

Health Consultation

HARDEMAN COUNTY LANDFILL UPDATE
(A/K/A VELSICOL CHEMICAL CORPORATION)

TOONE, HARDEMAN COUNTY, TENNESSEE

EPA FACILITY ID: TND980559033

SEPTEMBER 28, 2007

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

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

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

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HEALTH CONSULTATION

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Prepared By:

Tennessee Department of Health
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Foreward

This document summarizes an environmental public health investigation performed by Environmental Epidemiology 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 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 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.

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Introduction

In September 2005, the Tennessee Department of Environment and Conservation (TDEC), Division of Remediation (DoR), contacted the Tennessee Department of Health (TDH), Environmental Epidemiology (EEP), about chemical vapor intrusion concerns in a private residence located in the vicinity of the Hardeman County Landfill (a/k/a Velsicol Chemical Corporation Landfill). Carbon tetrachloride and chloroform, both volatile organic compounds (VOCs), have been identified as contaminants of concern at the site. The site is a one-story ranch-style house with a crawlspace underneath.

Environmental Epidemiology under a Cooperative Agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR) prepared the *Health Consultation: Hardeman County Landfill*, dated April 16, 2007. The report concluded that vapor intrusion of carbon tetrachloride was a health hazard and vapor intrusion of chloroform was an indeterminate health hazard. As recommended, additional air sampling was performed to better characterize the site and estimate risk to the occupants. This update will include February 2007 indoor air data for carbon tetrachloride and chloroform due to vapor intrusion. This update will also provide a new recommendation based on the indoor air testing results. When additional ambient air data becomes available we anticipate another report to respond to outdoor air data.

Background

The Velsicol Chemical Corporation Landfill (VCCL) is located in rural Toone, Hardeman County, Tennessee. Prior to modern environmental regulations, approximately 130,000 drums of chemical wastes were disposed of in the landfill from 1964 to 1973. The VCCL site was added to the EPA Superfund National Priorities List (NPL) of hazardous waste sites in urgent need of cleanup in September 1983 (EPA Facility ID# TND980559033).

Investigations of the site found that an estimated 3.6 million cubic yards of soils underlying the wastes were contaminated. Soil contamination has been found at 60 to 70 feet below the base of the waste. Contaminated groundwater emanating from the VCCL flows to the northeast, north, and northwest, and then discharges as groundwater seeps and as stream flow in Pugh Creek to the east, unnamed streams to the north and northwest, and Clover Creek to the north (EIC 2005a & 2005b). North of VCCL, land elevation decreases. This makes the contaminated groundwater closer to ground surface. Because of this, even though the private residence is 1.1 miles north of the landfill it is in proximity to contamination that has migrated off-site in groundwater.

Elevated amounts of carbon tetrachloride in soil gas near the home led to the investigation of possible vapor intrusion of contaminants into the home. As chemical vapors migrate from groundwater or soil they may intrude into the confined space of the house and lead to exposure. Air samples were collected in the crawlspace in May 2005 (EIC 2005c) and again in February 2007 (EIC 2007).

Discussion

Introduction to Chemical Exposure

To determine whether persons are, have been, or are likely to be exposed to chemicals, Environmental Epidemiology of the Tennessee Department of Health 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 are, have been, or will be present at the site. The pathway is considered either a potential or an incomplete exposure pathway if there is no evidence that at least one of the five elements listed is, has been, or will be present at the site, or if there is a lower probability of exposure. For this site, whether indoors or outdoors, there is a completed exposure pathway for the inhalation of carbon tetrachloride and chloroform.

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
- the person's diet and nutritional habits.

To better understand the likelihood for exposure of the house occupants to chemicals vapors, indoor and outdoor air samples were collected. The purpose of this public health consultation is to continue to examine any potential health hazard from carbon tetrachloride or chloroform. To evaluate exposure to a hazardous substance, health assessors often use health 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 for a particular chemical, as demonstrated in the prior Health Consultation, then further site evaluation is needed.

