

# Health Consultation

---

## **PUBLIC COMMENT RELEASE**

### **Soil, Soil Gas, and Indoor Air Evaluation**

FORMER CUSTOM CLEANERS  
3517 SOUTHERN AVENUE  
MEMPHIS, SHELBY COUNTY, TENNESSEE 38111  
EPA ID: TNN000402275

Prepared by the  
Tennessee Department of Health

DECEMBER 20, 2019

**COMMENT PERIOD ENDS: FEBRUARY 18, 2020**

Prepared under a Cooperative Agreement with the  
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Agency for Toxic Substances and Disease Registry  
Division of Community Health Investigations  
Atlanta, Georgia 30333

## Foreword

This document summarizes an environmental public health investigation performed by the State of Tennessee Department of Health's Environmental Epidemiology Program. Our work is conducted under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry. The process to answer an environmental public health questions includes many steps, including the following:

*Evaluate exposure:* Tennessee health assessors begin by reviewing available information about environmental conditions at a site. We interpret environmental data, review site reports, and talk with environmental officials. Usually, we do not collect our own environmental sampling data. We rely on information provided by the Tennessee Department of Environment and Conservation, U.S. Environmental Protection Agency, other government agencies, businesses, and the public. We work to understand how much contamination might be present, where it is located on a site, and how people might be exposed to it. We look for evidence that people might have been, are being, or in the future could be exposed to harmful substances.

*Evaluate health effects:* If people could be exposed to contamination, then health assessors take steps to determine if it could be harmful to human health. We base our health conclusions on routes of exposure, risk assessments, toxicology, cleanup actions, and the scientific literature.

*Make recommendations:* Based on our conclusions, we will recommend that any potential health hazard posed by a site be reduced or eliminated. These actions will prevent possible harmful health effects. Environmental Epidemiology serves as an advisor in dealing with hazardous waste sites. Often, our recommendations will be action items for other agencies. However, the Tennessee Department of Health can issue a public health advisory warning people of the danger of an urgent public health hazard and will work with other agencies to resolve the problem.

If you have questions or comments about this report, we encourage you to contact us.

Write:           Environmental Epidemiology  
                  Tennessee Department of Health  
                  3rd Floor, Andrew Johnson Tower  
                  710 James Robertson Parkway  
                  Nashville TN 37243

Call:            615-741-7247 or 1-800-404-3006 (toll-free) during normal business hours

Email:          [eeep.health@tn.gov](mailto:eeep.health@tn.gov)

HEALTH CONSULTATION

Public Comment Release

Soil, Soil Gas, and Indoor Air Evaluation

FORMER CUSTOM CLEANERS  
3517 SOUTHERN AVENUE  
MEMPHIS, SHELBY COUNTY, TENNESSEE 38111  
EPA FACILITY ID: TNN000402275

Prepared by the  
Tennessee Department of Health  
under a Cooperative Agreement with the  
U.S. Department of Health and Human Services  
Agency for Toxic Substances and Disease Registry  
Division of Community Health Investigations  
Atlanta, Georgia 30333

*This information is distributed by the Agency for Toxic Substances and Disease Registry for public comment under applicable information quality guidelines. It does not represent and should not be construed to represent final agency conclusions or recommendations.*

## Table of Contents

Summary .....	1
Introduction .....	1
Conclusions .....	2
Statement of Issues and Background .....	4
Site Location and Details .....	4
Figure 1. Former Custom Cleaners Site Location .....	5
Figure 2. Former FCC Building .....	6
Figure 3. Former 3523 Southern Avenue Building .....	7
Site Operational History .....	7
Regional Geology and Hydrogeology .....	7
Environmental Investigations .....	8
Figure 4. Diagram of Contamination Movement at the FCC Site .....	9
Water Use .....	10
Health Education and Community Involvement .....	10
Discussion .....	11
Introduction to Chemical Exposure and Evaluation .....	11
Site-Related Chemicals .....	12
Exposure Pathways .....	13
Table 1. Exposure Pathways at the FCC Site .....	14
Environmental Sampling Results and Evaluation .....	15
Site Soils .....	15
Soil Gas .....	15
Adjacent Restaurant Indoor Air .....	16
Limitations .....	17
Conclusions .....	17
Recommendations .....	18
Public Health Action Plan .....	19
References .....	21
Glossary of Terms and Acronyms .....	23
Report Preparation .....	27
Appendix A. Additional Site Photographs – April 26, 2016 and March 27, 2017 .....	29
Appendix B. Timeline of Events at Former Custom Cleaners NPL Site .....	32
Appendix C. Geologic Profile at Former Custom Cleaners NPL Site .....	36
Appendix D. Soil, Soil Gas, and Indoor Air Testing Results Summary .....	37

## **Summary**

### **Introduction**

The Former Custom Cleaners (FCC) in Memphis used dry-cleaner solvents that contaminated the site. The FCC was added to the National Priorities List (NPL) (Superfund) because of the chemical contamination. The Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP) has evaluated the contamination. TDH EEP has a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) to evaluate health implications of potential exposure to chemicals at hazardous waste sites in Tennessee.

On September 9, 2016, the U.S. Environmental Protection Agency (EPA) proposed adding the FCC property to the NPL. The FCC site was officially listed on the NPL on August 3, 2017. The NPL is part of EPA's Superfund cleanup process intended to identify the nation's most highly impacted hazardous waste sites. EEP became involved with the FCC site because Congress mandates that ATSDR conduct public health activities at Superfund sites that EPA proposes adding to its NPL.

Past releases of metals, semi-volatile organic compounds, and volatile organic compounds, primarily the dry-cleaning chemical tetrachloroethylene (PCE), traveled into soil and groundwater. PCE vapors from soil and groundwater might also migrate into indoor air should the FCC property be redeveloped.

TDH EEP and ATSDR's top priority at this site is to ensure that authorities and affected groups have the best information possible to safeguard the health of Memphis' citizens. Those authorities and groups include the Shelby County Health Department; Memphis Light, Gas, and Water; the Tennessee Department of Environment and Conservation; and the local community.

TDH EEP evaluated potential exposure from onsite indoor air for a former tenant of the FCC site in 2014. The tenant was living upstairs, above the former art supply store housed in the building. EEP concluded at that time that the tenant should not be living in the building unless steps were taken to reduce levels of PCE and trichloroethylene (TCE) in the indoor air [TDH EEP 2014]. EEP also concluded that PCE and TCE source removal and additional air sampling should be done before the building was occupied again. Instead, the building was demolished and source area soils were removed.

This health consultation evaluates the soil, soil gas, and off-site indoor air exposure pathways based on recent data collected onsite and off-site by EPA. Current fast food workers in the restaurant adjacent to the site and people who live in the area may walk across the site. Past exposures were not evaluated as part of this assessment. Rather, this assessment focused on current exposures at the site. In the future, additional data might become available from EPA or the Tennessee Department of Environment and Conservation (TDEC). We would use that data to evaluate the groundwater exposure pathway and other potential off-site exposure pathways. We did not evaluate subsurface soil for this health consultation because the public would not have access to these soils and would not be exposed to chemicals in those soils.

## Overview

The Tennessee Department of Health's Environmental Epidemiology Program (EEP) reached two conclusions about the Former Custom Cleaners (FCC) site.

## Conclusions

---

### Conclusion 1

Current exposure to tetrachloroethylene (PCE) in soil at the FCC site is not expected to harm the health of community members living, attending school, playing, or working near the FCC site.

---

### Basis for Decision

No one has long-term exposure to soils at the site. The site is open land. There would be no exposure to anyone walking across the site. The major source area of the contamination has been removed. Even so, we evaluated levels of PCE and other chemicals remaining in site soils. Levels of PCE and other chemicals in onsite soil samples are below levels expected to result in non-cancer or cancer health effects.

The amount of PCE in site soils will be removed to levels specified in the site remedial design. Low levels of PCE are likely to remain in site soils which may not be suitable for certain land uses.

---

### Next Steps

EEP recommends that EPA adopt institutional controls for the FCC property. These controls would include restricting certain development options for the property. The property owner also might adopt such controls.

---

### Conclusion 2

Based on limited data, soil vapor intrusion is not presently a concern for the public at the site. The source area soils have been removed and buildings are no longer on the site. Also, breathing PCE in air inside the fast food restaurant next to the FCC site is not expected to harm the health of current customers and workers. However, indoor air samples have been collected only once in the fast food restaurant, therefore data is limited. A definitive health call cannot be made at this time.

---

### Basis for Decision

In the past, customers and workers of the former dry cleaner, and later art supply store, were exposed to various volatile organic chemicals through breathing indoor air. Those chemicals included elevated levels of PCE and TCE, and acetone, cyclohexane, ethanol, ethylbenzene, methylene chloride, toluene, and xylenes. Other chemicals were found in indoor air in trace amounts, below health comparison values.

TDH EEP evaluated the onsite indoor air exposure pathway for a former tenant of the FCC site in 2014. The tenant was living upstairs above the former art supply store housed in the building. EEP concluded at that time that the tenant should not be living in the building unless elevated PCE and TCE levels in indoor air were reduced. EEP also concluded that PCE and TCE source removal and

---

additional air sampling should be done before the building was occupied again. Instead, the building was demolished and source area soils were removed, eliminating the soil vapor intrusion hazard.

Measured levels of PCE in indoor air of an adjacent fast food restaurant from April 2018 were below or at detection limits of the tests and below levels expected to result in non-cancer or cancer health effects. This one set of samples is not enough to rule out a possible vapor intrusion problem. More indoor air samples over several seasons are needed to conclude if there is or is not a vapor intrusion problem. More sampling is scheduled as part of the startup portion of the remedial activities to be conducted at the site in 2020.

---

### **Next Steps**

EEP recommends that EPA take the following steps to protect the health of people near the FCC site:

- Conduct sampling over different seasons and monitor air indoors and from beneath the adjacent fast food restaurant during key periods of the proposed soil treatment system (startup, steady state or everyday operation, and recovery) and take actions needed to protect health.
  - Assess soil gas in all directions and at appropriate depths during startup and operation of interim action soil treatment. Additional vapor intrusion investigations might be warranted based on the soil gas data collected. These additional investigations might include nearby homes and businesses.
  - Adopt institutional controls for the FCC property. These controls would include restricting certain development options for the property. The property owner also might adopt such controls.
  - Take proper health and safety precautions to protect any workers during site excavation and activities associated with installing the proposed soil treatment system.
- 

### **For More Information**

If you have any questions or concerns about your health, contact your healthcare provider. For more information on the Former Custom Cleaners site, call the Tennessee Department of Environment and Conservation toll free at 1-888-891-8332. For more information on this health report, call TDH EEP at 615-741-7247 or 1-800-404-3006 during normal business hours. You can also email TDH EEP at [eep.health@tn.gov](mailto:eep.health@tn.gov).

## **Statement of Issues and Background**

The Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP) evaluated possible environmental health exposures at the Former Custom Cleaners (FCC) Superfund site (the site) in Memphis. On September 9, 2016, the U.S. Environmental Protection Agency (EPA) proposed to add the FCC site to its National Priorities List (NPL) of hazardous waste sites. The FCC site was officially listed on the NPL on August 3, 2017. The NPL is part of EPA's Superfund cleanup process to determine the nation's worst hazardous waste sites. Congress mandates the Agency for Toxic Substances and Disease Registry (ATSDR) to conduct public health activities at Superfund sites that EPA proposes adding to its NPL. EEP prepared this public health consultation under a cooperative agreement with ATSDR.

