
Health Consultation

**RENTAL UNIFORM COMPANY
KINGSPORT, SULLIVAN COUNTY, TENNESSEE**

**Prepared by:
Tennessee Department of Health**

April 18, 2011

This report was supported by funds from a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. This document has not been reviewed and cleared by ATSDR.

Foreword

This document summarizes an environmental public health investigation performed by the Environmental Epidemiology Program of the State of Tennessee Department of Health. Our work is conducted under a Cooperative Agreement with the federal Agency for Toxic Substances and Disease Registry. In order for the Health Department to answer an environmental public health question, several actions are performed:

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, and other government agencies, businesses, or the general public. We work to understand how much contamination may be present, where it is located on a site, and how people might be exposed to it. We look for evidence that people may have been exposed to, are being exposed to, or in the future could be exposed to harmful substances.

Evaluate Health Effects: If people have the potential to 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 exposure pathways, risk assessment, 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. The role of Environmental Epidemiology in dealing with hazardous waste sites is to be an advisor. Often, our recommendations will be actions items for other agencies. However, if there is an urgent public health hazard, the Tennessee Department of Health can issue a public health advisory warning people of the danger, 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.

Please write to: Environmental Epidemiology Program
 Tennessee Department of Health
 1st Floor, Cordell Hull Building
 425 5th Avenue North
 Nashville, TN 37243

Or call us at: 615-741-7247 or 1-800-404-3006 during normal business hours

Or e-mail us at: eep.health@tn.gov

Table of Contents

Glossary of Terms.....	iii
SUMMARY.....	1
Introduction.....	3
Background.....	3
Discussion.....	5
Introduction to Chemical Exposure.....	5
Solvent Explanation.....	6
Vapor Intrusion.....	6
Comparison Values.....	7
Non-Cancer Comparison Values.....	7
Cancer Comparison Values.....	7
Environmental Sampling.....	8
Results.....	8
Health Risk Evaluation.....	8
Non-Cancer Evaluation.....	9
Cancer Evaluation.....	9
Table 1. Indoor air sampling results for Rental Uniform Company building, Kingsport, Sullivan County, TN.	10
Johnson & Ettinger Evaluation.....	11
Chemical Mixture.....	12
Future Considerations.....	12
Child Health Considerations.....	12
Conclusions.....	12
Recommendations.....	13
Public Health Action Plan.....	13
Preparer of Report.....	14
References.....	15
Figure 1 - Overhead view of Rental Uniform Company.	17
Figure 2 - Indoor air sampling locations inside the former drycleaning.....	18
Certification.....	19

Glossary of Terms

Acute: Occurring over a short time [compare with chronic].

Acute exposure: Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Additive health effect: A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together.

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

Ambient: Surrounding (for example, *ambient* air).

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: A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen: A substance that causes cancer.

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 public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment 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 or is present at levels that might cause harmful (adverse) health effects.

Detection limit: The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

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: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Groundwater: Water beneath the earth's surface in the spaces between soil particles and between rock surfaces.

Health consultation: A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical.

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

Intermediate duration exposure: Contact with a substance that occurs for more than 14 days and less than a year.

No-observed-adverse-effect level (NOAEL): The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

ppb: Parts per billion.

Risk: The probability that something will cause injury or harm.

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).

Sample: A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Soil-Gas: Gaseous elements and compounds in the small spaces between particles of the 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 groundwater concentrations, or both, of the chemical of concern. The source of contamination is the first part of an exposure pathway.

Toxicological profile: An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology: The study of the harmful effects of substances on humans or animals.

SUMMARY

INTRODUCTION

The Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP) wrote this health consultation at the request of the Tennessee Department of Environment and Conservation (TDEC), Division of Remediation (DOR), Johnson City Environmental Field Office. This health consultation was prepared to evaluate the results of indoor air sampling completed inside the commercial cleaning facility. The building which housed Rental Uniform Company is located at 2117 Berry Street in Kingsport, Sullivan County, Tennessee.

Site investigations began in 2002 pending a sale of the property to G&K Services. Drycleaning operations had been conducted at the site from 1972 until 1982. Five underground storage tanks were also located on the property. Environmental investigations found that site soil and groundwater were impacted by drycleaner solvent and its breakdown chemicals. Concentrations of the drycleaner solvent tetrachloroethylene (PCE) and breakdown products trichloroethylene (TCE) cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, 1,1-dichloroethylene, and vinyl chloride in site soils did not exceed the U.S. Environmental Protection Agency's industrial screening levels. Concentrations of some of these site chemicals did exceed groundwater screening levels, however. Because of the potential for PCE and TCE vapors to migrate from groundwater beneath the site into indoor air of the site building, indoor air testing was completed. The testing was done in the area of historic drycleaning.

All data supplied for this health consultation were compared to residential health comparison values provided by the Agency for Toxic Substances and Disease Registry (ATSDR) and the U.S. Environmental Protection Agency (EPA). Comparison values are chemical concentrations based on toxicology below which no adverse health effects are predicted to occur.

