

Health Consultation

FORMER CUSTOM CLEANERS NPL SITE
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

April 22, 2021

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

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 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: eep.health@tn.gov

HEALTH CONSULTATION

FORMER CUSTOM CLEANERS NPL SITE
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
Office of Capacity Development and Applied Prevention Science
Atlanta, Georgia 30333

Table of Contents

Summary	1
Introduction.....	1
Conclusions.....	3
Statement of Issues and Background	6
Site Location and Details	6
Figure 1. Former Custom Cleaners Site Location	7
Figure 2. Former FCC Building.....	8
Figure 3. Former 3523 Southern Avenue Building	9
Site Operational History	9
Regional Geology and Hydrogeology	9
Environmental Investigations	10
Figure 4. Diagram of Contamination Movement at the FCC Site	11
Figure 5. EPA soil gas sampling locations and results	12
Figure 6. EPA outdoor and indoor air sampling locations.....	13
Water Use.....	14
Health Education and Community Involvement.....	14
Discussion.....	15
Introduction to Chemical Exposure and Evaluation	15
Site-Related Chemicals.....	16
Exposure Pathways	17
Table 1. Exposure Pathways at the FCC Site	18
Environmental Sampling Results and Public Health Evaluation	19
Site Soils	19
Soil Gas.....	19
Adjacent Restaurant Indoor Air and Subslab Soil Gas.....	21
Limitations	22
Conclusions.....	22
Recommendations.....	23
Public Health Action Plan.....	24
References.....	26
Glossary of Terms and Acronyms	28
Report Preparation	31
Appendix A. Additional Site Photographs – April 26, 2016 and March 27, 2017.....	33
Appendix B. Timeline of Events at Former Custom Cleaners NPL Site.....	36
Appendix C. Geologic Profile at Former Custom Cleaners NPL Site.....	40

Appendix D. Soil, Soil Gas, and Indoor Air Testing Results Summary..... 41
Appendix E. Public Comments and Responses.....48

Summary

Introduction

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

On September 9, 2016, EPA proposed adding the FCC property to the NPL. EPA also demolished the FCC building in September 2016. EPA officially listed the FCC site 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. TDH 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 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 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. TDH 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 2014]. TDH 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 to a depth of 17 feet were removed, decreasing the soil vapor intrusion hazard.

This health consultation evaluates the soil, soil gas, and off-site indoor air exposure pathways based on data collected onsite and off-site by EPA in 2018. 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 because these data were not previously collected at the restaurant or in the area surrounding the FCC site and past on-site exposures were previously addressed. *Rather, this assessment focuses on current exposures at and near 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.

TDH released this initial document for a public comment period of 60 days on December 20, 2019. All public comments received were addressed in this final document. If additional data become available, TDH will further evaluate the potential for vapor intrusion near the FCC site.

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

Conclusions

Conclusion 1 Current exposure to tetrachloroethylene (PCE) in soil from surface to one-foot depth 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 harmful exposure (by swallowing small amounts of soil or through skin contact with dust or soil particles) to PCE for anyone walking across the site. The major source area of contamination was removed in 2016 by excavation of contaminated soil from beneath and near the former dry-cleaner building to a maximum depth of 17 feet. Even so, TDH evaluated levels of PCE and other chemicals remaining in site soils from surface to one-foot depth. Levels of PCE and other chemicals in these onsite soil samples collected after removal of contaminated soil are below health-based comparison values (CVs) used for screening such that no further health evaluation was conducted. No harmful health effects are expected from this exposure pathway.

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 TDH recommends that EPA adopt institutional controls for the FCC property. These controls would include restricting certain development options for the property. A vapor mitigation system could also be another way to mitigate vapor concerns should the property be redeveloped. The property owner also might adopt such controls and a vapor mitigation system.

Conclusion 2 Based on limited indoor air data at the fast food restaurant (adjacent and west of the site), breathing PCE in indoor air is not expected to cause adverse health effects for current customers and workers. However, a definitive health call cannot be made at this time because seasonal sampling data are not available and future remediation activities may result in changes to soil gas.

Additionally, there is a potential vapor intrusion hazard for nearby homes and other nearby businesses. TDH does not have sufficient soil gas data (or indoor air data) to determine the potential for a vapor intrusion hazard near the site.

Basis for Decision

Although the major source area of contamination was removed in 2016 by excavation of contaminated soil from beneath and near the former drycleaner building to a maximum depth of 17 feet, some contamination remains in subsurface soils (the proposed treatment area goes down to approximately 40 feet in the subsurface). Currently, the site has no buildings, and so has no exposure point for these chemical vapors to become an indoor air issue on-site.

Subslab and indoor air samples were collected at the fast food restaurant in 2018. Subslab 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. However, PCE was found in indoor air 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 the crew room sample. Air samples from the customer dining area and the men's restroom were also tested for PCE but were below the detection level. The levels of PCE detected in indoor air at the restaurant are well below the CV of $3.8 \mu\text{g}/\text{m}^3$. TCE was not detected in these indoor air samples though the detection limits of the testing were greater than the CV of $0.21 \mu\text{g}/\text{m}^3$. 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.

Limited soil gas testing has been conducted north of the site next to underground utilities, and to the southwest of the site. Five of the 29 chemicals were found at levels exceeding their soil gas CVs and data do not show how far the contamination extends. These VOCs include benzene, chloroform, PCE, TCE, and vinyl chloride.

Next Steps

TDH 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) or other remediation of site 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 or other remediation of site. Additional vapor intrusion investigations might be warranted based on the soil gas data collected. These additional investigations might include nearby homes and businesses.

- 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 about this health report, call the Tennessee Department of Health's Environmental Epidemiology Program at 615-741-7247 or 1-800-404-3006 during normal business hours. You can also email TDH EEP at eep.health@tn.gov.

