Pottstown Area Air Monitoring
Final Report

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Commonwealth of Pennsylvania
Department of Environmental Protection

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Executive Summary

This report supplements the original Pottstown Area Air Monitoring report issued May 12, 2004 with sampling data and risk analysis for the air samples collected in 2004 and 2005. The risk factors for several of the sampled compounds have changed and the risk assessment has been adjusted accordingly.

The Pennsylvania Department of Environmental Protection (DEP) 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 DEP began sampling near the intersection of Adams and Franklin Streets to determine the concentration of pollutants collectively known as air toxics. This site is centrally located and was not established to monitor the emissions from a specific facility. Initially, the study included sampling and analysis of volatile organic compounds (VOCs) and the measurement of wind speed, wind direction, temperature, relative humidity, precipitation and solar radiation (visible sunlight). In June 2003, the DEP began sampling for toxic metals in airborne particles.

Two types of air samples are collected at the Pottstown site over a 24-hour period from midnight to midnight. Samples are collected on the same schedule every sixth day at all Pennsylvania air toxics monitoring network sites. The DEP's central laboratory analyzes all samples. Air collected in an evacuated canister is tested for 55 VOCs based on the Environmental Protection Agency (EPA) Method TO-15. An air filter sample is weighed for total particulates and analyzed for arsenic, beryllium, cadmium, chromium, lead, manganese, nickel and zinc (based on EPA Method IO-3).

Note that there are neither state nor national air quality standards for these pollutants, except for lead and beryllium. Instead, the DEP evaluated the health risks associated with breathing the measured concentrations of these pollutants using risk assessment methods approved by EPA. The DEP also compared Pottstown data to other monitoring sites in Pennsylvania where similar sampling is conducted.

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. However, early in the study, higher annual average concentrations of one compound, trichloroethylene (TCE) significantly increased the aggregate excess lifetime cancer risk at Pottstown compared to other sites in Pennsylvania. Since then, the concentrations of this compound have decreased so that the risk is comparable to levels found at most other monitoring sites. The annual average TCE concentration at Pottstown was 0.04 parts per billion volume (ppbv) in 2005, down from 0.22 ppbv in 2002. In comparison, most other Pennsylvania sites in 2005 were near or below the 0.04 ppbv detection limit. The corresponding TCE excess lifetime cancer risk for Pottstown was 0.23 in 10,000 in 2005, down from 1.3 in 10,000 in 2002.

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Introduction

Background

In response to citizen concerns about potentially harmful air quality in Pottstown, Montgomery County, the 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, 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 breathe. The original study plan was to sample volatile organic compounds (VOCs) for one year in order to have sufficient data for a meaningful evaluation of the risk to area residents. After sampling for one year, DEP decided to continue sampling for VOCs because the risk at Pottstown, based on the first year of data, was greater than other Pennsylvania sites. In June of 2003, DEP began sampling for toxic metals in airborne particles to better characterize the overall level of pollutants in the air in Pottstown.

Note that there are neither state nor national air quality standards for these pollutants, except for lead and beryllium. Instead, the DEP evaluated the health risks associated with breathing the measured concentrations of these pollutants using risk assessment methods approved by EPA. The DEP also compared Pottstown data to other monitoring sites in Pennsylvania where similar sampling is conducted.

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

Monitoring

Since May 2, 2002, the DEP 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 15, 2003 until March 22, 2003 while the laboratory analytical system was being replaced. Sampling stopped again between July 27, 2005 and November 6, 2005 while the laboratory moved to a new building. Nine random samples were taken during the period from November 2004, to June 2005, to identify any ambient concentration patterns.

The specific VOCs that can be measured are determined by the analytical method and by the number of compounds in the calibration standards. 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 GC/MS separates the chemical compounds and then detects and identifies the compounds by matching the ion fragment patterns and retention times to known chemical standards.

The 55 target VOCs include 33 "Hazardous Air Pollutants" listed in the 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 lists the target compounds, other commonly-used names, each compound's Chemical Abstract Service (CAS) number that uniquely identifies the chemical, and the DEP Laboratory's method detection limits (MDLs). 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 is also equipped with 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.

Table 1. Volatile organic compounds reported by the DEP laboratory and the 2002-2005 method detection limits (MDL).

Compound*	Synonyms	CAS Number	2002 MDL (ppbv)	2003 MDL (ppbv)	2004 MDL (ppbv)	2005 MDL (ppbv)
1,3-Butadiene		106-99-0	0.04	0.06	0.04	0.04
1,2-Dibromoethane	Ethylene dibromide, EDB	106-93-4	0.04	0.08	0.04	0.04
cis-1,3-Dichloro-1-propene		10061-01-5	0.04	0.07	0.02	0.02
trans-1,3-Dichloro-1-propene		10061-02-6	0.03	0.07	0.04	0.02
1,2-Dichloro-1,1,2,2-tetrafluoroethane	Freon 114	76-14-2	0.03	0.06	0.04	0.04
1,2-Dichlorobenzene		95-50-1	0.03	0.06	0.04	0.16
1,3-Dichlorobenzene		541-73-1	0.03	0.06	0.04	0.14
1,4-Dichlorobenzene	Para-Dichlorobenzene	106-46-7	0.03	0.06	0.04	0.14
1,1-Dichloroethane	Ethylidene chloride	75-34-3	0.04	0.07	0.04	0.04
1,2-Dichloroethane	Ethylene chloride	107-06-2	0.03	0.07	0.04	0.04
1,1-Dichloroethene	Vinylidene chloride	75-35-4	0.03	0.05	0.04	0.04
cis-1,2-Dichloroethene		156-59-2	0.03	0.06	0.04	0.04
trans-1,2-Dichloroethene		156-60-5	0.05	0.06	0.04	0.04
1,2-Dichloropropane		78-87-5	0.03	0.05	0.04	0.04
1-Ethyl-4-methyl benzene		622-96-8	0.03	0.05	0.04	0.16
1,1,2,2-Tetrachloroethane		79-34-5	0.03	0.06	0.04	0.14
1,1,2-Trichloro-1,2,2-trifluoroethane	Freon 113	76-13-1	0.03	0.06	0.04	0.04
1,2,4-Trichlorobenzene		120-82-1	0.07	0.07	0.02	0.2
1,1,1-Trichloroethane	Methyl chloroform	71-55-6	0.03	0.06	0.04	0.04
1,1,2-Trichloroethane		79-00-5	0.03	0.07	0.04	0.04
1,2,4-Trimethylbenzene	Pseudocumene	95-63-6	0.02	0.05	0.04	0.14
1,3,5-Trimethylbenzene		108-67-8	0.03	0.06	0.04	0.14
2-Butanone	Methyl ethyl ketone, MEK	78-93-3	0.05	0.07	0.04	0.16
2-Hexanone	Methyl butyl ketone, MBK	591-78-6	0.06	0.07	0.14	0.38
2-Methoxy-2-methyl propane	Methyl-tert-butyl ether, MTBE	1634-04-4	0.03	0.06	0.04	0.04
4-Methyl-2-pentanone	MIBK	108-10-1	0.05	0.06	0.12	0.88
Acetone		67-64-1	0.05	0.06	0.04	0.14
Benzene	Benzol	71-43-2	0.04	0.07	0.04	0.04
Bromodichloromethane		75-27-4	0.04	0.05	0.04	0.04
Bromoform	Tribromomethane	75-25-2	0.03	0.05	0.04	0.02
Bromomethane		74-83-9	0.03	0.05	0.04	0.04
Carbon disulfide		75-15-0	0.05	0.05	0.04	0.04
Carbon tetrachloride	Tetrachloromethane	56-23-5	0.03	0.06	0.04	0.04
Chlorobenzene		108-90-7	0.03	0.07	0.04	0.04
Chloroethane	Ethyl chloride	75-00-3	0.03	0.06	0.04	0.04
Chloroethene	Vinyl Chloride	75-01-4	0.04	0.06	0.04	0.04
Chloroform	Trichloromethane	67-66-3	0.04	0.07	0.04	0.04

Table 1. (continued).

