Letter Health Consultation

Former Macon Naval Ordnance Plant
Allied Industrial Park, Unit 1
Macon, Bibb County, Georgia

Vapor Intrusion Into Indoor Air

EPA FACILITY ID: GAD003302676

August 29, 2025

Prepared by the
Georgia Department of Public Health

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Office of Capacity Development and Applied Prevention Science
Atlanta, Georgia, 30333

Health Consultation A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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The Georgia Department of Public Health (GA DPH) prepared this Letter Health Consultation for the Former Macon Naval Ordnance Plant (Allied Industrial Park, Unit 1), located in Macon, Bibb County, Georgia. This publication was made possible by a cooperative agreement (program #CDC-RFA-TS-23-0001) with the federal Agency for Toxic Substances and Disease Registry (ATSDR). GA DPH evaluated data of known quality using approved methods, policies, and procedures existing at the date of publication. ATSDR reviewed this document and concurs with its findings based on the information presented by the GA DPH.

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GEORGIA DEPARTMENT OF PUBLIC HEALTH

Kathleen E. Toomey, M.D., M.P.H., Commissioner / Brian Kemp, Governor

200 Piedmont Avenue, SE
Atlanta, Georgia 30334

dph.ga.gov

August 29, 2025

Mr. Brian Farrier and Mr. Peter Johnson
Remedial Project Manager, Superfund Division
U.S. Environmental Protection Agency, Region 4
61 Forsyth St. SW
Atlanta, GA 30303-8960

RE: Letter Health Consultation with Attachments
Unit 1 of Former Macon Naval Ordnance Plant NPL site, Allied Industrial Park
Macon, Bibb County, Georgia

Dear Mr. Ferrier and Mr. Johnson:

The Georgia Department of Public Health (DPH) developed this Letter Health Consultation (LHC) to evaluate indoor air and sub-slab soil gas sampling results. DPH looked for potential health effects from breathing indoor air, contaminated with chlorinated volatile organic compounds (VOCs), within Unit 1 of the former Macon Naval Ordnance Plant (MNOP). Unit 1, currently operated by Freudenberg Texbond LP, is located at 810 Allied Industrial Blvd. in Macon, Bibb County, Georgia. The former MNOP's National Priorities Listing prompted DPH, under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), to develop this LHC. The potential contaminants of concern at Unit 1 are trichloroethene [(TCE) CAS# 79-01-6] and vinyl chloride [(VC) CAS# 75-01-4].

We reviewed indoor air and sub-slab soil gas sample results from 2015, 2020, and 2023. Data provided by Environmental Resources Management (ERM) indicates inhalation exposure to TCE and VC within the breakroom of the facility. Our assessment shows that employees breathing VC in the breakroom were not likely to be harmed by noncancer or cancer health effects. Employees breathing TCE in the breakroom in 2020 and 2023 were not likely to be harmed by noncancer health effects in the past. However, based on 2015 TCE levels, there is a concern for increased cancer risk for employees who have worked at Unit 1 for 20 years or more. In addition, the 2015 adjusted exposure point concentration (EPC) approached the human equivalent concentration (HEC) for fetal cardiac malformation. So, pregnant women who used the breakroom in 2015 might have been at risk of having a child with fetal heart malformations. Remediation actions taken in 2015 significantly reduced TCE concentrations in the Unit 1 breakroom, as reflected in the 2020 and 2023 sampling results.

Our evaluations did have some limitations. Some indoor air samples were collected during a small snapshot of time (eight hours). There was a data gap from 2015 through 2020, and a lack of sub-slab soil sampling data from 2023. We also don't know if any doors and windows were open during the indoor air sampling events, but we can assume they were shut because sampling happened in the winter. We used health-protective exposure assumptions in this LHC to evaluate and account for some of these limitations.

We recommend yearly indoor air sampling of the breakroom, preferably during the winter. This will confirm that concentrations of TCE and VC remain below their respective Minimal Risk Levels (MRLs). The remainder of the LHC discusses our Unit 1 data assessment and how we arrived at our conclusions. We also give recommendations for preventing or reducing exposure to contaminants that enter the facility through vapor intrusion. We also inform facility personnel of the health risks associated with breathing contaminated air.

We will distribute the LHC and a fact sheet summarizing the findings to Freudenberg Texbond LP employees. Furthermore, based on the TCE groundwater plume, we recommend a similar sampling strategy and health evaluation for the nearby Unit 2 buildings.

Historical and Current Use of the Property

The former MNOP property, currently the Allied Industrial Park (AIP), is located on 433 acres of an industrialized area located in south Macon, Bibb County, Georgia [ERM 2019]. The U.S. Navy and the Reynolds Corporation produced ordnance materials at the site from 1941 until 1965. Ordnance manufactured at the MNOP included flares, small primers, detonators, and other triggering mechanisms. Allied Chemical Corporation, the subsequent owner of the property, manufactured automobile seat belts. Allied Chemical used nearly all the buildings, underground storage tanks (UST), aboveground storage tanks (AST), and utilities on the property. A wastewater treatment plant (WWTP), located near the western boundary of the property, was constructed in the early 1940s and operated until the early 1970s. The WWTP was designed to only handle sewage generated by the ordnance plant. However, chemicals may have been disposed of in drains that connected to the WWTP [ERM 2019]. The U.S. Environmental Protection Agency (EPA) placed the site on Superfund's National Priorities List (NPL) in 2013 because waste disposal practices had impacted groundwater and nearby Rocky Creek [EPA 2015a].

This LHC focuses on Unit 1 (Attachment A, Figure 1). The current occupant of Unit 1 is Freudenberg Texbond LP, also known as Freudenberg Performance Material (FPM). The company has operated at this site since 1985 and produces polyester nonwoven products, roofing material, soundproofing, and thermal insulation products. The company operates 24 hours a day and employs approximately 50 people. DPH used a typical five-day workweek for exposure calculations. There are several female adult workers under age 40 years employed at Freudenberg Texbond LP [Freudenberg 2022].

FPM owns three buildings: the Line 7 building is Unit 1. The main building and the extrusion building are in nearby Unit 2 (Attachment A, Figures 4 . There are offices, a quality control laboratory, storage, and a breakroom in Unit 1. The area of concern is the breakroom (Attachment A, Figure 3). The Unit 1 building sits on top of a groundwater plume containing chlorinated organic solvents, among other contaminants (Attachment A, Figure 2). The plume lies roughly 20 to 40 feet below the ground surface (bgs). EPA believes it originated from the former MNOP WWTP, 450 feet to the northwest of Unit 1 [EPA 2015a]. Groundwater generally flows southeast from the WWTP toward Units 1 and 2 at speeds that range from 2.2 to 12.4 feet/day [ERM 2023].

The Unit 1 building is used for textile manufacturing and printing and has several cabinets containing chemicals that are stored and used in Unit 1. In addition, Unit 1 building workers receive and wear dry-cleaned uniforms on a weekly basis. In the southeast corner of the building, near the breakroom, is a smoking area and door that opens into the building [EPA 2022].

Environmental Contamination

The EPA, along with representatives of the potentially responsible parties (PRPs), is currently investigating the former MNOP. EPA is overseeing vapor intrusion (VI) sampling because a known groundwater plume containing TCE and its breakdown products underlies many of the 15 investigative units on the property. ATSDR selects contaminants for further evaluation using comparison values (CVs), which are media-specific health-based screening levels. We used ATSDR's CVs for air, water, and soil gas to select contaminants and identify pathways that needed additional evaluation. Unit 1 VI sampling results showed TCE levels above CVs in both sub-slab soil gas and indoor air samples. They also showed VC in indoor air and possibly in some sub-slab soil gas samples. The groundwater conditions and the vadose zone soil conditions underneath the buildings are both important considerations for potential vapor intrusion.

According to a site soil survey, the soils at the MNOP site are mostly composed of sandy loam. This soil type drains relatively well and is somewhat porous, allowing potential organic vapors to move freely up the vadose zone from the groundwater contaminant plume. Sub-slab sampling, however, showed that the soils directly beneath the slab of Unit 1 were relatively tight and more claylike. These soils were more than likely brought in for construction and are much less porous, preventing free movement of organic vapors underneath the Unit 1 building. But they are not complete vapor barriers. They can develop cracks that allow movement of vapors throughout, especially with dry conditions beneath the concrete slab [EPA 2015c].

Elevated TCE and VC levels were found in the employee breakroom area of Unit 1 in 2015 [ERM 2019]. Indoor air sampling was not conducted again until 2020, and elevated TCE and VC levels were once again detected in indoor air above ATSDR’s CVs. In 2020, TCE was detected in sub-slab soil gas but did not exceed ATSDR’s noncancer soil gas CVs. Steps have been taken to reduce TCE to acceptable levels in indoor air at these locations. These steps included increased air circulation, installation of additional air purification filters, and the sealing of cracks in the building foundation. From 2015 to 2020 TCE concentrations decreased significantly in the employee breakroom [EPA 2015c]. Indoor air sampling results were provided again in 2023 but no sub-slab soil gas samples were taken. Concentrations of TCE in indoor air further decreased from 2020 to 2023.

TCE is volatile, moderately water-soluble, and readily migrates from contaminated surface soil into the sub-surface soil. TCE is a dense, nonaqueous phase liquid (DNAPL) that can move through the unsaturated (vadose) zone, where it displaces water and dissolves in it. TCE volatilizes rapidly from water, and its volatility increases with increasing temperature [NC DEQ 2018]. Volatilization of TCE from soil is slower than with water but is faster than that of many other VOCs. In the subsurface, the dominant fate of TCE is volatilization rather than

degradation. Chemical degradation and biodegradation rates of TCE in the soil and groundwater are slow, with a biodegradation half-life of months to years [ATSDR 2019]. Biodegradation products of TCE through anaerobic processes include dichloroethene (DCE), VC, and ethylene [NC DEQ 2018].

Vinyl chloride (VC) is a colorless gas. It burns easily and is not stable at high temperatures. It has a mild, sweet odor that may become noticeable at 3,000 parts per million (ppm) in air. VC is a manufactured substance that does not occur naturally. It can form when other substances such as trichloroethane (TCA), TCE, and tetrachloroethene (PCE) break down. VC in water or soil evaporates rapidly if it is near the surface [ATSDR 2006].

Sub-Slab Soil Gas Assessment

Tables 1 and 2 present a summary of sub-slab soil gas results collected from beneath Unit 1 by Environmental Resources Management (ERM) from 2015 and 2020. ERM collected and analyzed nine sub-slab soil gas samples, all from winter months. ERM collected four samples in February 2015, four in January 2020, and one in January 2023. Sub-slab soil gas concentrations with "U" qualifier (undetected at reported detection limit) were included in the sample results but were considered not detected. The "U" qualifier means that the concentration of analyte was not detected above the reference reporting limit [ATSDR 2022b]. ERM installed a vapor pin to collect representative samples of soil gas immediately below the floor slab. The samples were collected with 1-liter Summa canisters and sent for laboratory analysis of VOCs using US EPA Method-TO15 [ERM 2019, 2023]. ERM performed the sampling event with windows and doors closed. This reflected normal winter working conditions in Unit 1, in accordance with Section 3.2 of the 2015 USEPA Vapor Intrusion Guidance [EPA 2015b]. The main contaminant of concern, TCE, was detected in high concentrations in sub-slab soil gas and exceeded health-based comparison values in eight out of the nine samples. The highest levels detected were 6,800 $\mu g/m^3$, 265 $\mu g/m^3$, and 41.1 $\mu g/m^3$. Table 1 provides a summary, with more detailed results in Table 2.