Statement of Issues and Background

The Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP) evaluated possible environmental 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 adding 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. TDH 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 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, unless the unhealthy levels of PCE and TCE in the indoor air were mitigated. The tenant chose to vacate the building and the owner chose not to install a mitigation system. 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. Wells drilled at the site encounter groundwater after a depth of 125 feet below ground surface. PCE and low levels of TCE have been detected in groundwater samples collected from onsite monitoring wells. The extent of groundwater contamination is being further refined at the site through drilling off-site monitoring wells. 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.

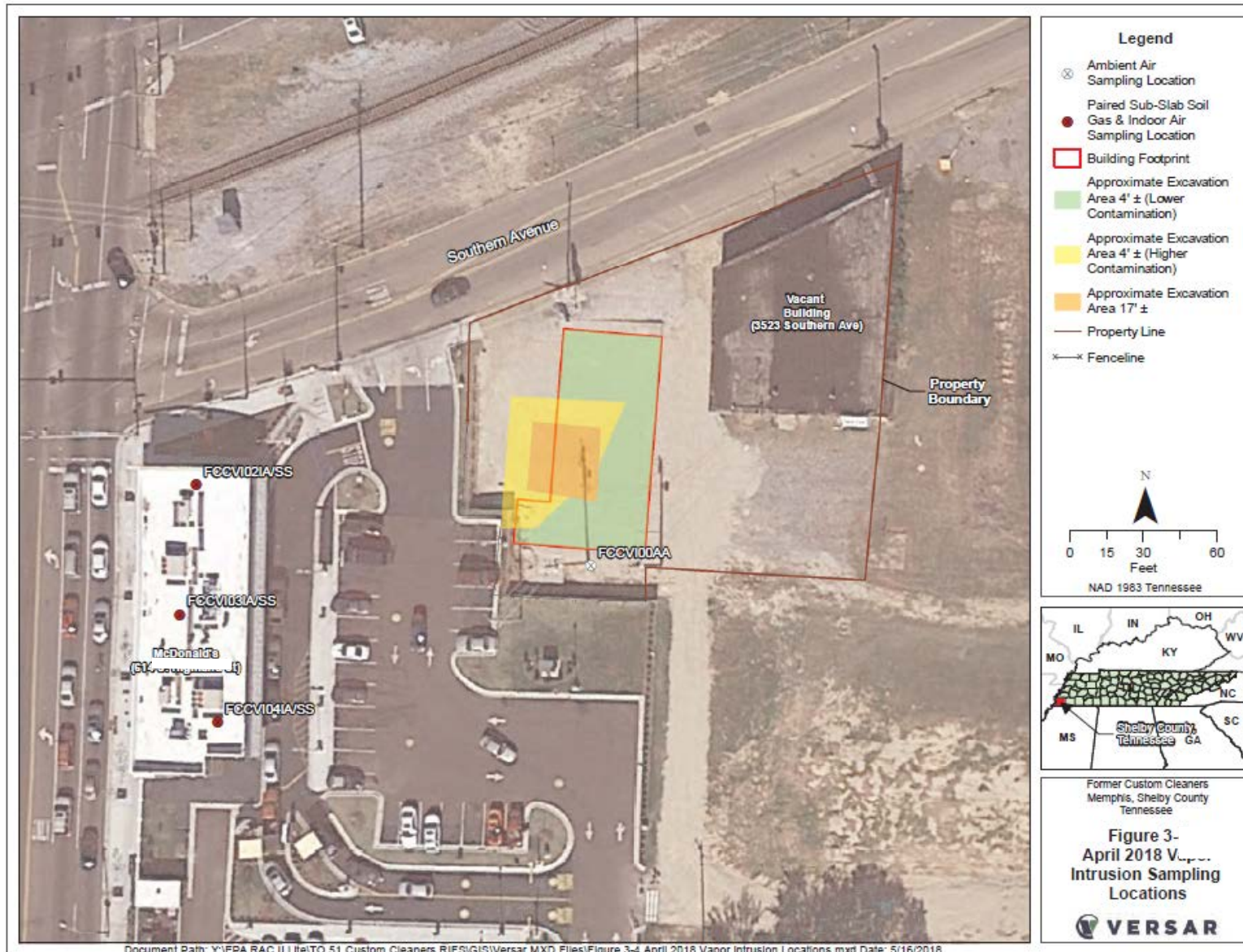
TDH EEP released this initial document for a public comment period of 60 days on December 20, 2019. All public comments received were addressed in this final document.

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 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 FCC building, which was torn down in September 2016 and is now a gravel lot (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

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



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.

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 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'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 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.

Appendix C shows the general geology of the site. It depicts the geologic units encountered during the EPA investigation of the site.

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, encountered at about 125 feet below ground surface. The PCE then contaminates groundwater. The groundwater flow can spread the contamination further away and may impact area drinking water wells.

Environmental Investigations

TDEC became involved in the FCC site in 2013 in response to a complaint by a former tenant of the building. TDEC 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 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 prepared a health consultation evaluating the indoor air data and recommended the tenant not live in the building [TDH 2014]. TDEC agreed with the conclusions and contacted the tenant, who then vacated the building in February 2014. TDEC also contacted the building owner who chose not to install a vapor mitigation system.

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].

An EPA contractor performed additional extensive soil, soil gas, and indoor air investigations during August 2017 through April 2018 (Versar 2017 and 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 north of the site next to underground utilities, and to the southwest of the site (Figure 5). Indoor air testing locations are shown in Figure 6. Appendix B provides a more detailed description of environmental investigations performed at the site.

