Public Health Assessment

Public Comment Release

EAST TROY CONTAMINATED AQUIFER

TROY, MIAMI COUNTY, OHIO

EPA FACILITY ID: OHSFN0507962

Prepared by
Ohio Department of Health

MAY 12, 2010

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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

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SUMMARY

Introduction

The Ohio Department of Health (ODH), in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), seeks to assist the Troy, Ohio community by using the best environmental science, providing accurate health information, and taking public health actions to prevent harmful exposures and disease related to toxic substances.

This public health assessment (PHA) is ODH's evaluation of environmental data regarding the contaminated groundwater plumes in the eastern portion of Troy, Ohio to assess past, present, and future impacts on public health. This site, known as the East Troy Contaminated Aquifer, was added to the U.S. EPA's Superfund National Priorities List (NPL) in September 2008. This report is an update of an earlier health consultation completed in July 2008 and reviews the available environmental sampling data collected by Ohio EPA and U.S. EPA regarding the contamination of groundwater, soil and indoor air at the East Troy Contaminated Aquifer site.

Overview

ODH reached two conclusions about the East Troy Contaminated Aquifer site in Troy, Ohio.

Conclusion 1

ODH concludes that aquifer's contaminated groundwater could harm people's health in the future. The reason for this is that the contamination may impact Troy's drinking water supply if actions are not taken to mitigate potential exposures to chlorinated solvents.

Basis for decision

Area groundwater has been contaminated by the chlorinated solvents trichloroethylene (TCE), tetrachloroethylene (PCE) and their degradation byproducts, as documented by Ohio EPA and U.S. EPA. The contaminated groundwater plumes are migrating towards the well fields that supply Troy's drinking water. A breakdown product of TCE and PCE, cis-1,2-dichloroethylene (cis-1,2-DCE), has been detected in the nearest municipal well located within a quarter of a mile from the likely source area. Cis-1,2-DCE, in turn, can degrade into vinyl chloride, a known human carcinogen. Current levels of cis-1,2-DCE (below reporting limits) do not currently pose a health hazard to city residents. The municipal water supply serves about 28,000 people, who could potentially be exposed to contaminated drinking water in the future.

Next steps

The source(s) of the contaminated groundwater plumes need to be fully identified and removed or isolated and contained. The NPL process will be providing more information and ways to best approach all of the contamination associated with the contaminated groundwater plumes based on the results of a remedial investigation and feasibility study (RI/FS) that is set to begin in the fall of 2009.

Conclusion 2

ODH cannot currently conclude whether breathing in volatile organic compounds (VOCs) in the indoor air of untested Troy properties could harm people's health. The information we need to make a decision is not available for the properties that may be affected by vapor intrusion. We are working with the U.S. EPA to gather the additional information needed.

Basis for decision

The indoor air in 16 homes and one school sampled by the U.S EPA in 2006 were found to have levels of PCE and/or TCE above recommended ODH/ATSDR health-based screening levels. These levels were based on a theoretical increased risk of developing cancer from breathing air containing low levels of PCE and/or TCE for 30 years or more. In 2007, the U.S. EPA took action to vent the volatile organic compounds (VOCs) from below the structure slab to above the roof line at 16 residences and a school. Following installation and operation of vapor mitigation systems at these locations, the chemicals of concern were no longer detected in indoor air in these structures. However, the vapor abatement systems are only intended to be a temporary solution. In addition, less than 15% of the homes in the area of concern have been sampled, and it is likely that other homes in this area could be at risk through vapor intrusion with levels of PCE or TCE above health-based screening levels. In order to reach a conclusion, additional sub-slab and indoor air samples in the eastern portion of Troy are needed. More data will become available following the U.S. EPA remedial investigation.

Next steps

The East Troy Contaminated Aquifer site has been placed on the National Priorities List (NPL) of Superfund sites. The U.S. EPA has taken the lead to conduct a Remedial Investigation (RI)/Feasibility Study (FS) under its superfund authority. The source(s) of the VOC plumes need to be fully identified, contained, remediated and/or removed. In the meantime, the U.S. EPA should test more homes in the plume area and provide vapor migration systems for the properties affected by vapor intrusion of volatile chemicals. Follow-up sampling should be done to insure that the systems are reducing contaminant levels to below HAS/ATSDR health-based screening levels.

For more information

For more information about hazardous substances identified in this report, including health effects, please see ODH chemical fact sheets and public health assessments and consultations available on-line at: http://www.odh.ohio.gov *(go to "H" and "Health Assessment Section")* or please see ATSDR ToxFAQs, available at: http://www.atsdr.cdc.gov/toxfaq.html. You may also call ODH at 614-466-1390 for more information on this site.

For information about this site, including site remediation, please see the U.S. EPA site fact sheet available at: http://www.epa.gov/region5superfund/npl/ohio/OHSFN0507962.htm.
For information on EPA's cleanup progress at the East Troy Contaminated Aquifer site, please see: http://cfpub.epa.gov/supercpad/cursites/csitinfo.cfm?id=0507962.

PURPOSE AND HEALTH ISSUES

In June 2006, the Health Assessment Section (HAS) of the Ohio Department of Health (ODH) was asked by the U.S. EPA to assist in evaluating the health impacts of elevated levels of volatile organic compounds (VOCs)in groundwater, soil, and indoor air of residential and commercial properties on the east side of Troy, Ohio. The results of an environmental study funded by the city of Troy indicated the presence of the volatile organic compound tetrachloroethylene (perchloroethylene or PCE) in indoor air samples collected from several public buildings, including the Troy police station, a church, and a school. Ohio EPA requested U.S. EPA assistance to carry out a time-critical removal action in the neighborhood to address these concerns.

With the assistance of the Agency for Toxic Substances and Disease Registry (ATSDR), ODH HAS provided health-based screening levels for indoor air in residential and non-residential buildings to the U.S. EPA and proposed that interim measures be taken at those properties that exceeded the screening criteria to reduce or eliminate exposure to site-related contaminants via the vapor intrusion pathway (HAS/ATSDR 2006). The U.S. EPA sampled 85 homes and businesses in the area in 2006-2007. The U.S. EPA installed vapor abatement systems at 17 locations where screening values were exceeded in June-July 2007; conducted post-installation sampling at all 17 locations; implemented upgrades as necessary, and confirmed that indoor air levels were below ATSDR and ODH indoor air screening levels as of April 17, 2008 (U.S. EPA's completion date). ODH produced a health consultation on July 29, 2008 documenting the vapor intrusion into a number of residences and a school and concluded that until the source(s) of contamination were identified and removed or abated, the site posed a public health hazard to nearby residents in the future (HAS/ATSDR 2008).

The East Troy Contaminated Aquifer site was proposed for addition to the Superfund National Priorities List (NPL) on September 19, 2007 (U.S. EPA 2007), and listed as Final NPL on September 3, 2008 (U.S. EPA 2008c). Because a public health assessment is required at all sites proposed for or listed on EPA's NPL, this public health assessment is an update to the 2008 health consultation and reviews the available environmental sampling data collected by Ohio EPA and U.S. EPA regarding the contamination of groundwater, soil and indoor air at the East Troy Contaminated Aquifer site. HAS makes conclusions and recommendations for additional actions that may be necessary to protect the public health.

BACKGROUND

Site Location and Description

The East Troy Contaminated Aquifer (ETCA) site consists of an area on the east side of Troy, Ohio, along the western bank of the Great Miami River (Figure 1). The site boundaries and all contamination source(s) have not yet been identified. Existing data indicate that the site includes at least a twelve square block area where volatile organic compounds (VOCs) have been identified in groundwater, soils, and indoor air of residential, public and commercial properties (U.S. EPA 2008d). The area includes residential neighborhoods with primarily single-family homes, along with public, commercial and industrial properties. A majority of homes in the area are in excess of 70-years old and are multi-story houses; most with concrete-floored basements. Industrial facilities (Hobart Cabinet, Spinnaker Products) occur to the north along Water Street, adjacent to the Great Miami River. Commercial properties are located primarily to the west towards Market Street and downtown Troy. Two churches, three schools, and a police station are also within the area impacted by the VOC plume. In 2006-2007, the U.S. EPA investigated the vapor intrusion concerns in a 24-block portion of the city east of Market Street, south of the Great Miami River, west of Williams Street, and north of Race Drive.