Initial FCC site investigations found elevated levels of the volatile organic compounds (VOCs) tetrachloroethylene (PCE) and trichloroethylene (TCE) in soil gas. Indoor air then became the focus of further site investigations because a tenant had both a business in and was living in the onsite building. Elevated levels of PCE were found in the indoor air. In 2014, TDH EEP prepared a health consultation that considered the amount of time the tenant spent in the building. It concluded that the tenant should no longer live in the FCC building because of the unhealthy levels of PCE and TCE in the indoor air. Because the site was placed on the NPL, EPA performed further investigations. This health consultation used recent data collected onsite and off-site by EPA to evaluate the soil, soil gas, and off-site indoor air exposure pathways.

Groundwater data for the site are limited. We will evaluate the groundwater exposure pathway and other potential off-site pathways when additional groundwater data become available from future EPA or Tennessee Department of Environment and Conservation (TDEC) investigations.

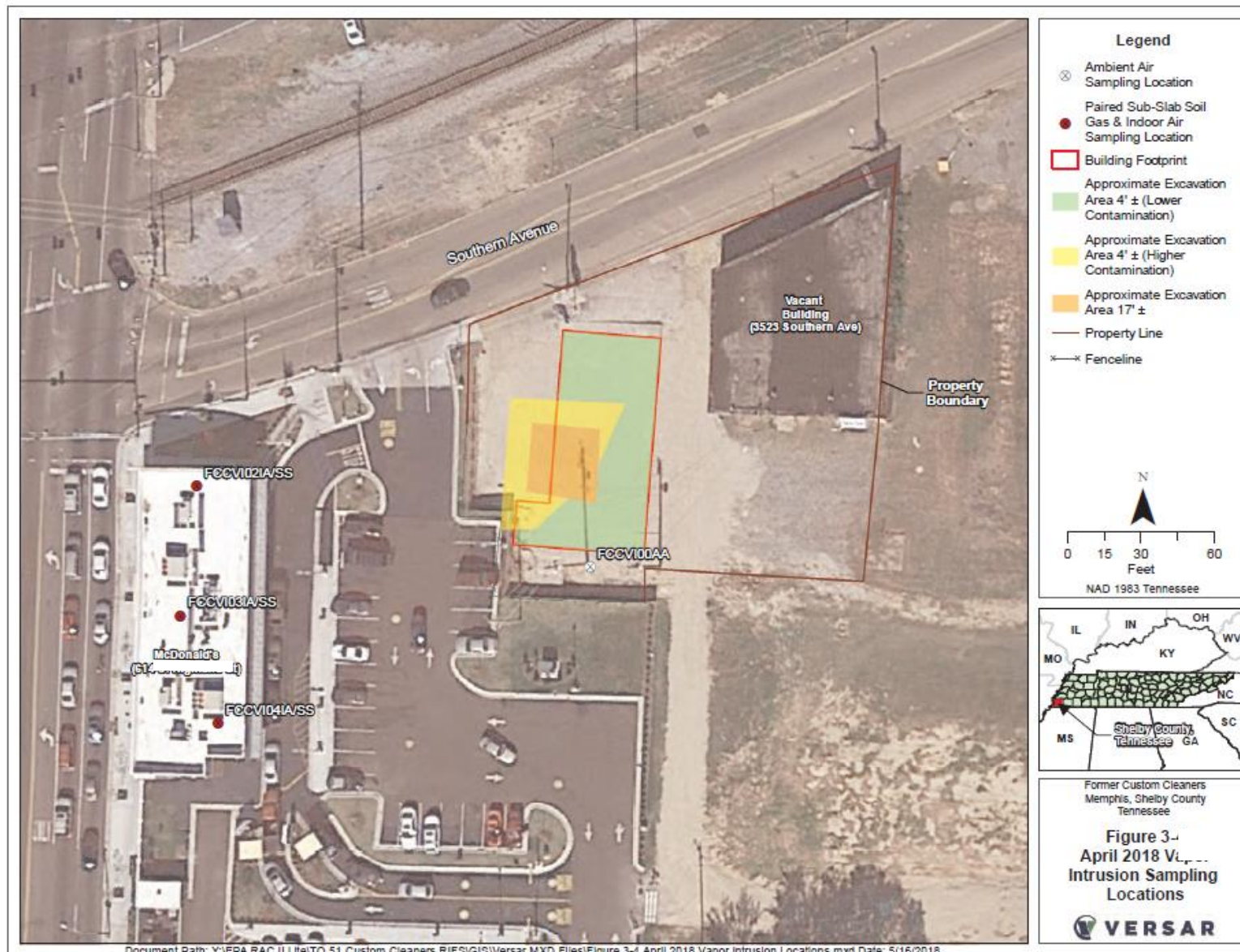
## **Site Location and Details**

The FCC site is located at 3517 Southern Avenue in Memphis, Shelby County, Tennessee 38111 (Figure 1). The property is zoned commercial and is located in a commercial business area west of the University of Memphis. The TDEC's Division of Remediation (DoR) site number is #79-897. The EPA identification number, as recorded in the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database, is TNN000402275 [Tetra Tech 2017].

The FCC site is in a residential and commercial area of Memphis. The site includes the area of the torn down FCC building, now a gravel lot, at 3517 Southern Avenue (Figure 1). The site also includes the area of a second commercial building at 3523 Southern Avenue, which was torn down in November 2018. The site is bounded by Southern Avenue on the north, South Highland Street on the west, Minor Road on the east, and Spottswood Avenue on the south. The site was part of a strip mall and was adjoined by additional buildings to the west [TDEC 2015]. The buildings to the west were torn down in 2015. The property was redeveloped with a fast food restaurant that opened for business in 2016 and operates 24 hours each day. A strip mall to the east on Minor Road has at least one commercial business, an animal hospital, located about 300 feet east of the FCC property.



**Figure 1.** Former Custom Cleaners building location, excavation areas, 3523 Southern building (now demolished), and property boundary [Versar 2018].



The FCC building shown in Figure 2 was approximately 3,900 square feet [TDEC 2015] and had been vacant since February 2014. The total area occupied by buildings on the property was 10,476 square feet. This included the FCC building and the separate building at 3523 Southern Avenue (Figure 3) [TDEC 2015]. The entire property is approximately 0.62 acres [Shelby County Register of Deeds 2015]. Appendix A shows additional site photographs.

The site is accessible. It is near the University of Memphis, in an area with many people walking by. The nearest residential properties include apartment complexes approximately 375 feet east of the site and single homes approximately 360 feet south of the site [TDEC 2015].



**Figure 2.** The Former Custom Cleaners building, which formerly housed Sharri's Discount Arts. Southern Avenue is in the foreground. The dry-cleaning machine was located in the back left of the building. View is looking south. [Photo credit: J. George, TDH, 4/26/16].





**Figure 3.** Former site of the 3523 Southern Avenue building located east of the Former Custom Cleaners. View is to the west. Southern Avenue is at extreme right. [Photo credit: K. Mallary, EPA, 12/6/18].

### Site Operational History

Appendix B shows a timeline of FCC site-related events and activities. TDEC DoR obtained information regarding past businesses at or near 3517 Southern Avenue from Sanborn Fire Insurance Maps and the R.L. Polk City Directories [TDEC 2013]. The FCC building was built in 1943. TDEC DoR's review of this information indicated dry-cleaning or laundry facilities were located at or near 3517 Southern Avenue as early as 1933 and as recently as 1993 [TDEC 2013]. Auto repair facilities, service stations, lumber companies, machine shops, furniture repair companies, woodworking facilities, appliance repair shops, fuel plants, and printing companies also were located in this area from 1933 to 1993. Further investigation by TDEC DoR indicated the property had been used as a laundry or dry cleaner since at least the early 1950s. A dry cleaner operated at the site for about 50 years, from approximately 1945 until it closed in the mid-1990s [TDEC 2013, Shelby County Register of Deeds 2015]. Sharri's Discount Arts operated in the 3517 Southern Avenue (FCC) building from about the early 2000s until February 2014 [TDEC 2014]. The building was vacant from February 2014 until September 2016. The building at 3517 Southern Avenue was torn down and removed during an EPA time-critical removal action in September 2016 (Figure 4) [TetraTech 2017].

### Regional Geology and Hydrogeology

Understanding the geology of the Memphis area is critical to understanding the concern that chemicals might migrate from the FCC property. The geology at the site allows movement of the chemicals present. Contamination from the FCC can move downward with relative ease,

contaminating site soils and soil gas, and eventually groundwater in the Memphis Sand, the area's drinking water source, if there is not an impenetrable layer above the Memphis Sand. As noted earlier, EEP will prepare another health consultation evaluating health effects of potential groundwater exposures after data from EPA become available.

Appendix C shows the general geology of the site. It depicts the geologic units encountered during the EPA investigation of the site. The FCC site is in the Gulf Coastal Plain. The Gulf Coastal Plain section in the Memphis area is characterized by thick loess deposits associated with alluvial plains from Mississippi River tributaries. Underlying this loess are sand and gravel deposited by flowing water. The Cockfield and/or Cook Mountain Formation (Figure 4) underlies these sands and gravels and rests on top of the Memphis Sand [TDEC 2015].

