Letter Health Consultation

BUILDING 5 WAREHOUSE

BAYER COMPLEX – PMC BIOGENIX

MEMPHIS, SHELBY COUNTY, TENNESSEE

FEBRUARY 9, 2017

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This document has not been formally reviewed and cleared by ATSDR.

TN Department of Health

February 9, 2017

Alison D. Campany, Remediation Project Manager
Tennessee Department of Environment and Conservation
Memphis Environmental Field Office
8383 Wolf Lake Drive
Bartlett, TN 38133-4119

RE: Letter Health Consultation
Building 5 Warehouse
Bayer Complex - PMC Biogenix
1248 Warford Street, Memphis, Tennessee 38108

This letter is to provide you with our health conclusions and recommendations based on evaluating indoor air and sub-slab air sample results for this site. Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP) evaluated indoor air results from the sampling event conducted in February 2016 at the Building 5 Warehouse, Bayer Complex - PMC Biogenix, 1248 Warford Street, Memphis, Tennessee 38108.

EEP's conclusions and recommendations:

- EEP concludes that the concentration of trichloroethylene (TCE) in indoor air in the warehouse represents a moderate increase in risk for excess cancers to workers. The concentrations of benzene, carbon tetrachloride, and 1, 3-butadiene present represents a very low increase for excess cancers to workers.

- EEP concludes that the estimated levels of TCE could be harmful to pregnant women who spend their day in the warehouse area of the building and that strong consideration should be given to limiting their exposure.

- EEP also concludes that contaminants in the air of the Building 5 Warehouse are below levels of concern for non-cancer health effects for workers. This is based on the February 2016 and September 2016 data.

- EEP recommends additional testing following mitigation/remedial activities.

The remainder of this letter presents background information as well as the evaluation of the indoor air data to support the conclusions and recommendations for the Building 5 Warehouse.

Background and Statement of Issues

The subject property is developed with one 165,354 square foot (ft^2) office and open area warehouse building. The property is located at 1248 Warford Street, Memphis, Tennessee 38108.

The building was used for manufacture of automobile parts until the late 1980's. Operations during this time reportedly included the use of degreasing pits that were later filled with sand and capped with a concrete floor.

Previous environmental investigations that date back to the mid 1990's included soil and groundwater sampling which identified the presence of volatile organic compound (VOC) contamination in soil and in an intermediate aquifer beneath the site. The contamination was limited to an area beneath the southeast portion of the building (*Attachment 1-Figure 1-Site Map*). In 1999, the Tennessee Department of Environment and Conservation (TDEC) issued a letter allowing no further action to be taken at the site. The decision that no further action was needed was based on results of an analysis of heavy metals in soil and because groundwater analytical results indicated that the concentration of contaminants had remained below detection limit for two rounds of sampling. It was determined that the source of the contamination had been removed.

A limited investigation was conducted in 2014 to evaluate vapor intrusion potential from remaining contamination beneath the central portion of the building where the former degreasing pit was located. Soil results showed VOC detections below residential and industrial screening values. Groundwater results indicated VOC levels exceeding residential and industrial screening values in the area of the former degreasing pit. The 2014 investigation also indicated the presence of vapors in the indoor air (*Attachment 1-Figure 1-Site Map*).

Confirmation indoor air sampling was conducted on February 2, 2016 and September 23, 2016. Six indoor air samples and one outdoor (background) sample were collected based on recommendations by the New Jersey Vapor Intrusion Technical Guidance for a building of this square footage. Two samples were taken at PMCID02 and PMCID03 that were in the area believed to have been the source. Samples were also collected at PMCID04 (shipping office), PMCID05 (receiving office) and PMCID07 (upstairs office area). A basement in the western portion of the building was also sampled at PMCID06 (Ensafe 2016, Ensafe 2017) (*Attachment 2-Table 3–Indoor Air Sampling Results*) (*Attachment 1-Figure 1-Site Map*).

Exposed Population

According to personal communication with Ensafe staff, there were 14 workers who worked in the Building 5 Warehouse in January 2017. There were two shifts that operated only during the daytime. Each shift length was 9 hours which included a break for lunch. Both male and female employees worked in the building. At the time of the investigation, one female was reported to be of child-bearing age who worked in an office near sample location PMCID07 (*Attachment 1-Figure 1-Site Map*).