VC in sub-slab soil gas was not detected in 2015 and 2020. However, two of eight samples had very high detection limits, far above the CVs for VC. Because of the two high detection limits, it's uncertain whether VC is present in groundwater beneath Unit 1. Other VOCs (PCE; 1,1 DCE; and 1,2 DCE) were present in soil gas but were not above their CVs. These VOCs are not likely to migrate to indoor air of Unit 1 at levels of health concern.

Sample locations (Map ID) are shown in Figures 3 and 4 in Attachment A. Sub-slab soil gas data confirms significant TCE contamination below Unit 1: a source for vapor intrusion into the interior of the facility. Table 2 includes VC because it was found in indoor air in 2015 and 2020 above screening comparison values. It isn't clear if VC was found in sub-slab soil gas because of high detection limits in two sub-slab soil gas samples. VC was not detected in sub-slab soil gas in other areas of the building.

Table 1: Summary of Sub-Slab Soil Gas Contaminants and Concentrations Exceeding Health-based Comparison Values in at Least One Medium

Analyte	Concentration Range (µg/m³) *	Samples Exceeding Comparison Value	Comparison Value[1] (µg/m³) and type
Trichloroethene (TCE)	0.029 – 6,800	5 out of 9 3 out of 9	7 CREG[2] 70 cEMEG[3]

* µg/m³: micrograms of analyte per cubic meter of air

** VC was not detected in 2015 and 2020 in soil gas. However, in 2015, two samples of eight had detection limits orders of magnitude above its CV of 3.7 µg/m³ but were reported as not detected at 260U and 270U µg/m³ (Details in Table 2).

[1] Comparison Value: Health-based screening value used to select contaminants for further evaluation.

[2] CREG: ATSDR cancer risk evaluation guide. CREGs (2021) are an estimated contaminant concentration in water, soil, or air that is unlikely to result in no more than one excess cancer in a million persons exposed during their lifetime (78 years). EMEG: ATSDR environmental media evaluation guide. EMEGs represent an estimated contaminant concentration in water, soil, or air below which humans exposed during a specific timeframe (acute, intermediate, or chronic) are not expected to experience noncarcinogenic health effects.

[3] cEMEG: ATSDR chronic (exposure for more than 365 days) Environmental Media Evaluation Guideline for Ambient Air (2021).

Table 2: Summary of Sub-Slab Soil Gas Contaminants and Concentrations from Winter 2015, Winter 2020, and Winter 2023 Exceeding Health-based Comparison Values in at Least One Medium. See Figure 3 for SS-1 locations and Figure 4 for VI-MNOP locations.

Analyte	Map ID	2015 Sub-Slab Soil Gas Concentration (µg/m³)*	Map ID	2020 Sub-Slab Soil Gas Concentration (µg/m³)*	2023 Sub-Slab Soil Gas Concentration (µg/m³)*	Comparison Value[1] (µg/m³) and type
Trichloroethene (TCE)	VI-MNOP-17	0.29	SS-1-1	<2.3[5]	Not Sampled	7 (CREG[2]) 70 (cEMEG[3])
Trichloroethene (TCE)	VI-MNOP-18	2.4 U[4]	SS-1-2	**12.1**~	Not Sampled	7 (CREG[2]) 70 (cEMEG[3])
Trichloroethene (TCE)	VI-MNOP-19	**6600**~	SS-1-3	**265**~	Not Sampled	7 (CREG[2]) 70 (cEMEG[3])
Trichloroethene (TCE)	VI-MNOP-19	**6800**~	SS-1-4	<2.32[5]	**41.1**~	7 (CREG[2]) 70 (cEMEG[3])
Vinyl Chloride (VC)	VI-MNOP-17	1.1 U[4]	SS-1-1	<1.09[5]	Not Sampled	3.7 (CREG[2])
Vinyl Chloride (VC)	VI-MNOP-18	1.1 U[4]	SS-1-2	<1.04[5]	Not Sampled	3.7 (CREG[2])
Vinyl Chloride (VC)	VI-MNOP-19	260 U[4]	SS-1-3	<1.14[5]	Not Sampled	3.7 (CREG[2])
Vinyl Chloride	VI-MNOP-19	270 U[4]	SS-1-4	<1.1[5]	Not Sampled	3.7 (CREG[2])

(VC)						

* µg/m^3: micrograms of analyte per cubic meter of air

~Indicates the concentration is greater than a comparison value or values. Such concentrations have also been **bolded**.

[1] Comparison Value: Health-based screening value used to select contaminants for further evaluation.

[2] CREG: ATSDR cancer risk evaluation guide. CREGs (2021) are an estimated contaminant concentration in water, soil, or air that is unlikely to result in no more than one excess cancer in a million persons exposed during their lifetime (78 years). EMEG: ATSDR environmental media evaluation guide. EMEGs represent an estimated contaminant concentration in water, soil, or air below which humans exposed during a specific timeframe (acute, intermediate, or chronic) are not expected to experience noncarcinogenic health effects.

[3] cEMEG: ATSDR chronic (exposure for more than 365 days) Environmental Media Evaluation Guideline for Ambient Air (2021).

[4] U= analyte not detected above the reference reporting limit

[5] < = Compound not detected at concentrations above the laboratory reporting limit. The laboratory reporting limit is shown.

VC was not detected in 2015 and 2020 in soil gas, and it was not sampled in 2023. However, in 2015, two samples of eight had detection limits orders of magnitude above its CV of 3.7 µg/m^3 but were reported as not detected at 260U and 270U µg/m^3. VC is included in the screening table because it was found in indoor air in 2015 and 2020 above screening comparison values. It isn't clear, because of high detection limits in two samples, if it was also present in these sub-slab soil gas samples.

Indoor Air Assessment

Tables 3 and 4 summarize indoor air results collected at the former MNOP Unit 1 from 2015, 2020, and 2023. Nine indoor air samples were collected and analyzed: Four in winter and spring 2015, four in winter 2020, and one in winter 2023 [ERM 2023]. ERM collected the samples via summa canister over an eight-hour period. ERM performed the sampling event with windows/doors opened and/or closed to reflect normal working conditions in Unit 1 in accordance with Section 3.2 of the 2015 USEPA Vapor Intrusion Guidance [EPA 2015b]. If the contaminant was a known or probable carcinogen, we used ATSDR's cancer risk evaluation guide (CREG) as a health-based comparison value (CV) to screen it for further evaluation. The main contaminant of concern, TCE, was detected at elevated concentrations in Unit 1, mainly in the breakroom area. TCE and VC exceeded ATSDR's CREGs (Table 2). TCE exceeded the chronic environmental media evaluation guideline (cEMEG) for noncancer health effects (Tables 4 and 5). In addition, other contaminants (PCE; VC; 1,1 DCE; *trans*-1,2 DCE, and *cis*-1, 2 DCE) were also detected in the Unit 1 building (Table 3).

Table 3: Summary of Indoor Air Contaminants and Concentrations from 2015 and 2020. See Figure 3 for IA-1 locations and Figures 4 and 5 for VI-MNOP locations.

Analyte	Map ID	2015 Indoor Air Concentration (µg/m^3)*	Comparison Value[1] (µg/m^3)* and type	Map ID	2020 Indoor Air Concentration (µg/m^3)*
PCE	VI-MNOP-21	<3.7 U[5]	41 (cEMEG[3]) 3.8 (CREG[2])	IA-1-1	<0.136[7]
PCE	VI-MNOP-20	<4.4 U	41 (cEMEG[3]) 3.8 (CREG[2])	IA-1-2	<0.136
PCE	VI-MNOP-20	<4.5 U	41 (cEMEG[3])	IA-1-3	<0.136

			3.8 (CREG[2])		
PCE	VI-MNOP-20	<93 U	41 (cEMEG[3]) 3.8 (CREG[2])	IA-1-4	<0.136
1,1-DCE	VI-MNOP-21	<2.1 U	4 (cEMEG)	IA-1-1	<0.079
1,1-DCE	VI-MNOP-20	<2.5 U	4 (cEMEG)	IA-1-2	<0.079
1,1-DCE	VI-MNOP-20	0.32 J, O[6]	4 (cEMEG)	IA-1-3	<0.079
1,1-DCE	VI-MNOP-20	<53 U	4 (cEMEG)	IA-1-4	0.159
trans-1,2 DCE	VI-MNOP-21	<2.3 U	12,000 (aEMEG[4])	IA-1-1	<0.079
trans-1,2 DCE	VI-MNOP-20	<58 U	12,000 (aEMEG[4])	IA-1-2	<0.079
trans-1,2 DCE	VI-MNOP-20	<2.7 U	12,000 (aEMEG[4])	IA-1-3	<0.079
trans-1,2 DCE	VI-MNOP-20	<2.8 U	12,000 (aEMEG[4])	IA-1-4	0.115
cis-1,2 DCE	VI-MNOP-21	<2.2 U	No ATSDR CV	IA-1-1	<0.079
cis-1,2 DCE	VI-MNOP-20	64	No ATSDR CV	IA-1-2	<0.079
cis-1,2 DCE	VI-MNOP-20	2 J, O	No ATSDR CV	IA-1-3	0.139
cis-1,2 DCE	VI-MNOP-20	11	No ATSDR CV	IA-1-4	8.52

Note: Sample locations MNOP-20 and IA-1-4 are the same sample locations in the employee breakroom.
* µg/m^3: micrograms of analyte per cubic meter of air
[1] Comparison value: Health-based screening value.
[2] CREG: ATSDR cancer risk evaluation guide (2021) based on an excess lifetime cancer risk of 1E-6 (a concentration expected to cause no more than 1 additional cancer case in 1,000,000 exposed people)
EMEG: An EMEG is an estimate of daily human exposure to a chemical (in mg/kg/day) that is likely to be without noncarcinogenic health effects over a specified duration of exposure to include acute, intermediate, and chronic exposures.
[3] cEMEG: ATSDR chronic (exposure for more than 365 days) Environmental Media Evaluation Guideline for Ambient Air (2021)
[4] aEMEG: ATSDR acute (exposure for less than 14 days) Environmental Media Evaluation Guideline for Ambient Air (2021).
[5] U= analyte not detected above the reference reporting limit
[6] J, O= estimated value, analysis lost or not performed
[7] < = Compound not detected at concentrations above the laboratory reporting limit. The laboratory reporting limit is shown.