Compound*	Synonyms	CAS Number	2002 MDL (ppbv)	2003 MDL (ppbv)	2004 MDL (ppbv)	2005 MDL (ppbv)
Chloromethane	Methyl chloride	74-87-3	0.04	0.06	0.04	0.04
Cyclohexane		110-82-7	0.03	0.06	0.04	0.04
Dibromochloromethane		124-48-1	0.03	0.06	0.04	0.04
Dichlorodifluoromethane	Freon 12	75-71-8	0.03	0.06	0.04	0.04
Ethylbenzene		100-41-4	0.05	0.06	0.04	0.04
n-Heptane		142-82-5	0.03	0.09	0.04	0.04
Hexachloro-1,3-butadiene		87-68-3	0.02	0.05	0.04	0.12
n-Hexane		110-54-3	0.03	0.05	0.04	0.04
Methylene chloride	Dichloromethane	75-09-2	0.04	0.07	0.04	0.04
Propene	Propylene	115-07-1	0.04	0.06	0.02	0.16
Styrene		100-42-5	0.03	0.07	0.04	0.02
Tetrachloroethene	Perchloroethylene, PERC	127-18-4	0.04	0.07	0.04	0.04
Tetrahydrofuran	1,4-Epoxybutane, THF	109-99-9	0.04	0.06	0.04	0.04
Toluene	Toluol	108-88-3	0.03	0.08	0.04	0.04
Trichloroethylene	Trichloroethene, TCE	79-01-6	0.04	0.04	0.04	0.04
Trichlorofluoromethane	Freon 11	75-69-4	0.03	0.06	0.04	0.04
m,p- Xylene		108-38-3	0.07	0.12	0.1	0.06
o-Xylene		95-47-6	0.04	0.07	0.04	0.04

* Highlighted compounds are listed in the 1990 Clean Air Act Amendments as Hazardous Air Pollutants.

On June 18, 2003, a total suspended particulate (TSP) sampler was installed next to the air monitoring shelter to measure particulates 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 occur in the atmosphere in more than one form, with some forms being much more toxic than others. In particular, this method does not distinguish between hexavalent chromium (Cr^{+6}), which is considered highly toxic (carcinogenic), and other chromium compounds that are less toxic. Particulate and metals data are reported in units of micrograms per standard cubic meter of air ($\mu g/m^3$).

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 Pennsylvania air toxics monitoring sites.

Because there are neither state nor national ambient air quality standards for these pollutants (except for lead and beryllium), Pottstown data are compared in this report to data collected at the other DEP air toxics monitoring sites including Arendtsville, Chester, Erie, Evansburg, Lancaster, Lewisburg, Marcus Hook, Swarthmore and Trappe. Sampling began at the Evansburg and Trappe sites in January 2005. Figure 1 shows the locations of DEP air toxic monitoring sites.

Discussion of Monitoring Results

Volatile Organic Compounds

In summarizing the data, DEP calculated annual average concentrations for each of the 55 VOCs. In an effort to be more conservative with these averages, one-half the MDL was used, rather than zero, whenever a VOC was not detected (ND) in the sample. A VOC is considered non-detected if the data is less than its MDL. When concentrations are below the MDL the result cannot be distinguished with statistical confidence from background noise. The MDLs are determined by a standard laboratory quality control procedure (40 CFR Part 136, Appendix B). The definition of MDL is "the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte". In addition to the MDL, the lab also uses a reporting limit (RL) for each VOC, which is approximately ten times the MDL. If data is between the RL and the MDL, there is confidence that the VOC is actually present, but less certainty in the accuracy of the reported concentration.

From 2004 through 2005, 31 out of 55 target VOCs have been detected at Pottstown. Table 2 shows the percent of the time each VOC was detected at each Pennsylvania air toxics site. Fifteen VOCs were detected at all 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 reflecting local influences. Arendtsville is a rural background site in Adams County, and as would be expected, fewer pollutants were detected. Note that there are neither state nor national air quality standards for these pollutants, except for lead and beryllium. Instead, the DEP evaluated the health risks associated with breathing the measured concentrations of these pollutants using risk assessment methods approved by EPA. The DEP also compared Pottstown data to other monitoring sites in Pennsylvania where similar sampling is conducted.

Results from the nine random samples collected from November 2004 to June 2005 showed average TCE concentrations at or below the annual average for the year they were collected.

Annual average concentrations are used to compare the toxic air pollutants at different sites, and to estimate the cancer and non-cancer risk from inhalation exposure to ambient air. Tables 3 and 4 show these comparisons for 2004 and 2005, respectively.

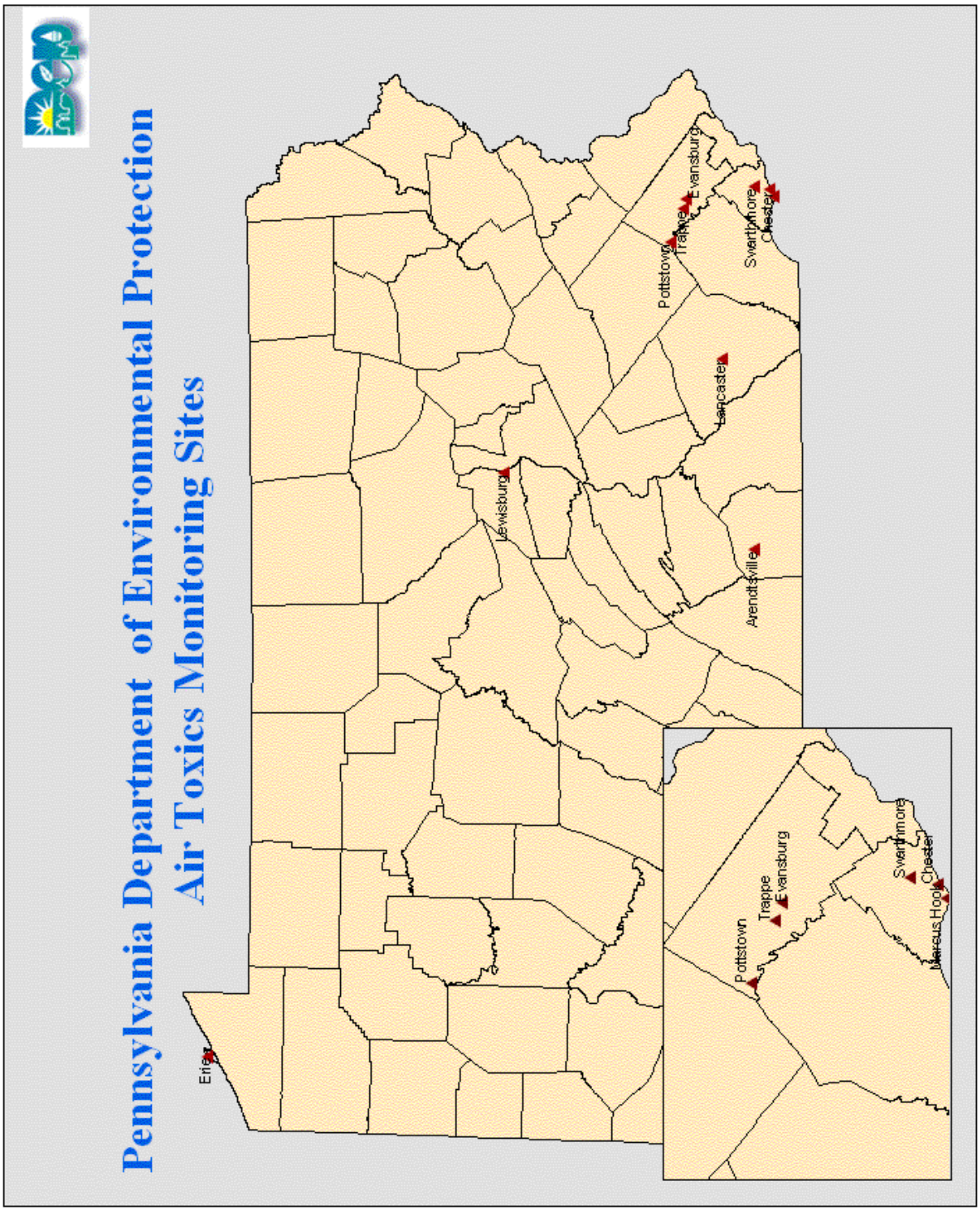


Figure 1. Map of air toxic monitoring sites in Pennsylvania in 2005.