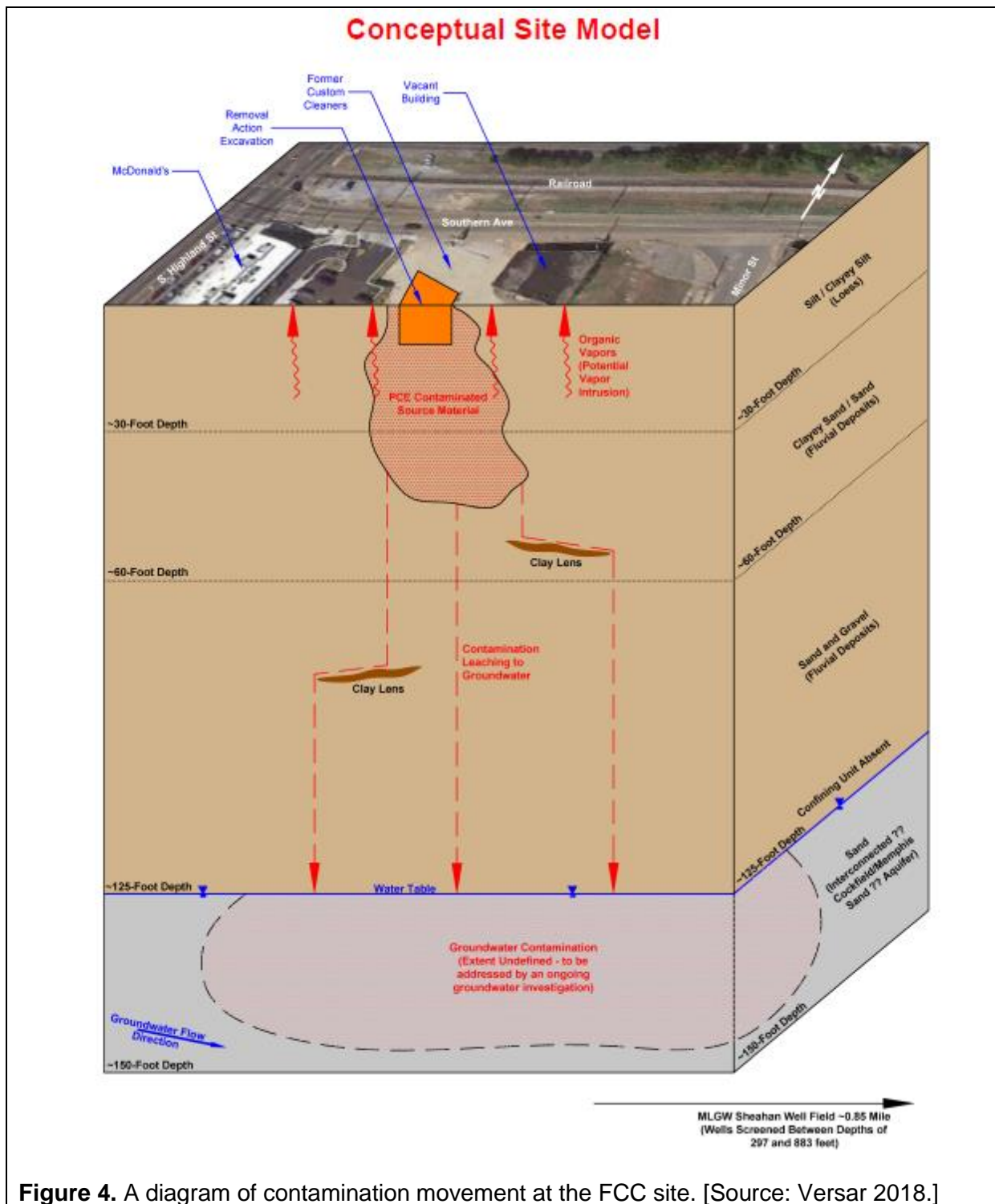
The Jackson Clay confining bed separates shallow water-table (unconfined) aquifers from the underlying Memphis Sand and other aquifers. This confining bed is thin, sandy, or absent in the area of the FCC site. In spots where the confining bed is absent, the chemical contamination at the site could move through and spread further away more easily. Figure 4 shows where the chemical contamination is and how the chemicals are moving at the FCC site. The removal action area in the figure shows the bulk of the PCE soil source area at the site that was removed during EPA's 2016 interim action. The PCE-contaminated source material area in the figure shows deeper soil still contaminated by PCE that will be addressed by EPA's soil cleanup plan. The arrows show how water seeping into the ground from rain and snow continues to allow remaining PCE to move downward to groundwater beneath the site. The PCE then contaminates groundwater. The regional confining unit might be absent at the site, allowing contaminated groundwater to move further downward. Chemical vapors can be released from the groundwater and move along local and regional flow patterns. The groundwater flow can spread the contamination further away, allowing chemical vapors to move upward through the soils into overlying buildings.

### **Environmental Investigations**

TDEC DoR became involved in the FCC site in 2013 in response to a complaint by a former tenant of the building. TDEC DoR collected air samples inside the building and soil gas samples around the building to assess the potential for chlorinated solvent contamination in indoor air and soil gas. Results showed levels of the dry-cleaning solvent chemical PCE and a breakdown chemical of PCE, TCE, in indoor air. TDH EEP evaluated levels of both chemicals and found they exceeded ATSDR's health comparison values (CVs) and EPA residential air regional screening levels. Further evaluation of these indoor air levels indicated a potential health concern. TDH EEP prepared a health consultation evaluating the indoor air data and recommended the tenant not live in the building [TDH 2014]. TDEC DoR agreed with the conclusions and contacted the tenant, who then vacated the building in February 2014.

TDEC performed additional onsite investigations in 2014 and 2015 to evaluate site soils and groundwater and further evaluate onsite soil gas. In 2016, an EPA contractor drilled 15 soil borings to outline the area of soil affected at the site. In September 2016, EPA contractors tore down the FCC building, removed the slab-on-grade building foundation, and removed approximately 980 cubic yards of PCE-contaminated soil. Soil was excavated to a maximum depth of 17 feet below ground surface (bgs) in the defined source area. Tearing down the

building resulted in approximately 700 cubic yards of non-hazardous materials being either removed or recycled. The excavated area was backfilled to original grade with clean soil and gravel [TetraTech 2017].



**Figure 4.** A diagram of contamination movement at the FCC site. [Source: Versar 2018.]

An EPA contractor performed additional extensive soil, soil gas, and indoor air investigations during August 2017 through April 2018. The contractor drilled numerous soil borings and collected 168 soil samples. Soil gas monitors were installed at several locations onsite and off-site to understand if PCE vapors had migrated beyond the FCC property. Soil gas and indoor air were also tested in a fast food restaurant to the west of the FCC property. Limited soil gas testing has been conducted northeast of the site next to underground utilities, and to the southeast of the site.

Appendix B provides a more detailed description of environmental investigations performed at the site.

### **Water Use**

Memphis Light, Gas, and Water (MLGW) provides drinking water for the Memphis metropolitan area. Memphis relies exclusively on groundwater for its water supply and has one of the most extensive artesian well systems in the world [MLGW 2016]. Memphis has eight major water treatment plants and well fields and approximately 135 production wells throughout Shelby County. No single well supplies more than 40% of the total water. The Sheahan Well Field lies about 0.6 miles east of the FCC. The well field has 22 wells, all of which pump groundwater from the Memphis Sand Aquifer. As these wells pump water, VOC contamination from FCC could be drawn to the wellfield. Everyone in the surrounding area is served by public water. No VOCs have been found so far in the outer-most monitoring wells for, and wells of, the wellfield. The extent of groundwater contamination leaving the site will be delineated by EPA with future site investigations. We will evaluate the potential impact of the contamination to nearby public water supply wells in a future health consultation.

### **Health Education and Community Involvement**

So far, five community meetings about the site have been held. On April 26, 2016, TDEC held a public meeting to share information about its investigative process and investigative activities. It also proposed the site to the TDEC DoR's List of Inactive Hazardous Substance Sites. Four people attended the meeting, including a local property developer and three university students.

On October 6, 2016, EPA held a public meeting about the site status and proposal for listing the FCC property on the NPL. EPA explained what the FCC site's listing on the NPL meant, and who would oversee work that might be completed as part of the remedial process for the site. Stakeholders in the community included a representative from the local Sierra Club chapter and two persons who had measurable interest in the FCC. Short summaries of the site history and environmental investigation activities conducted to date were presented. Attendees asked how information about the cleanup would be shared and the timeframe for future cleanup actions. TDH EEP provided fact sheets about PCE and vapor intrusion and Healthy Homes materials during the meeting. A Shelby County Health Department official also attended the sessions.

EPA added the FCC site to the NPL on August 3, 2017. EPA held two public availability sessions on the same day, which drew 60 attendees. Numerous health education materials about the site, PCE, vapor intrusion, and Healthy Homes were provided to the many attendees who visited our display at the sessions. TDH EEP partnered with the Shelby County Health Department for both sessions.

Twenty-five people attended the public availability sessions held February 1, 2018. The sessions outlined the investigation activities conducted to date and potential interim action remedies for soil cleanup at the FCC site. Again, we provided many health education materials to attendees.

On July 10, 2018, public meetings were held to inform stakeholders of proposed remedial alternatives and the preferred alternative to clean up PCE in site soils. The 30-day public comment period for the Proposed Plan for the Operational Unit 1 Interim Action Record of Decision for cleaning up soil at the site began on July 10, 2018. Approximately 32 members of the public participated in the two availability sessions that day. Most of those attendees received health education materials from us.

TDH EEP visited the FCC property the days of the public availability sessions to understand new work being done on the property or off-site. At least five site visits by EEP were coordinated through TDEC or EPA.

## **Discussion**

### **Introduction to Chemical Exposure and Evaluation**

To determine whether persons have been or are likely to be exposed to chemicals, TDH EEP evaluates pathways that could lead to human exposure. Chemicals released into the environment have the potential to cause harmful health effects. Even so, a release does not always result in exposure. People can only be exposed to a contaminant if they come into contact with it. If no one comes into contact with a contaminant, then no exposure occurs, and thus, no health effects could occur.

The five questions to consider when deciding if a person could be exposed to a chemical include the following:

- 1) Where is the chemical coming from (source)?
- 2) What in a person's environment has been contaminated (environmental medium)?
- 3) Is there a way a person might come into contact with the chemical (exposure point)?
- 4) How might a person come into contact with the chemical (exposure route)?
- 5) Who might be exposed to the chemical (exposed population)?

An exposure pathway is considered complete if evidence shows that all five of these elements have been, are, or will be present at the site. An exposure pathway is considered incomplete if one of the five elements is missing.

The source of contamination is the place where the chemical was released. For the FCC site, three possible sources for the contamination were found:

- Spills and leaks from the dry-cleaning machine
- Storage of PCE and filters associated with the dry-cleaning operation
- Chemicals from other spills, leaks, and anything else that could have occurred over the 70 years that this and surrounding properties have been used by commercial businesses

Certain population groups might have a different or enhanced response to hazardous chemicals than will most persons exposed to the same level of hazardous chemicals in the environment. Reasons for sensitivity might include genetic makeup, age, gender, health and nutritional status, and exposure to other toxic substances. In general the elderly, with declining organ function, and the young, with immature and developing organs, are more vulnerable to toxic substances than are healthy adults. The health of children and the elderly are carefully considered in this health consultation. We've used cautious estimates for understanding exposure to measured PCE levels in soil and indoor air.

A number of health CVs are available for screening environmental contaminants to determine if an additional in-depth analysis is needed [ATSDR 2005]. These include ATSDR environmental media evaluation guides (EMEGs) and reference dose media evaluation guides (RMEGs). EMEGs are estimated levels of chemicals to which humans might be exposed to over a certain period without experiencing adverse non-cancer health effects, based on ATSDR's minimal risk level (MRL). A MRL is an ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. Exposure might be for up to 2 weeks (acute), 2 weeks to less than a year (intermediate), or more than a year (chronic). RMEGs represent the level of a chemical in water or soil at which a chronic human exposure is not likely to result in adverse non-carcinogenic effects, based on EPA's reference dose. A reference dose is an EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans. If the substance is a known or a probable carcinogen, ATSDR's cancer risk evaluation guides (CREGs) were considered as CVs. CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million persons exposed during their lifetime (78 years). The background lifetime risk for cancer is about one in two for men and one in three for women [ACS 2018]. All cancer risk values we used express the additional chance of developing cancer above this baseline. Cancer risk is a theoretical estimate that is used as a tool to trigger whether further public health actions are necessary to protect the health of those that may live or work near or on the site or those who may use the site in some way. If contaminant levels are found above environmental guideline CVs, it does not mean adverse health effects are likely. Appendix D shows chemical-specific CVs in the evaluation tables.

### **Site-Related Chemicals**

Chemicals identified in soil at the FCC site are grouped in a class of chemicals called VOCs, specifically, chlorinated solvents. Chemicals such as PCE, TCE, cis-1,2-dichloroethylene (cis-1,2-DCE), and 1,1,2-trichloroethylene (1,1,2,-TCE) are all chlorinated solvents. They are used for a wide variety of commercial and industrial purposes, but many are used as cleaning solutions. Their chemical structure helps them to efficiently dissolve organic materials such as fats and greases [ATSDR 2014a]. The main chemical used in the dry-cleaning operations at this site was PCE.

