

Public Health Assessment

Final Release

MILFORD CONTAMINATED AQUIFER

MILFORD, CLERMONT COUNTY, OHIO

EPA FACILITY ID: OHSFN0507973

**Prepared by the
Ohio Department of Health**

FEBRUARY 21, 2013

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

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR's Cooperative Agreement Partner pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR's Cooperative Agreement Partner has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 60-day public comment period. Subsequent to the public comment period, ATSDR's Cooperative Agreement Partner addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR's Cooperative Agreement Partner which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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SUMMARY

Introduction

The Health Assessment Section (HAS) at the Ohio Department of Health (ODH), in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), seeks to assist the Milford, 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.

The Milford Contaminated Aquifer was proposed for the U. S. Environmental Protection Agency's (U.S. EPA's) Superfund program National Priorities List (NPL) in October 2010 and officially added to the NPL in March 2011. Under the Superfund law, ATSDR is charged with assessing the presence and nature of health hazards to communities living near Superfund sites, helping prevent or reduce harmful exposures, and expanding the knowledge base about the health effects that result from exposure to hazardous substances. This public health assessment (PHA) is the HAS's evaluation of environmental data regarding the contaminated groundwater plume in the City of Milford, Clermont County, Ohio. This report reviews the available environmental sampling regarding the contamination of groundwater in Milford, Ohio to determine whether people could be harmed from coming into contact with hazardous substances via their drinking water supply or the vapor intrusion pathway.

Overview

The HAS reached three conclusions about the Milford Contaminated Aquifer site in Milford, Ohio.

Conclusion 1

Volatile organic compounds (VOCs) found in the City of Milford's public water supply are not expected to harm people's health. The reason for this is that the water is treated so that VOCs in the finished city water are below levels of health concern.

Basis for Decision

The raw water in three of the public wells operated by the City of Milford were found to be contaminated with the chlorinated solvents tetrachloroethylene (PCE), trichloroethylene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), and cis-1,2-dichloroethylene (cis-1,2-DCE). The source of this VOC contamination has not been identified. Chlorinated solvents were first detected in the City of Milford public wells PW-1 and PW-3 in 1986, indicating possible past exposure for those using the water. It is unknown how long the contamination has existed in the groundwater or whether or not residents were being exposed to these chemicals prior to 1986. Records show that since 1988, the City of Milford kept concentrations of VOCs in the public drinking water below federal drinking water standards by blending the water from several public wells. In 1990, an air stripper was installed and has been in operation since then to remove VOCs from the raw water in the well field. In addition, the City of Milford installed a new well (PW-4) which has not shown significant contamination, except for traces of 1,1,1-trichloroethane, since its initial operation in 2008. Although VOCs are present in the raw water, after treatment, the finished drinking water currently meets federal drinking water standards.

Next Steps

The source(s) of the contamination needs to be fully identified and either isolated and contained or removed. The NPL process will provide this information and develop ways to best mitigate or eliminate the contamination associated with the contaminated groundwater plume. The U.S. EPA will investigate the full extent of the contamination before deciding how best to address contamination at the site.

Conclusion 2

HAS concludes that using groundwater as drinking water (private residential wells) will not harm people's health because there are no private wells located in the plume area.

Basis for Decision

About 24 private wells within a 4-mile radius from the site might be affected by chemical contamination. About 63 people are estimated to be served by the 24 private wells. However, many of these private wells are either up-gradient of the site or too far away to be affected by the contamination. The Ohio EPA has reviewed the occurrence of private wells within the area impacted by the contaminated groundwater plume and found no private potable wells located in this area (Randy Watterworth, personal communication, August 2012).

Next Steps

None anticipated.

Conclusion 3

HAS cannot currently conclude whether vapor intrusion of VOCs into nearby residences and buildings could harm people's health. The information needed to make a decision is currently not available.

Basis for Decision

Sub-slab and indoor air samples from properties in and around the contaminant plumes are needed in order to assess the public health impact of exposures to vapor phase VOCs. It is unknown how long the contamination has existed under the impacted area or whether or not residents were being exposed to these chemicals in the past via the vapor intrusion pathway. At present, there are indications of a potential vapor intrusion issue in the vicinity. PCE was detected in the sub-slab sample at the Baker Party Store by the Ohio EPA in 2006. PCE was also detected at trace levels in a sub-slab sample taken at the Milford city building. The precise extent of the groundwater plume and the source(s) of contamination have not yet been identified. It is possible that residential properties in the area could be affected by chemicals entering homes via vapor intrusion.

Next Steps

The Milford Contaminated Aquifer site has been placed on the NPL. The source(s) of the chlorinated compounds identified in the water supply wells needs to be fully identified and remediated. The U.S. EPA will conduct a remedial investigation and feasibility study (RI/FS) under its Superfund authority to determine the full extent of the contamination before deciding how best to address contamination at the site. The U.S. EPA should evaluate the potential for

vapor intrusion in both homes and buildings in the plume area as a part of this investigation. HAS will evaluate any new data and exposure information for the vapor intrusion pathway when it becomes available.

For More Information

For information about this site, including site remediation, please see the U.S. EPA site fact sheet available at: <http://www.epa.gov/region5/sites/milford/index.html>. You can also call the Health Assessment Section at the ODH at 614-466-1390 for information on the Milford Contaminated Aquifer site.

PURPOSE AND HEALTH ISSUES

The Milford Contaminated Aquifer site consists of an area of groundwater contaminated with chlorinated solvents from an unknown source. The site is located on the east bank of the Little Miami River east of Cincinnati, in Milford in Clermont County, Ohio. The Milford Contaminated Aquifer site was proposed for inclusion on the U. S. Environmental Protection Agency's (U.S. EPA's) National Priorities List (NPL) of Superfund sites in October 2010 and officially added to the NPL in March 2011. The NPL is the U.S. EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The site was added to the NPL because the contaminated groundwater plume has affected three of the City of Milford's public water supply wells, which were discovered to be contaminated with volatile organic compounds (VOCs). Despite several investigations by the Ohio Environmental Protection Agency (Ohio EPA), the source of contamination has not been found and the state referred the site to the U.S. EPA. As part of the inclusion on the NPL, the Agency for Toxic Substances and Disease Registry (ATSDR) is required by a congressional mandate to complete a public health assessment (PHA) evaluating the threat to public health posed by all NPL sites. The Health Assessment Section (HAS) of the Ohio Department of Health (ODH) has had a cooperative agreement with ATSDR since 1990. As ATSDR's cooperative agreement partner in Ohio, the HAS agreed to take the lead in completing the PHA, which will evaluate environmental data, demographic data and community concerns for this site. The PHA also makes conclusions and recommendations, and lists additional actions that may be necessary to protect public health.

BACKGROUND

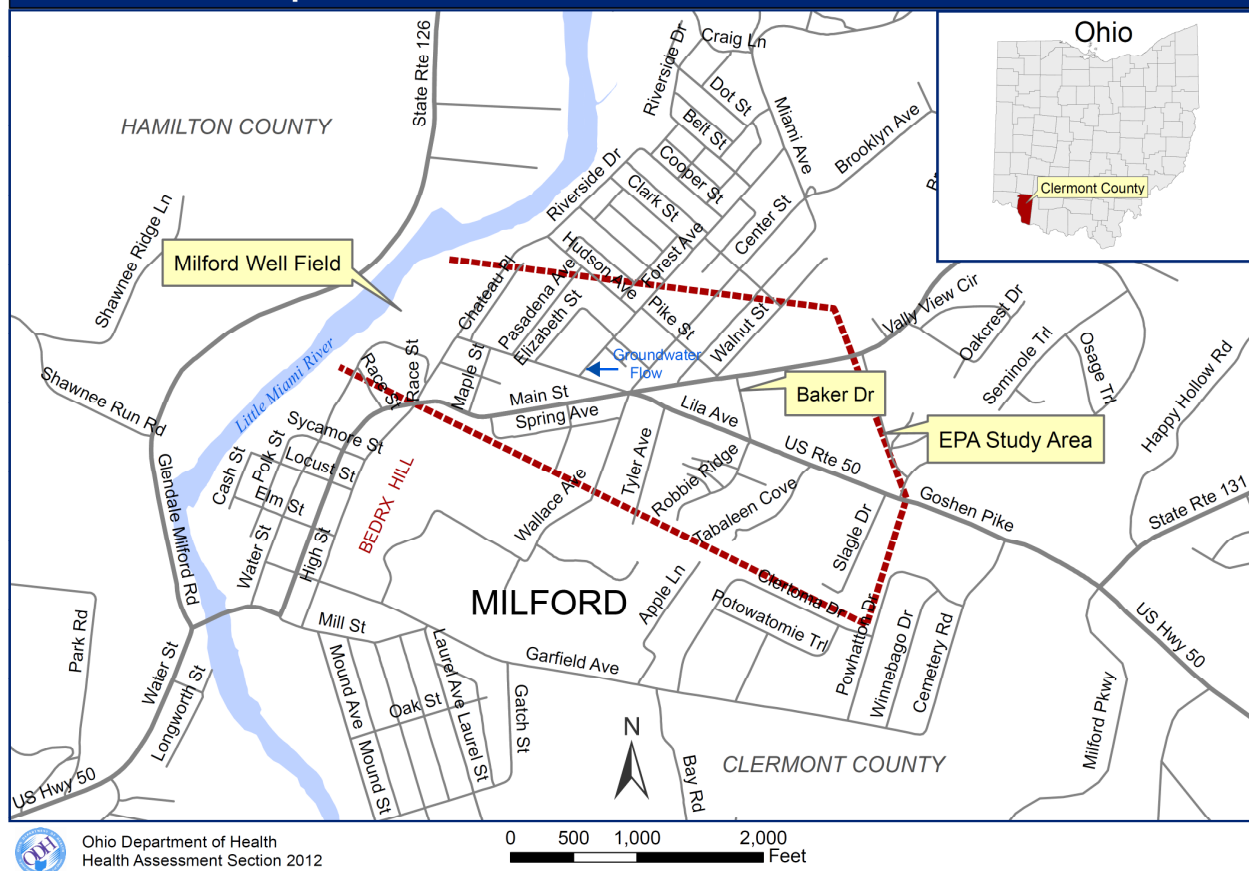
Site Location and Description

The Milford Contaminated Aquifer site is a groundwater plume contaminated with chlorinated solvents in the vicinity of Main Street and Lila Avenue in Milford, Clermont County, Ohio (Figure 1). The City of Milford obtains its drinking water from a well field that consists of four municipal wells and serves an estimated 5,546 people. In 1986, the raw water from two of the wells was found to be contaminated with several chlorinated solvents, including tetrachloroethylene (PCE), trichloroethylene (TCE), and 1,1,1-trichloroethane (1,1,1-TCA) (U.S. EPA 2010). In 1990, the City of Milford installed an air stripper to remove the volatile organic compounds (VOCs) from the water. Although VOCs are present in the raw water in the well field, the finished drinking water after treatment currently meets both state and federal drinking water standards.

Demographics and Land Use

The 2010 Census indicates that the City of Milford has a total population of 6,709. (The population increased by 6.76 percent since 2000.) Out of that number, 5,273 (78.6 percent) are adults 18 years and over, and 1,436 are under 18. Milford has 3,019 occupied housing units and 272 vacant housing units (U.S. Census Bureau, 2010 Census). According to 2000 Census data, about half of the occupied housing units are owner-occupied and half are renter-occupied. About 4.1 percent of families were below the poverty level based on income in 1999 dollars (U.S. Census Bureau, 2000 Census). Land use in the area primarily consists of mixed residential and

Figure 1. Milford Contaminated Aquifer Site Location Map



commercial uses, with some industrial activity interspersed throughout the area (U.S. EPA 2010).

