Health Assessment Section
Ohio Department of Health
Bureau of Environmental Health

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Ohio Department of Health
Health Assessment Section

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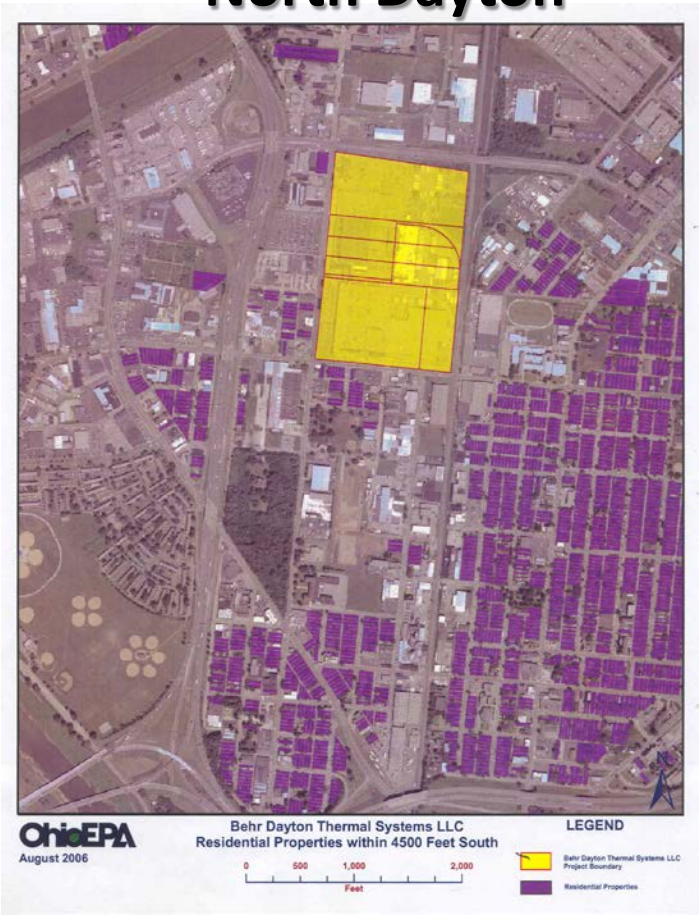
Dayton & Montgomery County Public Health
Prevent. Promote. Protect.

Behr Dayton Site
North Dayton



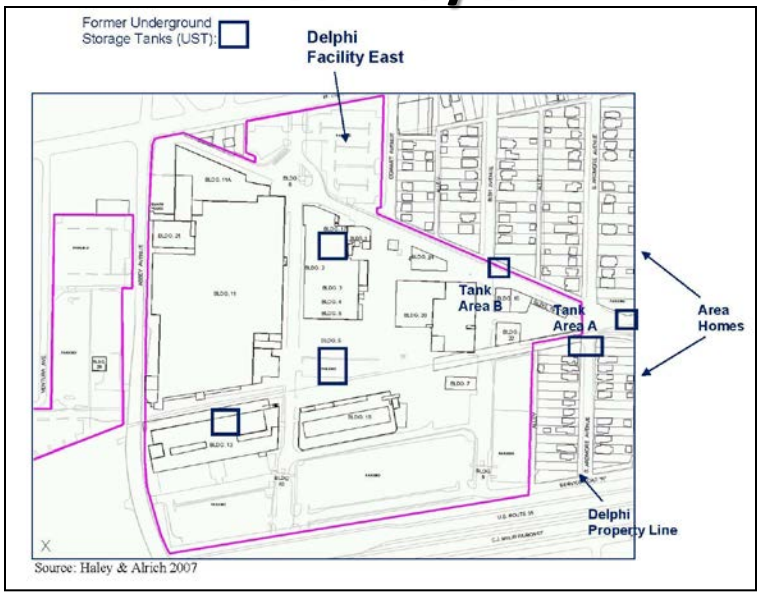
OHIO DEPARTMENT OF HEALTH
ODH
To protect and improve the health of all Ohioans

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

OhioEPA

Delphi Home Ave. Site
West Dayton



Springfield St. Site Riverside

U.S. EPA RACER Moraine Facility

Riverview Plat Vapor Intrusion Investigation

Chemicals of Concern

Trichloroethylene (TCE)

Tetrachloroethylene or Perchloroethylene (PCE)

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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 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.

