

Health Consultation

**CARRIAGE HOUSE CLEANERS
BRENTWOOD, WILLIAMSON COUNTY, TENNESSEE**

**Prepared by the
Tennessee Department of Health**

APRIL 28, 2009

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

Health Consultation: A Note of Explanation

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

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

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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. In order for the Environmental Epidemiology Program 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 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 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 the Environmental Epidemiology Program 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.

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Introduction

The Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP) was asked by the Tennessee Department of Environment and Conservation's (TDEC) Drycleaner Environmental Response Program (DCERP) to investigate the Carriage House Cleaners Site. Evaluation of indoor air data for drycleaner solvent and breakdown products was requested to ensure the health and safety of people working at or visiting the site.

Background

The Carriage House Cleaners operated from 1955 until 2007. It was located at 128 Franklin Road in Brentwood, Williamson County, Tennessee, 37207. The drycleaner owner participated in the TDEC DCERP. The site was assigned DCERP Facility ID # D-94-104.

DCERP retained E. Roberts Alley & Associates (ERA&A) to conduct a Prioritization Investigation – Task Group B (PIB) for Carriage House Cleaners (2008a). According to their report, the drycleaner solvent, tetrachloroethylene (perc or PCE), was the only solvent used at the 0.26 acre site. In the past, PCE was stored in a 100 gallon above ground storage tank. This storage tank was believed to have been permanently closed and removed about twenty years ago. Soil borings were made to collect environmental samples. All samples were soil measurements as no groundwater was encountered.

An area of soil contamination, approximately 10 ft by 25 ft, was identified near where the above ground storage tank was located. The contaminant plume seemed to have remained small and on site. Six measurements in the contaminated soil area ranged from 380 to 920 parts of PCE per million parts of soil (ppm) with a mean of 620 ppm. Figure 1 illustrates this impacted soil area near the northeast corner of the building. The soil measurements outside of the contaminated area were much less, ranging from 0.0079 to 66 ppm with a mean concentration of 6.5 ppm.

As part of their continued commitment to maintaining drycleaner sites, the TDEC DCERP expanded their environmental investigation of the site. A Remedial Action and Confirmation Sampling project was ordered (ERA&A 2008b).

On July 28, August 4, and August 11, 2008, contaminant source removal was performed. More than 200 tons of soil were removed from the site (Figure 1). Then, a sodium lactate biostimulant was placed at the bottom of the excavation area to stimulate the bioremediation of any residual contamination. The excavation area was backfilled with clean rock and clay. On September 10, six soil borings were made for confirmatory sampling.

Also on September 10, 2008, Summa canisters were deployed to collect air samples. Two canisters were placed inside the 2,350 square foot drycleaner building. Some drycleaner solvent and two breakdown product vapors were found in the indoor air. Whether these vapors were residuals from drycleaning operations or the result of vapor intrusion was unknown.

On September 16, 2008, TDH EEP met with a representative for the property owner, assisted by ERA&A, TVG Environmental, Inc., and the DCERP. An active discussion about moving the site's commercial redevelopment forward in a safe manner was held. A general review of the site history and future reuse potential was shared. Engineering controls for new construction were also discussed. These controls included the use of a high-density plastic liner and a vapor extraction system. After the meeting, the general path forward to redevelop the Carriage House Cleaners in a safe manner seemed to be understood by all stakeholders. This health consultation presents our environmental public health investigation of the Carriage House Cleaners.

Discussion

Introduction to Chemical Exposure

To determine whether persons have been or are likely to be exposed to chemicals, the TDH's 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. The pathway is considered an incomplete exposure pathway if there is no evidence that at least one of the five elements listed has been, is, or will be present at the site. For this site, there was a potential exposure pathway for the inhalation of drycleaner solvent or breakdown product vapors inside the former drycleaner 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 purpose of this public health consultation was to examine any potential health hazard from drycleaner-related chemicals. To evaluate exposure to a hazardous substance, health assessors often use health comparison values (ATSDR 2008, 2008a). 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 might be exposed. If concentrations are above the comparison values for a particular chemical, then further evaluation of that chemical is in order.