Table 4: Summary of Unit 1 Indoor Air Contaminants and Concentrations Exceeding Health-based Comparison Values

Indoor Air Analyte	Concentration Range (µg/m^3)*	Samples Exceeding Comparison Value	Comparison Value[1] (µg/m^3)*and type
Trichloroethene	0.107 - 230	7 of 9 2 of 9	0.21 CREG[2] 2.1 cEMEG[3]
Vinyl Chloride	0.86 – 16	5 of 8	0.11 CREG[2]

* µg/m^3: micrograms of analyte per cubic meter of air
[1] Comparison value: Health-based screening value.
[2] CREG: ATSDR cancer risk evaluation guide (2021) based on an excess lifetime cancer risk of 1E-6 (a concentration expected to cause no more than 1 additional cancer case in 1 million exposed people)
EMEG: An EMEG is an estimate of daily human exposure to a chemical (in mg/kg/day) that is likely to be without noncarcinogenic health effects over a specified duration of exposure to include acute, intermediate, and chronic exposures.
[3] cEMEG: ATSDR chronic (exposure for more than 365 days) Environmental Media Evaluation Guideline for Ambient Air

(2021)

Table 5: Summary of Indoor Air Contaminants and Concentrations from 2015, 2020, and 2023 Exceeding Health-based Comparison Values. See Figure 3 for IA-1 locations and Figure 5 for VI-MNOP locations.

Analyte	Map ID for 2015 data	2015 Indoor Air Concentration (µg/m³)*	Map ID for 2020 and 2023 data	2020 Indoor Air Concentration (µg/m³)*	2023 Indoor Air Concentration (µg/m³)*	Comparison Value[1] (µg/m³)* and type
Trichloro-ethene (TCE)	VI-MNOP-21	**0.85~**	IA-1-1	0.107	Not Sampled	2.1 (cEMEG[3]) 0.21 (CREG[2]
Trichloro-ethene (TCE)	VI-MNOP-20	**7.1~**	IA-1-2	0.134	Not Sampled	2.1 (cEMEG[3]) 0.21 (CREG[2]
Trichloro-ethene (TCE)	VI-MNOP-20	**35~**	IA-1-3	**0.355~**	Not Sampled	2.1 (cEMEG[3]) 0.21 (CREG[2]
Trichloro-ethene (TCE)	VI-MNOP-20	**230~**	IA-1-4	**6.45~**	**2.63~**	2.1 (cEMEG[3]) 0.21 (CREG[2]
Vinyl Chloride (VC)	VI-MNOP-21	**1.4 U[4]~**	IA-1-1	<0.051[5]	Not Sampled	0.11 (CREG[2])
Vinyl Chloride (VC)	VI-MNOP-20	**16~**	IA-1-2	<0.051[5]	Not Sampled	0.11 (CREG[2])
Vinyl Chloride (VC)	VI-MNOP-20	**0.86~**	IA-1-3	<0.051[5]	Not Sampled	0.11 (CREG[2])
Vinyl Chloride (VC)	VI-MNOP-20	**4~**	IA-1-4	**2.05~**	**1.25~**	0.11 (CREG[2])

Note: Sample locations MNOP-20 and IA-1-4 are the same sample locations in the employee breakroom.
* µg/m³: micrograms of analyte per cubic meter of air
~Indicates the concentration is greater than the recommended comparison value for TCE or VC (µg/m³). Such concentrations have also been bolded.
[1] Comparison value: Health-based screening value.
[2] CREG: ATSDR cancer risk evaluation guide (2021) based on an excess lifetime cancer risk of 1E-6 (a concentration expected to cause no more than 1 additional cancer case in 1 million exposed people)
EMEG: An EMEG is an estimate of daily human exposure to a chemical (in mg/kg/day) that is likely to be without noncarcinogenic health effects over a specified duration of exposure to include acute, intermediate, and chronic exposures.
[3] cEMEG: ATSDR chronic (exposure for more than 365 days) Environmental Media Evaluation Guideline for Ambient Air (2021).
[4] U= analyte not detected above the reference reporting limit
[5] < = Compound not detected at concentrations above the laboratory reporting limit. The laboratory reporting limit is shown.

Evaluation Process

A two-stage evaluation process was used in the assessment of indoor air data. The first step is reviewing available sampling data and selecting contaminants that warrant further evaluation. This initial step involves screening indoor air concentrations using ATSDR CVs. If a chemical exceeds the recommended CV, we evaluate it further.

DPH then considers how people could come into contact with the contaminants that exceed their recommended CV. The level of exposure depends on the concentration of the contaminants and the route, frequency, and duration of exposure. This information is essential for determining if people could experience harmful effects and whether a public health hazard exists. The next step involves an in-depth health-effects evaluation of these contaminants. The

primary focus is determining the potential for cancer and noncancer health effects in people who work in Unit 1 [ATSDR 2020a].

DPH uses ATSDR environmental media evaluation guides (EMEGs) to evaluate noncarcinogenic health effects and cancer risk evaluation guides (CREGs) for carcinogenic health effects. CVs such as the EMEG and CREG offer a high degree of protection and assurance that people are unlikely to be harmed by contaminants in the environment. CREGs represent levels that are calculated to increase the estimated risk of cancer by about one additional cancer in a million people exposed. From the results illustrated in Table 4, TCE and VC are the only contaminants that exceeded an indoor air health-based CV during the sampling events. Therefore, they are the potential contaminants of concern in the next section.

Potential Contaminants of Concern

Trichloroethene (TCE)

TCE is a clear, colorless, nonflammable liquid that has a sweet, fruity odor characteristic of chloroform. The odor threshold is approximately 100 parts per million (ppm). TCE does not occur naturally, so its presence indicates manufacture, use, or storage. It is used mainly as a degreaser for metal parts. It is also used as a solvent in other ways and is used to make other chemicals. TCE can also be found in some household products, including typewriter correction fluid, paint removers, adhesives, and spot removers. The biggest source of TCE in the environment is evaporation from the factories that use it. Once TCE is in the air, about half will be broken down within a week. If released to the soil, TCE generally does not break down. It migrates into groundwater, where it does break down at a very slow rate [ATSDR 2019].

People are usually exposed to TCE in air or water. If a person breathes TCE, about half of it will get into the bloodstream and organs. The rest will be exhaled. With skin contact, some TCE can enter the body, although not as easily as when breathed or swallowed [ATSDR 2019]. Once TCE is in the blood, the liver changes much of it into other chemicals. Most of these breakdown products leave the body in the urine within a day. A person will also quickly breathe out much of the TCE in their bloodstream. Some of the TCE or its breakdown products can be stored in body fat for a brief period and thus may build up in your body if exposure continues [ATSDR 2019].

Some human studies indicate that trichloroethylene may cause developmental effects such as spontaneous abortion, congenital heart defects, central nervous system defects, and small birth weight. However, these people were exposed to other chemicals as well. In some animal studies, exposure to trichloroethylene during development may have caused effects such as decreased body weight, increased incidences of heart defects, functional or structural changes in the developing nervous system, and effects on the immune system [ATSDR 2019].

Vinyl Chloride (VC)

VC is a colorless gas. It burns easily, is not stable at high temperatures, and has a mild, sweet odor. Vinyl chloride is a volatile compound used almost exclusively by the plastics industry to produce polyvinyl chloride (PVC) and several VC derived copolymers in the United

States. It can form when other substances, such as trichloroethane (TCA), tetrachloroethene (TCE), and perchloroethylene (PCE), break down in the environment by bactrerial degradation. VC in water evaporates rapidly if it is near the surface. VC released to soil either volatilizes rapidly from soil surfaces or leaches readily through soil, ultimately entering groundwater. When released to the atmosphere, vinyl chloride is expected to be removed by reaction with photochemically generated hydroxyl radicals (half-life of 1–2 days) At one time, VC was used as a refrigerant, as an aerosol propellant in spray cans, and as an ingredient of drug and cosmetic products; however, these practices were banned by the EPA in 1974 [ATSDR 2024].

People are usually exposed to VC in air or water. If VC gas contacts your skin, tiny amounts could enter your body. At low levels (<20 parts per million [ppm]), most of the VC that you breathe, or swallow enters your bloodstream rapidly, then travels throughout your body. When VC reaches your liver, your liver changes it into several substances (metabolites). Most of these new metabolites also travel in your bloodstream; once they reach your kidneys, they are excreted in urine. Most of the VC is eliminated from your body a day after you breathe or swallow it. The liver, however, makes new metabolites that do not leave your body as rapidly. A few of these new metabolites are more harmful than VC because they react with chemicals inside your body and interfere with the way your body normally uses or responds to these chemicals. Some of these metabolites react in the liver and, depending on how much VC you breathed in, and could cause liver damage. Eventually your body eliminates these metabolites as well [ATSDR 2024].

Exposure Assumptions

ATSDR recommends assuming a full-time worker exposure scenario of 8.5 hours a day, five days a week, and 50 weeks per year for 20 years as a reasonable maximum exposure (RME). A reasonable central tendency exposure (CTE) is 8.5 hours a day, five days a week, and 50 weeks per year for five years. Site-specific conditions could warrant an adjustment to these standard assumptions [ATSDR 2020a].

CTE refers to individuals who have an average or typical exposure to a contaminant in a work environment. RME refers to the high end of the exposure distribution (approximately the 95th percentile) for the exposed population. The RME scenario is for assessing exposures that are higher than average but are still within a realistic range of exposure. An exposure factor (EF) is an expression of how often and how long a person could be contacting a substance in the environment. In many instances, the EF will equal 1, representing a daily, continuous exposure to the contaminant. However, exposures can occur on an intermittent or irregular basis (such as in a work environment). Therefore, the EF can be less than 1.

Indoor air in the breakroom area of Unit 1 had the highest concentration of TCE and VC. However, employees do not occupy the breakroom 8.5 hours a day. Exposure assumptions for a full-time employee are 1.5 hours a day in the breakroom, five days a week, for 50 weeks per year. Exposure assumptions include using 20 years of employment as a reasonable RME, and five years as a reasonable CTE. Table 6 summarizes exposure factors for full-time employees at Unit 1 based on areas.

Table 6: Summary of Noncancer Exposure Factors for Employees Working at Unit 1

Scenarios	Reasonable Maximum Exposure (RME)[2] (20 years)	Central Tendency Exposure (CTE)[3] (5 Years)	Breakroom[4] Reasonable Maximum Exposure (RME)[2] (20 years)	Breakroom[4] Central Tendency Exposure (CTE)[3] (5 Years)
Exposure Assumption	8.5 hours per day	8.5 hours per day	1.5 hours per day	1.5 hours per day
Exposure Factor[1]	0.24	0.24	0.0428	0.0428

[1] Exposure factor (EF): An expression of how often and how long a person may be contacting a substance in the environment. See Attachment B for calculations.
[2] RME: Reasonable maximum exposure factor. RME refers to the high end of the exposure distribution (approximately the 95th percentile) for the exposed population. The RME scenario is intended to assess exposures that are higher than average but are still within a realistic range of exposure.
[3] CTE: Central tendency exposure concentration. CTE refers to individuals who have average or typical exposure to a contaminant.
[4] Breakroom: The exposure scenario is intended to assess exposures of employees working at facility during breakroom usage of 1.5 hours per day.