Health Evaluation

EEP uses guidance provided by the Agency for Toxic Substances and Disease Registry (ATSDR) to evaluate potential exposure and resulting cancer risk and non-cancer health effects. ATSDR considers exposure in a settling such as that in the Building 5 Warehouse a secondary exposure because the people working there may not have known about the past solvent use. Therefore, ATSDR has a more protective and conservative approach than the Environmental Protection Agency (EPA) in a commercial setting that has been repurposed (ATSDR 2006).

Cancer Health Effects

Based on **February 2016** sampling, the maximum air concentration for TCE, benzene, carbon tetrachloride, and 1, 3-Butadiene exceeded ATSDR Cancer Risk Evaluation Guide (CREG) screening values (Table 1) (ATSDR 2016). To better evaluate the levels to which workers in the warehouse may be exposed, EEP adjusted the measured maximum levels for each chemical of concern to account for the employees shift duration and number of days worked each week. The adjusted maximum concentrations are shown below.

Calculation - Adjusted Maximum Concentration – February 2016:

Adjusted Maximum Concentration = Maximum Concentration x ET x EF
where:
ET = exposure time (hours [hrs]/day); and
EF = exposure frequency (days/week)

Adjusted Maximum Concentration - TCE = 43 µg/m^3 x 9 hrs/24-hr day x 5 days/7-day week = **11.52 µg/m^3**

Adjusted Maximum Concentration - benzene = 0.84 µg/m^3 x 9 hrs/24-hr day x 5 days/7-day week = **0.225 µg/m^3**

Adjusted Maximum Concentration - carbon tetrachloride = 1.1 µg/m^3 x 9 hrs/24-hr day x 5 days/7-day week = **0.29 µg/m^3**

Adjusted Maximum Concentration – 1, 3-Butadiene = 0.26 µg/m^3 x 9 hrs/24-hr day x 5 days/7-day week = **0.07 µg/m^3**

The adjusted maximum concentration for each of these chemicals of concern also exceeded ATSDR CREG screening values (Table 1), so EEP calculated an estimated lifetime excess cancer risk for the adjusted maximum concentration for each.

Calculation – Estimated Lifetime Excess Cancer Risk – February 2016:

Estimated Lifetime Excess Cancer Risk (LECR) = EPA Inhalation Unit Risk x Adjusted Max Concentration

LECR TCE **=** $(4.1 \times 10^{-6}) \times 11.52$ µg/$m^3 = 4.72 \times 10^{-5}$

The estimated lifetime excess cancer risk of 4.72×10^{-5} for **TCE** represents about 5 possible excess cancer cases in a population of 100,000 over a lifetime of exposure. This is considered a moderately increased cancer risk. The actual or true risk is likely to be less because exposure is 3 years or less rather than a lifetime duration of 78 years.

LECR benzene **=** $(7.8 \times 10^{-6}) \times 0.23$ µg/$m^3 = 1.79 \times 10^{-6}$

The estimated lifetime excess cancer risk of 1.79×10^{-6} for **benzene** represents about 2 possible excess cancer cases in a population of 1,000,000 over a lifetime of exposure. As with TCE, this is considered a very low increased cancer risk. The actual or true risk is likely to be less because exposure is 3 years or less rather than a lifetime duration of 78 years.

LECR carbon tetrachloride **=** $(6.0 \times 10^{-6}) \times 0.29$ µg/$m^3 = 1.74 \times 10^{-6}$

The estimated lifetime excess cancer risk of 1.74×10^{-6} represents for **carbon tetrachloride** represents about 2 possible excess cancer cases in a population of 1,000,000 over a lifetime of exposure. This is considered a very low increased cancer risk. The actual or true risk is likely to be less because exposure is 3 years or less rather than a lifetime duration of 78 years.

LECR 1, 3-Butadiene **=** $(3.0 \times 10^{-5}) \times 0.07$ µg/$m^3 = 2.10 \times 10^{-6}$

The estimated lifetime excess cancer risk of 2.10×10^{-6} represents for ***1, 3-Butadiene*** represents about 2 possible excess cancer cases in a population of 1,000,000 over a lifetime of exposure. This is considered a very low increased cancer risk. The actual or true

risk is likely to be less because exposure is 3 years or less rather than a lifetime duration of 78 years.