Milford's public water supply is drawn from four groundwater wells located along the east bank of the Little Miami River in Milford. These wells are approximately 50-60 feet deep and draw their water supply from a sand and gravel aquifer. The raw water is passed through a treatment process which includes air stripping, which reduces the levels of VOCs present in the raw water to levels that are well below federal drinking water maximum contaminant levels. Prior to September 2011, only water from wells PW-1 and PW-3, the two most highly contaminated wells, were passed through the air stripper. The City of Milford installed a new production well (PW-4) in the well field in 2007 because of the VOC contamination (City of Milford 2011). Since September of 2011, Milford has been running water from all four wells over the air stripper (Randy Watterworth, personal communication, 2012).

Area Geology and Hydrogeology

The Milford well field is located in the floodplain of the Little Miami River. The aquifer in this area is a buried bedrock valley containing sand and gravel deposits. Area soils consist of 10 feet of silt, loam, clay, and fill, with the remainder being sand and gravel down to about 50 feet. The

bedrock surface is encountered at depths ranging from 38 to 60 feet below the ground surface. Groundwater in the area appears to flow west from Baker Drive to the well field (Figure 1). The aquifer is unconfined and consequently receives direct recharge from rainfall (U.S. EPA 2010). The city obtains its drinking water from a well field consisting of four wells drilled into water-bearing sand and gravel deposits at depths of 50-60 feet and can pump up to 1,300 gallons of water per minute (ODNR well logs). The aquifer that supplies water to the City of Milford is highly susceptible to contamination because of the relatively thin protective surficial soil layer and shallow depth to the aquifer.

Chemicals Detected in the Public Water Supply

Milford conducts quarterly monitoring of each public well (PW) for VOCs and provided data from 1986 to the present for this public health assessment (Matt Newman, personal communication, April 11, 2011). Chemical contaminants were first detected in the City of Milford public wells PW-1 and PW-3 in 1986. Since then, tetrachloroethylene (PCE), trichloroethylene (TCE), and 1,1,1-trichloroethane (1,1,1-TCA) have been detected in PW-3 at concentrations above their respective MCLs, the maximum contaminant levels established by the U.S. EPA under the Safe Drinking Water Act, for 80 percent, 22 percent, and 2 percent of the time, respectively (Table 1). PCE concentrations in PW-3 in 1986 were 12.7 ppb and 6.3 ppb for the 3rd and 4th quarters of 1986, respectively. In 1987, a sudden spike in PCE concentration (2,627 ppb) appears to have occurred; however, subsequent PCE detections ranged from 1.61–17.6 ppb from 1988 to 2011. PCE concentrations in PW-1 exceeded the MCL in the first and fourth quarters of 1989, and TCE exceeded the MCL in the first quarter of 1989 and again in 2001 (Table 1). 1,1,1-TCA and less frequently, other chlorinated VOCs, were detected in PW-2 but at concentrations less than the MCLs (Table 1). PW-4 is a new well and so far has had no significant detections of VOCs since 2008 (Table 1). The City of Milford has kept the concentration of VOCs in the finished drinking water below MCLs by blending the water from the public wells, adding an air stripper in 1990, and installing a new well in 2007. A summary of plant tap results from the 1988 to present is presented in Table 2.

Previous Site Investigations

The Ohio Environmental Protection Agency (Ohio EPA) has conducted several investigations in an effort to find the source of contamination. A preliminary assessment/site investigation in 2001 confirmed that the aquifer and well field were contaminated with VOCs. Groundwater sample results from soil boring locations indicated that the VOCs originated from sources east of the well field. An expanded site investigation in 2002 detected the presence of tetrachloroethylene (PCE) in groundwater samples at concentrations up to 730 parts per billion (ppb), TCE at concentrations up to 40 ppb, cis-1,2-dichloroethylene (cis-1,2-DCE) at concentrations up to 40 ppb, and 1,1,1-TCA at concentrations up to 19 ppb. Results from a subsequent investigation in 2003 suggested that a source of PCE was located near Baker Drive.

In 2006, Ohio EPA conducted a state site assessment investigation collecting sub-slab soil gas samples at the Baker property suspected to be a potential source of VOCs. PCE was detected in the sub-slab soil gas at the Baker Party Store at a concentration of 350 ppb (U.S. EPA 2010).

PCE was also detected at trace levels in a sub-slab sample taken at the Milford city building (Randy Watterworth, personal communication, April 13, 2011).

In 2009, Ohio EPA conducted a supplemental expanded site inspection that included sampling of the city's public water supply wells, 15 monitoring wells, and 5 soil samples in order to identify a potential source area. This inspection confirmed that the aquifer is contaminated with VOCs; however, the soil sampling was not able to identify the source. The results for water samples collected from public wells in 2009 and 2010 by Ohio EPA show that PCE was detected in PW-1 at a concentration of 1.2 ppb and in PW-3 at a concentration of 9.9 ppb. 1, 1, 1-TCA was detected in PW-1 and PW-2 at concentrations of 9.6 ppb and 3.6 ppb, respectively (U.S. EPA 2010). Public well PW-4 did not show the presence of chlorinated solvents above the contract-required quantitation limit of 0.5 ppb; however, trace levels of 1,1,1-TCA were detected in a sample collected in 2009. The Ohio EPA 2009/2010 groundwater sampling results from public wells and monitoring wells at the Milford Contaminated Aquifer site (Figure 1) are summarized in Table 3.

NPL Site Listing and Hazard Ranking System (HRS) Documentation Record

The U.S. EPA proposed the Milford Contaminated Aquifer site for placement on the National Priorities List (NPL) of Superfund sites on October 21, 2010, and added it to the NPL on March 10, 2011. 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 contamination. Analytical results of groundwater samples within the plume area found chlorinated chemicals: primarily tetrachloroethylene (PCE), trichloroethylene (TCE), cis-1,2-dichloroethylene (cis-1,2-DCE), and 1,1,1-trichloroethane (1,1,1-TCA) (Table 3). In their HRS Documentation Record, the U.S. EPA speculates that there is a possible source of PCE and its degradation products (TCE and cis-1,2-DCE) located east of the City of Milford well field in the commercial business area between Lila Avenue and Main Street (Figure 1). The pattern of detections also suggest that the source of 1,1,1-TCA is north of the source of PCE and related compounds (U.S. EPA 2010).

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

Since the Milford site is placed on the NPL, the U.S. EPA will conduct a Remedial Investigation (RI) and Feasibility Study (FS) of the site under its Superfund authority. The purpose of the RI is to determine the full extent of the contamination at a site and to identify the source of the contamination. A FS is a process for developing, evaluating, and selecting a cleanup plan to deal with the contaminants identified at the site.

DISCUSSION

Exposure Pathways

In order for people to be exposed to elevated levels of chemical contaminants in and around the Milford site, they must first come into contact with the contaminated groundwater, soils, soil gas, 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** (a chemical release, landfills, and others);
2. **Environmental Transport** (the way chemicals move away from the source through air, water, soil, food chain);
3. **Point of Exposure** (a place where people come into physical contact with the chemical, e.g., soil, air, groundwater, surface water, sediment, food);
4. **Route of Exposure** (how people come into physical contact with the chemical, e.g., breathing, drinking, eating, touching); and
5. **A Population at Risk** (people likely to come into physical contact with site-related chemicals).

The existence of a completed pathway does not necessarily mean that a public health hazard existed in the past, exists currently, or is likely to exist in the future.

People could come in contact with contaminants at this site by:

- Drinking water containing the chemical (ingestion),
- Skin contact (dermal), and
- Breathing air containing the chemical vapors (inhalation).

Table 4 identifies the potential exposure pathways for people to contact the contaminants at this site.

Groundwater Pathway

Groundwater is water that occurs below the surface of the earth in pore-spaces in rock layers and soil deposits. Groundwater supplies water to wells and springs and is a substantial source of water used in the United States. About 3½ million Ohioans or thirty percent of the Ohio population, drink water from a community water system that uses groundwater (U.S. EPA 2009b).

Milford's municipal water system has approximately 2,077 service connections and serves approximately 5,546 people, based on 2.67 persons per household in Clermont County (U.S. EPA 2010). Water for the City of Milford is supplied by a well field consisting of four production wells (PW-1 through PW-4). Water is obtained from sand and gravel deposits underlying the Little Miami River at depths of 50 to 60 feet. The water pumped from these wells is mixed together prior to going to the water plant. Low concentrations of chlorinated VOCs, including PCE, TCE, cis-1,2-DCE, and 1,1,1-TCA, have been detected in samples of raw water from three production wells (PW-1, PW-2, and PW-3). In 1990, the City of Milford installed an air stripper to remove the VOCs from the water prior to distribution. Initially, only water from wells PW-1 and PW-3, the most contaminated wells, were passed through the air stripper. Since September 2011, Milford has been running water from all four wells through the air stripper (Randy Watterworth, personal communication, 2012). After treatment, levels of VOCs in the finished drinking water currently meet federal drinking water standards. Past sampling indicates

a completed exposure pathway via the groundwater route in the past before VOCs were removed from the raw well water by air stripping. It is unknown how long the contamination has existed in the groundwater before it was first detected in 1986 or whether or not residents were being exposed to these chemicals prior to 1986. The air stripper was installed in 1990 and has been in operation since then (Matt Newman, personal communication). Detections of VOCs in the finished drinking water were substantially reduced or eliminated after 1990 (see Table 2).

A total of 18 municipal wells are within the 4-mile radius target distance limit from the groundwater contamination plume. The four public water supply wells operated by the City of Milford are the primary municipal wells of concern. Approximately 24 private wells are within the 4-mile radius target distance limit. About 63 people are estimated to be served by private wells within the target distance limit (U.S. EPA 2010). However, many of these private wells are either up-gradient of the site or too far away to be affected by the contamination. The Ohio EPA has reviewed well logs for the area within the plume and has determined that there are no private potable wells located in the area impacted by the groundwater contamination (Randy Watterworth, personal communication, 2012).

Vapor Intrusion Pathway

Vapor intrusion is the movement of volatile chemicals and gases from soil and groundwater into the indoor air of homes and commercial buildings. VOCs can vaporize from contaminated groundwater or soil and migrate as a gas to the indoor environment of nearby buildings. Factors that favor the transport of these chemicals at the Milford site include the shallow depth to the groundwater table; the porous and permeable nature of the shallow subsurface soil under the site; the detection of VOCs like PCE in off-site monitoring wells at levels up to 1,100 ppb (Table 3); and the detection of PCE in soil gas in a sub-slab sample at levels up to 350 ppb near the likely source area all suggest there is a potential vapor intrusion pathway in the plume area (U.S. EPA 2010).

It is unknown how long the contamination has existed under the impacted area or whether or not residents were being exposed to these chemicals in the past by the vapor intrusion pathway. The precise extent of the groundwater plume and the source(s) of contamination have not yet been identified. The aquifer contamination was first discovered in 1986 when chlorinated solvents were detected in the City of Milford public wells PW-1 and PW-3. Ohio EPA soil gas sampling in the area in 2006 detected elevated levels (350 ppb) of vapor phase PCE in the sub-slab sample under a commercial building on Baker Drive east of the site (U.S. EPA 2010). PCE was also detected at trace levels in a sub-slab sample taken at the Milford city building (Randy Watterworth, personal communication).

Public Health Implications

The primary contaminants of concern at the Milford site are the chlorinated solvents tetrachloroethylene (also known as perchloroethylene or PCE), trichloroethylene (TCE), cis-1,2-dichloroethylene (cis-1,2-DCE), and 1,1,1-trichloroethane (1,1,1-TCA).

Tetrachloroethylene (PCE)

Tetrachloroethylene (also known as perchloroethylene, PCE or PERC) is a nonflammable liquid at room temperature and is widely used for dry cleaning fabrics and for degreasing metal parts. Other major uses of PCE are as a solvent in some consumer products and in the production of other chemicals. It evaporates easily into the air and has a sharp, sweet-smelling odor. Most people can smell PCE in air at levels in excess of 1,000 parts per billion (ppb). PCE is frequently found in air as well as in groundwater and surface 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 (for example, industrial releases). Much of the PCE that gets into surface water and soil evaporates into the air, where it is broken down by sunlight into other chemicals or brought back to the soil and water by rain. Because PCE can travel down through soils quite easily, it can make its way into underground water, where it may remain for a long time. Under oxygen-poor conditions over time, bacteria will break down some of the PCE that is in soil and groundwater into breakdown products including trichloroethylene, dichloroethylene, and vinyl chloride (Vogel and McCarty 1985).

