



Maryland Department of the  
Environment

# FACTS ABOUT: Vapor Intrusion

*The Land Restoration Program (LRP) is charged with assessing and cleaning up uncontrolled hazardous waste sites throughout Maryland to protect public health and the environment at sites historically contaminated by hazardous waste. Cleanups abate immediate uncontrolled discharges, ensure that contaminated soil does not pose a risk to public health and the environment, address groundwater contamination that may affect drinking water supplies or otherwise pose a risk to public health and the environment and address surface water discharges.*

## Purpose

This fact sheet provides general information on vapor intrusion issues. It also provides technical guidance for target indoor air and soil gas remedial goals at residential and commercial properties. It is intended to supplement other technical guidance documents prepared by the Maryland Department of the Environment (MDE).

## What Is Vapor Intrusion?

As illustrated in Figure 1, vapor intrusion is a way that chemicals in soil or groundwater can get into indoor air. Sometimes, chemicals are spilled on the ground at a factory, shopping center or gas station or leak from an underground storage tank. These chemicals can seep down into the soil and groundwater. Some chemicals can also travel through soil as vapors or via the groundwater. These vapors may then move up through the soil and groundwater and into nearby buildings, contaminating indoor air. Homes in the same neighborhood and right next to each other can be affected differently by vapor intrusion.

Vapor intrusion is similar to how radon, a naturally occurring radioactive gas, can enter a home through cracks in the foundation. Vapor intrusion should be considered when there is a known source of soil or groundwater contamination nearby and conditions like soil type and depth to groundwater indicate a potential for vapor intrusion exists.

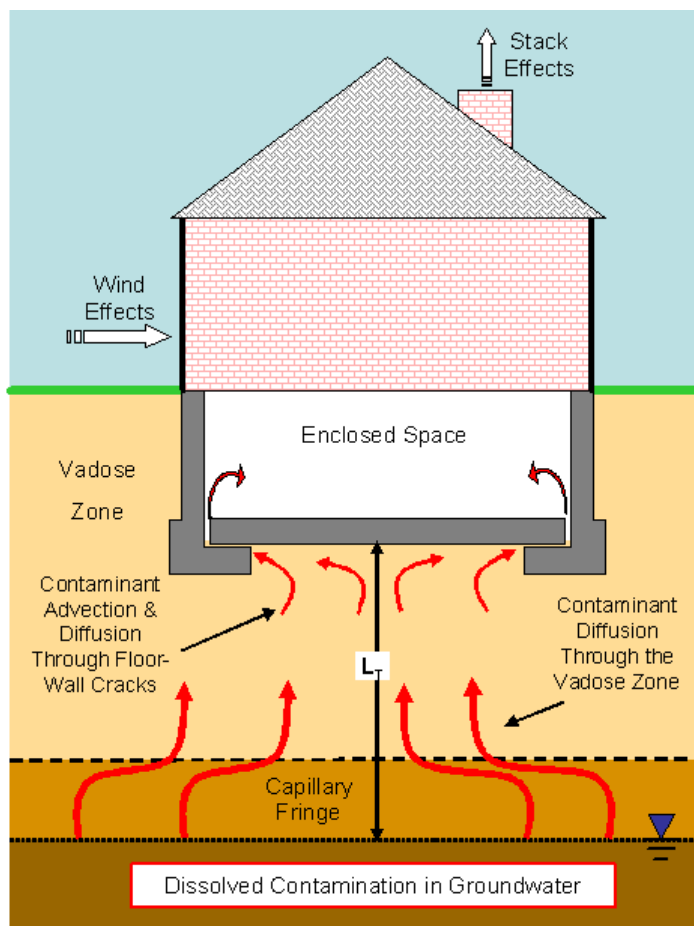


Figure 1—Vapor Intrusion Pathway

## What Chemicals Might Be Entering My Home?

Volatile organic compounds (VOCs) are one group of chemicals that easily become gases and can move through the soil and enter buildings. Some examples of VOCs are petroleum products such as gasoline, chemicals for dry cleaning and industrial products.

Some VOCs are also found in products that may be in your home. Paints, paint strippers and thinners, cigarette smoke, aerosol sprays, moth balls, air fresheners, new carpeting or furniture, hobby supplies (glues and solvents), stored fuels and dry-cleaned clothing all contain VOCs and are more likely to be a source of VOCs in your home than vapor intrusion.

Vapor intrusion cases sometimes involve VOCs that have leaked from underground storage tanks. Leaks from underground gasoline tanks are usually accompanied by the smell of fuel.

## What Are The Health Concerns With Vapor Intrusion?

The health effects from chemical exposures vary based on the individual exposed and the chemical involved. As chemicals build up in indoor air (at levels high enough to cause a strong petroleum odor, for example), some people experience eye and respiratory irritation, headache, and/or nausea. These symptoms are temporary and should go away when the person is moved to fresh air. Complicating the problem is that both household products and vapors entering homes from environmental sources can accumulate at levels of concern well below our ability to detect them with our senses. Usually, health officials are most concerned about low-level chemical exposures over many years, as this may raise a person's lifetime risk for developing cancer. The likelihood of indoor air contamination by vapor intrusion is low at most cleanup sites. Even though the risk is usually quite low, the Maryland Department of the Environment (MDE) considers these risks to be unnecessary and avoidable and requires remediation to conservatively safe levels.

## What Should I Expect If Vapor Intrusion Is A Concern Near My Home?

If you live near a site with VOC contamination, such as a gas station or dry cleaner where petroleum or

chemicals have contaminated soil or groundwater, you should expect that the potential for vapor intrusion is also being investigated. You may be contacted by the cleanup site owner or others working on the MDE investigation cleanup with information about the project. Your cooperation and consent would be requested before any testing/sampling would be done on your property. You may ask the person contacting you any questions about the work being done, or you can contact the MDE cleanup project manager, or a MDE employee. Telephone numbers and Internet addresses for MDE are provided below.

## How Is Vapor Intrusion Investigated?

In most cases, the potential for vapor intrusion can be ruled out by collecting soil gas or groundwater



**Figure 2—Sub-slab Gas Samples Collected**

samples near the contamination site. In some cases, sampling closer to your property and/or home may be necessary. MDE do not usually recommend indoor air sampling for vapor intrusion during the early stages of an investigation. Indoor air quality changes a lot from day to day. Therefore, sampling one day may not show a problem even though sampling a day later might show contamination. Since a variety of VOC sources are present in most homes, testing will not necessarily confirm that VOCs in the indoor air are from VOC contamination in soils or groundwater nearby. Often, soil vapor samples are taken from areas outside of the home to see if vapors are near the home. Samples may also be taken from beneath the home's foundation (called sub-slab samples), to see if vapors have reached the home. Due to the variability



**Figure 3—Indoor Air Samples Collected Using a Summa Canister**

of indoor air samples sub-slab samples may be more reliable in predicting and assessing indoor air problems.