Impacted Community and Resources

The area affected by vapor intrusion identified previously by the U.S. EPA had a population of 1,263 living in 548 housing units (HAS 2008). About 12,400 people reside within a one-mile radius of the site (U.S. Census Bureau 2000). Over 400 residences in the plume area were notified by U.S. EPA of the vapor intrusion concerns in 2006. However, only about 15% of the total agreed to allow U.S. EPA access to conduct sub-slab and indoor air sampling. Of a total of 85 locations tested from July 2006 through April 2007, 16 residences and one school (20% of the total) were affected by the migration of volatile chemicals from soil and groundwater into the indoor air of these structures.

The City of Troy uses ten (10) production wells to draw water from sand and gravel aquifers underlying the Great Miami River: five (5) wells in the East Well Field and five (5) wells in the West Well Field. The groundwater flow direction is from southwest to northeast toward the Great Miami River. The contaminated ground water plumes have detections of TCE and PCE at levels greater than the EPA's drinking water standard or maximum contaminant level (MCL) of 5 parts per billion (ppb). These plumes are migrating towards the well fields that supply Troy's drinking water. A contamination byproduct, cis-1,2-dichloroethylene (cis-1,2-DCE), has been detected in two municipal wells located within a quarter mile from the site in the East Well Field. Overall, the municipal water supply serves about 28,000 people primarily living in the City of Troy who could potentially be exposed to contaminated drinking water.

Area Geology and Hydrogeology

The area of concern is located on the level floodplain of Great Miami River. Groundwater-bearing sands, gravels, and clays fill a buried bedrock valley under the river and adjacent portions of the city to depths in excess of 140 ft. Groundwater from these floodplain sand and

gravel deposits serves as the primary source of drinking water for the city and its residents. City public water supply wells are located on the north side of the Great Miami River, within a 1,000 ft of the identified groundwater contamination area. City water wells draw groundwater from sand and gravel at depths of between 80 and 125 ft below the ground surface. Individual water wells can pump up to 2,100 gallons of water per minute (ODNR well logs, 2007). All of the residents in the area of concern get their drinking water from the city of Troy public water supply (city of Troy, pers. comm. 2006). Cis-1,2 DCE and TCE have been detected in the City of Troy east municipal well field since 1988 (U.S. EPA. 2008b). Groundwater flow in the area is naturally to the southeast, following the course of river. However, groundwater pumping by the city's water wells and high-yield industrial production wells in the area may alter groundwater flow locally, pulling the groundwater to the north towards the individual wells and the well field.

In the vicinity of the city of Troy well field, the depth to the groundwater surface is only 11 to 15 ft below the ground surface (ODNR well logs, 2007). Ohio EPA (pers. comm., 2006) indicated that water table in the vicinity of Franklin and Clay Streets, on the south side of the Great Miami River, was between 15 and 17 ft below the ground surface. The intervening soils usually consists of a thin layer of topsoil (less than 2 ft thick) and a clay layer of variable thickness (0 - 12 ft thick) followed by highly porous and permeable sand and gravel down to the water table (ODNR well logs, 2007). The floors of most basements in area homes appear to penetrate the upper clay layer and extend into the underlying sand and gravel layer.

Ohio EPA Groundwater Investigation

The Ohio EPA conducted groundwater monitoring in 2002, 2003 and 2004 to determine if groundwater contaminants posed a threat to water quality in the well field. Groundwater sample results indicated that the aquifer was contaminated with tetrachloroethylene (perchloroethylene or PCE). PCE concentrations were greater than 800 parts per billion (ppb) in groundwater along Franklin Street and greater than 40 ppb in groundwater along Water Street (Figure 2).

In 2006, the Ohio EPA completed soil-gas and monitoring well sampling along Franklin and Main Streets on the city's east side. PCE levels were found to be as high as 801 ppb in groundwater and as high as 58 ppb in soil-gas in soils under residential yards along Franklin Street (Figure 3, Ohio EPA 2006).

Ohio EPA requested U.S. EPA assistance in conducting an assessment of the East Troy plume site to determine the extent of vapor intrusion under the neighborhood and, as part of a Time-Critical Removal Action, to mitigate impacted homes, schools and businesses.

U.S. EPA Soil Gas/Indoor Air Investigation

From July through September 2006, as part of the Time-Critical Removal Action, U.S. EPA collected sub-slab and indoor air samples from the east Troy residential area near Franklin Street in order to determine the extent of vapor intrusion under area homes, schools and businesses. Vapor intrusion is the movement of volatile chemicals and gases from soil and groundwater into the indoor air of homes and commercial buildings. A total of 19 locations were sampled, including 14 residential locations, 3 schools, a church, and the City of Troy Police Station.

Along with representatives of the U.S. EPA and the Ohio EPA, HAS staff met individually with residents and representatives of St. Patrick's Church and Troy City Schools to discuss their sub-slab and indoor air sampling results at Troy City Center on August 24, 2006. HAS presented information on the toxicology of PCE and answered health-related questions.

HAS participated in a public meeting hosted by the U.S. EPA on October 25, 2006 at the Van Cleve School. The U.S. EPA updated residents on its investigation of chemical pollution underneath sections of Troy, Ohio and offered free sampling to the residents of the neighborhood. HAS presented information on PCE, the chemical of concern, and its toxicology and answered health-related questions from the audience. Further expanding the vapor intrusion investigation, the U.S. EPA sent letters to 400 residents in December 2006, asking for access to conduct sub-slab and indoor air sampling. About 60 more residents, or about 15% of the total, agreed to allow access for the sub-slab and indoor air sampling. It must be emphasized that the testing was voluntary, dependent upon the owner, who can consent or deny access to the residence. As part of the investigation, the U.S. EPA required a signed access agreement to enter a residence and collect samples.

From July 2006 through April 2007, U.S. EPA collected sub-slab and indoor air samples from a total of 85 locations, which included 78 residences, 2 churches, 4 schools and the Troy Police Station during Phase 1 and Phase 2 sampling activities. All owners of properties with elevated indoor air levels (16 residential locations and one elementary school – see table below and Figure 4) were contacted with regard to their results. HAS attended several meetings with impacted residents conducted by the U.S. EPA in February 2007 and May 2007 to explain sample results, answer health questions, and discuss the installation of the proposed sub-slab vapor abatement systems.

U.S. EPA Removal Action

The U.S. EPA, HAS and Ohio EPA met with 16 property owners and school representatives on May 31, 2007 with a plan to design and install a vapor abatement system (VAS) at each location. HAS staff were available to answer health questions from owners. Property owners and school representatives signed agreements with U.S. EPA for the VAS installation.

Vapor abatement systems were installed at 16 residences in June-July 2007, and a multi-unit vapor abatement system was installed in the St. Patrick's school July 9-17, 2007. The school's system went into operation July 17 and following consultations with HAS, 10-day confirmation samples were collected for the sub-slab gas and indoor air in the school on July 25, 2007. Preliminary results from the confirmation sampling were received by HAS on July 31, 2007 and indicated that the system was working. Results indicated that sub-slab levels of PCE had been reduced from 230 ppb to 2.3 ppb. Indoor air levels for the solvents PCE and trichloroethylene (TCE) were at undetectable levels. School was scheduled to start back up by the middle of the month. HAS provided the school staff with a draft letter they could use to communicate the results of the system operation to parents prior to the start of the school year. HAS staff participated in a meeting Friday August 3, 2007 between U.S. EPA, its contractors, and representatives of the St. Patrick's advisory board to discuss the results of the installation and subsequent operation of the vapor abatement system in the St. Patrick Elementary School.

Most of the impacted residences also showed reductions in PCE and TCE after installation of the vapor abatement systems. However, six of the residences still exceeded HAS/ATSDR screening levels one month after installation of the vapor abatement systems. The contractor added dampers to draw basement air for some residences and increased fan size in others in order to reach screening level requirements. One of these homes had holes in the floor and a sub-slab sample had not been taken. Additional system upgrades were required for four residences in October 2007 and again in January and February 2008. All 16 residences were in compliance (no indoor air exceedances of ATSDR/HAS screening levels) by April 2008. The indoor air quality at the St. Patrick School has remained in compliance since July 2007 (U.S. EPA 2008a).

Chemicals Detected in Indoor Air from 17 Locations in Troy, Ohio

Chemical	*Range of Detections (ppb)*	*Average (ppb)*	*Frequency of Detections*[1]	*# Above Comparison Value*	*Comparison Value (ppb)*
PCE	1.3 – 22	5.5	14/17	14	1.2
TCE	0.51 – 1.3	0.9	4/17	4	0.4

Source: EPA 2007

ppb = parts per billion
PCE – Perchloroethylene, also known as tetrachloroethylene
TCE – Trichloroethylene
1 – Out of a total number of buildings in which systems were installed.