PCE is characterized by the U.S. EPA as “likely to be carcinogenic to humans” by all routes of exposure. 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 (NTP 2011). The International Agency for Research on Cancer (IARC) has classified PCE as a Group 2A carcinogen—probably carcinogenic to humans (limited human evidence, sufficient evidence in animals) (IARC 1995).

Health studies involving the ingestion of PCE in drinking water supplies are limited. PCE was identified as a chemical of concern in contaminated drinking water (along with the chlorinated solvent trichloroethylene) in environmental exposure studies of populations in Woburn, Massachusetts, selected towns in New Jersey, and Camp Lejeune in North Carolina. The Woburn, Massachusetts study (Lagakos et al. 1986) and the New Jersey study (Fagliano et al. 1990) have associated exposure to these chemicals through ingestion of contaminated water with increased levels of leukemia in specific populations within these communities.

Site-Specific Assessment

The Safe Drinking Water Act requires that municipal water facilities perform routine monitoring of its drinking water wells. Based on results of monitoring by the City of Milford from 1986 to present, city well 3 (PW-3) has been the most contaminated well, with an average detected concentration of 39.7 ppb PCE (Table 1). Samples collected by the Ohio EPA in 2009 and 2010 from city wells 1 and 3 before treatment contained PCE at 1.2 and 9.9 ppb respectively (Table 3). The City of Milford has kept the concentration of PCE in the public drinking water below the 5 ppb MCL by blending the water from the wells, adding an air stripper in 1990, and installing a new well in 2007. Based on plant tap results from 1988 to present, PCE was detected about 11 percent of the time in the finished water; however, PCE has not been detected in the finished water since the 2nd quarter of 2005.

The HAS calculated adult and child exposure doses for the maximum concentration PCE levels in drinking water for both before and after the air stripper was installed in 1990. (Appendix B).

The calculated exposure dose for PCE is far below ATSDR's minimal risk level (MRL) for acute-duration (≤ 14 days) oral exposure and far less than the U.S. EPA's chronic reference dose (RfD). The RfD is an estimate, with safety factors built in, of the daily dose of a substance that is unlikely to cause adverse health effects (excluding cancer) in humans during a lifetime. Based on the exposure doses calculated using the highest detected concentration, exposure to PCE is not expected to cause any adverse, noncancer health effects.

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.

Estimated cancer risk represents the number of possible additional cases of cancer in a population due to exposure to a toxic substance, usually written as a negative power of 10. For example, one additional case of cancer per 10,000 individuals is written as 1×10^{-4} .

ATSDR's cancer risk evaluation guide (CREG) for PCE in drinking water is 17 ppb and represents an estimated cancer risk of one in a million (1×10^{-6}). Based on the highest PCE concentration detected in the finished drinking water, we calculated an estimated lifetime cancer risk of 5.4×10^{-7} and 1.8×10^{-7} , before and after the installation of the air stripper, respectively

(Appendix B). The estimated cancer risks are extremely low when compared to the cancer risk range typically used by the U.S. EPA (1×10^{-6} to 1×10^{-4}). The true risk is likely to be even less when considering exposure durations less than a lifetime (70 years). Although PCE is present in the raw water wells, concentrations in the finished water are below EPA's MCL and ATSDR's CREG.

Trichloroethylene (TCE)

The primary use of trichloroethylene (TCE) has been as a solvent for the degreasing of metal parts. 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. Although some dry cleaners used TCE in the past, most dry cleaners now use tetrachloroethylene (PCE). 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 degrades rapidly when exposed to light, with about half of it breaking down to simple chemical compounds within a week (ATSDR 1997b). TCE adsorption 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 will rapidly vaporize into the air spaces between soil grains above the water table. Studies indicate that it disperses by two primary routes; first, diffusion through the soil air spaces and then be re-adsorbed by groundwater or infiltrating rainwater, or second, it will migrate to the surface and be released to the atmosphere.

TCE at low levels in shallow groundwater has caused a vapor intrusion risk to overlying homes and buildings at several sites in Ohio. 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).

TCE is characterized as “carcinogenic in humans by all routes of exposure” by the U.S. EPA. This conclusion is based on convincing evidence of a causal association between TCE exposure in humans and kidney cancer (U.S. EPA 2011). The IARC has classified TCE as “*probably carcinogenic to humans*” (Group 2A). The National Toxicology Program (NTP) determined that trichloroethylene is reasonably anticipated to be a human carcinogen (NTP 2011). 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 (Lagakos et al. 1986). 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).

Site-Specific Assessment

From 1986 to present, testing by the City of Milford indicated detections of TCE primarily in public well #3 and well #1, with levels of TCE above the MCL 22% and 2% of the time, respectively (Table 1). However, TCE has not been detected (with one exception) in the finished drinking water supply (plant tap) since an air stripper system was installed in 1990. Recent sampling by the Ohio EPA did not detect TCE in the City of Milford public wells, based on three sampling events from August 2009 and February 2010. TCE levels in the finished water delivered to homes are either below health-based standards or otherwise not detected. The City of Milford has kept the concentration of TCE in the public drinking water below the 5 ppb MCL by blending the water from the wells, adding an air stripper in 1990, and installing a new well in 2007. Calculated exposure doses are below health-based comparison values (Appendix B); therefore, TCE is not expected to cause any adverse, noncancer health effects.

The ATSDR CREG for TCE in drinking water is 0.76 ppb and represents a possible risk of one excess cancer case in a population of one million (1×10^{-6}). Since concentrations of TCE have been below this level for the last 20 years, it is unlikely that Milford residents would experience cancer health effects from exposure related to TCE in the municipal drinking water supply. Based on the highest TCE concentration detected in the finished drinking water, we calculated an estimated cancer risk of 8.1×10^{-6} and 1.8×10^{-6} , before and after the installation of the air stripper, respectively (Appendix B). The estimated cancer risks are extremely low when compared to U.S. EPA’s cancer risk range of 1×10^{-6} to 1×10^{-4} . However, it is possible that TCE could pose a potential vapor intrusion risk to buildings surrounding the suspected sources of contamination.

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

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 ppm (17,000 ppb). The presence of 1,2-DCE in groundwater is most likely due to the biodegradation of other more highly chlorinated compounds tetrachloroethylene and trichloroethylene present in groundwater (ATSDR 1996).

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. Neither the NTP nor the IARC have classifications for this chemical.

Site-Specific Assessment

The U.S. EPA has established a MCL of 70 ppb for cis-1,2-DCE in drinking water. Cis-1,2-DCE has been detected in Milford’s finished drinking water in the past but levels did not exceed federal drinking water standards (Table 2). Water monitoring by the City of Milford indicates that cis-1,2-DCE has not been detected in drinking water supply (plant tap) since 2000. Cis-1,2-DCE, a biodegradation product of PCE and TCE, was detected in one monitoring well at 9.5 ppb in August 2009 (U.S. EPA 2010). Based on HAS’s evaluation of historical data from past and current exposures to 1,2-DCE in Milford public water wells, the levels of cis-1,2-DCE do not pose a noncancer health threat to the residents. It is unlikely that past or current exposure to cis-1,2-DCE in drinking water would pose a cancer risk to the residents of Milford.

1,1,1-Trichloroethane (1,1,1-TCA)

1,1,1-Trichloroethane (1,1,1-TCA), also known as methyl chloroform, is a colorless liquid with a sweet, sharp odor. It was often used as a solvent to dissolve other substances, such as glues and paints. In industry, it was widely used to remove oil or grease from manufactured parts and was developed initially as a safer alternative to replace other more toxic chlorinated and flammable solvents. Currently 1,1,1-trichloroethane is almost entirely used as a precursor for the chemical production of hydrofluorocarbons. No 1,1,1-trichloroethane was to be produced and sold for domestic use in the United States after January 1, 2002, because of its potential effects on the ozone layer. Outdoor air levels of 1,1,1-trichloroethane in urban areas have been reported to be in the range of 0.1–1 ppb, while the concentrations in rural areas have been reported to be less than 0.1 ppb. 1,1,1-Trichloroethane tends to evaporate from soil surfaces to the atmosphere and it dissolves slightly in water. If released to soil, 1,1,1-trichloroethane is expected to be highly mobile and has the potential to leach into the groundwater (ATSDR 2006).

Available information does not indicate that 1,1,1-trichloroethane causes cancer. The International Agency for Research on Cancer (IARC) has determined that 1,1,1-trichloroethane is not classifiable as to its carcinogenicity in humans. EPA has also determined that 1,1,1-trichloroethane is not classifiable as to its human carcinogenicity (ATSDR 2006). Therefore, it is very unlikely that past or current exposure to 1,1,1-TCA in drinking water would pose a cancer risk to the residents of Milford.

Site-Specific Assessment

1,1,1-TCA was one of the major contaminants found in the groundwater and in the soil gas at the Milford site. City monitoring results from 1988–1990 indicate an average concentration of 22.9 ppb 1,1,1-TCA in Milford’s finished drinking water (Table 2). After the installation of the air stripper in 1990, the average concentration of 1,1,1-TCA decreased to 3.2 ppb. Historically, public well #3 had the highest levels of 1,1,1-TCA, with 2 quarterly samples exceeding the MCL of 200 ppb. Samples collected in 2009 and 2010 showed the presence of 1,1,1-TCA in raw water (before treatment), which contained 1,1,1-TCA at 9.6 and 3.6 ppb respectively. 1,1,1-TCA levels in Milford’s finished drinking water have not exceeded federal drinking water standards. Based on current and historical data of Milford public water supply, it is unlikely that Milford residents would experience any harmful noncancer health effects from exposure related to drinking water (Appendix B).

Mixture Assessment

Exposures to mixtures of tetrachloroethylene, trichloroethylene, and 1,1,1-trichloroethane are likely to be additive in nature in producing nervous system effects or non-cancer kidney or liver effects (ATSDR 2004). Exposures to mixtures of TCE and PCE - two of the chemicals of concern that are suspected to cause cancer - are also likely to be additive in nature in producing cancer. The estimated lifetime cancer risks for PCE and TCE from combined oral exposure to drinking water at the maximum levels detected in drinking water is about 7.5×10^{-5} (before 1990) and 2.4×10^{-5} (after 1990), which indicates a very low excess cancer risk. The true risk is likely to be even less when considering exposure durations were less than a lifetime (70 years).

HEALTH OUTCOME DATA

In a public health assessment, the Superfund law requires consideration of health outcome data, which can include information on the number of reportable diseases or deaths in a community. ATSDR evaluates health outcome data 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 that is of sufficient size for the health effects to be detected (4) sufficient exposure to result in plausible health effects, (5) information available at the geographic level necessary to compare to the exposed population, and (6) a database on the health outcomes of interest likely to occur from exposure.

Based on our current knowledge of the Milford Contaminated Aquifer site, there is not sufficient exposure to result in noncancer health effects or a measureable increase in cancer rates. Nonetheless, some statistics on cancer incidence for Clermont County and the census tract that includes the City of Milford were available and reviewed.

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 tract level. The census tract which includes the contaminated groundwater plume in Milford in Clermont County, Ohio, is Census Tract 405,

which has a total population of about 5,050 (U.S. Census Bureau 2000). This census tract has a high average annual (1996-2005) rate for lung and bronchus cancer, low incidence rates of breast cancer, and very low rates for colon and rectum cancer and prostate cancer (ODH 2008).

Exposure to PCE and TCE has not been linked with lung cancer. 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, and therefore 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 incidence and mortality rates for Clermont County are very similar to those reported for all of Ohio and the United States (ODH 2008). More information regarding the county profile is available at: <http://www.odh.ohio.gov/healthstats/ocisshs/newrpts1.aspx>.