Environmental Sampling

Indoor Air

Indoor air samples were collected from the crawlspace of the house in May 2005 (EIC 2005c) and February 2007 (EIC 2007). The crawlspace samples will be considered indoor air samples for this investigation. SUMMA canisters were used to collect 24-hour air samples. The amounts of carbon tetrachloride and chloroform measured in the crawlspace air are presented in Table 1.

TABLE 1. Air concentrations and health comparison values for crawlspace (indoor) air samples collected in May 2005 and February 2007 within a house north of the Hardeman County Landfill.

sample date	chemical name	conc. (ppb)	conc. ($\mu\text{g}/\text{m}^3$)	ATSDR EMEG ($\mu\text{g}/\text{m}^3$)	ATSDR CREG ($\mu\text{g}/\text{m}^3$)	EPA unit risk ($\mu\text{g}/\text{m}^3$) ⁻¹	inhalation risk value (unitless)
May 2005	carbon tetrachloride	1.8	11.3	200	0.07	1.5E-5	1.7E-4
Feb 2007		5.7	35.9				5.4E-4
Average		3.8	23.9				3.6E-4
May 2005	chloroform	0.30	1.5	100	0.04	2.3E-5	3.4E-5
Feb 2007		0.07	0.3				6.9E-6
Average		0.19	0.9				2.1E-5

ATSDR = Agency for Toxic Substances and Disease Registry
 EMEG = Environmental Media Evaluation Guide
 CREG = Cancer Risk Evaluation Guide
 EPA = Environmental Protection Agency
 ppb = part per billion (by volume)
 $\mu\text{g}/\text{m}^3$ = microgram per cubic meter
 inhalation risk value = concentration ($\mu\text{g}/\text{m}^3$) x EPA unit risk ($\mu\text{g}/\text{m}^3$)⁻¹

Three important results were obtained from the indoor air sampling data. First, there was a small change in the vapors measured in May 2005 and February 2007. Next, the amounts of both carbon tetrachloride and chloroform were far below their respective non-cancer comparison values, the Environmental Media Evaluation Guide (EMEG). Third, for each chemical, its cancer comparison value, the Cancer Risk Evaluation Guide (CREG), was exceeded. Thus, there may be an increased cancer risk due to inhalation exposure for residents in the Old Toone Road house.

The previous Health Consultation detailed the assumptions and caveats to the environmental sampling. It noted that the crawlspace air samples were collected to minimize any stress to the house residents. The crawlspace samples were then used as a reasonable substitute for actual indoor air samples.

Ambient Outdoor Air

Outdoor ambient air samples collected near the house in February 2007 were less than those measured in May 2005. Over this period, the average risk of increased cancer incidence due to carbon tetrachloride or chloroform was about 10^{-5} . Refer to Table 2 for the air data and calculated risk values. The average ambient air measurements were 0.42 parts per billion (ppb) for carbon tetrachloride and 0.25 ppb for chloroform. These measurements are above national background ambient air levels. In other words, there is more carbon tetrachloride and chloroform in this rural outdoor air than what would be expected in the most places, rural or urban, within the United States. The national ambient air background values are 0.2 ppb for carbon tetrachloride and 0.02 ppb for chloroform (ATSDR 1997, 2005). At a TDEC air monitoring station in Loudon County, Tennessee, the 2004-2005 average ambient air level of carbon tetrachloride was 0.09 ppb and chloroform was 0.10 ppb.

TABLE 2. Air concentrations and health comparison values for outdoor ambient air samples collected in May 2005 and February 2007 near a house north of the Hardeman County Landfill.

sample date	chemical name	conc. (ppb)	conc. ($\mu\text{g}/\text{m}^3$)	ATSDR EMEG (ug/m^3)	ATSDR CREG (ug/m^3)	EPA unit risk (ug/m^3) ⁻¹	inhalation risk value (unitless)
May 2005	carbon tetrachloride	0.70	4.4	200	0.07	1.5E-5	6.6E-5
Feb 2007		0.14	0.9				1.4E-5
Average		0.42	2.6				3.9E-5
May 2005	chloroform	0.46	2.2	100	0.04	2.3E-5	5.1E-5
Feb 2007		0.04	0.2				4.6E-6
Average		0.25	1.2				2.8E-5