NPL Site Listing and Document Record

The U.S. EPA proposed the East Troy Contaminated Aquifer site for addition to the Superfund National Priorities List (NPL) on September 19, 2007 (U.S. EPA 2007) and added it to the Superfund NPL on September 3, 2008 (U.S. EPA 2008c). Adding the site to the NPL allows the U.S. EPA to study site conditions further, identify possible sources of the contamination, and develop a comprehensive strategy to address all locations and sources of the VOC contamination. In their Hazard Ranking System (HRS) Documentation Record, U.S. EPA speculates that there are at least two sources of contamination in the impacted area:

Source 1 – A contaminated soil source under the Spinnaker property due to previous TCE releases. Soil was removed at the Spinnaker property in 1995, but soil samples collected in 2005 indicated about 9,000 square feet of soil contamination. One hundred and twenty-nine soil samples from 41 soil borings were analyzed at this site. Analytical results show the presence of chlorinated chemicals and are summarized below:

Chemicals Detected in Soil at Source 1 – Contaminated Soil Source Area

Chemical	*Range of Detections (ppb)*	*Average (ppb)*	*Frequency of Detections*	*Frequency Above Comparison Value*	*Soil Screening Level* (ppb)*
PCE	10.4 – 931	146	57/134	57	2.4
TCE	68.6 – 133,000	3950	65/134	65	1.9
cis-1,2-DCE	6.1 – 14,900	1690	12/134	11	21

Source: U.S. EPA HRS Documentation Record 2008

*MCL-based Protection of Groundwater Soil Screening Level (SSL) from Master Table April 2009
ppb – parts per billion
PCE – Tetrachloroethylene
TCE – Trichloroethylene
Cis-1,2-DCE – Cis-1,2-dichloroethylene

Source 2 – A PCE plume with no identified source located upgradient and underneath the Spinnaker property (U.S. EPA 2008b). The chemicals detected include tetrachloroethylene (PCE), trichloroethylene (TCE), cis-1,2-dichloroethylene (cis-1,2-DCE), and vinyl chloride (VC). The contaminated well information is summarized below:

Chemicals Detected in Wells at Source 2 – Contaminated Plume

Chemical	*Range of Detections (ppb)*	*Average (ppb)*	*Frequency of Detections*	*Frequency Above Comparison Value*	*MCL (ppb)*
PCE	ND – 78	21	9/25	6	5
TCE	ND – 34	6	11/25	3	5
cis-1,2-DCE	ND – 69	16	14/25	0	70
Vinyl chloride	ND – 6.6	3	3/25	1	2

Source: U.S. EPA HRS Documentation Record 2008

ppb – parts per billion or micrograms per liter
MCL – Maximum Contaminant Level for drinking water (EPA)
PCE – Tetrachloroethylene
TCE – Trichloroethylene
Cis-1,2-DCE – Cis-1,2-dichloroethylene

U.S. EPA Remedial Investigation and Feasibility Study (RI/FS)

Once the ETCA site was placed on the NPL, the U.S. EPA has taken the lead to conduct a Remedial Investigation (RI) and Feasibility Study (FS) of the site under its Superfund authority. The purpose of the RI is to collect data necessary to determine the type and extent of contamination at a site and assess risk. A FS is a process for developing, evaluating, and selecting a remedial action. The RI/FS currently underway and will allow U.S. EPA to determine the type and extent of contamination at the site and the best way to clean up this environmental contamination.

DISCUSSION

Chemicals of Concern

The primary contaminants of concern at the Troy site include tetrachloroethylene, also known as perchloroethylene (PCE) and trichloroethylene (TCE). Other volatile organic compounds also present include cis-1,2-dichloroethylene (cis-1,2-DCE) and vinyl chloride (VC). These latter chemicals are the products of the breakdown of PCE and TCE in the environment.

Potential Exposure Pathways

For the public to be exposed to elevated levels of chemical contaminants in and around the Troy site, they must first come into contact with the contaminated groundwater, soils or air. To come into contact with the contaminated media, there must be a completed exposure pathway. A completed exposure pathway consists of five main parts, all of which must be present for a chemical exposure to occur.

A **completed exposure pathway** consists of five main parts:

1. **A source of contamination**;
2. **Environmental transport**, which is a way for the chemical to move away from its source (soil, air, groundwater, surface water);
3. **A point of exposure**, which is a place where people come into physical contact with the chemical (on-site, off-site);
4. **A route of exposure**, which is how people come into physical contact with the chemical (breathing, drinking, eating, touching); and
5. **People who could be exposed**, which are people likely to come into physical contact with site-related chemicals.

Physical contact with a chemical contaminant does not necessarily result in adverse health effects. A chemical's ability to affect a resident's health is also controlled by a number of factors including:

- How much of the chemical a person is exposed to (dose).
- How long a person is exposed to the chemical (duration).
- How often a person is exposed to the chemical (frequency).
- The toxicity of the chemical of concern (how a chemical affects the body).

Other factors affecting a chemical's likelihood of causing adverse health effects upon contact include the resident's:

1. Past exposure
2. Smoking, drinking alcohol, or taking certain medications
3. Current health status, sensitivity to certain substances
4. Age
5. Family medical history

Exposure Pathways

Groundwater Pathway

The East Troy Contaminated Aquifer site consists of at least two distinct groundwater plumes, which are moving toward the City of Troy's municipal wells, which serve approximately 28,000 people. Cis-1,2-DCE, a breakdown product of PCE, has been detected in two municipal wells (PW-14 and PW-18) located within 0.25 to 1 mile of the site. The concentrations of cis-1,2-DCE are estimated and below the reporting limit (less than 1 µg/L or 1 ppb). The U.S. EPA has established a maximum contaminant level (MCL) of 70 ppb for cis-1,2-DCE in drinking water. The plume has the potential to directly impact the public drinking water supply, but current levels of cis-1,2-DCE do not currently pose a health hazard to city residents.

Vapor Intrusion Pathway

PCE and TCE are volatile organic compounds (VOCs). VOCs are chemicals that can vaporize from contaminated groundwater or soil and migrate as a gas to the indoor environment of nearby buildings.

Vapor intrusion is the movement of volatile chemicals and gases from soil and groundwater into the indoor air of homes and commercial buildings. Factors that favor the transport of these chemicals at the Troy site include: 1) elevated concentrations of PCE in groundwater and soil gas underlying residential and commercial portions of the city of Troy, 2) shallow depth to the groundwater table, and 3) intervening porous and permeable soils that readily facilitate movement of vapor-phase solvent up from underlying groundwater.

Access to 85 locations provided the collection by U.S. EPA of sub-slab and indoor air samples at 78 homes, 2 churches and 4 schools and the Troy Police Station (U.S. EPA 2008a). Figure 4 shows the U.S. EPA indoor air sampling locations at the Troy plume site and marks those locations with PCE or TCE concentrations that were above long-term screening levels. Sixteen homes and one school had levels of PCE and/or TCE above long-term screening levels in 2006-2007. All of these structures received vapor abatement systems (see Vapor Intrusion Fact Sheet) from U.S. EPA in 2007. Post-installation confirmation sampling conducted at these homes and the school indicated levels of PCE and TCE in these structures were below levels of health concern.

It is unknown how long the contamination has existed under the impacted neighborhood or whether or not residents were being exposed to these chemicals in the past by the vapor intrusion pathway. The source(s) of contamination are currently unknown. The aquifer was confirmed to be contaminated based on a report completed in 2002. Elevated levels of PCE were indicated in the soil gas in the residential area in 2006 (Ohio EPA 2006).

The indoor air pathway was determined to be complete and pose a public health hazard to nearby residents (HAS and ATSDR 2008). Only about 15% of the homes in the area were sampled and only a few received vapor abatement systems. It is likely that other nearby homes could be affected by the vapor intrusion pathway.

