DRAFT
TECHNICAL MEMORANDUM FOR
VAPOR INTRUSION SAMPLING
RAVENSWOOD PCE SUPERFUND SITE
RAVENSWOOD, WEST VIRGINIA

TO: Anthony Iacobone, EPA Work Assignment Manager
FROM: [redacted], HGL Project Manager
DATE: June 2017
SUBJECT: Vapor Intrusion Sampling, February and April 2017
CONTRACT: EP-S3-07-05
WA: 035RICOC368

1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) Region 3 tasked HydroGeoLogic, Inc. (HGL) to conduct a vapor intrusion (VI) investigation at the Ravenswood PCE Superfund site (Site) in Ravenswood, West Virginia. The February 2017 VI sampling event included collection of subslab, indoor, outdoor, and basement air samples; and completion of building surveys. The April 2017 sampling event, conducted in combination with the groundwater sampling event, included only subslab vapor samples, which were collected to evaluate the effectiveness of the soil vapor extraction system on reducing subslab vapor concentrations. This work is being executed by HGL under the referenced EPA Region 3 Remedial Action Contract (RAC).

FIELD ACTIVITIES

Field activities were completed on February 20 and 21, and April 12 and 13, 2017. All samples were collected in accordance with the Sampling and Analysis Plan (SAP) prepared by HGL, dated March 2011, unless otherwise described in this technical memo. As described in the SAP, air samples were collected over an approximate 24-hour period into 6-liter summa canisters using flow regulators provided by the EPA Region 3 Laboratory. The samples were sent to the EPA Region 3 Laboratory for analysis of volatile organic compounds (VOCs) using EPA method TO-15.

A summary of the buildings sampled and samples collected is shown in **Table 1** included below**.**

February 2017 Sampling Event

VI sampling was conducted February 20 and 21, 2017. As detailed in the SAP, a 24-hour grab air sample was collected from each location into a 6-liter summa canister. HGL collected 10 indoor air samples, three outdoor air samples, one duplicate, and three subslab vapor samples from within and outside of the following properties:

- a former beauty salon business at [redacted PII];

- an operating pottery business at [redacted];
- an operating beauty salon at [redacted];
- an operating office at [redacted]; and
- an unoccupied building at [redacted].

Air samples were collected from the indoor main floor, basement, and outdoors approximately 10 feet from the structures. One outdoor air sample was collected to represent background at [redacted] and [redacted]. One outdoor air sample was collected to represent background at [redacted] and [redacted]. Subslab vapor ports were installed previously at [redacted] (2 ports), and one subslab vapor port was installed at [redacted] (1 port). Soil vapor samples were collected from each port. One duplicate pair was collected from a basement sample at [redacted].

April 2017 Sampling Event

Subslab vapor sampling was conducted April 12 and 13, 2017. As detailed in the SAP, a 24-hour grab air sample was collected from each location into a 6-liter summa canister. HGL collected subslab vapor samples from following properties:

- operating pottery business at [redacted] (two subslab samples and a duplicate); and
- unoccupied building at [redacted] (one subslab sample).

3.0 SUMMARY OF ANALYTICAL RESULTS

Analytical results of the February 2017 air samples are summarized in Table 2. The sample results for tetrachloroethene (PCE), the primary contaminant of interest at the Site, are illustrated on the attached Figure 1. Results were compared to the June 2017 residential Screening Level (RSL) for air.

The following contaminants were identified at concentrations above the residential indoor air screening value in samples collected in February 2017 (see Table 2):

- 1,4-dioxane;
- Acetone;
- Benzene;
- Chloroform;
- Ethylbenzene;
- Isopropyl alcohol; and
- PCE.

PCE was identified in two of the subslab vapor samples at concentrations that exceed the residential RSL. At [redacted], the concentration of PCE in the subslab samples was 18 micrograms per cubic meter ($\mu g/m^3$). At [redacted] the concentrations of PCE in one subslab sample was 6.5 $\mu g/m^3$. PCE was also detected in the indoor and/or outdoor air samples at these locations. One basement sample at [redacted] had a PCE concentration of 4.7 $\mu g/m^3$, which exceeded the residential RSL.

No other detections of PCE exceeded the RSL. No other site contaminants of daughter products of PCE were detected in the air samples.

Analytical results of the February 2017 air samples are summarized in Table 2. The sample results are presented on Figure 1.

