2/2023	11:45:00 PM	58.4	57.9	3	NNE	29.576
3/2/2023	12:00:00 AM	58	57.7	3	ENE	29.58
3/2/2023	12:15:00 AM	57.7	57.2	2	NE	29.574
3/2/2023	12:30:00 AM	57.2	57	4	NNE	29.572
3/2/2023	12:45:00 AM	57	56.6	3	NNE	29.575
3/2/2023	1:00:00 AM	56.6	56.2	3	NNE	29.575
3/2/2023	1:15:00 AM	56.2	56	2	ENE	29.576
3/2/2023	1:30:00 AM	56.1	55.9	2	E	29.573
3/2/2023	1:45:00 AM	56	55.6	2	NNE	29.581
3/2/2023	2:00:00 AM	55.7	55.3	2	NNE	29.58
3/2/2023	2:15:00 AM	55.3	54.7	1	NNE	29.58
3/2/2023	2:30:00 AM	54.7	54.3	1	NNE	29.574
3/2/2023	2:45:00 AM	54.4	54.1	2	NNE	29.574
3/2/2023	3:00:00 AM	54.1	53.9	2	E	29.569
3/2/2023	3:15:00 AM	53.9	53.6	2	E	29.565
3/2/2023	3:30:00 AM	53.8	53.6	3	E	29.567
3/2/2023	3:45:00 AM	53.6	53.6	4	ESE	29.567
3/2/2023	4:00:00 AM	53.6	53.4	4	E	29.569
3/2/2023	4:15:00 AM	53.4	53.1	3	E	29.57
3/2/2023	4:30:00 AM	53.1	52.8	3	E	29.575
3/2/2023	4:45:00 AM	52.8	52.6	3	E	29.577
3/2/2023	5:00:00 AM	52.7	52.4	3	E	29.59
3/2/2023	5:15:00 AM	52.4	52.1	2	NE	29.6
3/2/2023	5:30:00 AM	52.1	51.8	3	NNE	29.604
3/2/2023	5:45:00 AM	51.9	51.7	2	NNE	29.615
3/2/2023	6:00:00 AM	51.7	51	4	NNE	29.621
3/2/2023	6:15:00 AM	51.1	50.5	4	NNE	29.622
3/2/2023	6:30:00 AM	50.5	50.2	3	E	29.622
3/2/2023	6:45:00 AM	50.3	50.2	4	E	29.624
3/2/2023	7:00:00 AM	50.6	50.3	3	E	29.633
3/2/2023	7:15:00 AM	50.8	50.5	4	E	29.629