CONCLUSIONS

The EEP reached three conclusions in this health consultation:

Conclusion 1

EEP concludes that the concentrations of the drycleaner solvent PCE and its breakdown chemical TCE measured in Rental Uniform Company building were not expected to harm the health of the workers of the commercial laundry operating in the building.

Basis for Conclusion

Indoor air in the former cleaner contained low levels of PCE and TCE. Exposure to PCE and TCE at their highest measured concentrations is not likely to lead to long-term exposure to workers working a normal work

week over 20 years. The measured amounts of PCE and TCE will also not likely result in a higher cancer risk from breathing indoor air.

Next Steps None recommended.

Conclusion 2 The EEP concludes that although S&ME was conservative in their approach to conducting the indoor air investigation, the findings and data presented in the February 2010 S&ME Report appear to be valid.

Basis for Conclusion The investigation methods and the sample testing were conducted using accepted methods employed at other sites investigated for the occurrence of vapor intrusion and in general accordance with investigation methods outlined in vapor intrusion investigation guidance documents.

Next Steps None recommended.

Conclusion 3 It is EEP's opinion that the results of the indoor air investigation should be compared to residential indoor air inhalation health risk values.

Basis for Conclusion Although the building is still being used as a commercial laundry, drycleaning of clothing and other materials has not been conducted at the site since 1982. Current employees are likely not aware drycleaning solvent was used in the building in the past, and are not trained in the use, handling, or what protective equipment may be needed when using drycleaning solvent. Therefore, the employees are subjected to a secondary occupational exposure and are evaluated based on this conclusion.

Next Steps None recommended.

FOR MORE INFORMATION If you have any questions or concerns about your health, you should contact your healthcare provider. For more information on this site, call TDEC DOR at 423-854-5400. For health information, call TDH EEP at 615-741-7247 or toll-free at 1-800-404-3006 during normal business hours. You may also e-mail the TDH EEP at eep.health@tn.gov.

Introduction

Tennessee's Department of Environment and Conservation (TDEC), Division of Remediation (DOR), Johnson City Environmental Field Office, requested that the Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP), review the results of indoor air samples collected at the former Rental Uniform Company building. The building which housed Rental Uniform Company is located at 2117 Berry Street in Kingsport, Sullivan County, Tennessee. Through previous environmental investigations, soil and groundwater beneath the site were found to be contaminated by drycleaner-related chemicals. Rental work uniforms were historically drycleaned at the site. TDEC DOR was concerned about intrusion of vapors from the contaminated groundwater migrating beneath the main site building into its indoor air. The indoor air was sampled by the site's environmental consultant, S&ME.

This review will specifically evaluate the indoor air concentrations of the chemical PCE used in drycleaning and the PCE breakdown chemicals. The review of the data collected is to protect the health of those who work in the former Rental Uniform Company building.

Background

The building which housed Rental Uniform Company is approximately 100,000 square feet in size (Figure 1). The building is currently being used as a commercial cleaning facility. Drycleaning is no longer conducted at the site. The building is surrounded by residential developments with some commercial properties present within approximately ¼ mile (S&ME 2010).

Site History

The building that once housed Rental Uniform Company has been used as a commercial cleaning facility for over 50 years. Rental Uniform Company conducted laundering, rental and delivery of uniforms, doormats, and towels at this facility from 1956 until 2003. In 2003, G&K Services purchased the property and continued the laundering of these items. Drycleaning operations were conducted by the Rental Uniform Company in an area in the building from 1972 until 1982 (S&ME 2008). Tetrachloroethylene (PCE) was the chemical used in the drycleaning operation. The laundry reportedly used soap, water, and various commercially-available non-solvent-based products as cleaning agents. The commercial cleaning products were stored in 55-gallon drums. The site is under a consent order with TDEC DOR.

There were no site environmental investigations performed prior to 2002. In 2002, as part of the pending property transfer to G&K, Phase 1 and Phase 2 Limited Environmental Site Assessments (ESA) were conducted by Law Engineering and Environmental Services (S&ME 2008). The Phase 1 ESA identified environmental conditions at the site due to the former drycleaning activities and the presence of the petroleum underground storage tanks (USTs) (S&ME 2008). Groundwater sampling completed during the limited Phase 2 ESA found PCE concentrations in groundwater above U.S. Environmental Protection Agency (EPA) maximum contaminant levels (MCLs) for drinking water (S&ME 2008).

Five USTs which stored petroleum products were located on the site. Three USTs have been removed and received clean closure letters from TDEC. One UST was closed in place, and one is still used to store heating oil. Various investigations were conducted concerning the closing of these USTs in 2003. There is no record that PCE was stored in the closed-in-place UST. This evaluation will not address any potential contamination resulting from the USTs on the site. During the over excavation of soils adjacent to the UST that was closed in place, the drycleaner solvent PCE was discovered in site soil at a depth of 10 to 12 feet below ground surface (bgs) (S&ME 2008)(Figure 1). The PCE breakdown chemicals trichloroethylene (TCE) and cis-1,2-dichloroethylene (cis-1,2-DCE) were also found at 10 to 12 feet bgs. This UST closure was issued a contaminated closure letter by TDEC which reflected the drycleaner chemicals remaining after closure.