Health Evaluation

Tetrachloroethylene (PCE)

Discussion

Tetrachloroethylene (also known as perchloroethylene, PCE or PERC) is a nonflammable liquid at room temperature and is widely used for dry cleaning of fabrics and for metal degreasing. Other major uses of PCE are as a solvent in some consumer products and as a building block to make other chemicals. It evaporates easily into the air and has a sharp, sweet-smelling odor. At levels in excess of 1 part PCE per million parts of air (1 ppm or 1,000 ppb), PCE's distinctive odor can be smelled by most people. Much of the PCE that gets into surface water and soil evaporates into the air. In the air, it is broken down by sunlight into other chemicals or brought back to the soil and water by rain. Because PCE can travel through soils quite easily, it can make its way into underground water, where it may remain for a long time. Under oxygen-poor conditions and with time, bacteria will break down some of the PCE that is in soil and groundwater, leading to the formation of breakdown products, including 1,2-dichloroethylene and vinyl chloride. PCE in the environment is found most frequently in the air and less often in drinking water. It does not appear to bioaccumulate in fish or other animals that live in water. People are typically exposed to PCE from occupational sources, consumer products, and environmental sources (see Appendix B Fact Sheet for PCE).

Ohio EPA investigations show that the groundwater in the general area of concern in Troy is contaminated with PCE, along with TCE and associated degradation byproducts. Cis-1,2-DCE has been detected in two municipal wells, PW-14 and PW-18, located across the Great Miami River to the northeast of the plume areas (U.S. EPA 2008b).

Public Health Assessment

Acute Effects

ODH and ATSDR recommended 200 ppb as a level requiring an immediate response action to reduce exposures to PCE in the indoor air (HAS/ASTDR 2006). This level is the ATSDR acute minimal risk level (MRL), based on protection from neurological effects associated with acute (short-term) exposure to PCE.

A MRL is an estimate of daily human exposure to a substance that is not expected to cause non-cancer health effects during a specified duration of exposure.

A health consultation conducted by HAS found that PCE concentrations in East Troy homes, schools and businesses do not pose a short-term health threat to the residents (HAS/ATSDR 2008). The levels of PCE detected in the indoor air of the basements of Troy are in the low part per billion (ppb) range (less than or equal to 22 ppb) and no non-cancer health effects are expected.

Chronic Effects (Noncancer)

Animal studies have reported effects on the liver, kidney, and central nervous system (CNS) from chronic inhalation exposure to PCE. ATSDR has calculated a chronic-duration inhalation minimal risk level (MRL) of 40 ppb for PCE based on neurological effects in humans.

The levels of PCE detected in the indoor air of the basements of Troy are in the low ppb range (up to 22 ppb PCE) and are below the chronic MRL (40 ppb).

Cancer Risk

PCE's classification as a human carcinogen is under review by the U.S. EPA. Although exposure to PCE has not been directly shown to cause cancer in humans, the U.S. Department of Health and Human Services has determined that PCE may reasonably be anticipated to be a carcinogen (National Toxicology Program, 2005). The International Agency for Research on Cancer (IARC) has classified PCE as a Group 2A carcinogen (IARC, 1995); probably carcinogenic to humans (limited human evidence, sufficient evidence in animals).

PCE tends to be retained in the body for a longer period of time than TCE, having limited ability to accumulate in fatty tissues (NIOSH, 1976; 1978). Several studies of workers at dry-cleaning businesses have suggested associations between the development of elevated occurrence of urinary tract, kidney, and cervical cancers and chronic exposures to high levels (parts per million range) of PCE and other dry-cleaning chemicals in the air at their places of work (Katz and Jowett, 1981; Brown and Kaplan, 1987). These studies were confounded by the presence of carbon tetrachloride, TCE, and several petroleum-based solvents, in addition to PCE, in these indoor air environments.

The Woburn, Massachusetts study (Lagako et al., 1984), the New Jersey study (Fagliano et al., 1990), and ATSDR studies of PCE and TCE contaminated water supplies at the Camp Lejuene Marine base (ATSDR, 2003) have associated exposure to these chemicals through ingestion of contaminated water with increased levels of leukemia in specific populations within these communities.

In a letter dated September 11, 2006 to the U.S. EPA, ATSDR and ODH recommended 1.2 ppb as a screening level for residential indoor air for PCE. The 1.2 ppb screening level would apply to homes and schools. For building spaces that are not used for residences or where children are not continuously present, such as churches, commercial businesses and public buildings; then the recommended screening level for PCE for indoor air was 5 ppb. The levels for PCE were derived from target concentrations listed in the U.S. EPA "OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), 2002," based on a calculated 10^{-5} theoretical cancer risk (HAS/ATSDR 2006).

Theoretical cancer risk due to exposure to PCE in indoor air in the homes of Troy was calculated to range from 1×10^{-5} or 1 in 100,000 to 2×10^{-4} or 2 in 10,000, based on an exposure of 24 hours a day, 350 days/year for 30 years. The true risk is likely to be far less, considering that most people do not live in their basements and that exposure would usually be more intermittent. Of the residences and public buildings tested, 13 homes and one school (St. Patrick School) had exceeded the recommended 1.2 ppb health-based screening level for PCE and received sub-slab vapor abatement systems. Three other homes and the school exceeded the long-term screening level for TCE (HAS/ATSDR 2008).

> Theoretical cancer risk can be defined as the number of additional cases of cancer in a population, usually written as a negative power of 10. For example, one additional case of cancer per one hundred thousand individuals is written as $1x10^{-5}$.

Trichloroethylene (TCE)

Discussion

The primary use of trichloroethylene has been the degreasing of metal parts and its use has been closely associated with the automotive and metal-fabricating industries from the 1950's through the 1970's. It is an excellent solvent for removing greases, oils, fats, waxes, and tars. As a solvent it was used alone or blended with other solvents, such as PCE. These solvents were also added to adhesives, lubricants, paints, varnishes, paint strippers, pesticides, and cold metal cleaners. When in surface soils, TCE will form a gas faster than many other volatile organic compounds. It has been shown that the majority of the TCE spilled on top of soils will vaporize into the air. When TCE is released into the air, it reacts relatively quickly with other chemicals with about half of it breaking down to simple chemical compounds in about a week. TCE sorption to soil is largely dependent on the organic carbon content of the soil, as soils with a higher organic carbon content tend to more effectively adsorb the TCE. TCE is known to be only slightly soluble in water, but there is ample evidence that dissolved TCE remains in groundwater for a long time. Studies show that TCE in water will rapidly form a gas when it comes into contact with air. In a sand and gravel aquifer, TCE in the groundwater would rapidly vaporize into the air spaces between soil grains above the water table. Studies indicate that it would then disperse by two primary routes; first, diffusion through the soil air spaces and then be re-adsorbed by groundwater or infiltrating rainwater, or second, it would migrate to the surface and be released to the atmosphere. The primary means of degradation of trichloroethylene in groundwater is by bacteria, but the breakdown product by this means is vinyl chloride, a known human carcinogen that potentially can be more of a health concern than TCE (Vogel and McCarty, 1985).

Public Health Assessment

Acute Effects

ATSDR has established a 2,000 ppb acute MRL for TCE. The levels of TCE (up to 1.3 ppb TCE) detected in the indoor air of the basements of Troy do not pose a short-term health threat to the residents (HAS/ATSDR 2008).

Chronic Effects (Noncancer)

ATSDR does not have a chronic-duration inhalation minimal risk level for TCE; however, ATSDR has established a 100 ppb MRL based on protection from neurological effects to intermediate exposure (15-365 days) to TCE. The intermediate ATSDR value of 100 ppb has been used by HAS as a "short term action level" that would trigger immediate action to reduce exposure levels in homes affected by vapor intrusion. The indoor air levels of TCE detected in Troy were in the low ppb range (up to 1.3 ppb TCE) and no non-cancer adverse health effects are expected at these levels (HAS/ATSDR 2008).

Cancer Risk

TCE was most recently classified by the U.S. EPA as a B2 carcinogen – a probable human cancer-causing agent. However, the cancer classification of TCE has been withdrawn and is currently under review by U.S. EPA. IARC has classified TCE as: *probably carcinogenic to humans (Group 2A).*

Occupational exposure to high levels TCE in the air, based on the analysis of seven workplace studies, was associated with excess incidences of liver cancer, kidney cancer, non-Hodgkin's lymphoma, prostate cancer and multiple myeloma, with the strongest evidence for the first three cancers (NTP 2005). Agreement between animal and human studies supports the conclusion that TCE is a potential kidney carcinogen. High doses are needed to induce liver toxicity and cancer in animals; however differences in the mode of action of the major metabolites in humans suggest that humans would be less susceptible to liver cancer than these laboratory animals (NAS 2006).

