Pottstown Area Air Monitoring

May 12, 2004

Commonwealth of Pennsylvania
Department of Environmental Protection

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www.dep.state.pa.us

Executive Summary

The Pennsylvania Department of Environmental Protection (Department) received numerous complaints and questions about the air quality in the Pottstown area, and determined that additional information was needed to address these concerns. On April 29, 2002, the Department began sampling near the local High School, located at Adams and Franklin Streets, Pottstown, to determine the concentration of some of the pollutants collectively known as air toxics, and some other compounds. This site is in a central location and is representative of the area. It was not established to monitor the emissions from a specific facility. Initially, the study included sampling and analysis of volatile organic compounds and the measurement of wind speed, wind direction, temperature, relative humidity, precipitation and solar radiation (visible sunlight). In June 2003, the Department began sampling for toxic metals in airborne particles.

Air samples are collected over a 24-hour period from midnight to midnight once every six days at Pottstown and most other Pennsylvania air toxics monitoring sites. The Department's central laboratory analyzes all the samples. Sampling and analysis to measure 55 organic compounds is based on U.S. Environmental Protection Agency (EPA) Method TO-15. Particulate sampling and subsequent laboratory analysis measures the metals arsenic, beryllium, cadmium, chromium, lead, manganese, nickel and zinc (based on EPA Method IO-3).

The Department evaluated the health risks associated with breathing the measured concentrations of these pollutants using risk assessment methods approved by EPA. Note that there are neither state nor national air quality standards for these pollutants, except for lead. The Department compared Pottstown data to the other sites in Pennsylvania. The number of compounds that were detected at Pottstown and the concentrations of most compounds were similar to other sites in urban or industrial areas. Solely due to one compound, trichloroethylene (TCE), the aggregate excess lifetime cancer risk at Pottstown was significantly higher at Pottstown than at other sites. The annual average TCE concentration at Pottstown was 0.22 ppbv in 2002, while, in comparison, other Pennsylvania sites were near or below the 0.02 ppbv detection limit. The aggregate excess lifetime cancer risk, calculated from the averages of total VOC samples collected during 2002, was 2 in 10,000 at Pottstown, compared to slightly less than 1 in 10,000 at other urban and industrial sites. The TCE excess lifetime cancer risk in 2002 was 1.3 in 10,000 for the Pottstown site. In 2003, the annual average TCE concentration decreased to 0.07 ppbv, and therefore, the calculated TCE excess lifetime cancer risk decreased to 0.42 in 10,000, and the aggregate excess lifetime cancer risk for total VOC samples decreased 1.6 in 10,000. Note that the cancer risks are calculated for one-half the detection limit when a compound is not detected, thus for many of the compounds this method gives an upper limit of the risk.

The Department asked the Pennsylvania Department of Health to review the public health implications of the sampling results, and for reasons discussed in more detail in the report, they do not believe that the observed concentrations of TCE pose an unacceptable risk to the community. Nevertheless, Regional Office personnel have been inspecting possible sources of TCE in the Pottstown area. The Department's Mobile Analytical Unit (MAU) has also conducted short-term studies to identify possible TCE sources, to better define the area where TCE is detectable, and to assist in the selection of additional sampling sites. Based on the results to date, DEP intends to establish an additional VOC sampling site in or near Pottstown and to continue sampling for air toxics and metals at the current site.

Background

In response to citizen concerns about potentially harmful air quality in Pottstown, Montgomery County, the Pennsylvania Department of Environmental Protection (DEP) began operating an air monitoring station, with a meteorological tower, on April 29, 2002. The monitoring station was installed near the Pottstown Senior High School, located at Adams and Franklin Streets, Pottstown, and was selected because it is centrally located in Pottstown and has the physical characteristics necessary for a monitoring location – access to electric power, reasonable security, and sufficient distance from major roads, tall trees and obstructions to the wind. The station was not established to monitor the emissions from a specific facility.

The purpose of the monitoring station is to determine the concentration of various pollutants known as air toxics in the outdoor air, and to evaluate the risk to residents associated with the exposure to the air they actually breathe. The type of air toxics that are being sampled are classified as volatile organic compounds (VOCs). The original study plan was to sample VOCs for one year in order to have sufficient data for a meaningful evaluation of the risks to area residents. After sampling for one year, DEP decided to continue sampling for VOCs, and, in June of 2003, began total suspended particulate (TSP) sampling for toxic metals in airborne particles.

The U.S. Environmental Protection Agency (EPA) has not established national ambient air quality standards (NAAQS) for the pollutants being monitored, except for lead, so it is not possible to compare the measured ambient air concentrations to Federal standards. However, DEP has evaluated the health risks associated with breathing these pollutants in the concentrations found using risk assessment methods approved by the EPA. For this report, DEP will also include data from the other sites in Pennsylvania where DEP does the same type of air toxics sampling.

Details on the monitoring equipment, sampling method, pollutants monitored, risk assessment and next steps for this study are described in the following sections of this report.

Monitoring

Since May 2, 2002, the Department has collected air samples, every sixth day, in evacuated stainless steel canisters that are analyzed by the DEP laboratory for 55 VOCs. Some samples were missed due to equipment problems, and sampling stopped from January 10, 2003 until March 15, 2003 while the laboratory analytical system was being replaced and samples could not be analyzed. The specific volatile organic compounds that can be measured are determined by the analytical method and by the number of calibration standards used. The DEP Laboratory's method is based on EPA Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS). EPA's National Risk Management Research Laboratory developed this "Compendium of Methods for the Determination of Toxic Organic (TO) Compounds in Ambient Air" to assist Federal, State, and local regulatory personnel in

developing and maintaining necessary expertise and up-to-date monitoring technology for characterizing organic pollutants in the ambient air.

The GC/MS instrument detects very low levels of pollutants, down to a few hundredths of a part per billion, by concentrating the pollutants onto a trap cooled with liquid nitrogen. The gas chromatograph separates the chemical compounds and then the mass spectrometer detects and identifies the compounds by matching their patterns, like fingerprints, to known standards.

The 55 target VOC compounds include some of the hazardous air pollutants (HAPs) listed in the Federal 1990 Clean Air Act Amendments and additional compounds emitted by industry, motor vehicles and other sources. The laboratory reports the concentration of VOCs in parts per billion volume (ppbv). Table 1 of this report lists the target compounds, other commonly used names, each compound's Chemical Abstract Service (CAS) number which uniquely identifies the chemical compound, and the DEP Laboratory's typical method detection limit (MDL). The MDLs, which are determined by a standard laboratory quality control procedure (40 CFR Part 136, Appendix B), have varied somewhat over the course of the study. The DEP laboratory also has a reporting limit for each compound, typically ten times the MDL, above which the measured concentrations meet the laboratory standard for accuracy. At concentrations between the MDL and the reporting limit, there is confidence that the compound is actually present but less certainty in the accuracy of the reported concentration. The monitoring site also has a meteorological system, which measures wind speed and direction at a height of ten meters, temperature, relative humidity, precipitation and solar radiation (visible sunlight). An electronic datalogger takes a measurement every 10 seconds, and then calculates and stores 15-minute averages and one-hour averages for all parameters, except for precipitation, for which it stores the one-hour total.

On June 18, 2003, a total suspended particulate (TSP) sampler was installed next to the air monitoring shelter to measure particulate and the metals arsenic, beryllium, cadmium, chromium, lead, manganese, nickel and zinc. Particulate samples are collected on quartz fiber filters and analyzed by a standard DEP procedure similar to EPA Compendium Method IO-3.5, Determination of Metals in Ambient Particulate Matter Using Inductively Coupled Plasma/Mass Spectrometry (ICP/MS). A portion of the filter is digested in strong acids and the extract is analyzed for metals. Some metals exist in the atmosphere in several forms, with some forms being much more toxic than others. In particular, this method does not distinguish between chromium^{+6}, which is considered highly toxic (carcinogenic), and other forms that are less toxic. Particulate and metals data are reported in micrograms per cubic meter (ug/m^3).

Both the canister and the quartz filter samples are collected over a 24-hour period from midnight to midnight. Samples are collected on the same schedule every sixth day at all the Pennsylvania air toxics monitoring sites. Because there are no national air quality standards for these pollutants, Pottstown data are compared in this report to data collected at the other DEP air toxics monitoring sites. The other eastern Pennsylvania sites are located at Lincoln Middle School in Lancaster; West Chester University (south campus) in East Bradford Township; Front and Norris Streets in Chester; Eighth and Market Streets in Marcus Hook; and Swarthmore College in Swarthmore. Figure 1 shows the locations of DEP air toxic monitoring sites.