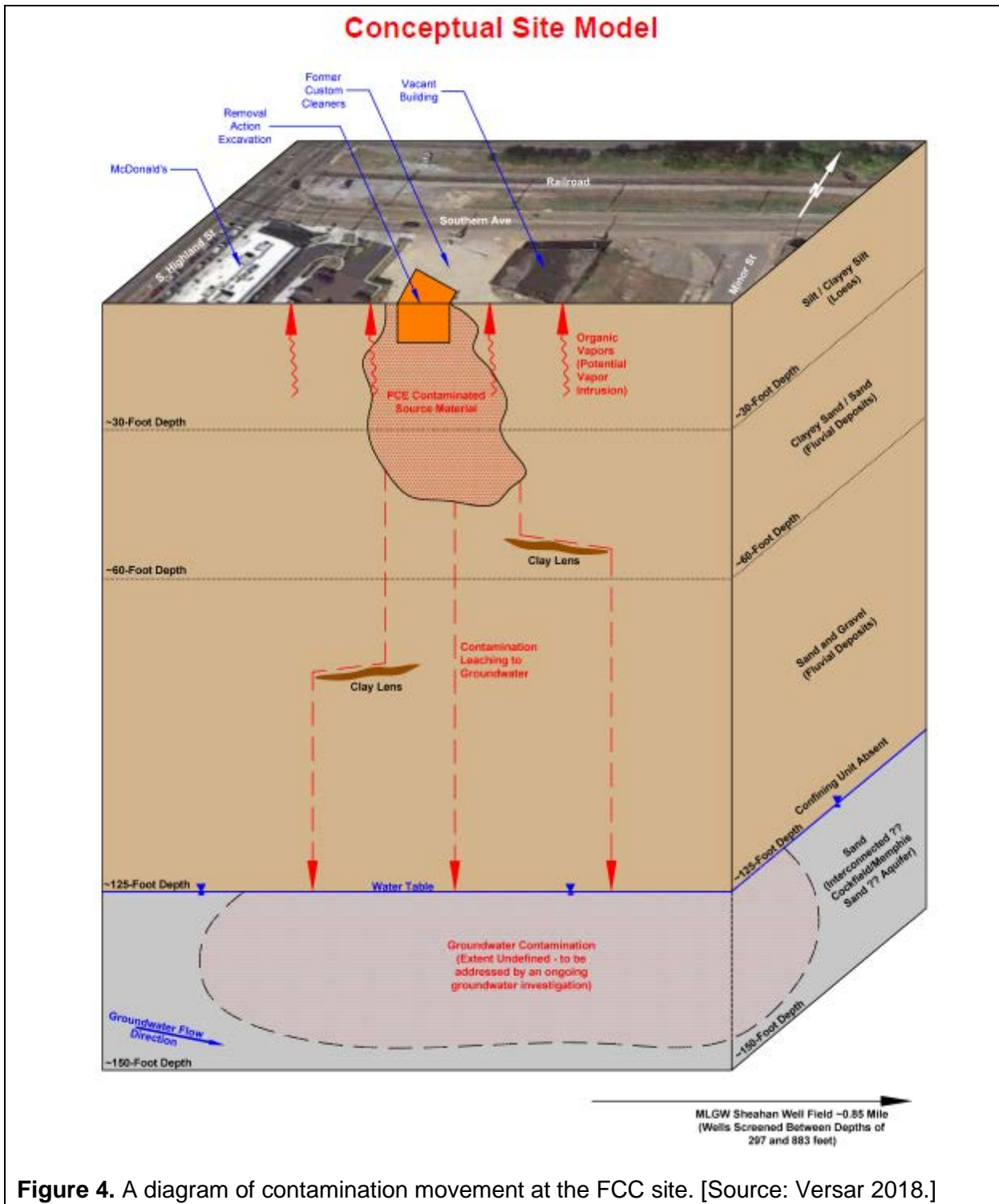


Figure 4. A diagram of contamination movement at the FCC site. [Source: Versar 2018.]