### **What Happens If A Problem Is Found?**

If vapor intrusion is having an effect on the air in your home, the most common solution is to install a mitigation system similar to a radon mitigation system. This prevents 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. The system typically should remain in place until the contamination is cleaned up and may remain in place permanently.

### **Target Indoor Air and Soil Gas Remedial Goals**

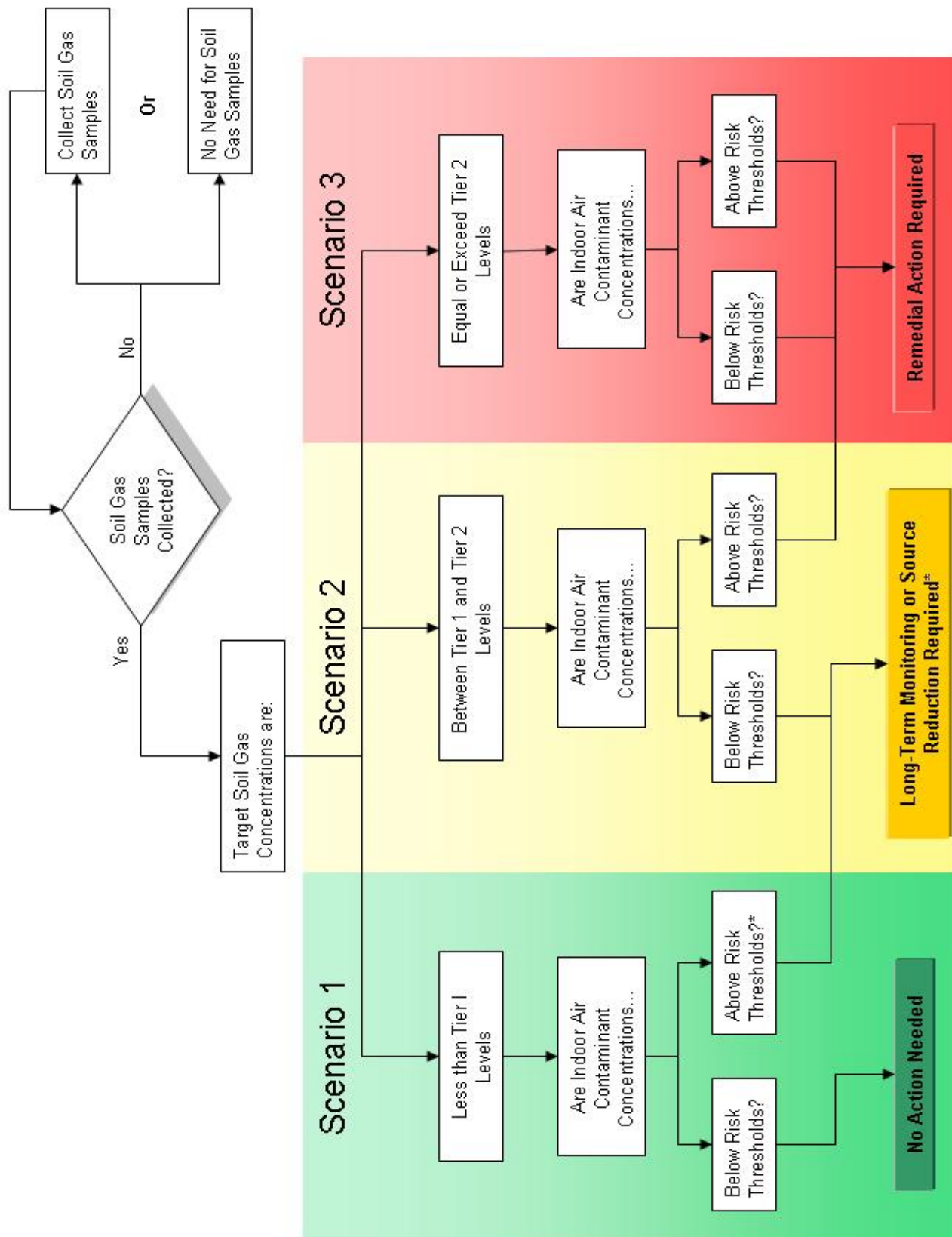
In the past MDE has evaluated potential indoor air hazards from volatile contaminants using the EPA Regional Screening Level (RSL) table as the foundation for toxicity information used to derive hazard screening values and remedial goals. As evaluating the vapor intrusion pathway evolves, LMA is adopting the process illustrated in Figure 4 for determining remedial goals for both indoor air and soil gas at residential and commercial properties within the LMA.

The residential and commercial target indoor air remedial goals are based on whichever represents the lowest indoor air concentration for noncarcinogens set at a Hazard Index of 1 or carcinogens set at a target 1 in 100,000 ( $1 \times 10^{-5}$ ) cancer risk. In an effort to reduce uncertainty and future reopeners on cases the LMA is taking a tiered approach to target soil gas action levels. As long as indoor air contaminant concentrations are below acceptable risk thresholds soil gas concentrations that are below the Tier I soil gas screening values will not require any additional monitoring or assessment when source conditions are known and appear to be stable. When target soil gas concentrations are between the Tier 1 and Tier 2 values, and indoor air is acceptable, additional long term soil gas monitoring or source reduction will be necessary. When target soil gas concentrations exceed the Tier 2 values remedial measures will be necessary at the site. In all instances site-specific factors will be considered in establishing remedial goals and selecting monitoring frequencies.

At a minimum, the LRP also requires that the sub-slab soil gas levels in the source area be reduced target levels less than 500 times the indoor air criteria. The remediator can achieve these objectives through one or more remedial options, including but not limited to soil venting. Target levels in the indoor air and sub slab levels may need to be lower if the additive effects of multiple constituents have a total cancer risk greater than  $1 \times 10^{-5}$  and a Hazard Index greater than 1. The applicant may elect to adopt sub-slab soil gas target levels at or below 100 times the indoor air criteria to reduce post monitoring requirements. Once such levels are achieved, the remediator may request permission to shut the system down and establish an approved confirmation sampling schedule with MDE's approval.

See the Tables 1 and 2 on pages 6 through 11 for the appropriate indoor air and tiered soil gas concentrations.

Figure 4—Indoor Air and Soil Gas Remedial Goals Flow Chart



\* Additional sampling may be needed to determine next steps, which could include long-term monitoring and/or remedial action.