The health effects from drinking and inhaling low levels of TCE (in the single or double digit ppb range) over long periods of time remain poorly-documented and controversial (ATSDR 1997b).

A study of residents in Woburn, Massachusetts associated excessive cases of acute lymphocytic leukemia in male children with their mothers' exposure to elevated levels of TCE (183 – 267 ppb) in a public drinking water well over a course of 5 to 10 years (Lagako et al., 1984). The impacted well also contained low levels (<50 ppb) of PCE, 1,2-DCE, and chloroform. Statistically significant excess leukemia cases in females were associated with residents exposed to TCE and other chemicals in their drinking water supply in New Jersey (Fagliano et al., 1990). A health study conducted by ATSDR (2003) of birth defects and childhood leukemia in children born to parents stationed at Camp Lejeune Marine base between 1975 and 1988 linked an increased incidence of these adverse health effects to the parents' exposure to high levels of TCE (up to 1,400 ppb), PCE (up to 407 ppb), and 1,2-DCE (up to 215 ppb) in the base public drinking water supply (ATSDR 2003). Further investigations of the Camp Lejuene exposures are being carried out by ATSDR.

In contrast, consecutive surveys of self-reported health effects from over 4,000 residents at 15 sites in five states exposed to TCE through their drinking water supplies (of levels of 3 to 24,000 ppb) for varying periods of time (7-20 years) failed to link these exposures with the development of excess cancer cases. Non-cancer health effects tentatively linked to these exposures included an increased incidence of strokes, increased incidence of diabetes, some increased incidence in liver and kidney disease, and urinary tract disorders (ATSDR, 1999).

A TCE concentration of 0.4 ppb was used as a screening level for residential indoor air, based on a calculated theoretical cancer risk of 1 in 10,000 (10^{-4}). The levels for TCE were derived from target concentrations listed in the U.S. EPA 2002 OSWER Draft Vapor Intrusion Guidance, based on an adult residential exposure scenario that assumes exposure of an individual for 24 hours per day for 350 days per year over a period of 30 or more years. A target concentration of 0.04 ppb, based on a 10^{-5} theoretical cancer risk, was below the laboratory's minimum detection limit; therefore, a concentration of 0.4 ppb, representing a 10^{-4} cancer risk, was recommended as the long-term screening level for TCE in indoor air.

The theoretical cancer risk due to exposure to TCE in indoor air in the homes of Troy was calculated to range from 1×10^{-4} or 1 in 10,000 to 2×10^{-4} or 2 in 10,000. The true risk is likely to be less, considering that exposure would usually be more intermittent. Further, other estimates of cancer risk may be lower due to the use of less conservative inhalation unit risk factors, which

serve as an indication of the carcinogenicity of a substance. Three homes and the St. Patrick School in Troy, Ohio exceeded the long-term screening level for TCE (0.4 ppb) and received sub-slab mitigation systems (HAS/ATSDR 2008).

1,2-Dichloroethylene (1,2-DCE)

Discussion

1,2-Dichloroethylene (1,2-DCE), also called 1,2-dichloroethene, is a highly flammable, colorless liquid with a sharp, harsh odor. There are two forms of 1,2-dichloroethylene: cis-1,2-dichloroethylene and trans-1,2-dichloroethylene. Industrial quantities of 1,2-dichloroethylene are used to produce other chlorinated solvents and compounds. The odor threshold in air is about 17,000 parts per billion. The presence of 1,2-dichloroethylene in groundwater is most likely due to the biodegradation of other more highly chlorinated compounds tetrachloroethylene and trichloroethylene present in groundwater (ATSDR 1996). Groundwater samples (March 2007) have shown that cis-1,2-DCE was detected at estimated concentrations (less than 1 ppb) in two Troy municipal wells, PW-14 and PW-18 (U.S. EPA 2008b).

Public Health Assessment

Acute Effects

The levels of cis-1,2-DCE detected in East Troy do not pose a acute (immediate, short-term) health threat to the residents. Cis-1,2-DCE, a biodegradation product of PCE and TCE, was detected at levels below the reporting limit (less than 1 ppb) in drinking water. The U.S. EPA has established a maximum contaminant level (MCL) of 70 ppb for cis-1,2-DCE in drinking water. ATSDR has established a minimal risk level (MRL) for cis-1,2-DCE of 1 mg/kg/day for acute oral exposure, based on hematological (related to the blood and blood forming organs) effects and a no-observed-adverse-effect level (NOAEL) of 97 mg/kg/day.

Chronic Effects (Noncancer)

ATSDR does not have a minimal risk level for chronic (one year or more) exposure to cis-1,2-DCE. However, ASTDR has established a MRL of 0.3 mg/kg/day for intermediate (15-365 days) exposure, based on a hematological study. HAS and ASTSR have established a long-term screening level of 8.8 ppb for cis-1,2-DCE in residential indoor air, taken from OSWER Vapor Intrusion Guidance and based on non-cancer effects (U.S. EPA 2002).

The levels of cis-1,2-DCE in Troy drinking water (below reporting limits) are not expected to harm people's long-term health because the concentrations are below the maximum contaminant level of 70 ppb. Samples taken by a City of Troy consultant did not detect cis-1,2-DCE in the indoor air from the basements of a church school or police station in January 2006. Cis-1,2-DCE was also not detected in the soil gas samples taken by Ohio EPA at the Troy site and analyzed in January 2006.

Cancer Risk

The U.S. EPA has given cis-1,2-DCE a "not classifiable" rating (D) as to its ability to cause cancer, since cancer effects have not been studied in humans or animals. NTP and IARC do not have classifications for this chemical.

Mixture Assessment

Exposures to mixtures of both tetrachloroethylene and trichloroethylene are likely to be additive in nature in producing nervous system effects or noncancer and cancer kidney or liver effects (ATSDR 2004). However, TCE was not detected in most residences in Troy where PCE was the major contaminant of concern.

HEALTH OUTCOME DATA

In addition to evaluating exposure and substance-specific toxicological information, ODH may review available health outcome data, such as the number of reportable diseases or deaths in a community, as part of the public health assessment process.

An evaluation of health outcomes is reasonable if there is:
1) A current (or past) completed or potential exposure pathway.
2) A way to know the levels and length of exposure.
3) An identified exposed population.
4) Sufficient exposure to result in plausible health effects.
5) Information available at the geographic level necessary to compare to the exposed population.
6) A database on the health outcomes of interest likely to occur from exposure.

ODH identified a completed exposure pathway via vapor intrusion route at the East Troy Contaminated Aquifer site. Seventeen residential and school locations exceeded the long term health-based screening levels for PCE and/or TCE in indoor air. However, no long or short term non-cancer health effects are known to occur at the low ppb-levels measured in homes in east Troy. The theoretical increase in cancer risk due to exposure to the highest levels found for PCE or TCE in indoor air was estimated to be about two additional cases of cancer in 30 years of exposure per ten thousand individuals (2 in 10,000). Based on the site area defined by the U.S. EPA time-critical removal, the number of people potentially affected by vapor intrusion was 1,263 (HAS/ATSDR 2008). This number of people is not sufficient to measure one additional case of cancer per 10,000 individuals, usually used as a health guideline.

The ODH's Ohio Cancer Incidence Surveillance System (OCISS) and the Ohio State University (OSU) Comprehensive Cancer Center have compiled a series of county-level profiles of cancer incidence, mortality, stage at diagnosis, and cancer-related health behaviors. The profiles include cancer incidence rate information at the census track level. The census track which includes the plume area in the eastern portion of Troy in Miami County, Ohio, is Census Tract 3652, which has a total population of about 3,900 and includes an area south of the of the east Troy area (U.S. Census Bureau 2000). This census tract, has one of the highest average annual (1996-2005) rates in Miami County for cancers of the lung and bronchus, but low incidence rates of colon and rectum cancer, female breast cancer, and prostate cancer. Exposure to PCE and TCE has not been linked with lung cancer. However, smoking is strongly associated with lung cancer, and Miami County has a higher self-reported percentage (23.7%) of people who smoke compared to the rest of Ohio. The diseases potentially linked to PCE and TCE exposures are liver and kidney cancers, which are available in this profile only at the county level, which may not be useful for comparison to a smaller geographical area. The reported cases for these types of cancer are few in number and the county-wide incidence and mortality rates are similar to those reported for all of Ohio and the United States (ODH 2008). Based on the criteria above, there is not sufficient exposure to cause non-cancer health effects or a measureable increase in cancer rates to warrant a separate health study for the population on the east side of Troy.

