May 17, 2021

Trevor Bannister
Hydrogeologist – Remediation and Redevelopment Program
Wisconsin Department of Natural Resources
3911 Fish Hatchery Road
Fitchburg, Wisconsin 53711

Subject: **Off-Site Vapor Intrusion Assessment Report – 614 Oak St**
Badger Cleaners
616 Oak Street
Baraboo, WI 53913
BRRTS#: 02-57-548538

Dear Mr. Bannister:

In an email dated September 28, 2020, the Wisconsin Department of Natural Resources (WDNR) requested a report summarizing vapor intrusion (VI) assessment activities conducted at 614 Oak Street in Baraboo, Wisconsin. The VI assessment at 614 Oak Street is related to the on-going investigation and remediation at the Badger Cleaners facility located at 616 Oak Street in Baraboo, Wisconsin (Site). EnviroForensics, LLC (EnviroForensics) has prepared this Off-Site Vapor Intrusion Assessment Report in response to that request.

SITE BACKGROUND AND SETTING

Originally developed in the 1800s, the 614 Oak Street property (614) has been used as a residential dwelling, a non-descript business office, a cobbler shop, and a dry cleaner (1922 Map). Sometime between 1947 and 1952, the current structure occupying 614 was built and was used for automotive repair in conjunction with the structure at 618 Oak Street. After the 1950s, 614 was used for various general business shops including most recently a Curves fitness studio. On October 31, 2020, an art supply sales and studio started operations in the building.

The 614 building is a single-story brick and block structure with a flat roof that shares a common wall with the Badger Cleaner building located directly to the north. It has a partial basement and crawl space at the eastern side of the building as shown on the attached **Figure 1**. 614 has a flat roof and a split 90% efficient furnace that utilizes fresh air from outdoors for combustion with a rooftop air conditioner. Water service enters the building from the alley on the south via the crawl space, and the sewer exits the south side of the building. The natural

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gas service is located at the east end, and the electric service comes from overhead lines on the east end as well.

Figure 1 shows the basement layout, and photographs of the basement are presented in **Attachment 1**. There are two (2) floor drains within the basement and the floor is in good condition. The exterior basement walls are poured concrete and also appear in good condition. The notable exception is the west wall of the basement, which has a doorway and several openings into the crawl space area. However, no access is available to the crawlspace. Likely during the construction of the current structure, the basement of the Site building was connected to 614.

Vapor Intrusion Assessment

Initially, two (2) VI assessment events were conducted, in September and December 2017, respectively. During each event, two indoor air samples designated 6492-614 Oak St.-IA-B and 6492-614 Oak St.-IA-1 were collected from within the basement and the first floor, respectively. For quality control purposes, a sample of outdoor ambient air designated 6492-OA-1 was collected. One (1) sub-slab vapor sample designated 6492-614 Oak St.-SSV-1 was collected from beneath the basement floor of the building. The sampling locations are depicted on the attached **Figure 1**.

During the initial event on September 7, 2017, the basement indoor air sample and the sub-slab vapor sample contained the chlorinated volatile organic compound (cVOC) tetrachloroethene (PCE) at concentrations exceeding the indoor air Vapor Action Level (VAL) of 180 micrograms per cubic meter (µg/m^3) and the vapor risk screening level (VRSL) of 6,000 µg/ m^3, respectively. PCE was also detected in the first-floor indoor air sample, but at a concentration below the VAL. Likewise, trichloroethene (TCE) was detected in the sub-slab vapor sample but below the VRSL. The weather during the sampling event was calm, with a temperature of 59-63^o Fahrenheit (^{o} F), relative humidity between 45% and 56 %, and a steady barometric pressure of approximately 30 inches of mercury (in Hg).

The results of the second VI assessment event, conducted on December 6, 2017, were similar to the first event with the notable exception of a PCE concentration above the VAL in the first-floor air sample. The weather during the December 2017 event was windy (up to 20 mph and calming), with a temperature of 29-33^o F, relative humidity between 48% and 61%, and a steady barometric pressure of approximately 29.8 in Hg. **Table 1** presents a summary of the analytical results compared to VRSLs and VALs.

Because 614 was only periodically occupied as a fitness studio and planning for a soil vapor extraction system (SVE) at the Site was underway, vapor mitigation was not implemented. The

SVE system began operating at the Site in January 2020. After several months of SVE system operation, the owner of 614 requested follow-up testing to evaluate the efficacy of SVE. On June 22, 2020, sampling occurred at the sample locations as previously collected. Weather during the event was generally calm with wind up to 5 mph, a steady temperature of 63-64^{o} F, relative humidity between 97% and 98%, and a slightly decreasing barometric pressure of 28.83 down to 28.75 inches of mercury. There were periods of drizzling rain throughout the day. Sub-slab pressure measured with a manometer in the sub-slab sample port indicated -0.051 inches of water (in H_20) prior to sample collection. The SVE system had removed several pounds of PCE at that point; however, PCE concentrations in the indoor air samples and sub-slab vapor samples remained above regulatory standards.