Additional soil and groundwater data were collected by S&ME in August and September 2007 investigations. The results were reported by S&ME in a Site Assessment Report (SAR) dated July 30, 2008. Both soil and groundwater were impacted by the historical drycleaning operations at the site (S&ME 2010) and both remain impacted. Drycleaner solvent PCE and its breakdown chemicals were present in soil at levels below their respective EPA regional screening levels (RSLs) for industrial use settings. Groundwater samples collected from onsite monitoring wells showed concentrations of PCE and vinyl chloride above their respective MCLs. S&ME reports that natural attenuation is happening at the site. Natural attenuation is the process of breaking down of one chemical to another by biological or other natural processes. No off-site groundwater monitoring wells have been installed because TDEC indicated there were no private homes using groundwater as their sole source household water found within a one-mile radius of the site (S&ME 2010).

Indoor Air Investigation

Indoor air sampling was performed in December 2009 by S&ME (2010). Samples of the indoor air were collected at two locations inside the building, in the area of the former drycleaning operation (Figure 2). The indoor air testing was performed to determine if the chemicals formerly used in the drycleaning operation were present in the indoor air. No doors or windows were open and the heating, ventilation, and air conditioning (HVAC) system was not operating for several hours before, and during the indoor air sampling. It is unknown if there were other background sources of drycleaner-related chemicals at the site. No background or ambient air sample was collected at the site during the testing.

The indoor air investigation conducted by S&ME at the site was conducted under cautious, worst-case scenario conditions. TDEC DOR requested TDH EEP review the indoor air data to identify whether the health of the current employees in the building of Rental Uniform Company could be affected by chemicals that could be in the indoor air from the previous drycleaning operations.

TDH EEP spoke with Mr. Eugene C. McCall, Jr., Esq. on July 27, 2010 (McCall 2010), regarding the site and S&ME's *Indoor Air Sampling Report* dated February 2010. Mr. McCall was concerned about the report. TDH EEP informed Mr. McCall that they had been asked by TDEC to review the indoor air results and provide an evaluation of the health effects for workers at the site. Mr. McCall provided his viewpoint that the methods used to evaluate the health risk

of the site was incorrect, and, perhaps, the data itself was not representative of the working conditions for the workers at the site. McCall stressed the air results being collected in a totally closed building were too cautious or conservative sampling conditions. In EEP's review of the on-site practices employed during the indoor air investigation or the data obtained, EEP did not see anything that would lead to the conclusion that the data was suspicious and not representative of cautious, worst-case scenario conditions inside the site building. Overall, the investigation and data analysis were conducted using accepted methods to conduct indoor air investigations at potential vapor intrusion sites (NYDOH 2006, ITRC 2007, S&ME 2010).

Drycleaner solvent is no longer used at the site. The current workers may not know that there are potential exposure issues at the site from the previous use of drycleaning solvent. The current employees are not trained in the use or handling of solvents. Hence, the exposure would be a "secondary occupational exposure" or involuntary exposure (ATSDR 2006).

Discussion

Introduction to Chemical Exposure

To determine whether persons have been or are likely to be exposed to chemicals, TDH EEP evaluates mechanisms that could lead to human exposure. An exposure pathway contains five parts:

- a source of contamination,
- contaminant transport through an environmental medium,
- a point of exposure,
- a route of human exposure, and
- a receptor population.

An exposure pathway is considered complete if there is evidence that all five of these elements have been, are, or will be present at the site. A pathway is incomplete if one of the elements is missing. For this site, there was a completed exposure pathway for workers who work in the former Rental Uniform building.

Physical contact alone with a potentially harmful chemical in the environment by itself does not necessarily mean that a person will develop adverse health effects. A chemical's ability to affect public health is controlled by a number of other factors, including:

- the amount of the chemical that a person is exposed to (dose),
- the length of time that a person is exposed to the chemical (duration),
- the number of times a person is exposed to the chemical (frequency),
- the person's age and health status, and
- the person's diet and nutritional habits.

The potentially exposed population at this site is the current and future adult workers of the commercial cleaning operation that is housed in the same building as Rental Uniform Company.