Table 2. Percent of 2004 and 2005 samples at each monitoring site in which compounds were above the method detection limit.

Compound[1]	Arendtsville	Chester	Erie	Evansburg [2]	Lancaster	Lewisburg	Marcus Hook	Pottstown	Swarthmore	Trappe [2]
1,3-Butadiene	0	0	0	0	0	4	0	28	0	5
1,2-Dibromoethane (EDB)	0	0	0	0	0	0	0	0	0	0
cis-1,3-Dichloro-1-propene	0	0	2	0	0	0	0	0	0	0
trans-1,3-Dichloro-1-propene	0	0	0	0	0	0	0	0	0	0
1,2-Dichloro-1,1,2,2,tetrafluoroethane	0	0	0	0	0	0	0	0	0	0
1,2-Dichlorobenzene	0	1	0	0	0	0	0	0	0	0
1,3-Dichlorobenzene	0	0	0	0	0	0	0	0	0	0
1,4-Dichlorobenzene	0	4	0	0	1	0	4	0	0	0
1,1-Dichloroethane	0	0	0	0	0	0	0	0	0	0
1,2-Dichloroethane	0	1	0	0	0	0	1	0	0	0
1,1-Dichloroethene	0	0	0	0	0	0	0	0	0	0
cis-1,2-Dichloroethene	0	0	0	0	0	0	0	0	0	0
trans-1,2-Dichloroethene	0	0	0	0	0	0	0	0	0	0
1,2-Dichloropropane	0	0	0	0	0	0	0	0	0	0
1-Ethyl-4-methyl benzene	0	7	0	0	13	9	17	4	1	2
1,1,2,2-Tetrachloroethane	0	0	0	0	0	0	0	0	0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	100	100	100	100	100	100	100	100	100	100
1,2,4-Trichlorobenzene	1	0	0	0	0	0	0	0	1	0
1,1,1-Trichloroethane	0	98	0	0	2	0	0	0	0	0
1,1,2-Trichloroethane	0	0	0	0	0	0	0	0	0	0
1,2,4-Trimethylbenzene	0	60	8	10	59	35	87	49	33	30
1,3,5-Trimethylbenzene	2	44	5	10	36	31	61	53	43	5
2-Butanone (MEK)	100	100	95	98	98	100	100	100	100	100
2-Hexanone (MBK)	8	1	0	5	0	0	1	0	0	3
2-Methoxy-2-methyl propane (MTBE)	29	98	0	86	51	25	100	94	96	91
4-Methyl-2-pentanone (MIBK)	4	0	0	4	2	3	7	5	1	5
Acetone	100	100	100	100	99	100	100	100	100	100
Benzene	98	100	97	100	100	100	100	100	100	100
Bromodichloromethane	0	0	0	0	0	0	0	0	0	0
Bromoform	0	0	0	0	0	0	0	0	0	0
Bromomethane	0	4	2	2	2	0	7	0	6	5
Carbon disulfide	24	23	6	24	11	31	18	29	22	39
Carbon tetrachloride	100	100	100	100	100	100	100	100	100	100
Chlorobenzene	0	0	0	0	99	0	1	0	0	0
Chloroethane	45	27	0	12	2	0	21	5	13	7
Chloroethene	0	6	0	2	0	0	12	10	3	0
Chloroform	0	1	2	0	7	0	0	2	3	0

Table 2. (continued).

Compound[1]	Arendtsville	Chester	Erie	Evansburg [2]	Lancaster	Lewisburg	Marcus Hook	Pottstown	Swarthmore	Trappe [2]
Chloromethane	100	100	100	100	100	100	100	100	100	100
Cyclohexane	0	37	3	10	13	5	89	12	25	20
Dibromochloromethane	0	0	0	0	0	0	0	0	0	0
Dichlorodifluoromethane	100	100	100	100	100	100	100	100	100	100
Ethylbenzene	0	40	8	18	57	57	99	99	36	45
n-Heptane	37	96	17	84	75	61	100	93	89	75
Hexachloro-1,3-butadiene	0	0	0	0	0	0	0	0	0	0
n-Hexane	50	98	75	80	96	83	99	97	99	86
Methylene chloride	47	89	59	88	83	76	91	88	97	75
Propene	95	100	94	98	100	99	100	100	100	98
Styrene	0	2	10	0	11	20	99	97	3	5
Tetrachloroethene (PERC)	0	38	6	12	12	12	26	7	26	25
Tetrahydrofuran (THF)	0	100	0	4	2	5	5	27	1	0
Toluene	73	100	87	100	99	99	100	100	100	98
Trichloroethylene (TCE)	0	8	5	76	5	8	7	47	26	82
Trichlorofluoromethane	100	100	100	100	100	100	100	100	100	100
m & p- Xylene	0	68	17	46	69	73	99	100	49	82
o-Xylene	0	44	10	28	56	64	99	98	42	66
Number of Compounds Detected	20	35	26	29	33	28	34	31	32	30

[1] Highlighted compounds were not detected at any site.
[2] Evansburg and Trappe percentages are from 2005 data only.

Table 3. Summary of 2004 annual average concentrations and excess lifetime cancer risks from inhalation of targeted VOCs across all Pennsylvania monitoring sites.