**Weather Data (Continued)**

Date	Time	Temperature (°F)		Wind		Barometric Pressure (in Hg)
		High	Low	Speed (mph)	Direction	
3/2/2023	7:30:00 AM	51	50.7	3	E	29.624
3/2/2023	7:45:00 AM	51.4	50.9	4	E	29.625
3/2/2023	8:00:00 AM	51.7	51.4	4	E	29.624
3/2/2023	8:15:00 AM	51.8	51.3	5	ESE	29.624
3/2/2023	8:30:00 AM	53.8	51.2	6	ESE	29.619
3/2/2023	8:45:00 AM	55.1	53.8	7	ESE	29.62
3/2/2023	9:00:00 AM	55.8	55.1	6	SE	29.617
3/2/2023	9:15:00 AM	55.9	55.3	7	ESE	29.614
3/2/2023	9:30:00 AM	55.5	55.2	7	ESE	29.609
3/2/2023	9:45:00 AM	56	55.4	6	ESE	29.605
3/2/2023	10:00:00 AM	56.5	56	6	ESE	29.597
3/2/2023	10:15:00 AM	56.5	56.2	7	ESE	29.591
3/2/2023	10:30:00 AM	57	56.3	6	ESE	29.591
3/2/2023	10:45:00 AM	57.2	56.8	5	ESE	29.577
3/2/2023	11:00:00 AM	57.8	57.1	6	ESE	29.561
3/2/2023	1:15:00 PM	58.3	57.8	6	ESE	29.545
3/2/2023	1:30:00 PM	---	---	7	ESE	29.541
3/2/2023	1:45:00 PM	---	---	7	ESE	29.533
3/2/2023	2:00:00 PM	---	---	6	ESE	29.527
3/2/2023	2:15:00 PM	---	---	7	ESE	29.51
3/2/2023	2:30:00 PM	---	---	8	ESE	29.497
3/2/2023	2:45:00 PM	---	---	8	ESE	29.492
3/2/2023	3:00:00 PM	---	---	8	ESE	29.488
3/2/2023	3:15:00 PM	---	---	7	ESE	29.488
3/2/2023	3:30:00 PM	---	---	7	ESE	29.475
3/2/2023	3:45:00 PM	---	---	8	ESE	29.477
3/2/2023	4:00:00 PM	---	---	7	SE	29.476
3/2/2023	4:15:00 PM	---	---	6	ESE	29.489
3/2/2023	4:30:00 PM	---	---	5	ESE	29.528
3/2/2023	4:45:00 PM	---	---	2	N	29.542
3/2/2023	5:00:00 PM	---	---	7	ESE	29.505
3/2/2023	5:15:00 PM	---	---	3	NNE	29.535
3/2/2023	5:30:00 PM	---	---	4	E	29.517
3/2/2023	5:45:00 PM	---	---	9	ESE	29.469
3/2/2023	6:00:00 PM	---	---	7	SE	29.466
3/2/2023	6:15:00 PM	---	---	7	ESE	29.47
3/2/2023	6:30:00 PM	---	---	4	SE	29.459
3/2/2023	6:45:00 PM	---	---	4	ESE	29.471
3/2/2023	7:00:00 PM	---	---	3	ESE	29.486
3/2/2023	7:15:00 PM	---	---	3	NE	29.485
3/2/2023	7:30:00 PM	---	---	3	ESE	29.479
3/2/2023	7:45:00 PM	---	---	5	ESE	29.465
3/2/2023	8:00:00 PM	---	---	6	ESE	29.456
3/2/2023	8:15:00 PM	---	---	5	SE	29.448
3/2/2023	8:30:00 PM	---	---	5	ESE	29.451

**Weather Data (Continued)**

Date	Time	Temperature (°F)		Wind		Barometric Pressure (in Hg)
		High	Low	Speed (mph)	Direction	
3/2/2023	8:45:00 PM	---	---	6	ESE	29.446
3/2/2023	9:00:00 PM	---	---	7	ESE	29.444
3/2/2023	9:15:00 PM	---	---	7	SE	29.431
3/2/2023	9:30:00 PM	---	---	8	SE	29.415
3/2/2023	9:45:00 PM	---	---	8	ESE	29.407
3/2/2023	10:00:00 PM	---	---	8	ESE	29.395
3/2/2023	10:15:00 PM	---	---	7	ESE	29.409
3/2/2023	10:30:00 PM	---	---	8	ESE	29.411
3/2/2023	10:45:00 PM	---	---	7	ESE	29.408
3/3/2023	11:00:00 PM	---	---	4	ESE	29.4
3/3/2023	11:15:00 PM	---	---	6	ESE	29.389
3/3/2023	11:30:00 PM	---	---	6	ESE	29.39
3/3/2023	11:45:00 PM	---	---	6	ESE	29.375
3/3/2023	12:00:00 AM	---	---	6	ESE	29.373
3/3/2023	12:15:00 AM	---	---	5	ESE	29.362
3/3/2023	12:30:00 AM	---	---	5	ESE	29.345
3/3/2023	12:45:00 AM	---	---	6	SE	29.337
3/3/2023	1:00:00 AM	---	---	8	ESE	29.313
3/3/2023	1:15:00 AM	---	---	8	SE	29.289
3/3/2023	1:30:00 AM	---	---	9	ESE	29.268
3/3/2023	1:45:00 AM	---	---	8	ESE	29.251
3/3/2023	2:00:00 AM	---	---	8	SE	29.235
3/3/2023	2:15:00 AM	---	---	7	SE	29.218
3/3/2023	2:30:00 AM	---	---	8	SSE	29.201
3/3/2023	2:45:00 AM	---	---	8	SSE	29.19
3/3/2023	3:00:00 AM	---	---	8	SE	29.15
3/3/2023	3:15:00 AM	---	---	10	SE	29.118
3/3/2023	3:30:00 AM	---	---	8	SSE	29.126
3/3/2023	3:45:00 AM	---	---	6	SE	29.123
3/3/2023	4:00:00 AM	---	---	7	ESE	29.097
3/3/2023	4:15:00 AM	---	---	9	SE	29.077
3/3/2023	4:30:00 AM	---	---	6	ESE	29.095
3/3/2023	4:45:00 AM	---	---	5	E	29.076
3/3/2023	5:00:00 AM	---	---	4	E	29.072
3/3/2023	5:15:00 AM	---	---	5	E	29.064
3/3/2023	5:30:00 AM	---	---	4	E	29.07
3/3/2023	5:45:00 AM	---	---	4	NNE	29.046
3/3/2023	6:00:00 AM	---	---	6	ESE	29.016
3/3/2023	6:15:00 AM	---	---	12	ESE	28.954
3/3/2023	6:30:00 AM	---	---	5	SSE	28.976
3/3/2023	6:45:00 AM	---	---	5	SE	28.96
3/3/2023	7:00:00 AM	---	---	7	SSE	28.95
3/3/2023	7:15:00 AM	---	---	7	SSE	28.972
3/3/2023	7:30:00 AM	---	---	3	S	28.963
3/3/2023	7:45:00 AM	---	---	4	SSE	28.913