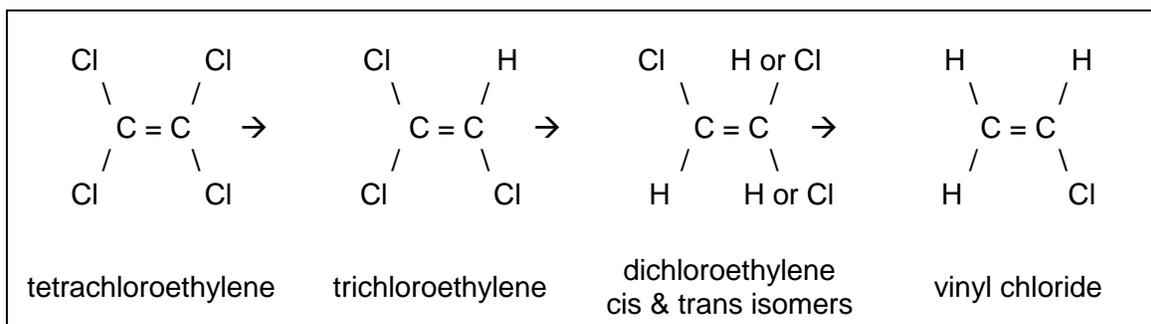
Solvent Explanation

The process of drycleaning that was conducted at the former Rental Uniform site for 10 years is not truly dry, but it uses so little water that it has come to be known as drycleaning. Instead of water, chemical solvents are used in the cleaning process. The most commonly used solvent for drycleaning is PCE. PCE is a clear, colorless liquid said to produce a sharp, sweet smell. It evaporates very readily at room temperature. PCE is a synthetic chemical and is often used as a starting point for the manufacture of other chemicals (ATSDR 1997). This site purchased and used PCE as a solvent to dryclean work uniforms. People can detect the smell of PCE in the air at 1 part per million (ppm) or more. The background concentration of PCE in the environment is usually less than 1 ppb. The significance of exposure to small amounts of PCE is unknown, but to date, they appear to be relatively harmless (ATSDR 1997).

PCE is readily absorbed following inhalation and oral exposure as well as by direct exposure to the skin. For this site, we are concerned with the inhalation of PCE from vapor intrusion into indoor air. Pulmonary absorption of PCE is dependent on the ventilation rate, on the duration of exposure, and at lower concentrations, on the proportion of PCE in the inspired air.

PCE is currently classified as reasonably anticipated to be a carcinogen (ATSDR 2004). The cancer risk posed by PCE has been under evaluation for some time within EPA and the health community. Its toxicity class is also under review.

As its name implies, PCE has four chlorine anions on a two-carbon molecule. As these chlorine anions react, the molecule breaks down into other chlorinated volatile organics. Each of these breakdown products has slightly different chemical properties and toxicities. The following diagram is an example of how one chemical can breakdown to form another.



For example, PCE can breakdown to TCE, then to DCE, and then to VC. The only way to truly know the ratio of these breakdown products is to collect environmental samples. The drycleaner solvent, PCE, and all of its breakdown products plus their isomers were carefully considered in developing this report.

Vapor Intrusion

Soil and groundwater contamination beneath buildings can lead to vapor intrusion. Vapor intrusion is the movement of volatile chemicals from the subsurface into overlying buildings. Volatile chemicals in buried wastes and/or contaminated groundwater can emit vapors that migrate through subsurface soils and into the indoor air of overlying buildings. Vapors may

accumulate in buildings to levels that pose safety hazards, health risks, or odor problems. Vapor intrusion has been documented in buildings with basement, crawlspace, or slab-on-grade foundation types. Vapor intrusion can be an acute health hazard. Usually, indoor vapor levels are low. Low levels of vapors, inhaled over a long period of time, may or may not be a chronic health concern.

Comparison Values

To evaluate exposure to a hazardous substance, health assessors often use comparison values. If the chemical concentrations are below the comparison value, then health assessors can be reasonably certain that no adverse health effects will occur in people who are exposed. If concentrations are above the comparison values (ATSDR 2010) for a particular chemical, then further evaluation is needed.

Non-Cancer Comparison Values

The Agency for Toxic Substances and Disease Registry (ATSDR) uses the no observed adverse effect level/uncertainty factor (NOAEL/UF) approach to derive non-cancer health effect environmental media evaluation guides (EMEGs) for hazardous substances. EMEGs are set below levels that, based on current information, might cause adverse health effects in the people most sensitive to such substance induced effects. Exposure to a level above the EMEG does not mean that adverse health effects will occur (ATSDR 2005).

EMEGs are based on conservative assumptions about chemical exposure. EMEGs consider non-cancer adverse health effects. Exposure durations are defined as acute (14 days or less), intermediate (15–365 days) or chronic (365 days or more). (For this site, we will evaluate the data against chronic exposure duration EMEGs, if established.)

Cancer Comparison Values

Typically the measured concentrations of solvents are compared to ATSDR cancer risk evaluation guides (CREGs) to understand if concentrations of the chemicals could cause excess cancers in workers or visitors to the site. The CREG comparison values are established for no more than one theoretical excess cancer in 1,000,000 people exposed during a 70-year lifetime. CREGs are calculated from EPA's cancer slope factors for oral exposures or unit risk values for inhalation exposures. These values are based on EPA evaluations and assumptions about hypothetical cancer risks at low levels of exposure.

ATSDR does not have a published CREG for PCE. EPA has a PCE inhalation Regional Screening Level (RSL) for one excess cancer in 1,000,000 people of 0.06 ppb for a residential setting. For EPA's policy of considering 10^{-6} to 10^{-4} range of risk as acceptable (EPA 1991), the acceptable range for the concentration of PCE in indoor air is 0.06 to 6 ppb PCE.