Spills and leaks of chlorinated solvents have caused widespread subsurface contamination in the environment. Chlorinated solvents in general can be harmful to human and ecological health if levels of these chemicals are high enough to cause harmful exposures. They can cause or are suspected of causing cancer, and are toxic or harmful to aquatic organisms.



Chlorinated solvents such as PCE can also degrade into other chemicals. PCE can degrade to TCE, then dichloroethylene, and then vinyl chloride through natural processes.

Any corrective process that will remove PCE from site soils will also remove other breakdown chemicals, such as trichloroethylene, dichloroethylene, and vinyl chloride. PCE is generally a clear liquid that will readily vaporize to a gas when exposed to air. PCE has a sweet odor. PCE is not flammable [ATSDR 2014a]. PCE is a suspected carcinogen. TCE is a breakdown chemical found in soil gas at the site and is classified as probably carcinogenic to humans [ATSDR 2014b]. Cis-1,2-DCE, also a PCE breakdown product chemical found in site soil gas, is not known to cause cancer [ATSDR 1996]. TCE and cis-1,2-DCE levels found in samples are compared with published health-based comparison values. Another breakdown chemical, vinyl chloride, was found in one soil gas sample. Vinyl chloride is a known carcinogen. It was also compared with published ATSDR EMEGs.

### **Exposure Pathways**

The major source of the chemicals released at the FCC was contaminated soil in the area in which the former dry-cleaning machine was located. The soil was removed in 2016. However, some chemicals remain in site soils, soil gas, and groundwater beneath the site. A contaminant can enter the body through swallowing, breathing, or skin contact. Overall, onsite soils, soil gas, and indoor air are possible points of exposure for this site. In the past, during site operations, the indoor air at the site also might have been a point of exposure. Table 1 lists the exposure pathways present at the site in the past, at present, and thought to be present in the future.

Outside air is not affected by chemicals previously used at the site. The last building on the FCC property was torn down in November 2018. Therefore, onsite indoor air vapor intrusion is not an issue. Should the property be redeveloped, institutional controls might be needed to restrict certain types of development.

The major source area for the contamination at the site was removed along with the main site building. Original soil beneath the building was replaced with clean soil. The site is now a vacant parcel of land. No one will come into contact with contaminated soil at the site. Even so, a cautious approach was taken and levels of chemicals found in onsite soils were evaluated.

Inhalation of chemicals from site soil gas was also evaluated. No buildings remain on the site. Again, using a cautious approach, levels of chemical measured in soil gas were screened in order to determine whether vapor intrusion could be occurring. People walk across the site daily because it is near shops, restaurants, and a university.

We used a cautious approach to evaluate the possibility of exposure for fast food restaurant workers and customers. Testing results showed very low levels of PCE in the indoor air of the restaurant. Results of the evaluation are presented in the following section.

Site workers installing the soil treatment system should be told of potential hazards. The workers would be required to wear appropriate personal protective equipment (PPE) suitable for the activities they conduct. That would reduce, if not eliminate, potential exposure. While wearing appropriate PPE, workers could accidentally swallow potentially contaminated soil if they were excavating or working onsite. A worker could also inhale the vapors of

chemicals from contaminated site soil. In general, these workers would be protected by their PPE, and these potential exposures would not be likely. Site workers would not encounter groundwater unless they were involved in well installation activities.

**Table 1.** Exposure pathways for the general public, onsite workers, and trespassers at the Former Custom Cleaners site.

Source	Environmental Medium	Exposure Point	Exposure Route	Exposed Population	Time Frame	Exposure
Operations at the Former Custom Cleaners	Soil	Contact with dust or soil particles	Ingestion and skin contact	Onsite workers	Past Present Future	Incomplete Incomplete Potential
		Contact with dust or soil particles	Ingestion and skin contact	Community members living, attending school, playing, or working near the site	Past Present Future	Incomplete Incomplete Incomplete
	Soil gas	Vapor intrusion from chemicals in subsurface soil beneath the site	Inhalation	Nearby residents	Past Present Future	Incomplete Incomplete Incomplete
				Future site workers or residents	Past Present Future	Completed Incomplete Incomplete
		Vapor intrusion from chemicals in subsurface soil beneath an off-site building	Inhalation	Fast food workers and customers inside an off-site building	Past Present Future	Potential Completed Potential
Incomplete = indicates at least one element of the exposure was or is not present. Potential = indicates all five elements of the exposure pathway might have occurred in the past or might occur in the future Completed = indicates all five elements of the exposure pathway are either expected to occur or are occurring.						

## **Environmental Sampling Results and Public Health Evaluation**

EEP analyzed soil, soil gas, and indoor air sampling results. Appendix D summarizes those sampling results. Table D-1 shows soil sampling results, Table D-2 shows soil gas results, and Table D-3 shows indoor air sampling results from the restaurant.

### **Site Soils**

Table D-1 in Appendix D shows soil sampling results. These samples were collected after the 2016 EPA source area soil removal action. Results show site soils did not have PCE levels above health comparison values. PCE levels 0–1 foot bgs ranged from 0.0015 milligrams per kilogram (mg/kg) to 1 mg/kg. (ATSDR's soil CREG for PCE is 180 mg/kg). This likely was because contaminated soil beneath the former building was removed and replaced with clean soil that did not have VOCs.

We compared maximum levels of various VOCs in 18 soil samples and various metals found in one soil sample on the FCC property to ATSDR soil CVs. The results show that exposure to site soil through skin contact or swallowing should not cause harmful health effects to anyone.

### **Soil Gas**

Soil gas is chemical vapor trapped between soil particles. Soil gas can spread from an area of high concentration to areas of low concentration. It can also travel along preferential pathways such as fractures in the soil, layers of sand, or in underground utility trenches where there is more space around crushed gravel making it easier for soil gas to pass through. When we find high levels of chemicals in subsurface soil, we usually also see high levels of these same chemicals in soil gas. At the FCC site, high levels of PCE and TCE in subsurface soils can cause a high potential for soil vapor intrusion into buildings present above where the soil gas is located. The chemical vapors can migrate into the buildings and cause potential health effects to workers and customers.

To understand the presence and movement of soil gas on and off the site, soil gas samples were collected from 17 locations after the 2016 soil removal. Six locations were sampled onsite and 11 locations were sampled off-site in January and April 2018. As expected, the most abundant chemical found in onsite soil gas was PCE. Onsite PCE levels in soil gas ranged from 11.4 to 5,570,000 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ). Table D-2 in Appendix D gives a summary of levels found in samples compared with ATSDR screening values.

A total of 29 VOCs were found in soil gas samples collected. Five of the 29 chemicals were found at levels exceeding their soil gas CVs. These VOCs include benzene, chloroform, PCE, TCE, and vinyl chloride. Benzene and chloroform are both of unknown origin and are not related to dry-cleaning operations. These chemicals might be from other commercial activities that were conducted in the immediate area. Only PCE and its breakdown chemicals, TCE and vinyl chloride, in soil gas are discussed here. When evaluating the potential health effects of chemicals in soil gas to people, an exposure to levels of chemicals above their CV indicates a potential for chemical migration into inhabited spaces, such as the fast food restaurant. Soil gas data do not show high levels of soil gas to the west and north of the site. That suggests that the potential for soil vapor intrusion into buildings away from the FCC site in these directions is low.

Soil gas has not been measured to the west and south of the FCC site. The potential for soil gas to occur in these directions will be evaluated during future site groundwater investigations.

Currently, the site has no buildings, and so has no exposure point for these chemical vapors to become an indoor air issue. The levels of PCE or PCE breakdown chemicals in soil gas would not cause harmful exposures to anyone on the site.

EPA plans to start interim cleanup activities to lower chemical vapor levels in soils. EPA will use a method that combines heating of the soil and soil vapor extraction using vapor extraction wells [EPA 2018]. The process is called in-situ thermal desorption (ISTD). This treatment exposes site soils to elevated temperatures to drive off PCE from subsurface PCE-saturated soil particles and pore spaces. This treatment process will have the added benefit of collecting the PCE breakdown chemicals TCE and vinyl chloride in soil gas.

Soil gas below the fast food restaurant did not contain PCE, TCE, cis-1,2-DCE, or vinyl chloride at levels above their respective CVs in any of the three samples collected. Results showed only chloroform above its CREG in only one of the three samples tested, at a level of  $4.3 \mu\text{g}/\text{m}^3$

The treatment area extends to depths of about 4 feet to 40 feet (EPA 2018). EPA also plans to install an asphalt or concrete cap over the site ISTD treatment area. The cap will stop water from rain and other sources from seeping into the area and limit short-circuiting of the soil vapor extraction wells. As soil heats, soil gas could move into chemical-free areas and areas that had low levels of chemicals.

### **Adjacent Restaurant Indoor Air**

Table D-3 in Appendix D shows results for the three indoor air samples collected from the adjacent fast food restaurant in April 2018. The restaurant is open every day, 24 hours a day. The samples were collected over a 24-hour period. The primary site-related chemical, PCE, was found at  $1.1 \mu\text{g}/\text{m}^3$ , slightly above the method detection limit of  $1.0 \mu\text{g}/\text{m}^3$ , in only the crew room sample. Air samples from the customer dining area and the men's restroom also were tested. Measured PCE levels in those two locations were below the  $1.0 \mu\text{g}/\text{m}^3$  detection level. The levels of PCE detected in indoor air at the restaurant are well below the CV of  $41 \mu\text{g}/\text{m}^3$ . Even though the exposure pathway is completed there should not be adverse health effects from working in or being a customer of the fast food restaurant.

TCE, one PCE breakdown chemical, was not detected above method detection limits in the three indoor air samples from the restaurant. Detection limit levels ranged from  $0.79 \mu\text{g}/\text{m}^3$  to  $0.83 \mu\text{g}/\text{m}^3$ . The ATSDR CREG for TCE is  $0.21 \mu\text{g}/\text{m}^3$ , about four times lower than the detection limit of the indoor air testing. Therefore, although TCE could be present below the level of detection, for the amount of time workers would be working in and the public would be visiting the restaurant, breathing these levels should not cause harmful health effects.

Another chemical, methylene chloride, showed elevated levels above one of its ATSDR CVs. Methylene chloride is not a dry cleaner-related chemical and was not found in the correlating sub-slab soil gas measurements collected at the same location from beneath the floor of the fast food restaurant. Methyl chloride was only found in one of the four samples tested and likely came from an unknown item or process inside the restaurant. The maximum

concentration ( $146 \mu\text{g}/\text{m}^3$ ) was also within the range of EPA's background studies ( $2.0\text{--}510 \mu\text{g}/\text{m}^3$ ) [EPA 2015]. Adjusting the measured methylene chloride level for a typical work week of 8 hours per day, 5 days per week, the maximum theoretical exposure concentration would be about  $35 \mu\text{g}/\text{m}^3$ . The adjusted exposure level is lower than ATSDR's CREG of  $63 \mu\text{g}/\text{m}^3$ , and thus there should not be an increased risk for cancer for someone working and breathing air containing the levels of methylene chloride found.