Exposure Point Concentration (EPC) Evaluation

Table 6 summarizes the adjusted EPCs based on site-specific exposure factor scenarios. To find the adjusted EPC, we multiplied the maximum indoor air concentration from the breakroom with the exposure factor value (0.0428) from Table 6. Sample EPC calculations are available in Attachment B. We calculated the EPC for the breakroom only because the highest concentrations of TCE and VC were found there in 2015, 2020, and 2023. Other areas in Unit 1 contained very low concentrations of TCE, and VC was not detected (see Table 5). Therefore, the adjusted EF is based on workers being in the breakroom for 1.5 hours per workday, five days per week, and 50 weeks per year.

In Table 7, we calculated the adjusted EPC values using the maximum indoor air concentration of TCE in that specific area. The adjusted EPC of TCE in Unit 1 in 2015 was 9.9 $\mu g/m^3$. It decreased to 0.28 $\mu g/m^3$ in 2020 and to 0.11 $\mu g/m^3$ in 2023. The adjusted EPC of VC in Unit 1 in 2015 was 0.69 $\mu g/m^3$. It decreased to 0.088 $\mu g/m^3$ in 2020 and to 0.054 $\mu g/m^3$ in 2023.

Indoor air samples from other rooms in Unit 1 showed either nondetectable or very low levels of TCE and VC. There is some uncertainty in the adjusted EPC values because we assumed workers were exposed only in the breakroom, not in other rooms in Unit 1. Although VC was detected in indoor air, it was not detected in the sub-slab soil gas. However, there were two samples with high detection limits and some uncertainty about its presence in those soil gas samples.

Limitations

One limitation was not knowing if doors and windows were open during the indoor air sampling events. But because sampling was done in the winter months, we assumed they were shut except for when people entered and exited the building. If doors were opened frequently during the sampling events, contaminant concentrations found may be underestimated. Indoor air samples were collected during a small snapshot of time and thus may not have been reflective of

temporal changes that can occur over longer periods of time. Seasonal indoor air sampling with concurrent outdoor air and sub-slab gas sampling is recommended for assessing exposure risks during different seasonal conditions. Using indicators, tracers, and surrogate technology[1] can increase confidence in the results.

[1] Temperature Measurement Fact Sheet (https://iavi.rti.org/assets/docs/Temp_Measurement_Fact_Sheet_int.pdf), Pressure Measurement Fact Sheet (https://iavi.rti.org/assets/docs/Pressure_Measurement_Fact_Sheet_Int.pdf), Radon Methods Fact Sheet (https://iavi.rti.org/assets/docs/Radon_methods_fact_sheet_int.pdf)

Table 7: Summary of Adjusted Exposure Point Concentrations in the Unit 1 Breakroom based on 1.5 Hours per Day Exposure Assumption

Indoor Air Analyte	Year	Area in Unit 1 Breakroom	Maximum Indoor Air Concentration (µg/m^3)*	Exposure Factor	Adjusted Exposure Point Concentration (EPC)[1] (µg/m^3)*
TCE	2015	VI-MNOP20	230	0.0428	**9.9~**
TCE	2020	IA-1-4	6.45	0.0428	**0.28~**
TCE	2023	IA-1-4	2.63	0.0428	0.11
VC	2015	VI-MNOP20	16	0.0428	**0.68~**
VC	2020	IA-1-4	2.05	0.0428	0.088
VC	2023	IA-1-4	1.25	0.0428	0.054

Note: Sample locations MNOP-20 and IA-1-4 are the same sample locations in the employee breakroom.
TCE: Trichloroethene
VC: Vinyl chloride
* µg/m^3: micrograms of analyte per cubic meter of air
~Indicates the concentration is greater than the recommended comparison value for TCE or VC (µg/m^3). Such concentrations have also been bolded.
[1] Exposure point concentration (EPC): The representative contaminant concentration within an exposure unit or area in an exposure pathway to which people are exposed for acute (1-14 days), intermediate (15-364 days), or chronic (365+ days) durations during the past, present, or future.

Toxicological Evaluation

To assess health impacts, we compare the doses calculated for exposure to individual chemicals to an established health guideline. These guidelines include ATSDR minimal risk levels (MRLs) or U.S. EPA reference doses (RfDs) or concentrations (RfCs). They are chemical-specific values that are based on available scientific literature and are considered protective of human health. Noncarcinogenic effects, unlike carcinogenic effects, are believed to have a threshold—a dose below which adverse health effects will likely not occur.

TCE Noncancer Health Effects

The primary health concerns for employees in Unit 1 are associated with inhalation of TCE that has migrated into indoor air via vapor intrusion from groundwater. Studies of low-level exposures in rats and mice [ATSDR 2019] showed reductions in thymus weight [Kiel et al. 2009] and the development of fetal heart malformations during a three-week window [Johnson et al. 2003]. Although these studies involved TCE exposure through drinking water, physiological-based pharmacokinetic (PBPK) modeling was used to extrapolate oral doses in animals to human equivalent concentrations (HECs) in air. The MRL of 2.1 µg/m^3 was derived from the Keil study, which identified immunological effects, and the Johnson study, which identified

developmental heart effects. ATSDR adopted the EPA RfC as both the intermediate and chronic inhalation MRLs for TCE exposure [ATSDR 2019].

Unit 1 indoor air concentrations were above the MRL for TCE in the breakroom in 2015. They were significantly lower in 2020 and 2023. The HEC for a 1% extra risk of fetal cardiac malformations is 21 $\mu g/m^3$, while the HEC for decreased thymus weight is 180 $\mu g/m^3$ [EPA 2011]. For fetal heart malformations, EPA used an uncertainty factor of 10 to account for human variation and species differences. For decreased thymus weight, EPA used an uncertainty factor of 100 to account for the use of the lowest observed adverse effects level (LOAEL), as well as human variation and species differences. The midpoint between the candidate RfC for the two critical effects (rounding to one significant digit) was used to derive the TCE RfC of 2.1 $\mu g/m^3$ [Kiel et al. 2009].

The adjusted EPCs assume that employees occupy the breakroom no more than 1.5 hours per day and were used to assess exposure for noncancer health effects. The highest adjusted EPC detected in the breakroom in 2015 (9.9 $\mu g/m^3$) exceeded the MRL for chronic inhalation of TCE by approximately five times. In addition, the 2015 adjusted EPC approached the HEC for fetal cardiac malformation (21 $\mu g/m^3$). The adjusted concentration (9.9 $\mu g/m^3$) was only two times below the HEC calculated from animal studies that showed a small risk of fetal heart malformation. Exposure of pregnant women to TCE levels above the MRL does not mean that fetal heart development will be impaired. However, breathing air approaching or exceeding 21 $\mu g/m^3$ of TCE begins to introduce a small risk to proper fetal development. Therefore, pregnant women who used the breakroom in 2015 might have been at risk of having a child with fetal heart malformations.

The adjusted concentration (9.9 $\mu g/m^3$) was 19 times below the HEC (180 $\mu g/m^3$) calculated from animal studies that showed a decreased thymus weight, an indicator of possible immune effects (Table 8). Pregnant women and other workers who used the breakroom in 2015 were not at risk of decreased thymus weight [ATSDR 2019].

The adjusted EPC did not exceed the MRL in both 2020 and 2023 (Table 8). There's no risk of harmful effects because the adjusted TCE concentrations were below the MRL.

Table 8: Summary of Adjusted TCE EPC Exceeding MRL and HEC Based on Animal Studies

Sampling Year	Sampling ID	Adjusted TCE EPC[1] (µg/m³*)	EPC Exceeded MRL[2] For TCE (2.1 µg/m³*)	HEC[3] Associated with Thymus Changes (180 µg/m³*)	HEC Associated with Fetal Heart Malformations (21 µg/m³*)
2015	VI-MNOP20	9.9	Exceeded	19 times lower	2 times lower
2020	IA-1-4	0.28	No	679 times lower	75 times lower
2023	IA-1-4	0.11	No	1727 times lower	190 times lower

Note: Sample locations MNOP-20 and IA-1-4 are the same sample locations in the employee breakroom.
TCE: Trichloroethene
* µg/m³: micrograms of analyte per cubic meter of air
[1]Exposure point concentration (EPC): The representative contaminant concentration within an exposure unit or area in an exposure pathway to which people are exposed for acute (1-14 days), intermediate (15-364 days), or chronic (365+ days) durations during the past, present, or future.
[2]MRL: ATSDR minimal risk level for TCE and vinyl chloride (2021). An MRL is defined as an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (noncancer) over a specified duration of exposure. MRLs are based on noncancer health effects only. MRLs can be derived for acute (1-14 days), intermediate (15-364 days), or chronic (365+ days) duration exposures by the inhalation and oral routes.
[3]HEC: human equivalent concentration based on animal studies.

Cancer Risks

In addition to noncancer health risks, long-term inhalation of TCE can also increase the chance of developing certain cancers. The EPA released an extensive toxicological review of TCE, in which they reclassified it as "carcinogenic to humans by all routes of exposure" [USEPA 2011]. The National Toxicology Program has also determined that TCE is "reasonably anticipated to be a human carcinogen." Kidney cancer is the most consistent and convincing evidence of an association with TCE exposure in humans. However, there are also compelling links with cancers of the lymphoid tissues (lymphoma) and liver [USEPA 2011].

Duration is another important factor in estimating someone's risk of getting cancer from work exposure. We estimated cancer risk based on working at the facility for five and 20 years. The average worker works at a job for five years, while some stay for 20 years.

Typically, screening levels for carcinogens are based on one excess cancer case per 1 million individuals and assume that people are exposed to the same concentration over their lifetime. Because workers are not exposed for their entire lifetime, we estimated cancer risk based on their working at the facility for different durations. DPH considers estimated cancer

risks of less than one additional cancer case among 1 million persons exposed as insignificant and not a health concern (expressed exponentially as 1 x 10^{-6}).

Table 9 summarizes the cancer risks for employees from ages 21 to 65 years who spend 1.5 hours a day in the breakroom for five to 20 years. We calculated cancer risks using ATSDR's Public Health Assessment Site Tool (PHAST) [ATSDR 2020]. Bolded values are a concern for increased cancer risk. See Attachment B for examples of estimated excess cancer risk calculations associated with exposure to the maximum concentration of TCE detected in the breakroom during different years. Also, refer to Attachment B for estimated excess cancer risk calculations associated with VC exposure to the maximum concentration detected in the breakroom.

Table 9: Summary of Cancer Risk in the Unit 1 Breakroom

Indoor Air Analyte	Year	Cancer Risk* RME[1] (20yrs)	Cancer Risk* CTE[2] (5yrs)
TCE	2015	**$1x10^{-5}$~**	**$3x10^{-6}$~**
TCE	2020	$3x10^{-7}$	$7x10^{-8}$
TCE	2023	$1x10^{-7}$	$3x10^{-8}$
VC	2015	$8x10^{-7}$	$2x10^{-7}$
VC	2020	$1x10^{-7}$	$3x10^{-8}$
VC	2023	$6x10^{-8}$	$2x10^{-8}$

* 1.5 hours a day total spent in breakroom
TCE: Trichloroethene
VC: Vinyl chloride
~Indicates the cancer risk exceeds one excess cancer case per 1 million individuals. Such exceedances have also been bolded. Bolded values are a concern for increased cancer risk.
[1]RME: Reasonable maximum exposure dose. RME refers to the high end of the exposure distribution (approximately the 95th percentile) for the exposed population. The RME scenario is intended to assess exposures that are higher than average but are still within a realistic range of exposure.
[2]CTE: Central tendency exposure concentration. CTE refers to individuals who have average or typical exposure to a contaminant.