Table 1. Indoor Air Sampling Results, 1248 Warford Street, Memphis, Tennessee, February 2, 2016

Analyte	ATSDR CREG ($\mu g/m^3$)	EPA Inhalation Unit Risk $(\mu g/m^3)^{-1}$	ATSDR Chronic EMEG ($\mu g/m^3$)	Max Measured Conc. ($\mu g/m^3$)	Adjusted Max Conc. ($\mu g/m^3$)	Estimated Lifetime Excess Cancer Risk
benzene	0.13	7.80×10^{-6}	9.6	0.84	0.225	1.79×10^{-5}
carbon tetrachloride	0.043	6.0×10^{-6}	190	1.1	0.29	1.80×10^{-6}
trichloroethylene	0.22	4.1×10^{-6}	2.1	43	11.52	4.95×10^{-5}
1, 3-Butadiene	0.033	3.0×10^{-5}	NA	0.26	0.07	2.10×10^{-6}

Additional information concerning the evaluation cancer risk is available in Attachment 3 - Additional Exposure Evaluation Information.

Based on **September 2016** sampling, the concentrations of benzene increased in all sampling locations. Both carbon tetrachloride and TCE increased in one sampling location (*Attachment 2-Table 3*). The maximum air concentration for TCE, benzene, and carbon tetrachloride exceeded ATSDR CREG screening values (Table 2) (ATSDR 2016). To better evaluate the levels to which workers in the warehouse may be exposed, EEP adjusted the measured maximum levels for each chemical of concern to account for the employees shift duration and number of days worked each week. The adjusted maximum concentrations are shown below.

Calculation - Adjusted Maximum Concentration – September 2016:

Adjusted Maximum Concentration = Maximum Concentration x ET x EF
where:
ET = exposure time (hours [hrs]/day); and
EF = exposure frequency (days/week)

Adjusted Maximum Concentration - TCE = 24 $\mu g/m^3$ x 9 hrs/24-hr day x 5 days/7-day week = **6.43 $\mu g/m^3$**

Adjusted Maximum Concentration - benzene = 3 $\mu g/m^3$ x 9 hrs/24-hr day x 5 days/7-day week = **0.80 $\mu g/m^3$**

Adjusted Maximum Concentration - carbon tetrachloride = 1.2 $\mu g/m^3$ x 9 hrs/24-hr day x 5 days/7-day week = **0.32 $\mu g/m^3$**

Adjusted Maximum Concentration – 1, 3-Butadiene = 0.47 µg/m^3 x 9 hrs/24-hr day x 5 days/7-day week = **0.13 µg/m^3**

The adjusted maximum concentration for each of these chemicals of concern also exceeded ATSDR CREG screening values (Table 2), so EEP calculated an estimated lifetime excess cancer risk for the adjusted maximum concentration for each.

Calculation – Estimated Lifetime Excess Cancer Risk – September 2016:

Estimated LECR = EPA Inhalation Unit Risk x Adjusted Max Concentration

LECR TCE = $(4.1 \times 10^{-6}) \times 6.43$ µg/$m^3 = 2.64 \times 10^{-5}$

The estimated lifetime excess cancer risk of 2.64×10^{-5} for **TCE** represents about 2 possible excess cancer cases in a population of 100,000 over a lifetime of exposure. This is considered a moderately increased cancer risk. The actual or true risk is likely to be less because exposure is 3 years or less rather than a lifetime duration of 78 years.

LECR benzene = $(7.8 \times 10^{-6}) \times 0.8$ µg/$m^3 = 6.24 \times 10^{-6}$

The estimated lifetime excess cancer risk of 6.24×10^{-6} for **benzene** represents about 6 possible excess cancer cases in a population of 1,000,000 over a lifetime of exposure. This is considered a very low increased cancer risk. The actual or true risk is likely to be less because exposure is 3 years or less rather than a lifetime duration of 78 years. The concentrations of benzene increased in all samples from February to September. Consideration should be given to investigating the possibility of an ongoing source for this contamination.

LECR carbon tetrachloride = $(6.0 \times 10^{-6}) \times 0.32$ µg/$m^3 = 1.92 \times 10^{-6}$

The estimated lifetime excess cancer risk of 1.92×10^{-6} represents for **carbon tetrachloride** represents about 2 possible excess cancer cases in a population of 1,000,000 over a lifetime of exposure. As with TCE and benzene, this is considered a very low increased cancer risk. The actual or true risk is likely to be less because exposure is 3 years or less rather than a lifetime duration of 78 years.

LECR 1, 3-Butadeine = $(3.0 \times 10^{-5}) \times 0.13$ µg/$m^3 = 3.90 \times 10^{-6}$

The estimated lifetime excess cancer risk of 3.90×10^{-6} represents for ***1, 3-Butadeine*** represents about 4 possible excess cancer cases in a population of 1,000,000 over a lifetime of exposure. This is considered a very low increased cancer risk. The actual or true

risk is likely to be less because exposure is 3 years or less rather than a lifetime duration of 78 years.