COMMUNITY HEALTH CONCERNS

No public health concerns or comments were received during the public comment period for this Public Health Assessment. Comments were received from the Ohio EPA (See Appendix C). The U.S. EPA had no comments. The U.S. EPA held an availability session on December 5, 2011 to share information and answer questions about the Milford Contaminated Aquifer. Due to low attendance, no public health concerns were gathered at that time.

In May 2012, the U.S. EPA conducted in-person interviews with 10 Milford residents and officials who live and work near the site. This information will be in U.S. EPA's Community Involvement Plan which will be available online at www.epa.gov/region5/cleanup/milford. Most residents did not have concerns about the site though many expressed that they would like to see the mystery solved of where the contamination came from. One resident expressed health concerns and wondered if drinking water was a problem. Everyone interviewed said they would attend a meeting about the site but many said they really had no interest or concern (Patti Krause, U.S. EPA, personal communication, September 20, 2012).

CHILD HEALTH ISSUES

Both the HAS and the ATSDR recognize that children are inherently at a greater risk of developing illness due to exposure to hazardous chemicals given 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.

CONCLUSIONS

The HAS reached three conclusions for people exposed to volatile organic compounds in groundwater and indoor air at the Milford Contaminated Aquifer in Milford, Ohio:

1. Volatile organic compounds (VOCs) found in the City of Milford's public water supply are not expected to harm people's health. The reason for this is that the water is treated so that VOCs in the finished city water are below levels of health concern. Chlorinated solvents

were first detected in the City of Milford public wells PW-1 and PW-3 in 1986, indicating possible past exposure for those using the water. It is unknown how long the contamination has existed in the groundwater or whether or not residents were being exposed to these chemicals prior to 1986. Periodic water monitoring since 1988 indicates that the City of Milford kept concentrations of VOCs in the public drinking to within federal drinking water limits by blending water from its public drinking water supply wells. Milford's raw water is currently drawn from four wells. An air stripper was installed in 1990 and has been in operation since then to remove VOCs from the raw water in the well field. Although VOCs are present in the raw water, the finished drinking water after treatment currently meets both state and federal drinking water standards.

2. HAS concludes that using groundwater as drinking water (private residential wells) will not harm people's health because there are no private wells located in the plume area. About 24 private wells are located within a 4-mile radius from the site and could be potentially affected by chemical contamination. About 63 people are estimated to be served by the 24 private wells. However, many of the private wells within 4 miles are either up-gradient of the site or too far away to be affected by the contamination. The Ohio EPA has reviewed well logs for the area within the plume and has determined that there are no private potable wells located in the area impacted by the groundwater contamination.
3. It cannot be concluded whether vapor intrusion of VOCs into nearby residences is occurring, and, if so, are at levels that could harm people's health. The information needed to make a decision is currently not available. Sub-slab and indoor air samples from homes and buildings in and around the contaminant plumes are needed in order to assess the public health impact of exposures to vapor phase VOCs. PCE was detected at 350 ppb in the sub-slab sample at the Baker Party Store by the Ohio EPA in 2006. PCE was also detected at trace levels in a sub-slab sample taken at the Milford city building. The precise extent of the groundwater plume and the source(s) of contamination have not yet been identified. It is possible that residential properties in the area could be affected by chemicals entering homes via vapor intrusion.

RECOMMENDATIONS

1. The U.S. EPA should fully delineate the full extent of groundwater contamination in the Milford area.
2. The U.S. EPA should fully delineate the extent of vapor intrusion in the Milford area. The HAS recommends additional sub-slab samples in order to evaluate exposures to chlorinated solvents.
3. The U.S. EPA should fully investigate, identify, delineate and remediate, isolate and contain, or remove the possible sources of volatile organic compounds in the groundwater in the impacted area.

PUBLIC HEALTH ACTIONS

Completed Actions

1. In March 2011, the U.S. EPA listed the Milford Contaminated Aquifer Site to the National Priorities List (NPL) of Superfund hazardous waste sites.
2. The Ohio Department of Health issued a Public Health Assessment for public comment. The Initial/Public Comment Release, dated January 30, 2012, was made available for public comment until March 15, 2012.
3. An on-line search of the Ohio Department of Natural Resources (ODNR) well log database by the ODH HAS did not indicate any residential wells (out of 14 wells listed) within a 1-mile radius of the site.

Future Actions

1. The 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. The HAS will work with the U.S. EPA to review additional sampling results to insure that contamination in the Milford community does not pose an acute or chronic health threat to the area population.

REPORT PREPARATION

This Public Health Assessment was prepared by the Ohio Department of Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved agency methods, policies, and procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this document and concurs with its findings based on the information presented.

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TABLES

Table 1. Chemicals Detected in Public Wells by City of Milford

<i>Chemical</i>	<i>Range of Detections (ppb)</i>	<i>Average (ppb)</i>	<i>Frequency of Detections</i>	<i>Frequency Above Comparison Value</i>	<i>Comparison Value (ppb) and Source</i>
Public Well #1 (PW-1) from 1986 to Present					
PCE	ND–12.6	2.4	73/84	2/84	5 - MCL 17 - CREG
TCE	ND–6.9	1.8	52/84	2/84	5 - MCL 0.76 - CREG
1,1,1-TCA	ND–110	23.5	77/84	0/84	200 - MCL
Cis-1,2-DCE	ND–20.8	6.6	51/84	0/84	70 - MCL
Public Well #2 (PW-2) from 1986 to Present					
PCE	ND–0.5	N/A	1/85	0/85	5 - MCL 17 - CREG
TCE	ND–2.1	1.3	2/85	0/85	5 - MCL 0.76 - CREG
1,1,1-TCA	ND–9.1	2.5	55/85	0/85	200 - MCL
Cis-1,2-DCE	ND–0.9	0.8	2/85	0/85	70 - MCL
Public Well #3 (PW-3) from 1986 to Present					
PCE	ND–2,627	39.7	83/86	69/86	5 - MCL 17 - CREG
TCE	ND–24.5	3.7	80/86	19/86	5 - MCL 0.76 - CREG
1,1,1-TCA	ND–257	66.2	84/86	2/86	200 - MCL
Cis-1,2-DCE	ND–72.6	14.5	75/86	1/86	70 - MCL
Public Well #4 (PW-4) from 2008 to Present					
PCE	ND	N/A	0/12	0/12	5 - MCL 17 - CREG
TCE	ND	N/A	0/12	0/12	5 - MCL 0.76 - CREG
1,1,1-TCA	ND–0.68	N/A	1/12	0/12	200 - MCL
Cis-1,2-DCE	ND	N/A	0/12	0/12	70 - MCL

Source: Matt Newman, City of Milford, personal communication, April 2011

ppb – parts per billion
PCE – tetrachloroethylene
TCE – trichloroethylene
1,1,1-TCA – 1,1,1-trichloroethane
Cis-1,2-DCE – cis-1,2-dichloroethylene

MCL – maximum contaminant level (U.S. EPA)
CREG – cancer risk evaluation guide (ATSDR)
ND – not detected
N/A – not applicable

Table 2. Chemicals Detected in the Plant Tap (Distribution) from 1988–Present

<i>Chemical</i>	<i>Range of Detections (ppb)</i>	<i>Average of Detections (ppb)</i>	<i>Frequency of Detections</i>	<i>Frequency Above Comparison Value</i>	<i>Comparison Value (ppb) and Source</i>
<i>From 1988 to 1990</i>					
PCE	ND–4.5	2.5	6/10	0	5 - MCL 17 - CREG
TCE	ND–3.1	2.5	4/10	0	5 - MCL 0.76 - CREG
1,1,1-TCA	ND–72.3	22.9	10/10	0	200 - MCL
Cis-1,2-DCE	ND–9.3	4.3	4/10	0	70 – MCL
<i>After 1990 to present (Air stripper installed)</i>					
PCE	ND–1.5	1.2	4/81	0	5 - MCL 17 - CREG
TCE	ND–0.7	---	1/81	0	5 - MCL 0.76 - CREG
1,1,1-TCA	ND–15.5	3.2	37/81	0	200 - MCL
Cis-1,2-DCE	ND–3.3	1.4	12/81	0	70 – MCL

Source: Matt Newman, City of Milford, personal communication, July 2011

ppb – parts per billion

MCL – maximum contaminant level (U.S. EPA)

CREG – cancer risk evaluation guide (ATSDR)

ND – not detected

PCE – tetrachloroethylene

TCE – trichloroethylene

1,1,1-TCA – 1,1,1-trichloroethane

Cis-1,2-DCE – cis-1,2-dichloroethylene

Table 3. Chemicals Detected in Groundwater by Ohio EPA in 2009 and 2010

<i>Chemical</i>	<i>Detections (Well #) (ppb)</i>	<i>Frequency of Detections</i>	<i>Frequency Above Comparison Value</i>	<i>Comparison Value (ppb) and Source</i>
Public Wells (2/2/10)				
PCE	1.2 (PW-1) 9.9 (PW-3)	2/4	1	5 - MCL 17 - CREG
TCE	ND	0/4	0	5 - MCL 0.76 - CREG
Cis-1,2-DCE	ND	0/4	0	70
1,1,1-TCA	3.6 (PW-2) 9.6 (PW-1)	2/4	0	200
Monitoring Wells (8/4–6/09)				
PCE	9.6 (MW-10D) 16 (MW-15) 40 (MW-18) 31 (MW-19) 1,100 (MW-14) 530 (MW-17) 1,100 (MW-20)	7/15	7	5 - MCL 17 - CREG
TCE	39 (MW-17) 78 (MW-14) 57 (MW-20)	3/15	3	5 - MCL 0.76 - CREG
Cis-1,2-DCE	9.5 (MW-20)	1/15	0	70
1,1,1-TCA	10 (MW-11) 45 (MW-5D) 17 (MW-5S) 13 (MW-10S)	4/15	0	200

Source: U.S. EPA 2010 (HRS Documentation Record)

ppb – parts per billion or micrograms per liter

ND – non detect

MCL – Maximum Contaminant Level for drinking water (EPA)

CREG – cancer risk evaluation guide (ATSDR)

PCE – tetrachloroethylene

TCE – trichloroethylene

Cis-1,2-DCE – cis-1,2-dichloroethylene

1,1,1-TCA – 1,1,1-trichloroethane

Table 4. Exposure Pathways

Pathway Name	Exposure Pathway Elements					Time Frame for Exposure
	Source of Contamination	Fate and Transport	Point of Exposure	Route of Exposure	Potentially Exposed Population	
Groundwater Pathway						
Private drinking water	Unknown	Groundwater	None. No private wells in plume area.	Ingestion Inhalation Skin Contact	None	None
Public drinking water	Unknown	Groundwater	Tap water in homes that use public water	Ingestion Inhalation Skin Contact	Residents using the municipal water supply	Past (before 1990)
Vapor Intrusion Pathway						
Potential exposure to VOCs in homes and buildings	Unknown	Groundwater to soil gas to sub-slab to indoor air	Indoor air	Inhalation	People in homes and buildings in the vicinity	Past Current Future

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 chronic exposure].

Adverse health effect

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

Adsorption

Adherence of the atoms or molecules of a gas or liquid to the surface of another substance, such as soil.

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).

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.

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).

Concentration

The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant

A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Detection limit

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

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.

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 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.

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).

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).

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.

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].

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)

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).

ppb

A unit of measurement of concentration: parts per billion.

ppm

A unit of measurement of concentration: 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.

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.

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

Mathematical adjustments for reasons of safety when knowledge is incomplete. Typically set at ten, they are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use safety factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also called an uncertainty factor].

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.

Substance

A chemical.

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

Surface water

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

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).