Compound	Arendtsville			Chester			Erie			Lancaster		
	Annual Avg[1]		Cancer Risk	Annual Avg		Cancer Risk	Annual Avg		Cancer Risk	Annual Avg		Cancer Risk
	ppbv	µg/m^3		ppbv	µg/m^3		ppbv	µg/m^3		ppbv	µg/m^3	
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-Dibromoethane	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05
cis-1,3-Dichloro-1-propene	0.01	0.05	1.3E-07	0.01	0.05	1.3E-07	0.01	0.05	1.3E-07	0.01	0.05	1.3E-07
1,2-Dichlorobenzene	0.02	0.12	----------	0.02	0.12	----------	0.02	0.12	----------	0.02	0.12	----------
1,3-Dichlorobenzene	0.02	0.12	----------	0.02	0.12	----------	0.02	0.12	----------	0.02	0.12	----------
1,4-Dichlorobenzene	0.02	0.12	7.6E-07	0.02	0.12	7.8E-07	0.02	0.12	7.6E-07	0.02	0.12	7.7E-07
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	0.08	2.1E-06	0.02	0.08	2.1E-06	0.02	0.08	2.1E-06	0.02	0.08	2.1E-06
1,1-Dichloroethene	0.02	0.08	----------	0.02	0.08	----------	0.02	0.08	----------	0.02	0.08	----------
1,2-Dichloropropane	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------
1,1,2,2-Tetrachloroethane	0.02	0.14	8.0E-06	0.02	0.14	8.0E-06	0.02	0.14	8.0E-06	0.02	0.14	8.0E-06
1,1,2-Trichloro-1,2,2-trifluoroethane	0.06	0.49	----------	0.08	0.65	----------	0.06	0.48	----------	0.06	0.49	----------
1,2,4-Trichlorobenzene	0.01	0.08	----------	0.01	0.07	----------	0.01	0.07	----------	0.01	0.07	----------
1,1,1-Trichloroethane	0.02	0.11	----------	0.09	0.48	----------	0.02	0.11	----------	0.02	0.11	----------
1,1,2-Trichloroethane	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06
1,2,4-Trimethylbenzene	0.02	0.10	----------	0.06	0.31	----------	0.02	0.11	----------	0.07	0.34	----------
1,3,5-Trimethylbenzene	0.02	0.10	----------	0.05	0.24	----------	0.02	0.11	----------	0.04	0.20	----------
Benzene	0.11	0.34	2.7E-06	0.21	0.69	5.3E-06	0.15	0.48	3.8E-06	0.24	0.76	5.9E-06
Bromoform	0.02	0.21	2.3E-07	0.02	0.21	2.3E-07	0.02	0.21	2.3E-07	0.02	0.21	2.3E-07
Bromomethane	0.02	0.08	----------	0.02	0.08	----------	0.02	0.08	----------	0.02	0.08	----------
Carbon Tetrachloride	0.08	0.50	7.5E-06	0.08	0.48	7.3E-06	0.08	0.48	7.3E-06	0.08	0.51	7.6E-06
Chlorobenzene	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------	0.08	0.39	----------
Chloroethane	0.04	0.11	----------	0.05	0.14	----------	0.02	0.05	----------	0.02	0.06	----------
Chloroethene	0.02	0.05	4.5E-07	0.03	0.06	5.6E-07	0.02	0.05	4.5E-07	0.02	0.05	4.5E-07
Chloroform	0.02	0.10	2.2E-06	0.02	0.10	2.3E-06	0.02	0.10	2.2E-06	0.02	0.11	2.5E-06
Chloromethane	0.49	1.00	----------	0.49	1.01	----------	0.45	0.94	----------	0.48	0.99	----------
Cyclohexane	0.02	0.07	----------	0.05	0.17	----------	0.02	0.07	----------	0.03	0.09	----------
Dichlorodifluoromethane	0.44	2.16	----------	0.46	2.25	----------	0.44	2.16	----------	0.45	2.20	----------
Ethylbenzene	0.02	0.09	----------	0.04	0.16	----------	0.02	0.09	----------	0.05	0.23	----------
Hexachloro-1,3-butadiene	0.02	0.21	4.7E-06	0.02	0.21	4.7E-06	0.02	0.21	4.7E-06	0.02	0.21	4.7E-06
Methylene Chloride	0.04	0.13	6.2E-08	0.09	0.30	1.4E-07	0.05	0.16	7.5E-08	0.07	0.25	1.2E-07
Styrene	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------
Tetrachloroethylene	0.02	0.14	7.7E-07	0.06	0.38	2.2E-06	0.03	0.20	1.1E-06	0.03	0.17	9.8E-07
Tetrahydrofuran	0.02	0.06	1.1E-07	0.73	2.16	4.2E-06	0.02	0.06	1.1E-07	0.02	0.06	1.1E-07
Toluene	0.07	0.26	----------	0.59	2.23	----------	0.11	0.42	----------	0.51	1.94	----------
Trichloroethylene (TCE)	0.02	0.11	1.2E-05	0.03	0.15	1.7E-05	0.02	0.11	1.2E-05	0.02	0.12	1.4E-05
Trichlorofluoromethane	0.21	1.17	----------	0.22	1.25	----------	0.21	1.15	----------	0.23	1.30	----------
m,p-Xylene	0.05	0.22	----------	0.13	0.57	----------	0.05	0.23	----------	0.18	0.78	----------
o-Xylene	0.02	0.09	----------	0.04	0.18	----------	0.02	0.09	----------	0.06	0.28	----------
	Total Risk		1.3E-04			1.5E-04			1.3E-04			1.4E-04

Table 3. (continued).

Compound	Lewisburg			Marcus Hook			Pottstown[2]			Swarthmore		
	Annual Avg[1]		Cancer Risk	Annual Avg		Cancer Risk	Annual Avg		Cancer Risk	Annual Avg		Cancer Risk
	ppbv	µg/m³		ppbv	µg/m³		ppbv	µg/m³		ppbv	µg/m³	
1,3-Butadiene	0.02	0.05	1.6E-06	0.02	0.04	1.3E-06	0.04	0.09	2.6E-06	0.02	0.04	1.3E-06
1,2-Dibromoethane	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05	**0.02**	**0.15**	8.8E-05	0.02	0.15	8.8E-05
cis-1,3-Dichloro-1-propene	0.01	0.05	1.3E-07	0.01	0.05	1.3E-07	**0.01**	**0.05**	1.3E-07	0.01	0.05	1.3E-07
1,2-Dichlorobenzene	0.02	0.12	----------	0.02	0.12	----------	**0.02**	**0.12**	----------	0.02	0.12	----------
1,3-Dichlorobenzene	0.02	0.12	----------	0.02	0.12	----------	**0.02**	**0.12**	----------	0.02	0.12	----------
1,4-Dichlorobenzene	0.02	0.12	7.6E-07	0.02	0.13	8.0E-07	**0.02**	**0.12**	7.6E-07	0.02	0.12	7.6E-07
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	0.08	2.1E-06	0.02	0.08	2.1E-06	**0.02**	**0.08**	2.1E-06	0.02	0.08	2.1E-06
1,1-Dichloroethene	0.02	0.08	----------	0.02	0.08	----------	**0.02**	**0.08**	----------	0.02	0.08	----------
1,2-Dichloropropane	0.02	0.09	----------	0.02	0.09	----------	**0.02**	**0.09**	----------	0.02	0.09	----------
1,1,2,2-Tetrachloroethane	0.02	0.14	8.0E-06	0.02	0.14	8.0E-06	**0.02**	**0.14**	8.0E-06	0.02	0.14	8.0E-06
1,1,2-Trichloro-1,2,2-trifluoroethane	0.06	0.48	----------	0.07	0.50	----------	0.07	0.51	----------	0.07	0.51	----------
1,2,4-Trichlorobenzene	0.01	0.07	----------	0.01	0.07	----------	**0.01**	**0.07**	----------	0.01	0.08	----------
1,1,1-Trichloroethane	0.02	0.11	----------	0.02	0.11	----------	**0.02**	**0.11**	----------	0.02	0.11	----------
1,1,2-Trichloroethane	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06	**0.02**	**0.11**	1.7E-06	0.02	0.11	1.7E-06
1,2,4-Trimethylbenzene	0.04	0.21	----------	0.09	0.46	----------	0.06	0.29	----------	0.04	0.20	----------
1,3,5-Trimethylbenzene	0.04	0.22	----------	0.08	0.39	----------	0.06	0.31	----------	0.06	0.28	----------
Benzene	0.19	0.60	4.7E-06	0.44	1.40	1.1E-05	0.24	0.77	6.0E-06	0.22	0.69	5.4E-06
Bromoform	0.02	0.21	2.3E-07	0.02	0.21	2.3E-07	**0.02**	**0.21**	2.3E-07	0.02	0.21	2.3E-07
Bromomethane	0.02	0.08	----------	0.02	0.08	----------	**0.02**	**0.08**	----------	0.02	0.09	----------
Carbon Tetrachloride	0.08	0.49	7.3E-06	0.08	0.48	7.3E-06	0.08	0.49	7.4E-06	0.08	0.50	7.5E-06
Chlorobenzene	0.02	0.09	----------	0.02	0.09	----------	**0.02**	**0.09**	----------	0.02	0.09	----------
Chloroethane	0.02	0.05	----------	0.04	0.11	----------	0.02	0.06	----------	0.03	0.07	----------
Chloroethene	0.02	0.05	4.5E-07	0.03	0.07	6.0E-07	0.03	0.07	6.5E-07	0.02	0.06	4.9E-07
Chloroform	0.02	0.10	2.2E-06	0.02	0.10	2.2E-06	0.02	0.10	2.3E-06	0.03	0.15	3.6E-06
Chloromethane	0.43	0.89	----------	0.50	1.03	----------	0.48	0.99	----------	0.52	1.08	----------
Cyclohexane	0.02	0.08	----------	0.18	0.61	----------	0.02	0.08	----------	0.04	0.14	----------
Dichlorodifluoromethane	0.45	2.23	----------	0.47	2.32	----------	0.45	2.22	----------	0.45	2.24	----------
Ethylbenzene	0.08	0.34	----------	0.16	0.69	----------	0.16	0.70	----------	0.06	0.24	----------
Hexachloro-1,3-butadiene	0.02	0.21	4.7E-06	0.02	0.21	4.7E-06	**0.02**	**0.21**	4.7E-06	0.02	0.21	4.7E-06
Methylene Chloride	0.06	0.20	9.4E-08	0.11	0.37	1.7E-07	0.11	0.38	1.8E-07	0.10	0.36	1.7E-07
Styrene	0.05	0.21	----------	0.13	0.57	----------	0.23	0.98	----------	0.02	0.09	----------
Tetrachloroethylene	0.03	0.20	1.1E-06	0.03	0.20	1.1E-06	0.02	0.15	8.8E-07	0.03	0.22	1.2E-06
Tetrahydrofuran	0.02	0.07	1.3E-07	0.03	0.08	1.5E-07	0.03	0.09	1.7E-07	0.02	0.06	1.2E-07
Toluene	0.29	1.08	----------	0.90	3.38	----------	0.46	1.71	----------	0.39	1.48	----------
Trichloroethylene (TCE)	0.02	0.12	1.4E-05	0.02	0.12	1.4E-05	0.04	0.23	2.6E-05	0.03	0.15	1.8E-05
Trichlorofluoromethane	0.24	1.37	----------	0.22	1.22	----------	0.21	1.19	----------	0.30	1.67	----------
m,p-Xylene	0.31	1.35	----------	0.48	2.09	----------	0.33	1.43	----------	0.19	0.83	----------
o-Xylene	0.08	0.36	----------	0.17	0.75	----------	0.11	0.49	----------	0.05	0.21	----------
	Total Risk		1.4E-04			1.4E-04			1.5E-04			1.4E-04