Table 2. Indoor Air Sampling Results, 1248 Warford Street, Memphis, Tennessee, September 23, 2016

Analyte	ATSDR CREG ($\mu g/m^3$)	EPA Inhalation Unit Risk $(\mu g/m^3)^{-1}$	ATSDR Chronic EMEG ($\mu g/m^3$)	Max Measured Conc. ($\mu g/m^3$)	Adjusted Max Conc. ($\mu g/m^3$)	Estimated Lifetime Excess Cancer Risk
benzene	0.13	7.8×10^{-6}	9.6	3	0.80	6.24×10^{-6}
carbon tetrachloride	0.043	6.0×10^{-6}	190	1.2	0.32	1.92×10^{-6}
trichloroethylene	0.22	4.1×10^{-6}	2.1	24	6.43	2.64×10^{-5}
1, 3-Butadeine	0.033	3.0×10^{-5}	NA	0.47	0.13	3.9×10^{-6}

Additional information concerning the evaluation cancer risk is available in Attachment 3 - Additional Exposure Evaluation Information.

Non-Cancer Health Effects

The maximum level of TCE measured in indoor air exceeded a study effect level of 21 $\mu g/m^3$ for fetal heart effects during both the February 2016 and September 2016 sampling events. The maximum level did not exceed a study effect level of 190 $\mu g/m^3$ for immune system effects (Johnson et al. 2003, Keil et al. 2009). To better evaluate the levels to which workers in the warehouse may be exposed, EEP again compared the maximum level of TCE adjusted for workplace exposure duration (11.52 $\mu g/m^3$ in February 2016 and 6.43 $\mu g/m^3$ in September 2016) to these two comparison values. The adjusted maximum values of TCE did not exceed the study effect level of 21 $\mu g/m^3$ for fetal heart effects nor the study effect level of 190 $\mu g/m^3$ for immune system effects. **However, the estimated levels of TCE could be harmful to pregnant women who spend their day in the warehouse area of the building and that strong consideration should be given to limiting any exposure.**

Additional information concerning the evaluation of non-cancer health effects is available at Attachment 3 - Additional Exposure Evaluation Information.

Additional Resources and Assistance

EEP can provide fact sheets about exposure for persons wanting to better understand risk. Workers wishing to discuss health concerns related to TCE, benzene, or carbon tetrachloride exposure may contact their personal care physician. Their physician can refer them to the Tennessee Poison Center at 800-222-1222 and the American College of

Occupational and Environmental Medicine (www.acoem.org). The Tennessee Poison Center has physicians specializing in environmental and occupational medicine.

EEP is available to review any additional data at the request of TDEC and are able to provide further guidance as appropriate. EEP and ATSDR are available to assist TDEC in communicating the health risks to building owners, workers and the community. If you have any questions regarding the findings presented in this letter, please contact me at 615-741-7247 or by email at rebecca.gorham@tn.gov.

Respectfully,

Rebecca Gorham
Environmental Health Assessor
Tennessee Department of Health
Environmental Epidemiology Program

cc: Ahmet Bulbulkaya, TDEC, DOR, Central Office
Tamal Chakaverty, Shelby County Health Department

References

[ACS] American Cancer Society, 2015. Cancer Facts and Figures 2015. Atlanta: American Cancer Society.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2006. Health Assessment Guidance on Secondary Exposures. Atlanta, GA. U.S. Department of Health and Human Services. June 5, 2006.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2014. Toxicological profile for Trichloroethylene. U.S. Department of Health and Human Services, Atlanta, GA. October 2014. Available at: http://www.atsdr.cdc.gov/toxprofiles/tp19.pdf

[ATSDR] Agency for Toxic Substances and Disease Registry. 2016. Indoor air health comparison values. Atlanta, GA: U.S. Department of Health and Human Services. November 2016.

[ENSAFE] Ensafe, Inc. 2016. Indoor Air Vapor Assessment Report. May 2016.

[ENSAFE] Ensafe, Inc. 2017. Indoor Air Vapor Assessment Report Winter and Summer Events. January 2017.

[EPA] U.S. Environmental Protection Agency. 1991. Role of the baseline risk assessment in Superfund remedy selection determination. OSWER Directive 9355.0-30. Washington, D.C.