**Weather Data (Continued)**

Date	Time	Temperature (°F)		Wind		Barometric Pressure (in Hg)
		High	Low	Speed (mph)	Direction	
3/3/2023	8:00:00 AM	---	---	7	SE	28.909
3/3/2023	8:15:00 AM	---	---	4	SE	28.884
3/3/2023	8:30:00 AM	---	---	4	S	28.859
3/3/2023	8:45:00 AM	---	---	6	S	28.832
3/3/2023	9:00:00 AM	---	---	5	S	28.826
3/3/2023	9:15:00 AM	---	---	6	S	28.799
3/3/2023	9:30:00 AM	---	---	5	S	28.78
3/3/2023	9:45:00 AM	---	---	4	SSW	28.793
3/3/2023	10:00:00 AM	---	---	6	S	28.714
3/3/2023	10:15:00 AM	---	---	9	S	28.663
3/3/2023	10:30:00 AM	---	---	10	SSW	28.658
3/3/2023	10:45:00 AM	---	---	9	SW	28.649
3/3/2023	11:00:00 AM	---	---	7	SW	28.633
3/3/2023	11:15:00 AM	---	---	14	WSW	28.668
3/3/2023	11:30:00 AM	---	---	11	W	28.7
3/3/2023	11:45:00 AM	---	---	12	W	28.717
3/3/2023	12:00:00 PM	---	---	11	W	28.72
3/3/2023	12:15:00 PM	---	---	13	W	28.738
3/3/2023	12:30:00 PM	---	---	12	W	28.751
3/3/2023	12:45:00 PM	---	---	8	W	28.787
3/3/2023	1:00:00 PM	---	---	8	W	28.827
3/3/2023	1:15:00 PM	---	---	8	NNW	28.868
3/3/2023	1:30:00 PM	---	---	8	N	28.895
3/3/2023	1:45:00 PM	---	---	10	N	28.933
3/3/2023	2:00:00 PM	---	---	10	N	28.966
3/3/2023	2:15:00 PM	---	---	10	N	29
3/3/2023	2:30:00 PM	---	---	9	N	29.04
3/3/2023	2:45:00 PM	---	---	8	NNW	29.073
3/3/2023	3:00:00 PM	---	---	9	NNW	29.097
3/3/2023	3:15:00 PM	---	---	9	N	29.135
3/3/2023	3:30:00 PM	---	---	9	N	29.173
3/3/2023	3:45:00 PM	---	---	9	N	29.192
3/3/2023	4:00:00 PM	---	---	10	N	29.203

**APPENDIX G**

**REVIEW OF OCCUPATIONAL THRESHOLDS FOR PRELIMINARY  
INVESTIGATION ANALYTES**

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Table G.1. Review of Occupational Thresholds for Preliminary Investigation Analytes