[1] Annual Avg is the arithmetic mean of valid samples with 1/2 the MDL substituted for non-detects.
[2] A highlighted concentration indicates the compound was not detected at the Pottstown site in 2004.

Table 4. Summary of 2005 annual average concentrations and excess lifetime cancer risks from inhalation of targeted VOCs across all Pennsylvania monitoring sites.

Compound	Arendtsville			Chester			Erie			Evansburg		
	Annual Avg[1]		Cancer Risk	Annual Avg		Cancer Risk	Annual Avg		Cancer Risk	Annual Avg		Cancer Risk
	ppbv	µg/m^3		ppbv	µg/m^3		ppbv	µg/m^3		ppbv	µg/m^3	
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-Dibromoethane	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05
cis-1,3-Dichloro-1-propene	0.01	0.05	1.3E-07	0.01	0.05	1.3E-07	0.01	0.05	1.3E-07	0.01	0.05	1.3E-07
1,2-Dichlorobenzene	0.08	0.48	----------	0.08	0.48	----------	0.08	0.48	----------	0.08	0.48	----------
1,3-Dichlorobenzene	0.07	0.42	----------	0.07	0.42	----------	0.07	0.42	----------	0.07	0.42	----------
1,4-Dichlorobenzene	0.07	0.42	2.6E-06	0.07	0.42	2.6E-06	0.07	0.42	2.6E-06	0.07	0.42	2.6E-06
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	0.08	2.1E-06	0.02	0.08	2.2E-06	0.02	0.08	2.1E-06	0.02	0.08	2.1E-06
1,1-Dichloroethene	0.02	0.08	----------	0.02	0.08	----------	0.02	0.08	----------	0.02	0.08	----------
1,2-Dichloropropane	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------
1,1,2,2-Tetrachloroethane	0.07	0.48	2.8E-05	0.07	0.48	2.8E-05	0.07	0.48	2.8E-05	0.07	0.48	2.8E-05
1,1,2-Trichloro-1,2,2-trifluoroethane	0.06	0.50	----------	0.08	0.61	----------	0.06	0.45	----------	0.06	0.48	----------
1,2,4-Trichlorobenzene	0.10	0.74	----------	0.10	0.74	----------	0.10	0.74	----------	0.10	0.74	----------
1,1,1-Trichloroethane	0.02	0.11	----------	0.10	0.54	----------	0.02	0.11	----------	0.02	0.11	----------
1,1,2-Trichloroethane	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06
1,2,4-Trimethylbenzene	0.07	0.34	----------	0.07	0.37	----------	0.07	0.34	----------	0.07	0.34	----------
1,3,5-Trimethylbenzene	0.07	0.34	----------	0.07	0.34	----------	0.07	0.34	----------	0.07	0.34	----------
Benzene	0.14	0.45	3.5E-06	0.27	0.86	6.7E-06	0.18	0.56	4.4E-06	0.18	0.58	4.5E-06
Bromoform	0.01	0.10	1.1E-07	0.01	0.10	1.1E-07	0.01	0.10	1.1E-07	0.01	0.10	1.1E-07
Bromomethane	0.02	0.08	----------	0.04	0.16	----------	0.02	0.08	----------	0.02	0.09	----------
Carbon Tetrachloride	0.08	0.51	7.6E-06	0.07	0.45	6.8E-06	0.08	0.52	7.8E-06	0.09	0.55	8.2E-06
Chlorobenzene	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------
Chloroethane	0.04	0.11	----------	0.03	0.09	----------	0.02	0.05	----------	0.03	0.07	----------
Chloroethene	0.02	0.05	4.5E-07	0.02	0.06	4.9E-07	0.02	0.05	4.5E-07	0.02	0.05	4.6E-07
Chloroform	0.02	0.10	2.2E-06	0.02	0.10	2.2E-06	0.02	0.12	2.8E-06	0.02	0.10	2.2E-06
Chloromethane	0.54	1.11	----------	0.48	0.99	----------	0.48	0.99	----------	0.48	0.98	----------
Cyclohexane	0.02	0.07	----------	0.05	0.19	----------	0.02	0.08	----------	0.02	0.08	----------
Dichlorodifluoromethane	0.43	2.14	----------	0.43	2.14	----------	0.43	2.11	----------	0.43	2.11	----------
Ethylbenzene	0.02	0.09	----------	0.05	0.20	----------	0.03	0.12	----------	0.03	0.12	----------
Hexachloro-1,3-butadiene	0.06	0.64	1.4E-05	0.06	0.64	1.4E-05	0.06	0.64	1.4E-05	0.06	0.64	1.4E-05
Methylene Chloride	0.03	0.12	5.6E-08	0.08	0.26	1.2E-07	0.04	0.15	6.9E-08	0.07	0.25	1.2E-07
Styrene	0.01	0.04	----------	0.01	0.05	----------	0.01	0.06	----------	0.01	0.04	----------
Tetrachloroethylene	0.02	0.14	7.7E-07	0.04	0.30	1.7E-06	0.05	0.34	1.9E-06	0.02	0.16	9.4E-07
Tetrahydrofuran	0.02	0.06	1.1E-07	0.90	2.66	5.2E-06	0.02	0.06	1.1E-07	0.02	0.07	1.4E-07
Toluene	0.09	0.35	----------	0.51	1.92	----------	0.19	0.73	----------	0.34	1.29	----------
Trichloroethylene (TCE)	0.02	0.11	1.2E-05	0.03	0.15	1.7E-05	0.02	0.12	1.4E-05	0.14	0.77	8.8E-05
Trichlorofluoromethane	0.21	1.20	----------	0.22	1.23	----------	0.21	1.15	----------	0.21	1.19	----------
m,p-Xylene	0.03	0.13	----------	0.16	0.68	----------	0.07	0.28	----------	0.07	0.32	----------
o-Xylene	0.02	0.09	----------	0.05	0.21	----------	0.03	0.13	----------	0.03	0.13	----------
	Total Risk		1.6E-04			1.8E-04			1.7E-04			2.4E-04

Table 4. (continued).