In April 2017, PCE was detected in all the subslab samples. The only detection above the residential RSL for PCE as detected at [redacted] at a concentration of 124 μg/m^3. TCE was detected at this location at a concentration of 1.4 μg/m^3, which exceeds the RSL of 0.21 μg/m^3.

4.0 SUMMARY OF FINDINGS

The detections of PCE in subslab soil vapor samples and indoor air samples suggest that vapor intrusion may be occurring at these locations. The expanded soil vapor extraction (SVE) system began operating at the Site in February 2016. Subslab and indoor air concentrations of PCE that were detected during the February and March 2017 sampling events have declined in comparison in with sampling results from 2016 and data collected prior to start-up of the SVE system. This suggests the SVE system may be mitigating VI concerns. However concentrations of PCE and other contaminants still were above RSLs during the latest sampling events. HGL therefore recommends that additional sampling be conducted at the Site to confirm the remedial system's effect on subslab vapor concentrations.

ATTACHMENTS

Table 1	Sample Locations
Table 2	February 2017 Summary of Analytical Results
Table 3	April 2017 Summary of Analytical Results
Figure 1	February and April 2017 Vapor Intrusion Sample Results

Table 1
Ravenswood PCE Site, VI Sample Locations

Sample Location	Sample Collection Point	February 2017	April 2017
PII			
PII SS03	Subslab	X	X
PII-MAIN-IA08	Main Floor – Indoor Air	X	
PII-MAIN-IA09	Main Floor – Indoor Air	X	
PII			
PII-OA03	Outdoor Air	X	
PII-MAIN-IA07	Main Floor – Indoor Air	X	
PII MAIN-IA06	Main Floor – Indoor Air	X	
PII			
PII-OA01	Outdoor Air	X	
PII-MAIN-IA01	Main Floor – Indoor Air	X	
PII			
PII-OA02	Outdoor Air	X	
PII-SS01	Subslab	X	X
PII-SS02	Subslab	X	X
PII BSMNT-IA02	Basement – Indoor Air	X	
PII BSMNT-IA03	Basement – Indoor Air (Duplicate)	X	
PII-MAIN-IA04	Main Floor – Indoor Air	X	
PII-MAIN-IA05	Main Floor – Indoor Air	X	
PII			
PII MAIN-IA10	Main Floor – Indoor Air	X	
PII-BSMNT-IA11	Basement – Indoor Air	X	

Table 2

Ravenswood PCE Vapor Sampling Analytical Results - February 2017

Sample Location:		[redacted]											
Sample ID:	Residential	[redacted] SS03		[redacted] -MAIN-IA09		[redacted] MAIN-IA08		[redacted] OA03		[redacted] -MAIN-IA07		[redacted] MAIN-IA06	
Field QC:													
Units :		µg/m^3		µg/m^3		µg/m^3		µg/m^3		µg/m^3		µg/m^3	
Date Sampled :		2/21/2017		2/21/2017		2/21/2017		2/21/2017		2/21/2017		2/21/2017	
Volatile Compound	RSL	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag
1,2,4-trimethylbenzene	0.73	4.8											
1,2-dichlorobenzene	21												
1,2-dichloroethane	0.11	1.1	J										
1,3,5-Trimethylbenzene	NA												
1,4-dioxane	0.56												
2-Butanone (MEK)	520	8.8		1.7		2.1		0.9	J	1.2	J	1.3	J
2-Hexanone	3.1												
4-Methyl-2-pentanone (MIBK)	310	1.0	J										
Acetone	3200	466		495		500		9.5		15.3		15.2	
Benzene	0.36	3.9		1.8		2.5		0.8	J	1.0	J	1.0	J
Chloroform	0.12												
Chloromethane	9.4	1.2		1.5		1.4		1.2		1.3		1.3	
Cyclohexane	630	8.0	K	1.2	J	2.3	K			1.7	K	1.8	K
Dichlorodifluoromethane (Freon 12)	10	2.1	J	2.1	J	2.5		2.3		2.1	J	2.2	J
Ethanol	NA	298		217		207		4.1		8.3		8.5	
Ethyl Acetate	7.3	2.9		2.2		2.5							
Ethylbenzene	1.1	2.3											
Heptane	NA	7.2				0.9	J			1.4	J	1.5	J
Hexane	73	15.8		1.1	J	1.4	J			0.9	J	1.0	J
Isopropyl alcohol	21	307		265		263							
Methylene Chloride	63	3.1								0.9	J	1.0	J
Tetrachloroethene	4.2	18.0		2.3	J							4.1	
Tetrahydrofuran	210	3.0		0.6	J	0.7	J						
Toluene	520	13.6				3.1		0.9	J	1.3	J	1.5	J
Triclhorofluoromethane (Freon 11)	NA	3.9		4.8		4.7		1.3	J	4.5		4.4	
m,p-xylene	10	9.3				2.0	J						
o-xylene	10	3.8											

µg/m^3 - micrograms per meter cubed

SS - subslab

IA - indoor air

OA - outdoor air

MAIN - main floor

Highlighted values exceed the RSL.