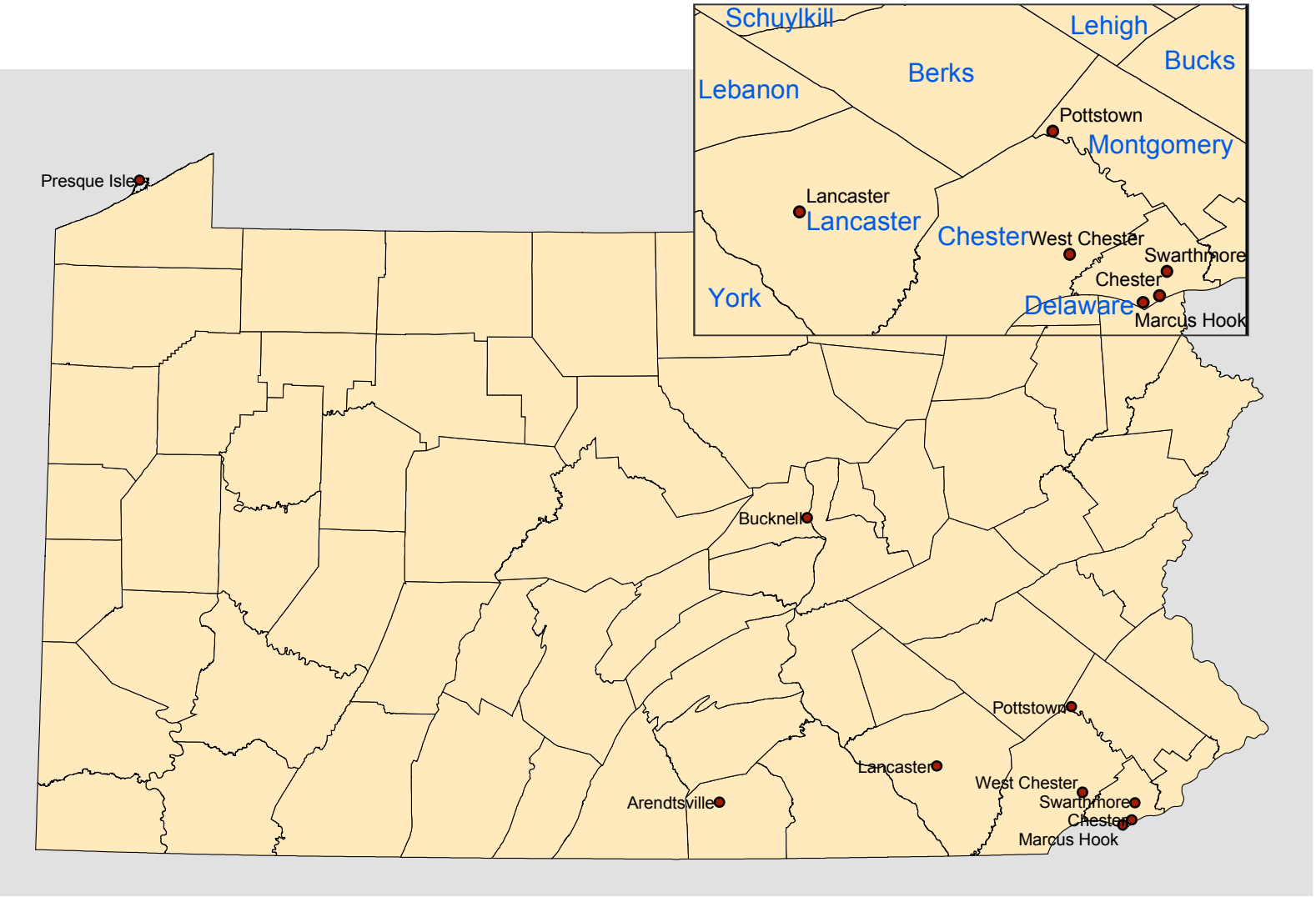

Figure 1. Pennsylvania DEP Toxics Monitoring Site Locations.

Discussion of Monitoring Results

In summarizing the data, DEP calculated averages for each of the compounds. In an effort to be more conservative, one-half the detection limit rather than zero was used when the compound was not detected in the sample. DEP usually calculates averages for the calendar year. Since the Pottstown monitor was installed in April 2002, the averages are not for a complete year. The 2003 annual averages also include less than a full year of sample data because samples were not collected for approximately 10 weeks.

A total of 37 out of the 55 target VOCs have been detected in Pottstown. Table 2 of this report shows which of the 55 target VOCs were detected at least once in 2003 at each Pennsylvania air toxics site. Thirteen target compounds were detected at all of the monitoring sites. The number of compounds detected at Pottstown is similar to other sites in industrial or urban areas, although different compounds are present at different sites. Arendtsville is a rural background site in Adams County, and, as one would expect, fewer pollutants were detected. When the concentration of a compound is below the reporting limit but is still above the method detection limit (MDL), the value reported may be less accurate, so it is flagged by the laboratory with a "J" data quality code. (Below the MDL, the result cannot be distinguished with statistical confidence from background noise.) The J code conveys a high degree of confidence that the compound is present in the sample, but the concentration is below the accurate calibration range of the instrument, thus the result may be less accurate. Seventeen of the 37 compounds had concentrations that were below the reporting limit in all the samples in which they were detected at Pottstown.

The annual averages are used to compare the toxic air pollutants at different sites, and to estimate the risk from inhalation exposure to ambient air for cancer and non-cancer health effects. The report appendix gives details of the risk calculation, which is a standard methodology used by EPA. A spreadsheet file with all of the VOC data can be requested from the DEP Southeast Regional Office and will be available on the DEP website (www.dep.state.pa.us).

Additional Air Monitoring for TCE

Trichloroethylene (TCE) concentrations were higher in the first samples, leading DEP to suspect sampler contamination. The sampler was replaced and TCE continued to be detected at approximately the same concentrations, in the 0.1 to 0.4-ppbv range. Although the data appeared to be suspect, they were retained because no problems with the sampling equipment were discovered. In addition, it was also possible that a local source contributed to the higher TCE levels in 2002 because there was construction activity and material stored near the monitoring site during startup of the 2002 sampling period.

Particulate and Metals Results

At the time this report was prepared, laboratory results for metals were available for samples collected from June 20, 2003 through December 31, 2003. In Figure 2, graphs for each of the eight metals show either the concentration or the laboratory reporting limit if the metal was not detected.

Table 1. Volatile Hydrocarbon Compounds Reported by the DEP Laboratory

Chemical Compound Name	Synonyms	CAS Number	3/21/02 MDL (ppbv)
Ethylbenzene		100-41-4	0.05
Styrene		100-42-5	0.03
cis-1,3-Dichloro-1-propene		10061-01-5	0.04
trans-1,3-Dichloro-1-propene		10061-02-6	0.03
1,4-Dichlorobenzene	para-Dichlorobenzene	106-46-7	0.03
1,2-Dibromoethane	Ethylene dibromide, EDB	106-93-4	0.04
1,3-Butadiene		106-99-0	0.04
1,2-Dichloroethane	Ethylene chloride	107-06-2	0.03
4-Methyl-2-pentanone (MIBK)		108-10-1	0.05
m & p- Xylene		108-38-3	0.07
1,3,5-Trimethylbenzene		108-67-8	0.03
Toluene	Toluol	108-88-3	0.03
Chlorobenzene		108-90-7	0.03
Tetrahydrofuran		109-99-9	0.04
n-Hexane		110-54-3	0.03
Cyclohexane		110-82-7	0.03
Propene	Propylene	115-07-1	0.04
1,2,4-Trichlorobenzene		120-82-1	0.07
Dibromochloromethane		124-48-1	0.03
Tetrachloroethene	perchloroethylene PERC	127-18-4	0.04
n-Heptane		142-82-5	0.03
cis-1,2-Dichloroethene		156-59-2	0.03
trans-1,2-Dichloroethene		156-60-5	0.05
2-Methoxy-2-methyl propane (MTBE)	Methyl-tert-butyl ether	1634-04-4	0.03
1,3-Dichlorobenzene		541-73-1	0.03
Carbon tetrachloride		56-23-5	0.03
2-Hexanone		591-78-6	0.06
1-Ethyl-4-methyl benzene		622-96-8	0.03
Acetone		67-64-1	0.05
Chloroform		67-66-3	0.04
Benzene	Benzol	71-43-2	0.04
1,1,1-Trichloroethane	Methyl chloroform	71-55-6	0.03
Bromomethane		74-83-9	0.03
Chloromethane	Methyl chloride	74-87-3	0.04
Chloroethane	Ethyl chloride	75-00-3	0.03
Chloroethene	Vinyl Chloride	75-01-4	0.04
Methylene chloride	Dichloromethane	75-09-2	0.04
Carbon disulfide		75-15-0	0.05
Bromoform		75-25-2	0.03
Bromodichloromethane		75-27-4	0.04
1,1-Dichloroethane	Ethylidene chloride	75-34-3	0.04
1,1-Dichloroethene	Vinylidene chloride	75-35-4	0.03
Trichlorofluoromethane	Freon 11	75-69-4	0.03
Dichlorodifluoromethane	Freon 12	75-71-8	0.03
1,1,2-Trichloro-1,2,2-trifluoroethane	Freon 113	76-13-1	0.03
1,2-Dichloro-1,1,2,2,tetrafluoroethane	Freon 114	76-14-2	0.03

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Chemical Compound Name	Synonyms	CAS Number	3/21/02 MDL (ppbv)
1,2-Dichloropropane		78-87-5	0.03
2-Butanone (MEK)	Methyl ethyl ketone	78-93-3	0.05
1,1,2-Trichloroethane		79-00-5	0.03
Trichloroethene	Trichloroethylene, TCE	79-01-6	0.04
1,1,2,2-Tetrachloroethane		79-34-5	0.03
Hexachloro-1,3-butadiene		87-68-3	0.02
o-Xylene		95-47-6	0.04
1,2-Dichlorobenzene		95-50-1	0.03
1,2,4-Trimethylbenzene	Pseudocumene	95-63-6	0.02

Table 2. Sites Where Target VOCs Were Detected at Least Once during 2003.