ATSDR = Agency for Toxic Substances and Disease Registry
 EMEG = Environmental Media Evaluation Guide
 CREG = Cancer Risk Evaluation Guide
 EPA = Environmental Protection Agency
 ppb = part per billion (by volume)
 ug/m^3 = microgram per cubic meter
 inhalation risk value = concentration (ug/m^3) x EPA unit risk (ug/m^3)⁻¹

Carbon Tetrachloride Exposure

Non-cancer health effects from inhalation exposure to carbon tetrachloride whether indoors or outdoors are not expected.

Based on the data presented in Table 1, there has been more carbon tetrachloride measured in the crawlspace air than what Environmental Epidemiology can consider safe. For a lifetime exposure to carbon tetrachloride there may be an increased risk for adverse cancer health effects. The risk, which is only a theoretical value, can be explained as approximately 3.6 additional cancers in 10,000 people. This risk is more than the typical risk value of 1 in 10,000 that government agencies set as a benchmark (EPA 1991). Environmental Epidemiology considered vapor intrusion of carbon tetrachloride at this residence a health hazard.

Chloroform Exposure

Non-cancer health effects from inhalation exposure to chloroform whether indoors or outdoors are not expected.

For a lifetime exposure to chloroform the indoor data, as shown in Table 1, indicate that there may be an increased risk for adverse cancer health effects. The risk, which is only a theoretical value, can be explained as 2.1 additional cancers when considered among 100,000 people.

There has been more chloroform measured in the crawlspace than what Environmental Epidemiology can consider safe. The cancer risk values for chloroform are less the typical 1 in 10,000 benchmark but more than the 1 in a 1,000,000 most desirable risk level (EPA 1991). Environmental Epidemiology considered vapor intrusion of chloroform at this residence a health hazard.

Understanding Risk Calculations

As previously stated, the cancer risk values for both carbon tetrachloride and chloroform should be considered a health hazard. These exposures should be eliminated. It is important to keep in mind, that the risk values presented are theoretical and not real-world, tangible numbers. For example, the real lifetime cancer risk is somewhere between 0 and average risk value of 3.6×10^{-4} for carbon tetrachloride. As a health assessor, we often use cautious, overly careful methods to analyze data in exposure situations because our job is to protect public health.

As the risks presented are theoretical, there are some additional facts about the exposure that likely would reduce the risk. First, the indoor air values were actually collected in the crawlspace of the house. Typically, there will be more vapors in the crawlspace than within the living area of the home. Thus, the concentration of vapors present in the living area, where people spend the majority of the time, should be less than in the crawlspace.

Carbon tetrachloride and chloroform are both considered probable human carcinogens. This means that there is evidence for cancer in animals, but there is insufficient evidence of cancer in humans. If a chemical is a probable or known human carcinogen, EPA derives a cancer risk

value for that chemical. EPA uses data from animal studies (and human epidemiology studies, if they are available) to extrapolate from high doses with known carcinogenic end points to very low doses using complex models. Often EPA assumes there is no threshold; that is, any exposure will result in some risk of cancer. This is an assumption that is valid in some cases and not in others, but for most chemicals we lack sufficient data to know the validity of the assumption. EPA then uses one of several models to determine the slope of the 95% upper confidence level of the extrapolated response at low concentrations. This derived slope factor is the number that represents the theoretical risk of excess cancer from exposure to the chemical in question per unit dose (EPA 1992). It is important to note that the cancer risk value is a statistically-derived number representing an upper 95% confidence level of a theoretical straight line predicting one extra cancer case in one million people, when the background lifetime risk of cancer is about one in two for men and one in three for women (ACS 2005). ATSDR has developed a guidance value called a Cancer Risk Evaluation Guide (CREG) that equates to a theoretical risk of one excess cancer in a million people.

