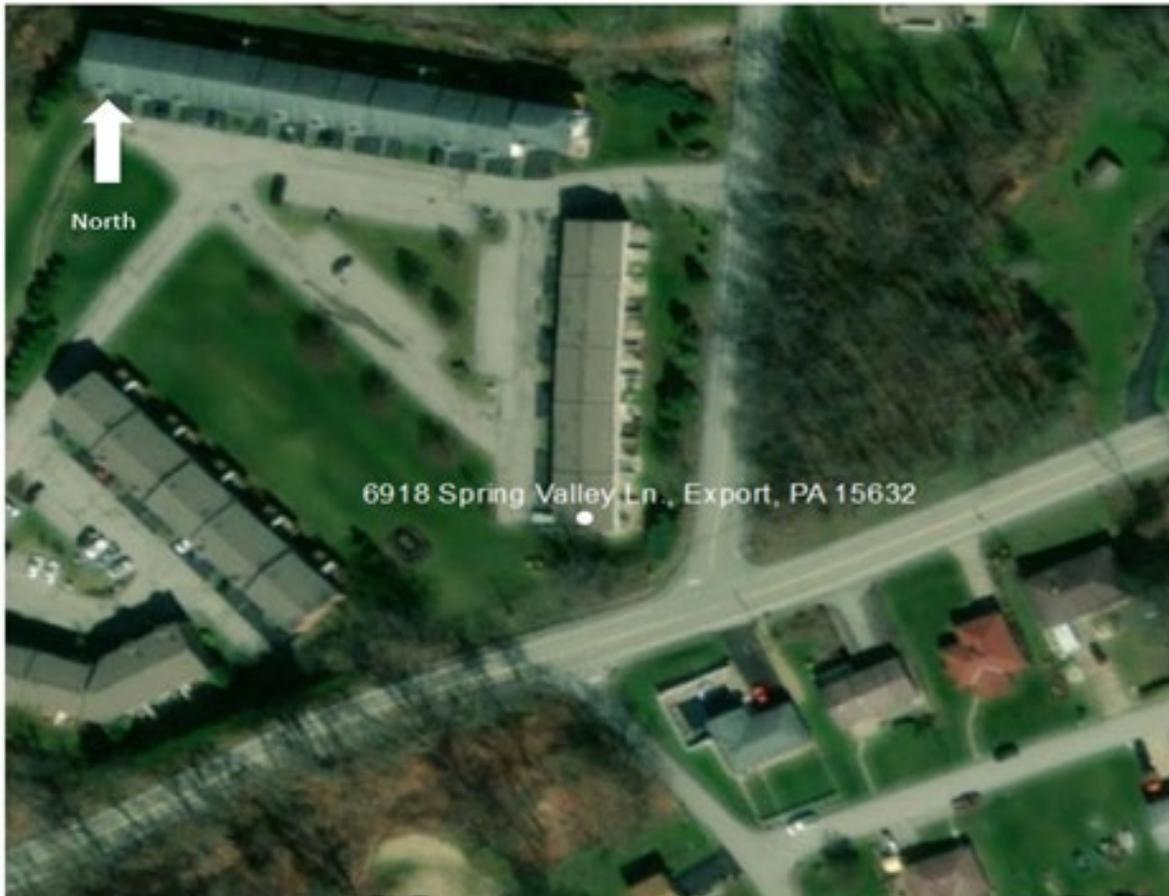




Technical Assistance Report

Export (Delmont), PA – Gas Investigation



Author: Omar Beckford, Ph.D.

Date: October 9, 2020

Field Date(s)

July 29, 2020

August 12, 2020

August 28, 2020

September 11, 2020

September 18, 2020

September 25, 2020

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Location

6918 Spring Valley Ln., PA 15632 (townhouse complex) Latitude = 40.416608° (N)
Longitude = -79.585838° (W)

Personnel

Arthur Crossman (PA-DEP) Mike Stayrook (PA-DEP)
James Peles (PA-DEP-Inspector) Omar Beckford (OSMRE-TSD)

Introduction

On July 24, 2020 Office of Surface Mining Reclamation and Enforcement (OSM), Technical Support Division (TSD) personnel (Omar Beckford) was asked to provide technical assistance to investigate a carbon dioxide (CO₂) gas issue at a residence located at 6918 Spring Valley Lane, Export (Delmont), PA 15632 (Figure 1) by the Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation (PA DEP-BAMR). Periodically, Lori Jackson, a resident at 6918 Spring Valley Lane, has experienced shortness of breath and an inability to light a candle due to elevated carbon dioxide (CO₂) and/or low oxygen (O₂) levels. OSM did not have a gas meter in the residence prior to this investigation. It should be noted that 6914 and 6916 Spring Valley Lane., also have experienced a CO₂ issue, recently. However, the unit at 6918 Spring Valley Lane, has the highest levels of CO₂ recorded, of the three residences. Mike Stayrook (PA-DEP) also lives in this townhouse complex, however his unit has not been affected by CO₂. PA DEP-BAMR has conducted ongoing mitigation efforts to abate CO₂ and subsidence problems at this location (June - August 2020).