EPA's residential inhalation RSLs were used to evaluate the results of the testing at the former Rental Uniform Company building instead of EPA industrial inhalation RSLs because the exposure to workers at the site is involuntary. The workers may not know that there are potential exposure issues at the site from previous use of drycleaner solvent. Drycleaner solvent is no

longer used in the activities of the company. The current employees are not trained in the use or handling of solvents. Hence, the exposure would be a “secondary occupational exposure” or an involuntary exposure (ATSDR 2006).

Environmental Sampling

Indoor air sampling was performed on December 5, 2009, in the former Rental Uniform Company building. Two sampling locations were established in the area of the former drycleaning operation (Figure 2). The two samples were approximately 40 feet apart from one another. Sampling was performed by S&ME of Spartanburg, South Carolina. The two samples, SP-1 and SP-2, were collected over an eight-hour period between 8:00 a.m. and 4:00 p.m. using Summa canisters. Both Summa canisters were positioned at a height of approximately 4 feet above the floor at their respective sampling locations.

The facility personnel were requested to avoid the use of any materials containing volatile organic compounds within the building for a period of 24 to 48 hours before sampling. No doors or windows were open and the heating, ventilation, and air conditioning (HVAC) system was not operating for several hours before, and during the indoor air sampling. In addition, a background or ambient air sample was not collected at the site during the testing. These actions represent a cautious or worst-case indoor air environment to evaluate the effects on indoor air from vapor intrusion.

Indoor air samples collected in December 2009 were tested for the following drycleaner solvent and drycleaner solvent breakdown chemicals: PCE, trichloroethylene (TCE), 1,1-dichloroethylene (1,1-DCE), cis-1,2-dichloroethylene (cis-1,2-DCE), trans-1,2-dichloroethylene (trans-1,2-DCE), 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethane (1,2-DCA), and vinyl chloride (VC). Indoor air samples were analyzed by Air Toxics, Ltd., of Folsom, California using EPA Method TO-15 (S&ME 2010).

Results

The PCE result at sampling location SP-1 was 7.53 parts per billion (ppb). The PCE result at sampling location SP-2 was 13.71 ppb. TCE was detected at only the SP-1 sample location at a measurement of 1.69 ppb. No other PCE solvent breakdown chemicals were detected above the method reporting limits for the analysis. See Table 1 for more information about reporting limits.

Health Risk Evaluation

PCE was detected in both samples at the former Uniform Rental Company building above the EPA RSL of 0.06 parts per billion (ppb), but did not exceed the ATSDR non-cancer EMEG comparison value of 40 ppb. TCE was detected in sample SP-1 from the former Uniform Rental Company building at 1.69 ppb, exceeding its EPA RSL excess cancer risk comparison value of 0.22 ppb. TCE was not found in sample SP-2. In order to be most protective of human health, the higher level of each compound was chosen for the evaluation of health risk. The results of the December 2009 indoor air sampling are in Table 1.

Non-Cancer Evaluation

Indoor air results were compared to air health comparison values published by the ATSDR (ATSDR 2010). ATSDR did not have a comparison value for TCE. Results were compared to an EPA inhalation reference concentration (EPA 2001).

To evaluate if there could be non-cancer health effects from breathing indoor air in the former Rental Uniform Company building, indoor air results were compared to the PCE EMEG of 40 ppb. In the case of TCE, there is not a published ATSDR EMEG. The results were compared to the EPA's most current provisional value for evaluation of the potential health risks from exposure to TCE at 7.4 ppb (EPA 2001).

The higher PCE concentration was 13.71 ppb found in indoor air sample SP-2. This PCE result was below the ATSDR non-cancer effects EMEG comparison value of 40 ppb for chronic (greater than 365 days) exposure.

The higher TCE concentration was 1.69 ppb found in indoor air sample SP-1. This TCE result was below the EPA provisional value of 7.4 ppb for non-cancer health effects.

Since the concentration of PCE in indoor air was below the non-cancer EMEG and the concentration of TCE was below 7.4 ppb, the workers should not experience non-cancer health effects from breathing the indoor air of the former Rental Uniform Company building containing these chemicals.

No drycleaner solvent breakdown chemicals including 1,1-dichloroethene (1,1-DCE) cis-1,2-DCE, trans 1,2-dichloroethene (trans-1,2-DCE), 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethane (1,2-DCA) and vinyl chloride, were present in measureable amounts in the indoor air at the former Rental Uniform Company building. Reporting limits for these chemicals were very low. Because of the age of the release at the site, EEP expected to see higher concentrations of these chemicals in the indoor air. None were found. The presence of these chemicals in amounts below the detection limits will not lead to non-cancer health effects from breathing the indoor air of the site.

Cancer Evaluation

The higher PCE concentration was found in sample SP-2 at 13.71 ppb. When compared to the RSL for residential air, the measured concentration exceeded the comparison value range of concentrations that equate to an acceptable risk of 1 excess cancer in 10,000 people to 1 excess cancer in 1 million people, or a concentration range of 0.06 to 6 ppb (EPA 2010a).