Methylene chloride found in the indoor air could be from maintenance and cleaning products used in the restaurant. Users of these products should follow instructions on use and provide ventilation during use of the cleaning products. Users of cleaning products can identify cleaning products containing chemicals at <https://householdproducts.nlm.nih.gov/>.

## Limitations

Vapor intrusion can vary over time, depending on weather and building conditions and occupant behaviors, such as opening windows and doors. Soil gases can also vary by location in the subsurface, including under different areas of the same slab and from building to building.

Indoor air sample collection during multiple seasons would be needed to characterize seasonal variability in soil gas and indoor air levels. Winter is considered the worst season for vapor intrusion variability in the northern United States. Higher vapor intrusion was seen in summer and in buildings with air conditioning in southern states. Therefore, accuracy improves with sample results from multiple seasons at sites. Year-to-year variation in vapor intrusion can occur because of factors such as weather patterns and occupant behaviors [ATSDR 2016].

## Conclusions

EEP reached the following two conclusions in this health consultation concerning the FCC site:

- Current exposure to tetrachloroethylene (PCE) in soil at the FCC site is not expected to harm the health of community members living, attending school, playing, or working near the FCC site.

No one has long-term exposure to soils at the site. The site is open land. There would be no exposure to anyone walking across the site. The major source area of the contamination has been removed. Even so, we evaluated levels of PCE and other chemicals remaining in site soils. Levels of PCE and other chemicals in onsite soil samples are below levels expected to result in non-cancer or cancer health effects.

The amount of PCE in site soils will be removed to levels specified in the site remedial design. Low levels of PCE are likely to remain in site soils which may not be suitable for certain land uses.

- Based on limited data, soil vapor intrusion is not presently a concern for the public at the site. The source area soils have been removed and buildings are no longer on the site. Also, breathing PCE in air inside the fast food restaurant next to the FCC site is not

expected to harm the health of current customers and workers. However, indoor air samples have been collected only once in the fast food restaurant, therefore data is limited. A definitive health call cannot be made at this time.

In the past, customers and workers of the former dry cleaner, and later art supply store, were exposed to various volatile organic chemicals through breathing indoor air. Those chemicals included elevated levels of PCE and TCE, and acetone, cyclohexane, ethanol, ethylbenzene, methylene chloride, toluene, and xylenes. Other chemicals were found in indoor air in trace amounts, below health comparison values.

TDH EEP evaluated the onsite indoor air exposure pathway for a former tenant of the FCC site in 2014. The tenant was living upstairs above the former art supply store housed in the building. EEP concluded at that time that the tenant should not be living in the building unless elevated PCE and TCE levels in indoor air were reduced. EEP also concluded that PCE and TCE source removal and additional air sampling should be done before the building was occupied again. Instead, the building was demolished and source area soils were removed, eliminating the soil vapor intrusion hazard.

Measured levels of PCE from April 2018 were below or at detection limits of the tests and below levels expected to result in non-cancer or cancer health effects. This one set of samples is not enough to rule out a possible vapor intrusion problem. More indoor air samples over several seasons are needed to conclude if there is or is not a vapor intrusion problem. More sampling is scheduled as part of the startup portion of the remedial activities to be conducted at the site in 2020.

## **Recommendations**

EEP recommends that EPA take the following actions to protect the health of people on or near the FCC site:

- Adopt institutional controls for the FCC property. These controls would include restricting certain development options for the property. The property owner also might adopt such controls.
- Take proper health and safety precautions to protect any workers during site excavation and activities associated with installing the proposed soil treatment system.
- Conduct sampling over different seasons. Monitor air inside and soil gas beneath the adjacent fast food restaurant during key parts of the proposed soil treatment system (startup, steady state, operation, and rebound) and take actions needed to protect health.
- Assess soil gas in all directions and at appropriate depths during startup and operation of the interim action soil treatment. Additional vapor intrusion investigations might be warranted based on the soil gas data collected. These additional investigations might include nearby homes and businesses.

## **Public Health Action Plan**

This public health action plan for the FCC site lists steps TDH EEP and other agencies have taken or plan to take. Those steps are designed to limit and prevent harmful health effects that might result from exposure to hazardous substances in the environment. EEP is committed to following up on this plan to ensure that it is implemented.

### **TDH EEP Actions Completed**

- Reviewed numerous reports summarizing activities performed and environmental data collected from this site.
- Prepared this health consultation based on data collected during the previous EPA-lead environmental investigations conducted at the site.
- Attended various public meetings (April 26, 2016; October 6, 2016; August 3, 2017; February 1, 2018; and July 10, 2018) with our EPA, TDEC, and Shelby County Health Department partners. We provided an information display at the meetings and various handouts about the site, chemicals used at the site, vapor intrusion, healthy homes, and common environmental issues homeowners could experience in the course of owning a home. We also answered many questions citizens had about the site during each meeting.
- Prepared a health consultation, *Former Custom Cleaners Air Sampling Results Evaluation, Memphis, Shelby County, Tennessee*, on July 18, 2014, for the site after reviewing results of an indoor air investigation. The owner of the former art supply store in the Custom Cleaners building lived upstairs of the store. Our health evaluation led to a recommendation to the owner that to prevent potentially harmful exposures to PCE they should no longer work and live in the store.
- Attended a meeting with MLGW, EPA, and TDEC officials requesting sampling of select wells in Sheahan Wellfield located 0.6 miles northeast of the FCC site.

### **TDH EEP Actions Planned**

- Be available to EPA, TDEC, City of Memphis, MLGW, the Shelby County Health Department and local citizens should they have questions regarding this health consultation.
- Provide copies of this health consultation to state, federal, and local government, MLGW officials, and interested local citizens.
- Review future onsite and off-site soil gas and indoor air results collected by EPA, TDEC, or the property owner and provide interpretation of the data as requested.
- Review groundwater data when it becomes available. EEP will prepare another health consultation evaluating potential groundwater exposure onsite and off-site after data from EPA become available.

- Attend future public meetings to improve the understanding of the community in the environmental regulatory process and in the improvements in the environment of the FCC site as a result of the regulatory process.
- Maintain dialogue with the Shelby County Health Department, TDEC, ATSDR, EPA, MLGW, other government agencies, and interested stakeholders to safeguard public health in the City of Memphis near the site.



## References

- [ACS] American Cancer Society. 2018. Cancer facts & figures 2018. Atlanta, GA [accessed 2019 August 13]. Available from: <https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/annual-cancer-facts-and-figures/2018/cancer-facts-and-figures-2018.pdf>.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2004. Interaction profile for 1,1,1-trichloroethane, 1,1-dichloroethane, trichloroethylene, and tetrachloroethylene. Atlanta GA: U.S. Department of Health and Human Services.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2005. Public Health Assessment Guidance Manual. Atlanta GA: U.S. Department of Health and Human Services [accessed 2019 August 12]. Available from: [https://www.atsdr.cdc.gov/hac/PHAManual/PDFs/PHAGM\\_final1-27-05.pdf](https://www.atsdr.cdc.gov/hac/PHAManual/PDFs/PHAGM_final1-27-05.pdf).
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2014a. Toxicological profile for tetrachloroethylene. Atlanta GA: U.S. Department of Health and Human Services.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2014b. Toxicological profile for trichloroethylene. Atlanta, GA: U.S. Department of Health and Human Services.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2016. Evaluating vapor intrusion pathways. Atlanta, GA: U.S. Department of Health and Human Services [accessed 2019 August 12]. Available from: [https://www.atsdr.cdc.gov/docs/svi\\_guidance\\_508.pdf](https://www.atsdr.cdc.gov/docs/svi_guidance_508.pdf).
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2019. Comparison values. Atlanta, GA: U.S. Department of Health and Human Services. February 2019.
- [EPA] U.S. Environmental Protection Agency. 2011. Background indoor air concentrations of volatile organic compounds in North American residences (1990–2005): a compilation of statistics for assessing vapor intrusion. EPA 530-R-10-001. Washington, DC [accessed 2019 August 13]. Available from: <https://www.epa.gov/sites/production/files/2015-09/documents/oswer-vapor-intrusion-background-report-062411.pdf>.
- [EPA] U.S. Environmental Protection Agency. 2018. Proposed plan for interim action record of decision, Former Custom Cleaners Superfund site, operable unit 1 (OU-1) – soil, Memphis, Shelby County, Tennessee. Washington, DC.
- [MLGW] Memphis Light, Gas, and Water. 2016. [http://www.mlgw.com/about] Memphis, TN [accessed 2018 2 July]. Available from: [www.mlgw.com](http://www.mlgw.com).
- Shelby County Register of Deeds. 2015. Deeds and tax records for 3517 Southern Avenue. Memphis, TN.
- [TDEC] Tennessee Department of Environment and Conservation, Division of Remediation. 2013. Discovery assessment sampling and analysis plan – Former Custom Cleaners. September 24, 2013. Memphis, TN.

[TDEC] Tennessee Department of Environment and Conservation, Division of Remediation. Preliminary assessment letter report – Former Custom Cleaners. June 27, 2014. Memphis, TN.

[TDEC] Tennessee Department of Environment and Conservation, Division of Remediation. 2015. Site inspection (SI) report, Former Custom Cleaners (FCC) site, 3517 Southern Avenue, Memphis, Shelby County, Tennessee. Memphis, TN.

[TDH] Tennessee Department of Health, Environmental Epidemiology Program. 2014. Former Custom Cleaners air sampling results evaluation, Memphis, Shelby County, Tennessee. Nashville, TN [accessed 2019 August 12]. Available from: [www.tn.gov/content/dam/tn/health/documents/hc-e-custom\\_cleaners\\_071814.pdf](http://www.tn.gov/content/dam/tn/health/documents/hc-e-custom_cleaners_071814.pdf).

Tetra Tech. 2017. Letter report (2016 removal action), Former Custom Cleaners, Memphis, Shelby County, Tennessee. February 6, 2017. Duluth, GA. 29 p.

Versar Inc. 2017. Sampling and analysis plan (Volume 1 – Field sampling plan and Volume 2 – Quality assurance project plan); remedial investigation / feasibility study; Former Custom Cleaners site; Memphis, Shelby County, Tennessee. Atlanta, GA.

Versar Inc. 2018. Final focused remedial investigation report, Operable unit (OU-1) 1 – soil, Former Custom Cleaners Site, Memphis, Shelby County, Tennessee. Atlanta, GA.

## Glossary of Terms and Acronyms

**adverse health effect:** A change in body function or cell structure that might lead to disease or health problems.

**ATSDR:** Federal Agency for Toxic Substances and Disease Registry.

**cancer:** Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

**cancer risk:** The theoretical excess risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower. The excess cancer risk is often expressed as  $1 \times 10^{-6}$  for one excess cancer in 1 million people.

**Cancer Risk Evaluation Guide (CREG):** CREGs are environmental media (water, soil, air) specific comparison values that are used to identify amounts of cancer-causing substances that are unlikely to result in an increase of cancer rates in people that have been exposed to the media.

**chronic exposure:** Contact with a substance that occurs over a long time (more than 1 year).

**comparison value (CV):** Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the health consultation process. Substances found in amounts greater than their CVs might be selected for further evaluation in the health consultation process.