Compounds	Arendtsville	Chester	Lancaster	Marcus Hook	Pottstown	Presque Isle	Swarthmore	West Chester
Dichlorodifluoromethane	X	X	X	X	X	X	X	X
Chloromethane	X	X	X	X	X	X	X	X
Chloroethene				X	X			X
1,3-Butadiene	X				X			
Bromomethane		X		X			X	
Chloroethane	X	X	X	X	X			
Trichlorofluoromethane	X	X	X	X	X	X	X	X
Methylene chloride	X	X	X	X	X	X	X	X
1,1,2-Trichloro-1,2,2-trifluoroethane	X	X	X	X	X	X	X	X
1,1,1-Trichloroethane		X	X				X	
Benzene	X	X	X	X	X	X	X	X
Carbon tetrachloride	X	X	X	X	X	X	X	X
Trichloroethene		X	X	X	X	X	X	
Toluene	X	X	X	X	X	X	X	X
Tetrachloroethene		X					X	X
Chlorobenzene			X					
Ethylbenzene		X	X	X	X	X	X	X
m & p- Xylene		X	X	X	X	X	X	X
Styrene		X	X	X	X	X		
o-Xylene		X	X	X	X	X	X	X
1-Ethyl-4-methyl benzene		X	X	X	X			
1,3,5-Trimethylbenzene		X	X		X	X		X
1,2,4-Trimethylbenzene		X	X	X	X	X	X	X
1,4-Dichlorobenzene		X	X					
4-Methyl-2-pentanone (MIBK)		X	X	X	X		X	X
Tetrahydrofuran		X		X	X			X
n-Hexane	X	X	X	X	X	X	X	X
Cyclohexane		X	X	X		X	X	
Propene	X	X	X	X	X	X	X	X
n-Heptane	X	X	X	X	X	X	X	X
2-Methoxy-2-methyl propane (MTBE)	X	X	X	X	X	X	X	X
2-Hexanone	X	X	X	X	X		X	
Acetone	X	X	X	X	X	X	X	X
Carbon disulfide	X		X	X	X	X	X	X
2-Butanone (MEK)	X		X	X	X	X	X	X
Number of compounds detected	18	30	30	29	29	23	26	24

Compounds detected at all sites are highlighted

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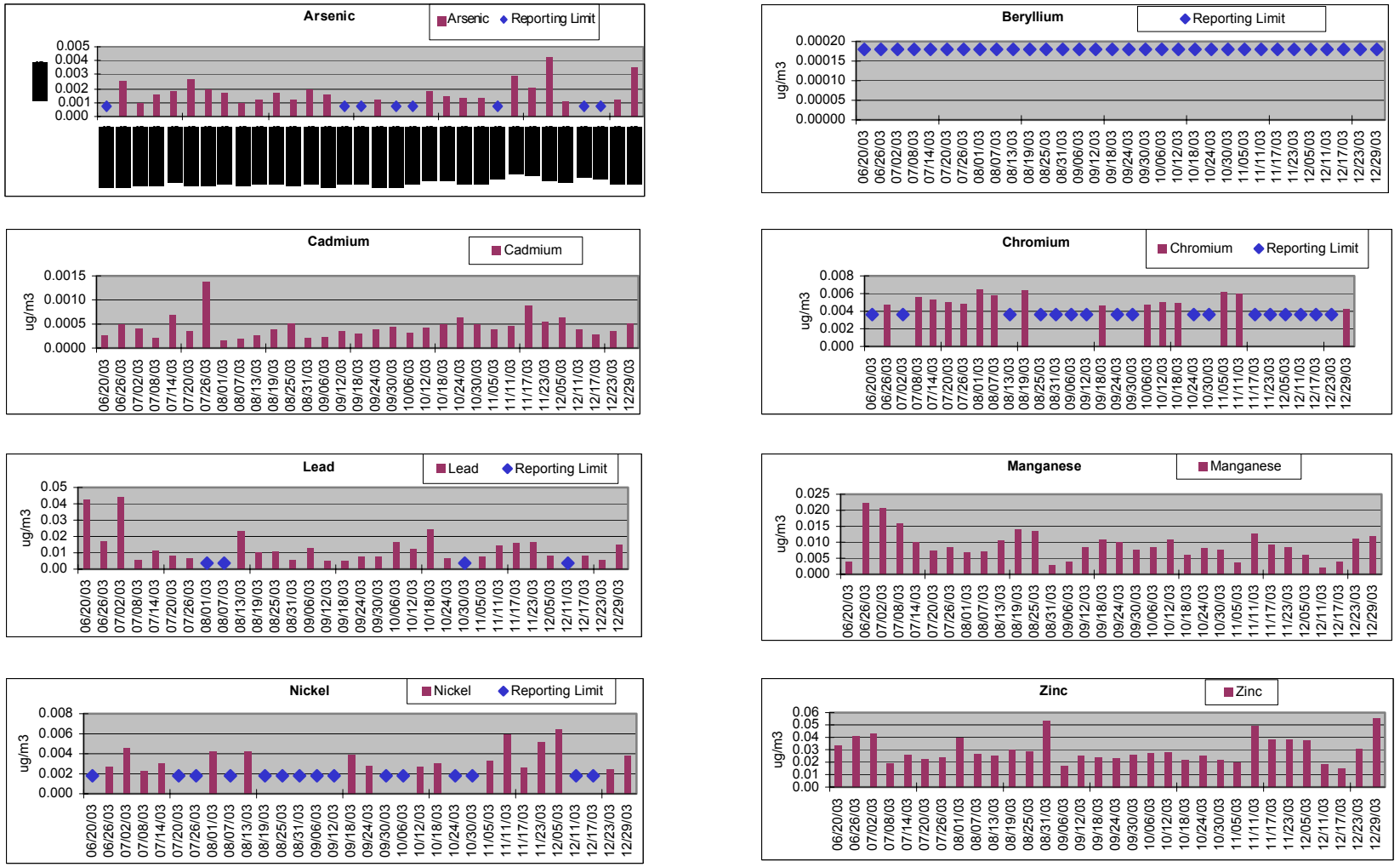

Figure 2. Metals Concentrations or Reporting Limits for Non-detects in Micrograms per Cubic Meter

Toxicity Assessment and Inhalation Risk Characterization

Overview of Risk Factors and Reference Doses

The excess lifetime cancer risk for each of the chemical compounds was calculated using unit risk factors (URFs), and the risk for non-cancer health effects was calculated using reference air concentrations (RfCs). The URF is a measure of the probability of developing cancer from exposure over a lifetime to a specified concentration of a given chemical. The RfC is the concentration below which no (non-cancer) adverse health affects are expected to occur over a lifetime of continuous exposure. The EPA Region III Superfund Technical Support Section's risk-based concentration (RBC) table was the primary source for the risk factors. In some cases, there were no inhalation risk data for a chemical in the RBC table and other sources, such as the Boilers and Industrial Furnaces (BIF) Regulation, had to be referenced. Appendix Table 5 gives all of the URFs and RfCs, and summarizes their sources. EPA has recently revised some of the risk factors and these changes are listed in the appendix. Of the VOCs on the GC/MS target list, 38 had data for either the inhalation reference dose or inhalation cancer potency slope (from which the RfC and URF are derived). Six of the metals had data for either the inhalation reference dose or inhalation cancer potency slope.

The URF and RfC are derived by assuming an adult weighing 70 kilograms (154 pounds) will breathe 20 m^3 (706 ft^3) of air each day for 365 days a year, over a 70-year lifetime of exposure. This is a standard conversion methodology and is detailed in the RBC table. The excess lifetime cancer risk is calculated for each chemical by multiplying its URF by the average concentration of all the valid air samples collected during the year. The individual risks for each chemical are added to get the total excess lifetime cancer risk at that site. Tables 3 and 4 show the calculated excess lifetime cancer risks for VOCs based on the 2002 and 2003 annual average concentrations, respectively. Any risk estimate is based on a number of assumptions and some of the assumptions made for this study include:

- The measured annual average concentration is the concentration that the individual will be exposed to over a lifetime;
- The concentrations measured at the sampling site are representative of exposures to the population in the area;
- The effects from exposure to multiple chemicals are additive;
- The exposure is based on a typical adult;
- The only excess risk considered in this report is due to inhalation;
- The cancer potency slope factor for each compound is assumed to be correct although reliability ratings vary greatly from compound to compound. Some are based on many well controlled studies, while others, based on limited data, are listed as provisional values.

The non-cancer risk associated with each of the relevant compounds is calculated by simply dividing the measured air concentration by the compound's respective RfC. If this value is less than one, and inhalation is the only source of exposure, then that chemical is not likely to cause adverse non-cancer health affects. No VOCs were detected with annual averages above

the RfC. None of the eight metals were above their RfCs for non-cancer health effects in any of the samples. Not enough samples for metals have been collected yet to estimate cancer risks.

Tables 3 and 4 show the excess lifetime cancer risks for inhalation exposure calculated using 2002 averages and 2003 averages, respectively. The risk totals for each site include compounds that were not detected. It is accepted practice to include non-detected compounds in risk calculations by substituting a concentration defined as "one-half the MDL" (see page 3 of this report). Thus, by conservatively including these non-detected compounds in the aggregate risk at concentrations of one-half the MDL, the risks in Tables 3 and 4 are an upper limit risk calculation. To emphasize this practice, note that the "grayed-out" concentrations for Pottstown in Tables 3 and 4 were not detected, but are reported at one-half the MDL.

> **Note:** The MDLs for the new GC/MS system that was installed at the DEP laboratory in January 2003 were higher than the MDLs for the GC/MS system used in 2002. Because the lowest concentrations that the laboratory could detect were higher in 2003, the calculated risks *appear* to be greater in 2003 than in 2002. This problem has since been corrected and the MDLs are now as good or better than in 2002.