Appendix B. Estimates of Exposure Doses and Determination of Health Effects

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 of exposure).
- 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:

- Past exposure to toxic chemicals (occupation, hobbies, etc.)
- Smoking, drinking alcohol, or taking certain medications
- Current health and nutritional status
- Age and gender
- Family medical history

The Health Assessment Section (HAS) of the Ohio Department of Health (ODH) evaluated exposures to groundwater in the Milford area. Ingestion of contaminated water is one of the most significant exposure pathways at this site. Showering or bathing with contaminated water can also result in VOC exposure. When showering in chlorinated hydrocarbon-contaminated water, a resident may be exposed from (1) breathing the portion of the contaminant that is released into the air and (2) absorbing the contaminant through the skin. Studies in humans have demonstrated that the internal dose of VOCs from showering (inhalation plus dermal) can be comparable to the exposure dose resulting from drinking the water (ATSDR 2005). Therefore, in our estimation of exposure, we have doubled the ingestion exposure to account for additional exposure from inhalation and dermal exposures. We also used default assumptions for the amount of water consumed per day by an average adult weighing 70 kg and a child weighing 16 kg.

Monitoring data from the plant tap, which represents water from up to four of the city's public wells that is blended and treated before being delivered to homes, were used to calculate exposure doses. Exposure doses were calculated using the maximum VOC concentrations detected in the finished water before 1990. This was done to evaluate past exposures to contaminants before an air stripper treatment system was installed to remove VOCs from the water prior to distribution to homes. In addition, exposures after treatment (1990) were also evaluated for the public water supply (See Table B-1).

Exposure Dose Calculation

The following equation and the maximum detected concentrations of contaminants in the effluent tap were used to estimate upper limits for exposure to contaminants in groundwater:

$$ED = 2 \times \frac{C \times IR \times EF}{BW}$$

where:

- ED: Exposure dose expressed in mg/kg/day
 C: Maximum concentration in parts per million (mg/L)
 IR: Intake rate of contaminated water: adult = 2 liters per day; child = 1 liter per day
 EF: Exposure factor (unitless)
 BW: Body weight (kg): adult = 70 kg; child = 16 kg

Example:

$$ED_{PCE} = 2 \times \frac{0.0045 \text{ mg/L} \times 2 \text{ L/day} \times 1}{70 \text{ kg}} = 0.00026 \text{ mg/kg/day}$$

Table B-1. Estimated Exposure Doses to Chemicals of Concern

Chemical	Maximum Concentration (ppb)	Quarter-Year	Estimated Exposure Dose (mg/kg/day)		MRL (mg/kg/day)	RfD (mg/kg/day)
			Adult	Child		
From 1988 to 1990						
PCE	4.5	3-1990	0.00026	0.00056	0.05	0.006
TCE	3.1	4-1988	0.00018	0.00038	0.2	0.0005
1,1,1-TCA	72.3	3-1990	0.0042	0.0090	20	2
Cis-1,2-DCE	9.3	4-1988	0.00054	0.0012	0.3	0.002
After 1990 to present (Air Stripper Installed)						
PCE	1.5	1-1995	0.000086	0.00019	0.05	0.006
TCE	0.7	1-1995	0.00004	0.000088	0.2	0.0005
1,1,1-TCA	15.5	1-1995	0.00088	0.0019	20	2
Cis-1,2-DCE	3.3	1-1995	0.00019	0.00042	0.3	0.002

Source: City of Milford, pers. comm., July 2011

ppb – parts per billion or micrograms per liter

PCE – tetrachloroethylene

TCE – trichloroethylene

1,1,1-TCA – 1,1,1-trichloroethane

Cis-1,2-DCE – cis-1,2-dichloroethylene

MRL – Minimal Risk Level (ATSDR)

RfD – Reference Dose (U.S. EPA)

Cancer Risk Calculation

Exposure to a cancer-causing compound, even at low concentrations, is assumed to be associated with some increased risk. The estimated cancer risk from exposure to contaminants associated with this site was calculated by multiplying the estimated exposure dose with the cancer slope

factor (CSF) for the chemical of concern. This calculation estimates the excess cancer risk expressed as a proportion of the population that may be affected by a carcinogen during a lifetime of exposure. For example, an estimated cancer risk of 1×10^{-4} represents a possible 1 additional cancer case in a population of 10,000. The following equation was used to estimate possible excess cancer risk in a population:

$$ER = CSF \times ED$$

where:

ER: Estimated cancer risk (unitless)

CSF: Cancer slope factor expressed in $(\text{mg/kg/day})^{-1}$

ED: Estimated exposure dose expressed in mg/kg/day

Because of conservative safety factors used to calculate the CSFs, using these values provides only a estimate of risk; the true or actual risk is unknown and could be as low as zero.

PCE and TCE are both considered to be reasonably anticipated to be human carcinogens, according to the National Toxicology Program at the U.S. Department of Health and Human Services. The U.S. EPA has recently characterized TCE as carcinogenic to humans by all routes of exposure and PCE as likely to be carcinogenic to humans by all routes of exposure (U.S. EPA 2012). HAS calculated the estimated increase in cancer risk from exposure to PCE- and TCE-contaminated water, assuming a 70-year (lifetime) exposure. The exposure scenario assumed a 70 kg adult exposed to the maximum concentration of PCE or TCE detected before and after treatment via air stripping in 1990. Using the current U.S. EPA cancer slope factor (CSF) for PCE of 2.1×10^{-3} per mg/kg/day (U.S. EPA 2012) and a CSF of 4.6×10^{-2} per mg/kg/day for TCE (U.S. EPA 2011), the resulting estimates of increased risk are given below:

Table B-2. Estimated Cancer Risk

<i>Chemical</i>	<i>Maximum Concentration (ppb)</i>	<i>Exposure Dose</i>	<i>Cancer Slope Factor (mg/kg/day)⁻¹</i>	<i>Estimated Cancer Risk</i>
<i>From 1988 to 1990</i>				
PCE	4.5	2.6×10^{-4}	2.1×10^{-3}	5.4×10^{-7}
TCE	3.1	1.8×10^{-4}	4.6×10^{-2}	8.1×10^{-6}
<i>After 1990 to present (Air Stripper Installed)</i>				
PCE	1.5	8.6×10^{-5}	2.1×10^{-3}	1.8×10^{-7}
TCE	0.7	4.0×10^{-5}	4.6×10^{-2}	1.8×10^{-6}

ppb – parts per billion or micrograms per liter

PCE – tetrachloroethylene

TCE – trichloroethylene

The estimated cancer risks are extremely low when compared to the cancer risk range typically used by the U.S. EPA (1×10^{-6} to 1×10^{-4}). The true risk is likely to be even less when considering exposure durations less than a lifetime (70 years) of exposure.

Appendix C. Response to Agency and Public Comments

Government agencies and the general public were asked to review this Public Health Assessment for the Milford Contaminated Aquifer site and provide comments and questions. The Initial/Public Comment Release, dated January 30, 2012, was made available for public comment until March 15, 2012. The document was available for public review on the Ohio Department of Health web page at <http://www.odh.ohio.gov>. Printed copies of the assessment were also available at the Clermont County Public Library, Milford-Miami Township Branch, 1099 State Route 131, Milford, OH 45150. The U.S. Environmental Protection Agency (U.S. EPA) did not have any comments. Comments were received from the Ohio Environmental Protection Agency (Ohio EPA). No comments or questions were received from the community regarding suspected exposures or health effects from exposures from the Milford Contaminated Aquifer.

Ohio Environmental Protection Agency Comments:

I found an error on page 3, last paragraph, second to last sentence. It says **“In addition, the City of Milford installed a new well (PW-4) which has not shown contamination since its initial operation in 2008.”** This is not correct. Ohio EPA collected water samples from PW-4 on three separate occasions in 2009 as part of the supplemental expanded site assessment (SESI). The second SESI sample from PW-4 had traces of TCA (0.79 ug/l). This is an extremely low concentration but it was a positive detection. This was during a period of time when PW-3 was out of commission and the other three public wells started seeing more contaminants than when PW-3 is in use. I suggest modifying the PHA text to take this into consideration.

Response: The city data also showed low concentrations of 1,1,1-trichloroethane. The text was modified to read: “In addition, the City of Milford installed a new well (PW-4) which has not shown significant contamination, except for traces of 1,1,1-trichloroethane, since its initial operation in 2008.”

1. This is related to the SESI detection of TCA in PW-4. On page 6, first paragraph, a sentence about mid-paragraph says **“The site was proposed for and added to the NPL because *some* of the City of Milford’s public water supply wells were contaminated with volatile organic compounds (VOCs).”** Since all four wells have had detections the word *some* causes me a problem because it isn’t quite right. On the other hand saying all the wells were contaminated when the concentrations vary quite a bit, wouldn’t be a really accurate statement either. Instead, could you say that the site was added to the NPL simply because VOCs have been detected in groundwater within the well field? That would avoid the well issue.

Response: The U.S. EPA Fact Sheet (December 2011) indicates that three wells have been affected. So, with this in mind, the sentence was changed to read: “The site was added to the NPL because the contaminated groundwater plume has affected three of the City of Milford’s public water supply wells, which were discovered to be contaminated with volatile organic compounds (VOCs).”

2. Page 6, Background section, Site Location and Description, second to last sentence says **“In 1990, the City of Milford installed an air stripper to remove the volatile**

organic compounds (VOCs) before final treatment of the water.” To me this implies that all water goes through the stripper. I checked with Matt Newman and he says in the past Milford only stripped wells PW 1 & PW 3. Since September of 2011 Milford has been running all 4 wells over the stripper. It is easier to manage the plant that way. I guess no change to the PHA is needed regarding stripping.

Response: No change.

3. Page 7, first paragraph, third sentence says **“The raw water is passed through a treatment process which includes air stripping, which reduces the levels of VOCs present in the raw water to levels that are well below federal drinking water maximum contaminant levels.”** You might specify here that since September 2011 the raw water..... This might also be a good place to say that prior to September 2011 only water from wells PW1 & PW3 went through the stripper.

Response: Added the following two sentences to this section: “Prior to September 2011, only water from wells PW-1 and PW-3, the two most highly contaminated wells, were passed through the air stripper.” And: “Since September of 2011, Milford has been running all four wells over the air stripper (Randy Watterworth, personal communication, 2012).”

4. Page 7, section on chemicals detected in the public water supply, third sentence says **“Since then, tetrachloroethylene (PCE), trichloroethylene (TCE), and 1,1,1-trichloroethane (1,1,1-TCA) have been detected in PW-3 at levels exceeding the maximum contaminant levels.”** As table 1 indicates, only PCE has exceeded MCLs consistently in PW-3 so this sentence is not accurate. It should probably say that PCE was above MCLs and TCE and TCA were detected at concentrations below their MCLs.

Response: Based on the city’s results, all three compounds have, at one time or another exceeded their MCLs. The sentence was changed to read: “Since then, tetrachloroethylene (PCE), trichloroethylene (TCE), and 1,1,1-trichloroethane (1,1,1-TCA) have been detected in PW-3 at concentrations above MCLs, the maximum contaminant levels established by the U.S. EPA under the Safe Drinking Water Act, for 80 percent, 22 percent, and 2 percent of the time, respectively (Table 1).”

5. Page 7, section on chemicals detected in the public water supply, a sentence near the bottom says **“PW-4 is a new well and so far has had no significant detections of VOCs since 2008 (Table 1).”** This is a true statement but contradicts earlier statements about no detections in PW-4. Also, Table 1 apparently does not take into account samples collected by Ohio EPA. For instance, the 9/14/2009 sample Ohio EPA collected from PW-4 detected 0.19 ug/l of TCA. I don’t see a reason to add all the historic Ohio EPA into the analysis in Table 1 but it should be made clear that there are additional samples collected by Ohio EPA and the table is limited to sample results collected by Milford.

Response: To clarify, the title of Table 1 was changed to read: “Chemicals Detected in Public Wells by City of Milford.” Ohio EPA data is presented in Table 3, Chemicals Detected in Groundwater by Ohio EPA in 2009 and 2010. However, the detections of 1,1,1-TCA in PW-4 do not appear to be included in the source used to create that table, the U.S. EPA HRS Documentation Record.