Preliminary Investigation (PI) Analyte	Building with Highest Detected Crawlspace or Indoor Air Concentration	Sample Location with Highest Detected Crawlspace or Indoor Air Concentration	Highest Detected Concentration in Crawlspace or Indoor Air Samples ( $\mu\text{g}/\text{m}^3$ )	Highest Detected Concentration in Crawlspace or Indoor Air Samples ( $\text{mg}/\text{m}^3$ )	Highest Detected Concentration in Crawlspace or Indoor Air Samples (ppm) <sup>d</sup>	ACGIH TLV/TWA (ppm) <sup>e,h</sup>	NIOSH REL/TWA (ppm) <sup>fi</sup>	OSHA PEL/TWA (ppm) <sup>g,h</sup>
Chloroform	C-310	23C310VI-IA-3	2.2	0.0022	0.0005	10	No REL-TWA; only has short term exposure limit (STEL)	No PEL-TWA; only has ceiling peak PEL
Dichloroethene, 1,2- <i>cis</i> - ( <i>cis</i> -1,2-DCE)	NA <sup>b</sup>	NA <sup>b</sup>	1 U	0.001	0.0003	200	200	200
Dichloroethene, 1,2- <i>trans</i> - ( <i>trans</i> -1,2-DCE)	NA <sup>b</sup>	NA <sup>b</sup>	1 U	0.001	0.0003			
Trichloroethane, 1,1,1- (1,1,1-TCA) <sup>a</sup>	C-409	23C409VI-IA-1	1.1 J	0.0011	0.0002	350	No REL	350
Trichloroethene (TCE)	C-310	23C310VI-IA-3	4.4	0.0044	0.0008	10	25 <sup>j</sup>	100
Vinyl Chloride (VC)	NA <sup>c</sup>	NA <sup>c</sup>	0.66 U	0.00066	0.0003	1	No REL; recommends exposure limited to lowest feasible concentration <sup>h</sup>	1

<sup>a</sup> 1,1,1-TCA was included to be considered only when there is documented use within a facility. It was not considered in ranking PI facilities; however, it was sampled in each building identified for PI sampling.

<sup>b</sup> *cis*-1,2-DCE and *trans*-1,2-DCE were not detected in any sample across all buildings. The reporting limit for indoor air samples was 1  $\mu\text{g}/\text{m}^3$  or less for all samples.

<sup>c</sup> Vinyl chloride was not detected in any sample across all buildings. The reporting limit for indoor air samples was 0.66  $\mu\text{g}/\text{m}^3$  or less for all samples.

<sup>d</sup> Calculated using the National Institute for Occupational Safety and Health (NIOSH) conversion calculator for  $\text{mg}/\text{m}^3$  to ppm, which uses a conversion equation based on 25°C and 1 atmosphere (<http://niosh.dnaci.hhs.gov/nioshdbs/calc.htm>).

<sup>e</sup> American Conference of Government Industrial Hygienists (ACGIH) standard from *ACGIH: Documentation of the Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs)*; exposure limit type = TLV/TWA (threshold limit value/time-weighted average): time-weighted average concentration for a normal 8-hour workday or 40-hour week to which nearly all workers may be repeatedly exposed.

<sup>f</sup> NIOSH Recommended Exposure Limit-Time Weighted Average (REL-TWA) for up to a 10-hour work day.

<sup>g</sup> Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit-Time Weighted Average (PEL-TWA) for an 8-hour work day.

<sup>h</sup> Source: OSHA Occupational Chemical Database.

<sup>i</sup> Source: NIOSH Pocket Guide to Chemical Hazards (<https://www.cdc.gov/niosh/npg/default.html>).

<sup>j</sup> Recommendation listed in NIOSH Pocket Guide to Chemical Hazards Appendix C, not on main TCE page.

"J" Compound detected below method quantitation limit; estimated value provided.

"U" Less than laboratory reporting limit.