Discussion of Risk

As summarized in the table below, the aggregate excess lifetime cancer risk for inhalation, calculated using the annual average VOC concentrations measured in 2002, was significantly higher at Pottstown than the risks calculated for the other sites. Almost all of the higher aggregate risk at Pottstown was due to trichloroethylene (TCE). This chemical is used primarily to clean and degrease metals. The annual average TCE concentration measured in Pottstown in 2002 was 0.22 ppbv. If exposure at this concentration were to continue over an entire 70-year lifetime, the excess lifetime cancer risk would be 1.3 in 10,000. However, the TCE concentration has decreased since the summer of 2002. In 2003, the annual average TCE concentration fell to 0.07 ppbv, with a corresponding excess lifetime cancer risk for TCE of 0.42 in 10,000. The excess lifetime cancer risk for all VOC samples, excluding TCE, were 0.7 in 10,000 for 2002 and 1.2* (see below) in 10,000 for 2003, which is within the range at the other sites.

Excess Lifetime Cancer Risk for Inhalation per 10,000 Population

Site	2002 VOC Total	2003 VOC Total	2002 TCE	2003 TCE
Arendtsville	0.73	1.2	0.12	0.12
Chester	0.82	1.3	0.17	0.15
Lancaster	0.79	1.3	0.13	0.13
Marcus Hook	0.93	1.3	0.15	0.13
Pottstown	2.0	1.6	1.3	0.42
Presque Isle	0.79	1.2	0.2	0.12
Swarthmore	0.81	1.3	0.12	0.13
West Chester	0.76	1.2	0.13	0.12

* Please note that the preceding paragraph and table, especially the apparent increase in "2003 VOC Total" risk for all sites except Pottstown, must be read within the context of the indented paragraph, above.

EPA rates cancer unit risk factors based on the quantity and quality of information available to calculate the risk. The inhalation unit risk factors used in this study were taken from the latest values in the EPA Integrated Risk Information System (IRIS). The National Center for Environmental Assessment (NCEA) is EPA's national resource center for human health and ecological risk assessment, which according to their mission statement: manages IRIS, conducts risk assessments, carries out research to improve the state-of-the-science of risk assessment, and provides guidance and support to risk assessors. IRIS risk factors are published by NCEA along with supporting documentation and assessment of their reliability. Since there is no IRIS risk factor for TCE, DEP used an EPA-NCEA provisional value. Toxicity factors contained in IRIS have been thoroughly reviewed and a consensus on their reliability has been reached. Until a consensus on TCE's URF has been reached, DEP will use the newest, most conservative provisional URF of 1.14E-04 m3/ug.

DEP asked the Pennsylvania Department of Health (PA DoH) for its opinion on the public health risk associated with breathing TCE in the concentrations found. PA DoH provided DEP with the following comments:

1. PA DoH reviewed air data collected by DEP on TCE during the years 2002 and 2003. Based on that review, PA DoH believes there is no apparent cancer health hazard associated with the exposure to the levels of TCE detected at this site at the present time.

2. The average annual concentration for TCE during 2002 is 0.22 ppbv (1.17 ug/m^3) and the average six-month concentration for TCE from March through December 2003 is 0.07 ppbv (0.39 ug/m^3). The trend from 2002 to 2003 indicates that levels of TCE are declining. Further monitoring is recommended to determine whether this trend is continuing over time.

3. The average levels of TCE that were detected in Pottstown in 2002 (1.17 ug/m^3) and in 2003 (0.39 ug/m^3) are not unusual because the reported levels fall within the ambient air values of 0.01 to 3.9 ug/m^3 based on the measurement data from the Aerometric Information Retrieval System (which has 1,200 measurements from 25 states from 1985-1995).

4. TCE has not yet been classified as a human carcinogen.

Use of the Mobile Analytical Unit:

In an effort to determine the source(s) of TCE detected at the monitoring site, and to be sure that there was no contamination in or around the station, DEP deployed its Mobile Analytical Unit (MAU) on several occasions beginning on November 3, 2003. The MAU used Open-Path Fourier Transform Infra-red Spectrometry (OPFTIR), which is a different sampling method than that used by the monitoring station. Although both this method and the canister sampling method used at the stationary monitoring site can detect TCE, the technique by which measurements are made and the minimum detection limits are quite different, making the results not directly comparable. OPFTIR takes many separate short-term scans (up to a few minutes) during a sampling event. It can detect how the pollutant concentration varies with changes in wind direction, changes in atmospheric mixing, and possibly, changes in the pollutant source. The canister sampling method collects a single sample over 24 hours, providing an average daily concentration. The canister sample is collected at a single point and has a low detection limit, typically 0.02 to 0.04 ppbv. The OPFTIR measures the concentration over the distance traveled by a beam of infrared light, and has a detection limit on the order of 1 ppbv, depending on the path length and atmospheric conditions. Because of this, the OPFTIR is most useful in determining how TCE concentration varies at different locations and with changes in wind direction, while the canister samples provide long-term data most useful for estimating excess lifetime cancer risk.

On November 3, 2003, the OPFTIR was set up next to the monitoring station at the Pottstown High School. It detected TCE in approximately 30% of the scans when the wind direction was out of the west. TCE was not detected when the wind direction changed from the westerly origin. On November 4, 5 and 6, 2003, TCE was detected, and again, only when the winds were out of the west.

On January 5 and 6, 2004, the OPFTIR was set up west of the Pottstown High School in Memorial Park. TCE was again detected when the wind blew from the west at concentrations similar to those observed in November 2003. On January 7, 2004, the OPFTIR was moved to an abandoned Sunoco gas station west of Memorial Park. TCE was detected when winds blew from the west, but was recorded below reportable limits.

On March 1, the OPFTIR returned to the abandoned Sunoco gas station. The wind direction was out of the southeast during sampling and TCE was not detected. On March 2, the OPFTIR was moved to the West Pottsgrove Township Municipal Building. The wind was from the southwest during this sampling and TCE was not detected.

During the week of March 29, the OPFTIR returned for another round of sampling in the Pottstown area. On March 29, the OPFTIR was set up at a closed shopping center at Charlotte Street and Pottsgrove High School Drive in Lower Pottsgrove Township. TCE was detected at an average concentration of 5 ppbv on three separate occasions when winds were out of the west. On March 30, the OPFTIR was positioned at the West Pottsgrove Municipal Building. Winds were originally out of the east and TCE was detected when winds shifted to the west. On March 31, the OPFTIR was set up at the Seventh Day Adventist Camp Complex in Douglass Township. Winds were out of the

northeast and TCE was not detected.

To determine if the ambient TCE levels being detected by the air monitoring station and the OPFTIR are unique to Pottstown or more widespread, the OPFTIR was moved to Ursinus College in Collegeville on April 1. Collegeville was selected because the area has known TCE groundwater contamination. This location showed the highest levels of TCE over the longest duration of any site sampled in Pottstown. TCE was detected at an average concentration of 5 ppbv, with the highest concentration being 15 ppbv.

Next Steps:

DEP intends to continue sampling for air toxics and metals at the current site to determine if the downward trend in TCE continues. An additional VOC sampling site will be set up in or near Pottstown to gain a better understanding of air quality over a larger geographic area. DEP will continue to work with the PA Department of Health to determine the risk to the public from breathing the air contaminants at the measured concentrations. Finally, DEP will continue inspecting known and suspected sources of TCE in order to ensure compliance with existing regulations and to encourage voluntary measures to reduce TCE emissions.

Table 3. Summary of Excess Lifetime Cancer Risks from Inhalation Across Chemicals of Concern at Pennsylvania Sites for 2002 Annual Averages with 1/2 the MDL for non-detects.