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Trichloroethylene (TCE)

(try- klor'oh eth'uh- leen)
Answers to Frequently Asked Health Questions

What is TCE?

TCE is man-made chemical that is not found naturally in the environment. TCE is a non-flammable (does not burn), colorless liquid with a somewhat sweet odor and has a sweet, "burning" taste. It is mainly used as a cleaner to remove grease from metal parts. TCE can also be found in 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. But TCE also enters the air when we use common household products that contain TCE. It can also enter the soil and water as the result of spills or improper disposal.

What happens to TCE in the environment?

- TCE will quickly evaporate from the surface waters of rivers, lakes, streams, creeks and puddles.
- If TCE is spilled on the ground, some of it will evaporate and some of it may leak down into the ground. When it rains, TCE can sink through the soils and into the ground (underground drinking) water.
- When TCE is in an oxygen-poor environment and with time, it will break down into different chemicals such as 1,2 Dichloroethene and Vinyl Chloride.
- TCE does not build up in plants and animals.
- The 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?

- TCE can get into your body by breathing (inhalation) air that is polluted with TCE vapors. The vapors can be produced from the manufacturing of TCE, from TCE polluted water evaporating in the shower or by using household products such as spot removers and typewriter correction fluid.
- TCE can get into your body by drinking (ingestion) TCE polluted water.
- Small amounts of TCE can get into your body through skin (dermal) contact. This can take place when using TCE as a cleaner to remove grease from metal parts or by contact with TCE polluted 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 immune system functions and damage fetal development in pregnant women (although the extent of some of these effects is not yet clear).
- 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 rashes.

What are TCE and PCE?

- Both man-made, **volatile organic compounds (VOCs)**
- **Chlorinated Organic compounds** = made up of combinations of chlorine, hydrogen and carbon
- **Volatiles** = non-flammable clear liquids at room temperature that readily vaporize (to into a gas) upon exposure to the air
- Used by industry as solvents to remove grease from metal parts (heavily used by automobile manufacturers and parts industry in 60's and 70's)
- **PCE** widely used by dry cleaners to clean fabrics (i.e. dry-cleaning fluid)

What are TCE and PCE? (cont.)

- Upon being spilled on the ground, most TCE and PCE will vaporize to the air but some will also sink into the soil