Compound	Lancaster			Lewisburg			Marcus Hook			Pottstown[2]		
	Annual Avg[1]		Cancer Risk	Annual Avg		Cancer Risk	Annual Avg		Cancer Risk	Annual Avg		Cancer Risk
	ppbv	µg/m^3		ppbv	µg/m^3		ppbv	µg/m^3		ppbv	µg/m^3	
1,3-Butadiene	0.02	0.04	1.3E-06	0.03	0.07	2.2E-06	0.02	0.04	1.3E-06	0.19	0.42	1.3E-05
1,2-Dibromoethane	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05	**0.02**	**0.15**	8.8E-05
cis-1,3-Dichloro-1-propene	0.01	0.05	1.3E-07	0.01	0.05	1.3E-07	0.01	0.05	1.3E-07	**0.01**	**0.05**	1.3E-07
1,2-Dichlorobenzene	0.08	0.48	----------	0.08	0.48	----------	0.08	0.48	----------	**0.08**	**0.48**	----------
1,3-Dichlorobenzene	0.07	0.42	----------	0.07	0.42	----------	0.07	0.42	----------	**0.07**	**0.42**	----------
1,4-Dichlorobenzene	0.07	0.42	2.6E-06	0.07	0.42	2.6E-06	0.07	0.42	2.6E-06	**0.07**	**0.42**	2.6E-06
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	0.08	2.1E-06	0.02	0.08	2.1E-06	0.02	0.08	2.2E-06	**0.02**	**0.08**	2.1E-06
1,1-Dichloroethene	0.02	0.08	----------	0.02	0.08	----------	0.02	0.08	----------	**0.02**	**0.08**	----------
1,2-Dichloropropane	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------	**0.02**	**0.09**	----------
1,1,2,2-Tetrachloroethane	0.07	0.48	2.8E-05	0.07	0.48	2.8E-05	0.07	0.48	2.8E-05	**0.07**	**0.48**	2.8E-05
1,1,2-Trichloro-1,2,2-trifluoroethane	0.06	0.48	----------	0.06	0.46	----------	0.06	0.49	----------	0.07	0.50	----------
1,2,4-Trichlorobenzene	0.10	0.74	----------	0.10	0.74	----------	0.10	0.74	----------	**0.10**	**0.74**	----------
1,1,1-Trichloroethane	0.02	0.11	----------	0.02	0.11	----------	0.02	0.11	----------	**0.02**	**0.11**	----------
1,1,2-Trichloroethane	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06	**0.02**	**0.11**	1.7E-06
1,2,4-Trimethylbenzene	0.12	0.59	----------	0.07	0.36	----------	0.09	0.45	----------	0.07	0.36	----------
1,3,5-Trimethylbenzene	0.08	0.40	----------	0.07	0.36	----------	0.08	0.38	----------	0.07	0.35	----------
Benzene	0.30	0.95	7.4E-06	0.24	0.76	6.0E-06	0.72	2.29	1.8E-05	0.32	1.02	7.9E-06
Bromoform	0.01	0.10	1.1E-07	0.01	0.00	0.0E+00	0.01	0.10	1.1E-07	**0.01**	**0.10**	1.1E-07
Bromomethane	0.02	0.08	----------	0.02	0.08	----------	0.06	0.21	----------	**0.02**	**0.08**	----------
Carbon Tetrachloride	0.09	0.56	8.4E-06	0.09	0.56	8.4E-06	0.08	0.51	7.6E-06	0.09	0.58	8.7E-06
Chlorobenzene	0.08	0.38	----------	0.02	0.09	----------	0.02	0.10	----------	**0.02**	**0.09**	----------
Chloroethane	0.02	0.05	----------	0.02	0.05	----------	0.06	0.15	----------	**0.02**	**0.05**	----------
Chloroethene	0.02	0.05	4.5E-07	0.02	0.05	4.5E-07	0.02	0.06	5.1E-07	0.02	0.06	4.9E-07
Chloroform	0.02	0.10	2.4E-06	0.02	0.10	2.2E-06	0.02	0.10	2.2E-06	0.02	0.10	2.4E-06
Chloromethane	0.49	1.02	----------	0.44	0.91	----------	0.53	1.10	----------	0.50	1.03	----------
Cyclohexane	0.03	0.10	----------	0.03	0.11	----------	0.20	0.69	----------	0.03	0.09	----------
Dichlorodifluoromethane	0.43	2.13	----------	0.44	2.16	----------	0.45	2.24	----------	0.44	2.19	----------
Ethylbenzene	0.06	0.26	----------	0.06	0.25	----------	0.20	0.89	----------	0.21	0.93	----------
Hexachloro-1,3-butadiene	0.06	0.64	1.4E-05	0.06	0.64	1.4E-05	0.06	0.64	1.4E-05	**0.06**	**0.64**	1.4E-05
Methylene Chloride	0.08	0.28	1.3E-07	0.06	0.19	9.1E-08	0.13	0.45	2.1E-07	0.08	0.28	1.3E-07
Styrene	0.02	0.08	----------	0.09	0.40	----------	0.20	0.87	----------	0.33	1.42	----------
Tetrachloroethylene	0.02	0.16	9.4E-07	0.02	0.15	8.4E-07	0.04	0.24	1.4E-06	0.02	0.17	9.6E-07
Tetrahydrofuran	0.08	0.22	4.4E-07	0.06	0.19	3.6E-07	0.02	0.07	1.4E-07	0.04	0.10	2.0E-07
Toluene	0.58	2.20	----------	0.33	1.26	----------	1.14	4.30	----------	0.58	2.19	----------
Trichloroethylene (TCE)	0.02	0.11	1.2E-05	0.02	0.13	1.5E-05	0.03	0.14	1.6E-05	0.04	0.20	2.3E-05
Trichlorofluoromethane	0.22	1.23	----------	0.22	1.22	----------	0.22	1.26	----------	0.22	1.23	----------
m,p-Xylene	0.20	0.86	----------	0.22	0.96	----------	0.57	2.46	----------	0.38	1.66	----------
o-Xylene	0.07	0.30	----------	0.07	0.30	----------	0.22	0.94	----------	0.13	0.57	----------
	Total Risk		1.7E-04			1.7E-04			1.8E-04			1.9E-04

Table 4. (continued).