A follow-up assessment event was performed on August 26, 2020, to confirm the results post-remediation. Weather during the event was generally calm with wind up to 5 mph, with a steady temperature range of 79-89^{o} F, relative humidity between 65% and 46%, and a falling barometric pressure of 29.97 down to 29.48 inches of mercury. Sub-slab pressure measured with a manometer indicated -0.035 in H_20 prior to sample collection. While there were detections of PCE in indoor air and sub-slab samples, all concentrations were below action/screening levels.

CONCLUSIONS AND RECOMMENDATIONS

The indoor air and sub-slab vapor data have fluctuated, and SVE operations may have reduced the potential for a completed VI exposure pathway. Atmospheric conditions may affect the potential for the vapor intrusion pathway even during the SVE operation on short term periods. Subsurface pressure readings indicate the radius of influence of the SVE system encompasses 614, and cVOC vapor beneath the 614 basement is being captured. Additionally, the dry cleaning at the Site has been discontinued. Given the current SVE operation and the decrease in PCE concentrations observed during the last sampling event, an assessment of short-term and longer-term VI is warranted. To further assess the VI pathway, we recommend the following:

- Conduct 8-hour VI sampling events during two separate occasions. Each event will include sub-slab vapor, basement, and first-floor air samples. Additionally, vapor around the basement foundation from below the Site building will be evaluated by collecting a sample through the north basement concrete wall. Indoor air samples will be collected in metered summa canisters and analyzed for the dry cleaning-related cVOCs by US EPA Test Method TO-15.
    - One (1) Beacon ® passive indoor air sample will be paired with the first-floor summa canister over an 8-hour period to compare the analytical test method results during each of the two events.

- Sample indoor air using the passive samplers during four (4) consecutive seven (7)-day periods, and one (1) sample over the 28-day long period bracketed by the two (2) traditional aforementioned 8-hour indoor air sample events. SSV samples will be paired with a Beacon ® passive sub-slab vapor sample during the 8-hour 7-day, and 28-day events sampling events. Indoor air samples will be analyzed for dry cleaning-related cVOCs by US EPA Test Method TO-17.
- Collect follow up 8-hour indoor air samples from the first floor and sub-slab vapor only during September, November, and December 2021, and pair each with one (1) 28-day passive sample each month. The September event is proposed mid-September to mid-October for a shoulder month with minimal air-conditioning or heating use. November and December will capture heating months.
- Provide results to the building owner and occupants upon receipt of the analytical reports, with a copy sent to the WDNR.

The following table details the sampling plan as outline above.

Sample Event	**614 Oak Indoor Air 8 Hr w/ Summa**	**614 Oak Sub-slab vapor w/ Summa**	**Beacon IA samples**	**Beacon SSV samples**
1st Event/Day 1	3 - one basement, one 1st floor, & one outdoor	2 - one floor, one wall	3 - one 28 day, one 7 day, one 8 hour	2 - one 28 day and one 7 day
Day 7	--	--	One 7 day	One 7 day
Day 14	--	--	One 7 day	One 7 day
Day 21	--		One 7 day	One 7 day
2nd Event/Day 28	3 - one basement, one 1st floor, & one outdoor	2 - one floor, one wall	1 - one 8 hour	
September	1		one 28 day	one 28 day
November	1		one 28 day	one 28 day
December	1	1	one 28 day	one 28 day

This evaluation at 614 provides an appropriate time to also conduct a corresponding evaluation of the remedial effects of the SVE at the 618 Oak Street off-site property north of the Site. We recommend discontinuing the operation of the sub-slab depressurization system (SSDS) at 618 Oak Street, and sampling sub-slab vapor and indoor air during the two initial heating season sampling events at 614. If the results are favorable, the SSDS will remain off. If the initial results continue to show elevated concentrations of PCE above screening/action levels, the SSDS will be restarted. Results will be conveyed in a brief letter or email to the owner or occupants after receipt of each set of results. A comprehensive assessment report will be submitted, documenting the methodology, results, locations, and atmospheric conditions during sampling.

If you have any questions or require additional information, please contact us at (262) 290-4001.