Carbon dioxide is not an explosive gas, but elevated levels can contribute to an oxygen deficient atmosphere. The United States Environmental Protection Agency (EPA) recommends a maximum continuous exposure concentration (indoor living space) for CO₂ of 1,000 parts per million (ppm) or 0.1% by volume. The American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), and National Institute for Occupational Safety and Health (NIOSH) has a threshold limit value which is a time weighted average of 5,000 ppm (0.5% by volume) for CO₂ for a worker's 8-hour/day, and 40,000 ppm (4% by volume) as the maximum instantaneous limit considered immediately dangerous to life and health (ACGIH, 2013). Normal atmospheric CO₂ is approximately 0.03% by volume (300 ppm). The minimum O₂ level for humans required by Mine Safety and Health Administration is 19.5% by volume. A person's breathing becomes faster and deeper with O₂ at 17% by volume. Normal breathing is maintained with O₂ at 20.9% by volume. Carbon dioxide is heavier than air and is generally found at higher concentrations at lower levels of a structure.

History and Site Visit(s)

In June 2020, 6918 Spring Valley Lane, exhibited CO₂ values greater than 5.0% with O₂ at 12.3% (lowest). Unit 6916 had CO₂ near 4.8% with the lowest O₂ of 14.4%. Unit 6914 had CO₂ near 4.3% with the lowest O₂ of 14.4%. PA DEP-BAMR installed five fans in an existing passive radon system for the



entire building (10 units), units 6900 through 6918 (even numbers) Spring Valley Lane. This installation eliminated the gas issue at 6914 Spring Valley Lane and reduced the CO₂ levels in units 6916 and 6918. In July 13 to 17, 2020, PA DEP-BAMR installed two 8-inch diameter degasification wells. The degasification well on the south side of 6918 Spring Valley Lane, was venting CO₂ at 4.5% and O₂ at 15.5% on July 21, 2020, according to PA DEP-BAMR. Drilling of the degasification wells showed the overburden was 6 to 7 feet followed by, a void space (mine height) of 11 feet in height. The top of mining depth was 11.7 to 14.4 feet, and the total depth to the bottom of the mine was 21.8 to 22.3 feet. Based on the above overburden information, PA DEP-BAMR moved forward with an exploratory drilling project to secure data to be used in a mine stabilization project to protect the structure. Given the shallow depth and a highly weathered shale unit directly overlaying the mine, it was determined by PA DEP-BAMR that there was a high potential for subsidence in this area. The exploratory drilling project started on July 27, 2020. Based on information gained, it was determined that the underlying Pittsburgh Coal seam is the likely source of the CO₂.

Equipment

OSM uses Dräger gas meters with CC-Vision Basic software version 7.4.7. The Dräger meters are equipped with methane (CH₄), carbon dioxide (CO₂), oxygen (O₂), carbon monoxide (CO), and hydrogen sulfide (H₂S) sensors. The units for CH₄, CO₂, and O₂ read the gases in percent by volume. The units for CO and H₂S are read in parts per million (ppm) because these gases tend to occur at very low concentrations.

Summary of Site Visits and Data collection

On July 29, 2020 OSM (Omar Beckford) and PA DEP-BAMR (Art Crossman and Mike Stayrook) conducted point gas measurements of CO₂ inside and outside of 6918 Spring Valley Lane. The barometric pressure ranged from 29.92 to 30.04 in-Hg (inches of mercury) on July 29, 2020 (entire day) for Export, PA (www.localconditions.com). Generally, there is an inverse relationship between fugitive gas concentrations emitted from underground sources and barometric pressures (i.e. higher gas concentrations are associated with lower barometric pressure and vice-versa). Table 1 shows readings for unit 6918. Note, CO₂ percentages are to the tenth of a percent when a different OSM meter and CO₂ sensor were used. A plan view of unit 6918 is located in the Appendix and Photo Log section (data logging locations are shown in red).

Site	Date	Time	CO ₂ % Volume	O ₂ % Volume
6918 Spring Valley Ln.				
Data Log Location (south-east/back room to the right)	7/29/2020	11:07 AM	0.35	20.9
	7/29/2020	11:15 AM	0.61	20.9
Degasification Well Exhaust #1 (right side of 6918)	7/29/2020	11:30 AM	7.6	15.8
Degasification Well Exhaust #2 (behind 6918 across the street)	7/29/2020	11:45 AM	0.0	20.9

Table 1: Site 6918 Spring Valley Lane (south-east/back room to the right) Date:7-29-2020 at 11:07 AM carbon dioxide % 0.35 volume, oxygen % volume 20.9; at 11:15 AM Carbon Dioxide % Volume 0.61, oxygen % 20.9 Volume.

Degasification Well Exhaust #1 (right side of 6918) 7-29-2020 at 11:30 AM carbon dioxide % volume 7.6, oxygen % volume 15.8.

Degasification Well Exhaust #2 (behind 6918 across the street) 7-29-2020 11:45 AM carbon dioxide % 0.0, oxygen % volume 20.9.

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Prior to leaving 6918 Spring Valley Lane on July 29, 2020, a sensor/data logger was placed in the south-east room (back right - side room when looking at the front door) and was set to record the peak CO₂ concentrations every 10 minutes.