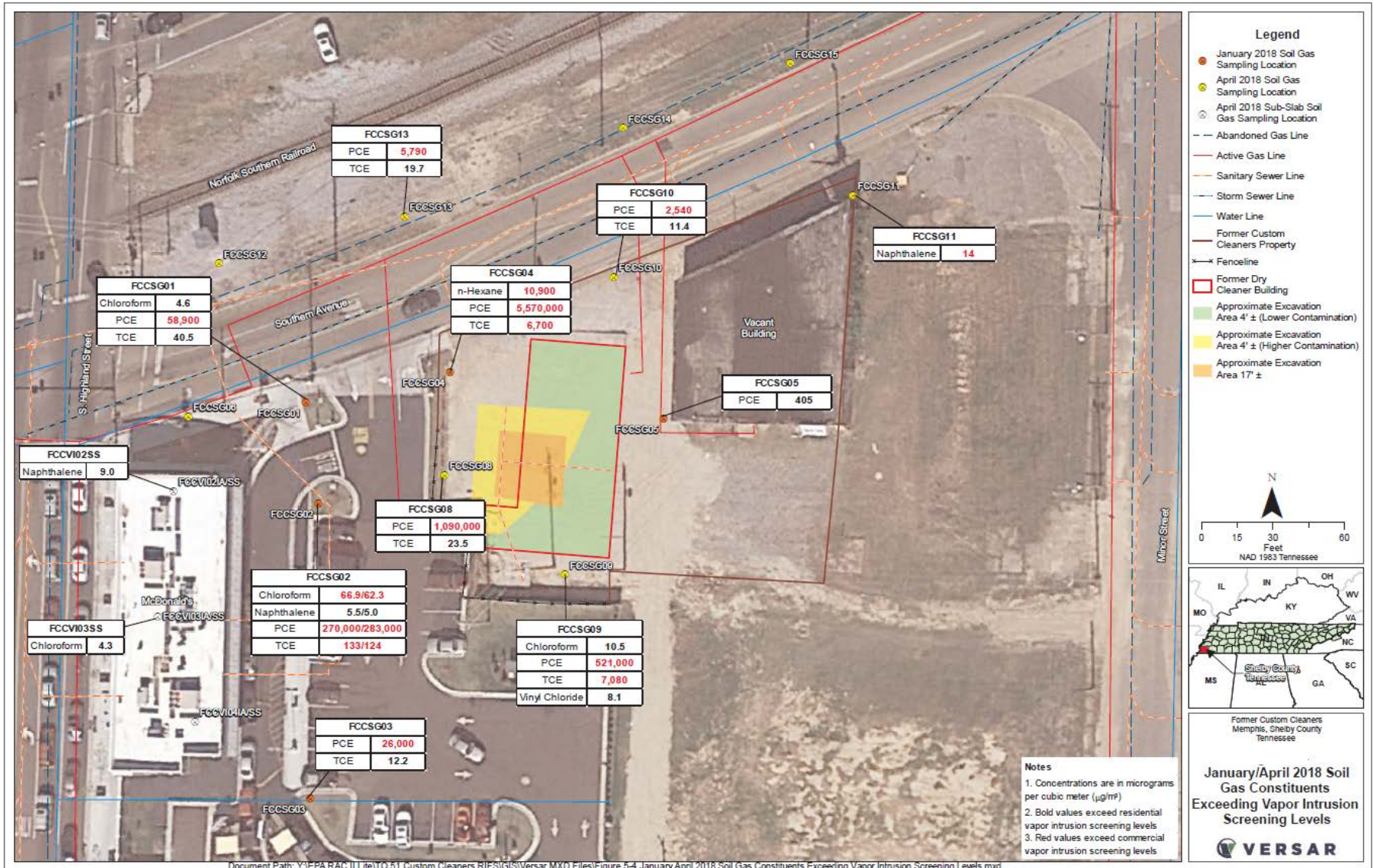


Figure 5. EPA soil gas sampling locations and results at the Former Custom Cleaners site. [Source: Versar 2018.]

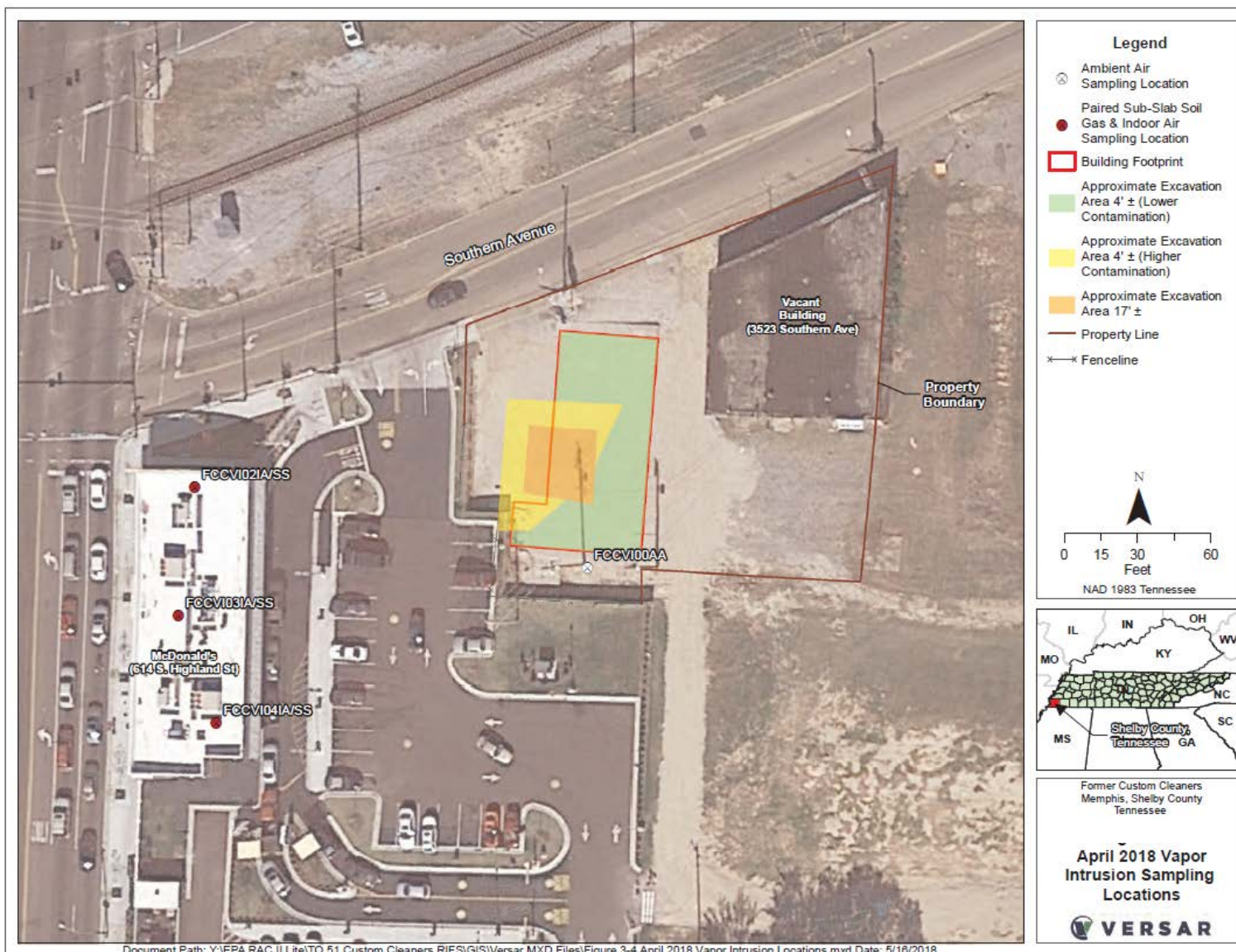


Figure 6. EPA outdoor and indoor air sampling locations at the Former Custom Cleaners site. [Source: Versar 2018.]