In Ohio, about one of three people will develop cancer in their lifetime, so every Ohio community is affected by cancer. More information regarding the county profile is available at: http://www.odh.ohio.gov/odhPrograms/dis/ociss/ci_surv1.aspx.

COMMUNITY HEALTH CONCERNS

ODH and ATSDR identified a few community members' concerns through public meetings, individual meetings with affected residents and local authorities, and correspondence from past residents for this site. Following are ODH's responses to the community concerns that were expressed most frequently or to a specific question from an individual regarding this site.

1. **Where do Troy residents get their drinking water and it is affected by the PCE plume?**

   The City of Troy obtains its drinking water from two municipal well fields: five wells in the East Well Field and five wells in the West Well Field. These wells, located near the Great Miami River at the Miami Shores Golf Course and at the Troy Municipal Park, have depths ranging from 44 to 132 feet. Well water is pumped to the water treatment plant where it is treated, disinfected, and filtered, prior to being pumped to consumers. The city's water system is susceptible to contamination because the wells are located at shallow depths in permeable sand and gravel deposits. Any surface spill of solvents or other hazardous chemicals can percolate through the permeable sand and gravel soils and contaminate groundwater. In eastern Troy, the contaminated ground water plumes are moving northeast toward the East Well Field (see Figure 1). The City of Troy routinely tests its water and uses monitoring wells as an early warning system and to study groundwater quality upgradient of the aquifer area under the municipal wells. Currently, PCE is not in the municipal well field water and the water is safe to drink.

2. **How are Troy residents exposed to this plume and how long has this been going on?**

   In Troy, people can be exposed to volatile organic compounds (VOCs) like PCE by breathing in vapors that have entered their homes and buildings through vapor intrusion. In this process, vapors migrate from PCE-contaminated groundwater, move to the surface, and enter buildings through basement or foundation cracks, holes and pipes. Concentrations are usually highest in basements, especially when the basements are not vented. People become exposed to PCE by inhaling the vapors that have entered these buildings. Since the sampling of homes and buildings in Troy only began in the last few years and the source(s) of the contamination are unknown, it is difficult to say when exposures first occurred in the past. In order to assess current exposures to VOCs, more information is needed, including additional sub-slab and indoor air samples from residences in the eastern portion of Troy. More data will become available following the U.S. EPA remedial investigation.

3. **Several of our family members who spent their childhoods in east Troy in the 1950's - 1970's now have a specific type of lung cancer. Could this be due to exposure to the VOC plume in Troy?**

   This question was responded to by ATSDR's Region V Medical Officer, and the response, in part, follows:

   "Although PCE has not been shown to cause cancer in people, the International Agency for Research on Cancer classifies PCE as a probable human carcinogen. The Department of Health and Human Services (DHHS) has also determined that PCE may reasonably be

anticipated to be a cancer causing agent. Results of animal studies, performed at high doses, revealed that PCE can cause liver and kidney tumors and leukemia in animals. Some epidemiologic studies of workers exposed to PCE have found increases in the incidence of esophageal, urinary bladder, and cervical dancers and non-Hodgkin's lymphoma. An increased frequency of liver cancer and leukemia has not been found in workers. No reports could be found about a relationship between PCE and small cell lung cancer.

Small cell lung cancer makes up about 10-15% of the new cases of lung cancer each year. Thus, of the 175,000 new cases of lung cancer diagnosed each year, approximately 20,000 would be classified as a type of small-cell lung cancer. The cause of small cell lung cancer is almost exclusively believed to be tobacco smoke. Another risk factor for lung cancer is a family history of lung cancer. It is believed that individuals inherit a predisposition to small cell carcinoma such as the inability to adequately repair damaged DNA, suppress the growth of cancer, and the inability to detoxify cancer-causing chemicals.

Thus, from what is known about small cell carcinoma and on tetrachloroethylene, there does not appear to be a relationship between them." (ATSDR 2006)

CHILD HEALTH ISSUES

Children can be at a greater risk of developing illness due to exposure to hazardous chemicals because of their smaller stature and developing body systems. Children are likely to breathe more air and consume more food and water per body weight than are adults. Children are also likely to have more opportunity to come into contact with environmental pollutants due to being closer to the ground surface and taking part in activities on the ground such as, crawling, sitting, and lying down on the ground.

Children's exposures and public health implications were considered in this evaluation. As a result of special concerns with regard to children's exposures, a multi-unit vapor extraction system was installed at the St. Patrick Elementary School. The 90-day performance sampling was conducted on November 23, 2007, and none of the chemicals of concern were detected in the indoor air at the school.

CONCLUSIONS

ODH reached two conclusions for people exposed to volatile organic compounds in groundwater and indoor air at the East Troy Contaminated Aquifer site in Troy, Ohio:

- ODH concludes that aquifer's contaminated groundwater could harm people's health in the future, because the contamination may impact Troy's drinking water supply if actions are not taken to mitigate potential exposures to chlorinated solvents. The groundwater of the combined aquifer has been contaminated by TCE, PCE and its byproducts, as documented by Ohio EPA and U.S. EPA. The contaminated ground water plumes are migrating towards the well fields that supply Troy's drinking water. Cis-1,2-DCE, a breakdown product of TCE and PCE, has been detected in two municipal wells, PW-14 and PW-18, located within a quarter mile to one mile of the site. Another breakdown product, vinyl chloride, a known human carcinogen that often occurs with cis-1,2-DCE, has also been detected in the groundwater at the site. The municipal water supply serves about 28,000 people who could potentially be exposed to contaminated drinking water in the future.

- ODH cannot currently conclude whether breathing in volatile organic compounds (VOCs) in the indoor air of untested Troy properties could harm people's health. The information we need to make a decision is not available for many of the properties in the area impacted by vapor intrusion. In order to reach a conclusion, additional sub-slab and indoor air samples in the eastern portion of Troy are needed. More data will become available following the U.S. EPA remedial investigation.

    - The groundwater plume under the eastern portions of the city of Troy may have been impacting these properties for an extended period of time. However there were no data indicating a vapor intrusion hazard in the neighborhood until recently.

    - In 2007, the U.S. EPA took action to vent the volatile organic compounds from below the structure slab to above the roof line at 16 residences and a school. Following installation and operation of the units in these homes and school, these chemicals of concern were no longer detected in indoor air in these structures. However, the vapor mitigation systems are only intended to be a temporary solution.

    - Less than 15% of the homes in the area of concern have been sampled, and it is likely that other homes in this area could be at risk through vapor intrusion with vapor levels of these chemicals above ODH/ATSDR health-based screening levels. Until the source(s) of contamination are identified and removed or remediated, the site poses a public health hazard to nearby residents in the future.

    - People breathing air containing low levels of PCE and/or TCE for 30 years or more could have slightly increased risks of developing certain types of cancer.

RECOMMENDATIONS

1. U.S. EPA should fully delineate the full extent of groundwater contamination and vapor intrusion contamination in the East Troy area.

2. U.S. EPA should continue to take interim measures at the affected properties to disrupt or eliminate the vapor intrusion pathway into homes and buildings and conduct follow-up sampling to determine if the systems continue to reduce levels of these contaminants to below HAS/ATSDR screening levels.

3. U.S. EPA and Ohio EPA should fully investigate, delineate and remediate or remove the possible sources of PCE and TCE in subsurface soils and groundwater in the neighborhood.

PUBLIC HEALTH ACTIONS

Completed Actions

1. U.S. EPA sampled sub-slab and indoor air in 85 structures in East Troy for site-related chemicals of concern. Sixteen residences and the St. Patrick School had levels of solvents PCE and TCE above HAS/ATSDR's conservative chronic screening values. U.S. EPA installed individual vapor abatement systems in all 16 homes and the school in August 2007.

2. U.S. EPA has conducted follow-up sampling of the school's and residences' sub-slab and indoor air in 2007 and 2008 to insure continued effective operation of the installed vapor extraction systems.

3. HAS and ATSDR evaluated results to confirm that indoor air levels in homes and the school no longer pose a health threat to impacted residents, staff, and students.

4. U.S. EPA has listed the East Troy Contaminated Aquifer Site on the National Priorities List (NPL) of Superfund hazardous waste sites.

Future Actions

1. U.S. EPA will conduct a Remedial Investigation/Feasibility Study to identify source(s) of groundwater contamination in the area and take steps to mitigate or eliminate this contamination.