Cancer risks for 20 years

The estimated excess cancer risks shown in Table 9 assume that workers are exposed to the same continuous concentration of TCE for 20 years (RME, long employment durations).

Using 2015 sampling data, workers spending 1.5 hours in the breakroom every day for a five-day work week have the highest cancer risk. They have an estimated increased cancer risk of approximately ten (10) excess cancers in a population of a million workers exposed to the same TCE concentration for 20 years. Using 2020 and 2023 sampling data, workers spending 1.5 hours in the break room every day for a five-day work week have an estimated increased cancer risk below one in a million. Their estimated cancer risk is insignificant and not a health concern.

Cancer risk decreases as employment duration and time in the break room decrease. Cancer risk from VC exposure is insignificant and is not a health concern.

Cancer risks for five years

The estimated excess cancer risks shown in Table 9 assume that workers are exposed to the same concentration of TCE for five years (CTE, average employment duration).

Using 2015 sampling data, workers spending 1.5 hours in the breakroom every day for a five-day work week have the highest estimated cancer risk. They have an estimated increased cancer risk of approximately three (3) excess cancers in a population of a million workers exposed to the same TCE concentration for five years. Based on 2020 and 2023 sampling data, the estimated cancer risks are also below one in a million, respectively. These are considered insignificant estimated excess cancer risks and are not a health concern. Cancer risk from VC exposure is insignificant and is not a health concern.

Conclusions

DPH evaluated past and current exposure to TCE from breathing indoor air at the Unit 1 breakroom at the former MNOP. This evaluation includes an assessment of inhalation exposures and the possible noncancer and cancer risks from breathing air with TCE and VC.

DPH reached the following conclusions:

1. Some employees may have experienced adverse noncancer health effects from their exposure to TCE in indoor air. Exposure concentration varies based on sampling year. Potential noncancer health effects from TCE exposure within Unit 1 are specified below:

   Pregnant women who used the breakroom in Unit 1 during 2015 might have had a slight risk of having a child with fetal heart development problems. Their exposure levels were approaching the human equivalent concentrations calculated from experiments with animal studies. Employees exposed to the levels of TCE found in the breakroom are unlikely to be harmed by immune system impacts. The levels of TCE were 19 times lower than the human equivalent concentrations calculated from experiments with animals that showed decreased thymus weight.

   These conclusions assume employees were exposed to TCE in the breakroom for 1.5 hours per day for five days per week. We also assumed that the concentrations detected in the breakroom are representative of air concentrations throughout the year. Worker exposure is lower with less time in the breakroom. There also might have been periods where exposures were higher, thus increasing the risk for harmful noncancer health effects from breathing TCE.

   a. 2020 and 2023 Sampling Years: Employees exposed to TCE in indoor air via vapor intrusion for five to 20 years in the breakroom of Unit 1 are not expected to

be harmed.

The levels of TCE were lower than the MRL and noncancer health effects are not likely.

2. Cancer risk varies depending upon sampling year. The following cancer risks are based on assuming workers worked for short periods (five years) or long periods (20 years) in Unit 1 and were exposed to TCE in indoor air. We have a concern for increased cancer risk for most personnel using the breakroom in Unit 1 in 2015. Breathing TCE for long periods at this concentration can increase the risk of kidney cancer, liver cancer, and non-Hodgkin's lymphoma.

   Cancer risk for TCE based on five years of exposure

   a. 2015: We do not have a concern for increased cancer risk for employees breathing TCE from vapor intrusion in the breakroom (three in a million). Their actual risk is lower because employees were not exposed to elevated levels for a long time.

   b. 2020: The estimated cancer risk for TCE is lower. For the typical employee who works five years or less at the facility, the estimated increased cancer risk is less than one in a million, so this is not a concern.

   c. 2023: The cancer risk for TCE reduces slightly. The estimated cancer risk for the typical employee who works five years or less at the facility is also less than one in a million. This is not a concern.

   Cancer risk for TCE based on 20 years of exposure

   a. 2015: We have a concern for increased cancer risk for employees breathing TCE from vapor intrusion in the breakroom (ten in a million).

   b. 2020: Cancer risk for TCE is approximately 0.3 in a million; this is not a concern.

   c. 2023: Cancer risk for TCE is approximately 0.1 in a million; this is not a concern.

3. Employees exposed to VC from vapor intrusion for five to 20 years in the breakroom are not expected to experience cancer health effects. Based on these data:

   a. The estimated cancer risks for the typical employee who works five to 20 years at the facility range from approximately 0.02 to 0.8 in a million This is not a concern.

   b. VC was detected in indoor air but not in the sub-slab soil gas. However, there were two samples with high detection limits and some uncertainty about its presence in those soil gas samples.

4. Based on sub-slab soil gas data, there will be potential for vapor intrusion of TCE at unacceptable risk levels until contamination in the sub-slab and groundwater is sufficiently reduced or removed.

Recommendations

To protect the current and future health of individuals working at Freudenberg Texbond LP, DPH recommends the following actions:

1. EPA is highly encouraged to inform employees of past elevated TCE and VC concentrations in the Unit 1 breakroom, the potential health risks associated with TCE and VC inhalation and plans to mitigate TCE and VC exposure in the breakroom.

2. The EPA/PRP is highly encouraged to perform indoor air sampling during winter at Unit 1 to confirm that concentrations of TCE and VC remain below their respective MRLs. It is important to note that indoor air samples were collected during a small snapshot of time and thus may not have been reflective of temporal changes that can occur over longer periods of time. In addition, we recommend winter indoor air sampling, with concurrent outdoor air and sub-slab gas sampling, to assess exposure risks with windows and doors shut. Using indicators, tracers, and surrogate technology can increase confidence in the results and provide more accurate data. Vapor intrusion rates can fluctuate with changes in season and the use of heating and cooling systems. Temperature and humidity can affect monitors, so these parameters would also have to be monitored. Additional actions by PRP to reduce exposure may include implementing indoor air filtration and ventilation and sealing all cracks and openings on the floors (slab) in Unit 1.

3. Based on the TCE groundwater plume map (Figure 2), the buildings in Unit 2 may need to be evaluated for TCE and other chlorinated solvents in indoor air, concurrently with sub-slab soil gas and outdoor air. Seasonal samples (hot and cold weather when windows and doors are likely closed) may also need to be taken in Unit 2 as well.

Public Health Action Plan

DPH will:

1. Distribute a fact sheet to Unit 1 employees summarizing our findings. Make sure that health education on TCE and VC exposure reaches those employees.

2. Continue to review sampling data and take action as additional data become available.

3. Continue to respond to all requests for information and health concerns regarding the safety of breathing indoor air.

DPH and ATSDR are available to review additional data and assist with communicating health risks to the facility owner and employees. If you have any questions about the findings presented in this letter, please contact Franklin Sanchez at (404) 657- 6534 or Franklin.sanchez@dph.ga.gov.

Sincerely,

Franklin Sanchez, REHS

Director and Principal Environmental Exposure Risk Assessor
Chemical Hazards Program, Environmental Health Section
Georgia Department of Public Health
200 Piedmont Ave | East Tower, Suite 486 | Atlanta, GA 30334
P (404) 657-6534
Franklin.sanchez@dph.ga.gov

Cc: Amy Potter, Risk Assessment Senior Program Manager, Georgia Environmental Protection Division
Carla Coley, DPH District 5-2 Environmental Health Director

Preparers of Report

Author:

Anita Saha, MS
Chemical Hazards Program
Georgia Department of Public Health – Atlanta, GA

State Reviewer:

Franklin Sanchez, REHS
Chemical Hazards Program
Georgia Department of Public Health – Atlanta, GA

ATSDR Cooperative Agreement Coordinator and Technical Project Officer:

Audra Henry, MS
Cooperative Agreement Coordinator
Office of Capacity Development and Applied Prevention Science

John Truhe, MPH
Technical Project Officer
Office of Capacity Development and Applied Prevention Science

ATSDR Regional Representative:

Katheryn L. (Leann) Bing
Region 4 Regional Representative
Office of Community Health and Hazard Assessment

For questions about this report, please contact:

Chemical Hazards Program
Environmental Health Section
Georgia Department of Public Health
200 Piedmont Ave | East Tower, Suite 486 | Atlanta, GA 30334

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Attachment A: Maps and Images

Figure 1: Former Macon Naval Ordnance Plant at 600 Guy Paine Road, Macon, GA 31206. Unit 1, which is the focus of this letter health consultation and is highlighted in yellow, is at 810 Allied Industrial Blvd., Macon, Bibb County, GA. Currently, Freudenberg Texbond LP is operating at Unit 1. *Map Credit: Environmental Resources Management (ERM).*