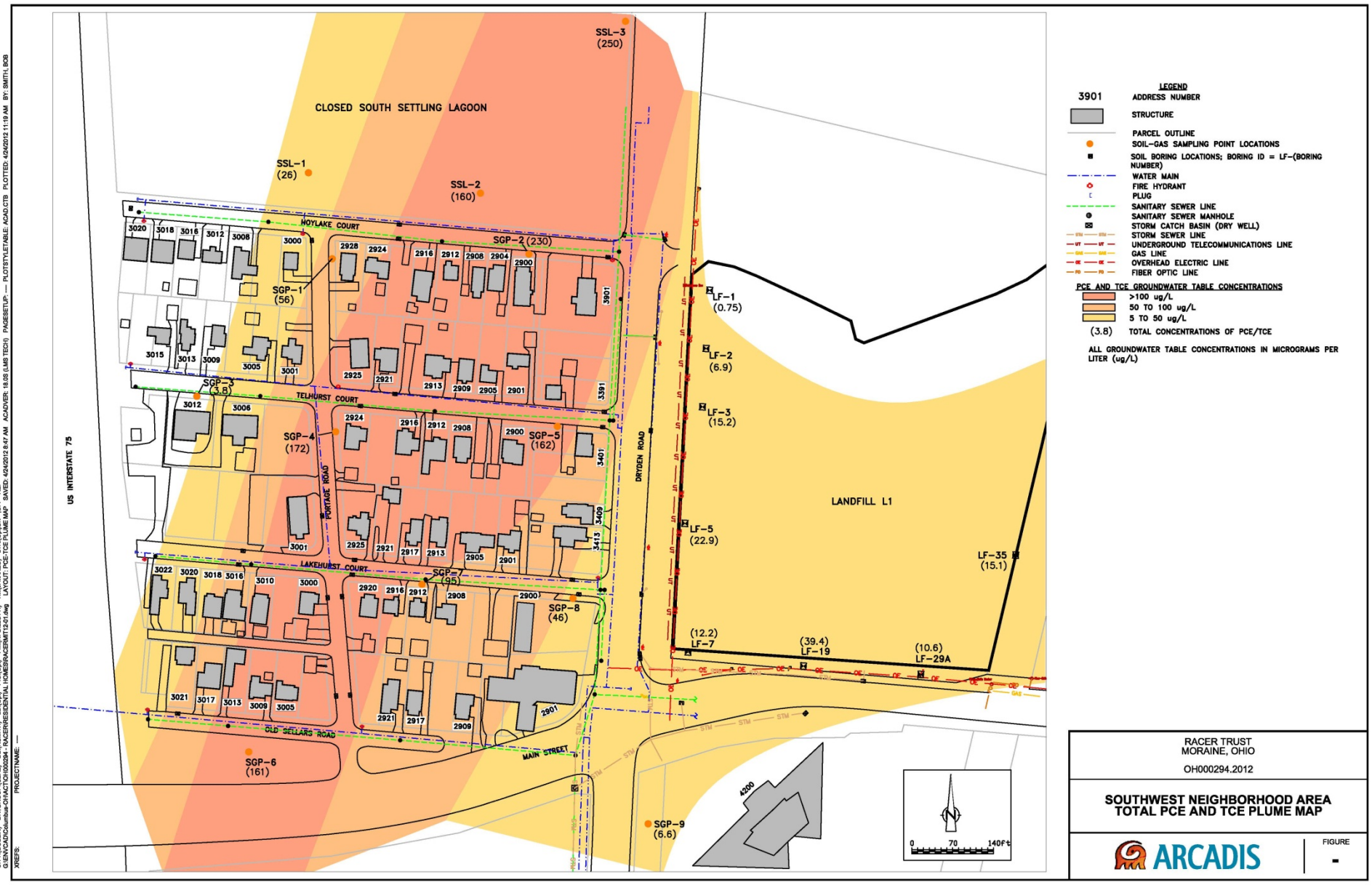
- TCE and PCE are heavier than water and will sink through porous and permeable soils (sands and gravels) down to the underground water table where it will partially mix with groundwater to form a “chlorinated solvent plume” that flows with the groundwater (towards the Great Miami River in Moraine)

- Chemicals on the groundwater surface will vaporize, resulting in vapor-phase TCE and PCE that rises up through the soil to the air

What are TCE and PCE? (cont.)

- Upon release to the air, both chemicals will break-down to simpler compounds in the presence of sunlight and oxygen over a period of several days (TCE) or several weeks (PCE)
- PCE can be detected as by its sharp, sweet odor at levels of 1,000 parts of PCE per billion parts of air (ppb)
- TCE can be detected in the air by its similar but somewhat more acrid odor at levels of 100,000 ppb in the air