Chemical Name	Chester			Marcus Hook			Swarthmore			Pottstown		
	Annual Average (ppbv)	Annual Average (ug/m3)	Excess Lifetime Cancer Risk	Annual Average (ppbv)	Annual Average (ug/m3)	Excess Lifetime Cancer Risk	Annual Average (ppbv)	Annual Average (ug/m3)	Excess Lifetime Cancer Risk	Annual Average (ppbv)	Annual Average (ug/m3)	Excess Lifetime Cancer Risk
1,3-Butadiene	0.02	0.04	1.3E-06	0.02	0.04	1.3E-06	0.02	0.04	1.3E-06	0.02	0.04	1.3E-06
1,2-Dichlorobenzene	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------	0.02	0.10	----------
1,3-Dichlorobenzene	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------	0.02	0.10	----------
1,4-Dichlorobenzene	0.02	0.12	7.3E-07	0.02	0.10	6.5E-07	0.02	0.09	5.9E-07	0.03	0.17	1.1E-06
1,2-Dibromoethane	0.02	0.15	3.4E-05	0.02	0.15	3.4E-05	0.02	0.15	3.4E-05	0.02	0.15	3.4E-05
1,1-Dichloroethane	0.02	0.08	1.3E-07	0.02	0.08	1.3E-07	0.02	0.08	1.3E-07	0.02	0.08	1.3E-07
1,2-Dichloroethane	0.02	0.06	1.6E-06	0.02	0.06	1.6E-06	0.02	0.06	1.6E-06	0.02	0.06	1.6E-06
1,1-Dichloroethene	0.02	0.06	----------	0.02	0.06	----------	0.02	0.06	----------	0.02	0.06	----------
1,2-Dichloropropane	0.02	0.07	----------	0.02	0.07	----------	0.02	0.07	----------	0.02	0.07	----------
1,3-Dichloropropene	0.02	0.09	3.6E-07	0.02	0.09	3.6E-07	0.02	0.09	3.6E-07	0.02	0.09	3.6E-07
1,1,2,2-Tetrachloroethane	0.02	0.10	6.0E-06	0.02	0.10	6.0E-06	0.02	0.10	6.0E-06	0.02	0.10	6.0E-06
1,2,4-Trichlorobenzene	0.04	0.26	----------	0.04	0.26	----------	0.04	0.26	----------	0.04	0.26	----------
1,1,1-Trichloroethane	0.05	0.29	----------	0.02	0.12	----------	0.03	0.17	----------	0.02	0.12	----------
1,1,2-Trichloroethane	0.02	0.08	1.3E-06	0.02	0.08	1.3E-06	0.02	0.08	1.3E-06	0.02	0.08	1.3E-06
1,1,2-Trichloro-1,2,2-triflluoroethane	0.08	0.61	----------	0.07	0.55	----------	0.07	0.57	----------	0.07	0.51	----------
1,2,4-Trimethylbenzene	0.09	0.42	----------	0.12	0.60	----------	0.05	0.26	----------	0.12	0.61	----------
1,3,5-Trimethylbenzene	0.03	0.14	----------	0.04	0.20	----------	0.02	0.10	----------	0.05	0.24	----------
Benzene	0.27	0.86	6.7E-06	0.77	2.47	1.9E-05	0.33	1.06	8.3E-06	0.27	0.88	6.8E-06
Bromomethane	0.05	0.20	----------	0.03	0.12	----------	0.02	0.06	----------	0.02	0.06	----------
Carbon Tetrachloride	0.06	0.40	6.1E-06	0.07	0.42	6.3E-06	0.07	0.42	6.3E-06	0.06	0.39	5.9E-06
Chlorobenzene	0.02	0.07	----------	0.02	0.07	----------	0.02	0.07	----------	0.02	0.07	----------
Chloroethane	0.06	0.17	----------	0.04	0.11	----------	0.02	0.05	----------	0.04	0.10	----------
Chloroethene (Vinyl Chloride)	0.03	0.06	5.6E-07	0.02	0.06	5.6E-07	0.02	0.05	4.5E-07	0.04	0.11	9.5E-07
Chloroform	0.02	0.10	2.2E-06	0.02	0.10	2.2E-06	0.04	0.19	4.5E-06	0.02	0.10	2.3E-06
Chloromethane	0.57	1.18	----------	0.59	1.22	----------	0.61	1.25	----------	0.63	1.29	----------
Dichlorodifluoromethane	0.49	2.41	----------	0.49	2.40	----------	0.51	2.52	----------	0.50	2.48	----------
Ethylbenzene	0.05	0.21	----------	0.14	0.61	----------	0.28	1.21	----------	0.14	0.62	----------
Hexachloro-1,3-butadiene	0.01	0.11	2.3E-06	0.01	0.11	2.3E-06	0.01	0.11	2.3E-06	0.01	0.15	3.3E-06
Methylene Chloride	0.08	0.26	1.2E-07	0.11	0.37	1.7E-07	0.10	0.36	1.7E-07	0.16	0.55	2.6E-07
Styrene	0.02	0.06	----------	0.07	0.30	----------	0.02	0.07	----------	0.20	0.87	----------
Tetrachloroethylene	0.06	0.41	2.4E-06	0.03	0.21	1.2E-06	0.03	0.22	1.2E-06	0.03	0.18	1.0E-06
Toluene	0.76	2.86	----------	1.79	6.75	----------	1.10	4.16	----------	0.73	2.75	----------
Trichloroethylene	0.03	0.15	1.7E-05	0.03	0.14	1.5E-05	0.02	0.11	1.2E-05	0.22	1.17	1.3E-04
Trichlorofluoromethane	0.24	1.34	----------	0.25	1.43	----------	0.74	4.16	----------	0.26	1.45	----------
o-Xylene	0.06	0.25	----------	0.18	0.77	----------	0.17	0.73	----------	0.12	0.50	----------
m,p-Xylene	0.19	0.80	----------	0.58	2.51	----------	0.97	4.20	----------	0.34	1.46	----------
			8.2E-05			9.3E-05			8.1E-05			2.0E-04

EPA Urban Air Toxic Monitoring Program Target Compound (Bold)
Average is the arithmetic mean of all valid samples with one-half the MDL substituted for non-detects.
Not detected at Pottstown - risk is for 1/2 MDL

Table 3. Summary of Excess Lifetime Cancer Risks from Inhalation Across Chemicals of Concern at Pennsylvania Sites for 2002 Annual Averages with 1/2 the MDL for non-detects.

Chemical Name	West Chester			Lancaster			Erie (Presque Isle)			Arendtsville		
	Annual Average		Excess Lifetime	Annual Average		Excess Lifetime	Annual Average		Excess Lifetime	Annual Average		Excess Lifetime
	(ppbv)	(ug/m3)	Cancer Risk	(ppbv)	(ug/m3)	Cancer Risk	(ppbv)	(ug/m3)	Cancer Risk	(ppbv)	(ug/m3)	Cancer Risk
1,3-Butadiene	0.02	0.04	1.3E-06	0.02	0.04	1.3E-06	0.02	0.04	1.3E-06	0.02	0.04	1.3E-06
1,2-Dichlorobenzene	0.02	0.09	----------	0.02	0.09	----------	0.02	0.10	----------	0.02	0.09	----------
1,3-Dichlorobenzene	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------
1,4-Dichlorobenzene	0.02	0.09	5.7E-07	0.02	0.11	6.8E-07	0.02	0.10	6.1E-07	0.02	0.09	5.7E-07
1,2-Dibromoethane	0.02	0.15	3.4E-05	0.02	0.15	3.4E-05	0.02	0.15	3.4E-05	0.02	0.15	3.4E-05
1,1-Dichloroethane	0.02	0.08	1.3E-07	0.02	0.08	1.3E-07	0.02	0.08	1.3E-07	0.02	0.08	1.3E-07
1,2-Dichloroethane	0.02	0.06	1.6E-06	0.02	0.06	1.6E-06	0.02	0.06	1.6E-06	0.02	0.06	1.6E-06
1,1-Dichloroethene	0.02	0.06	----------	0.02	0.06	----------	0.02	0.06	----------	0.02	0.06	----------
1,2-Dichloropropane	0.02	0.07	----------	0.02	0.07	----------	0.02	0.07	----------	0.02	0.07	----------
1,3-Dichloropropene	0.02	0.09	3.6E-07	0.02	0.09	3.6E-07	0.02	0.09	3.6E-07	0.02	0.09	3.6E-07
1,1,2,2-Tetrachloroethane	0.02	0.10	6.0E-06	0.02	0.10	6.0E-06	0.02	0.10	6.0E-06	0.02	0.10	6.0E-06
1,2,4-Trichlorobenzene	0.04	0.26	----------	0.04	0.26	----------	0.04	0.26	----------	0.04	0.26	----------
1,1,1-Trichloroethane	0.02	0.10	----------	0.02	0.11	----------	0.02	0.08	----------	0.02	0.09	----------
1,1,2-Trichloroethane	0.02	0.08	1.3E-06	0.02	0.08	1.3E-06	0.02	0.08	1.3E-06	0.02	0.08	1.3E-06
1,1,2-Trichloro-1,2,2-triflluoroethane	0.07	0.54	----------	0.07	0.56	----------	0.04	0.34	----------	0.07	0.55	----------
1,2,4-Trimethylbenzene	0.04	0.18	----------	0.09	0.45	----------	0.04	0.21	----------	0.02	0.07	----------
1,3,5-Trimethylbenzene	0.02	0.09	----------	0.03	0.14	----------	0.03	0.13	----------	0.02	0.09	----------
Benzene	0.19	0.60	4.7E-06	0.31	0.99	7.7E-06	0.14	0.45	3.5E-06	0.16	0.50	3.9E-06
Bromomethane	0.02	0.06	----------	0.02	0.06	----------	0.02	0.06	----------	0.02	0.06	----------
Carbon Tetrachloride	0.07	0.43	6.4E-06	0.06	0.39	5.8E-06	0.04	0.27	4.1E-06	0.06	0.40	6.1E-06
Chlorobenzene	0.02	0.07	----------	0.07	0.32	----------	0.02	0.07	----------	0.02	0.07	----------
Chloroethane	0.02	0.04	----------	0.02	0.05	----------	0.03	0.07	----------	0.03	0.08	----------
Chloroethene (Vinyl Chloride)	0.02	0.05	4.5E-07	0.02	0.05	4.5E-07	0.02	0.05	4.5E-07	0.02	0.05	4.5E-07
Chloroform	0.02	0.10	2.3E-06	0.02	0.12	2.8E-06	0.02	0.10	2.2E-06	0.02	0.10	2.2E-06
Chloromethane	0.56	1.16	----------	0.59	1.22	----------	0.39	0.80	----------	0.59	1.22	----------
Dichlorodifluoromethane	0.48	2.38	----------	0.48	2.36	----------	0.29	1.42	----------	0.47	2.34	----------
Ethylbenzene	0.04	0.16	----------	0.08	0.36	----------	0.03	0.14	----------	0.03	0.12	----------
Hexachloro-1,3-butadiene	0.01	0.11	2.5E-06	0.01	0.11	2.3E-06	0.01	0.11	2.3E-06	0.01	0.11	2.3E-06
Methylene Chloride	0.07	0.26	1.2E-07	0.10	0.34	1.6E-07	0.04	0.15	7.1E-08	0.07	0.24	1.1E-07
Styrene	0.02	0.07	----------	0.02	0.09	----------	0.02	0.09	----------	0.02	0.10	----------
Tetrachloroethylene	0.03	0.19	1.1E-06	0.02	0.16	9.4E-07	0.02	0.15	8.3E-07	0.02	0.14	7.9E-07
Toluene	0.42	1.57	----------	0.81	3.07	----------	0.24	0.89	----------	0.17	0.65	----------
Trichloroethylene	0.02	0.12	1.3E-05	0.02	0.12	1.3E-05	0.03	0.18	2.0E-05	0.02	0.11	1.2E-05
Trichlorofluoromethane	0.24	1.34	----------	0.26	1.45	----------	0.14	0.77	----------	0.23	1.32	----------
o-Xylene	0.04	0.17	----------	0.09	0.40	----------	0.03	0.13	----------	0.02	0.10	----------
m,p-Xylene	0.12	0.54	----------	0.29	1.24	----------	0.08	0.33	----------	0.05	0.21	----------
			7.6E-05			7.9E-05			7.9E-05			7.3E-05

EPA Urban Air Toxic Monitoring Program Target Compound
Average is the arithmetic mean of all valid samples with one-half the MDL substituted for non-detects.