Compound	Swarthmore			Trappe		
	Annual Avg[1]		Cancer Risk	Annual Avg		Cancer Risk
	ppbv	µg/m^3		ppbv	µg/m^3	
1,3-Butadiene	0.02	0.04	1.3E-06	0.03	0.06	1.8E-06
1,2-Dibromoethane	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05
cis-1,3-Dichloro-1-propene	0.01	0.05	1.3E-07	0.01	0.05	1.3E-07
1,2-Dichlorobenzene	0.08	0.48	----------	0.08	0.48	----------
1,3-Dichlorobenzene	0.07	0.42	----------	0.07	0.42	----------
1,4-Dichlorobenzene	0.07	0.42	2.6E-06	0.07	0.42	2.6E-06
1,1-Dichloroethane	0.02	0.08	1.3E-07	0.02	0.08	1.3E-07
1,2-Dichloroethane	0.02	0.08	2.1E-06	0.02	0.08	2.1E-06
1,1-Dichloroethene	0.02	0.08	----------	0.02	0.08	----------
1,2-Dichloropropane	0.02	0.09	----------	0.02	0.09	----------
1,1,2,2-Tetrachloroethane	0.07	0.48	2.8E-05	0.07	0.48	2.8E-05
1,1,2-Trichloro-1,2,2-trifluoroethane	0.07	0.50	----------	0.06	0.50	----------
1,2,4-Trichlorobenzene	0.10	0.74	----------	0.10	0.74	----------
1,1,1-Trichloroethane	0.02	0.11	----------	0.02	0.11	----------
1,1,2-Trichloroethane	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06
1,2,4-Trimethylbenzene	0.07	0.34	----------	0.08	0.37	----------
1,3,5-Trimethylbenzene	0.08	0.37	----------	0.07	0.34	----------
Benzene	0.26	0.82	6.4E-06	0.23	0.74	5.8E-06
Bromoform	0.01	0.10	1.1E-07	0.01	0.10	1.1E-07
Bromomethane	0.02	0.09	----------	0.02	0.09	----------
Carbon Tetrachloride	0.08	0.48	7.3E-06	0.09	0.58	8.8E-06
Chlorobenzene	0.02	0.09	----------	0.02	0.09	----------
Chloroethane	0.02	0.06	----------	0.02	0.06	----------
Chloroethene	0.02	0.05	4.5E-07	0.02	0.05	4.5E-07
Chloroform	0.02	0.10	2.2E-06	0.02	0.10	2.2E-06
Chloromethane	0.52	1.08	----------	0.47	0.97	----------
Cyclohexane	0.03	0.10	----------	0.03	0.09	----------
Dichlorodifluoromethane	0.44	2.18	----------	0.43	2.13	----------
Ethylbenzene	0.04	0.16	----------	0.04	0.18	----------
Hexachloro-1,3-butadiene	0.06	0.64	1.4E-05	0.06	0.64	1.4E-05
Methylene Chloride	0.11	0.38	1.8E-07	0.06	0.22	1.0E-07
Styrene	0.01	0.05	----------	0.01	0.04	----------
Tetrachloroethylene	0.03	0.23	1.3E-06	0.03	0.24	1.3E-06
Tetrahydrofuran	0.02	0.06	1.1E-07	0.02	0.06	1.1E-07
Toluene	0.51	1.92	----------	0.37	1.38	----------
Trichloroethylene (TCE)	0.03	0.17	1.9E-05	0.26	1.37	1.6E-04
Trichlorofluoromethane	0.35	1.94	----------	0.22	1.22	----------
m,p-Xylene	0.10	0.43	----------	0.15	0.63	----------
o-Xylene	0.04	0.17	----------	0.07	0.29	----------
	Total Risk		1.8E-04			3.1E-04

[1] Annual Avg is the arithmetic mean of valid samples with 1/2 the MDL substituted for non-detects.
[2] A highlighted concentration indicates the compound was not detected at the Pottstown site in 2005.

Metals

Figure 2 contains the results of particulate/metal sampling for the Pottstown area from the start of sampling in 2003. For those dates where a metal is not detected, the RL is shown instead. As seen in the graphs, beryllium was not detected in any Pottstown samples. Conversely, concentrations of cadmium, manganese and zinc were found in all samples.

Again, DEP calculated annual average concentrations to allow for comparisons between monitoring sites in the state. For the metals averages, one-half the RL was used, rather than zero, whenever a metal was not detected in the sample. This is different from the discussion above on VOCs averages and is due to differences in analytical system capabilities between the two methods. The lab does not report MDLs for metals, therefore reporting limits were used instead. Tables 5 and 6 show comparisons between sites for 2004 and 2005, respectively. The comparisons are discussed in greater detail in the "Discussion of Risk" section of this report.

Pottstown data can be downloaded from the DEP web site. Go to www.dep.state.pa.us; click "Search", "Toxics", "Toxics Monitoring Sites", then "Pottstown".

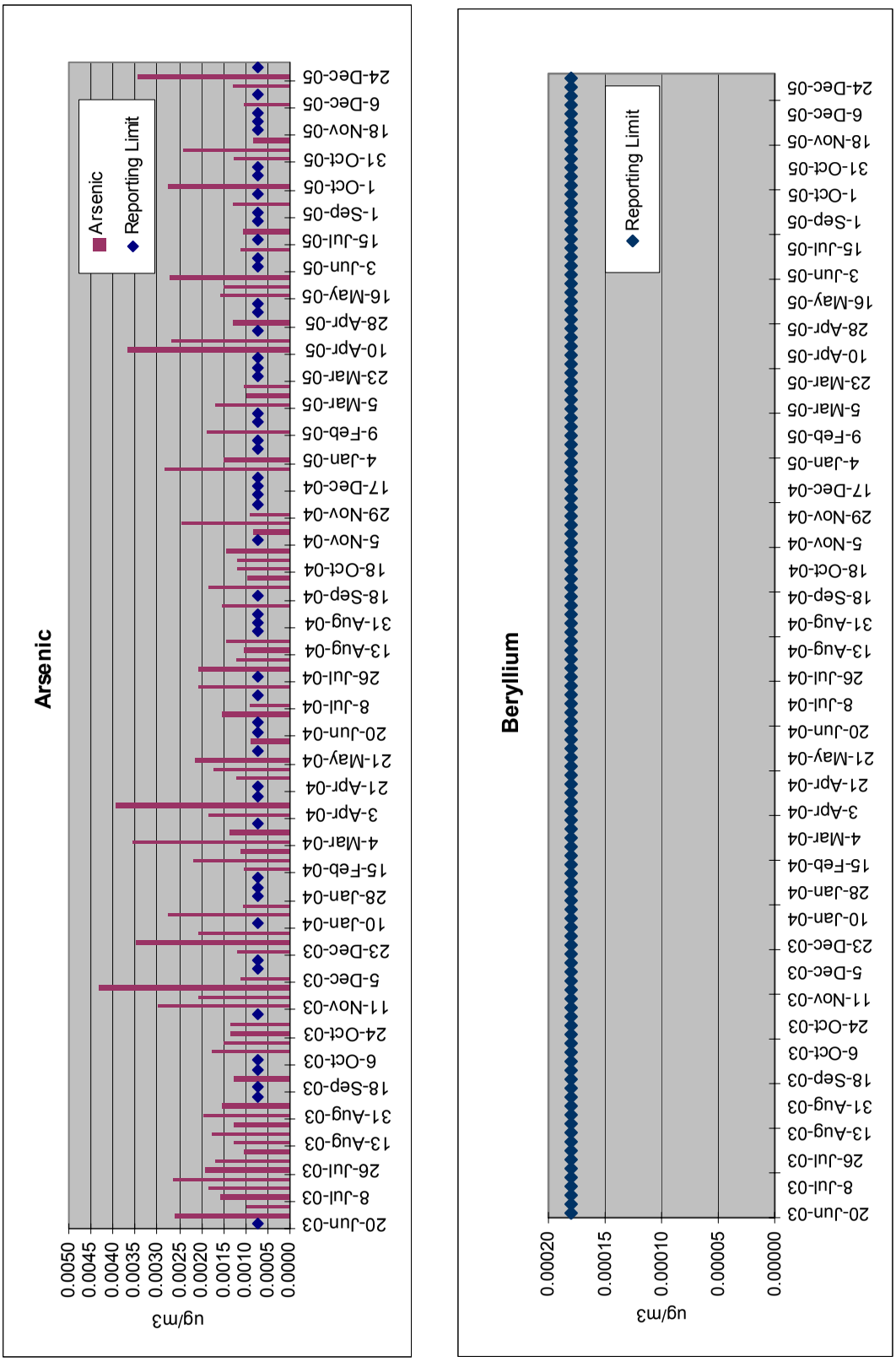
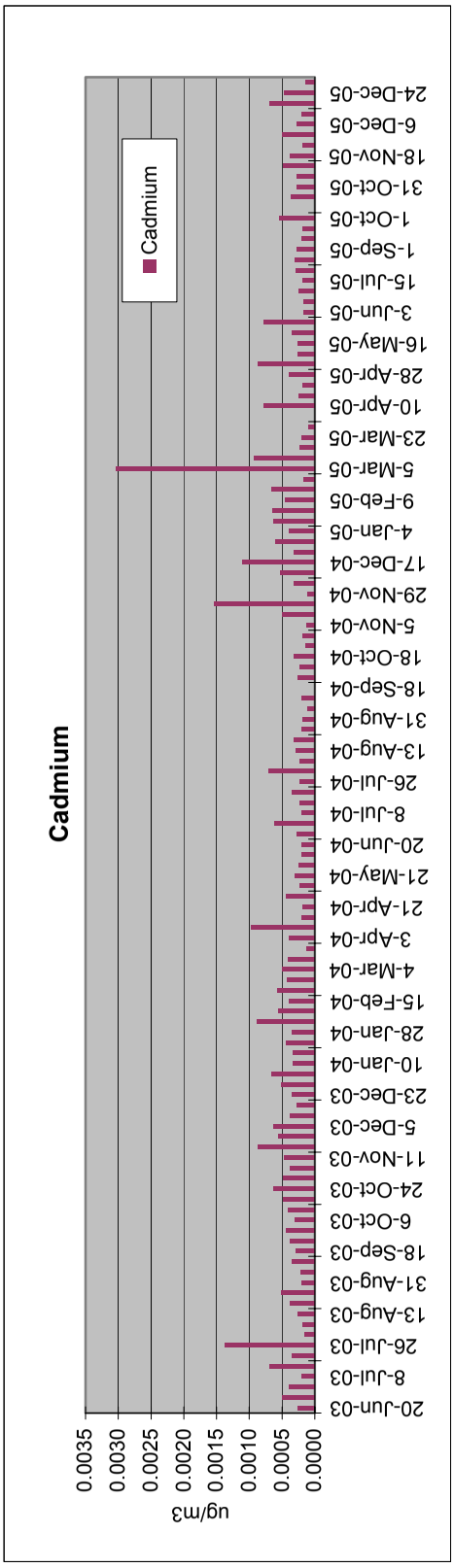