6. Page 8, paragraph beginning “in 2006”, second sentence says **“PCE was detected in the sub-slab soil gas at the Baker Party Store at a concentration of 350 ppb (U.S. EPA 2010a).”** I’ve usually seen sub-slab concentrations given as units of parts per billion by volume (ppbv) rather than ppb. I’m not sure this is important but it caught my eye. Same comment for the last sentence on page 10 where ppb is used rather than ppbv.
Response: We prefer to use parts per billion as ppb alone rather than ppbv or $\mu\text{g}/\text{m}^3$ (micrograms per cubic meter) when presenting environmental results to the general public. The reason is that “ppb” is commonly used and understood by the lay person and “by volume” may be unnecessary.
7. Page 10, bottom of first large paragraph says **“The air stripper was installed in 1990 and has been in operation since then (Matt Newman, personal communication).”** This would be another good place to be more clear about the history of use of the air stripper ie PW-1 and P#-3 only prior to September 2011, all wells since then.
Response: Added to page 10: “Initially, only water from wells PW-1 and PW-3, the most contaminated wells, were passed through the air stripper. Since September 2011, Milford has been running water from all four wells through the air stripper (Randy Watterworth, personal communication, 2012).”
8. Conclusion 1, page 17 near the bottom says **“An air stripper was installed in 1990 and has been in operation since then to remove VOCs from the raw water in the well field.”** Another opportunity for air stripper use history.
Response: The air stripper use history was added to the text on pages 7 and 10. The details were not included in Conclusion 1 on page 17, because the conclusion statement should be succinct and not repeat large portions of statements presented in previous sections, according to ATSDR PHA guidance.

Additional Ohio Environmental Protection Agency Comments:

1. **Conclusion one pg 3**
Volatile organic compounds (VOCs) found in the City of Milford’s public water supply are not expected to harm people’s health because VOC levels in the ~~treated~~ **finished** city water are **treated** below levels of health concern.
Response: Changed Conclusion 1 to read: “Volatile organic compounds (VOCs) found in the City of Milford’s public water supply are not expected to harm people’s health. The reason for this is that the water is treated so that VOCs in the finished city water are below levels of health concern.”
2. **Site Location and Description pg 6**
In 1990, the City of Milford installed an air stripper to remove the volatile organic compounds (VOCs) ~~before final treatment of the water~~. Although VOCs are present in the raw water in the well field, the finished drinking water after treatment currently meets **both state and** federal drinking water standards.
Response: Changes made as suggested.

3. **CONCLUSIONS pg 17**

Although VOCs are present in the raw water, the finished drinking water after treatment currently meets *both state and* federal drinking water standards.

Response: Changes made as suggested.

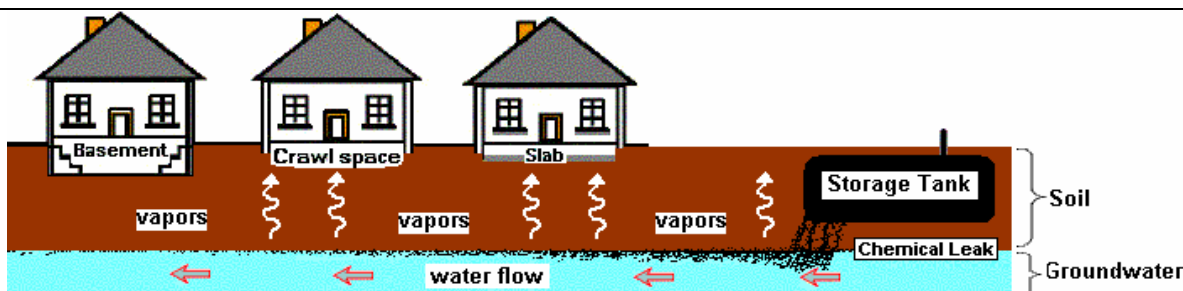


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Vapor Intrusion

Answers to Frequently Asked Health Questions



What is vapor intrusion?

Vapor intrusion refers to the vapors produced by a chemical spill/leak that make their way into indoor air. When chemicals are spilled on the ground or leak from an underground storage tank, they will seep into the soils and will sometimes make their way into the groundwater (underground drinking water). There are a group of chemicals called volatile organic compounds (VOCs) that easily produce vapors. These vapors can travel through soils, especially if the soils are sandy and loose or have a lot of cracks (fissures). These vapors can then enter a home through cracks in the foundation or into a basement with a dirt floor or concrete slab.

VOCs and vapors:

VOCs can be found in petroleum products such as gasoline or diesel fuels, in solvents used for industrial cleaning and are also used in dry cleaning. If there is a large spill or leak resulting in soil or groundwater contamination, vapor intrusion may be possible and should be considered a potential public health concern that may require further investigation.

Although large spills or leaks are a public health concern, other sources of VOCs are found in everyday household products and are a more common source of poor indoor air quality. Common products such as paint, paint strippers and thinners, hobby supplies (glues), solvents, stored fuels (gasoline or home heating fuel), aerosol sprays, new carpeting or furniture, cigarette smoke, moth balls, air fresheners and dry-cleaned clothing all contain VOCs.



Can you get sick from vapor intrusion?

You can get sick from breathing harmful chemical vapors. But getting sick will depend on:

How much you were exposed to (dose).

How long you were exposed (duration).

How often you were exposed (frequency).

How toxic the spill/leak chemicals are.

General Health, age, lifestyle: Young children, the elderly and people with chronic (on-going) health problems are more at risk to chemical exposures.

VOC vapors at high levels can cause a strong petroleum or solvent odor and some persons may experience eye and respiratory irritation, headache and/or nausea (upset stomach). These symptoms are usually temporary and go away when the person is moved to fresh air.

Lower levels of vapors may go unnoticed and a person may feel no health effects. A few individual VOCs are known carcinogens (cause cancer). Health officials are concerned with low-level chemical exposures that happen over many years and may raise a person's lifetime risk for developing cancer.

How is vapor intrusion investigated?

In most cases, collecting soil gas or groundwater samples near the spill site is done first to see if there is on-site contamination. If soil vapors or groundwater contamination are detected at a spill site, environmental protection and public health officials may then ask that soil vapor samples be taken from areas outside the immediate spill site and near any potential affected business or home. The Ohio Department of Health (ODH) does not usually recommend indoor air sampling for vapor intrusion before the on-site contamination is determined.

(continued on next page)

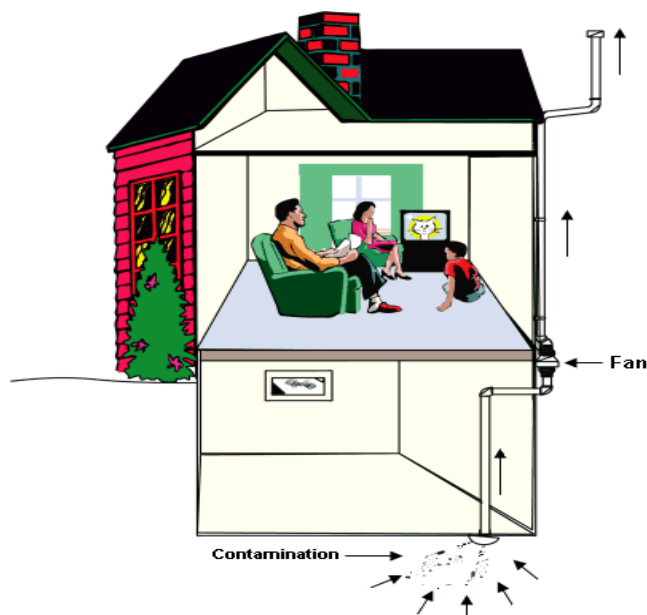
How is vapor intrusion investigated? (continued)

Because a variety of VOC sources are present in most homes, testing will not necessarily confirm VOCs in the indoor air are from VOC contamination in soils at nearby spill site. But if additional sampling is recommended, samples may be taken from beneath the home's foundation (called sub-slab samples), to see if vapors have reached the home. Sub-slab samples are more reliable than indoor air samples and are not as affected by other indoor chemical sources. If there was a need for additional sampling on a private property, homeowners would be contacted by the cleanup contractor or others working on the cleanup site and their cooperation and consent would be requested before any testing/sampling would be done.

What happens if a vapor intrusion problem is found?

If vapor intrusion is having an effect on the air in your home, the most common solution is to install a *radon mitigation system*. A radon mitigation system will prevent gases in the soil from entering the home. A low amount of suction is applied below the foundation and the vapors are vented to the outside. The system uses minimal electricity and should not noticeably affect heating and cooling efficiency. This mitigation system also prevents radon from entering the home, an added health benefit. Usually, the party responsible for cleaning up the contamination is also responsible for paying for the installation of this system. Once the contamination is cleaned up, the system should no longer be needed. In homes with on going radon problems, ODH suggests these systems remain in place permanently.

Radon Mitigation System



What can you do to improve your indoor air quality?

As stated before, the most likely source of VOCs in indoor air comes from the common items that are found in most homes. The following helpful hints will help improve air quality inside your home:

- ❖ Do not buy more chemicals than you need and know what products contain VOCs.
- ❖ If you have a garage or an out building such as a shed, place the properly stored VOC-containing chemicals outside and away from your family living areas.
- ❖ Immediately clean and ventilate any VOC spill area.
- ❖ If you smoke, go outside and/or open the windows to ventilate the second-hand, VOC-containing smoke outdoors.
- ❖ Make sure all your major appliances and fireplace(s) are in good condition and not leaking harmful VOC vapors. Fix all appliance and fireplace leaks promptly, as well as other leaks that cause moisture problems that encourage mold growth.
- ❖ Most VOCs are a fire hazard. Make sure these chemicals are stored in appropriate containers and in a well-ventilated location and away from an open pilot light (flame) of a gas water heater or furnace.
- ❖ Fresh air will help prevent both build up of chemical vapors in the air and mold growth. Occasionally open the windows and doors and ventilate.
- ❖ Test your home for radon and install a radon detector.

References:

Wisconsin Department of Health and Family Services, Environmental Health Resources, Vapor Intrusion, electronic, 2004.

New York State Department of Health, Center for Environmental Health, April 2003.

Ohio Department of Health, Bureau of Environmental Health, Indoor Environment Program, 2004.

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Tetrachloroethylene (PCE)

Other names for tetrachloroethylene include PCE, perchloroethylene, PERC or tetrachloroethene.

What is PCE?

Tetrachloroethylene (also known as PCE, PERC or perchloroethylene) is a man-made liquid chemical that is widely used for dry cleaning clothes and degreasing metal. It is also used to make other chemicals and can be found in some household products such as water repellents, silicone lubricants, spot removers, adhesives and wood cleaners. It easily evaporates (turn from a liquid to a gas) into the air and has a sharp, sweet odor. PCE is a nonflammable (does not burn) liquid at room temperature.

How does PCE get into the environment?

PCE can evaporate into the air during dry cleaning operations and during industrial use. It can also evaporate into the air if it is not properly stored or was spilled. If it was spilled or leaked on the ground, it may find its way into groundwater (underground drinking water).

People can be exposed to PCE from the environment from household products, from dry cleaning products and from their occupation (work). Common environmental levels of PCE (called background levels) can be found in the air we breathe, in the water we drink and in the food we eat. In general, levels in the air are higher in the cities or around industrial areas where it is used more than rural or remote areas.



The people with the greatest chance of exposure to PCE are those who work with it. According to estimates from a survey conducted by the National Institute for Occupational Safety and Health (NIOSH), more than 650,000 U.S. workers may be exposed. However, the air close to dry cleaning business and industrial sites may have levels of PCE higher than background levels. If the dry cleaning business or industry has spilled or leaked PCE on the ground, there may also be contaminated groundwater as well.

What happens to PCE in the environment?

Much of the PCE that gets into surface waters or soil evaporates into the air. However, some of the PCE may make its way to the groundwater.

Microorganisms can break down some of the PCE in soil or underground water.

In the air, it is broken down by sunlight into other chemicals or brought back to the

soil and water by rain. PCE does not appear to collect in fish or other animals that live in water.