Health Comparison Values

The federal Agency for Toxic Substances and Disease Registry (ATSDR) provides Minimal Risk Levels (MRLs) to be used in evaluating environmental data for non-cancer effects. The ATSDR uses the no observed adverse effect level/uncertainty factor (NOAEL/UF) approach to derive non-cancer adverse health effect MRLs for hazardous substances. MRLs are set below levels that, based on current information, might cause adverse health effects in people. MRLs are derived for acute (1 to 14 days), intermediate (15 to 364 days), and chronic (365 days and longer) exposure durations, and for the oral and inhalation routes of exposure. ATSDR does not use serious health effects (such as irreparable damage to the liver or kidneys, or birth defects) as a basis for establishing MRLs. Exposure to a level above the MRL does not mean that adverse health effects will occur (ATSDR 2008a). At this site, the indoor air results were compared to chronic MRLs to represent a long-term, worst case scenario. If there was no published chronic MRL, then an intermediate MRL value was substituted.

Concentrations of drycleaner solvent and breakdown products were also compared to ATSDR's cancer risk evaluation guides (CREGs) that represents a level that would theoretically result in 1 excess cancer per 1,000,000 people exposed during their lifetime (70 years). 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.

The US Environmental Protection Agency (EPA) also provides several types of their own comparison values. In 2002, the Office of Solid Waste and Emergency Response (OSWER) issued Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. This OSWER directive provided additional tools for screening environmental data including target indoor air concentrations to satisfy both the prescribed cancer risk level of 10^{-4} and the non-cancer target hazard index of 1. Some EPA regional offices also provide comparison values. For example, EPA Region 3 has published chemical specific screening levels to assist with the cleanup of waste sites (2009a).

Most of these comparison values use standard assumptions in computing the theoretical risk level. The standard assumptions used for calculating residential guidance values would not apply at this site. The exposure frequency and exposure duration would both be much smaller than standard assumptions. So the resulting theoretical inhalation health risk values will overestimate conditions at Carriage House Cleaners.

Drycleaner Solvent Explanation

The process of drycleaning 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 tetrachloroethylene (PCE) or perc. It is a colorless liquid and has a sweet smell (ATSDR 1997). Perc is a volatile organic compound. It will quickly evaporate into a gas at room temperature. As its name implies, tetrachloroethylene 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.

For example, tetrachloroethylene (PCE) can breakdown to trichloroethylene (TCE), then to isomers of dichloroethylene (DCE), and then to vinyl chloride (VC). Each of these breakdown products can act independently. The only way to truly know the ratio of these breakdown products is to collect environmental samples. The drycleaner solvent, tetrachloroethylene, and all of its breakdown products were considered in preparing this report.

Drycleaner solvent is typically purchased as a liquid. Spills that occurred while using drycleaner solvent can lead to contamination of soil and groundwater. As the solvent evaporates and the gas mobilizes, vapor intrusion into indoor spaces is possible. Drycleaner solvent or breakdown product vapors that become trapped indoors are the main concern when considering the health of persons working in or visiting the Carriage House Cleaners.

Indoor Air Sampling

Air samples were collected on September 10, 2008. Air samples were collected over a 24-hour time period and were analyzed using Method TO-15. A Summa canister was deployed outdoors to collect a background sample. A trace amount of PCE at 0.31 ppb was detected outdoors. Indoor air monitoring was performed using Summa canisters at two locations within the former drycleaner. The canisters were set at breathing height. The drycleaner building's ventilation system was turned off before sampling to create a worst case scenario for collecting indoor air vapors.

Small amounts of drycleaner solvent and breakdown product vapors were detected in both the north and south indoor air samples. The indoor air results for drycleaner solvent and breakdown products are shown in Table 1. The drycleaner solvent tetrachloroethylene (PCE) and two of its chemical breakdown products, trichloroethylene (TCE) and cis-1,2-dichloroethylene (cis-1,2-DCE), were detected in the indoor air.