Table 4. Summary of Excess Lifetime Cancer Risks from Inhalation Across Chemicals of Concern at Pennsylvania Sites for 2003 Annual Averages with 1/2 the MDL for non-detects.

Chemical Name	Chester			Marcus Hook			Swarthmore			Pottstown		
	Annual Average		Excess Lifetime	Annual Average		Excess Lifetime	Annual Average		Excess Lifetime	Annual Average		Excess Lifetime
	(ppbv)	(ug/m3)	Cancer Risk	(ppbv)	(ug/m3)	Cancer Risk	(ppbv)	(ug/m3)	Cancer Risk	(ppbv)	(ug/m3)	Cancer Risk
1,3-Butadiene	0.03	0.07	2.0E-06	0.03	0.07	2.0E-06	0.03	0.07	2.0E-06	0.10	0.22	6.6E-06
1,2-Dichlorobenzene	0.03	0.18	----------	0.03	0.18	----------	0.03	0.18	----------			----------
1,3-Dichlorobenzene	0.03	0.18	----------	0.03	0.18	----------	0.03	0.18	----------			----------
1,4-Dichlorobenzene	0.03	0.19	1.2E-06	0.03	0.18	1.1E-06	0.03	0.18	1.1E-06			1.1E-06
1,2-Dibromoethane	0.04	0.31	6.8E-05	0.04	0.31	6.8E-05	0.04	0.31	6.8E-05			6.8E-05
1,1-Dichloroethane	0.04	0.14	2.3E-07	0.04	0.14	2.3E-07	0.04	0.14	2.3E-07			2.3E-07
1,2-Dichloroethane	0.04	0.14	3.7E-06	0.04	0.14	3.7E-06	0.04	0.14	3.7E-06			3.7E-06
1,1-Dichloroethene	0.03	0.10	----------	0.03	0.10	----------	0.03	0.10	----------			----------
1,2-Dichloropropane	0.03	0.12	----------	0.03	0.12	----------	0.03	0.12	----------			----------
cis-1,3-Dichloro-1-propene	0.04	0.16	6.4E-07	0.04	0.16	6.4E-07	0.04	0.16	6.4E-07			6.4E-07
1,1,2,2-Tetrachloroethane	0.03	0.21	1.2E-05	0.03	0.21	1.2E-05	0.03	0.21	1.2E-05			1.2E-05
1,2,4-Trichlorobenzene	0.04	0.26	----------	0.04	0.26	----------	0.04	0.26	----------			----------
1,1,1-Trichloroethane	0.03	0.18	----------	0.03	0.16	----------	0.03	0.16	----------			----------
1,1,2-Trichloroethane	0.04	0.19	3.1E-06	0.04	0.19	3.1E-06	0.04	0.19	3.1E-06			3.1E-06
1,1,2-Trichloro-1,2,2-trifluoroethane	0.06	0.42	----------	0.06	0.44	----------	0.04	0.33	----------	0.06	0.50	----------
1,2,4-Trimethylbenzene	0.07	0.32	----------	0.10	0.51	----------	0.05	0.23	----------	0.07	0.34	----------
1,3,5-Trimethylbenzene	0.03	0.16	----------	0.04	0.21	----------	0.03	0.15	----------	0.04	0.21	----------
Benzene	0.17	0.55	4.3E-06	0.38	1.20	9.3E-06	0.18	0.57	4.4E-06	0.21	0.67	5.3E-06
Bromomethane	0.03	0.11	----------	0.04	0.15	----------	0.03	0.13	----------			----------
Carbon Tetrachloride	0.07	0.44	6.6E-06	0.07	0.47	7.0E-06	0.07	0.43	6.5E-06	0.07	0.43	6.4E-06
Chlorobenzene	0.04	0.16	----------	0.04	0.16	----------	0.04	0.16	----------			----------
Chloroethane	0.06	0.16	----------	0.04	0.10	----------	0.03	0.08	----------	0.03	0.09	----------
Chloroethene (Vinyl Chloride)	0.03	0.08	6.7E-07	0.04	0.10	9.2E-07	0.03	0.08	6.7E-07	0.03	0.09	7.7E-07
Chloroform	0.04	0.17	3.9E-06	0.04	0.17	3.9E-06	0.04	0.17	3.9E-06			3.9E-06
Chloromethane	0.42	0.87	----------	0.47	0.97	----------	0.44	0.91	----------	0.45	0.93	----------
Dichlorodifluoromethane	0.42	2.06	----------	0.45	2.22	----------	0.43	2.13	----------	0.45	2.20	----------
Ethylbenzene	0.04	0.18	----------	0.14	0.61	----------	0.04	0.19	----------	0.24	1.02	----------
Hexachloro-1,3-butadiene	0.03	0.27	5.9E-06	0.03	0.27	5.9E-06	0.03	0.27	5.9E-06			5.9E-06
Methylene Chloride	0.06	0.21	9.9E-08	0.07	0.25	1.2E-07	0.21	0.75	3.5E-07	0.10	0.36	1.7E-07
Styrene	0.04	0.16	----------	0.12	0.50	----------	0.04	0.15	----------	0.42	1.81	----------
Tetrachloroethylene	0.04	0.30	1.7E-06	0.04	0.24	1.4E-06	0.04	0.27	1.5E-06	0.04	0.24	1.4E-06
Toluene	0.46	1.74	----------	0.92	3.48	----------	0.47	1.75	----------	0.52	1.97	----------
Trichloroethylene	0.02	0.13	1.5E-05	0.02	0.11	1.3E-05	0.02	0.12	1.3E-05	0.07	0.37	4.2E-05
Trichlorofluoromethane	0.20	1.11	----------	0.21	1.16	----------	0.44	2.45	----------	0.21	1.21	----------
o-Xylene	0.05	0.22	----------	0.18	0.77	----------	0.05	0.22	----------	0.15	0.66	----------
m,p-Xylene	0.13	0.57	----------	0.46	2.02	----------	0.15	0.64	----------	0.45	1.95	----------
			1.3E-04			1.3E-04			1.3E-04			1.6E-04

EPA Urban Air Toxic Monitoring Program Target Compound

Average is the arithmetic mean of all valid samples with one-half the MDL substituted for non-detects.

Not detected at Pottstown – risk is for ½ MDL

Table 4. Summary of Excess Lifetime Cancer Risks from Inhalation Across Chemicals of Concern at Pennsylvania Sites for 2003 Annual Averages with 1/2 the MDL for non-detects.