On August 12, 2020 OSM (Omar Beckford) and PA DEP-BAMR (Art Crossman, Mike Stayrook, and James Peles - Inspector) discussed on site the activities going on at 6918 Spring Valley Lane, OSM retrieved CO₂ data logging information from July 29 to July 31, 2020 (meter was shut-off by homeowner due to alarms) and conducted an informal interview with homeowner, Lori Jackson. The barometric pressure ranged from 30.03 to 30.11 in-Hg (inches of mercury) on August 12, 2020 for Export, PA (www.localconditions.com). Table 2 shows the gas readings for unit 6918. Figure 2 shows the peak CO₂ value from July 29 to July 31 was 12.20%, with O₂ = 17.5% on July 30 at 3:22 PM. The corresponding barometric pressure was 29.89 in-Hg on that date at 2:53 PM. Peak CO₂ values were found on July 30, 2020 from 3:02 PM to 4:32 PM, with CO₂ ranging between 9.80% to 12.20%, with O₂ ranging between 17.30% to 18.30%. Peak CO₂ values were likely due to the resident turning on their air conditioner from approximately 3:00 PM to 4:30 PM which may pull some interior air from the home, which could draw CO₂ from the ground into the home. Barometric pressure July 29 to July 31, 2020 ranged from 29.82 to 30.04 in-Hg for Export, PA (www.localconditions.com). On August 12, 2020 OSM and PA DEP-BAMR observed contractors using Degasification Exhaust Well #1 to inject grout. As of August 24, 2020, PA DEP- BAMR had injected approximately 950 yd³ of grout into the mine voids under unit 6918.

Site	Date	Time	CO ₂ % Volume	O ₂ % Volume
6918 Spring Valley Ln.				
Data Log Location (south-east/back room to the right)	8/12/2020	10:20 AM	1.62	-
	8/12/2020	11:04 AM	1.92	20.2

Table 2: Site 6918 Spring Valley Lane, Data log (south-east/back room to the right) 8-12-2020, 11:20 AM, carbon dioxide % volume 1.62, oxygen % N/A.
 8-12-2020 11:04 AM carbon dioxide % volume 1.92, oxygen% volume 20.2.

On August 28, 2020 OSM and PA DEP-BAMR (Art Crossman) discussed on site the activities going on at 6918 Spring Valley Lane. OSM retrieved CO₂ data logging information from August 12 to August 28, 2020 and conducted informal interviews with Bernie Bradosky and Lori Jackson (husband and wife in unit 6918). The barometric pressure ranged from 29.63 to 29.99 in-Hg on August 28, 2020 for Export, PA (www.localconditions.com). Figure 3 shows the peak recorded CO₂ values from August 12 to August 28. The peak CO₂ concentration was 8.60%, with O₂ recorded as 18.7% on August 17, 2020 at 4:01 PM. The corresponding barometric pressure was 29.94 in-Hg on August 17, 2020 at 3:47 PM. Table 3 shows site readings for unit 6918 from August 28, 2020.



Site	Date	Time	CO ₂ % Volume	O ₂ % Volume
6918 Spring Valley Ln.				
Data Log Location (south-east/back room to the right)	8/28/2020	9:37 AM	0.13	20.9
	8/28/2020	10:12 AM	0.14	20.9
Utility Closet (under slab)	8/28/2020	10:53 AM	0.0	20.9

Table 3: 6918 Spring Valley Lane, 8-28-2020, 9:37 AM, carbon dioxide % volume, oxygen % volume 0.13.

8-28-2020, 10:12 AM, carbon dioxide % 0.14, oxygen % volume 20.9.

Utility Closet (under slab) 8-28-2020, 10:53 AM, carbon dioxide% volume 0.13, oxygen % volume 20.9.

On September 11, 2020 OSM discussed on site the latest CO₂ concentrations at 6918 Spring Valley Lane. OSM retrieved CO₂ data logging information from August 28 to September 11, 2020 and conducted informal interviews with Bernie Bradosky and Lori Jackson. Figure 4, shows the peak CO₂ concentration from August 28 to September 11 was 0.24%, with O₂ = 20.9% on September 11 at 8:16 AM. The corresponding barometric pressures were 30.26 and 30.27 in-Hg on September 11, 2020 at 7:47 AM and 8:47 AM, respectively. The second highest CO₂ concentration was 0.23% recorded on September 3, 2020 at 8:26 PM with O₂ level at 20.9%. August 28 to September 11, 2020 oxygen (O₂) levels were 20.9% (maximum) for all data-logging values. *Of note there were no alarms for CO₂ (set at 1 and 2% activated from August 28 to September 11, 2020).* The barometric pressure ranged from 30.21 to 30.28 in-Hg on September 11, 2020 for Export, PA (www.localconditions.com). Note, Figure 4 shows the barometric readings from August 28 to September 10, since adding the September 11 data impacts the graphical representation due to barometric pressure readings being once every hour and CO₂ data logging (recording) once every ten minutes (i.e September 11 barometric data would appear as September 10 data on the x-axis). Table 4 shows site readings for unit 6918 from September 11, 2020.