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. MLGW has sampled outer-most monitoring wells for, and wells of, the Shehan Well Field. No VOCs have been found in the outer-most wells to date. Additionally, routine monitoring of wells in the wellfield under the Clean Water Act requirement has not found levels of VOCs in the water of the wellfield. There are no privately-owned water wells in the area of the FCC site. 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'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 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 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 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 TDH 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 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, even though groundwater is present at about 125 below the ground surface. 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 will effectively dilute the soil gases released and therefore 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, mitigation systems may need to be installed and 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 migration of 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 migration of chemicals in subsurface soil beneath an off-site building into indoor air	Inhalation	Fast food workers and customers inside an off-site building	Past Present Future	Potential Completed Potential
	<p>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.</p>					

Environmental Sampling Results and Public Health Evaluation

TDH 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-based comparison values (CVs). 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 accidentally swallowing some soil 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 (Figure 5). 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. These chemicals might be from other commercial activities that were conducted in the immediate area.

TDEC found numerous other historic commercial businesses operated on and in the vicinity of the FCC site (TDEC 2015). Given the fact there were numerous historic gas stations, auto repair businesses, car washes, and other drycleaners in the immediate vicinity of South Highland and Southern Avenues, and on the FCC property, other chemicals such as benzene and chloroform would likely be found in subsurface soil gas. Benzene likely remains from auto repair and gas station businesses, or from historic dry cleaning operations that used Stoddard solvent. Chloroform may be related to historical dry cleaning operations in the area that may have used

carbon tetrachloride as a dry cleaning agent where chloroform is a breakdown product of carbon tetrachloride (TDEC 2015). Neither chemical was found in indoor air samples collected from the adjacent restaurant. Attenuation of levels found of both compounds in soil gas from soil to the indoor air is likely why we do not see detectable levels of either compound in indoor air samples collected from the adjacent restaurant.

Benzene was found above its soil gas CREG of $4.3 \mu\text{g}/\text{m}^3$ in 9 of 14 soil gas samples. The maximum level was $9.9 \mu\text{g}/\text{m}^3$. This maximum concentration would be attenuated as it migrates upwards through soil and into indoor air. A soil gas to indoor air attenuation factor of 0.03 (EPA 2012) can be used to estimate the indoor air concentration. Using the EPA attenuation factor and multiplying by the benzene result gives an estimate of $0.3 \mu\text{g}/\text{m}^3$. This estimated indoor air concentration is greater than the indoor air CV for benzene of $0.13 \mu\text{g}/\text{m}^3$. However, this estimated level is below background indoor air concentrations in U.S. residences with no known vapor intrusion (EPA 2011).

Chloroform was found above its soil gas CREG of $1.4 \mu\text{g}/\text{m}^3$ in six of fourteen soil gas samples. The maximum level found was $4.3 \mu\text{g}/\text{m}^3$. Similar to benzene, using EPA's soil gas to indoor air attenuation factor of 0.03 (EPA 2012), the maximum chloroform concentration is estimated to be $0.13 \mu\text{g}/\text{m}^3$. This estimated level is greater than ATSDR's indoor air CREG of $0.043 \mu\text{g}/\text{m}^3$. However, this estimated level is below background indoor air concentrations in U.S. residences with no known vapor intrusion (EPA 2011).

Soil gas has not been measured to the west, except at and near the fast food restaurant, and south of the FCC site. Soil gas data do not show high levels of soil gas to the west of the site. That suggests that the potential for soil vapor intrusion into buildings away from the FCC site in this direction is low. The potential for soil gas to occur in other directions will be evaluated during future site groundwater investigations. However, given the nearby residences to south, we considered the PCE soil gas concentration the farthest south (Figure 5) of $26,000 \mu\text{g}/\text{m}^3$. This concentration is 200 times greater than the soil gas CREG of $130 \mu\text{g}/\text{m}^3$ and illustrates the need for further soil gas sampling toward the residences and other nearby buildings.

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 under these conditions. However, further sampling or vapor intrusion mitigation measures should be considered if a building were constructed and occupied on or near 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.

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 and Subslab Soil Gas

Sub slab 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 $4.3 \mu\text{g}/\text{m}^3$.

Table D-3 in Appendix D shows results for the three indoor air samples collected from the adjacent fast food restaurant in April 2018 (Figure 6). 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. Using the highest detection limit of $0.83 \mu\text{g}/\text{m}^3$ and adjusting this concentration for an estimated commercial scenario (ATSDR 2020) with a timeframe of 8.5 hours a day, 5 days a week, for 5 years (out of a 78 year lifetime), a conservative estimated hypothetical exposure level of TCE in the restaurant would be $0.02 \mu\text{g}/\text{m}^3$. This level is 10 times lower than the ATSDR CREG. 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.

Benzene and chloroform were not detected in the indoor air of the restaurant above their method detection limits of $0.48 \mu\text{g}/\text{m}^3$ and $0.74 \mu\text{g}/\text{m}^3$ respectively, despite having been found in soil gas at the site. Chloroform is one of the nine most commonly detected background chemicals in indoor air [EPA 2011]. Chloroform was found in only one of the 3 indoor air samples collected in the restaurant above its indoor air CREG of $0.043 \mu\text{g}/\text{m}^3$. The level found was $4.3 \mu\text{g}/\text{m}^3$. EPA (2011) published a range of background levels of chloroform in North American residences. Chloroform ranged from non-detect to $7.5 \mu\text{g}/\text{m}^3$. Based on these measured background levels, it is unlikely that chloroform would be a health concern to those working or visiting the restaurant.