Chemical Name	West Chester			Lancaster			Erie (Presque Isle)			Arendtsville		
	Annual Average		Excess Lifetime	Annual Average		Excess Lifetime	Annual Average		Excess Lifetime	Annual Average		Excess Lifetime
	(ppbv)	(ug/m3)	Cancer Risk	(ppbv)	(ug/m3)	Cancer Risk	(ppbv)	(ug/m3)	Cancer Risk	(ppbv)	(ug/m3)	Cancer Risk
1,3-Butadiene	0.03	0.07	2.0E-06	0.03	0.07	2.0E-06	0.03	0.07	2.0E-06	0.03	0.07	2.1E-06
1,2-Dichlorobenzene	0.03	0.18	----------	0.03	0.18	----------	0.03	0.18	----------	0.03	0.18	----------
1,3-Dichlorobenzene	0.03	0.18	----------	0.03	0.18	----------	0.03	0.18	----------	0.03	0.18	----------
1,4-Dichlorobenzene	0.03	0.18	1.1E-06	0.03	0.18	1.1E-06	0.03	0.18	1.1E-06	0.03	0.18	1.1E-06
1,2-Dibromoethane	0.04	0.31	6.8E-05	0.04	0.31	6.8E-05	0.04	0.31	6.8E-05	0.04	0.31	6.8E-05
1,1-Dichloroethane	0.04	0.14	2.3E-07	0.04	0.14	2.3E-07	0.04	0.14	2.3E-07	0.04	0.14	2.3E-07
1,2-Dichloroethane	0.04	0.14	3.7E-06	0.04	0.14	3.7E-06	0.04	0.14	3.7E-06	0.04	0.14	3.7E-06
1,1-Dichloroethene	0.03	0.10	----------	0.03	0.10	----------	0.03	0.10	----------	0.03	0.10	----------
1,2-Dichloropropane	0.03	0.12	----------	0.03	0.12	----------	0.03	0.12	----------	0.03	0.12	----------
cis-1,3-Dichloro-1-propene	0.04	0.16	6.4E-07	0.04	0.16	6.4E-07	0.04	0.16	6.4E-07	0.04	0.16	6.4E-07
1,1,2,2-Tetrachloroethane	0.03	0.21	1.2E-05	0.03	0.21	1.2E-05	0.03	0.21	1.2E-05	0.03	0.21	1.2E-05
1,2,4-Trichlorobenzene	0.04	0.26	----------	0.04	0.26	----------	0.04	0.26	----------	0.04	0.26	----------
1,1,1-Trichloroethane	0.03	0.16	----------	0.03	0.16	----------	0.03	0.16	----------	0.03	0.16	----------
1,1,2-Trichloroethane	0.04	0.19	3.1E-06	0.04	0.19	3.1E-06	0.04	0.19	3.1E-06	0.04	0.19	3.1E-06
1,1,2-Trichloro-1,2,2-trifluoroethane	0.05	0.40	----------	0.06	0.43	----------	0.04	0.34	----------	0.06	0.43	----------
1,2,4-Trimethylbenzene	0.03	0.15	----------	0.08	0.38	----------	0.04	0.19	----------	0.03	0.12	----------
1,3,5-Trimethylbenzene	0.03	0.15	----------	0.04	0.20	----------	0.03	0.15	----------	0.03	0.15	----------
Benzene	0.12	0.39	3.0E-06	0.19	0.61	4.7E-06	0.08	0.25	2.0E-06	0.07	0.22	1.7E-06
Bromomethane	0.03	0.10	----------	0.03	0.10	----------	0.03	0.10	----------	0.03	0.10	----------
Carbon Tetrachloride	0.07	0.43	6.5E-06	0.07	0.43	6.5E-06	0.06	0.38	5.7E-06	0.07	0.46	6.9E-06
Chlorobenzene	0.04	0.16	----------	0.07	0.30	----------	0.04	0.16	----------	0.04	0.16	----------
Chloroethane	0.03	0.08	----------	0.03	0.08	----------	0.03	0.08	----------	0.03	0.08	----------
Chloroethene (Vinyl Chloride)	0.03	0.09	7.5E-07	0.03	0.08	6.7E-07	0.03	0.08	6.7E-07	0.03	0.08	6.7E-07
Chloroform	0.04	0.17	3.9E-06	0.04	0.17	3.9E-06	0.04	0.17	3.9E-06	0.04	0.17	3.9E-06
Chloromethane	0.43	0.90	----------	0.44	0.90	----------	0.33	0.68	----------	0.44	0.91	----------
Dichlorodifluoromethane	0.43	2.12	----------	0.42	2.09	----------	0.29	1.43	----------	0.42	2.09	----------
Ethylbenzene	0.03	0.14	----------	0.06	0.26	----------	0.04	0.15	----------	0.03	0.13	----------
Hexachloro-1,3-butadiene	0.03	0.27	5.9E-06	0.03	0.27	5.9E-06	0.03	0.27	5.9E-06	0.03	0.27	5.9E-06
Methylene Chloride	0.05	0.17	7.9E-08	0.07	0.25	1.2E-07	0.05	0.17	8.0E-08	0.04	0.13	5.9E-08
Styrene	0.04	0.15	----------	0.04	0.15	----------	0.04	0.15	----------	0.04	0.15	----------
Tetrachloroethylene	0.04	0.26	1.5E-06	0.04	0.24	1.4E-06	0.04	0.24	1.4E-06	0.04	0.24	1.4E-06
Toluene	0.27	1.03	----------	0.49	1.85	----------	0.12	0.46	----------	0.08	0.31	----------
Trichloroethylene	0.02	0.11	1.2E-05	0.02	0.11	1.3E-05	0.02	0.11	1.2E-05	0.02	0.11	1.2E-05
Trichlorofluoromethane	0.20	1.14	----------	0.21	1.20	----------	0.14	0.81	----------	0.20	1.10	----------
o-Xylene	0.04	0.16	----------	0.07	0.31	----------	0.04	0.19	----------	0.04	0.15	----------
m,p-Xylene	0.09	0.39	----------	0.22	0.94	----------	0.09	0.37	----------	0.06	0.26	----------
			1.2E-04			1.3E-04			1.2E-04			1.2E-04

EPA Urban Air Toxic Monitoring Program Target Compound
Average is the arithmetic mean of all valid samples with one-half the MDL substituted for non-detects.

Appendix

A. Monitoring

Equipment

- Canister Sampler: Andersen Instruments, Inc. AVOCS
- Canisters: Six-liter SUMMA polished (various suppliers)
- Wind Sensors: Climatronics F460 low threshold anemometer and tail vane
  Tower height: 10 meters
  Wind direction referenced to True North
- Temperature and Relative Humidity: Vaialsa model HMP-45
- Solar Radiation: Silicon Cell, Matrix, Inc. model Mk 1-G
- Precipitation (unheated, rain only): Texas Electronics, Inc. model TE-525 tipping bucket, 0.01 inches per tip
- Datalogger: Campbell Scientific model CR-10X
  Measurement interval: 10 seconds
  Calculated data: 15-minute averages, 15-minute sigma theta (standard deviation of horizontal wind direction) 1-hour averages and 1-hour total precipitation
- Total Suspended Particulate: General Metal Works GMWL-2000 housing with Sierra Andersen model 352 critical volume flow control orifice.
- Filters: quartz fiber, 8" x 10"
- VOC Standard Cylinder: Spectra Gases, Inc., 500 ppbv/compound nominal
- Canister Analysis: Entech 7000 or 7100A sample concentrator, Agilent 6890 gas chromatograph, 5973 quadrupole mass spectrometer
- Metals Analysis: ELAN 5000 ICP/MS or ELAN 6000 ICP/MS

Sampling schedule: Midnight to midnight every sixth day on the same day at all sites.

A shelter houses the canister sampler and supports the meteorological tower. A blower continuously draws ambient air into the shelter through a glass sampling cane and manifold. The automated canister sampler pumps air from the manifold into an evacuated stainless steel canister at a constant flow rate over the 24-hour period sampling period. The filled canister is returned the DEP laboratory for analysis.

Calibration and Analysis

The laboratory GC/MS system is calibrated with working standards prepared from a 500 part per billion, 60 component commercial gas cylinder standard (Spectra Gases, Inc.) diluted with humidified nitrogen. In addition, a 15 component primary standard (National Institute of Standards and Technology, NIST SRM-1800) is analyzed to verify the calibration. Each run consists of standards, blanks and continuing calibration standards after every ten samples.

After analysis, canisters are cleaned and evacuated by the laboratory. After each batch is cleaned, at least one canister is filled and retested as a blank to verify they are clean. Canisters are not dedicated to a specific site, so a canister used at Pottstown may be cleaned and sent to another ambient monitoring site. In January 2003, the laboratory replaced their canister analysis system with a newer model, resulting in some changes in MDLs. Note that canisters were not collected from January 15, 2003 to March 10, 2003 while the analytical system was being replaced.

A GMWL-2000 total suspended particulate samples at a flow rate of 40 actual cubic feet per minute to collect airborne particulate on a quartz fiber filter. The filter is returned to the DEP laboratory where it is conditioned to constant humidity then weighed. A one-inch wide strip of the filter is extracted in an ultrasonic bath with mixed 2.2 M hydrochloric and 1 M nitric acids. The extract is centrifuged then analyzed by ICP/MS for Arsenic, Beryllium, Cadmium, Chromium, Lead, Manganese, Nickel and Zinc. Duplicate strips are analyzed on at least 10% of the filters for quality control.

B. Definitions

Air basin — A geographic area of the Commonwealth of Pennsylvania as defined in 25 Pa. Code § 121.1. The Southeast Pennsylvania air basin includes the counties of Bucks, Chester, Delaware, Montgomery and Philadelphia.

AIRS —Aerometric Information and Retrieval System is EPA's national database of air quality information. The Air Quality Subsystem (AQS) contains data on ambient air measurements.

Blank – Sampling materials and chemicals analyzed without collecting a sample to test for contaminants that might interfere with the analysis. The analytical protocol specifies acceptable blank levels and how these values are used in calculating the results.

Chronic — Occurring over a long period of time. Cancer is the primary health effect considered when evaluating the risk from chronic exposure to a chemical compound.

Excess risk — The increased risk of disease above the normal background rate.

Halogenated compound — An organic compound bonded with one of the five halogen elements (astatine, bromine, chlorine, fluorine, and iodine).

Mean — The arithmetic average. For example, (2.2 +2.6 +4.8)/3 = 3.2.

Micron — A unit of length equal to one millionth of a meter or about 0.0000394 inches. Its symbol is the Greek letter :.

Microgram — A microgram is one millionth of a gram weight. (The symbol ug (:g) is commonly used for microgram) Ambient air concentrations are commonly expressed in micrograms per cubic meter of air (ug/m^3). Because air expands and contracts with changes in temperature and pressure, the cubic meter volume must be referenced to a specific temperature and pressure. Standard conditions for ambient air measurements are 25° C (77° F) and one atmosphere (29.92 inches of mercury).

Milligram — One thousandth of a gram weight.

Nanogram — One billionth of a gram weight. Very low ambient air concentrations are expressed in nanograms per cubic meter of air (ng/m^3).

Particulate matter — A material except uncombined water, which is or has been airborne and exists as a solid or liquid at 70° F and standard atmospheric pressure.

ppbv — Parts per billion by volume – the concentration units commonly used for gaseous pollutants in ambient air. These units are not used for non-gaseous pollutants.

PM-10 — Particulate matter with an effective aerodynamic diameter of less than or equal to a nominal 10 micron body as measured by the applicable reference method or an equivalent method. For practical purposes, these are the particles in the air that are small enough to be inhaled. Recent EPA regulations also cover PM-2.5, even smaller particles that can penetrate deeper into the lungs.