Site	Date	Time	CO ₂ % Volume	O ₂ % Volume
6918 Spring Valley Ln.				
Data Log Location (south-east/back room to the right)	9/11/2020	9:40 AM	0.08	20.9
Utility Closet (under slab)	9/11/2020	10:18 AM	0.0	20.9
Garage Drain	9/11/2020	10:25 AM	0.0	20.9
Data Log Location (south-east/back room to the right)	9/11/2020	10:29 AM	0.05	20.9

Table 4: 6918 Spring Valley Lane (south-east/back room to the right) 9-11-2020, 9:40 AM, carbon dioxide % volume 0.08, oxygen % volume 20.9.

Utility closet (under slab) 9-11-2020, 10:18 AM, carbon dioxide % volume 0.0, oxygen % volume 20.9.

Garage Drain 9-11-2020, 10:18 AM, carbon dioxide % volume 0.0, oxygen % volume 20.9.

Data log location (south/east back room to the right) 9-11-2020, 10:29 AM, carbon dioxide % volume 0.05, oxygen % volume 20.9.



On September 18, 2020 OSM (Omar Beckford) discussed the latest CO₂ values with Lori Jackson at 6918 Spring Valley Lane. OSM retrieved CO₂ data from September 11 to September 18. Figure 5, shows the peak CO₂ concentration from September 11 to September 18 was 0.22%, with O₂ recorded at 20.9% on September 13 at 6:55 PM. September 11 to September 18, 2020 oxygen (O₂) was 20.9% (maximum) for all data-logging values. *No alarms for CO₂ (set at 1 and 2%) were activated from September 11 to September 18, 2020.*

On September 25, 2020 Dr. Beckford updated Ms. Jackson with the latest CO₂ values recorded at 6918 Spring Valley Lane. He retrieved CO₂ data logging information from September 18 to September 25. Figure 6 shows the peak CO₂ concentration from September 18 to September 25 was 0.19%, with O₂ recorded at 20.9% on September 23 at 3:12 PM. September 18 to September 25, 2020 oxygen (O₂) was 20.9% (maximum) for all data-logging values. *No alarms for CO₂ (set at 1 and 2%) were activated from September 18 to September 25, 2020.* Table 5 shows site readings for unit 6918 from September 25, 2020.

Site	Date	Time	CO ₂ % Volume	O ₂ % Volume
6918 Spring Valley Ln.				
Data Log Location (south-east/back room to the right)	9/25/2020	9:37 AM	0.09	20.9
		10:05 AM	0.09	20.9
Utility Closet (under slab)		10:10 AM	0.14	20.9

Table 5: 6918 Spring Valley Lane: Location (south east/back room to the right) 9-25-2020, 9:37 AM, carbon dioxide % volume 0.09, oxygen % volume 20.9.
 9-25-2020, 10:05 AM, carbon dioxide % volume 0.09, oxygen % volume 20.9.
 Utility closet (under slab) 9-25-2020, 9-25-2020, carbon dioxide % volume 0.14, oxygen % volume 20.9.

Summary and Conclusions

In June 2020, 6918 Spring Valley Lane, had CO₂ concentrations greater than 5.0% with oxygen (O₂) at approximately 12.0%. The source of the elevated CO₂ in unit 6918 appears to be deficient air emanating from abandoned mines (likely the Pittsburgh Coal seam) and is facilitated by subsidence-related and/or natural stress-relief fractures. PA DEP-BAMR installed five fans on an existing passive radon system for the entire building (10 units), 6900 through 6918 (even numbers) Spring Valley Ln. This installation has eliminated the gas issue at 6914 Spring Valley Ln. and reduced the CO₂ levels in units 6916 and 6918. July 2020, PA DEP-BAMR installed two 8-inch diameter degasification wells, to increase the reduction of CO₂ levels in units 6916 and 6918. From July 29 to September 25, 2020 OSM installed a continuous gas monitor in unit 6918, data summarized in Figures 2 to 6. The peak CO₂ concentration from July 29 to August 28 was 12.20%, with O₂ at 17.5% (lowest concentration) on July 30, 2020. August 12 to August 24, 2020, contractors used Degasification Exhaust Well # 1 to inject approximately 950 yd³ of grout into the mine voids under unit 6918. August 28 to September 25, 2020 peak CO₂ concentrations further decreased from 0.24 to 0.19% with oxygen (O₂) at 20.9% (maximum) for all data-logging values. *No alarms for CO₂ (set at 1 and 2%) were activated from August 28 to September 25, 2020.*

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It can be concluded that the mine stabilization effort appears to have sealed most of the CO₂ gas pathways from the mine to townhouse unit 6918. OSM and PA DEP-BAMR agreed to pull the Drager X-am gas monitor (meter) from 6918 Spring Valley Lane, Export, PA on September 25, 2020. The residents at 6918, continue to have a CO₂ meter provided to them by PA DEP-BAMR.

Reference

American Conference of Governmental Industrial Hygienists (ACGIH, 2013). 2013 Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents & Biological Exposure Indices (BEIs) - Handbook. Signature Publications.