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Table 1—Residential Ambient Air

Ambient Air Toxicity - Residential			June 2012 - Revised according to 05/12/2012 published data from EPA/Region III					
Contaminant			Toxicity and Chemical-Specific Information			RESIDENTIAL TARGET RISK		
Analyte	CAS No.	Concentration (ug/m3)	IUR (ug/m <sup>3</sup> ) <sup>-1</sup>	RfCI (mg/m <sup>3</sup> )	key	mutagen	HI	Non-Mutagenic
Acetaldehyde	75-07-0	9.40E+00	2.2E-06	9.0E-03	I		1.00E+00	8.50E-06
Acetone	67-64-1	3.30E+04		3.1E+01	A		1.02E+00	
Acetone Cyanohydrin	75-86-5	6.30E+01		6.0E-02	P		1.01E+00	
Acetonitrile	75-05-8	6.30E+01		6.0E-02	I		1.01E+00	
Acrolein	107-02-8	2.10E-02		2.0E-05	I		1.01E+00	
Acrylonitrile	107-13-1	3.60E-01	6.8E-05	2.0E-03	I		1.73E-01	1.01E-05
Allyl Chloride	107-05-1	1.10E+00	6.0E-06	1.0E-03	I		1.05E+00	2.71E-06
Aroclor 1221	11104-28-2	4.30E-02	5.7E-04					1.01E-05
Aroclor 1232	11141-16-5	4.30E-02	5.7E-04					1.01E-05
Azobenzene	103-33-3	7.90E-01	3.1E-05					1.01E-05
Benzene	71-43-2	3.20E+00	7.8E-06	3.0E-02	I		1.02E-01	1.03E-05
Benzyl Chloride	100-44-7	5.00E-01	4.9E-05	1.0E-03	I		4.79E-01	1.01E-05
Biphenyl, 1,1'-	92-52-4	4.20E-01		4.0E-04			1.01E+00	
Bis(2-chloro-1-methylethyl) ether	108-60-1	2.50E+00	1.0E-05					1.03E-05
Bis(2-chloroethyl) ether	111-44-4	7.40E-02	3.3E-04					1.00E-05
Bis(chloromethyl) ether	542-88-1	4.00E-04	6.2E-02					1.02E-05
Bromo-2-chloroethane, 1-	107-04-0	4.10E-02	6.0E-04					1.01E-05
Bromobenzene	108-86-1	6.30E+01		6.0E-02	H		1.01E+00	
Bromochloromethane	74-97-5	4.20E+01		4.0E-02			1.01E+00	
Bromodichloromethane	75-27-4	6.60E-01	3.7E-05					1.00E-05
Bromomethane	74-83-9	5.30E+00		5.0E-03	I		1.02E+00	
Butadiene, 1,3-	106-99-0	8.20E-01	3.0E-05	2.0E-03	I		3.93E-01	1.01E-05
Carbon Disulfide	75-15-0	7.30E+02		7.0E-01	I		1.00E+00	
Carbon Tetrachloride	56-23-5	4.10E+00	6.0E-06	1.0E-01	A		3.93E-02	1.01E-05
Chloro-1,1-difluoroethane, 1-	75-68-3	5.30E+04		5.0E+01	I		1.02E+00	
Chloro-1,3-butadiene, 2-	126-99-8	8.20E-02	3.0E-04	2.0E-02	H		3.93E-03	1.01E-05
Chlorobenzene	108-90-7	5.30E+01		5.0E-02	P		1.02E+00	
Chlorobenzotrifluoride, 4-	98-56-6	3.20E+02		3.0E-01	P		1.02E+00	
Chlorodifluoromethane	75-45-6	5.30E+04		5.0E+01	I		1.02E+00	
Chloroform	67-66-3	1.10E+00	2.3E-05	9.8E-02	A		1.08E-02	1.04E-05
Chloromethane	74-87-3	9.40E+01		9.0E-02	I		1.00E+00	
Chloromethyl Methyl Ether	107-30-2	3.60E-02	6.9E-04					1.02E-05
Chloropirrin	76-06-2	4.20E-01		4.0E-04			1.01E+00	
Chromium(VI)	18540-29-9	1.20E-04	8.4E-02	1.0E-04	I	M	1.15E-03	1.05E-05
Cumene	98-82-8	4.20E+02		4.0E-01	I		1.01E+00	
Cyclohexane	110-82-7	6.30E+03		6.0E+00	I		1.01E+00	
Dibromo-3-chloropropane, 1,2-	96-12-8	1.70E-03	6.0E-03	2.0E-04	I	M	8.15E-03	1.06E-05
Dibromochloromethane	124-48-1	9.10E-01	2.7E-05				4.37E-03	1.01E-05
Dibromoethane, 1,2-	106-93-4	4.10E-02	6.0E-04	9.0E-03	I		1.01E+00	
Dibromomethane (Methylene Bromide)	74-95-3	4.20E+00		4.0E-03				
Dichloro-2-butene, cis-1,4-	764-41-0	5.80E-03	4.2E-03					
Dichloro-2-butene, trans-1,4-	1476-11-5	5.80E-03	4.2E-03					
Dichloro-2-butene, trans-1,4-	110-57-6	5.80E-03	4.2E-03					
Dichlorobenzene, 1,2-	95-50-1	2.10E+02		2.0E-01	H		1.01E+00	
Dichlorobenzene, 1,4-	106-46-7	2.30E+00	1.1E-05	8.0E-01	I		2.76E-03	1.04E-05
Dichlorodifluoromethane	75-71-8	2.10E+02		2.0E-01	H		1.01E+00	
Dichloroethane, 1,1-	75-34-3	1.60E+01	1.6E-06					
Dichloroethane, 1,2-	107-06-2	9.40E-01	2.6E-05	7.0E-03	A		1.29E-01	1.00E-05
Dichloroethylene, 1,1-	75-35-4	2.10E+02		2.0E-01	I		1.01E+00	
Dichloroethylene, 1,2-trans-	156-60-5	6.30E+01		6.0E-02	P		1.01E+00	
Dichloropropane, 1,2-	78-87-5	2.50E+00	1.0E-05	4.0E-03	I		5.99E-01	1.03E-05
Dichloropropene, 1,3-	542-75-6	6.10E+00	4.0E-06	2.0E-02	I		2.92E-01	1.00E-05
Dicyclopentadiene	77-73-6	7.30E+00		7.0E-03	P		1.00E+00	
Difluoroethane, 1,1-	75-37-6	4.20E+04		4.0E+01	I		1.01E+00	
Dihydrosalrole	94-58-6	1.90E+00	1.3E-05					1.02E-05
							RESIDENTIAL - Target Soil Gas	
							TIER 1 (20X)	TIER 2 (100X)
							1.88E+02	9.40E+02
							6.60E+05	3.30E+06
							1.26E+03	6.30E+03
							1.26E+03	6.30E+03
							4.20E-01	2.10E+00
							7.20E+00	3.60E+01
							2.20E+01	1.10E+02
							8.60E-01	4.30E+00
							8.60E-01	4.30E+00
							1.58E+01	7.90E+01
							6.40E+01	3.20E+02
							1.00E+01	5.00E+01
							8.40E+00	4.20E+01
							5.00E+01	2.50E+02
							1.48E+00	7.40E+00
							8.00E-03	4.00E-02
							8.20E-01	4.10E+00
							1.26E+03	6.30E+03
							8.40E+02	4.20E+03
							1.32E+01	6.60E+01
							1.06E+02	5.30E+02
							1.64E+01	8.20E+01
							1.46E+04	7.30E+04
							8.20E+01	4.10E+02
							1.06E+06	5.30E+06
							1.64E+00	8.20E+00
							1.06E+03	5.30E+03
							6.40E+03	3.20E+04
							1.06E+06	5.30E+06
							2.20E+01	1.10E+02
							1.88E+03	9.40E+03
							7.20E-01	3.60E+00
							8.40E+00	4.20E+01
							2.40E-03	1.20E-02
							8.40E+03	4.20E+04
							1.26E+05	6.30E+05
							3.40E-02	1.70E-01
							1.82E+01	9.10E+01
							8.20E-01	4.10E+00
							8.40E+01	4.20E+02
							1.16E-01	5.80E-01
							1.16E-01	5.80E-01
							1.16E-01	5.80E-01
							4.20E+03	2.10E+04
							4.60E+01	2.30E+02
							4.20E+03	2.10E+04
							3.20E+02	1.60E+03
							1.88E+01	9.40E+01
							4.20E+03	2.10E+04
							1.26E+03	6.30E+03
							5.00E+01	2.50E+02
							1.22E+02	6.10E+02
							1.46E+02	7.30E+02
							8.40E+05	4.20E+06
							3.80E+01	1.90E+02