Riverview Plat Neighborhood TCE/PCE Plume Map



RACER TRUST
MORAINE, OHIO

OH000294.2012

SOUTHWEST NEIGHBORHOOD AREA TOTAL PCE AND TCE PLUME MAP

ARCADIS

FIGURE -

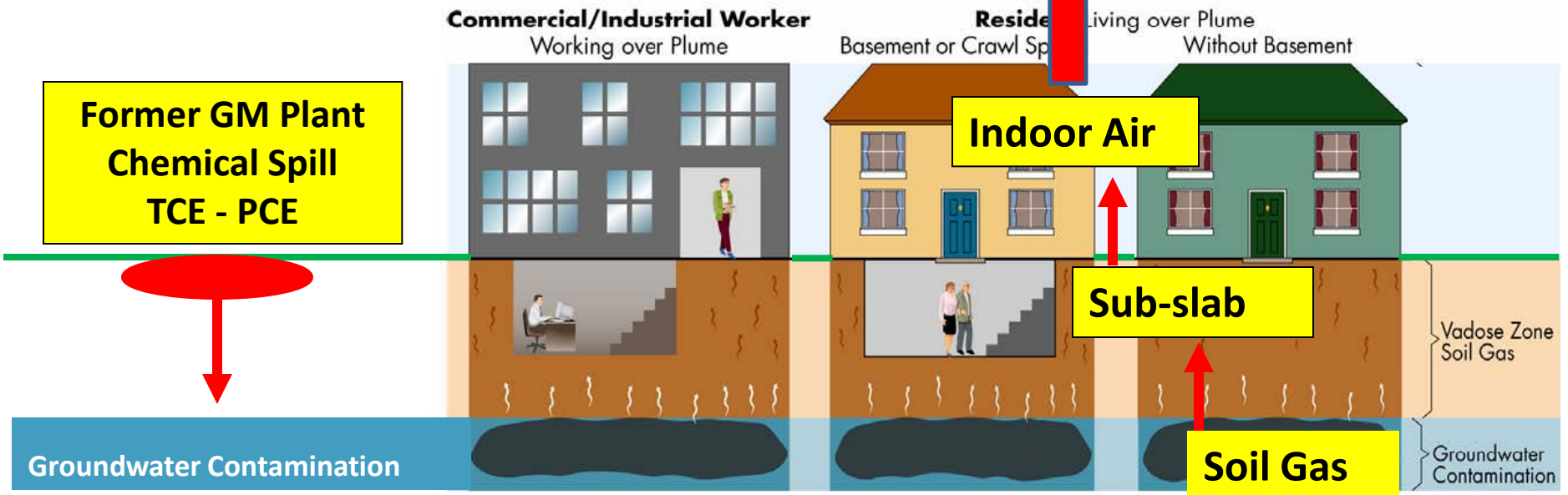
Units of measurement at the RACER Moraine Facility are measured in parts per billion (ppb). One (1) ppb would be equal to one (1) drop of water in an Olympic-sized pool.

Vapor Intrusion

Connecting The Dots

Riverview Plat Community

Completed Exposure Pathway



Former GM Plant Chemical Spill TCE - PCE

On-site Groundwater Contamination

Riverview Plat Groundwater Contamination

Factors Affecting Exposure and Health Effects

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

- **How much of the chemical a person is exposed to (the Dose)**
- **How long a person is exposed to the chemical (the Duration)**
- **How often a person is exposed to the chemical (the Frequency)**
- **How the chemical affects the body (the Toxicology of the chemical)**

Other factors affecting a chemical's likelihood of causing adverse health effects following exposure include:

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

Former GM Plant Chemical Contamination

TCE – PCE

On-site Groundwater

TCE = 810 ppb (Sept 2011) **TCE = 2,200 ppb (Nov 2001)**
PCE = 620 ppb (Sept 2011) **PCE = 15,000 ppb (Nov 2001)**

Riverview Plat Groundwater

TCE = 140 ppb
PCE = 180 ppb

Soil Gas

TCE = 2,900 ppb
PCE = 5,600 ppb

Sub Slab Soil Gas

TCE = 2,000 ppb
PCE = 3,700 ppb

Indoor Air

TCE = 9.3 ppb (average 1.2 ppb)
PCE = 22.0 ppb (average 2.2 ppb)

Note: Numbers based upon maximum levels detected

TCE Inhalation & Health Effects

Certainty

Well documented human health studies (workplace exposures)

Limited human health studies (calculated risk and modeling)

Uncertainty

10,000,000 ppb

1,000,000 ppb

Acute Human Effects:
200,000 ppb (irritation of eyes and respiratory tract)

Human Odor Threshold (where humans can smell TCE) = 100,000 ppb

100,000 ppb

Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL) = 100,000 ppb (based upon an 8 hr. work day -- industrial setting -- healthy adult)

Chronic Human Effects:
40,000 ppb (cancers, dizziness, headache, lack of coordination)

10, 000 ppb

1000 ppb

Former GM Moraine Site

November 2011 sampling

- 89 indoor air samples were collected from 42 properties
- Of the 89 samples, 63 had detections of TCE

100 ppb

U.S. EPA indoor air sampling at GM Moraine highest TCE value recorded in home = 9.3 ppb

10 ppb

U.S. EPA indoor air sampling at GM Moraine average TCE value recorded in homes = 1.2 ppb