Figure 1

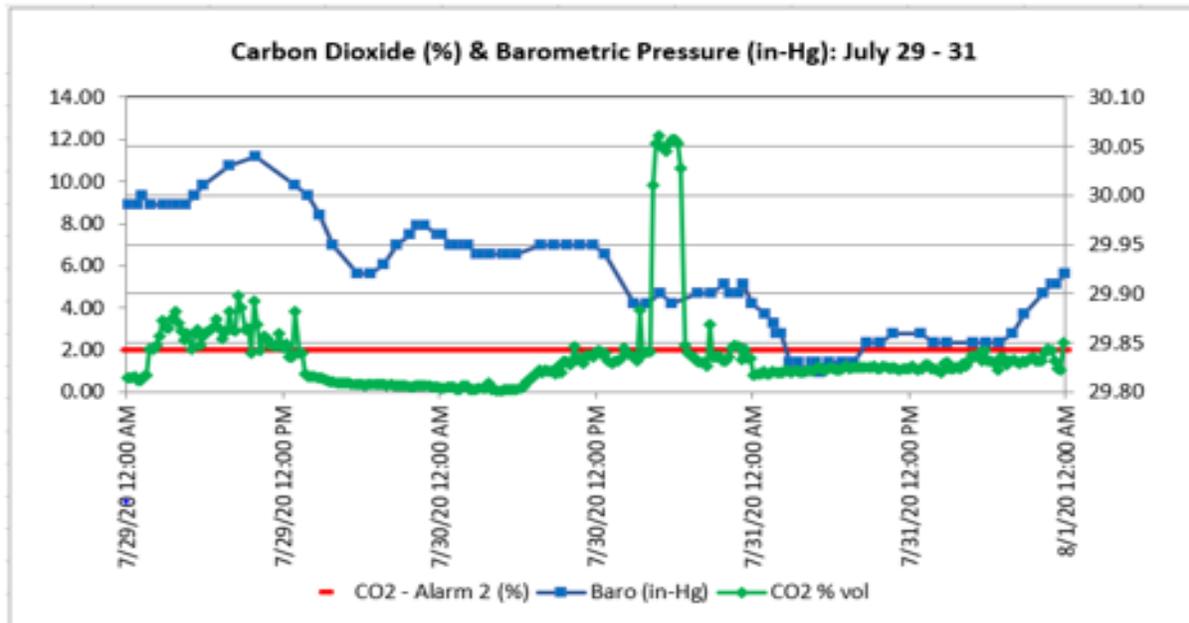


Figure 2

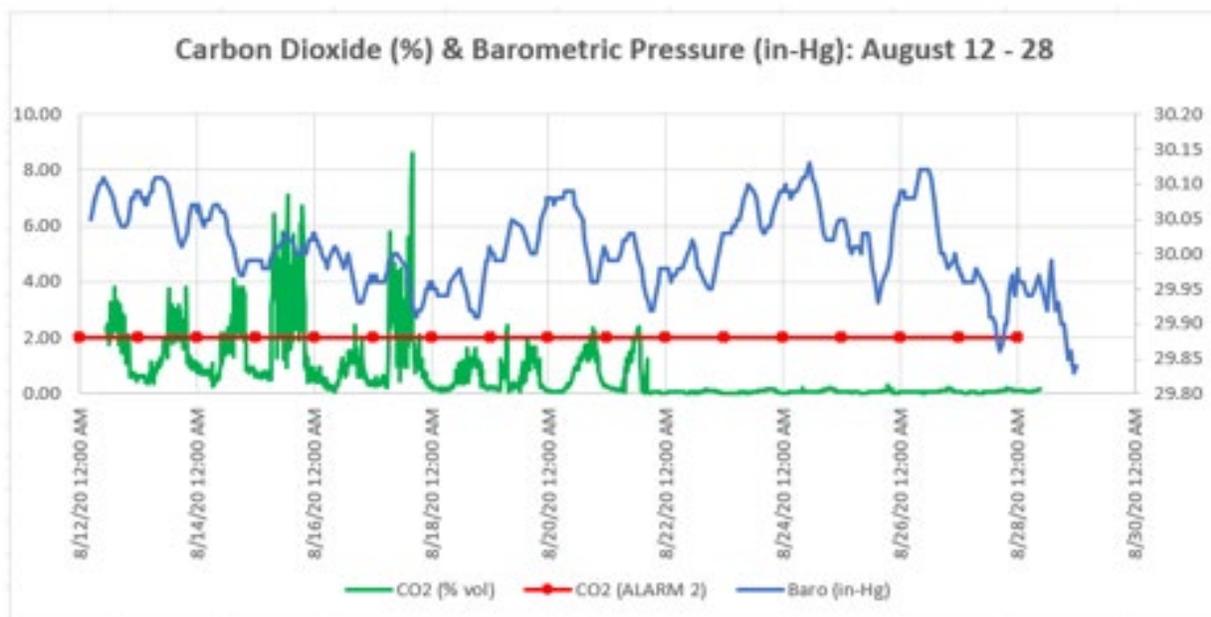


Figure 3

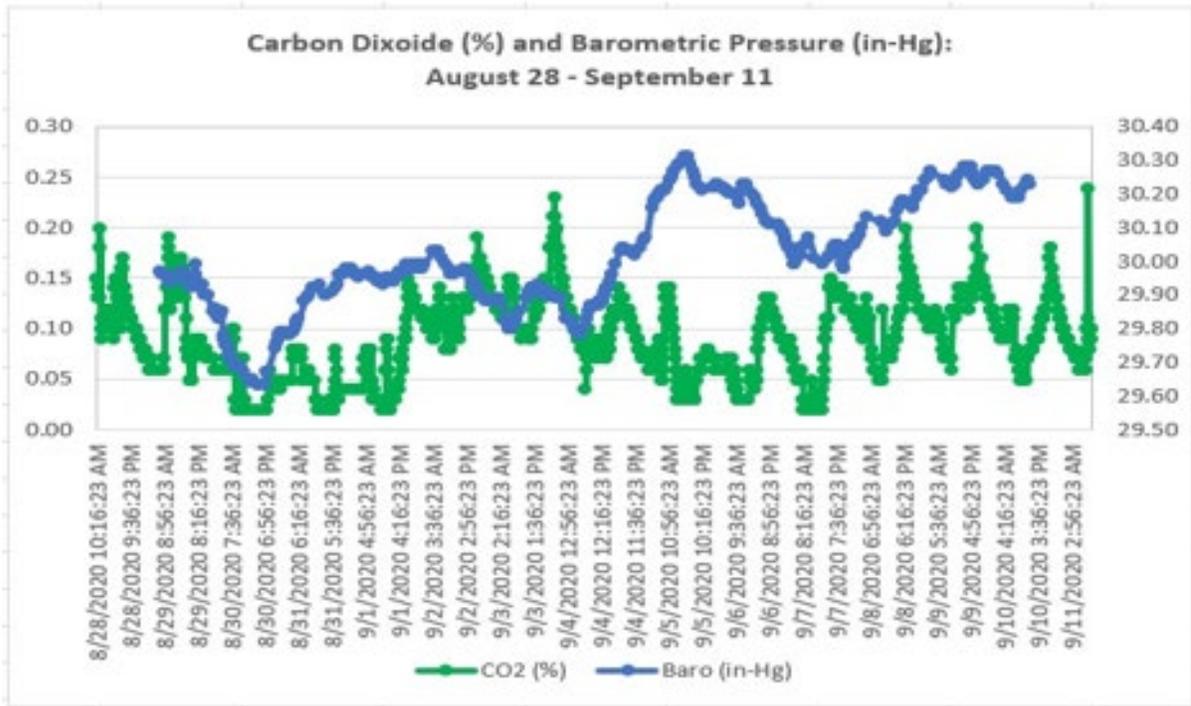


Figure 4

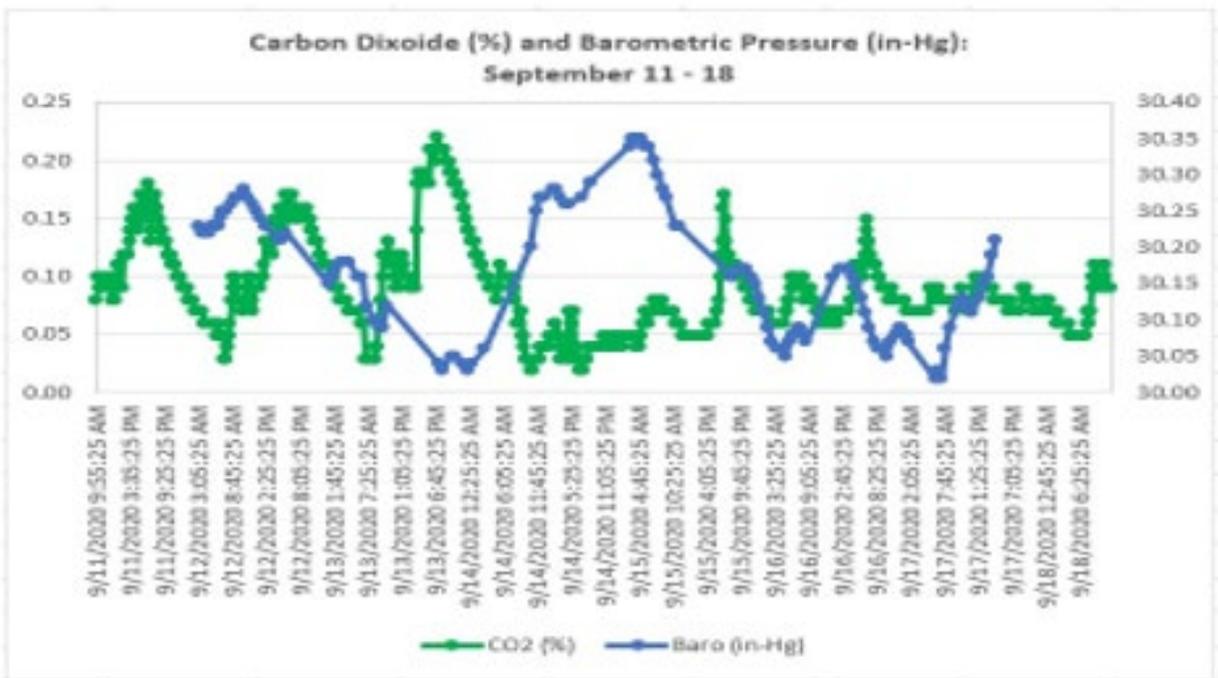


Figure 5