Table 1. Summary of indoor air data collected in September 2008 from the Carriage House Cleaners in Brentwood, Williamson County, TN. Summa canister 24-hour samples. All measurements in parts per billion (ppb) (ERA&A 2008a, b) & (ATSDR 2008, 2008a).					
Chemical	Acronym	09/10/2008		non-cancer effects (HI=1) ATSDR's MRL/EMEG	cancer effects (10 ⁻⁶ risk)
		inside north	inside south		
Tetrachloroethylene	PCE	2.8	3.0	40	0.06 ^{E3}
Trichloroethylene	TCE	0.30	0.30	100i	0.22 ^{E3}
1,1-Dichloroethylene	1,1-DCE	ND	ND	20i	nc
cis-1,2-Dichloroethylene	cis-1,2-DCE	0.26	0.38	ngv	nc
trans-1,2-Dichloroethylene	trans-1,2-DCE	ND	ND	200i	nc
Vinyl Chloride	VC	ND	ND	30i	0.04 ^{AC}
1,1-Dichloroethane	1,1-DCA	ND	ND	ngv	0.38 ^{E3}
1,2-Dichloroethane	1,2-DCA	ND	ND	600	0.01 ^{AC}

Notes:
A = ATSDR's MRL/EMEG = Minimal Risk Level / Environmental Media Evaluation Guide
AC = ATSDR's CREG = Cancer Risk Evaluation Guide for 1x10⁻⁶ excess cancer risk
E3 = EPA Region 3's residential indoor air screening value (EPA 2009a)
i = intermediate value (15 - 365 days)
nc = not classified as a carcinogen
ND = not detected (based on the analytical detection limit)
ngv = no guidance value established by ATSDR for this chemical/compound

The September 2008 indoor air samples contained 2.8 and 3.0 ppb of tetrachloroethylene (PCE). These values were below the ATSDR chronic, non-cancer EMEG of 40 ppb (ATSDR 2008a). At the time of this report, ATSDR had not published a CREG to evaluate cancer risk due to PCE as EPA's carcinogenicity assessment for PCE was still pending (EPA IRIS 2009). EPA Region 3 has a cancer comparison value for PCE of 0.06 ppb. The EPA Region 3 inhalation unit risk was 5.9x10⁻⁶ µg/m³. Multiplying the inhalation unit risk by the average PCE value of 2.9 ppb computed to a risk of 1.2x10⁻⁴. This theoretical risk value suggests 1.2 excess cancers due to many years of daily PCE in air exposure per 10,000 people in the building. This theoretical risk value assumes a person would be exposed to vapors twenty-four hours a day, seven days a week, every day of the year. These assumptions will calculate to a risk value higher than real world circumstances. EPA Region 3 used California's carcinogenicity assessment in its residential air screening value for PCE. This is not likely an appropriate screening value because EPA's

Scientific Advisory Board, in its review of EPA's carcinogenicity assessment, stated that the overall weight-of-evidence places PCE on a continuum between categories B2 (probable human carcinogen with inadequate human and sufficient animal studies) and C (possible human carcinogen with no human and limited animal studies). Standard assumptions used in calculating slope factors would not be applicable. According to the EPA OSWER directive the target indoor air concentration to satisfy both a cancer risk level of 10^{-4} and a target non-cancer hazard index of 1 is 12 ppb PCE. The average value of 2.9 ppb PCE was less than the EPA OSWER target indoor air concentration. Based on OSWER guidance, the health risk from inhalation of PCE would be in the range of 10^{-4} to 10^{-5} suggesting no further action is required.

The breakdown product, trichloroethylene (TCE), was measured to be 0.30 ppb in both Summa canister samples. This value was less than ATSDR's intermediate EMEG of 100 ppb. The TCE measurement was below EPA Region 3's non-cancer guidance value of 7.4 ppb. For cancer, TCE at 0.30 ppb was slightly higher than EPA Region 3's 0.22 ppb guidance value. As all guidance values are based on conservative assumptions, the difference between 0.22 and 0.30 ppb of TCE in air is relatively small. The EPA Region 3 inhalation unit risk is $2.0 \times 10^{-6} \mu\text{g}/\text{m}^3$. When the inhalation unit risk is multiplied by the TCE concentration it results in a theoretical risk of 3.0×10^{-6} or 3 excess cancers per 1,000,000 people. The EPA OSWER (2002) target indoor air concentration level is 0.41 ppb TCE. The New York State Department of Health's guidance value of for TCE in air is 0.93 ppb (NYSDOH 2006). The average measured indoor air values of 0.30 ppb TCE was lower than both the EPA OSWER and NYSDOH's guidance which considers both non-cancer and cancer endpoints.

Another drycleaner solvent breakdown product, cis-1,2-dichloroethylene (cis-1,2-DCE), was measured at 0.26 and 0.38 ppb. No health comparison values were found for non-cancer effects of cis-1,2-DCE, which is not classified as a carcinogen.