**concentration:** The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

**contaminant:** A substance that is either present in an environment where it does not belong.

**detection limit:** The lowest concentration of a chemical that a laboratory's analytical equipment can reliably distinguish from a zero concentration.

**DoR:** The Tennessee Department of Environment and Conservation's Division of Remediation.

**EEP:** The Tennessee Department of Health's Environmental Epidemiology Program.

**Environmental Media Evaluation Guide (EMEG):** EMEGs represent levels of substances in water, soil, and air, to which humans may be exposed during a specified amount of time (acute, intermediate, or chronic) without experiencing adverse health effects.

**EPA:** United States Environmental Protection Agency.

**epidemiology:** The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

**exposure:** Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

**exposure pathway:** The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: 1. a source of contamination (such as an abandoned business), 2. an environmental media and transport mechanism (such as movement through ground water), 3. a point of exposure (such as a private well), 4. a route of exposure (eating, drinking, breathing, or touching), and 5. a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

**FCC:** Former Custom Cleaners

**groundwater:** Water beneath the Earth's surface in the spaces between soil particles and between rock surfaces.

**hazard:** A source of potential harm from past, current, or future exposures.

**inhalation:** The act of breathing. A hazardous substance can enter the body this way.

**ISTD:** In-situ thermal desorption. A treatment technology used to heat soil to vaporize trapped chemical vapors.

**µg/m<sup>3</sup>:** micrograms per cubic meter - units of measure for volatile organic compounds in air.

**MLGW:** Memphis Light, Gas, and Water. The public utility which supplies consumers in Memphis, TN with water, electricity, and natural gas.

**Minimal Risk Level (MRL):** An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects.

**PAHs:** Polycyclic Aromatic Hydrocarbons. A group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat.

**PCE:** Tetrachloroethylene, a chlorinated solvent chemical used in dry cleaning.

**release:** A release is defined as any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing (including the abandonment or discarding of barrels, containers and other closed receptacles containing any hazardous substance, pollutant, or contaminant) into the to the air water or land.

**remediation:** Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a site.

**risk:** The probability that something will cause injury or harm. For non-carcinogen health effects, it is evaluated by comparing an exposure level over a period to a reference dose derived from experiments on animals. For carcinogenic health effects, risk is estimated as the incremental probability of an individual developing cancer over a lifetime (70 years) as a result of exposure to a potential carcinogen.

**route of exposure:** The way people come into contact with a hazardous substance. Three routes of exposure are breathing (inhalation), eating or drinking (ingestion), or contact with the skin (dermal contact).

**the site:** The Former Custom Cleaners property located at 3517 Southern Avenue, Memphis, TN 38111.

**soil gas:** Gaseous elements and compounds in the small spaces between particles of earth and soil. Such gases can be moved or driven out under pressure.

**solvent:** A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

**source area:** The location of or the zone of highest soil or ground water concentrations, or both, of the chemical of concern. The source of contamination is the first part of an exposure pathway.

**SVE:** soil vapor extraction. A remedial process by which chemical vapors are pulled from the subsurface.

**TDEC:** Tennessee Department of Environment and Conservation.

**TDH:** Tennessee Department of Health.

**Tetrachloroethylene (PCE):** A chlorinated solvent chemical that has a density greater than water. The most widely used chemical in dry cleaning.

**Trichloroethylene (TCE):** A chlorinated solvent chemical also having a density greater than water. Most commonly used degreasing chemical.

**volatile organic compounds (VOCs):** Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, dichloroethylene, toluene, trichloroethylene, methylene chloride, methyl chloroform, and vinyl chloride.

**window:** For this project, an opening in a geologic strata caused by erosion or incomplete deposition allowing water or contamination to migrate downward from an upper geologic strata to the lower strata.

## **REPORT PREPARATION**

The Tennessee Department of Health prepared this Health Consultation for the Former Custom Cleaners site located in Memphis (Shelby County), Tennessee under a cooperative agreement (Grant # CDC-RFA-TS17-170102CONT18) with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, and procedures existing at the date of publication. The Tennessee Department of Health evaluated and summarized the data used in this Health Consultation. ATSDR reviewed this document and concurs with its findings based on information presented by the Tennessee Department of Health.

### **Author**

Mr. Joseph P. George, MS, PG, Environmental Health Assessor  
Tennessee Department of Health (TDH)  
Communicable and Environmental Diseases and Emergency Preparedness (CEDEP)  
Environmental Epidemiology Program (EEP)  
3rd Floor, Andrew Johnson Tower  
710 James Robertson Parkway  
Nashville, TN 37243

### **State Reviewers**

Dr. John G. Benitez, MD, MPH, Medical Director  
Emergency Preparedness and Environmental Epidemiology Programs  
Tennessee Department of Health

Mr. David M. Borowski, MS, Principal Investigator, Assistant Director  
Environmental Epidemiology Program  
Tennessee Department of Health

Tamal Chakraverty, MD, MPH, CPH  
Epidemiologist  
Shelby County, Tennessee, Health Department

W. Jordan English, West Region Director  
Division of Remediation  
Tennessee Department of Environment and Conservation, Memphis Field Office

Merrie S. Embry, TDEC Environmental Consultant  
Memphis Field Office Division of Remediation  
Tennessee Department of Environment and Conservation, Memphis Field Office

Charles L. Jobe, TDEC Environmental Consultant  
Division of Remediation  
Tennessee Department of Environment and Conservation, Nashville Central Office

**ATSDR Cooperative Agreement Coordinator and Technical Project Officer**

Trent LeCoultré, MPH, REHS  
Cooperative Agreement Coordinator  
Division of Community Health Investigations

Audra Henry, MS  
Technical Project Officer  
Division of Community Health Investigations

**ATSDR Regional Representative**

John Wheeler, PhD  
Region 4 Director, Division of Community Health Investigations



## Appendix A. Additional Site Photographs—April 26, 2016 and March 27, 2017



**Photo 1** – View to north of Former Custom Cleaners/Sharri's Discount Art Supplies building. View shows railroad and general commercial development in the area. (Photo credit: J. George, 4/26/16).



**Photo 2** – View toward University of Memphis. The former 3523 Southern building is shown at the right and the animal hospital is located beyond the 3523 Southern building, across Minor Road. Railroad is to the left paralleling the road. View is to the west. (Photo credit: J. George, 4/26/16).



**Photo 3** – Former Custom Cleaners/Sharri's Discount Art Supplies building location. After building demolition and soil removal, gravel was part of the fill material brought onto site to fill the source area soil excavation. View is to the southeast toward nearby business strip center housing a rug cleaning company and vacant storefronts on Minor Road. (Photo credit: J. George, 3/27/17).



**Photo 4** – Former Custom Cleaners building location after EPA emergency response action. EPA removed source area soil to a depth of 17 feet from beneath the FCC building in 2016. View is looking southwest. (Photo credit: J. George, TDH, 3/27/17).



**Photo 5** – View of constructed fast food restaurant in which indoor air and sub-slab soil gas was tested. View is to the west. (Photo credit: J. George, 3/27/17).



## Appendix B. Timeline of Events at the Former Custom Cleaner NPL Site

Timeline for Former Custom Cleaners (FCC) Site Activities	
About 1933	Area near University of Memphis becomes developed. Numerous auto repair facilities, service stations, lumber companies, machine shops, furniture repair facilities, woodworking facilities, appliance repair facilities, fuel plants, printing companies are located in the area.
1943	3517 Southern Avenue building is constructed.
1945	Dry-cleaning operations begin.
About 1996	Dry-cleaning operations cease.
About 2001	Sharri's Discount Arts begins operating in 3517 Southern Avenue building. During later years the owner worked and lived in the building. Sharri's Discount Arts business closes in February 2014.
June 27, 2013 – October 2013	Tennessee Department of Environment and Conservation (TDEC) investigates June 27, 2013 complaint by tenant about the presence of drums of liquid in the building when tenant first rented the space. TDEC prepares Discovery Assessment document September 24, 2013. Elevated levels of tetrachloroethylene (PCE) found in soil gas beneath the Former Custom Cleaners (FCC) building and outside of building at the loading dock. Indoor air samples collected during September and October 2013 contained tetrachloroethylene (PCE) (180 to 220 µg/m <sup>3</sup> ) and trichloroethylene (<1.1 to 1.1 µg/m <sup>3</sup> ).
February 2014 - September 2016	FCC building remains vacant.
June 27, 2014	TDEC publishes Preliminary Assessment Letter Report for site.
July 18, 2014	Tennessee Department of Health (TDH) Health Consultation published. Evaluated the 2013 indoor air sampling results collected by TDEC inside Former Custom Cleaners/Sharri's Discount Arts building. TDH and TDEC recommend tenant not live in building due to elevated PCE levels.
March 9 – 18, 2015	TDEC and the U. S. Environmental Protection Agency's (EPA's) contractor TetraTech conduct field investigations at the site. Soil and groundwater samples are collected. PCE was found in site soils up to 7,100,000 µg/kg and groundwater up to 140 µg/L.
March - April 2015	U.S. Geological Survey Field Investigation at site.
August 17, 2015	TDEC publishes site Inspection Report based on the March and April 2015 work.
January 19 - 20, 2016	EPA's contractor TetraTech conducts field investigation activities at the site.

<b>Timeline for Former Custom Cleaners (FCC) Site Activities, continued</b>	
April 27, 2016	TDH attends TDEC Public Meeting for site proposal to the TDEC, Division of Remediation's (DoR) List of Inactive Hazardous Substance Sites.
September 2016	Demolition of FCC building begins. September 6, 2016, excavation of source area soils begins and ends on September 26, 2016. Approximately 980 cubic yards of soil removed from site. Maximum excavation depth was 17 feet. Soil disposed of at the Waste Management Tunica, MS landfill. FCC building debris disposed of at the Waste Management Robbinsville, MS landfill.
September 9, 2016	EPA proposes site to National Priorities List (NPL or Superfund) with comment period ending November 8.
October 6, 2016	EPA holds Public Availability Sessions during the public comment period to provide the community and stakeholders information on what it means for the Site to be proposed to the NPL. TDEC, TDH and Shelby County Health Department attend. TDH has display providing health information about PCE exposure to 23 interested community members and stakeholders.
June 7, 2017	The FCC site is added to TDEC DoR's List of Inactive Hazardous Substance Sites.
June 2017 – April 2018	EPA performs a Remedial Investigation focused on soil, soil gas, and indoor air at the site. Numerous soil samples from 24 soil borings and five monitoring well borings, and 14 soil gas samples were collected throughout the site. In April 2018 three indoor air and soil gas samples collected from an adjacent fast food restaurant west of location of FCC building. Further investigation of off-site groundwater impact will begin after soil remediation activities are put in place.
August 3, 2017	FCC site added to NPL.
August 3, 2017	EPA holds Public Availability Sessions discussing the addition of the site to the NPL and the path forward for investigation and remediation. TDEC, TDH, and Shelby County Health Department attend. TDH has display and provides health information about PCE exposure to 60 interested community members and stakeholders.
February 1, 2018	EPA holds Public Availability Sessions to discuss the on-going investigation activities and propose methods of remediation of PCE in site soils to 25 members of community and stakeholders. TDEC and TDH attend. TDH has display and provides health information.
March 30, 2018	Draft Operable Unit 1 (OU1) Focused Remedial Investigation Report and Draft OU1 Focused Feasibility Study Report released.
April 2018	Sampled indoor air of fast food restaurant next to the FCC site.
June 1, 2018	Final OU1 Focused Remedial Investigation Report and Final OU1 Focused Feasibility Study released.