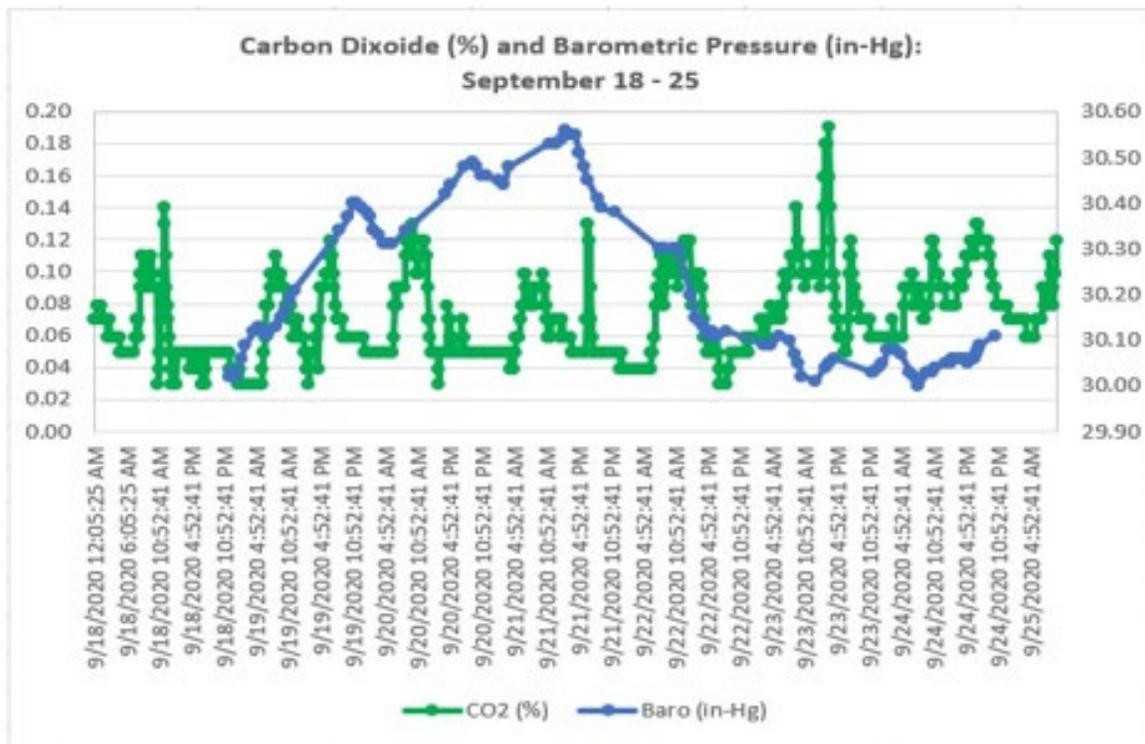


Figure 6



Appendix and Photo Log:



July 29, 2020 – Front of 6918 Spring Valley Ln.



July 29, 2020 – Data Logging Location 6918 Spring Valley Ln. (back right room).



July 29, 2020 – Degasification Well Exhaust #1.



July 29, 2020 – Degasification Well Exhaust #2 (behind 6918 Spring Valley Ln., and across the street)



July 29, 2020 ~ 6900 ~ 6918 (even numbers) Spring Valley Ln.