Unit Risk Factor (URF) — A measure of the probability of an individual developing cancer as a result of exposure to a specified unit ambient concentration of a specific chemical. In air, the unit concentration is 1.0 microgram per cubic meter. For example, an inhalation URF of 3.0E-04 implies that if 10,000 people breathe that chemical for 70 years at a concentration of 1.0 ug/m^3, three of the 10,000 may develop cancer as a result of the exposure.

Volatile Organic Chemical — A chemical compound containing carbon that can be present in the atmosphere as a vapor at normal temperatures. Generally, chemicals with vapor pressures greater than 0.1 mmHg at 20° C (0.0001316 atmospheres at 68° F) are classified as volatile, and chemicals with measurable vapor pressures that are less than 0.1 mmHg are classified as semi-volatile.

C. Risk Calculation

The excess lifetime cancer risk for each of the chemicals was calculated by using EPA's unit risk factors (URFs). The EPA Region III Superfund Technical Support Section has established a risk-based concentration (RBC) table for nearly 500 chemicals. Four different chronic toxicological constants are examined for each chemical compound: 1) Oral Reference Dose (RfDo); 2) Inhalation Reference Dose (RfDi); 3) Oral Cancer Potency Slope (CPSo); and 4) Inhalation Cancer Potency Slope (CPSi). The sources of the toxicological constants are: 1) the Integrated Risk Information System (IRIS); 2) Health Effects Assessment Summary Tables (HEAST); 3) HEAST Alternate; 4) EPA-NCEA Regional Support Provisional Value; and 5) other EPA documents. For this study, only the RfDi and CPSi were used. In some cases, there were no inhalation risk data for the chemicals in the RBC table, so other sources, such as the Boilers and Industrial Furnaces (BIF) Regulation, had to be referenced.

The URF and the reference air concentration (RfC) are derived from the CPSi and RfDi, respectively, by assuming that an adult weighing 70 kilograms (154 pounds) will breathe

20 m^3 (706 ft^3) of air a day for 365 days a year, over a 70-year lifetime of exposure. This is a standard conversion methodology and is detailed on page two of the "Contents, Uses, and Limitations of the RBC Table" section of the RBC table. From this standard 70-year exposure scenario for an adult, excess lifetime cancer risk is calculated for each chemical by multiplying the measured air concentrations by their respective URFs. The individual risks for each chemical are added to get the total excess lifetime cancer risk at that site. The non-cancer risk associated with each of the relevant chemicals is calculated by simply dividing the measured air concentration by the chemical's respective RfC.

The conversion from CPSi to URF is carried out as follows:

(kg-day)/mg x (1/70 kg) x (20 m^3/day) x (mg/1000 ug) = m^3/ug

The conversion from RfDi to RfC is carried out as follows:

mg/(kg-day) x (70 kg) x (day/20 m^3) x (1000 ug/mg) = ug/m^3

Table 5. Cancer Unit Risk Factors for Inhalation and Reference Concentrations

Chemical Compound Name	Unit Risk (m3/ug)	Reference Air Concentration (ug/m^3)	Molecular Weight	Source URF[1]	Source RFD[1]
1,3-Butadiene	3.00E-05	2.00E+00	54.1	I	I
1,2-Dichlorobenzene	-	1.40E+02	147.0		O
1,3-Dichlorobenzene	-	-	147.0		
1,4-Dichlorobenzene	6.29E-06	8.00E+02	147.0	O	I
1,2-Dibromoethane	2.20E-04	2.00E-01	187.9	I	O
1,1-Dichloroethane	1.60E-06	5.00E+02	99.0		O
1,2-Dichloroethane	2.60E-05	5.00E+00	99.0	I	O
1,1-Dichloroethene	-	2.00E+02	97.0		I
1,2-Dichloropropane	-	4.00E+00	113.0		I
1,3-Dichloropropene	4.00E-06	2.00E+01	111.0	I	I
1,1,2,2-Tetrachloroethane	5.80E-05	-	167.9	I	
1,2,4-Trichlorobenzene	-	3.50E+00	181.4		O
1,1,1-Trichloroethane	-	2.20E+03	133.4		O
1,1,2-Trichloroethane	1.60E-05	-	133.4	I	
1,1,2-Trichloro-1,2,2-Trifluoroethane	-	3.00E+04	187.4		O
1,2,4-Trimethylbenzene	-	6.00E+00	120.2		O
1,3,5-Trimethylbenzene	-	6.00E+00	120.2		O
Benzene	7.80E-06	3.00E+01	78.1	I	I
Bromoform	1.1E-06	-			
Bromomethane	-	5.00E+00	95.0		I
Carbon Tetrachloride	1.50E-05	2.00E+00	153.8	I	O
Chlorobenzene	-	6.00E+01	112.6		O
Chloroethane	-	1.00E+04	64.5		I
Chloroethene (Vinyl Chloride)	8.80E-06	1.00E+02	62.5	I	I
Chloroform	2.30E-05	4.90E+01	119.4	I	O
Chloromethane	-	9.00E+01	50.5	O	I

Table 5. Cancer Unit Risk Factors for Inhalation and Reference Concentrations

Chemical Compound Name	Unit Risk (m3/ug)	Reference Air Concentration (ug/m^3)	Molecular Weight	Source URF[1]	Source RFD[1]
Cyclohexane	-	6.0E+03	84.2		I
Dichlorodifluoromethane	-	1.75E+02	120.9		O
Ethylbenzene	-	1.00E+03	106.2	O	I
Hexachloro-1,3-butadiene	2.20E-05	-	260.7	I	
Methylene Chloride	4.70E-07	3.00E+03	84.9	I	O
Styrene	-	1.00E+03	104.2		I
Tetrachloroethylene	5.71E-06	5.00E+02	165.8	O	O
Tetrahydrofuran	1.94E-06	3.00E+02	72.1		
Toluene	-	4.00E+02	92.1		I
Trichloroethylene	1.14E-04	3.50E+01	131.4	O	O
Trichlorofluoromethane	-	7.00E+02	137.4		O
o-Xylene	-	1.00E+02	106.2		I
m,p-Xylene	-	1.00E+02	106.2		I
Arsenic	4.30E-03	3.00E-02		I	O
Beryllium	2.40E-03	2.00E-02		I	I
Cadmium	1.80E-03	2.00E-01		I	O
Chromium +VI	1.20E-02	8.00E-03		I	I
Lead	-	9.00E-02			B
Manganese	-	5.00E-02			I
Nickel[2]	2.40E-04	5.00E-02		I	O
Zinc	-	3.50E+01			O
PM-10[3]	-	5.00E+01			O

1. **I** Integrated Risk Information System (IRIS**), B** Boiler and Industrial Furnace Regulations (BIF), **O** Other sources

2. The URF is for nickel as refinery dust.

3. The RfC is the annual mean ambient air quality standard.

D. Changes in Unit Risk Factors and Reference Concentrations Since 2000

Compound	Change	Source
1,3-Butadiene	URF changed from 2.80E-04 to 3.00E-05 R_fC added	Change in IRIS Change in IRIS
1,2-Dichlorobenzene	R_fC deleted R_fC added	Change in EPA-NCEA Change in HEAST
1,3-Dichlorobenzene	R_fC deleted	Change in EPA-NCEA
1,1-Dichloroethane	R_fC corrected URF added	 Change in CARB
1,1-Dichloroethene	R_fC added URF deleted	Change in IRIS
1,3-Dichloropropene	URF changed from 3.71E-05 to 4.00E-06	Change in IRIS
1,2,4-Trichlorobenzene	R_fC changed from 2.00E-02 to 3.50E+00	Change in EPA-NCEA
1,1,1-Trichloroethane	R_fC changed from 1.00E+03 to 2.20E+03	Change in EPA-NCEA
Benzene	URF changed from 8.30E-6 to 7.80E-06 R_fC changed from 6.00E+00 to 3.00E+00	Change in IRIS Added to IRIS
Chlorobenzene	R_fC changed from 1.75E+01 to 6.00E+01	Change in EPA-NCEA
Chloroethene	URF changed from 8.57E-05 to 8.80E-06	Change in IRIS
Chloroethene	R_fC added	Change in IRIS
Chloroform	R_fC changed from 3.00E-01 to 4.90E+01	Change in IRIS
Cholormethane	URF deleted	Change in EPA-NCEA
Chloromethane	R_fC added	Change in IRIS
Ethylbenzene	URF deleted	Change in EPA-NCEA
Tetrachloroethene	URF changed from 2.86E-06 to 5.71E-06	Change in RBC Table
Trichloroethylene	R_fC deleted URF changed from 1.71E-06 to 1.14E-04	Change in EPA-NCEA Change in EPA-NCEA
Xylenes	R_fC changed from 8.00E+01 to 1.00E+02	Change in IRIS (added)
Arsenic	R_fC added	Change in CARB
Cadmium	R_fC added	Change in EPA-NCEA
Chromium^{+6}	R_fC changed from 3.50E-04 to 8.00E-03	Change in IRIS
Manganese	Compound added to study, R_fC	IRIS

E. Pennsylvania Air Toxic Monitoring Sites for Volatile Organics and Metals

Name	County
Arendtsville	Adams (VOC only)
Chester	Delaware
Marcus Hook	Delaware
Swarthmore	Delaware
Pottstown	Montgomery
Lancaster	Lancaster
West Chester (East Bradford Twp.)	Chester
Bucknell (Lewisburg)	Union
Presque Isle (Erie)	Erie