There are some drycleaner solvent breakdown products that have very low comparison values. In the air samples analyzed, vinyl chloride (VC) and 1,2-dichloroethane (1,2-DCA) were not detected. The laboratory analytical detection limit for each chemical was 0.20 ppb. The representative health screening levels for cancer endpoints were less than the analytical detection level. Although, we would prefer to have had actual measurements to evaluate these two chemicals it is unlikely that there would be any health concerns.

The CREGs listed in Table 1 are for chronic, lifelong exposure. A worker or visitor to this site would have a shorter exposure. The CREG marks a one in a million (1×10^{-6}) increased risk of excess cancer. The toxicology of the carcinogen VC is well understood. EPA's adult inhalation unit risk for VC is $4.4 \times 10^{-6} (\mu\text{g}/\text{m}^3)^{-1}$. Using the standard assumption of $\frac{1}{2}$ the analytical detection limit for the chemical concentration, this computes to a theoretical increased cancer risk of 1.1×10^{-6} from a lifetime exposure to vinyl chloride. The toxicology of 1,2-DCA is less well understood. It is anticipated to be a human carcinogen, but the data is less certain. Perhaps due to this uncertainty, the lifetime inhalation unit risk for 1,2-DCA is $2.6 \times 10^{-5} (\mu\text{g}/\text{m}^3)^{-1}$ which yields a 1.1×10^{-5} increased cancer risk. Again, it is unlikely that there would be any long-term health concerns since visitors to the site would have much shorter exposures.

The indoor drycleaner solvent and breakdown product vapors could be from more than one source. One possibility is that past drycleaning activities left residual chemical vapors within the building. Another option would be vapor intrusion if chemicals in the soil had migrated and became trapped under the former drycleaner building. Vapor intrusion has been an issue at other former drycleaner redevelopment sites. Therefore, we will assume that future vapor intrusion would be possible at this site if nothing were done to prevent it.

The extent of the contamination source was small and mostly outside the building footprint. Removal of the contaminated soil source area and injection of the sodium lactate biostimulant into soils resting on bedrock was performed. No large-scale contamination was discovered. With the removal of contaminated soil and the opportunity for bioremediation of any residual contamination, the site conditions were improved. Following the source removal, site conditions should continue to improve such that future health concerns would be unlikely.

Discussion about moving the site's commercial redevelopment forward in a safe manner included talking about engineering controls to vapor intrusion concerns. If engineering controls are used as part of new construction, then any future health concerns will be further minimized or eliminated.

Children's Health Considerations

In preparation of this report, the health and safety of children was thoughtfully considered. The site's likely future use as a commercial business would make children only occasional visitors. These visits would be infrequent and short in duration. The indoor air data were all below their health comparison values. Furthermore, given the soil removal and the completion of the site cleanup plan there should be no health issues unique to children.

Conclusions

There is no apparent public health hazard at the Carriage House Cleaners, Brentwood, Williamson County, Tennessee, DCERP site #D-94-104. This conclusion was based on: (1) our review of the indoor air measurements of drycleaner solvent and breakdown product vapors, and (2) the removal of the contaminated soil source area.

Recommendations

None at this time.

Public Health Action Plan

DCERP's remedial actions for the site included removal of the contaminated soil and the addition of a bioremediation aid.

The Environmental Epidemiology Program will provide this report to the DCERP and other stakeholders to record this environmental public health investigation for the Carriage House Cleaners in Brentwood, Williamson County, Tennessee.