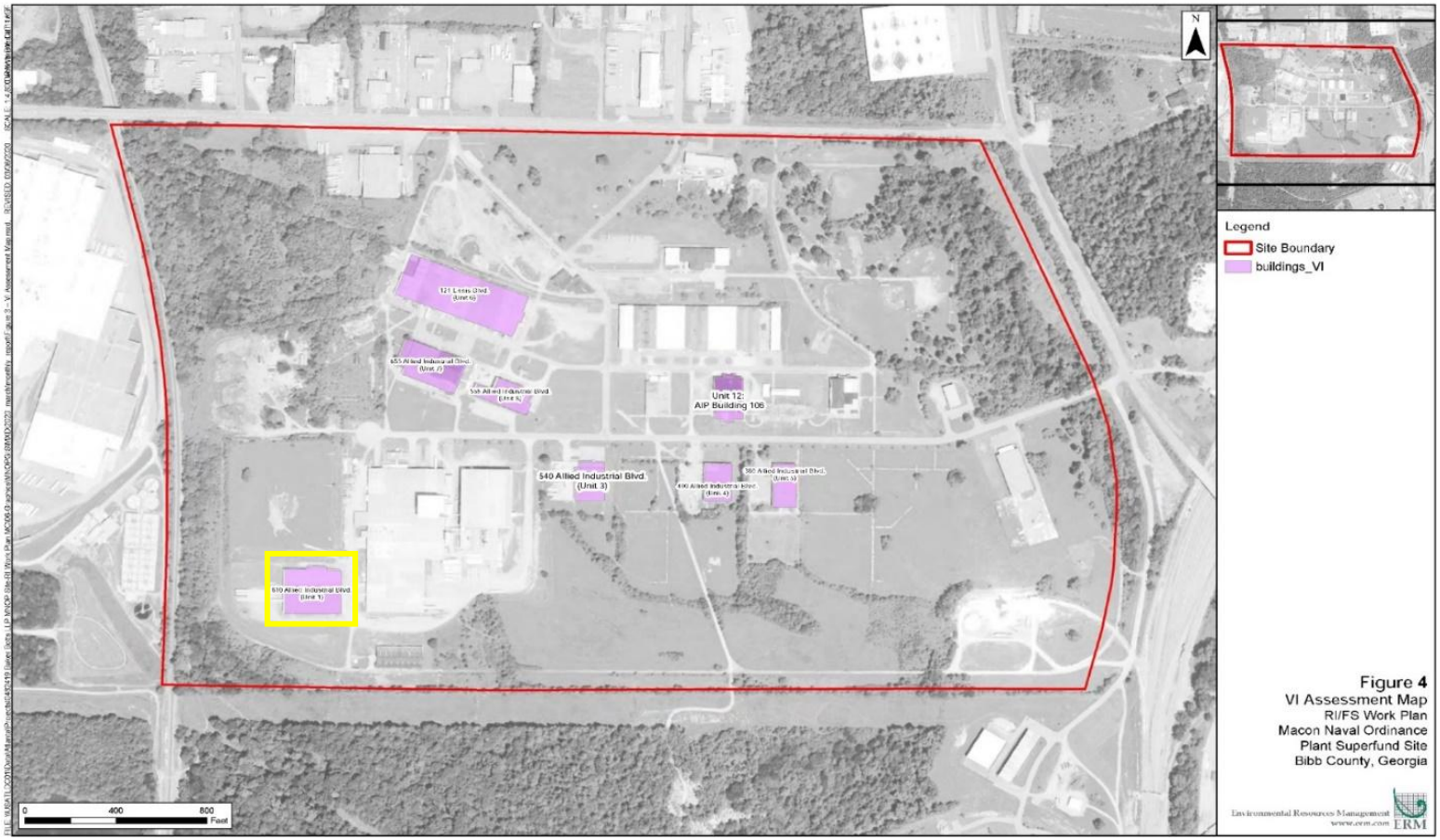
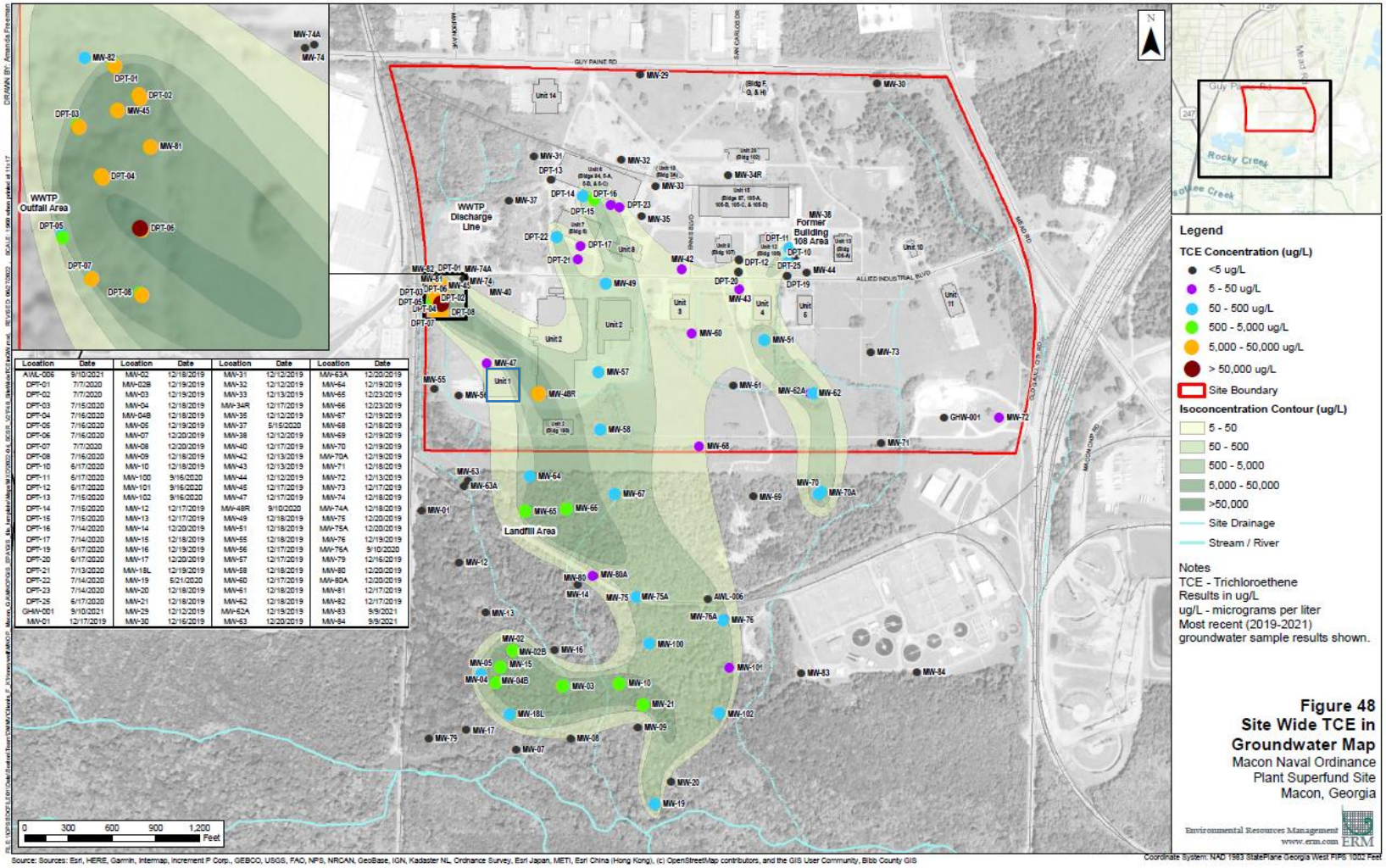
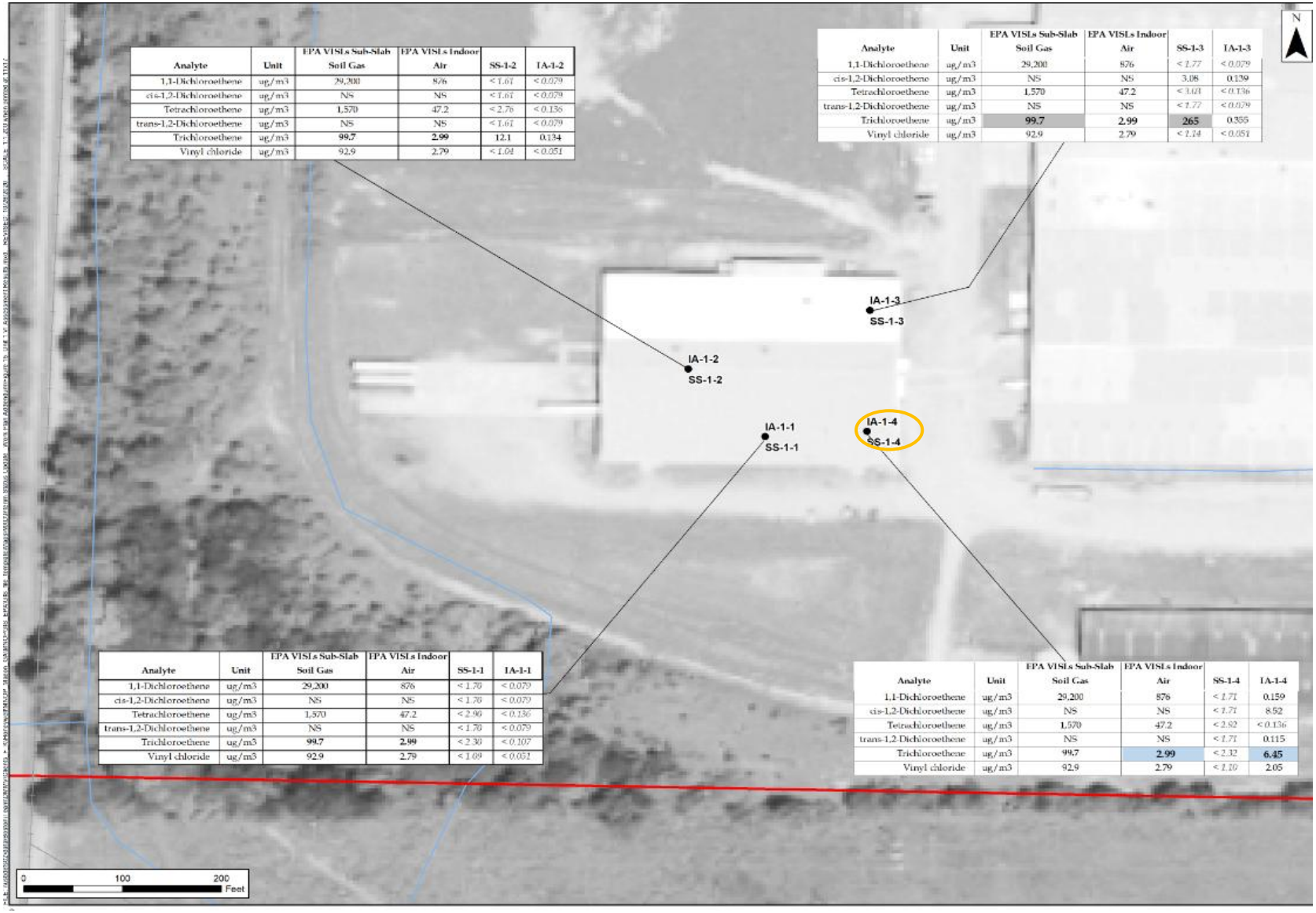


Figure 2: Site-wide TCE in Groundwater at Former Macon Naval Ordnance Plant at 600 Guy Paine Road, Macon, GA 31206. Unit 1 [highlighted in blue] is at 810 Allied Industrial Blvd., Macon, Bibb County, GA. Currently, Freudenberg Texbond LP is operating at Unit 1. *Map Credit: Environmental Resources Management (ERM).*