**Table 1—Residential Ambient Air (Cont'd)**

Ambient Air Toxicity - Residential			June 2012 - Revised according to 05/12/2012 published data from EPA/Region III											
Contaminant			Toxicity and Chemical-Specific						RESIDENTIAL TARGET RISK				RESIDENTIAL - Target Soil Gas	
Analyte	CAS No.	Concentration (ug/m3)	IUR (ug/m <sup>3</sup> ) <sup>-1</sup>	RFci (mg/m <sup>3</sup> )	key	mutagen	HI	Non-Mutagenic	Mutagenic	TIER 1 (20X)	TIER 2 (100X)			
Diisopropyl Ether	108-20-3	7.30E+02	7.0E-01	7.0E-01	I		1.00E+00			1.46E+04	7.30E+04			
Dimethylvinylchloride	513-37-1	1.90E+00	1.3E-05					1.02E-05		3.80E+01	1.90E+02			
Epichlorohydrin	106-89-8	1.10E+00	1.2E-06	1.0E-03	I		1.05E+00	5.42E-07		2.20E+01	1.10E+02			
Epoxybutane, 1,2-	106-88-7	2.10E+01		2.0E-02	I		1.01E+00			4.20E+02	2.10E+03			
Ethyl Chloride	75-00-3	1.10E+04		1.0E+01	I		1.05E+00			2.20E+05	1.10E+06			
Ethyl Methacrylate	97-63-2	3.20E+02		3.0E-01			1.02E+00			6.40E+03	3.20E+04			
Ethylbenzene	100-41-4	1.00E+01	2.5E-06	1.0E+00	I		9.59E-03	1.03E-05		2.00E+02	1.00E+03			
Ethylene Oxide	75-21-8	2.80E-01	8.8E-05	3.0E-02			8.95E-03	1.01E-05		5.60E+00	2.80E+01			
Ethyleneimine	151-56-4	1.30E-03	1.9E-02					1.02E-05		2.60E-02	1.30E-01			
Hexamethylene Diisocyanate, 1,6-	822-06-0	1.10E-02		1.0E-05	I		1.05E+00			2.20E-01	1.10E+00			
Hexane, n-	110-54-3	7.30E+02		7.0E-01	I		1.00E+00			1.46E+04	7.30E+04			
Hexanone, 2-	591-78-6	3.20E+01		3.0E-02			1.02E+00			6.40E+02	3.20E+03			
Hydrogen Cyanide	74-90-8	8.40E-01		8.0E-04	I		1.01E+00			1.68E+01	8.40E+01			
JP-7	NA	3.20E+02		3.0E-01			1.02E+00			6.40E+03	3.20E+04			
Mercury (elemental)	7439-97-6	3.20E-01		3.0E-04	I		1.02E+00			6.40E+00	3.20E+01			
Methacrylonitrile	126-98-7	7.40E-01		7.0E-04	H		1.01E+00			1.48E+01	7.40E+01			
Methyl Ethyl Ketone (2-Butanone)	78-93-3	5.30E+03		5.0E+00	I		1.02E+00			1.06E+05	5.30E+05			
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	3.20E+03		3.0E+00	I		1.02E+00			6.40E+04	3.20E+05			
Methyl Isocyanate	624-83-9	1.10E+00		1.0E-03	I		1.05E+00			2.20E+01	1.10E+02			
Methyl Methacrylate	80-62-6	7.30E+02		7.0E-01	I		1.00E+00			1.46E+04	7.30E+04			
Methyl Styrene (Mixed Isomers)	25013-15-4	4.20E+01		4.0E-02	H		1.01E+00			8.40E+02	4.20E+03			
Methyl tert-Butyl Ether (MTBE)	1634-04-4	9.40E+01	2.6E-07	3.0E+00	I		3.00E-02	1.00E-05	8.89E-06	1.88E+03	9.40E+03			
Methylene Chloride	75-09-2	6.30E+02	1.0E-08	6.0E-01	A	M	1.01E+00			1.26E+04	6.30E+04			
Naphtha, High Flash Aromatic (HFAN)	64724-95-6	4.40E+02		1.0E-01			4.22E+00			8.80E+03	4.40E+04			
Naphthalene	91-20-3	7.20E-01	3.4E-05	3.0E-03	I		2.30E-01	1.01E-05		1.44E+01	7.20E+01			
Nitrobenzene	98-95-3	6.10E-01	4.0E-05	9.0E-03	H		6.50E-02	1.00E-05		1.22E+01	6.10E+01			
Nitromethane	75-52-5	2.80E+00	9.0E-06	2.0E-02	P		1.34E-01	1.04E-05		5.60E+01	2.80E+02			
Nitropropane, 2-	79-46-9	9.10E-03	2.7E-03	2.0E-02	I		4.36E-04	1.01E-05		1.82E-01	9.10E-01			
Nitroso-di-N-butylamine, N-	924-16-3	1.60E-02	1.6E-03					1.05E-05		3.20E-01	1.60E+00			
Nonane, n-	111-84-2	2.10E+02		2.0E-01			1.01E+00			4.20E+03	2.10E+04			
Pentane, n-	109-66-0	1.10E+03		1.0E+00			1.05E+00			2.20E+04	1.10E+05			
Phosgene	75-44-5	3.20E-01		3.0E-04	I		1.02E+00			6.40E+00	3.20E+01			
Propionaldehyde	123-38-6	8.40E+00		8.0E-03			1.01E+00			1.68E+02	8.40E+02			
Propyl benzene	103-65-1	1.10E+03		1.0E+00			1.05E+00			2.20E+04	1.10E+05			
Propylene	115-07-1	3.20E+03		3.0E+00			1.02E+00			6.40E+04	3.20E+05			
Propylene Oxide	75-56-9	6.60E+00	3.7E-06	3.0E-02	I		2.11E-01	1.00E-05		1.32E+02	6.60E+02			
Styrene	100-42-5	1.10E+03		1.0E+00	I		1.05E+00			2.20E+04	1.10E+05			
Tetrachloroethane, 1,1,1,2-	630-20-6	3.30E+00	7.4E-06					1.00E-05		6.60E+01	3.30E+02			
Tetrachloroethane, 1,1,2,2-	79-34-5	4.20E-01	5.8E-05					1.00E-05		8.40E+00	4.20E+01			
Tetrachloroethylene	127-18-4	4.20E+01	2.6E-07	4.0E-02	A		1.01E+00	4.49E-06		8.40E+02	4.20E+03			
Tetrafluoroethane, 1,1,1,2-	811-97-2	8.40E+04		8.0E+01	I		1.01E+00			1.68E+06	8.40E+06			
Tetrahydrofuran	109-99-9	2.10E+03		2.0E+00			1.01E+00			4.20E+04	2.10E+05			
Toluene	108-88-3	5.30E+03		5.0E+00	I		1.02E+00			1.06E+05	5.30E+05			
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	3.20E+04		3.0E+01	H		1.02E+00			6.40E+05	3.20E+06			
Trichlorobenzene, 1,2,4-	120-82-1	2.10E+00		2.0E-03	H		1.01E+00			4.20E+01	2.10E+02			
Trichloroethane, 1,1,1-	71-55-6	5.30E+03		5.0E+00	I		1.02E+00			1.06E+05	5.30E+05			
Trichloroethane, 1,1,2-	79-00-5	2.10E-01	1.6E-05	2.0E-04			1.01E+00	1.38E-06	1.04E-05	4.20E+00	2.10E+01			
Trichloroethylene	79-01-6	1.80E+00	4.1E-06	2.0E-03	C	M	8.63E-01			3.60E+01	1.80E+02			
Trichlorofluoromethane	75-69-4	7.30E+02		7.0E-01	H		1.00E+00			1.46E+04	7.30E+04			
Trichloropropane, 1,2,3-	96-18-4	3.20E-02		3.0E-04		M	1.02E-01			6.40E-01	3.20E+00			
Trichloropropene, 1,2,3-	96-19-5	3.20E-01		3.0E-04	I		1.02E+00			6.40E+00	3.20E+01			
Triethylamine	121-44-8	7.30E+00		7.0E-03	I		1.00E+00			1.46E+02	7.30E+02			
Trimethylbenzene, 1,2,3-	526-73-8	5.30E+00		5.0E-03	P		1.02E+00			1.06E+02	5.30E+02			
Trimethylbenzene, 1,2,4-	95-63-6	7.30E+00		7.0E-03	P		1.00E+00			1.46E+02	7.30E+02			
Trimethylbenzene, 1,3,5-	108-67-8	5.30E+00		5.0E-03	P		1.02E+00			1.06E+02	5.30E+02			