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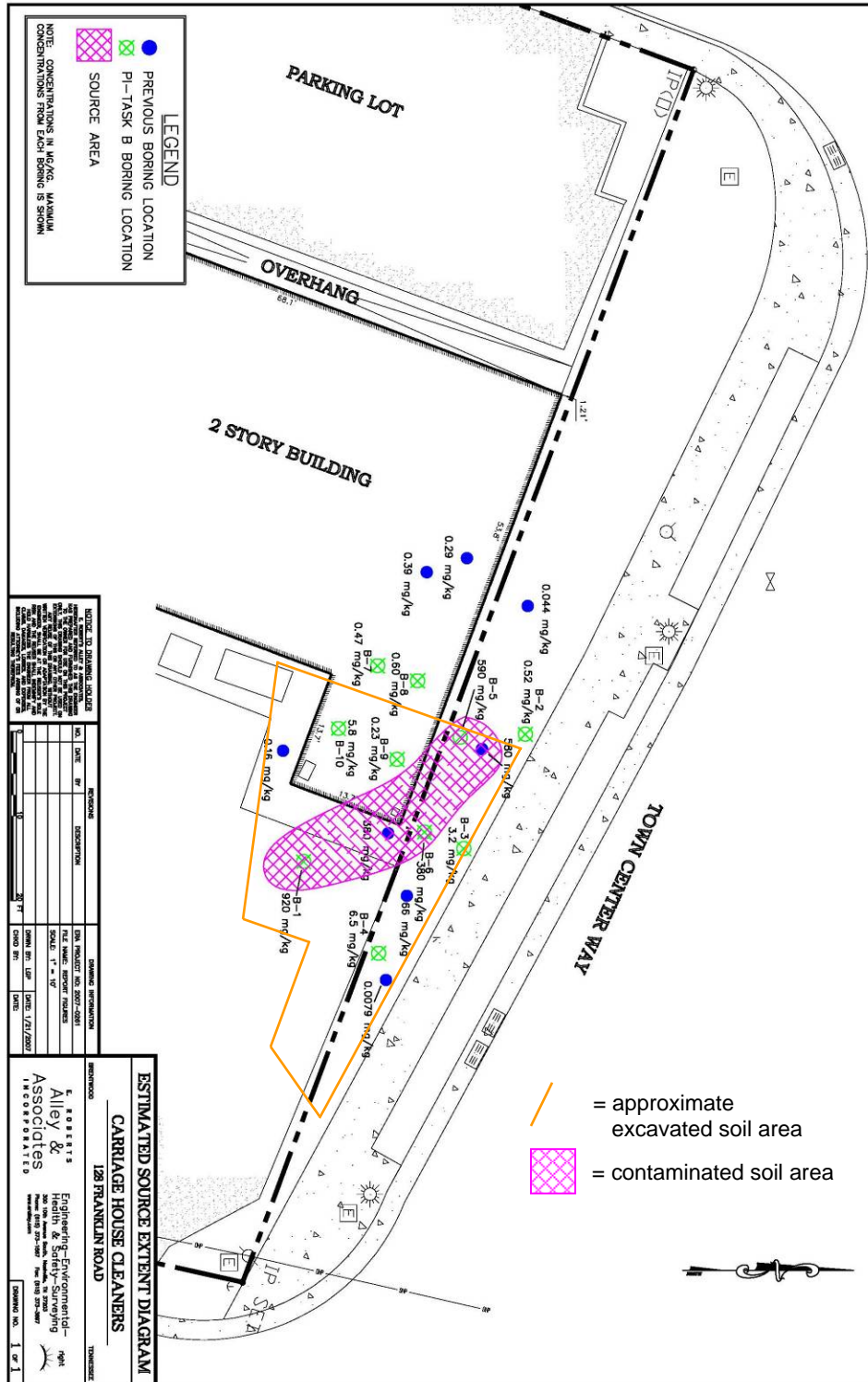
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Figure 1. Diagram of the Carriage House Cleaners Site with soil boring locations and approximate extent of tetrachloroethylene soil contamination and soil excavation areas (ERA&A 2008a, b).



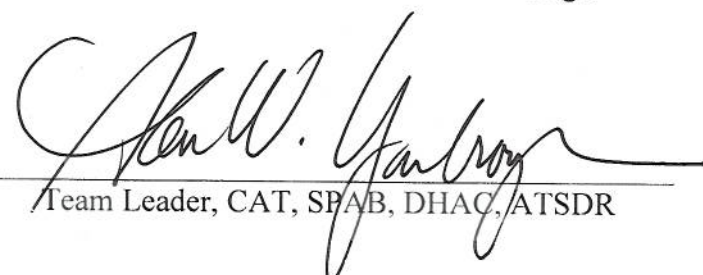
Certification

This Public Health Consultation: *Carriage House Cleaners, Brentwood, Williamson County, Tennessee*, was prepared by the Tennessee Department of Health's Environmental Epidemiology Program under a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It was prepared in accordance with the approved methodology and procedures that existed at the time the health consultation was begun.



Technical Project Officer, CAT, SPAB, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health assessment and concurs with the findings.



Team Leader, CAT, SPAB, DHAC, ATSDR