Location	Date	Location	Date	Location	Date	Location	Date
AWL-006	9/10/2021	MW-02	12/18/2019	MW-31	12/12/2019	MW-63A	12/20/2019
DPT-01	7/7/2020	MW-02B	12/19/2019	MW-32	12/12/2019	MW-64	12/19/2019
DPT-02	7/7/2020	MW-03	12/19/2019	MW-33	12/13/2019	MW-65	12/23/2019
DPT-03	7/15/2020	MW-04	12/18/2019	MW-34R	12/17/2019	MW-66	12/23/2019
DPT-04	7/16/2020	MW-04B	12/18/2019	MW-35	12/12/2019	MW-67	12/19/2019
DPT-05	7/16/2020	MW-05	12/19/2019	MW-37	5/15/2020	MW-68	12/18/2019
DPT-06	7/16/2020	MW-07	12/20/2019	MW-38	12/12/2019	MW-69	12/19/2019
DPT-07	7/7/2020	MW-08	12/20/2019	MW-40	12/17/2019	MW-70	12/19/2019
DPT-08	7/16/2020	MW-09	12/18/2019	MW-42	12/13/2019	MW-70A	12/19/2019
DPT-10	6/17/2020	MW-10	12/18/2019	MW-43	12/13/2019	MW-71	12/18/2019
DPT-11	6/17/2020	MW-100	9/16/2020	MW-44	12/12/2019	MW-72	12/13/2019
DPT-12	6/17/2020	MW-101	9/16/2020	MW-45	12/17/2019	MW-73	12/17/2019
DPT-13	7/15/2020	MW-102	9/16/2020	MW-47	12/17/2019	MW-74	12/18/2019
DPT-14	7/15/2020	MW-12	12/17/2019	MW-48R	9/10/2020	MW-74A	12/18/2019
DPT-15	7/15/2020	MW-13	12/17/2019	MW-49	12/18/2019	MW-75	12/20/2019
DPT-16	7/16/2020	MW-14	12/20/2019	MW-51	12/18/2019	MW-75A	12/20/2019
DPT-17	7/14/2020	MW-15	12/18/2019	MW-55	12/18/2019	MW-76	12/19/2019
DPT-19	6/17/2020	MW-16	12/19/2019	MW-56	12/17/2019	MW-76A	9/10/2020
DPT-20	6/17/2020	MW-17	12/20/2019	MW-57	12/17/2019	MW-79	12/16/2019
DPT-21	7/13/2020	MW-18L	12/19/2019	MW-58	12/18/2019	MW-80	12/20/2019
DPT-22	7/14/2020	MW-19	5/21/2020	MW-60	12/17/2019	MW-80A	12/20/2019
DPT-23	7/14/2020	MW-20	12/18/2019	MW-61	12/18/2019	MW-81	12/17/2019
DPT-25	6/17/2020	MW-21	12/18/2019	MW-62	12/18/2019	MW-82	12/17/2019
GHW-001	9/10/2021	MW-29	12/12/2019	MW-62A	12/19/2019	MW-83	9/9/2021
MW-01	12/17/2019	MW-30	12/16/2019	MW-63	12/20/2019	MW-84	9/9/2021

Figure 3: Indoor air and sub-slab 2020 sampling locations at Unit 1. Unit 1 is located at 810 Allied Industrial Blvd., Macon, Bibb County, GA. Currently, Freudenberg Texbond LP is operating at Unit 1. *Map Credit: ERM.*



Analyte	Unit	EPA VISLs Sub-Slab Soil Gas	EPA VISLs Indoor Air	SS-1-2	IA-1-2
1,1-Dichloroethene	ug/m3	29,200	876	< 1.61	< 0.079
cis-1,2-Dichloroethene	ug/m3	NS	NS	< 1.61	< 0.079
Tetrachloroethene	ug/m3	1,570	47.2	< 2.76	< 0.136
trans-1,2-Dichloroethene	ug/m3	NS	NS	< 1.61	< 0.079
Trichloroethene	ug/m3	**99.7**	**2.99**	12.1	0.134
Vinyl chloride	ug/m3	92.9	2.79	< 1.04	< 0.051

Analyte	Unit	EPA VISLs Sub-Slab Soil Gas	EPA VISLs Indoor Air	SS-1-3	IA-1-3
1,1-Dichloroethene	ug/m3	29,200	876	< 1.77	< 0.079
cis-1,2-Dichloroethene	ug/m3	NS	NS	3.08	0.139
Tetrachloroethene	ug/m3	1,570	47.2	< 3.03	< 0.136
trans-1,2-Dichloroethene	ug/m3	NS	NS	< 1.77	< 0.079
Trichloroethene	ug/m3	**99.7**	**2.99**	**265**	0.355
Vinyl chloride	ug/m3	92.9	2.79	< 1.14	< 0.051

Analyte	Unit	EPA VISLs Sub-Slab Soil Gas	EPA VISLs Indoor Air	SS-1-1	IA-1-1
1,1-Dichloroethene	ug/m3	29,200	876	< 1.70	< 0.079
cis-1,2-Dichloroethene	ug/m3	NS	NS	< 1.70	< 0.079
Tetrachloroethene	ug/m3	1,570	47.2	< 2.90	< 0.136
trans-1,2-Dichloroethene	ug/m3	NS	NS	< 1.70	< 0.079
Trichloroethene	ug/m3	**99.7**	**2.99**	< 2.30	< 0.107
Vinyl chloride	ug/m3	92.9	2.79	< 1.09	< 0.051

Analyte	Unit	EPA VISLs Sub-Slab Soil Gas	EPA VISLs Indoor Air	SS-1-4	IA-1-4
1,1-Dichloroethene	ug/m3	29,200	876	< 1.71	0.159
cis-1,2-Dichloroethene	ug/m3	NS	NS	< 1.71	8.52
Tetrachloroethene	ug/m3	1,570	47.2	< 2.82	< 0.136
trans-1,2-Dichloroethene	ug/m3	NS	NS	< 1.71	0.115
Trichloroethene	ug/m3	**99.7**	**2.99**	< 2.32	**6.45**
Vinyl chloride	ug/m3	92.9	2.79	< 1.10	2.05

Figure 4: Indoor air and sub-slab 2015 sampling locations at Units 1 and 2. Unit 1 is located at 810 Allied Industrial Blvd. in Macon, Bibb County, GA. Currently, Freudenberg Texbond LP is operating at Units 1 and 2. *Map Credit: ERM.*

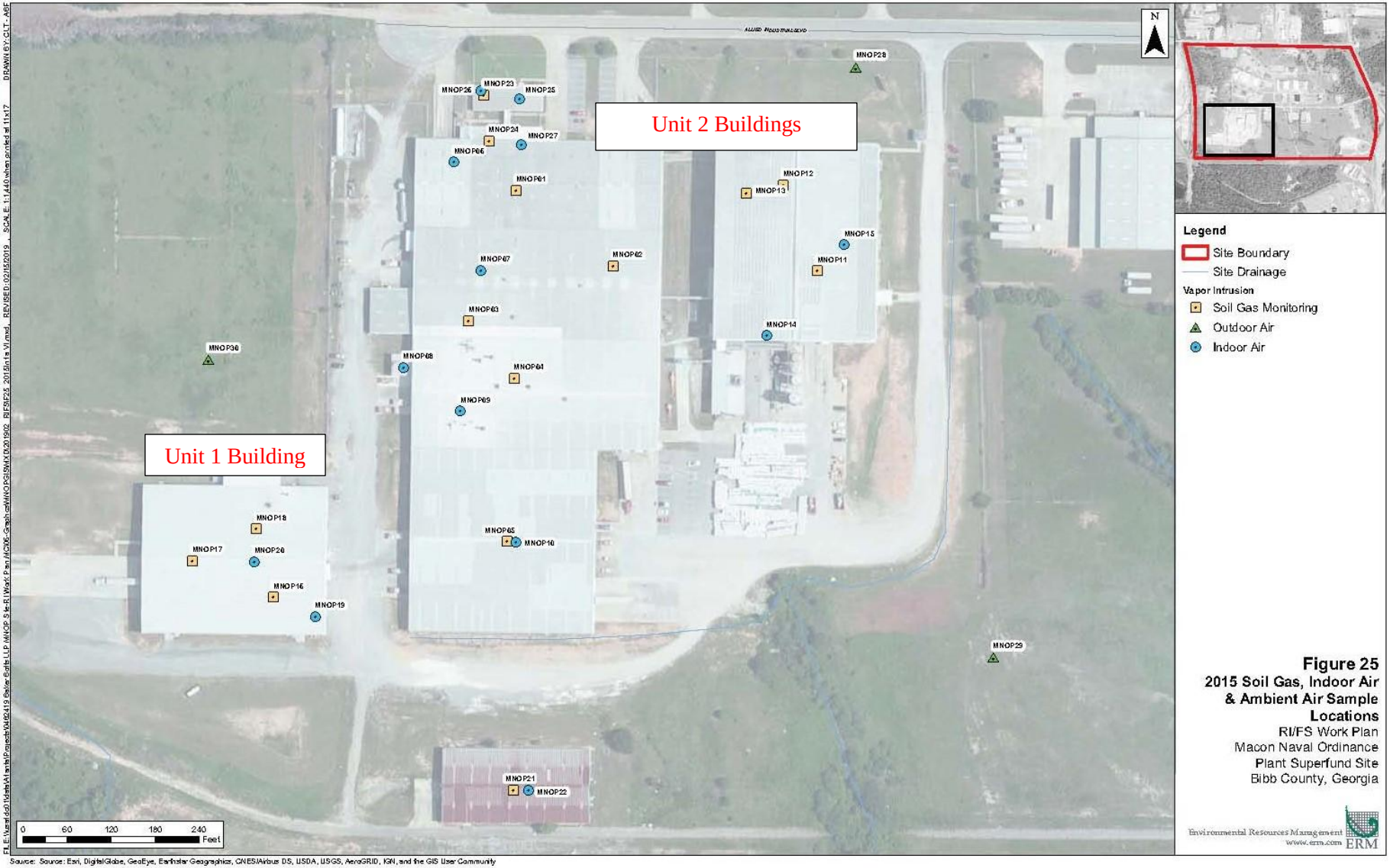
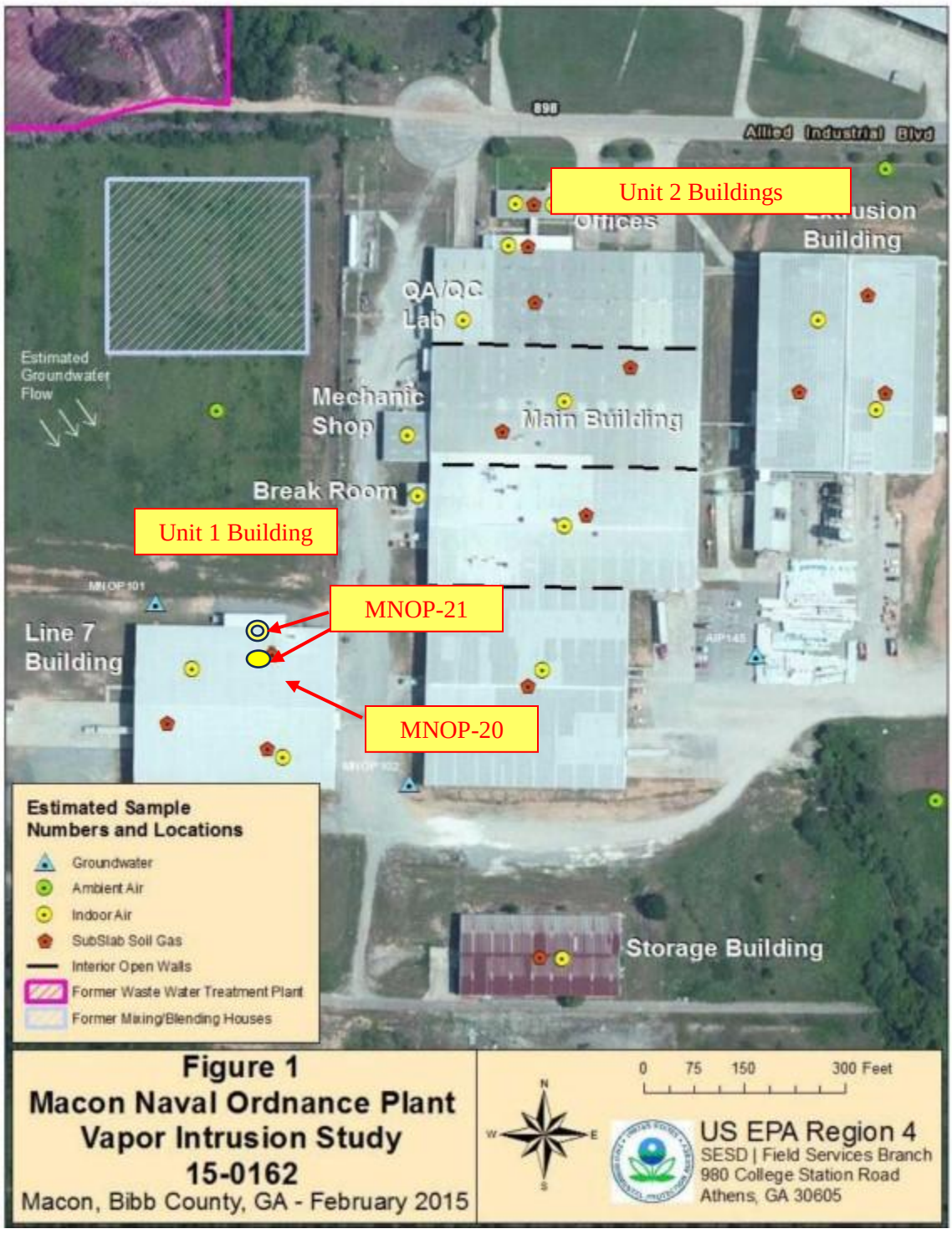