How can PCE enter and leave my body?

PCE can enter your body when you breathe contaminated air or when you drink water or eat food contaminated with the chemical. If PCE is trapped against your skin, a small amount of it can pass through into your body. Very little PCE in the air can pass through your skin into your body. Breathing contaminated air and drinking water are the two most likely ways people will be exposed to PCE. How much enters your body depends on how much of the chemical is in the air, how fast and deeply you are breathing, how long you are exposed to it or how much of the chemical you eat or drink.

Most PCE leaves your body from your lungs when you breathe out. This is true whether you take in the chemical by breathing, drinking, eating, or touching it. A small amount is changed by your body (in your liver) into other chemicals that are removed from your body in urine. Most of the changed PCE leaves your body in a few days. Some of it that you take in is found in your blood and other tissues, especially body fat. Part of the PCE that is stored in fat may stay in your body for several days or weeks before it is eliminated.

Can PCE make you sick?

Yes, you can get sick from contact with PCE. But getting sick will depend upon:

- How much you were exposed to (dose).
- How long you were exposed (duration).
- How often you were exposed (frequency).
- General Health, Age, Lifestyle Pregnant women, infants, young children, the elderly and people with chronic (on-going) health problems are more at risk to chemical exposures.

How can PCE affect my health?

Exposure to very high concentrations of PCE (particularly in closed, poorly ventilated areas) can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness and even death. Skin irritation may result from repeated or extended contact with the pure liquid product. These symptoms occur almost entirely in work (or hobby) environments when people have been accidentally exposed to high concentrations or have intentionally used PCE to get a "high." Normal background levels (or common environmental levels) will not cause these health effects.

Does PCE cause cancer (carcinogen)?

The US National Toxicology Program (NTP) releases the *Report on Carcinogens* (RoC) every two years. The *Report on Carcinogens* (RoC) identifies two groups of agents: "*Known to be human carcinogens*" & "*Reasonably anticipated to be human carcinogens*"

The *Twelfth Report on Carcinogens* (RoC) has determined that PCE is reasonably anticipated to be human carcinogen.

PCE has been shown to cause liver tumors in mice and kidney tumors in male rats. There is limited evidence for the carcinogenicity in humans. PCE has been studied by observing laundry and dry-cleaning workers, but they may have also been exposed to other solvents, especially trichloroethylene (TCE) and petroleum solvents.

References:

Agency for Toxic Substances and Disease Registry (ATSDR). 1997. Toxicological Profile for tetrachloroethylene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service

Report on Carcinogens, Twelfth Edition; U.S. Department of Health and Human Services, Public Health Service, National Toxicology Program, 2011.
<http://ntp.niehs.nih.gov/ntp/roc/twelfth/roc12.pdf>

Is there a medical test to show whether you have been exposed to PCE?

One way of testing for PCE exposure is to measure the amount of the chemical in the breath, much the same way breath-alcohol measurements are used to determine the amount of alcohol in the blood. Because PCE is stored in the body's fat and slowly released into the bloodstream, it can be detected in the breath for weeks following a heavy exposure. Also, PCE and trichloroacetic acid (TCA), a breakdown product of PCE, can be detected in the blood. These tests are relatively simple to perform but are not available at most doctors' offices and must be done at special laboratories that have the right equipment. Because exposure to other chemicals can produce the same breakdown products in the urine and blood, the tests for breakdown products cannot determine if you have been exposed to PCE or the other chemicals that produce the same breakdown chemicals.

What has the federal government made recommendations to protect human health?

The EPA MCL for the amount of PCE that can be in drinking water is 5 parts per billion (ppb) or 0.005 milligrams PCE per liter of water (0.005 mg/L).

The Occupational Safety and Health Administration (OSHA) have set a limit of 100 ppm for an 8-hour workday over a 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) recommends that PCE be handled as a potential carcinogen and recommends that levels in workplace air should be as low as possible.

The Ohio Department of Health is in cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), Public Health Service, U.S. Department of Health and Human Services.

This pamphlet was created by the Ohio Department of Health, Bureau of Environmental Health, Health Assessment Section and supported in whole by funds from the Cooperative Agreement Program grant from the ATSDR.





**Bureau of
Environmental Health
Health Assessment Section**

"To protect and improve the health of all Ohioans"

Trichloroethylene (TCE)

(try- klor'oh eth'uh- leen)

Answers to Frequently Asked Health Questions

What is TCE?

TCE is a man-made chemical that is not naturally found in the environment. TCE is a non-flammable (does not burn), colorless liquid with a somewhat sweet odor and sweet, "burning" taste. It is mainly used as a cleaner in industry to remove grease from metal parts. TCE can also be found in common household items such as glues, paint removers, typewriter correction fluids and spot removers.

The biggest source of TCE in the environment comes from evaporation (changing from a liquid into a vapor/gas) when industries use TCE to remove grease from metals or when we use common household products that contain TCE. It can also contaminate soils and groundwater (underground drinking water) as the result of spills or improper disposal.

What happens to TCE in the environment?

- Upon contact with the air, TCE quickly evaporates and breaks down in the sunlight and oxygen.
- TCE quickly evaporates from the surface waters of rivers, lakes, streams, creeks and puddles.
- If large amounts of TCE are spilled on the ground, some of it will evaporate and some of it may leak down into the soils. When it rains, TCE can be carried through the soils and into the groundwater (drinking water).
- When TCE-contaminated groundwater is in an anaerobic (without oxygen) environment and with time, it will break down into different chemicals such as 1,2 Dichloroethene (1,2 DCE) and Vinyl Chloride (VC).
- TCE does not build up in plants and animals.
- TCE found in foods is believed to come from TCE contaminated water used in food processing or from food processing equipment cleaned with TCE.

How does TCE get into your body?

- **Breathing (Inhalation):** TCE can get into your body by breathing air contaminated with TCE vapors. The vapors can be released from the industrial use of TCE, from using household products that contain TCE, or by TCE contaminated water evaporating in the shower.
- **Drinking (Ingestion):** TCE can get into your body by drinking TCE contaminated water.
- **Skin (Dermal):** Small amounts of TCE can get into your body through skin contact. This can take place when using TCE as a cleaner-degreaser or by contact with TCE contaminated soils.

Can TCE make you sick?

Yes, you can get sick from TCE. But getting sick will depend on the following:

- How much you were exposed to (dose).
- How long you were exposed (duration).
- How often you were exposed (frequency).
- General Health, Age, Lifestyle Young children, the elderly and people with chronic (on-going) health problems are more at risk to chemical exposures.

How does TCE affect your health?

Breathing (Inhalation):

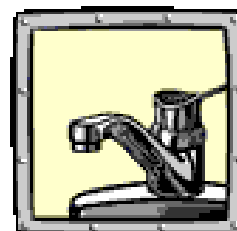
- Breathing high levels of TCE may cause headaches, lung irritation, dizziness, poor coordination (clumsy) and difficulty concentrating.
- Breathing very high levels of TCE for long periods may cause nerve, kidney and liver damage.

Drinking (Ingestion):

- Drinking high concentrations of TCE in the water for long periods may cause liver and kidney damage, harm the immune system and damage fetal heart development in pregnant women.
- It is uncertain whether drinking low levels of TCE will lead to adverse health effects.

Skin (Dermal) Contact:

- Short periods of skin contact with high levels of TCE may cause skin irritation and rash.



Does TCE cause cancer?

In September of 2011 the U.S. EPA revised their Integrated Risk Information System (IRIS) numbers for cancer and non-cancer effects for Trichloroethylene (TCE). The U.S. EPA newly revised IRIS document has classified TCE as "carcinogenic to humans." This classification is used when there is evidence between human exposure and cancer.

The National Toxicology Program's 12th Report on Carcinogens list TCE as *Reasonably Anticipated to be a Human Carcinogen*. **NOTE:** The 12th Report on Carcinogens was released prior to the release of the new EPA IRIS revision. It is likely the next Report on Carcinogens will reflect the EPA IRIS number changes.

Is there a medical test to show whether you have been exposed to TCE?

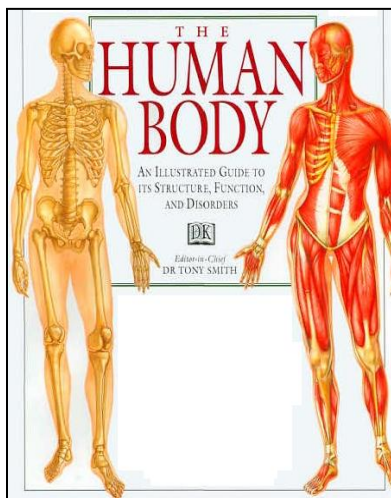
Yes, medical testing is available to determine recent exposure(s).

- TCE can be measured in your breath, but only if you have been exposed to **large** amounts (part per million -- ppm levels).
- Blood or urine samples can also be used, but only if you have been exposed to **large** amounts (part per million -- ppm levels).

TCE in the human body:

When chemicals enter the human body, they typically get broken down and eliminated through normal bodily functions. Some of the break down products (called metabolites) of TCE can be measured in your blood or urine. However, some of the same metabolites in your blood and urine can also be produced as a result of exposure to similar chemicals and other sources (diet, medications, environment, etc.). For this reason, blood and urine testing is not always an accurate measure of exposure to TCE.

It is important to note TCE and TCE's metabolites usually leave the body shortly after exposure, so the testing would only be useful for recent exposures. Also, testing may not be useful or reliable in determining whether people have been exposed to low-doses of TCE or whether they will experience any harmful health effects.



Has the federal government made recommendations to protect human health?

The federal government develops regulations and recommendations to protect public health and these regulations can be enforced by law.

Recommendations and regulations are periodically updated as more information becomes available. Some regulations and recommendations for TCE follow:

- ✓ On 09/28/2011 the U.S. EPA revised their Integrated Risk Information System (IRIS) numbers for Trichloroethylene (TCE) (CASRN 79-01-6) -- see below reference section for link --
- The Environmental Protection Agency (EPA) has set a maximum contaminant level (MCL) for TCE in drinking water at 0.005 milligrams per liter (0.005 mg/L) or 5.0 parts of TCE per billion parts water (5.0 ppb).
- The Occupational Safety and Health Administration (OSHA) have set an exposure limit of 100 ppm (or 100 parts of TCE per million parts of air) for a healthy adult, 8-hour workday, 40-hour workweek.
- The EPA has developed regulations for the handling and disposal of TCE.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1997. Toxicological profile for TCE (electronic at <http://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=173&tid=30>)

Report on Carcinogens, Twelfth Edition; U.S. Department of Health and Human Services, Public Health Service, National Toxicology Program, 2011 (electronic at <http://ntp.niehs.nih.gov/ntp/roc/twelfth/roc12.pdf>)

U.S. EPA Integrated Risk Information System (IRIS) for Trichloroethylene (TCE) (CASRN 79-01-6) <http://www.epa.gov/iris/subst/0199.htm>

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**Bureau of
Environmental Health
Health Assessment Section**

"To protect and improve the health of all Ohioans"

1,2-Dichloroethene

(also called *cis*- and *trans*- 1,2 DCE)

Answers to Frequently Asked Health Questions

What is 1,2 DCE?

1,2-Dichloroethene (1,2 DCE) is a highly-flammable, chlorinated, colorless liquid that has a sharp, harsh odor. There are no known products you can buy that contain 1,2 DCE. 1,2 DCE is used when mixing other chlorinated chemicals and is most often used to produce chemical solvents.

How does 1,2 DCE enter the environment?

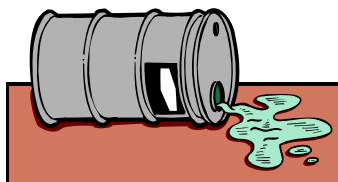
1,2 DCE is released to the environment from chemical factories that make or use this chemical, from landfills and hazardous waste sites that have a spill or leak, from chemical spills, from burning vinyl and from the chemical breakdown of other chlorinated chemicals in the underground drinking water (groundwater).