2. HAS will continue to review additional sampling results to insure that contamination in the East Troy community does not pose an acute health threat to area residents.

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CERTIFICATION

The Ohio Department of Health prepared this Public Health Assessment, East Troy Contaminated Aquifer Site, under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). At the time this Public Health Assessment was written, it was in accordance with approved methodology and procedures. Editorial review was completed by the Cooperative Agreement partner.

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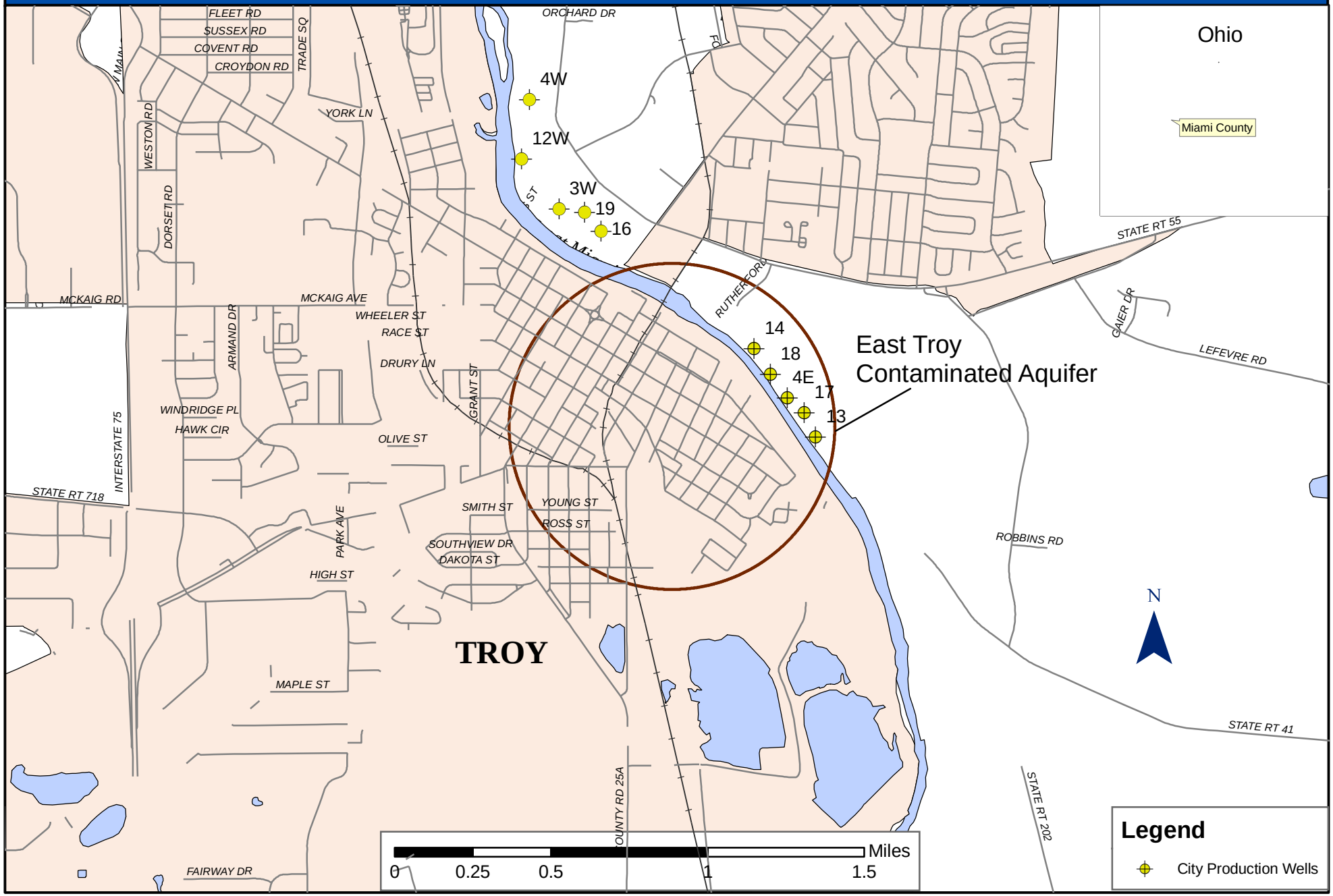
The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

Team Leader, Cooperative Agreement Team, CAPEB, DHAC, ATSDR

FIGURES

Figure 1. East Troy Contaminated Aquifer NPL Site (Ohio)
Site Location Map



Ground-Water Sampling Results for PCE
Concentrations in ug/l

OhioEPA

East Troy Soil-Gas, Indoor Air & Monitoring Well Results for PCE
January 2006

200 100 0 200 400
Feet

- Monitoring well (ug/l)
- Soil gas (ppb)
- Indoor air (ppb)

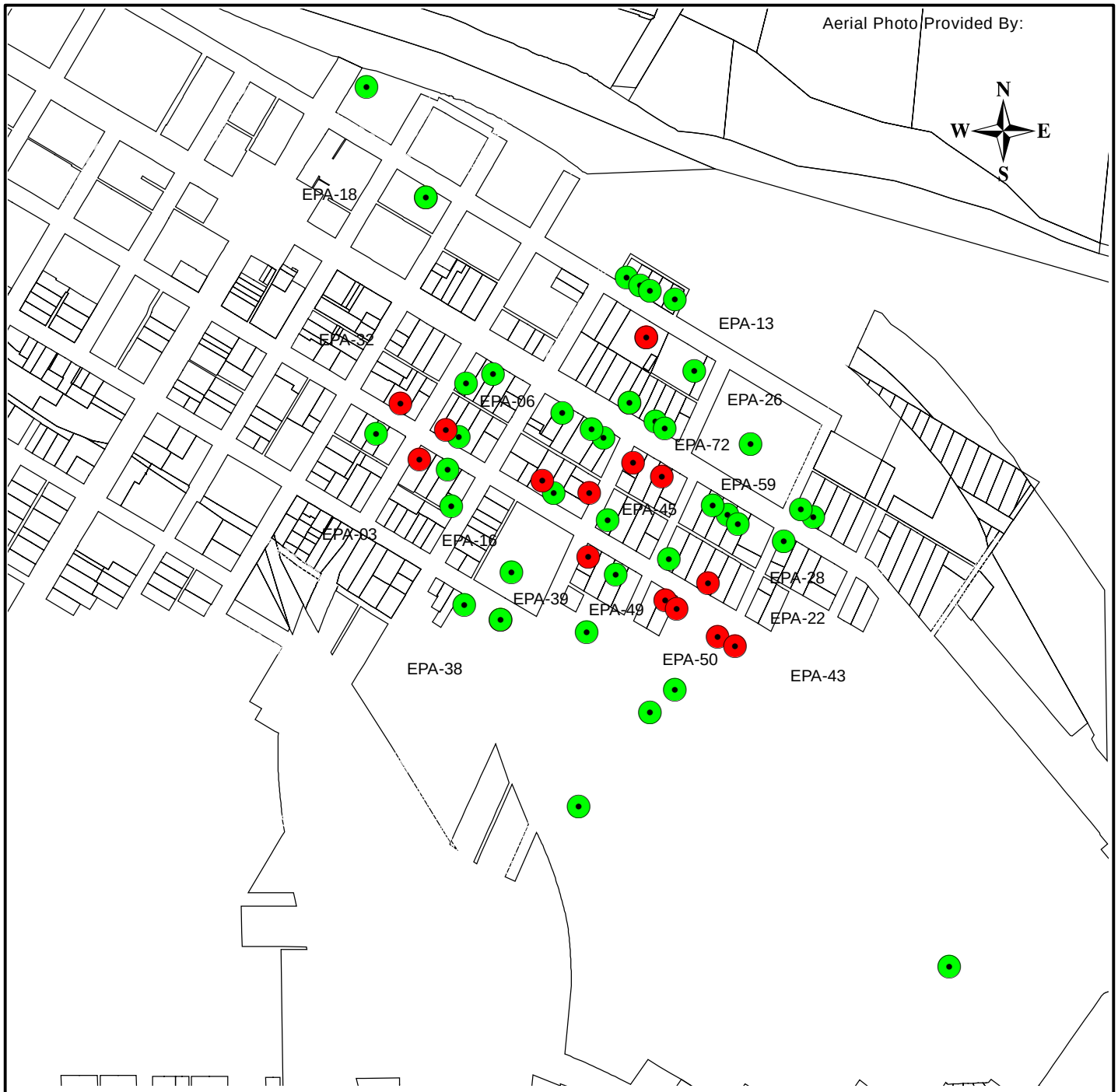


Figure 4-2

Prepared for:
U.S. EPA REGION V
Contract No: EP-S5-06-04

TDD No: S05-0609-003
DCN: 003-2A-AANW

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INDOOR AIR SAMPLING
LOCATION MAP
TROY VOC PLUME SITE
TROY, MIAMI COUNTY, OHIO
MAY 4, 2007
Scale: 0 0.05 0.1 Miles

APPENDICES

Appendix A. 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].