**Table 1—Residential Ambient Air (Cont'd)**

Ambient Air Toxicity - Residential		June 2012 - Revised according to 05/12/2012 published data from EPA/Region III													
Contaminant		Toxicity and Chemical-Specific Information						RESIDENTIAL TARGET RISK				RESIDENTIAL - Target Soil Gas			
Analyte	CAS No.	Concentration (ug/m3)	IUR (ug/m <sup>3</sup> ) <sup>-1</sup>	RF <sub>C1</sub> (mg/m <sup>3</sup> )	key	mutagen	HI	Non-Mutagenic	Mutagenic		TIER 1 (20X)	TIER 2 (100X)			
Vinyl Acetate	108-05-4	2.10E+02		2.0E-01	I		1.01E+00				4.20E+03	2.10E+04			
Vinyl Bromide	593-60-2	7.70E-01	3.2E-05	3.0E-03	I		2.46E-01		1.01E-05		1.54E+01	7.70E+01			
Vinyl Chloride	75-01-4	1.70E+00	4.4E-06	1.0E-01	I	M	1.63E-02		1.06E-05		3.40E+01	1.70E+02			
Xylene, m-	108-38-3	1.10E+02		1.0E-01	C		1.05E+00				2.20E+03	1.10E+04			
Xylene, o-	95-47-6	1.10E+02		1.0E-01	C		1.05E+00				2.20E+03	1.10E+04			
Xylene, p-	106-42-3	1.10E+02		1.0E-01	C		1.05E+00				2.20E+03	1.10E+04			
Xylenes	1330-20-7	1.10E+02		1.0E-01	I		1.05E+00				2.20E+03	1.10E+04			