<b>Timeline for Former Custom Cleaners (FCC) Site Activities, continued</b>	
July 10, 2018	EPA holds Public Availability Session to inform the community and stakeholders of the proposed remedial alternatives and the preferred alternative to clean up PCE in site soils. July 10, 2018 began the 30-day public comment period for the Proposed Plan for the OU1 Interim Action Record of Decision. 32 people attended. TDEC and TDH attend to answer questions about the site and health impacts. TDH has display and provides health information to those that attended. Soil cleanup activities are scheduled to begin when EPA allocates money, projected to be late 2018.
August 9, 2018	Completion of the 30-day public comment period for the Proposed Plan. The EPA will address comments and provide responses in the OU1 Interim Action Record of Decision.
September 2018	EPA submits OU1 Interim Action Record of Decision to TDEC and TDH for review. TDEC provides the concurrence letter to the EPA on September 26, 2018.
September 26, 2018	The EPA signs the OU1 Interim Action Record of Decision to begin soil cleanup at the site.
November 2018	3523 Southern Avenue building razed.

### Environmental Investigations

TDEC DoR became involved in the FCC site in 2013 in response to a complaint by a former tenant of the building. TDEC DoR performed a Discovery Assessment which included collecting air samples inside the building and passive soil gas samples around the building to assess the potential for chlorinated solvent contamination in indoor air and soil gas. Results showed levels of the dry cleaning solvent chemical PCE and a breakdown chemical of PCE, trichloroethylene (TCE), in indoor air. Levels of both chemicals exceeded ATSDR's health comparison values (CVs) as well as EPA residential air regional screening levels. EEP prepared a health consultation evaluating the indoor air data that recommended the tenant not live in the building [TDH 2014]. TDEC DoR agreed with the conclusions and informed the tenant. The tenant vacated the building in February 2014.

TDEC prepared two reports for the site ranging from a 2014 Preliminary Assessment (PA) to a 2015 Site Inspection (SI) Report. The PA cited previous work performed by the United States Geologic Survey (USGS) that found a geologic "window" between shallower non-drinking water aquifers and the deeper Memphis Sand Aquifer which the wells of the Sheahan Wellfield are completed in and produce water from. A window is an opening in a geologic strata caused by erosion or incomplete deposition allowing water or contamination to migrate downward from an upper geologic strata to the lower strata. The "window" could allow for contaminated water at the site to be drawn into the Memphis Sand Aquifer by pumping the wells within the Sheahan Well Field.

The 2015 SI was performed by TDEC DoR and its contractor TetraTech. Soil, soil gas, and groundwater samples were collected as part of the SI. Soil sample results showed a PCE

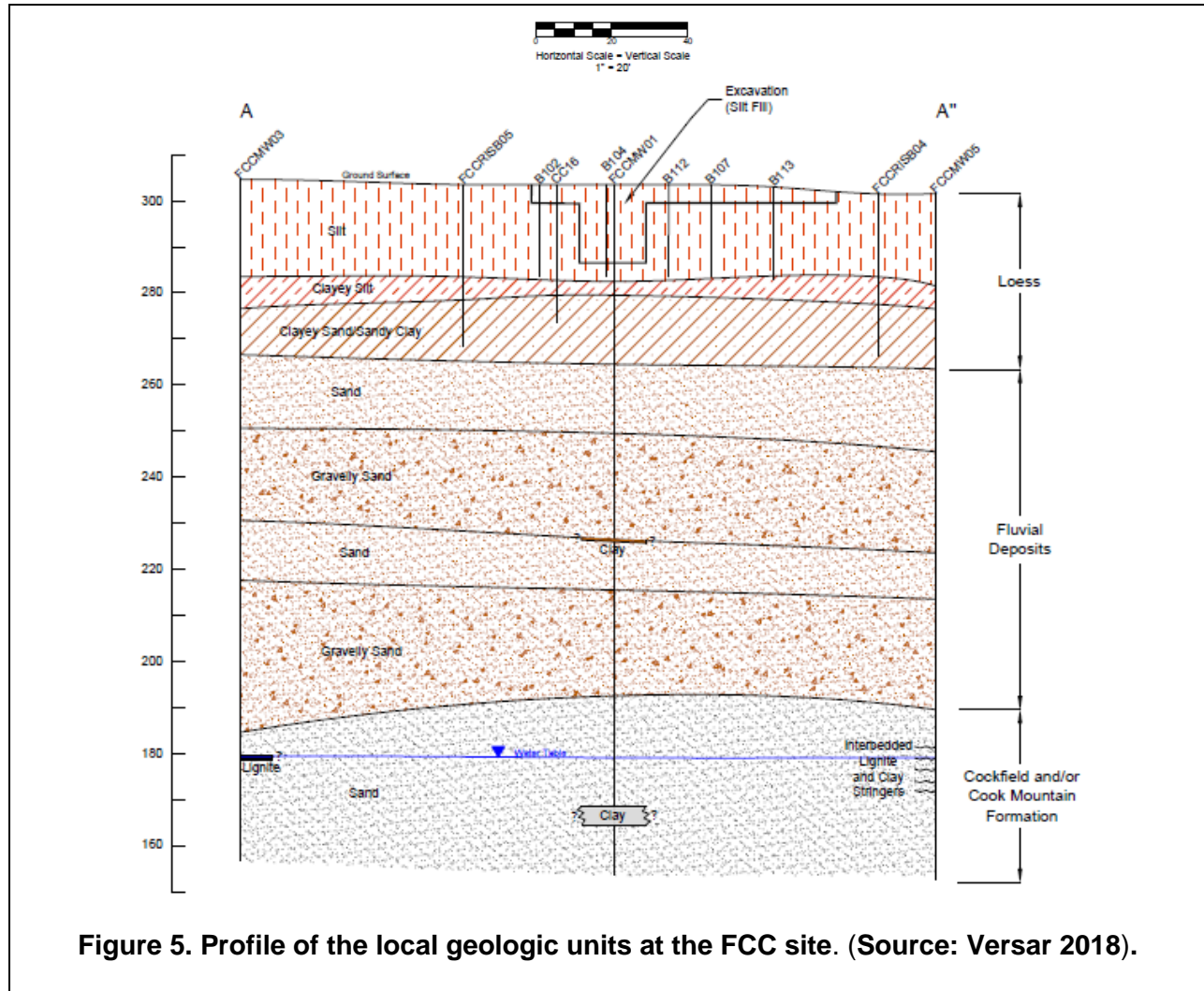
source area with highly contaminated soil beneath and immediately adjacent to the slab of the FCC building. Soil gas results showed PCE levels above EPA screening levels, indicating the potential for vapor intrusion to occur at the site. The highest PCE soil gas level was 620,000 micrograms per cubic meter. A site well was also installed and sampled. Soil samples were collected from approximately 6 feet bgs to 153 feet bgs. Water was encountered at approximately 125 feet bgs. Levels of PCE were detected in nearly every soil sample.

In 2016, an EPA contractor advanced 15 soil borings to outline the extent of source area soil impact at the site. The borings established the extent of a time-critical removal action source removal. All borings were advanced to 20 feet bgs but one, which was advanced to 12 feet bgs using a hand auger due to access limitations at the boring location.

In September 2016, EPA contractors demolished the FCC building, removed the slab-on-grade building foundation, and removed approximately 980 cubic yards of PCE-impacted soil. Soil was excavated to a maximum depth of 17 feet in the defined source area. Excavated soils were transported and disposed at the Waste Management Tunica Landfill in Robinsonville, MS, an EPA-approved facility. Building demolition resulted in approximately 700 cubic yards of non-hazardous materials being either disposed of or recycled. The excavated area was backfilled to original grade with clean soil [TetraTech 2017].

EPA contractor Versar performed additional extensive soil, soil gas, indoor air, and groundwater investigations from August 2017 to April 2018. Numerous soil borings were installed and 168 soil samples were collected. Several soil gas locations were installed onsite and off-site to understand if PCE vapors had migrated beyond the FCC property. Soil gas and indoor air were also tested in an adjacent fast food restaurant to the west of the FCC property. Limited soil gas testing has been conducted northeast of the site adjacent to the utility corridors. Passive soil gas sampling has also been conducted immediately southeast of the FCC property.

## Appendix C. Geologic Profile at the Former Custom Cleaners NPL Site





## **Appendix D. Tables of Soil, Soil Gas, and Indoor Air Results Compared to ATSDR Comparison Values**

**Table D-1.** Volatile organic compounds (VOCs) and total metals found in the soil interval from 0 to 1 foot below ground surface in the 2017 EPA (Versar) Remedial Investigation. All compounds and metals evaluated are reported in milligrams per kilogram (mg/kg). Screening values are ATSDR residential soil non-cancer environmental media evaluation guides (EMEGs) for chronic exposure duration (>364 days exposure), ATSDR Reference Dose Media Evaluation Guides (RMEGs) or ATSDR residential soil cancer risk evaluation guides (CREGs). Source: Versar 2018.

Chemical in Soil	Minimum Concentration Measured (mg/kg)	Maximum Concentration Measured (mg/kg)	Boring Location of Maximum Concentration	Concentration used for screening (mg/kg)	Selected Comparison Value (CV)	Source of Selected CV	No. Locations at or above CV	Selected for Further Evaluation
<b>VOCs</b>								
1,1,2-trichloroethane	<0.005	<0.0082	FCCRISB04	<0.0082	6.8	ATSDR CREG	0/18	No
acetone	0.011	0.021	FCCRISB05	0.021	47,000	ATSDR Chronic RMEG (c)	0/18	No
chloroform	0.027	0.050	FCCRISB04	0.050	520	ATSDR Chronic EMEG (c)	0/18	No
cis-1,2-dichloroethene	<0.005	<0.0082	FCCRISB04	<0.0082	100	ATSDR Chronic RMEG (c)	0/18	No
tetrachloroethylene	0.0015	1.0	FCCMW02	1.0	180	ATSDR CREG	0/18	No
trichloroethylene	0.0019	0.011	FCCRISB04	0.011	5.6	ATSDR CREG	0/18	No
methyl acetate	0.0019	0.0019	FCCMW02	0.0019	ngv	NA	0/18	No
<b>Metals</b>								
aluminum	9,900	9,900	FCCRISB02	9,900	52,000	ATSDR Chronic EMEG (c)	0/1	No
arsenic	9.3	9.3	FCCRISB02	9.3	16	ATSDR Chronic RMEG (c)	0/1	No
barium	110	110	FCCRISB02	110	10,000	ATSDR Chronic EMEG (c)	0/1	No
chromium	11	11	FCCRISB02	11	47	ATSDR Cr <sup>+6</sup> EMEG (c)	0/1	No
cobalt	5.9	5.9	FCCRISB02	5.9	520	ATSDR Interm. EMEG (c)	0/1	No
copper	13	13	FCCRISB02	13	520	ATSDR Interm. EMEG (c)	0/1	No
iron	20,000	20,000	FCCRISB02	20,000	ngv	NA	0/1	No

**Table D-1.** Volatile organic compounds (VOCs) and total metals found in the soil interval from 0 to 1 foot below ground surface in the 2017 EPA (Versar) Remedial Investigation. All compounds and metals evaluated are reported in milligrams per kilogram (mg/kg). Screening values are ATSDR residential soil non-cancer environmental media evaluation guides (EMEGs) for chronic exposure duration (>364 days exposure), ATSDR Reference Dose Media Evaluation Guides (RMEGs) or ATSDR residential soil cancer risk evaluation guides (CREGs). Source: Versar 2018.