Because the higher of two PCE concentrations exceeded the comparison values for acceptable risk, further evaluation was conducted. The PCE concentration of 13.71 ppb ($93 \mu\text{g}/\text{m}^3$) was multiplied by EPA's adult inhalation unit risk (IUR) for PCE of $5.90 \times 10^{-6} (\mu\text{g}/\text{m}^3)^{-1}$ (EPA 2010a). The theoretical cancer risk was calculated to be 4.49×10^{-4} or about 4 excess cancers in 10,000 people. This risk exceeded the acceptable limit of 1 excess cancer in 10,000 people. The IUR was based on assumptions that exposure would be continuous for 24 hours per day, 7 days

TABLE 1. Indoor air sampling results for Rental Uniform Company building, Kingsport, Sullivan County, TN. Samples were collected on December 5, 2009, over 8 hours with Summa canisters (S&ME 2010). Values reported in parts per billion (ppb). Health comparison values used are non-cancer chronic exposure duration greater than 365 days (ATSDR 2010), ATSDR cancer risk evaluation guides (ATSDR 2010), and/or EPA residential indoor air Regional Screening Levels (EPA 2010a).

Chemical / Sampling Data and Location	Acronym	SP-1		SP-2		ATSDR CREG (10 ⁻⁶ excess cancer risk) (ppb)	EPA RSL (10 ⁻⁶ excess cancer risk) (ppb)	ATSDR EMEG (non-cancer) (ppb)
		Concentration (ppb)	Data Qualifier	Concentration (ppb)	Data Qualifier			
Tetrachloroethylene	PCE	7.52	none	13.71	none	ngv	0.06	40
Trichloroethylene	TCE	1.69	none	0.18	U	ngv	0.22	7.4 ^{EPA}
1,1-dichloroethylene	1,1-DCE	0.17	U	0.18	U	nc	ngv	20ii
cis-1,2-dichloroethylene	cis-1,2-DCE	0.17	U	0.18	U	nc	nc	ngv
trans-1,2-dichloroethylene	trans-1,2-DCE	0.17	U	0.18	U	nc	nc	200ii
1,1-dichloroethane	1,1-DCA	0.17	U	0.18	U	ngv	0.38	ngv
1,2-dichloroethane	1,2-DCA	0.17*	U	0.18*	U	0.01	0.02	600
vinyl chloride	VC	0.17*	U	0.18*	U	0.04	0.06	30ii
Notes:	Reporting Limit = Limits that can be greater than or equal to the method detection limit for the analysis. ATSDR EMEG = Agency for Toxic Substances and Disease Registry Environmental Media Evaluation Guide (ATSDR 2010). Chronic non-cancer exposure comparison values (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 2010). Cancer risk comparison values for cancer risk of 1 excess cancer in 1,000,000 people used to determine if chemical concentrations warrant further health-based screening. EPA RSL = Environmental Protection Agency Regional Screening Level (EPA 2010a). The screening levels were developed using risk assessment guidance from the EPA Superfund Program. They are risk-based concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data. RSLs are considered by EPA to be protective for humans (including sensitive groups) over a lifetime. bold text = Indoor air concentration exceeded 1 in 1,000,000 excess cancer health comparison value but not the non-cancer health comparison value U = Not detected in the air sample. Concentration represents the analytical reporting limit. * = Reporting limit was greater than one or more comparison values. EPA = There is not a published EMEG for TCE. The results were compared to the EPA's most current provisional value for evaluation of the potential health risks from exposure to TCE at 7.4 ppb (EPA 2001). ii = ATSDR comparison value for intermediate exposures (15-365 days); typically higher than a chronic value nc = Not classified as to carcinogenicity ngv = No guidance value available							

per week, 365 days per year, and extend over a 70-year lifetime (ATSDR 2004). This calculated theoretical cancer risk would overestimate the actual exposure that would be expected in the former Rental Uniform Company building.

In an attempt to calculate a site-specific risk, the risk was modified for a worker working 8-hours per day, 5 days per week, 50 weeks per year, for 20 years. In an attempt to calculate a site-specific risk using time worked at the facility, the risk was modified for a worker working 8 hours per day, 250 days per year, for 20 years. The inhalation unit risk for PCE of 5.9×10^{-6} ($\mu\text{g}/\text{m}^3$)⁻¹ was multiplied by the measured concentration of 13.71 ppb (93 $\mu\text{g}/\text{m}^3$). The resulting risk of 5.5×10^{-4} was then multiplied by the factor 0.062 to adjust the exposure duration.

The exposure duration modifier was calculated as follows:

$$\frac{8 \text{ hours per day}}{24 \text{ hours per day}} \times \frac{250 \text{ days per year}}{365 \text{ days per year}} \times \frac{20 \text{ years exposure}}{70 \text{ years exposure}} = 0.062$$

The adjusted calculated risk for exposure to PCE in the indoor air at the former Rental Uniform building was 3.6×10^{-5} or approximately 4 excess cancers in 100,000 people. EEP believes this site-specific calculated cancer risk is closer to the actual risk, and it is within the 10^{-6} to 10^{-4} excess cancer risk considered acceptable by EPA (1991).