[IRIS 2014] Integrated Risk Information System. 2014. Trichloroethylene (CASRN 79-1-6). Available at: www.epa.gov/IRIS/subst/0199.htm

[Johnson et al. 2003] Johnson P., Goldberg S., Mays M., Dawson B. 2003. Threshold of trichloroethylene contamination in maternal drinking waters affecting fetal heart development in the rat. Environ. Health. Perspect, 111, 289-292.

[Keil et al. 2009] Keil DE., Peden-Adams M M., Wallace S., Ruiz P., Gilkeson GS., 2009. Assessment of trichloroethylene (TCE) exposure in murine strains genetically-prone and nonprone to develop autoimmune disease. J Environ Sci Health A Tox Hazard Subst Environ Eng 44, 443-453.

[NTP] National Toxicology Program. 2011. Report on carcinogens, 14th ed. Research Triangle Park, NC. Available at: https://ntp.niehs.nih.gov/ntp/roc/content/profiles/trichloroethylene.pdf

REPORT PREPARATION

This Letter Health Consultation for the Building 5 Warehouse, Bayer Complex - PMC Biogenix, 1248 Warford Street, Memphis, Tennessee, was prepared by the Tennessee Department of Health's Environmental Epidemiology Program. Preparation of this report was supported by funds from a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. It is in accordance with the approved agency methods, policies, and procedures existing at the date of publication.

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Author

Rebecca P. Gorham
Environmental Health Assessor, Environmental Epidemiology Program
Tennessee Department of Health

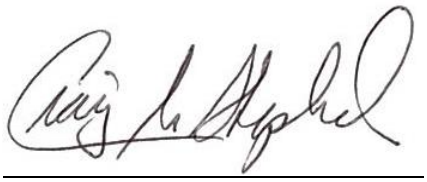
State Reviewers

Joseph P. George, PG, MS
Environmental Health Assessor, Environmental Epidemiology Program
Tennessee Department of Health

Craig A. Shepherd, MPH, REHS/RS, DAAS
Director, Environmental Epidemiology Program
Tennessee Department of Health

Certification

This Health Consultation: Building 5 Warehouse, Bayer Complex - PMC Biogenix, 1248 Warford Street, Memphis, Tennessee, was prepared by the Tennessee Department of Health's Environmental Epidemiology Program. It was prepared in accordance with the approved methodology and procedures that existed at the time the health consultation was prepared.