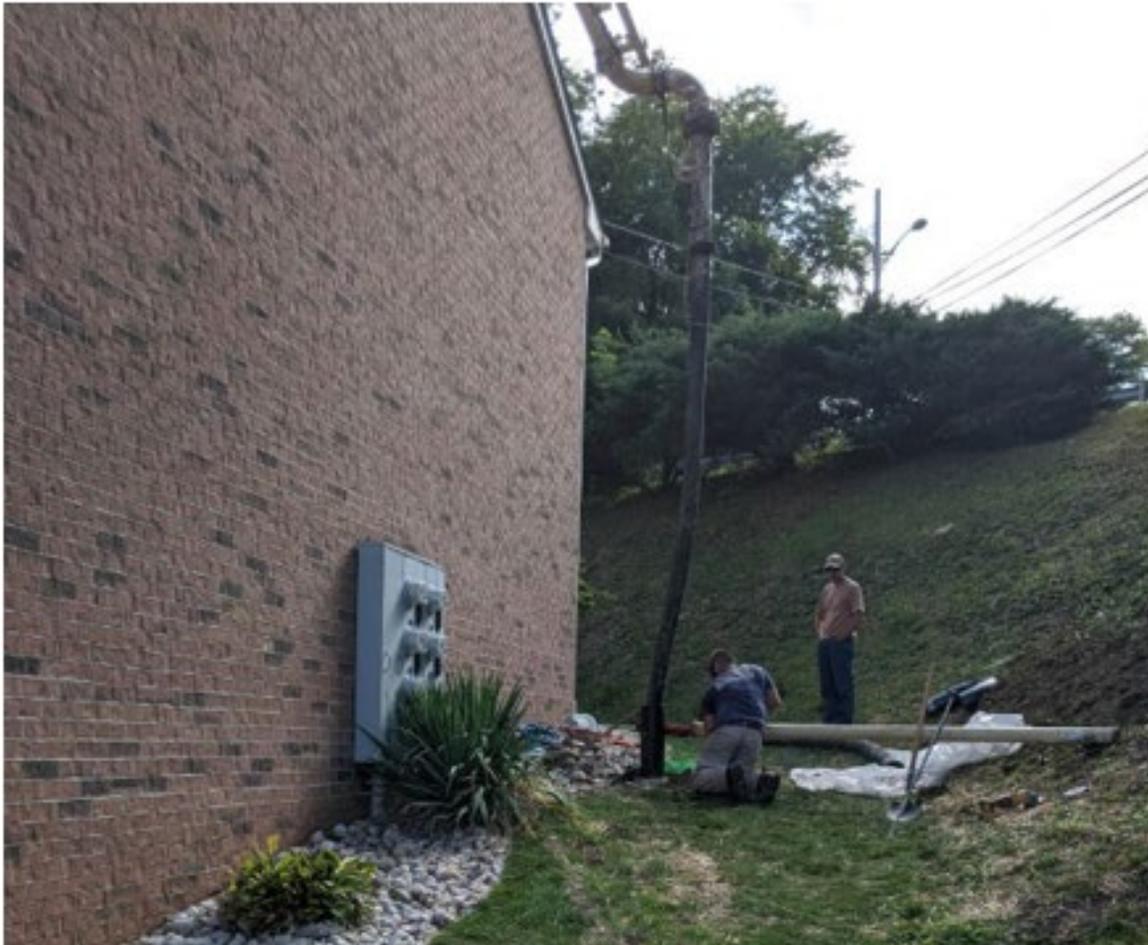
July 29, 2020 - 6900 Spring Valley Ln.



July 29, 2020 – Drill Rig for Grouting behind 6918 Spring Valley Ln.



August 12, 2020 – Grouting into Degasification Well Exhaust #1, on the right side of unit 6918 – (1)



August 12, 2020 – Grouting into Degasification Well Exhaust #1, on the right side of unit 6918 – (2).



August 28, 2020 - Degasification Well Exhaust #1 removed after grouting.

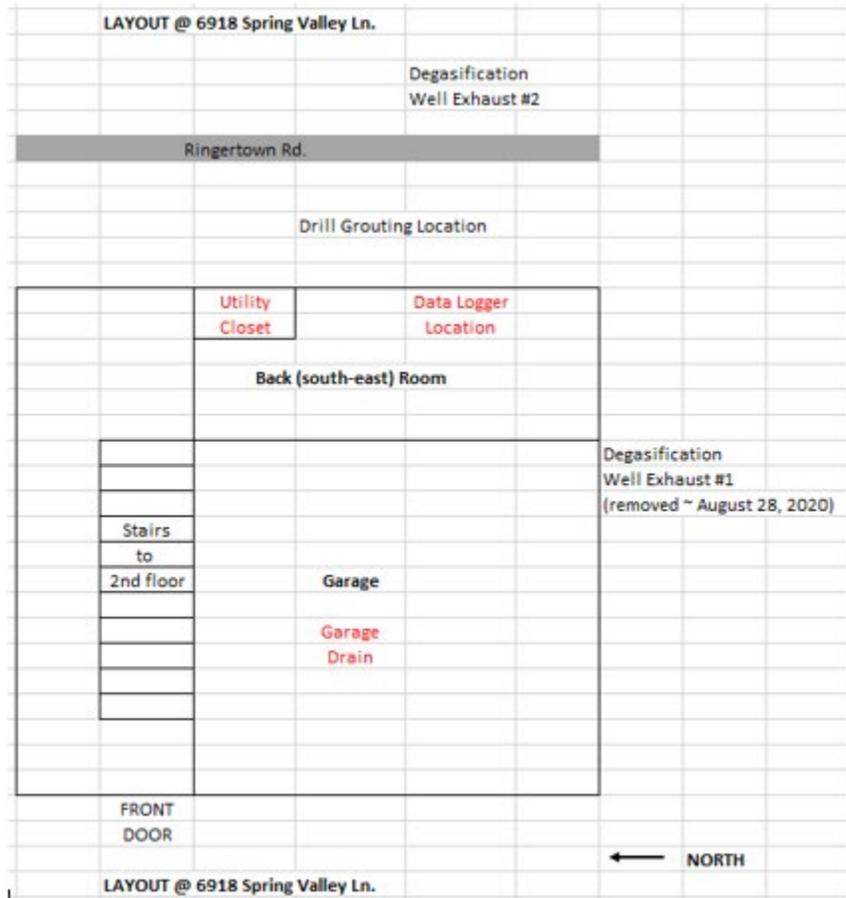


August 28, 2020 – Utility Closet in south-east (back) room of unit 6918.



September 11, 2020 – Garage drain of unit 6918

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Layout (1st floor) at 6918 Spring Valley Ln., Export, PA 15632 (data monitoring locations in red).