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. Methylene chloride was only found in one of the four indoor air 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 an estimated commercial scenario (ATSDR 2020) with a timeframe of 8.5 hours per day, 5 days per week, for 5 years (out of a 78 year lifetime), the estimated exposure concentration would be $2.3 \mu\text{g}/\text{m}^3$. The adjusted exposure level is about 28 times lower than ATSDR's CREG of $63 \mu\text{g}/\text{m}^3$, and thus there should not be an increased risk of significance 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

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

- Current exposure to tetrachloroethylene (PCE) in soil from surface to one-foot depth 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 harmful exposure (by swallowing small amounts of soil or through skin contact with dust or soil particles) to PCE for anyone walking across the site. The major source area of contamination was removed in 2016 by excavation of contaminated soil from beneath and near the former dry-cleaner building to a maximum depth of 17 feet. Even so, TDH evaluated levels of PCE and other chemicals remaining in site soils from surface to one-foot depth). Levels of PCE and other chemicals in these onsite soil samples collected after removal of contaminated soil are below health-based comparison values (CVs) used for screening such that no further health evaluation was conducted. No harmful health effects are expected from this exposure pathway.

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 indoor air data at the fast food restaurant (adjacent and west of the site), breathing PCE in indoor air is not expected to cause adverse health effects for current customers and workers. However, a definitive health call cannot be made at this time because seasonal sampling data are not available and future remediation activities may result in changes to soil gas.

Additionally, there is a potential vapor intrusion hazard for nearby homes and other nearby businesses. TDH does not have sufficient soil gas data (or indoor air data) to determine the potential for a vapor intrusion hazard near the site.

Although the major source area of contamination was removed in 2016 by excavation of contaminated soil from beneath and near the former drycleaner building to a maximum depth of 17 feet, some contamination remains in subsurface soils (the proposed treatment area goes down to approximately 40 feet in the subsurface). Currently, the site has no buildings, and so has no exposure point for these chemical vapors to become an indoor air issue.

Subslab and indoor air samples were collected at the fast food restaurant in 2018. Subslab 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. However, PCE, was found in indoor air 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 the crew room sample. Air samples from the customer dining area and the men's restroom were also tested for PCE but were below the detection level. The levels of PCE detected in indoor air at the restaurant are well below the CV of $3.8 \mu\text{g}/\text{m}^3$. TCE was not detected in these indoor air samples though the detection limits of the testing were greater than the CV of $0.21 \mu\text{g}/\text{m}^3$. 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.

Limited soil gas testing has been conducted north of the site next to underground utilities, and to the southwest of the site. Five of the 29 chemicals were found at levels exceeding their soil gas CVs and data do not show how far the contamination extends. These VOCs include benzene, chloroform, PCE, TCE, and vinyl chloride.

Recommendations

TDH 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) or other remediation of site 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 or other remediation of site. 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.

Public Health Action Plan

This public health action plan for the FCC site lists steps TDH 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. TDH is committed to following up on this plan to ensure that it is implemented.

TDH Actions Completed

- Released this health consultation on December 20, 2019, for a 60-day public comment period that ended on February 18, 2020.
- 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 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. TDH 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. 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.
- [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.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2019. Comparison values. Atlanta, GA: U.S. Department of Health and Human Services. February 2019.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2020. Guidance for inhalation exposure, v1- Sept 30, 2020 (in ATSDR's PHAST).
- [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. OSWER. EPA 530-R-10-001. June 2011. Washington, DC. [accessed 2020 30 October]. Available from <https://www.epa.gov/vaporintrusion/background-indoor-air-concentrations-volatile-organic-compounds-north-american>.
- [EPA] U.S. Environmental Protection Agency. 2012. EPA's vapor intrusion database: Evaluation and classification of attenuation factors for chlorinated volatile organic compounds. OSWER. EPA 530-R-10-002. March 16, 2012. Washington, DC. [accessed 2020 30 October]. Available from <https://www.epa.gov/vaporintrusion/epas-vapor-intrusion-database-evaluation-and-characterization-attenuation-factors>.
- [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.
- 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: https://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 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 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 1×10^{-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.

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/m³: 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 (TDH) prepared this Health Consultation for the Former Custom Cleaners site located in Memphis (Shelby County), Tennessee under a cooperative agreement (Grant # CDC-RFA-TS20-2001) 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 TDH 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 TDH.

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 Salyers, 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

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

Laura Frazier, MS
Technical Project Officer
Office of Capacity Development and Applied Prevention Science

ATSDR Regional Representative

John Wheeler, PhD
Region 4 Director
Office of Community Health and Hazard Assessment

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 ³) and trichloroethylene (<1.1 to 1.1 µg/m ³).
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.

Timeline for Former Custom Cleaners (FCC) Site Activities, continued	
April 27, 2016	TDH attends TDEC Public Meeting for site proposal to the TDEC Division of Remediation's 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'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.

Timeline for Former Custom Cleaners (FCC) Site Activities, continued	
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 became involved in the FCC site in 2013 in response to a complaint by a former tenant of the building. TDEC 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. TDH prepared a health consultation evaluating the indoor air data that recommended the tenant not live in the building [TDH 2014]. TDEC 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 and its contractor TetraTech. Soil, soil gas, and groundwater samples were collected as part of the SI. Soil sample results showed a PCE source