Table 2

Ravenswood PCE Vapor Sampling Analytical Results - February 2017

Sample Location:		[redacted]						[redacted]					
Sample ID:	Residential	[redacted]-OA01		[redacted] MAIN-IA01		[redacted]-OA02		[redacted]-SS01		[redacted] SS02		[redacted]-BSMNT-IA03	
Field QC:													
Units :		µg/m^3		µg/m^3		µg/m^3		µg/m^3		µg/m^3		µg/m^3	
Date Sampled :		2/21/2017		2/21/2017		2/21/2017		2/21/2017		2/21/2017		2/21/2017	
Volatile Compound	RSL	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag
1,2,4-trimethylbenzene	0.73			1	J			1.2	J	1.6	J		
1,2-dichlorobenzene	21												
1,2-dichloroethane	0.11												
1,3,5-Trimethylbenzene	NA							1.2	J				
1,4-dioxane	0.56												
2-Butanone (MEK)	520	0.9	J	16.6		0.9	J	7.4		6.4		4.8	
2-Hexanone	3.1												
4-Methyl-2-pentanone (MIBK)	310												
Acetone	3200	14		26800		15.5		82.3		76.2		17.7	
Benzene	0.36	0.9	J	1.9		1.0	J	1.0	J	1.0	J	1.0	J
Chloroform	0.12			5.7									
Chloromethane	9.4	1.4				1.3		0.9	J	1.1		1.1	
Cyclohexane	630							3.1	K	3.1	K	0.8	J
Dichlorodifluoromethane (Freon 12)	10	2.3		2.1	J	2.4		2.1	J	2.2	J	2.3	
Ethanol	NA	11.1		11900		8.4		72.0		68.9		6.2	
Ethyl Acetate	7.3			135									
Ethylbenzene	1.1			0.9	J								
Heptane	NA												
Hexane	73			1.1	J			0.8	J	0.9	J	0.8	J
Isopropyl alcohol	21					20.7		47.4		44.0		6.2	
Methylene Chloride	63			4.0				2.6		1.7		2.8	
Tetrachloroethene	4.2	2.2	J					2.1	J	6.5		4.7	
Tetrahydrofuran	210			0.8	J			2.4		2.4			
Toluene	520	1.0	J	2.6		1.2	J	6.8		5.6		4.9	
Triclhorofluoromethane (Freon 11)	NA	1.3	J	4.2		1.4	J	1.4	J	1.5	J	1.4	J
m,p-xylene	10			2.5	J								
o-xylene	10												

µg/m^3 - micrograms per meter cubed

SS - subslab

IA - indoor air

OA - outdoor air

MAIN - main floor

Highlighted values exceed the RSL.