The measured concentration of TCE was 1.69 ppb or 9.08 $\mu\text{g}/\text{m}^3$. This measurement was within the range of 0.22 to 2 ppb that corresponds to an acceptable range for cancer risk of 1 excess cancer in 10,000 people to 1 excess cancer in 100,000 people (EPA 1991). Furthermore, using the IUR of 2.0×10^{-6} ($\mu\text{g}/\text{m}^3$)⁻¹ for TCE, (EPA 2010a) and multiplying it by the TCE concentration of 9.08 $\mu\text{g}/\text{m}^3$, a calculated theoretical cancer risk of 1.82×10^{-5} is obtained. This risk equals about 2 excess cancers in 100,000 people. This theoretical calculated risk is within the range of 10^{-6} to 10^{-4} excess cancer risk considered acceptable by EPA (EPA 1991).

No drycleaner solvent breakdown chemicals except those outlined above were present in measureable amounts in the indoor air in the former Rental Uniform Company building. Reporting limits for these chemicals were very low. Since these breakdown products were not reported in measureable amounts, their presence in amounts below the detection limit of the analysis likely would not lead to any cancer health effects from breathing the indoor air at the site.

Johnson & Ettinger Evaluation

The potential for vapor intrusion from PCE, TCE, and VC was also modeled using groundwater data collected in September 2007 and the Johnson & Ettinger (J&E) (EPA 2010b) simplified model. The modeling of the potential for vapor intrusion using the groundwater concentrations found at the site was done as a check of EEP's risk calculations. As stated, the risk calculations were done using the actual measured indoor air concentrations.

The J&E model is a conservative simplified model that uses measured, site-specific groundwater or soil-gas concentrations, the type of soil at the site, the building foundation type, the depth to

groundwater or soil-gas measurement, and the exposure duration, among other chemical-specific details. The J & E model indicated that there should not be any cancer risk or non-cancer hazard to employees breathing the indoor air at the former Rental Uniform Company building.

Chemical Mixture

PCE and TCE were both measured in the indoor air samples from the site. There are possible additive health effects from these chemicals to an exposed population (ATSDR 2004). There is no evidence to indicate that greater-than-additive interactions among TCE or PCE health effects might occur. This includes interactions for the most common liver and kidney or nervous system effects observed from PCE or TCE exposure.

Adding together the calculated theoretical risks of PCE of 3.6×10^{-5} and 1.8×10^{-5} for TCE for the site, the total excess cancer risk was about 5 in 100,000. The actual risk would be within EPA's acceptable range of risk. It is unlikely that the presence of both PCE and TCE in indoor air would create any increased health effects to those who breathe the indoor air by working in the former Rental Uniform Company building.

Future Considerations

PCE and its breakdown chemicals were reported in site soils at concentrations below their respective EPA industrial soil RSLs (S&ME 2008). PCE and vinyl chloride were found in groundwater samples also collected in August 2007. Should the land use of the property now housing the commercial cleaning facility change from an industrial setting or if groundwater becomes a potential route of exposure, additional sampling of the soil would determine if concentrations of the chemicals would pose adverse health effects to populations using the site. It may be prudent to place institutional controls on the site if the concentrations of these compounds in site soil and groundwater are allowed to remain.

Child Health Considerations

The workers at the former Rental Uniform Company building are adults. It is unlikely that children would spend any time at the site now and in the future. If a child would spend a short time in the former Rental Uniform Company building, they would only have a minimal exposure to drycleaner solvent and related breakdown chemicals. Any limited exposure time would not be a health concern when breathing the indoor air containing these chemicals.

Conclusions

EEP concludes that the concentrations of the drycleaner solvent PCE and its breakdown chemical TCE measured in the former Rental Uniform Company building are not expected to harm the health of the workers of the current commercial laundry operating in the building. Indoor air in the former cleaner contained levels of PCE and TCE. Exposure to PCE and TCE at their highest measured concentrations is not likely to lead to long-term exposure to workers working a normal work week over many years. The measured amounts of PCE and TCE will also not likely result in a higher cancer risk from breathing indoor air.

The EEP concludes that although S&ME was cautious in their approach to conducting the indoor air investigation, the findings and data presented in the February 2010 S&ME Report appear to be valid. The investigation methods and the sample testing were conducted using accepted methods employed at other sites investigated for the occurrence of vapor intrusion and in general accordance with investigation methods outlined in vapor intrusion investigation guidance documents.

EEP compared the results of the indoor air investigation to residential indoor air inhalation health risk values. Although the building is still being used as a commercial laundry, drycleaning of clothing and other materials has not been conducted at the site since 1982. Current employees are likely not aware drycleaning solvent was used in the building in the past, and are not trained in the use, handling, or what protective equipment may be needed when using drycleaning solvent. Therefore, the employees are subjected to a secondary occupational exposure and were evaluated based on this conclusion.

Recommendations

EEP has no recommendations at this time.