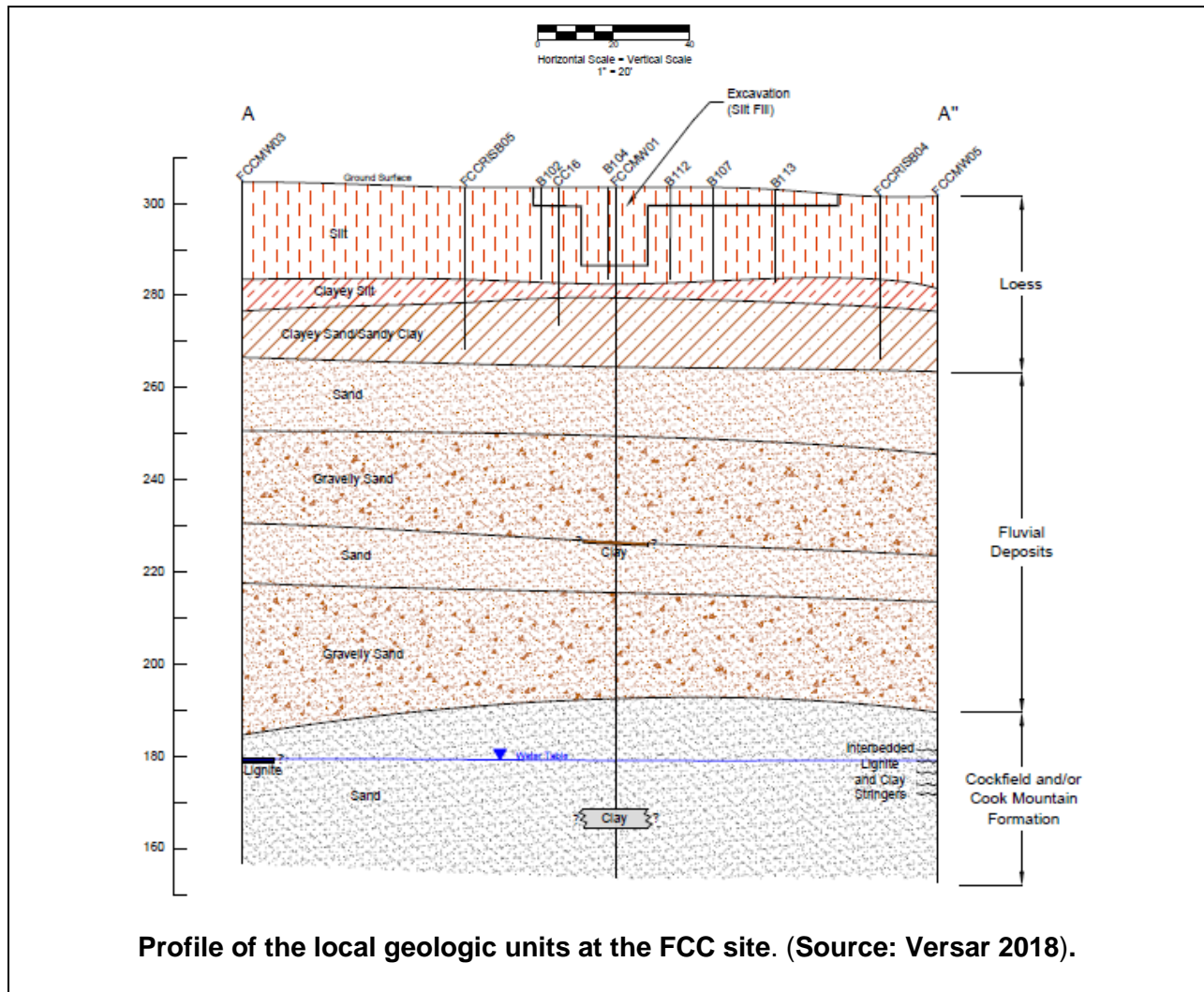
area with highly contaminated soil beneath and immediately adjacent to the slab of the FCC building. Soil gas results showed PCE levels above EPA screening levels, indicating the potential for vapor intrusion to occur at the site. The highest PCE soil gas level was 620,000 micrograms per cubic meter. 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 [Versar 2017 and 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
VOCs								
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
Metals								
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 ⁺⁶ EMEG (c)	0/1	No
cobalt	5.9	5.9	FCCRISB02	5.9	520	ATSDR Intern. EMEG (c)	0/1	No
copper	13	13	FCCRISB02	13	520	ATSDR Intern. 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⁺³ 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	9.9	4.3	CREG	9/14	FCCSG03
carbon disulfide	<1.2	14.5	23,000	Chronic RMEG	0/14	FCCSG03
chloroform	<0.81	66.9	1.4	CREG	6/14	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 [#]	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	10,900	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 [#]	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	5,570,000	130	CREG	9/14	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	7,080	7	CREG	8/14	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	8.1	3.7	CREG	2/14	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# = 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 indoor air non-cancer environmental media evaluation guides (EMEGs) for chronic exposure duration (>364 days exposure), ATSDR Reference Dose Media Evaluation Guides (RMEGs) or ATSDR indoor air 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 VOC								
acetone	11.5	11.5	42.8	FCCVI04IA	31,000	ATSDR Chronic EMEG	0/4	No
benzene	<0.47	<0.48	<0.49	FCCVI04IA	0.13	ATSDR CREG	4/4	Yes
chloroform	<0.71	<0.74	<0.75	FCCVI04IA	0.043	ATSDR CREG	4/4	Yes
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	146	FCCVI04IA	63	ATSDR CREG	1/4	Yes
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	4/4	Yes
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 Intern. 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).

Appendix E. Public Comments and Responses

During the Public Comment period from December 20, 2019 to February 18, 2020, three site stakeholders provided the following comments:

Comments from Protect our Aquifer (POA)

POA Comment #1:

First, the majority of this TDH report details the immediate effects of contamination in the vicinity of the site. The report concludes that the work of the EPA has alleviated many of these concerns and with careful, common sense restrictions on the use and development of this site—the worst is over.

The problem of below ground plumes of contamination, moving through groundwater systems and potentially harming drinking water wells (located less than a mile away) pose a larger and more long-term threat to all local citizens. I understand that the EPA and TDH will continue work with the Tennessee Department of Environment and Conservation (TDEC) and the Shelby County Health Department (SCHD) to explore and report on these contaminants and their movement. All well and good, if the resources hold out, and we do not forget that such plumes are moving below us.

In this regard, I would ask the EPA and TDH to not simply dismiss groundwater movement and contamination and relegate it to future investigations. With their resources, knowledge of the site, and the potential of more serious contamination—I think they should (jointly) develop a detailed plan as to their steps, their strategies, and their funding into the future for staying on top of these groundwater issues.