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

Aerobic
Requiring oxygen (compare with anaerobic).

Ambient
Surrounding (for example, ambient air).

Anaerobic
Requiring the absence of oxygen (compare with aerobic).

Analyte
A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation
Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biota
Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

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.

Central nervous system
The part of the nervous system that consists of the brain and the spinal cord.

CERCLA (see Comprehensive Environmental Response, Compensation, and Liability Act of 1980)

Chronic
Occurring over a long time [compare with acute].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

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.

Completed exposure pathway (see exposure pathway).

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

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.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin (see route of exposure).

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

DOD
United States Department of Defense.

DOE
United States Department of Energy.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose-response relationship
The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

Environmental media
Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA
United States Environmental Protection Agency.

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 assessment
The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure investigation
The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

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.

Feasibility study
A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Groundwater
Water beneath the earth's surface in the spaces between soil particles and between rock surfaces (compare with surface water).

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

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 (compare with public health assessment).

Health education
Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation
The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation
The act of breathing. A hazardous substance can enter the body this way (see route of exposure).

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Metabolism
The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite
Any product of metabolism.

mg/kg
Milligram per kilogram.

mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air.

Migration
Moving from one location to another.

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

Mutagen
A substance that causes mutations (genetic damage).

National Priorities List (NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The list is based primarily on the score a site receives from the Hazard Ranking System. The NPL is updated on a regular basis. A site must be on the NPL to receive money from the Trust Fund for remedial action.

National Toxicology Program (NTP)
Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

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.

NPL (see National Priorities List for Uncontrolled Hazardous Waste Sites)

Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure
The place where someone can come into contact with a substance present in the environment (see exposure pathway).

Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb
Parts per billion.

ppm
Parts per million.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health (compare with health consultation).

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future (ATSDR uses five public health hazard categories).

Public meeting
A public forum with community members for communication about a site.

RCRA [see Resource Conservation and Recovery Act (1976, 1984)]

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)
This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA
RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD [see reference dose]

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].

Safety factor (see uncertainty factor)

SARA (see Superfund Amendments and Reauthorization Act)

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.

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

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.

Substance
A chemical.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)

Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Teratogen
A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

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.

Tumor
An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Vapor intrusion
The movement of volatile chemicals and gases from soil and groundwater into the indoor air of homes and commercial buildings.

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, tetrachloroethylene (PCE), and trichloroethylene (TCE).

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Agency for Toxic Substances
and Disease Registry
Atlanta GA 30333

September 11, 2006

Steve Renninger
U.S. Environmental Protection Agency
Superfund Division, Emergency Response Branch
Cincinnati, OH

Dear Steve,

This letter is the response from the Ohio Department of Health (ODH) and the Agency for Toxic Substances and Disease Registry (ATSDR) to your request for health-based guidance to evaluate the results of air sampling of indoor air and subsurface for tetrachloroethylene (PERC) in the community of Troy (Miami County), Ohio.

The recommended screening levels presented in this letter are based on the understanding that exposures to PERC in this community has been on-going for some period of time, and that the removal of the source material will require an extensive effort that may not be accomplished in the near future. For those reasons, we have applied screening levels that are based more on chronic rather than acute exposures to this chemical. These are provided for residences, schools, commercial buildings, and public buildings. The application of these screening levels is considered by ODH and ATSDR to be protective of public health.

Residences/Schools:
The recommended health-based screening level for **residential indoor air** concentrations for PERC is **1.2 ppb**. This level is based on the EPA "Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils", at a 10^{-5} cancer risk. If the indoor PERC concentrations exceed 1.2 ppb, then an intervention strategy for reducing these levels should be initiated. Such a strategy should include the consideration of source control and installation of sub-slab depressurization systems to reduce the migration of vapors from the subsurface into indoor spaces. If the indoor PERC concentrations exceed **200 ppb**, then sub-slab depressurization systems should be installed as an immediate response action to reduce exposures. This level is the ATSDR Acute Minimal Risk Level, based on protection of neurological effects with short term exposure to PERC. We would recommend that this residential criterion also be applied to the evaluation of environments where children may occupy the space for a significant portion of the day, such as schools and daycare centers.

While data collected from sub-slab samples is an indication of contamination in subsurface soils levels that may migrate into indoor spaces, the determination of a public

health hazard is generally based on more direct measures of inhalation exposure. A more definitive conclusion about the level of health hazard would require additional indoor air sampling. However, in cases where indoor air samples have not been collected and only **sub-slab** sampling data are available, then a health-based screening level of **12 ppb** is recommended as the initial comparison. Levels below this would not be considered to be of a health concern. If this level is exceeded, then indoor air sampling would be recommended. This sub-slab value is a conservative 10-fold adjustment of the indoor air screening concentration. Concentrations below this level would not be of a health concern. However, site-specific conditions indicate that periodic monitoring of contamination levels may be needed.

Non-residential buildings:

For building spaces that are not used for residences or where children are not continuously present, such as churches, **commercial** businesses and public buildings, then a recommended health-based screening level of PERC in **indoor air** is **5 ppb**. Concentrations below this level would not be considered to be a health concern. If the indoor air concentrations are greater than 5 ppb, then an intervention strategy for reducing these levels should be initiated. Such a strategy should include the consideration of source control and installation of sub-slab depressurization systems to reduce the migration of vapors from the subsurface into indoor spaces. If the indoor PERC concentrations exceed **840 ppb**, then sub-slab depressurization systems should be installed as an immediate response action to reduce exposures.

In cases where indoor air samples have not been collected and only **sub-slab** sampling data are available, then a health-based screening level for non-residential buildings of **50 ppb** is recommended as the initial comparison. Levels below this would not be considered to be of a health concern. If the levels exceed 50 ppb, then indoor air sampling would be recommended to verify the extent of vapor migration into indoor air and levels of exposure.

Recommendations

The indoor air and sub-slab sampling results for Franklin St., Franklin St., Franklin St., Clay St., the St. Patrick School, and the Forest Elementary School exceed these screening criteria. The contaminated groundwater in this area may have been impacting these properties for an extended period of time. The implementation of a long-term remedy to remove the source is unlikely to occur in the near future. Therefore, we recommend that interim measures be taken at these properties to disrupt the vapor intrusion pathway into homes may include installation of a sub-slab depressurization system, sealing cracks in walls and floors of the basement, and sealing or fixing drains that could be a pathway. These interim measures should be initiated while a long-term remedy such as source removal at the site is being planned.

The sub-slab sampling at the Troy Police Station and St. Patrick Church also exceed the non-residential screening levels. Interim measure should also be considered for these buildings to reduce vapor intrusion.

If you have questions, please contact Mark Johnson (312-353-3436) or Bob Frey (614-466-1069).

Sincerely,

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Linda Nachowicz, USEPA-R5, Chief, Emergency Response Branch #2
Wendy Carney, USEPA-R5, Chief, Remedial Response Branch #1
Tina Forrester, ATSDR Division Director, Regional Operations
Clem Welsh, ATSDR Deputy Division Director, Regional Operations

Appendix C. Fact Sheets

Insert pdf ***Vapor Intrusion Fact Sheet page 1*** *here.*

Insert pdf ***Vapor Intrusion Fact Sheet page 2*** *here.*

Insert pdf ***Tetrachloroethylene Fact Sheet page 1*** *here.*

Insert pdf ***Tetrachloroethylene Fact Sheet page 2*** *here.*

Insert pdf ***Trichloroethylene Fact Sheet page 1*** *here.*

Insert pdf ***Trichloroethylene Fact Sheet page 2*** *here.*

*Insert pdf **1,2-Dichloroethylene Fact Sheet page 1** here.*

*Insert pdf **1,2-Dichloroethylene Fact Sheet page 2** here.*