Table 2—Commercial Ambient Air

Ambient Air Toxicity - Commercial		June 2012 - Revised according to 05/12/2012 published data from EPA/Region III									
Contaminant		Toxicity and Chemical-Specific Information									
Analyte	CAS No.	Concentration (ug/m3)	IUR (ug/m <sup>3</sup> -1)	RFCD (mg/m <sup>3</sup> )	key	mutagen	COMMERCIAL TARGET RISK			COMMERCIAL - Target Soil Gas	
							HI	CR		TIER 1 (100X)	TIER 2 (500X)
Acetaldehyde	75-07-0	4.00E+01	2.2E-06	9.0E-03	I		1.01E+00	7.18E-06		4.00E+03	2.00E+04
Acetone	67-64-1	1.40E+05	3.1E+01	A			1.03E+00			1.40E+07	7.00E+07
Acetone Cyanohydrin	75-86-5	2.70E+02	6.0E-02	P			1.03E+00			2.70E+04	1.35E+05
Acetonitrile	75-05-8	2.70E+02	6.0E-02	I			1.03E+00			2.70E+04	1.35E+05
Acrolein	107-02-8	8.80E-02	2.0E-05	I			1.00E+00			8.80E+00	4.40E+01
Acrylonitrile	107-13-1	1.90E+00	6.8E-05	2.0E-03	I		2.17E-01	1.05E-05		1.90E+02	9.50E+02
Allyl Chloride	107-05-1	4.40E+00	6.0E-06	1.0E-03	I		1.00E+00	2.15E-05		4.40E+02	2.20E+03
Aroclor 1221	11104-28-2	2.20E-01	5.7E-04					1.02E-05		2.20E+01	1.10E+02
Aroclor 1232	11141-16-5	2.20E-01	5.7E-04					1.02E-05		2.20E+01	1.10E+02
Azobenzene	103-33-3	4.00E+00	3.1E-05					1.01E-05		4.00E+02	2.00E+03
Benzene	71-43-2	1.60E+01	7.8E-06	3.0E-02	I		1.22E-01	1.02E-05		1.60E+03	8.00E+03
Benzyl Chloride	100-44-7	2.60E+00	4.9E-05	1.0E-03	I		5.94E-01	1.04E-05		2.60E+02	1.30E+03
Biphenyl, 1,1'-	92-52-4	1.80E+00	4.0E-04				1.03E+00			1.80E+02	9.00E+02
Bis(2-chloro-1-methylethyl) ether	108-60-1	1.30E+01	1.0E-05					1.06E-05		1.30E+03	6.50E+03
Bis(2-chloroethoxy)ether	111-44-4	3.80E-01	3.3E-04					1.02E-05		3.80E+01	1.90E+02
Bis(chloromethyl)ether	542-88-1	2.00E-03	6.2E-02					1.01E-05		2.00E-01	1.00E+00
Bromo-2-chloroethane, 1-	107-04-0	2.10E-01	6.0E-04					1.03E-05		2.10E+01	1.05E+02
Bromobenzene	108-86-1	2.70E+02	6.0E-02	H			1.03E+00			2.70E+04	1.35E+05
Bromochloromethane	74-97-5	1.80E+02	4.0E-02				1.03E+00			1.80E+04	9.00E+04
Bromodichloromethane	75-27-4	3.40E+00	3.7E-05					1.03E-05		3.40E+02	1.70E+03
Bromomethane	74-83-9	2.20E+01	3.0E-05	5.0E-03	I		1.00E+00			2.20E+03	1.10E+04
Butadiene, 1,3-	106-99-0	4.10E+00	3.0E-05	2.0E-03	I		4.68E-01			4.10E+02	2.05E+03
Carbon Disulfide	75-15-0	3.10E+03	7.0E-01	I			1.01E+00			3.10E+05	1.55E+06
Carbon Tetrachloride	56-23-5	2.10E+01	6.0E-06	1.0E-01	A		4.79E-02			2.10E+03	1.05E+04
Chloro-1,1-difluoroethane, 1-	75-68-3	2.20E+05	5.0E+01	I			1.00E+00			2.20E+07	1.10E+08
Chloro-1,3-butadiene, 2-	126-99-8	4.10E-01	3.0E-04	2.0E-02	H		4.68E-03			4.10E+01	2.05E+02
Chlorobenzene	108-90-7	2.20E+02	5.0E-02	P			1.00E+00			2.20E+04	1.10E+05
Chlorobenzotrifluoride, 4-	98-56-6	1.40E+03	3.0E-01	P			1.07E+00			1.40E+05	7.00E+05
Chlorodifluoromethane	75-45-6	2.20E+05	5.0E+01	I			1.00E+00			2.20E+07	1.10E+08
Chloroform	67-66-3	5.40E+00	2.3E-05	9.8E-02	A		1.26E-02			5.40E+02	2.70E+03
Chloromethane	74-87-3	4.00E+02	9.0E-02	I			1.01E+00			4.00E+04	2.00E+05
Chloromethyl Methyl Ether	107-30-2	1.80E-01	6.9E-04					1.01E-05		1.80E+01	9.00E+01
Chloropicrin	76-06-2	1.80E+00	4.0E-04				1.03E+00			1.80E+02	9.00E+02
Chromium (VI)	18540-29-9	1.50E-03	8.4E-02	1.0E-04	I	M	3.42E-03	1.03E-05		1.50E-01	7.50E-01
Cumene	98-82-8	1.80E+03	4.0E-01	I			1.03E+00			1.80E+05	9.00E+05
Cyclohexane	110-82-7	2.70E+04	6.0E+00	I			1.03E+00			2.70E+06	1.35E+07
Dibromo-3-chloropropane, 1,2-	96-12-8	2.10E-02	6.0E-03	2.0E-04	I	M	2.40E-02	1.03E-05		2.10E+00	1.05E+01
Dibromochloromethane	124-48-1	4.60E+00	2.7E-05					1.01E-05		4.60E+02	2.30E+03
Dibromoethane, 1,2-	106-93-4	2.10E-01	6.0E-04	9.0E-03	I		5.33E-03	1.03E-05		2.10E+01	1.05E+02
Dibromomethane (Methylene Bromide)	74-95-3	1.80E+01	4.0E-03				1.03E+00			1.80E+03	9.00E+03
Dichloro-2-butene, 1,4-	764-41-0	3.00E-02	4.2E-03					1.03E-05		3.00E+00	1.50E+01
Dichloro-2-butene, cis-1,4-	1476-11-5	3.00E-02	4.2E-03					1.03E-05		3.00E+00	1.50E+01
Dichloro-2-butene, trans-1,4-	110-57-6	3.00E-02	4.2E-03					1.03E-05		3.00E+00	1.50E+01
Dichlorobenzene, 1,2-	95-50-1	8.80E+02	2.0E-01	H			1.00E+00			8.80E+04	4.40E+05
Dichlorobenzene, 1,4-	106-46-7	1.20E+01	1.1E-05	I			3.42E-03	1.08E-05		1.20E+03	6.00E+03
Dichlorodifluoromethane	75-71-8	4.40E+02	1.0E-01	H			1.00E+00			4.40E+04	2.20E+05
Dichloroethane, 1,1-	75-34-3	7.70E+01	1.6E-06	H				1.00E-05		7.70E+03	3.85E+04
Dichloroethane, 1,2-	107-06-2	4.80E+00	2.6E-05	A			1.57E-01	1.02E-05		4.80E+02	2.40E+03
Dichloroethylene, 1,1-	75-35-4	8.80E+02	2.0E-01	I			1.00E+00			8.80E+04	4.40E+05
Dichloroethylene, 1,2-trans-	156-60-5	2.70E+02	6.0E-02	P			1.03E+00			2.70E+04	1.35E+05
Dichloropropane, 1,2-	78-87-5	1.30E+01	1.0E-05	I			7.42E-01	1.06E-05		1.30E+03	6.50E+03
Dichloropropene, 1,3-	542-75-6	3.10E+01	4.0E-06	2.0E-02	I		3.54E-01	1.01E-05		3.10E+03	1.55E+04