Sincerely,
EnviroForensics, LLC

Rob Hoverman, LPG
Senior Project Manager
rhoverman@enviroforensics.com

Attachments
Figure 1
Table 1
Photographs

Copy: Ted Warpinski, Davis Kuelthau, S.C.
Andy Skwierawski, Davis Kuelthau, S.C.
Dave Bieno, Portage Cleaners

TABLES

TABLE 1
VAPOR INTRUSION ANALYTICAL RESULTS SUMMARY - 614 OAK STREET
Badger Cleaners
616 Oak Street, Baraboo, WI 53913

Sample Identification	Sample Location	Date Sampled	Mitigation	Tetrachloroethene	Trichloroethene
INDOOR/ OUTDOOR AIR					
Small Commercial Vapor Action Level				**180**	**8.8**
6492-614 Oak ST-IA-B	614 Oak Street	9/7/2017	No	**383**	<1.07
		12/6/2017	No	**543**	<1.07
		6/22/2020	Yes	**7,890**	<1.07
		8/26/2020	Yes	**118**	<1.07
6492-614 Oak ST-IA-1		9/7/2017	No	**80.9**	<1.07
		12/6/2017	No	**331**	<1.07
		6/22/2020	Yes	**3,340**	<1.07
		8/26/2020	Yes	**108**	<1.07
6492-OA-1		9/7/2017	No	**46.3**	<1.07
		12/6/2017	No	**28.8**	<1.07
		6/22/2020	Yes	<3.19	<1.07
		8/26/2020	Yes	<3.19	<1.07
SUB-SLAB VAPOR					
Small Commercial Vapor Risk Screening Level				**6,000**	**290**
6492-614 Oak ST-SSV-1	614 Oak Street	9/7/2017	No	**56,300**	**54.8**
		12/6/2017	No	**197,000**	**29.0**
		6/22/2020	Yes	**32,000**	**4.5**
		8/26/2020	Yes	**5,720**	<10.7

Notes:

Results reported in micrograms per cubic meter ($\mu g/m^3$)

Samples analyzed according to EPA Method TO-15

The Vapor Risk Screeing/Action Levels are calculated in accordance with WDNR Publication RR-800 and subsequent guidance documents.

IA = Indoor Air

OA = Outdoor Air

SSV= Sub-slab vapor

Bolded values are above detection limits

Bolded and Orange shaded concentration exceed the applicable non-residential screening level

FIGURES

5th Street

Parking Lot

Municipal Building
120 5th St

(Slab on Grade)

SG-6A SG-6D
SG-6B SG-6C

614 Oak Street				
IA-B	9/7/17	12/6/17	6/22/20	8/26/20
PCE	**383**	**543**	**7,890**	**118**
IA-1	9/7/17	12/6/17	6/22/20	8/26/20
PCE	**80.9**	**331**	**3,340**	**108**
SSV-1	9/7/17	12/6/17	6/22/20	8/26/20
PCE	**56,300**	**197,000**	**32,000**	**5,720**
TCE	**54.8**	**29.0**	**4.5**	<10.7

SG-5D SG-5B
SG-5C SG-5A

Commercial
618 Oak St

(Crawlspace)

(Basement)

(Crawlspace)

MW3

SG-1A SG-1D
SG-1C SG-1B

SVE-1S,D

MW2

Badger Cleaners
616 Oak St

(Slab on Grade)

(Basement)

(Slab on Grade)

Oak Street

Commercial
614 Oak St

(Crawlspace)

(Basement)

614 OAK ST-SSV-1

614 OAK ST-IA-B-1A/B

MW1

SG-2A
SG-2B SG-2D
SG-2C

SG-3D SG-3C
SG-3B SG-3A

SG-4C SG-4D
SG-4A SG-4B

Alley

N

APPROXIMATE SCALE: 1" = 20'

Legend

- GAS — Underground gas utility line
- SAN — Underground sanitary utility line
- UGT — Fiber optics line
- OVHD — Over head electrical utility line
- WTR — Underground water utility line
- FD — Floor drain
- Continuous basement
- SG-1 — Soil Gas sample location
- SSV-1 — Sub-slab sample location
- IA-1 — Indoor air sample
- MW1 — Monitoring well (By Others)
- PZ1 — Piezometer well (By Others)
- SVE-1 — Soil Vapor Extraction Well (S = Shallow D= Deep)
- 0.1 — Vacuum influence from SVE system in inches of water (Dashed where inferred)

Analyte	Indoor Air Small Commercial Vapor Risk Screening Level	Sub-Slab Vapor Small Commercial Vapor Risk Screening Level
PCE	**180**	**6,000**
TCE	**8.8**	**290**

Note:
1. All results reported in micrograms per cubic meter (µg/m^3)
2. Samples analyzed according to EPA Method TO-15
3. The Vapor Risk Screening/Action Levels are calculated in accordance with WDNR Publication RR-800 and subsequent guidance documents
4. PCE = Tetrachloroethene
5. TCE = Trichloroethene
6. Sub-slab sample depths are relative to ground surface
7. ROI = Radius of Influence
8. 0.1 inches of water used for determining effective ROI