1 ppb

U.S. EPA's Chronic inhalation Reference Concentration (RfC) = 0.4 ppb

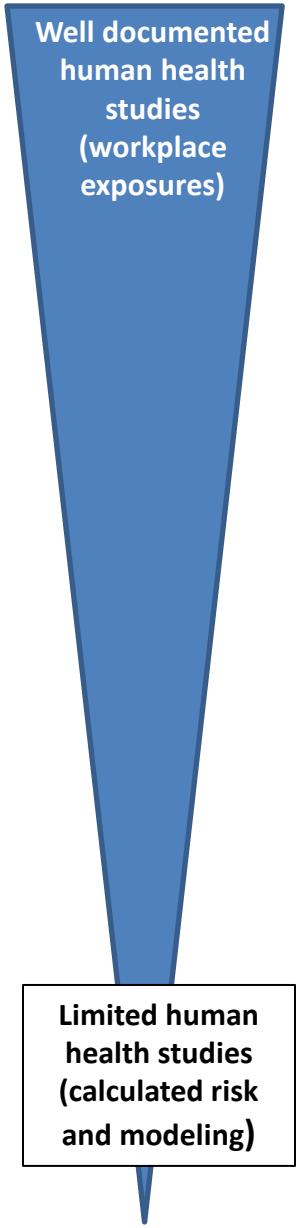
EPA Theoretical Additional Lifetime Cancer Risk Calculations for Chronic Inhalation Exposures
4.0 ppb = 1 in 10,000 risk 10^{-4}
0.4 ppb = 1 in 100,000 risk 10^{-5}
0.04 ppb = 1 in 1,000,000 risk 10^{-6}

Glossary of Terms:

- **Units measured in parts per billion (ppb).**
- **Acute exposure = short-term**
- **Chronic exposure = long-term**
- **Cancer Risk = Theoretical number of increases in cancer risk if a person is exposed 365 days a year for 70 years**
- **RfC = daily exposure that is unlikely to cause an adverse health effect**

Created: April 2012

PCE Inhalation & Health Effects



10,000,000 ppb

1,000,000 ppb

Acute Human Effects:
100,000 - 300,000 ppb (irritation eyes and respiratory tract)

100,000 ppb

Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL) = 100,000 ppb (based upon an 8 hr. work day -- industrial setting -- healthy adult)

Chronic Human Effects:
50,000 -200,00 ppb (cancers, dizziness, headache, lack of coordination)

10, 000 ppb

Human Odor Threshold (where humans can smell PCE) = 1000 ppb

1000 ppb

100 ppb

U.S. EPA indoor air sampling at GM Moraine highest PCE value recorded in a home = 22.0 ppb

10 ppb

U.S. EPA's Chronic inhalation Reference Concentration (RfC) = 6.0 ppb

1 ppb

U.S. EPA indoor air sampling at GM Moraine average PCE value recorded in homes = 2.2 ppb

Former GM Moraine Site

- 89 indoor air samples were collected from 42 properties
- Of the 89 samples, 82 had detections of PCE

Glossary of Terms:

- **Units measured in parts per billion (ppb).**
- **Acute exposure = short-term**
- **Chronic exposure = long-term**
- **Cancer Risk = Theoretical number of increases in cancer risk if a person is exposed 365 days a year for 70 years**
- **RfC = daily exposure that is unlikely to cause an adverse health effect**

EPA Theoretical Additional Lifetime Cancer Risk Calculations for Chronic PCE Inhalation Exposures
60.0 ppb = 1 in 10,000 risk 10^{-4}
6.0 ppb = 1 in 100,000 risk 10^{-5}
0.6 ppb = 1 in 1,000,000 risk 10^{-6}

Created: April 2012

Actions to take to reduce or eliminate residential exposure to TCE/PCE

Short-term interim actions to reduce exposure to TCE/PCE in indoor air

- Avoid prolonged exposure in basement areas, especially when its seal up in the winter months
- Open windows or otherwise ventilate basement areas when occupied
- Caulk and/or seal any visible cracks in basement floor/slab
- Install vinyl liners or plastic sheeting over bare-earth in crawl-spaces
- Install and operate home sub-slab vapor abatement systems (Radon reduction systems)

Actions to take to reduce or eliminate residential exposure to TCE/PCE (cont)

Long-term actions to reduce exposure to TCE/PCE in indoor air

- Intercept and contain contaminated groundwater plume under the former GM plant and up-stream of the Riverview Plat neighborhood

- Isolate and contain or remove the source of the contaminated groundwater plume under the former GM Moraine plant complex

For more information:

For health-related questions and/or information about public health involvement:

Public Health Dayton & Montgomery County
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For information about the site contamination and cleanup activities:

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