Child Health Considerations

Children who live in or visit this house could be exposed to carbon tetrachloride and chloroform via the inhalation pathway. Although children's lungs are usually smaller than adults, children breathe a greater relative volume of air compared to adults. According to environmental literature (ATSDR 1997, 2005; EPA IRIS 2007a), no adverse health effects that are unique to children have been observed from exposure of carbon tetrachloride or chloroform. No effects to the unborn fetus would be expected unless preceded by adverse maternal effects. As stated in the April 2007 report, prudent public health practice dictates that potentially harmful child exposure to carbon tetrachloride or chloroform should be eliminated. At this time, a teenager is the youngest person in the home. Still, house residents change so considerations for protecting children should be maintained.

Mixtures

The scientific literature reports that the liver and kidneys are both affected by exposure to carbon tetrachloride or chloroform (ATSDR 2005b and ATSDR 1997). However, documentation on the health effects of simultaneous multiple chemical exposures, i.e. chemical mixtures, is limited. Mixtures of chemicals may have different effects. No information concerning the simultaneous exposure to carbon tetrachloride and chloroform was located.

Additional Remarks

In May 2005, the outdoor air was measured to contain 0.69 parts per billion (ppb) of carbon tetrachloride and 0.45 ppb chloroform. In February 2007, outdoor air measurements were 0.14 ppb and 0.04 ppb, respectively. The additional air sampling did not provide a correlation for outdoor air concentrations to indoor air concentrations. When comparing the 2005 to 2007 data, the carbon tetrachloride was less outdoors but more indoors while the chloroform value was less outdoors and indoors. This is evidence that indoor air vapor concentrations, or the potential for inhalation exposure, is difficult to quantify through limited, periodic air monitoring. Given that

the indoor air exposure to both carbon tetrachloride and chloroform are chronic exposures, an intervention is preferred to monitoring.

The *Health Consultation: Hardeman County Landfill*, dated April 16, 2007, concluded that vapor intrusion of carbon tetrachloride was a health hazard and vapor intrusion of chloroform was an indeterminate health hazard. The conclusions in this update are similar. What has changed is the addition of a recommendation for action. Continual, periodic indoor air monitoring would likely be required over many years to assure that vapor intrusion was not a chronic health hazard. Therefore, mitigation of vapors that could potentially enter the house should be performed. Vapor mitigation within a crawlspace is a likely option. A vapor mitigation system should remove any potential exposure to either carbon tetrachloride or chloroform for the residents now and in the future.

A site visit with the property owner was done on May, 30, 2007. Staff from EEP, TDEC, ENVIRON, and EPA shared information and answered questions. A written plan for installing a vapor mitigation system into the crawlspace was provided to the property owner. Initial indications were that the vapor mitigation system would be installed during the summer of 2007.

Conclusions

1. A public health hazard exists because of carbon tetrachloride vapor intrusion in indoor air at the Old Toone Road residence near the Hardeman County Landfill site.
2. A public health hazard exists because of chloroform vapor intrusion into indoor air at the Old Toone Road residence near the Hardeman County Landfill site.

Recommendations

1. The Custodial Trust, Le Petomane Three, with TDEC and EPA oversight will install a vapor mitigation system at the residence.
2. Perform additional indoor sampling to ensure that mitigation was successful.

Public Health Action Plan

1. A site visit to share past reports, answer questions, and present a written plan for installing a vapor mitigation system was done with the property owner in May 2007.
2. A vapor mitigation system was installed in the crawlspace of the residence in July 2007.
3. EEP, working with TDEC and EPA, will provide this document and any needed health education to the affected property owner.
4. EEP will provide this public health consultation to the government agencies responsible for oversight of the VCCL to indicating the need to complete proposed actions.
5. EEP is available to review additional data including outdoor ambient air measurements.

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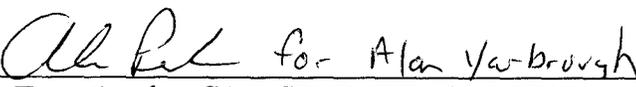
Certification

This Public Health Consultation: *Hardeman County Landfill Update (Velsicol Chemical Corporation), Toone, Hardeman County, Tennessee*, was prepared by the Tennessee Department of Health Environmental Epidemiology 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. Editorial review was completed by the Cooperative Agreement Partner.



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