What happens to 1,2 DCE when it enters the environment?

Air: When spilled on moist soils or in rivers, lakes and other bodies of water, most of the 1,2 DCE quickly evaporates into the air. 1,2 DCE quickly breaks down by reacting with the sunlight. In the air, it usually takes about 5-12 days for half of any amount spilled to break down.

Water: The 1,2 DCE found below soil surfaces in landfills or hazardous waste sites may dissolve in water during rain events and leak deeper in the soils, possibly contaminating the groundwater. Once in groundwater, it takes about 13-48 weeks for half of any amount spilled to break down.

Soils: Some 1,2 DCE trapped under ground may escape as soil-gas vapors. These vapors can travel through soils, especially if the soils are sandy and loose or have a lot of cracks (fissures). The vapors can then enter a home through cracks in the foundation or into a basement with a dirt floor or concrete slab. 1,2 DCE in groundwater will eventually break down into vinyl chloride and other chemicals, some of which are more hazardous to people than the 1,2 DCE.



How can I be exposed to 1,2 DCE?

People who live in cities or suburbs are more likely to be exposed to 1,2 DCE than people living in rural areas. Most people who are exposed through air or water are exposed to very low levels, in the parts per billion (ppb) range.

Notes: "ppb" is a unit of measurement. Example: 1 part per billion (1 ppb) would be equal to having one bean in a pile of one billion beans.

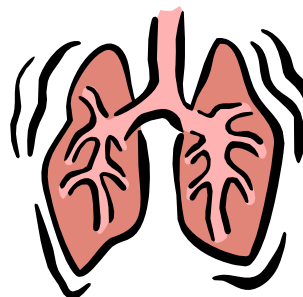
Human exposure to 1,2 DCE usually happens where the chemical has been improperly disposed of or spilled. Exposure mainly happens by breathing contaminated air or drinking contaminated water. If the water in your home is contaminated, you could also be breathing 1,2 DCE vapors while cooking, bathing or washing dishes.

The people who are most likely to be exposed to 1,2 DCE are people who work at factories where this chemical is made or used, people who work at a 1,2 DCE contaminated landfill, communities that live near contaminated landfills and hazardous waste sites.

How does 1,2 DCE enter and leave my body?

Most 1,2 DCE enters the body through your lungs when you breathe contaminated air (inhalation), through your stomach and intestines when you eat contaminated food or water (ingestion), or through your skin upon contact with the chemical (dermal).

Once breathed or swallowed, it enters your blood rapidly. Once in your blood, it travels throughout your body. When it reaches your liver it is changes into several other breakdown chemicals. Some of these chemicals are more harmful than 1,2 DCE.



Can 1,2 DCE make me sick?

Yes, you can get sick from exposure to 1,2 DCE. However, getting sick will depend on many factors such as:

- How much you were exposed to (dose).
- How long you were exposed (duration).
- How often you were exposed (frequency).
- How toxic is the chemical of concern.
- General Health, Age, Lifestyle
Young children, the elderly and people with chronic (on-going) health problems are more at risk to chemical exposures.

How can exposure to 1,2 DCE affect my health?

Most information about exposure to 1,2 DCE is from occupational studies where workers were exposed at very high levels. Most environmental exposures to 1,2 DCE are at much lower than those in the workplace.

The short-term occupational studies of workers exposed to breathing high levels of 1,2 DCE found workers became nauseous (upset stomach) and drowsy/tired.

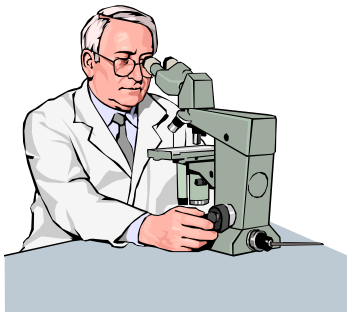
The long-term human health effects after exposure to low concentrations of 1,2 DCE are not known.

Will exposure to 1,2 DCE cause cancer?

The U.S. EPA classifies 1,2 DCE as a Class D carcinogen. The U.S. EPA Class D category is used when the chemical is not classifiable to its human carcinogenicity (ability to cause cancer). This classification is made because there is no solid data that this chemical causes cancer in humans or animals.

Is there a test to find out if I have been exposed to 1,2 DCE?

Tests are available to measure concentrations of 1,2 DCE in blood, urine and tissues. However, these tests aren't normally used to determine whether a person has been exposed to this compound. This is due to the fact that after you are exposed to 1,2 DCE, the breakdown products in your body that are detected with these tests may be the same as those that come from exposure to other chemicals. These tests aren't available in most doctors' offices, but can be done at special laboratories that have the right equipment.



What recommendations has the federal government made to protect human health?

The federal government has developed regulatory standards and guidelines to protect people from possible health effects of 1,2 DCE in water and air.

Water: The EPA has established water quality guidelines to protect both aquatic life and people who eat fish and shellfish. The EPA Office of Drinking Water has set a drinking water regulation that states that water delivered to any user of a public water system shall not exceed 70 ppb for cis-1,2 DCE and 100 ppb trans-1,2 DCE. For very short-term exposures (1 day) for children, EPA advises that concentrations in drinking water should not be more than 4 ppm for cis-1,2 DCE or 20 ppm for trans-1,2 DCE. For 10-day exposures for children, EPA advises that drinking water concentrations should not be more than 3 ppm for cis-1,2 DCE or 2 ppm for trans-1,2 DCE. For industrial or waste disposal sites, any release of 1,000 pounds or more must be reported to the EPA.

Air: The National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) have established guidelines for occupational exposure to cis- or trans-1,2 DCE. Average concentrations should not exceed 200 ppm in the air.

References:

Agency for Toxic Substances and Disease Registry (ATSDR). 1996. Toxicological profile for 1,2-Dichloroethene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

U.S. Environmental Protection Agency, Integrated Risk Information System, II.A.1. Weight-of-Evidence Characterization

Where Can I Get More Information?

Ohio Department of Health
Bureau of Environmental Health
Health Assessment Section
246 N. High Street
Columbus, Ohio 43215
Phone: (614) 466-1390



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**Bureau of
Environmental Health
Health Assessment Section**

"To protect and improve the health of all Ohioans"

1,1,1-Trichloroethane (1,1,1-TCA)

Answers to Frequently Asked Health Questions

What is 1,1,1-TCA?

1,1,1-TCA, also called methyl chloroform, is a man-made chemical that you will not find naturally in the environment. It is a colorless liquid with a sweet, sharp odor. 1,1,1-TCA dissolves very little in water and quickly evaporates (turns into a gas) when exposed to the air. 1,1,1-TCA burns easily when it comes in contact with a spark or flame.

Note: After January 1, 2002, no 1,1,1-TCA is to be manufactured for use in the U.S. because it may affect the earth's ozone layer.

How was 1,1,1-TCA used?

1,1,1-TCA was mainly used as a degreaser in industry, removing oil and grease from metal parts. It was also used as a solvent to dissolve other substances such as glues and paints. 1,1,1-TCA also had many common household uses as well. In the home, it was found in common products such as spot removers, cleaners, glues and aerosol sprays.

Where do you find 1,1,1-TCA in the environment?

1,1,1-TCA can be found in soil, water and air. Because it evaporates easily, it is most commonly found in the air. 1,1,1-TCA will also evaporate quickly from water and soil. It does not bind (stick) to soils, so it may easily leak into the under ground water (groundwater). Many cities in Ohio use groundwater as their drinking water supply. 1,1,1-TCA does not appear to build up in plants, animals or fish.

What happens to 1,1,1-TCA in the environment?

Most of the 1,1,1-TCA released into the environment enters the air. Once in the air, it can travel to the upper part of the earth's atmosphere, called the stratosphere (also called the ozone layer). There, sunlight breaks it down into other chemicals that may reduce the Earth's protective ozone layer.



How are you exposed to 1,1,1-TCA?

1,1,1-TCA can quickly enter your body if you breathe contaminated air (inhalation) and/or drink and eat contaminated food or water (ingestion). Very small amounts can be absorbed by skin contact (dermal).

1,1,1-TCA has been found in air samples taken from all over the world. However, normally you are not exposed to large enough amounts to cause health problems. Because 1,1,1-TCA was used so frequently in home and office products, much higher levels were found in the air inside the home or office than in the outdoor air.

If 1,1,1-TCA is released to surface and ground-water, individuals may be exposed through contaminated drinking water.

Occupational (worker) exposure to 1,1,1-TCA can occur during the use of metal degreasing agents, paints, glues and cleaning products.

Regardless of how 1,1,1-TCA enters your body, nearly all of it quickly leaves your body in the air you breath out (exhale). The small amount that is not breathed out can be changed in your body into other substances, known as metabolites. Most of the metabolites leave your body in the urine and breath within a few days.

Can you get sick from 1,1,1-TCA?

Yes, you can get sick. But getting sick will depend on the contact (exposure) you had with the chemical.

Exposure:

- How much you were exposed to (dose).
- How long you were exposed (duration).
- How often you were exposed (frequency).
- General Health, Age, Lifestyle Young children, the elderly and people with chronic (on-going) health problems are more at risk to chemical exposures.

What are some of the health problems caused by 1,1,1-TCA?

If you breathe high levels of 1,1,1-TCA for a short time, you may become dizzy, lightheaded and possibly lose your balance and coordination. These health effects quickly end when you stop breathing the contaminated air. If you breathe much higher levels of 1,1,1-TCA, you may become unconscious, your blood pressure may lower to dangerously low levels and your heart may stop beating.

We do not know if breathing low levels of 1,1,1-TCA for a long time causes harmful effects. Animals studies (mice and rats) show that breathing very high levels of 1,1,1-TCA damages the breathing passages, causes mild effects in the liver and affects the nervous system. There are no human studies that show that eating food or drinking water contaminated with 1,1,1-TCA could harm health.

The likelihood is very low that exposure to 1,1,1-TCA levels found near most hazardous waste sites would cause significant health effects.

Does 1,1,1-TCA cause cancer?

The EPA has classified 1,1,1-TCA as a Group D chemical, not classifiable as to human carcinogenicity. The Group D classification is based on no reported human data and inadequate animal data to suggest that exposure to this chemical can cause cancer.

The International Agency for Research on Cancer (IARC) has also determined that exposure to 1,1,1-TCA has not resulted in cancer in humans.

Is there a test to show whether you have been exposed to 1,1,1-TCA?

Samples of your breath, blood and urine can be tested to determine if you have recently been exposed to 1,1,1-TCA. To be of any value, samples of your breath or blood have to be taken within hours after the exposure and the urine samples have to be taken within 2 days after exposure.

In some cases, these tests can estimate how much 1,1,1-TCA has entered your body. However, these tests will not tell you whether your health will be affected by the exposure to 1,1,1-TCA.

These tests are not routinely done in your doctor's office, hospital and/or clinics because they require special lab equipment.



What has been done to protect human health?

The U.S. Environmental Protection Agency (U.S. EPA) has established a "maximum contaminant level" (MCL) for chemicals in water. If chemicals are found to be above the MCL, your water supplier must take steps to reduce the amount of chemicals so it falls below the level established by the EPA. **Note:** The MCL for 1,1,1-TCA is 200 parts per billion (ppb). In other words: 200 parts of 1,1,1-TCA per one billion parts of water.

After January 1, 2002, no 1,1,1-TCA is to be manufactured for use in the U.S. because it may affect the earth's ozone layer.

References:

Agency for Toxic Substances and Disease Registry (ATSDR). *Toxicological Profile for 1,1,1-Trichloroethane. (Update)*. U.S. Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA. July, 2006

U.S. Environmental Protection Agency. *Consumer Factsheet on: 1,1,1-Trichloroethane. Groundwater & Drinking Water*. November 2006.

U.S. Environmental Protection Agency. *Methyl chloroform (1,1,1-Trichloroethane)* 71-55-6. Technology Transfer Network Air Toxics Website. Rev. January 2000.

Where can I get more information?

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