Director, Environmental Epidemiology Program
Tennessee Department of Health

Attachment 1 – Figure 1 – Site Map

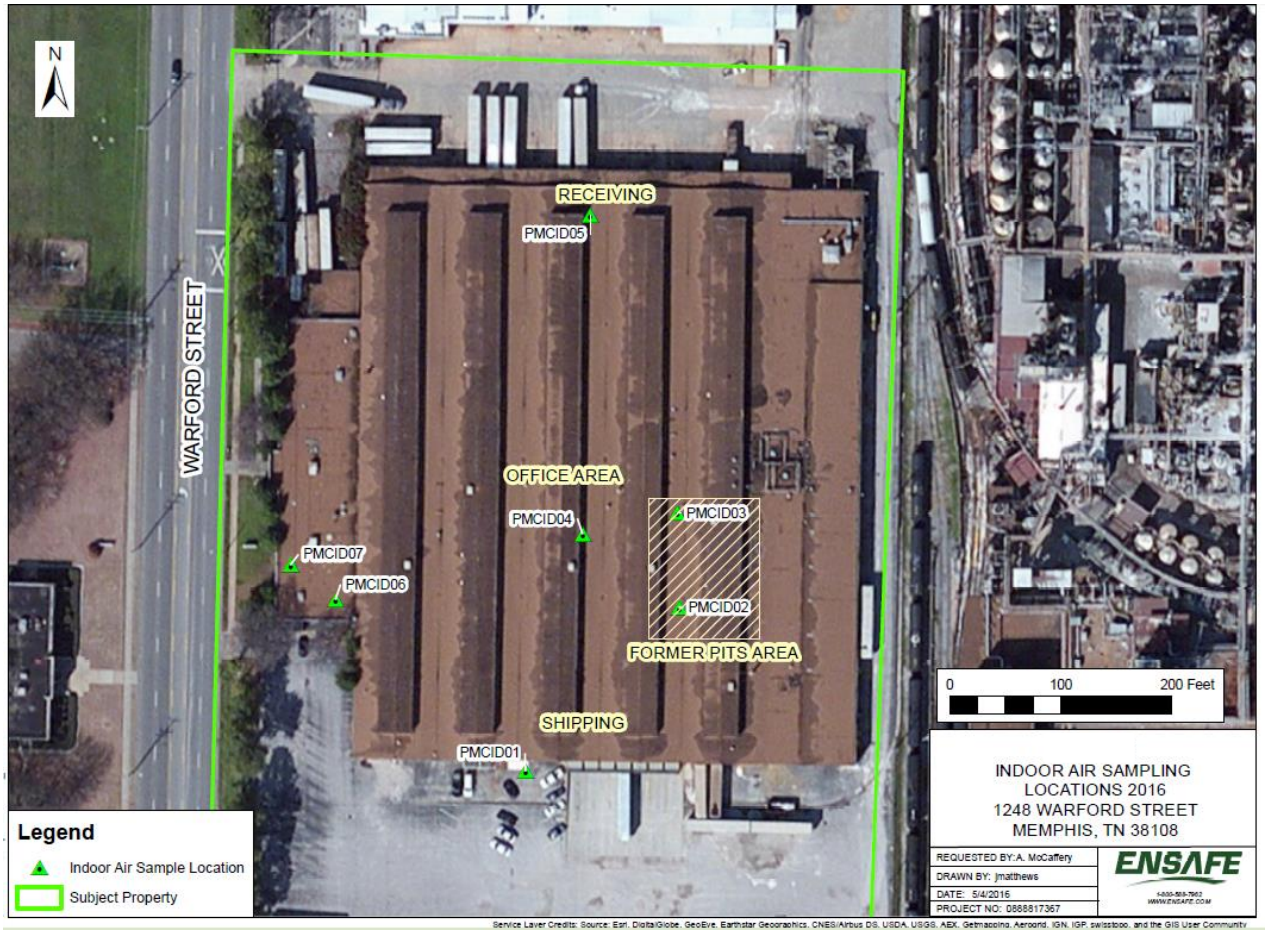


Figure 1. Building 5 Warehouse Site Map with 2016 Indoor Air Sampling Locations. Source: Indoor Air Vapor Assessment Report Winter and Summer Events, January 2017, Ensafe Inc.