Table 2

Ravenswood PCE Vapor Sampling Analytical Results - February 2017

Sample Location:		[redacted]								[redacted]		
Sample ID:	Residential	[redacted]-BSMNT-IA02		[redacted]-BSMNT-IA02-2		[redacted]-MAIN-IA04		[redacted] MAIN-IA05		[redacted] MAIN-IA10		[redacted]-BSMN
Field QC:		Duplicate		Duplicate								
Units :		µg/m^3		µg/m^3		µg/m^3		µg/m^3		µg/m^3		µg/m
Date Sampled :		2/21/2017		2/21/2017		2/21/2017		2/21/2017		2/21/2017		2/21/20
Volatile Compound	RSL	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result
1,2,4-trimethylbenzene	0.73			1.2	J							
1,2-dichlorobenzene	21					1.7	J					
1,2-dichloroethane	0.11											
1,3,5-Trimethylbenzene	NA											
1,4-dioxane	0.56					1.3	J	2.2				
2-Butanone (MEK)	520	3.1		3.1		2.8		3.0		2.0		1.2
2-Hexanone	3.1							1.6	J			
4-Methyl-2-pentanone (MIBK)	310							0.9	J	27.9		
Acetone	3200	15.5		15.8		50.5		56.7		0.7	J	5.5
Benzene	0.36	1.0	J	1.0	J	1.4	J	1.3	J			
Chloroform	0.12									1.3	J	
Chloromethane	9.4	1.1		1.2		1.4		1.4		1.2		1.0
Cyclohexane	630	0.8	J	0.8	J	2.4	K	1.8	K	1.4	J	
Dichlorodifluoromethane (Freon 12)	10	2.1	J	2.2	J	2.2	J	2.1	J	2.4		2.2
Ethanol	NA	5.4		5.3		36.6		38.9		96.8		1.9
Ethyl Acetate	7.3					4.1		4.8				
Ethylbenzene	1.1											
Heptane	NA											
Hexane	73	0.8	J	0.8	J	1.0	J	0.9	J			
Isopropyl alcohol	21					28.4		28.5				
Methylene Chloride	63	1.8		1.9		1.0	J	1.0	J			
Tetrachloroethene	4.2	2.8	J	3.6				1.4	J			
Tetrahydrofuran	210									2.7		5.3
Toluene	520	3.4		3.9		8.8		3.6		1.2	J	
Triclhorofluoromethane (Freon 11)	NA	1.3	J	1.4	J	1.5	J	1.5	J	1.4	J	1.5
m,p-xylene	10					2.0	J					
o-xylene	10											

µg/m^3 - micrograms per meter cubed
SS - subslab
IA - indoor air
OA - outdoor air
MAIN - main floor
Highlighted values exceed the RSL.

Table 3
Ravenswood PCE Vapor Sampling Analytical Results - April 2017

Sample Location:		[redacted]		[redacted]				[redacted]	
Sample ID:	Residential RSL	[redacted]-SS01		[redacted]-SS01-2		[redacted]2		[redacted]-SS03	
Field QC:									
Units :		µg/m^3		µg/m^3		µg/m^3		µg/m^3	
Date Sampled :		4/13/2017		4/13/2017		4/13/2017		4/13/2017	
Volatile Compound		Result	Flag	Result	Flag	Result	Flag	Result	Flag
1,2,4-trimethylbenzene	0.73	4.9		7.2		1.2	J	9.2	
1,2,4-Trichlorobenzene	NA	1.3	J	4.3	L				
1,2-dichlorobenzene	21			56				1.3	J
1,3-Dichlorobenzene	NA							1.3	J
1,3,5-Trimethylbenzene	NA	1.3	J	1.8	J			2.9	
1,4-dichlorobenzene	NA			30.5				1.5	J
2-Butanone (MEK)	520	12.1		13.6		4.3		12.8	
4-Ethyltoluene	NA	1.2	J	1.6	J			2.3	
4-Methyl-2-pentanone (MIBK)	310	0.9	J	1.4	J			2.1	
Acetone	3200	50.8		68.5		19.7		133	
Benzene	0.36	0.8	J	1.1	J	0.8	J	2.3	
Chloroform	0.12			1.1	J			1.1	J
Carbon Tetrachloride	0.47							1.3	J
Vinyl Chloride	0.17								
Chloromethane	9.4	0.9	J	0.8	J	1.3		0.6	J
Cyclohexane	630	20.9	K	31	K	1.2	J	135	J
Dichlorodifluoromethane (Freon 12)	10	2.4		2.1	J	2.3		2.5	
Ethanol	NA	38.8		48.8		6.7		90.7	
Ethyl Acetate	7.3	3.3		4.2				6.5	
Ethylbenzene	1.1	2.4		2.8				4.2	
Chlorobenzene	5.2			8.1				1.1	J
Heptane	NA	1	J	1.1	J			1.9	J
Hexane	73					1	J	0.9	J
Isopropyl alcohol	21	107		163				366	L
Methylene Chloride	63	1.6		1.2	J	2.4			
Tetrachloroethene	4.2	2.4	J	2.9	J	2.1	J	124	
Tetrahydrofuran	210	2.1		3.1				3.9	
Toluene	520	11		11.6		6.1		15.3	
Trichloroethene	0.21							1.4	J
Trichlorofluoromethane (Freon 11)	NA	1.5	J	1.5	J	1.5	J	2.6	
Styrene	100	1.6	J	2.2				1.1	J
m,p-xylene	10	8.6		10.6				14.7	
o-xylene	10	3.7		4.6				6.5	

µg/m^3 - micrograms per meter cubed
SS - subslab
Highlighted values exceed the RSL.

PII