Public Health Action Plan

1. This report and any needed explanation will be provided to TDEC. This report will also be provided to the property owner by TDEC. EEP suggests that the property owner should make this report available to workers at the site. TDH EEP will continue to work with TDEC as the site continues through the regulatory process and will be available to review additional data should the need arise.

Preparer of Report

Rebecca P. Gorham, BS
Environmental Health Assessor

Tennessee Department of Health (TDH)
Environmental Epidemiology Program (EEP)
Communicable and Environmental Disease Services (CEDS)
1st Floor, Cordell Hull Building
425 5th Avenue North
Nashville TN 37243

Reviewers of Report

Bonnie S. Bashor, MS
Environmental Epidemiology Director

David M. Borowski, MS
Environmental Epidemiology Assistant Director

Joseph P. George, PG, MS
Environmental Epidemiologist

Tennessee Department of Health (TDH)
Environmental Epidemiology Program (EEP)

Darrell Hale, MS
Environmental Specialist
Tennessee Department of Environment and Conservation, Division of Remediation,
Johnson City Environmental Field Office

Heather Mullins, BS
Regional Epidemiologist
Tennessee Department of Health
Sullivan County Regional Health Department

References

- [ATSDR] Agency for Toxic Substances and Disease Registry. 1997. Toxicological profile for Trichloroethylene. U.S. Department of Health and Human Services. September 1997.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2004. Interaction profile for 1,1,1-trichloroethane, 1,1-dichloroethane, trichloroethylene, and tetrachloroethylene. Atlanta, GA, U.S. Department of Health and Human Services. May 2004.
- [ATSDR] Agency for Toxic Substances and Disease Registry. Public Health Assessment Guidance Manual. Atlanta: U.S. Department of Health and Human Services. 2005.
- [ATSDR] Agency for Toxic Substances and Disease Registry. Health Assessment Guidance on Secondary Exposures, Atlanta: U.S. Department of Health and Human Services. June 5, 2006.
- [ATSDR] Agency for Toxic Substances and Disease Registry. Indoor air health comparison values. Atlanta: U.S. Department of Health and Human Services. 2010.
- [ATSDR] Agency for Toxic Substances and Disease Registry. 2011. Glossary of terms. Atlanta, GA: U.S. Department of Health and Human Services. Last accessed: January 14, 2011. Available online at: <http://www.atsdr.cdc.gov/glossary.html>.
- [EPA] U.S. Environmental Protection Agency. 1991. Role of the baseline risk assessment in superfund remedy selection determination. OSWER Directive 9355.0-30. Washington, D.C.
- [EPA] U.S. Environmental Protection Agency. 2001. Trichloroethylene health risk assessment: synthesis and characterization. Office of Research and Development, National Center for Environmental Assessment, Washington, D.C. EPA/600/P-01/002A. August 2001.
- [EPA] U.S. Environmental Protection Agency. 2010a. Regional Screening Levels (RSL) for chemical contaminants at superfund sites. Oak Ridge TN, Oak Ridge National Laboratory. Last accessed: January 20, 2011. Available online at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
- [EPA] U.S. Environmental Protection Agency. 2010b. EPA on-line tools for site assessment calculation, Screening level implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content). Available from: http://www.epa.gov/athens/learn2model/part-two/onsite/JnE_lite_forward.html. Last accessed: July 29, 2010.
- [EPA] U.S. Environmental Protection Agency. 2011. Terms of environment: glossary, abbreviations and acronyms. Washington, D.C. Last accessed: January 14, 2011. Available online at: <http://www.epa.gov/OCEPAterms/>
- [ITRC] Interstate Technology and Regulatory Council. 2007. Vapor Intrusion Pathway a Practical Guideline. The Interstate Technology & Regulatory Council Vapor Intrusion Team. Washington, DC. January 2007.

[NYSDOH] New York State Department of Health. 2006. Guidance for Evaluating Soil Vapor Intrusion in the State of New York, Final. New York State Department of Health, Center for Environmental Health, Bureau of Environmental Exposure Investigation. October 2006.

[McCall] Personal communication with Mr. Eugene C. McCall, Esq., McCall Environmental, Greenville, South Carolina, July 27, 2010.

[S&ME] S&ME. 2008. Site Assessment Report, Former Rental Uniform Company, Kingsport, Tennessee. July 30, 2008.

[S&ME] S&ME. 2010. Indoor Air Sampling Report, Former Rental Uniform Company, Kingsport, Tennessee. February 2010.

FIGURE 1 - Overhead view of Rental Uniform Company.
Photo credit: Google Maps, January 18, 2011.



FIGURE 2 - Indoor air sampling locations inside the former drycleaning area at the Rental Uniform Company. Recreated from Figure 1 in the Indoor Air Sampling Report prepared by S&ME dated February 2010.

Certification

This Public Health Consultation: *Rental Uniform Company, Kingsport, Sullivan County, Tennessee*, was prepared by the Tennessee Department of Health's Environmental Epidemiology Program. It was prepared in accordance with the approved methodology and procedures that existed at the time the health consultation was begun.



Director of EEP, CEDS, TDH