Attachment 2 – Table 3 – Indoor Air Sampling Results

Analyte	ASDR Chronic EMEG	ATSDR CREG	Industrial Air RSL (µg/m3)	PMCID01		PMCID02		PMCID03		PMCID04		PMCID05		PMCID06		PMCID07	
				16Q1	16Q3	16Q1	16Q3	16Q1	16Q3	16Q1	16Q3	16Q1	16Q3	16Q1	16Q3	16Q1	16Q3
Acetone			14000	5.6	23	27	46	22	39	34	52	47	42	30	52	43	52
Benzene	9.6	0.13	1.6	0.4	1.4	0.7	1.6	0.66	1.6	0.78	3 a	0.84	2.2 a	0.77	1.6	0.61	2.2 a
Butadiene, 1,3-		0.033	0.41	0.31 U	0.2 J	0.24	0.33 J	0.18	0.33 J	0.24	0.61 J a	0.26	0.31	0.1	0.29 J	0.17	0.47 a
Carbon Disulfide	930		310	0.86	3 U	2.4 U	0.67 J	2.5 U	2.6 U	4.6	4.5 U	2.7 U	0.29 J	0.24	0.6 J	0.25	2.4 U
Carbon Tetrachloride	190	0.043	2	0.4	0.54 J	0.92	0.55 J	1.1	0.59 J	0.65	0.67 J	0.56	0.99	0.62	1.2	0.7	1.2
Chloroform	98		0.53	0.68 U	0.71 J a	0.25	0.54 J a	0.33	0.55 J a	0.79 a	0.92 J a	2.4 a	1.1 a	0.49	0.43 J	0.43	0.88 a
Chloromethane	100		39	1.3	1.4 J	1.9	1.4 J	1.7	1.6 J	1.7	1.6 J	2.2	1.5	1.6	1.6	1.6	1.3 J
Cumene			180	0.68 U	0.94 U	0.76 U	0.81 U	0.78 U	0.82 U	0.81 U	1.4 U	0.84 U	0.68 U	0.75 U	0.23 J	0.81 U	0.75 U
Cyclohexane			2600	0.48 U	0.51 J	0.17	0.22 J	0.54 U	0.29 J	0.11	0.29 J	0.11	1.4	0.18	0.95	0.1	0.42 J
Dichlorobenzene, 1,2-			88	0.84 U	1.2 U	0.93 U	0.99 U	0.95 U	1 U	0.99 U	1.8 U	1 U	0.84 U	0.91 U	0.84 J	0.99 U	0.92 U
Dichlorobenzene, 1,4-	60		1.1	0.18	1.2 U	0.39	0.99 U	0.62	0.14 J	1.9 a	0.48 J	1.5 a	1.1	24 a	2.2 a	42 a	1.1
Dichlorodifluoromethane			44	1.9	2.7	2.7	2.6	2.5	2.9	2.3	2.5	2.4	2.7	2.5	2.7	2.3	2.8
Dioxane, 1,4-	110	0.2	2.5	0.5 U	0.69 U	0.56 U	0.59 U	0.57 U	0.41 J	0.59 U	1 U	0.62 U	0.5 U	0.55 U	0.55 U	0.59 U	0.55 U
Dichloroethane, 1,2-	2400	0.038	0.47	0.56 U	0.78 U	0.63 U	0.66 U	0.64 U	0.67 U	0.66 U	1.2 U	0.69 U	0.56 U	0.28	0.62 U	0.66 U	0.62 U
Ethylbenzene	260		4.9	0.6 U	0.51 J	1.3	0.47 J	1.4	0.44 J	2.4	0.79 J	1.3	0.92	1.4	0.88	1.5	0.71
Hexane, N-	2100		310	0.49 U	2.6	0.86	0.85	0.62	0.65	0.74	1.4	1.9	1.6	1.2	1.3	0.86	1.6
Hexanone, 2-			13	2.8 U	3.9 U	0.95	1.2 J	0.83	0.69 J	1.7	0.74 J	2.1	0.42 J	1	1.3 J	1.4	0.82 J
Isopropanol			88	0.45	1.8 J	5.5	1.8 J	1	2.3	1.6	53	2.6	3.2	5.6	16	3.1	4.6
Methyl Ethyl Ketone (2-Butanone)			2200	0.96	4.3	4	5.6	2.5	4.2	3.6	3.8 J	9.5	4.5	3.2	8.9	4.7	4.8
Methyl Isobutyl Ketone (4-methyl-2-pentanone)			1300	0.57 U	0.79 U	0.22	0.67 U	0.65 U	0.96	0.27	1.2 U	0.28	0.37 J	0.28	0.74	0.25	0.47 J

Attachment 2 – Table 3 – Indoor Air Sampling Results - continued

Analyte	ASDR Chronic EMEG	ATSDR CREG	Industrial Air RSL (µg/m3)	PMCID01		PMCID02		PMCID03		PMCID04		PMCID05		PMCID06		PMCID07	
				16Q1	16Q3	16Q1	16Q3	16Q1	16Q3	16Q1	16Q3	16Q1	16Q3	16Q1	16Q3	16Q1	16Q3
Methylene Chloride	1000		260	0.32	1.5	1.5	0.76 J	1.3	0.92 J	1.4	0.91 J	1.7	4.4	3.9	2.1	1.6	0.77 J
Naphthalene	3.7		0.36	NA	0.34 J	NA	0.48 J a	NA	0.47 J a	NA	0.63 J a	NA	0.52 J a	NA	11 a	NA	0.82 J a
Propyl benzene		63	440	0.68 U	0.94 U	0.76 U	0.81 U	0.78 U	0.82 U	0.81 U	1.4 U	0.84 U	0.13 J	0.14	0.23 J	0.81 U	0.14 J
Styrene	850		440	0.59 U	0.12 J	0.66 U	0.16 J	0.67 U	0.19 J	0.7 U	0.25 J	0.73 U	0.28 J	0.65 U	1.3	0.7 U	0.17 J
Toluene	3800		2200	0.57	6.1	1.6	4.9	0.95	5.3	1.9	8.4	5.2	9.3	3.4	7	1.7	6.5
Trichloro-1,2,2-trifluoroethane, 1,1,2-			13000	0.46	0.68 J	0.65	0.59 J	0.57	0.52 J	0.52	2.2 U	0.55	0.52 J	0.64	0.51 J	0.53	0.63 J
Trichlorobenzene, 1,2,4-			0.88	5.2 U	7.1 U	5.8 U	6.1 U	5.9 U	6.2 U	6.1 U	0.68 J	6.3 U	5.2 U	5.6 U	5.6 U	6.1 U	5.7 U
Trichloroethylene	2.1	0.22	0.88	0.75 U	1 U	22 a	24 a	43 a	22 a	7.6 a	2.5 a	5.3 a	1.4 a	7.8 a	2 a	7.1 a	3.1 a
Trichlorofluoromethane			NA	1	2.3	1.8	2.2	1.6	3.3	1.8	1.8	3.6	2	2	12	1.3	1.6
Trimethylbenzene, 1,2,4-			3.1	0.68 U	0.44 J	0.28	0.36 J	0.25	0.3 J	0.3	0.8 J	0.38	0.65 J	0.59	1.1	0.22	0.66 J
Trimethylbenzene, 1,3,5-			NA	0.68 U	0.94 U	0.76 U	0.81 U	0.78 U	0.82 U	0.81 U	1.4 U	0.84 U	0.2 J	0.17	0.43 J	0.81 U	0.24 J
Xylene, o-	220		44	0.6 U	0.51 J	1.9	0.5 J	1.8	0.45 J	3.2	0.87 J	1.4	0.77	1.5	1	1.7	0.9