Response to POA Comment #1:

Groundwater contamination is present below the site at depth of about 125 feet and greater below the ground surface. The contamination has not been identified in perimeter groundwater monitoring and water wells in the nearby Shehan Well Field to date. EPA and TDEC continue to address the extent of the groundwater contaminant plume. Additional groundwater monitoring wells were installed at the site to investigate the extent of the groundwater plume to the east and south, off-site. EPA performed the work during April 2020. Additional groundwater wells were installed further off-site to the east and south in March 2021. It is possible more investigations could be performed further off-site but will be dependent upon results of the 2021 investigation.

There are no changes to the text of this health consultation (HC) based on this comment.

POA Comment #2:

The EPA, the TDH, and local agencies (SCHD, SC Groundwater Quality Control Board, City Code Enforcement, and others) should develop a multi-year plan to assure that this site causes no more harm to groundwater resources. These same agencies should learn from this episode. Shelby County needs a plan and model to begin the identification and mitigation of multiple contaminated sites throughout the area. This model must identify proper cooperative, regulatory structures and propose sufficient resources, experts, and finances to start the long term cleanup of our historic and current environmental sites.

We at Protect Our Aquifer understand that this is a large long term task. But the example of Custom Cleaners should not simply be a “one and done.” All contaminated sites in the County bode ill for our citizens and our life sustaining resources, such as pristine drinking water. We will have missed an important opportunity if we do not learn from this incident and begin the necessary journey to clean up our environmental mistakes.

Response to POA Comment #2:

The EPA, TDEC, TDH, and the SCHD are cooperating on this project. Together our mission is to protect the environment and the health of the citizens of Memphis who live near the Former Custom Cleaners site. As such, as part of the listing on EPA’s National Priorities List, the site must go through a specific investigative process. Once the initial investigations are completed the site moves to the Remedial investigation/Feasibility Study (RI/FS) phase. Various remedial solutions for the site are examined during this phase and any additional onsite or off-site investigations are done if more data is needed. Any proposed remedial solutions are based on the results of the previous investigations and any new results generated as part of the RI/FS. The RI/FS is EPA’s and TDEC’s plan and model the FCC site must proceed through.

There are no changes to the text of the TDH HC based on this comment.

Comments from the Tennessee Department of Environment and Conservation (TDEC)

TDEC Comment #1:

TDEC DoR will further discuss the proposed site-related vapor intrusion sampling activities with the EPA to determine if additional sampling is needed, particularly during the Operable Unit 1 interim Action.

Response to TDEC Comment #1:

TDH appreciates TDEC’s willingness to revisit proposed site-related vapor intrusion sampling activities with EPA. Please keep TDH informed of future sampling activities during OU 1 start up and operation.

There are no changes to the text of the TDH HC based on this comment.

TDEC Comment #2:

Institutional controls likely will be a component of the final remedy or remedies for the Former Custom Cleaners site. TDEC DoR will further discuss with the EPA and the site owner once the EPA and TDEC DoR have determined that institutional controls are needed.

Response to TDEC Comment #2:

TDH appreciates this information. Please include TDH in these upcoming discussions.

There are no changes to the text of the TDH HC based on this comment.

Comments from the City of Memphis, Division of Public Works, Storm Water Department (MPW)

MPW Comment #1:

While current exposure to PCE in soil at the site is not expected to harm public health and surrounding properties the report did indicate that the low levels of PCE in site soils are likely to remain and may not be suitable for certain land use.

Response to MPW Comment #1

Suitable land uses will be discussed between the landowner, the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation (TDEC). What is a suitable land use will likely be based on how well the site remedial activities clean up the shallow contamination at the site, in addition to public health and safety concerns.

MPW Comment 1A

What is considered a suitable land use for this property in the future once the contaminated soils are removed to levels specified in the remedial design?

Response to MPW Comment 1A:

The highly contaminated PCE source soils were removed from the site during an EPA Emergency Response action in September 2016. What remains will be addressed by the upcoming remedial action where soils at depth less than 40 feet will be heated and the PCE vapors collected and treated. A suitable land use for the site, if it were to be redeveloped, remains undetermined at this time. Suitable land uses will be discussed between the landowner, the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation (TDEC). What is a suitable land use will likely be based on how well the remedial treatment system is able to clean up the shallow contamination at the site, in addition to public health and safety concerns.

MPW Comment #1B:

Who makes the final decision of whether or not it is suitable. The area is in a commercial and residential area of Memphis, and the property is zoned commercial.

Response to MPW Comment #1B:

The EPA and TDEC will further discuss land use restrictions once they determine if and what type are needed. EPA and TDEC discuss land use restrictions with site owners too, as TDEC prefers the owners place the Notice of Land Use Restrictions (NLUR) on the site. TDEC's Division of Remediation also has the authority to order the placement of NLURs and to enforce NLURs through Tennessee Code Annotated Section 68-212-225 (see the attachment to this email). Since the site is a National Priorities List site, EPA and TDEC will have significant input.

There are no changes to the text of the TDH HC based on these two comments.

MPW Comment #2:

The report recommends that EPA adopt institutional controls for the FCC property. These controls would include restricting development for the property. These restrictions need to be included with the property along with notice to Office of Planning and Development.

Response to MPW Comment #2:

Recording any future NLUR through the appropriate register of deeds (Shelby County in this case) is required, per TDEC's statute. Additionally, TCA Section 68-212-225 requires providing a copy of the NLUR to all local governments having jurisdiction over any part of the subject property (Memphis and Shelby County in this case), so the City of Memphis and Shelby County will definitely be notified of future land use restrictions.

With Shelby County, the City of Memphis, TDEC, and EPA aware of the Land Use Restrictions, then the site will not be redeveloped such that it would pose a health risk to anyone using the site.

There are no changes to the text of the TDH HC based on this comment.