Figure 5: 2015 Sampling locations at Unit 1. Unit 1 is located at 810 Allied Industrial Blvd., Macon, Bibb County, GA. Currently, Freudenberg Texbond LP is operating at Unit 1. *Map Credit: U.S. EPA*



Attachment B: Explanation of Evaluation Process

Step 1: The Screening Process

To evaluate the available data, DPH used comparison values (CVs) to determine which chemicals to examine more closely. CVs are contaminant concentrations found in a specific environmental media (air, soil, water, sediment, and food) that are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of environmental media that someone might inhale or ingest each day. CVs are generated to be conservative and non-site specific. The CV is used as a screening level during the public health assessment or health consultation process. CVs are not intended to be environmental cleanup levels or to indicate that health effects occur at concentrations that exceed these values.

CVs can be based on either carcinogenic (cancer-causing) or noncarcinogenic effects. Cancer-based CVs are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factors for ingestion exposure, or inhalation risk units for inhalation exposure. Non-cancer CVs are calculated from ATSDR's minimal risk levels, EPA's reference doses, or EPA's reference concentrations for ingestion and inhalation exposure. When a cancer and noncancer CV exist for the same chemical, the lower of these values is used as a conservative measure.

Step 2: Evaluation of Public Health Implications

The next step in the evaluation process is to take those contaminants that are above their respective CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Adult exposure doses (or the amount of a contaminant that gets into a person's body) are calculated for site-specific scenarios, using assumptions regarding an individual's likelihood of exposure to contaminants in indoor air. A brief explanation of the calculation of estimated exposure doses used in this health consultation is presented below.

Adjusted Exposure Point Concentration (EPC) Concentration:

Adjusted Exposure Point Concentration = Max Concentration x Exposure Factor

Example: Indoor Air EPC (Breakroom) = 230µg/m^3 x 0.043 = 9.846 µg/m^3

Exposure Factor (EF) Calculation:

Reasonable Maximum Exposure: 1.5 hours exposures per day for 20 years

$$\text{EF} = \frac{1.5\frac{hr}{d}\times 5\frac{d}{wk}\times 50\frac{wk}{yr}\times 20yr}{24\frac{hr}{d}\times 7\frac{d}{wk}\times 52.14\frac{wk}{yr}\times 20yr} = 0.043$$

Central Tendency Exposure: 1.5 hours exposures per day for five years

$$\text{EF} = \frac{1.5\frac{hr}{d}\times 5\frac{d}{wk}\times 50\frac{wk}{yr}\times 5yr}{24\frac{hr}{d}\times 7\frac{d}{wk}\times 52.14\frac{wk}{yr}\times 5yr} = 0.043$$

Step 3: Cancer Risk Evaluation

Exposure to a cancer-causing chemical, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated risk for developing cancer from exposure to contaminants associated with breathing indoor air in Unit 1 was calculated by multiplying the adjusted air concentrations by EPA's chemical-specific inhalation unit risks (IURs) available at www.epa.gov/iris. The adjusted air concentration was determined based on the following factors:

- How many hours per day someone worked/used the room (typically 8.5 hours/day),
- How many days a week someone worked (typically five days/week), and
- How many years someone worked (ranged from three to 25 years).

This calculation estimates an excess cancer risk expressed as a proportion of the population that may be affected by a carcinogen during a lifetime of exposure. For example, an estimated risk of 1×10^{-6} predicts the probability of one additional cancer over background in a population of 1 million exposed persons. An increased lifetime cancer risk is not an estimate of expected cancers in the workforce or community. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime in his or her lifetime following exposure to a particular contaminant under specific exposure scenarios.

In the case of TCE, the inhalation unit risk and oral slope factor estimates reflect lifetime risk for cancer at multiple sites, and a mutagenic mode of action has been established for one of these sites, the kidney. EPA provides three organ-specific cancer potency factors for TCE (kidney, liver, and non-Hodgkin's lymphoma) for calculating cancer risk. Because TCE is mutagenic for kidney cancers, ADAFs are applied to only the kidney portion of the cancer risk.

As shown the examples, it is assumed that an individual is exposed to the ATSDR MRL/cEMEG of 2.1 $\mu g/m^3$ of TCE in air from birth through age 78 years. The steps in the calculations are described below. A summary of the estimated cancer risks associated with specific areas in Unit 1 and based on different exposure scenarios is provided in Table 7 of this health consultation.

All calculations were performed using ATSDR's Public Health Assessment Site Tool (PHAST). The steps in the calculation are as follows:

CR = Adjusted EPC x IUR x (ED ÷ LY)

ADAF-adjusted CR = (Adjusted EPC x IUR) x (ED ÷ LY) x ADAF

Total CR = Sum of the CR for all exposure groups

CR = cancer risk (unitless), EPC = exposure point concentration ($\mu g/m^3$ or ppb), IUR = inhalation unit risk ($(\mu g/m^3 \text{ or ppb})^{-1}$),
ED = exposure duration (years), LY = lifetime years (78 years), ADAF = age-dependent adjustment factor (unitless),
EF (cancer) = exposure factor (cancer) calculated as follows: EF (non-cancer; unitless) x exposure group specific exposure duration (years) ÷ lifetime of 78 years

TCE 2020 CTE Cancer Risk Calculations

TCE Cancer Risk = EPC x IUR x ADAF x $\frac{5}{78}$

= 0.28 x ($1x10^{-06}$ + $1x10^{-06}$ + $2.1x10^{-06}$) x 1 x $\frac{5}{78}$

= $7.3x10^{-08}$

EPC: Exposure Point Concentration = 0.28 µg/m^3

IUR: Inhalation Unit Risk = ($1x10^{-06}$[Liver] + $1x10^{-06}$[kidney] + $2.1x10^{-06}$[NHL]) = $4.1x10^{-06}$

ADAF: Age Dependent Adjustment Factor = 1

Vinyl Chloride 2015 RME Cancer Risk Calculations

Vinyl Chloride Cancer Risk = EPC x IUR x ADAF x $\frac{20}{78}$

= 0.68 × ($4.4×10^{-06}$) × 1 × $\frac{20}{78}$

= $7.7 × 10^{-07}$

EPC: Exposure Point Concentration = 0.68 µg/m^3

IUR: Inhalation Unit Risk = $4.4×10^{-06}$

ADAF: Age Dependent Adjustment Factor = 1

Attachment C: General Cancer Information

Cancer will affect one in two men and one in three women in the United States, according to statistics collected by the Surveillance Epidemiology and End Results program at the National Cancer Institute (www.seer.cancer.gov). Cancer is a group of more than 100 diseases characterized by uncontrolled growth and spread of abnormal cells. Different types of cancers have differing rates of occurrence, different causes, and chances for survival. Therefore, we cannot assume that all the different types of cancers in a community or workplace share a common cause or can be prevented by a single intervention.

Cancers are caused by a variety of factors acting alone or together, usually over a period of many years. Scientists estimate that most cancers are due to factors related to how we live, or lifestyle factors that increase the risk for cancer, including: smoking cigarettes, drinking heavily, and diet (for example, excess calories, high fat, and low fiber). Other important cancer risk factors include reproductive patterns, sexual behavior, and sunlight exposure. A family history of cancer can also increase a person's chances of developing cancer.

Smoking is by far the leading risk factor for lung cancer. Smokers are about 20 times more likely to develop lung cancer than nonsmokers. People who don't smoke but who breathe the smoke of others also have a higher risk of lung cancer. A nonsmoker who lives with a smoker has about a 20% to 30% greater risk of developing lung cancer. Workers exposed to tobacco smoke in the workplace are also more likely to get lung cancer. Exposure to radon, asbestos, arsenic, chromium, nickel, soot, tar, and other substances can also cause lung cancer. An increased risk for lung cancer has also been associated with personal or family history of lung cancer. Most people are older than age 65 years when diagnosed with lung cancer.

Smoking tobacco is also an important risk factor for kidney cancer. Obesity and high blood pressure have also been linked to the disease. People with a family member who had kidney cancer have a slightly increased risk of kidney cancer. Also, certain hereditary conditions can increase the risk. Kidney cancer is about twice as common in men as in women and is slightly more common among blacks than other races. Workplace exposure to asbestos, cadmium, some herbicides, benzene, and organic solvents, particularly trichloroethylene, has also been associated with an increased risk for kidney cancer.

While cancer occurs in people of all ages, new cases of most types of cancer rise sharply among people over age 45 years. When a community, neighborhood, or workplace consists primarily of people over age 45 years (and even more so over age 60 years), we would expect more cancers than in a neighborhood or workplace with people of younger ages. However, cancer is also the second leading cause of death in children.

Many people believe that cancer is usually caused by toxic substances in the home, community, or workplace. Although we do not know the exact impact now of environmental pollutants on cancer development, less than 10% of cancers are estimated to be related to toxic exposures—only 2% are attributed to environmental causes.

Since the 1970s, when state cancer registries were first being organized, many public health scientists and residents have hoped that anecdotal observations of clusters of cancer in the community might lead to prevention of new cases via discovery of specific causes of these cancers. Since then, state, local, and federal agencies have conducted thousands of investigations throughout the country. With one or two possible exceptions involving childhood cancers, none of these investigations have led to the identification of the causes of any of these possible clusters, even when a statistically elevated number of cancers in a geographic area could be documented. The Georgia DPH has developed strategies for active cancer surveillance. This systematic approach to monitoring cancer trends in our state will lead to more opportunities for prevention and control of cancer in Georgia.