SITE PLAN 614 OAK STREET

Badger Cleaners
616 Oak Street
Baraboo, Wisconsin

Date:	12/3/20
Designed:	EB
Drawn:	EB
Checked:	RH
DWG file:	6492-1740

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Figure 1

Project 6492

PHOTOGRAPHS

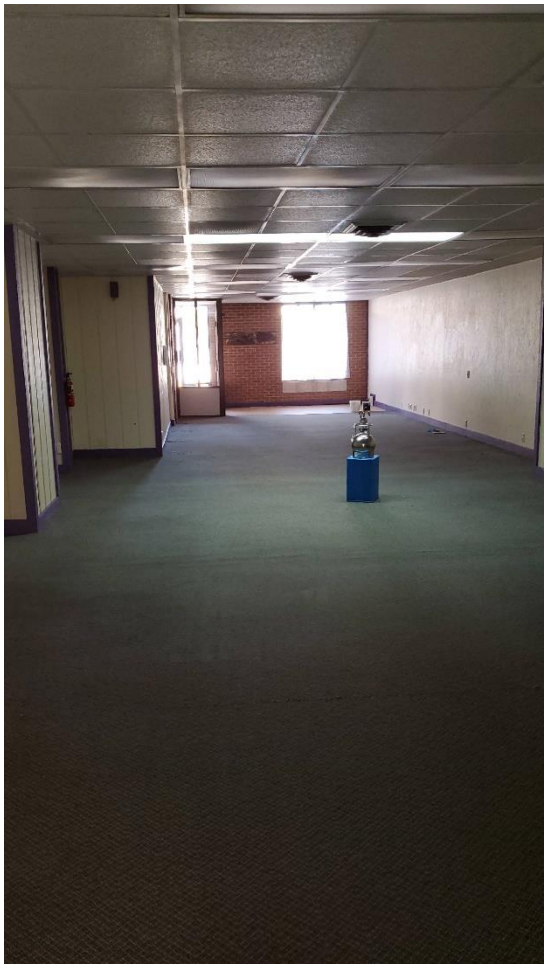

Photo 1: First Floor – Looking west

Photo 2: Basement- West end of the basement looking south. The furnace and floor drain is shown.

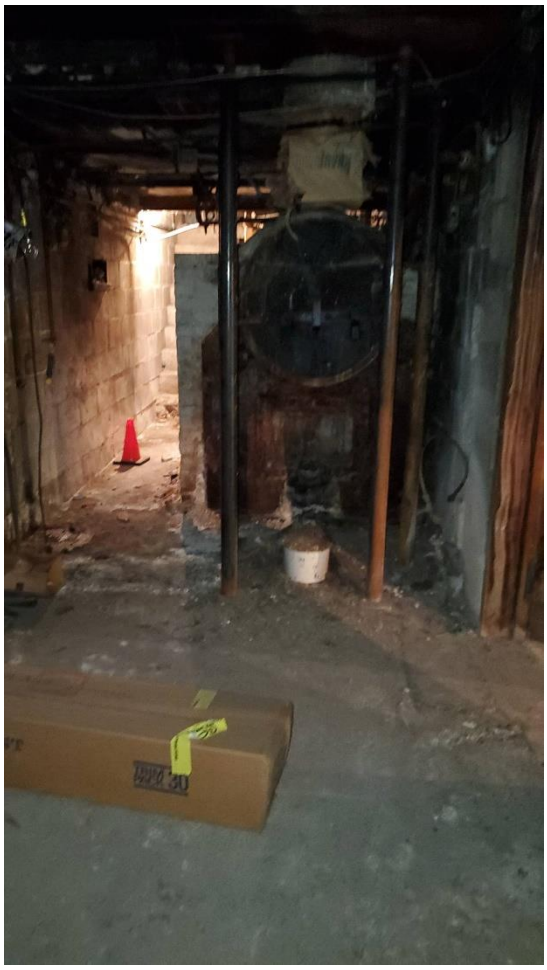

Photo 3: Basement – Looking north into adjoining basement of 616 Oak Street, unused coal furnace shown.

Photo 4: Basement- Northeast corner of basement. Plumbing stack, electric water heater, and electrical panel shown. Minor cracking along concrete forms shown.

Photo 5: Basement view to the west- Wall separating furnace room and floor drain shown. Likely window well on left side (south wall along alley) with insulation also shown.

Photo 6: East basement wall, plumbing stack, electrical panel, water heater, and HVAC duct work shown.

Photo 7: Second view of the basement- Electric water heater, and minor cracking along concrete forms, and transition from poured wall to blocks shown.

Photo 8: North basement wall, west of Photo 7, minor cracking along concrete forms, and transition from poured wall to blocks shown.