Table 2—Commercial Ambient Air (Cont'd)

Ambient Air Toxicity - Commercial		June 2012 - Revised according to 05/12/2012 published data from EPA/Region III									
Contaminant		Toxicity and Chemical-Specific Information									
Analyte	CAS No.	Concentration (ug/m3)	IUR (ug/m <sup>3</sup> ) <sup>-1</sup>	RfCi (mg/m <sup>3</sup> )	key	mutagen	COMMERCIAL TARGET RISK			COMMERCIAL - Target Soil Gas	
							HI	CR		TIER 1 (100X)	TIER 2 (500X)
Dicyclopentadiene	77-73-6	3.10E+01		7.0E-03	P		1.01E+00			3.10E+03	1.55E+04
Difluoroethane, 1,1-	75-37-6	1.80E+05		4.0E+01	I		1.03E+00			1.80E+07	9.00E+07
Dihydrosafrole	94-58-6	9.50E+00	1.3E-05					1.01E-05		9.50E+02	4.75E+03
Diisopropyl Ether	108-20-3	3.10E+03		7.0E-01	I		1.01E+00			3.10E+05	1.55E+06
Dimethylvinylchloride	513-37-1	9.50E+00	1.3E-05					1.01E-05		9.50E+02	4.75E+03
Epichlorohydrin	106-89-8	4.40E+00	1.2E-06	1.0E-03	I		1.00E+00	4.31E-07		4.40E+02	2.20E+03
Epoxybutane, 1,2-	106-88-7	8.80E+01		2.0E-02	I		1.00E+00			8.80E+03	4.40E+04
Ethyl Chloride	75-00-3	4.40E+04		1.0E+01	I		1.00E+00			4.40E+06	2.20E+07
Ethyl Methacrylate	97-63-2	1.40E+03		3.0E-01			1.07E+00			1.40E+05	7.00E+05
Ethylbenzene	100-41-4	5.00E+01	2.5E-06	1.0E+00	I		1.14E-02	1.02E-05		5.00E+03	2.50E+04
Ethylene Oxide	75-21-8	1.40E+00	8.8E-05	3.0E-02			1.07E-02	1.00E-05		1.40E+02	7.00E+02
Ethyleneimine	151-56-4	6.50E-03	1.9E-02					1.01E-05		6.50E-01	3.25E+00
Hexamethylene Diisocyanate, 1,6-	822-06-0	4.40E-02		1.0E-05	I		1.00E+00			4.40E+00	2.20E+01
Hexane, n-	110-54-3	3.10E+03		7.0E-01	I		1.01E+00			3.10E+05	1.55E+06
Hexanone, 2-	591-78-6	1.40E+02		3.0E-02			1.07E+00			1.40E+04	7.00E+04
Hydrogen Cyanide	74-90-8	3.60E+00		8.0E-04	I		1.03E+00			3.60E+02	1.80E+03
JP-7	NA	1.40E+03		3.0E-01			1.07E+00			1.40E+05	7.00E+05
Mercury (elemental)	7439-97-6	1.40E+00		3.0E-04	I		1.07E+00			1.40E+02	7.00E+02
Methacrylonitrile	126-98-7	3.10E+00		7.0E-04	H		1.01E+00			3.10E+02	1.55E+03
Methyl Ethyl Ketone (2-Butanone)	78-93-3	2.20E+04		5.0E+00	I		1.00E+00			2.20E+06	1.10E+07
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	1.40E+04		3.0E+00	I		1.07E+00			1.40E+06	7.00E+06
Methyl Isocyanate	624-83-9	4.40E+00		1.0E-03			1.00E+00			4.40E+02	2.20E+03
Methyl Methacrylate	80-62-6	3.10E+03		7.0E-01	I		1.01E+00			3.10E+05	1.55E+06
Methyl Styrene (Mixed Isomers)	25013-15-4	1.80E+02		4.0E-02	H		1.03E+00			1.80E+04	9.00E+04
Methyl tert-Butyl Ether (MTBE)	1634-04-4	4.80E+02	2.6E-07	3.0E-02	I		3.65E-02	1.02E-05		4.80E+04	2.40E+05
Methylene Chloride	75-09-2	2.70E+03	1.0E-08	6.0E-01	A	M	1.03E+00	2.20E-06		2.70E+05	1.35E+06
Naphtha, High Flash Aromatic (HFAN)	64724-95-6	4.40E+02		1.0E-01			1.00E+00			4.40E+04	2.20E+05
Naphthalene	91-20-3	3.70E+00	3.4E-05	3.0E-03	I		2.82E-01	1.03E-05		3.70E+02	1.85E+03
Nitrobenzene	98-95-3	3.10E+00	4.0E-05	9.0E-03	H		7.86E-02	1.01E-05		3.10E+02	1.55E+03
Nitromethane	75-52-5	1.40E+01	9.0E-06	2.0E-02	P		1.60E-01	1.03E-05		1.40E+03	7.00E+03
Nitropropane, 2-	79-46-9	4.60E-02	2.7E-03	2.0E-02	I		5.25E-04	1.01E-05		4.60E+00	2.30E+01
Nitroso-di-N-butylamine, N-	924-16-3	7.70E-02	1.6E-03					1.00E-05		7.70E+00	3.85E+01
Nonane, n-	111-84-2	8.80E+02		2.0E-01			1.00E+00			8.80E+04	4.40E+05
Pentane, n-	109-66-0	4.40E+03		1.0E+00			1.00E+00			4.40E+05	2.20E+06
Phosgene	75-44-5	1.40E+00		3.0E-04	I		1.07E+00			1.40E+02	7.00E+02
Propionaldehyde	123-38-6	3.60E+01		8.0E-03			1.03E+00			3.60E+03	1.80E+04
Propyl benzene	103-65-1	4.40E+03		1.0E+00			1.00E+00			4.40E+05	2.20E+06
Propylene	115-07-1	1.40E+04		3.0E+00			1.07E+00			1.40E+06	7.00E+06
Propylene Oxide	75-56-9	3.40E+01	3.7E-06	3.0E-02	I		2.59E-01	1.03E-05		3.40E+03	1.70E+04
Styrene	100-42-5	4.40E+03		1.0E+00	I		1.00E+00			4.40E+05	2.20E+06
Tetrachloroethane, 1,1,1,2-	630-20-6	1.70E+01	7.4E-06					1.03E-05		1.70E+03	8.50E+03
Tetrachloroethane, 1,1,2,2-	79-34-5	2.20E+00	5.8E-05					1.04E-05		2.20E+02	1.10E+03
Tetrachloroethylene	127-18-4	1.80E+02	2.6E-07	4.0E-02	A		1.03E+00	3.82E-06		1.80E+04	9.00E+04
Tetrafluoroethane, 1,1,1,2-	811-97-2	3.60E+05		8.0E+01	I		1.03E+00			3.60E+07	1.80E+08
Tetrahydrofuran	109-99-9	8.80E+03		2.0E+00			1.00E+00			8.80E+05	4.40E+06
Toluene	108-88-3	2.20E+04		5.0E+00	I		1.00E+00			2.20E+06	1.10E+07
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	1.40E+05		3.0E+01	H		1.07E+00			1.40E+07	7.00E+07
Trichlorobenzene, 1,2,4-	120-82-1	8.80E+00		2.0E-03	H		1.00E+00			8.80E+02	4.40E+03
Trichloroethane, 1,1,1-	71-55-6	2.20E+04		5.0E+00	I		1.00E+00			2.20E+06	1.10E+07
Trichloroethane, 1,1,2-	79-00-5	8.80E-01	1.6E-05	2.0E-04			1.00E+00	1.15E-06		8.80E+01	4.40E+02
Trichloroethylene	79-01-6	8.80E+00	4.1E-06	2.0E-03	C	M	1.00E+00	2.94E-06		8.80E+02	4.40E+03
Trichlorofluoromethane	75-69-4	3.10E+03		7.0E-01	H		1.01E+00			3.10E+05	1.55E+06