**From:** [Tinsley, Darren](#)  
**To:** [Fountain, Stefanie](#); [Moscon, Duke](#)  
**Cc:** [Adair, Barrett](#); [Ford, Bruce](#)  
**Subject:** RE: 2023 Vapor Intrusion Sampling Results  
**Date:** Tuesday, September 5, 2023 6:55:29 AM  
**Attachments:** [image006.png](#)  
[image001.png](#)  
[image005.png](#)

---

Good Morning Stefanie –

In review of the data provided in Table G.1 below, I concur that the indoor air concentrations from 2023 VI sampling are below relevant worker exposure limits. No additional information needed at this time.

Thank you,

**Darren E. Tinsley**  
**Safety & Health Manager**  
**Four Rivers Nuclear Partnership, LLC**  
270.441.5220 (o)  
270.816.4130 (c)



---

**From:** Fountain, Stefanie <Stefanie.Fountain@pad.pppo.gov>  
**Sent:** Thursday, August 31, 2023 3:22 PM  
**To:** Tinsley, Darren <Darren.Tinsley@pad.pppo.gov>; Moscon, Duke <Duke.Moscon@pad.pppo.gov>  
**Cc:** Adair, Barrett <Barrett.Adair@pad.pppo.gov>; Ford, Bruce <Bruce.Ford@pad.pppo.gov>  
**Subject:** RE: 2023 Vapor Intrusion Sampling Results

Good afternoon –

For completeness of record, I am including the summary table of results and relevant worker exposure limits here (as opposed to an attachment). Shown below is Table G.1 from the Addendum to the *Plant Industrial Area Vapor Intrusion Preliminary Risk Assessment Report*, Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE/LX/07-2471&D2/A1). As in our April correspondence, do you concur that the indoor air concentrations from the 2023 VI sampling are below the relevant worker exposure limits? Is there anything else that you would consider or evaluate on this topic?

Thank you



Table G.1. Review of Occupational Thresholds for Preliminary Investigation Analytes

Preliminary Investigation (PI) Analyte	Building with Highest Detected Crawspace or Indoor Air Concentration	Sample Location with Highest Detected Crawspace or Indoor Air Concentration	Highest Detected Concentration in Crawspace or Indoor Air Samples (µg/m <sup>3</sup> )	Highest Detected Concentration in Crawspace or Indoor Air Samples (mg/m <sup>3</sup> )	Highest Detected Concentration in Crawspace or Indoor Air Samples (ppm) <sup>d</sup>	ACGIH TLV/TWA (ppm) <sup>b</sup>	NIOSH REL/TWA (ppm) <sup>d</sup>	OSHA PEL/TWA (ppm) <sup>e</sup>
Chloroform	C-310	23C310V3-IA-3	2.2	0.0022	0.0005	10	No REL-TWA; only has short term exposure limit (STEL)	No PEL-TWA; only has ceiling peak PEL
Dichloroethane, 1,2-cis- (cis-1,2-DCE)	NA <sup>g</sup>	NA <sup>g</sup>	1 U	0.001	0.0003	200	200	200
Dichloroethane, 1,2-trans- (trans-1,2-DCE)	NA <sup>g</sup>	NA <sup>g</sup>	1 U	0.001	0.0003			
Trichloroethane, 1,1,1- (1,1,1-TCA) <sup>f</sup>	C-409	23C409V1-IA-1	1.1 J	0.0011	0.0002	350	No REL	350
Trichloroethene (TCE)	C-310	23C310V3-IA-3	4.4	0.0044	0.0008	10	2 <sup>h</sup>	100
Vinyl Chloride (VC)	NA <sup>g</sup>	NA <sup>g</sup>	0.66 U	0.00066	0.0003	1	No REL; recommends exposure limited to lowest feasible concentration <sup>h</sup>	1