Source: Indoor Air Vapor Assessment Report Winter and Summer Events, January 2017, Ensafe; (ATSDR 2016)

Notes:

All units are micrograms per cubic meter (µg/m^3)

ATSDR Chronic EMEG — Agency for Toxic Substances and Disease Registry Environmental Media Evaluation Guide
ATSDR CREG — Agency for Toxic Substances and Disease Registry Cancer Risk Evaluation Guide
RSL — regional screening level adjusted to 0.1 hazard quotient and target lifetime cancer risk of $1X10^{-6}$
U — not detected
J and E — value estimated
A — exceeds RSL
16Q1 — February 2, 2016
16Q3 — September 23, 2016

Attachment 3 – Additional Exposure Evaluation Information

Cancer Health Effects of TCE Inhalation

The Department of Health and Human Services, National Toxicology Program classified TCE as reasonably anticipated to be a human carcinogen. In humans, occupational exposure to TCE was associated with excess incidences of several cancers, particularly liver cancer, non-Hodgkin lymphoma, and kidney cancer (NTP 2014). The International Agency for Research on Cancer (IARC) has determined TCE is a probable human carcinogen based on epidemiological studies showing increased rates of liver cancer and non-Hodgkin lymphoma (NHL), primarily in workers who were exposed to TCE on the job and animal studies showing increased numbers of liver and kidney tumors upon oral administration. The EPA characterized TCE as carcinogenic to humans by all routes of exposure. The oral slope factor estimate for TCE is calculated from route-to-route extrapolation of the inhalation unit risk estimate for kidney cancer with a factor of 5 applied to include NHL and liver cancer risks (IRIS 2014).

The site-specific lifetime excess cancer risk (LECR) estimates are usually expressed in terms of excess cancer cases in an exposed population in addition to the background rate of cancer. For perspective, the lifetime risk of being diagnosed with cancer in the United States is 4 per 10 individuals for males, and 3 per 10 for females (ACS 2015). The lifetime risk of being diagnosed with any of several common types of cancer ranges between 1 in 10 and 1 in 100 (ACS 2015). EPA's target cancer risk range from chemical exposure is between 1 in 10,000 and 1 in a million (EPA 1991).

Non-Cancer Health Effects of TCE Inhalation

To assess the severity of exposures and the degree to which workers within the facility may develop adverse health effects from inhalation exposures to TCE, EEP compared the adjusted maximum TCE exposure concentration to the effects levels from animal studies used to derive the EPA RfC (Johnson et al. 2003, Keil et al. 2009). The EPA used physiologically based pharmacokinetic (PBPK) modeling to convert the oral dose in animals to a human equivalent concentration (HEC) of TCE in air (IRIS 2014). EPA predicts that there is a small risk of fetal heart malformations for pregnant women exposed to TCE at 21 $\mu g/m^3$ (Johnson et al. 2003). An uncertainty factor of 10 has been applied to this study to derive the RfC. Exposures during the critical period of development, during the first trimester of pregnancy, are the largest concern for cardiac effects. The EPA RfC is also based on an additional study of immune system impacts from exposure to TCE at 190 $\mu g/m^3$ which incorporated an uncertainty factor of 100 (Keil et al. 2009). In late 2014, ATSDR adopted the EPA RfC as its chronic and intermediate Minimal Risk Level/EMEGs for TCE (ATSDR 2014).