Table 2—Commercial Ambient Air (Cont'd)

Ambient Air Toxicity - Commercial		June 2012 - Revised according to 05/12/2012 published data from EPA/Region III				
Contaminant		Toxicity and Chemical-Specific Information				
Analyte	CAS No.	Concentration (ug/m3)	IUR (ug/m <sup>3</sup> ) <sup>-1</sup>	RfCI (mg/m <sup>3</sup> )	key	mutagen
Trichloropropane, 1,2,3-	96-18-4	1.40E+00		3.0E-04		M
Trichloropropene, 1,2,3-	96-19-5	1.40E+00		3.0E-04	I	
Triethylamine	121-44-8	3.10E+01		7.0E-03	I	
Trimethylbenzene, 1,2,3-	526-73-8	2.20E+01		5.0E-03	P	
Trimethylbenzene, 1,2,4-	95-63-6	3.10E+01		7.0E-03	P	
Trimethylbenzene, 1,3,5-	108-67-8	2.20E+01		5.0E-03	P	
Vinyl Acetate	108-05-4	8.80E+02		2.0E-01	I	
Vinyl Bromide	593-60-2	3.90E+00	3.2E-05	3.0E-03	I	
Vinyl Chloride	75-01-4	2.80E+01	4.4E-06	1.0E-01	I	M
Xylene, m-	108-38-3	4.40E+02		1.0E-01	C	
Xylene, o-	95-47-6	4.40E+02		1.0E-01	C	
Xylene, p-	106-42-3	4.40E+02		1.0E-01	C	
Xylenes	1330-20-7	4.40E+02		1.0E-01	I	

COMMERCIAL TARGET RISK		COMMERCIAL - Target Soil Gas	
HI	CR	TIER 1 (100X)	TIER 2 (500X)
1.07E+00		1.40E+02	7.00E+02
1.07E+00		1.40E+02	7.00E+02
1.01E+00		3.10E+03	1.55E+04
1.00E+00		2.20E+03	1.10E+04
1.01E+00		3.10E+03	1.55E+04
1.00E+00		2.20E+03	1.10E+04
1.00E+00		8.80E+04	4.40E+05
2.97E-01	1.02E-05	3.90E+02	1.95E+03
6.39E-02	1.00E-05	2.80E+03	1.40E+04
1.00E+00		4.40E+04	2.20E+05
1.00E+00		4.40E+04	2.20E+05
1.00E+00		4.40E+04	2.20E+05
1.00E+00		4.40E+04	2.20E+05

## **Definitions to Know**

### **Ambient Air Sample**

An ambient air sample is an outdoor air sample that is representative of the air surrounding a home or building.

### **Breathing Zone**

A breathing zone is defined as the area from 3 – 5 feet above the ground, lower if small children are present. Indoor Air samples should be taken from this zone to insure that they are representative of the air being breathed in the building.

### **Chlorinated Compounds**

These include chemicals such as PCE (also known by its chemical name tetrachloroethene) and TCE (also known by its chemical name trichloroethene) that are commonly used in dry cleaning and industrial operations. These chemicals can breakdown into others that may also be of concern for vapor intrusion. They do not readily biodegrade in subsurface soil and may require active remediation to remove.

### **Cracks**

A fracture or other narrow opening in the cement floor or foundation of a building can provide a means for soil vapor to enter a home or building.

### **Indoor Air Sample**

An air sample taken from within the living or workspace of a home or building that is used to determine the concentration of the chemical that may be inhaled.

### **Preferential Pathway**

A subsurface feature that exists below ground can include a fracture, utility line, or pipeline through which soil gas moves more easily than through the natural soil.

### **Soil Gas Sample**

A soil gas sample is an air sample taken from the air in the soil pore spaces. Soil gas samples are used to characterize chemical concentrations in the soil.

### **Sub-Slab Sample**

A sub-slab sample is an air sample collected immediately beneath a home or building with a basement foundation and/or a slab-on-grade. Sub-slabs are collected to determine the concentration of chemicals in the soil vapor beneath a home or building because these chemicals may enter the building.

### **Summa Canisters**

An airtight, stainless-steel container, which is used to collect air, samples. Summa canisters are evacuated and used under vacuum to take indoor air, ambient air or soil air vapor samples.

### **Vapor Intrusion (Radon) Mitigation System**

A mechanical device(s) that applies a low amount of suction immediately below the foundation or the occupied space of the building and collects soil vapors which are then vented to the outside. For more information on how these systems operate, please see the IDEM Web page "How Do You Get Radon Out of a Building?"

## **For More Information**

For vapor intrusion related questions, contact MDE at (410) 537 3437.

More information on this and related topics are available on the MDE website at:

[http://www.mde.state.md.us/Programs/LandPrograms/ERRP\\_Brownfields/forms/index.asp](http://www.mde.state.md.us/Programs/LandPrograms/ERRP_Brownfields/forms/index.asp).

Other sources of information about vapor intrusion are available at the websites listed below.

U.S. Environmental Protection Agency: <http://www.epa.gov/correctiveaction/eis/vapor.htm>.

Interstate Technology and Regulatory Council: <http://www.itrcweb.org/guidancedocument.asp?TID=49>