<sup>1</sup> 1,1,1-TCA was analyzed but not detected in any sample within a facility. It was not considered in ranking TLV/TWA, however, it was sampled in each building checked for PI sampling.  
<sup>2</sup> cis-1,2-DCE and trans-1,2-DCE were not detected in any sample across all buildings. The reporting limit for indoor air samples was 1 µg/m<sup>3</sup> or less for all samples.  
<sup>3</sup> Vinyl chloride was not detected in any sample across all buildings. The reporting limit for indoor air samples was 0.66 µg/m<sup>3</sup> or less for all samples.  
<sup>4</sup> Calculated using the National Institute for Occupational Safety and Health (NIOSH) conversion calculator for µg/m<sup>3</sup> to ppm, which uses a conversion equation based on 25°C and 1 atmosphere (http://www.niosh.gov/health/hazardstools.html).  
<sup>5</sup> American Conference of Governmental Industrial Hygienists (ACGIH) standard from ACGIH: Documentation of the Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs), separate limit type = TLV/TWA (chemical limit value time-weighted average) time-weighted average concentration for a normal 8-hour workday or 40-hour week to which nearly all workers may be repeatedly exposed.  
<sup>6</sup> NIOSH Recommended Exposure Limit Time Weighted Average (REL-TWA) for up to a 10-hour work day.  
<sup>7</sup> Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit Time Weighted Average (PEL-TWA) for an 8-hour work day.  
<sup>8</sup> Source: OSHA Occupational Chemical Database.  
<sup>9</sup> Source: NIOSH Pocket Guide to Chemical Hazards (http://www.niosh.gov/pocketguide/).  
<sup>10</sup> Recommendations listed in NIOSH Pocket Guide to Chemical Hazards Appendix C, not on main TCE page.  
<sup>11</sup> \*F\* Compound detected below method quantitation limit, estimated value provided.  
<sup>12</sup> \*U\* Less than laboratory reporting limit.

**Stefanie A. Fountain**  
 Mobile: (865) 361-1699

**From:** Tinsley, Darren <Darren.Tinsley@pad.pppo.gov>  
**Sent:** Monday, May 8, 2023 1:42 PM  
**To:** Fountain, Stefanie <Stefanie.Fountain@pad.pppo.gov>; Moscon, Duke <Duke.Moscon@pad.pppo.gov>  
**Cc:** Adair, Barrett <Barrett.Adair@pad.pppo.gov>; Ford, Bruce <Bruce.Ford@pad.pppo.gov>  
**Subject:** RE: 2023 Vapor Intrusion Sampling Results

Stefanie -

In review of the data provided on the attached, I concur that the indoor air concentrations from 2023 VI sampling are below relevant worker exposure limits. No additional information needed at this time.

Thank you,

**Darren E. Tinsley**  
**Safety & Health Manager**  
**Four Rivers Nuclear Partnership, LLC**  
 270.441.5220 (o)  
 270.816.4130 (c)



**From:** Fountain, Stefanie <Stefanie.Fountain@pad.pppo.gov>  
**Sent:** Wednesday, April 26, 2023 8:41 AM  
**To:** Moscon, Duke <Duke.Moscon@pad.pppo.gov>  
**Cc:** Tinsley, Darren <Darren.Tinsley@pad.pppo.gov>; Adair, Barrett <Barrett.Adair@pad.pppo.gov>; Ford, Bruce <Bruce.Ford@pad.pppo.gov>  
**Subject:** 2023 Vapor Intrusion Sampling Results

Good morning –

Please see attached the results for the vapor intrusion sampling performed in March 2023. These samples were recommended for collection by the *Plant Sitewide Vapor Intrusion Preliminary Risk Assessment Report, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2471&D2 (DOE 2022).

Back in 2021, in response to the original sampling event, we received an email from EPA asking “whether DOE is considering referring the chloroform results to the Paducah Site’s Safety Systems Oversight Office (or other appropriate office) to ensure that there are no current industrial worker health/safety exposure concerns.” Communication relevant to this email was included in the DOE 2022 report in Appendix H (attached here for reference).

I have summarized the indoor air information for the 2023 sampling event and exposure limits in the attached table. Do you concur that the indoor air concentrations from the 2023 VI sampling are below the relevant worker exposure limits? Is there anything else that you would consider or evaluate on this topic?

Thank you,  
Stefanie

**Stefanie A. Fountain, Ph.D., P.E.\*, PMP**

**\*Licensed in GA, ID, IL, KY, NC, NV, OH, SC, TN, and WV**

**Environmental Services | Subject Matter Expert**

**Four Rivers Nuclear Partnership, LLC | Geosyntec Consultants, Inc.**

Office: **(865) 291-4689**

Mobile: **(865) 361-1699**

**FRNP was awarded the first-ever U.S. Department of Energy Safety Culture Improvement Award**