Chemical in Soil	Minimum Concentration Measured (mg/kg)	Maximum Concentration Measured (mg/kg)	Boring Location of Maximum Concentration	Concentration used for screening	Selected Comparison Value (CV)	Source of Selected CV	No. Locations at or above CV	Selected for Further Evaluation
Metals (continued)								
lead	18	18	FCCRISB02	18	ngv	NA	0/1	No
manganese	330	330	FCCRISB02	330	2,600	ATSDR Chronic RMEG (c)	0/1	No
nickel	12	12	FCCRISB02	12	1,000	ATSDR Chronic RMEG (c)	0/1	No
strontium	22	22	FCCRISB02	22	31,000	ATSDR Chronic RMEG (c)	0/1	No
thallium	0.23	0.23	FCCRISB02	0.23	ngv	NA	0/1	No
titanium	120	120	FCCRISB02	120	ngv	NA	0/1	No
vanadium	23	23	FCCRISB02	23	520	ATSDR Interm. EMEG (c)	0/1	No
yttrium	4.0	4.0	FCCRISB02	4.0	ngv	NA	0/1	No
zinc	48	48	FCCRISB02	48	16,000	ATSDR Chronic EMEG (c)	0/1	No

**Notes:**

ATSDR EMEG = Agency for Toxic Substances and Disease Registry Environmental Media Evaluation Guide (ATSDR 2019). Chronic non-cancer exposure comparison values for an exposure greater than 365 days used to determine if chemical concentrations warrant further health-based screening. ATSDR CREG = Agency for Toxic Substances and Disease Registry Cancer Risk Evaluation Guide (ATSDR 2019).

ATSDR Environmental Media Evaluation Guide (EMEG) for Hexavalent Chromium used; ATSDR Chronic EMEG for Cr<sup>+3</sup> not available.

ATSDR RMEG = Reference Dose Media Evaluation Guide; ATSDR RMEG used as there was no Chronic EMEG available for the chemical.

ATSDR intermediate (Interm.) exposure duration (15 to 364 days) EMEG for mercuric chloride used; Chronic EMEG unavailable.

(c) = RMEG or EMEG represents that for a child exposure.

mg/kg = milligrams per kilogram, equivalent to parts per million in soil.

ngv = no guidance value for chemical

NA = not applicable

**Table D-2.** Volatile organic compounds (VOCs) found in soil gas at the Former Custom Cleaners Site, 3517 Southern Avenue, Memphis, Tennessee, during the January/April 2018 Versar Remedial Investigation. All compounds evaluated are reported in micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ). Source: Versar 2018.

Chemical	Minimum Concentration Measured ( $\mu\text{g}/\text{m}^3$ )	Maximum Concentration Measured ( $\mu\text{g}/\text{m}^3$ )	Selected ATSDR Screening Value ( $\mu\text{g}/\text{m}^3$ )	ATSDR Screening Value Source	Number of Detections above Screening Value	Boring Location of Maximum Concentration
1,1-dichloroethene	<1.4	4.4	2,600	Chronic RMEG	0/14	FCCSG09
1,2,4-trimethylbenzene	<1.6	31.2	2,000	Chronic RMEG	0/14	FCCSG11
1,3,5-trimethylbenzene	<1.6	10.1	2,000	Chronic RMEG	0/14	FCCSG11
2-butanone	<5.0	100	170,000	Chronic RMEG	0/14	FCCSG02
4-ethyltoluene	<1.6	7.7	ngv	ngv	0/14	FCCSG11
acetone	15.1	401	1,000,000	Chronic EMEG	0/14	FCCSG03
benzene	<0.84	<b>9.9</b>	4.3	CREG	<b>9/14</b>	FCCSG03
carbon disulfide	<1.2	14.5	23,000	Chronic RMEG	0/14	FCCSG03
chloroform	<0.81	<b>66.9</b>	1.4	CREG	<b>6/14</b>	FCCSG02
chloromethane	<0.71	3.9	3,000	Chronic RMEG	0/14	FCCSG10
cis-1,2-dichloroethylene	<1.3	4,990	26,000*	Interm. EMEG	0/14	FCCSG09
cyclohexane	<1.2	19.5	200,000	Chronic RMEG	0/14	FCCSG13
dichlorodifluoromethane	<1.8	58.3	ngv	ngv	0/14	FCCSG02
ethylbenzene	<1.5	23.7	8,700	Chronic EMEG	0/14	FCCSG11
m&p xylene	3.0	91.2	3,300 <sup>#</sup>	Chronic RMEG	0/14	FCCSG11
methylene chloride	<5.8	168	2,100	CREG	0/14	FCCSG08
n-Heptane	<1.4	44.5	ngv	ngv	0/14	FCCSG11
n-Hexane	5.2	29.8	23,000	Chronic RMEG	0/14	FCCSG03
naphthalene	<4.3	14	100	Chronic RMEG	0/14	FCCSG11
o-xylene	<1.5	18.7	3,300 <sup>#</sup>	Chronic RMEG	0/14	FCCSG03
propylene	<0.57	1,070	ngv	ngv	0/14	FCCSG03
styrene	<1.4	2.0	28,000	Chronic EMEG	0/14	FCCSG02
tetrachloroethylene	5.4	<b>5,570,000</b>	130	CREG	<b>9/14</b>	FCCSG04

**Table D-2.** Volatile organic compounds (VOCs) found in soil gas at the Former Custom Cleaners Site, 3517 Southern Avenue, Memphis, Tennessee, during the January/April 2018 Versar Remedial Investigation. All compounds evaluated are reported in micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ). Source: Versar 2018.

Chemical	Minimum Concentration Measured ( $\mu\text{g}/\text{m}^3$ )	Maximum Concentration Measured ( $\mu\text{g}/\text{m}^3$ )	Selected ATSDR Screening Value ( $\mu\text{g}/\text{m}^3$ )	ATSDR Screening Value Source	Number of Detections above Screening Value	Boring Location of Maximum Concentration
trichloroethylene	<0.89	<b>7,080</b>	7	CREG	<b>8/14</b>	FCCSG04
toluene	2.5	51.4	130,000	Chronic EMEG	0/14	FCCSG11
trans-1,2-dichloroethylene	<1.3	161	26,000	Interm. EMEG	0/14	FCCSG09
trichlorofluoromethane	<1.9	166	ngv	ngv	0/14	FCCSG03
vinyl acetate	<1.2	5.7	1,200	Interm. EMEG	0/14	FCCSG10
vinyl chloride	<0.42	<b>8.1</b>	3.7	CREG	<b>2/14</b>	FCCSG09

**Notes:**

<1.3 = Compound not detected at method detection limit for analysis.

ngv = no guidance value

Chronic RMEG = Reference Dose Media Evaluation Guide for a 365 day or longer exposure; ATSDR RMEG used as there was no Chronic EMEG available for the chemical.

Chronic EMEG = Agency for Toxic Substances and Disease Registry Environmental Media Evaluation Guide (ATSDR 2019). Chronic non-cancer exposure comparison values for an exposure greater than 365 days. Used to determine if chemical concentrations warrant further evaluation.

CREG = Agency for Toxic Substances and Disease Registry Cancer Risk Evaluation Guide (ATSDR 2019).

Interm. EMEG = Reference Dose Media Evaluation Guide for an intermediate (15 day to 364 day) exposure; ATSDR Intermediate EMEG used as there was no Chronic EMEG available for the chemical.

26,000\* = Screening value for trans-1,2-dichloroethylene used in absence of screening value for 1,2-cis-dichloroethylene.

3,300<sup>#</sup> = Total Xylenes screening value used in absence of screening value for m&p- and o-xylenes screening values.

FCCSG09 = Former Custom Cleaner soil gas location

**Table D-3.** Volatile organic compounds (VOCs) found in fast food restaurant indoor air in April 2018. The restaurant is located at 614 S. Highland Street. All compounds evaluated are reported in micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ). Screening values are ATSDR residential soil non-cancer environmental media evaluation guides (EMEGs) for chronic exposure duration (>364 days exposure), ATSDR Reference Dose Media Evaluation Guides (RMEGs) or ATSDR residential soil cancer risk evaluation guides (CREGs). Source: Versar 2018.

Chemical	Ambient Air Levels ( $\mu\text{g}/\text{m}^3$ )	Minimum Concentration Measured ( $\mu\text{g}/\text{m}^3$ )	Maximum Concentration Measured* ( $\mu\text{g}/\text{m}^3$ )	Location of Maximum Concentration	Selected Comparison Value (CV)	Source of Selected CV	Number of Locations above CV	Selected for Further Evaluation
Indoor Air VOCs Detected								
acetone	11.5	11.5	42.8	FCCVI04IA	31,000	ATSDR Chronic EMEG	0/4	No
chloromethane	<0.60	<0.60	1.6	FCCVI04IA	90	ATSDR Chronic RMEG	0/4	No
dichlorofluoromethane	<1.5	<1.5	2.2	FCCVI03IA	ngv	NA	0/4	No
m&p xylene	3.1	<2.6	3.1	FCCVI04IA	100	ATSDR Chronic RMEG (total xylenes)	0/4	No
methylene chloride	<5.1	<5.1	<b>146</b>	FCCVI04IA	63	ATSDR CREG	<b>1/4</b>	<b>Yes</b>
n-Hexane	1.2	<1.1	7.2	FCCVI04IA	700	ATSDR Chronic RMEG	0/4	No
propylene	<0.50	<0.50	1.9	FCCVI04IA	ngv	NA	0/4	No
tetrachloroethylene	<0.99	<0.99	1.1	FCCVI04IA	3.8	ATSDR CREG	0/4	No
trichloroethylene	<0.79	<0.79	<0.83	FCCVI04IA	0.21	ATSDR CREG	<b>4/4</b>	<b>Yes</b>
toluene	3.1	3.1	4.7	FCCVI04IA	3,800	ATSDR Chronic EMEG	0/4	No
vinyl acetate	<1.0	<1.0	4.8	FCCVI03IA	35	ATSDR Interm. EMEG	0/4	No

Notes: \* The maximum concentration measured is used for screening

ATSDR EMEG = Agency for Toxic Substances and Disease Registry Environmental Media Evaluation Guide (ATSDR 2019). Chronic non-cancer exposure comparison values for an exposure greater than 365 days.

ATSDR CREG = Agency for Toxic Substances and Disease Registry Cancer Risk Evaluation Guide (ATSDR 2019).

ATSDR Environmental Media Evaluation Guide (EMEG) for total xylenes used for m&p xylene comparison value; ATSDR Chronic EMEG for m&p xylene not available.

$\mu\text{g}/\text{m}^3$  – micrograms per cubic meter

ngv = no guidance value for chemical; NA = no source for comparison value.

<0.60 = Compound not detected at method detection limit for analysis (shown).