Figure 2. Pottstown metal concentrations for 2003-2005 using the reporting limit values for non-detects.



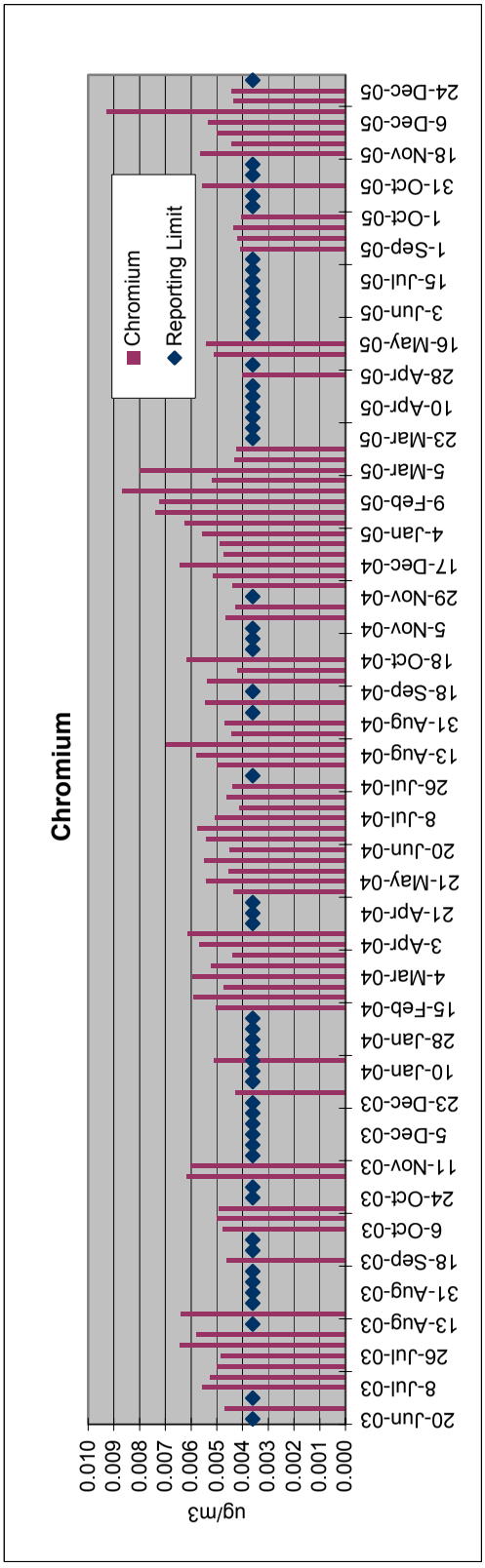


Figure 2. (continued).

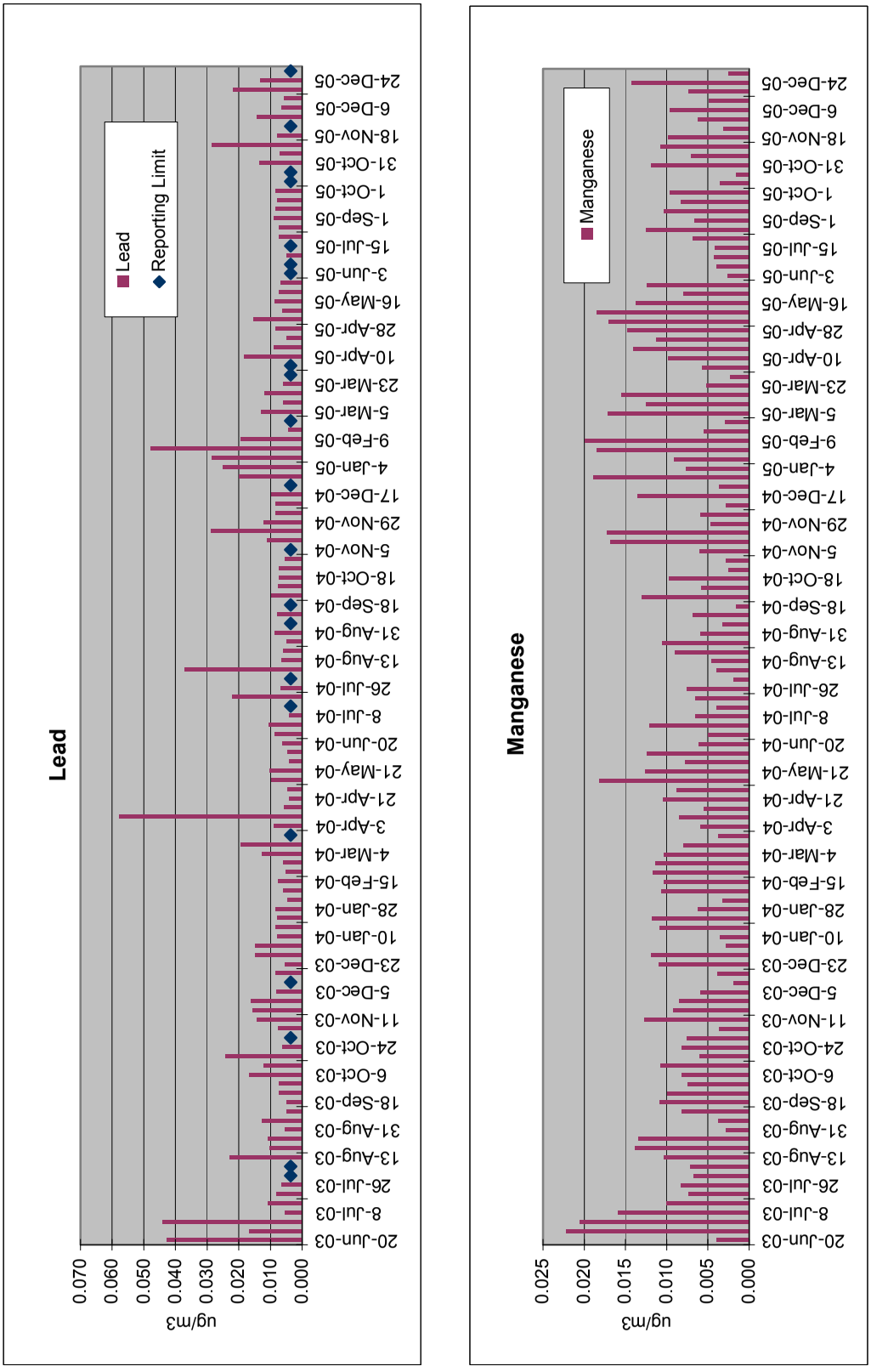


Figure 2. (continued).

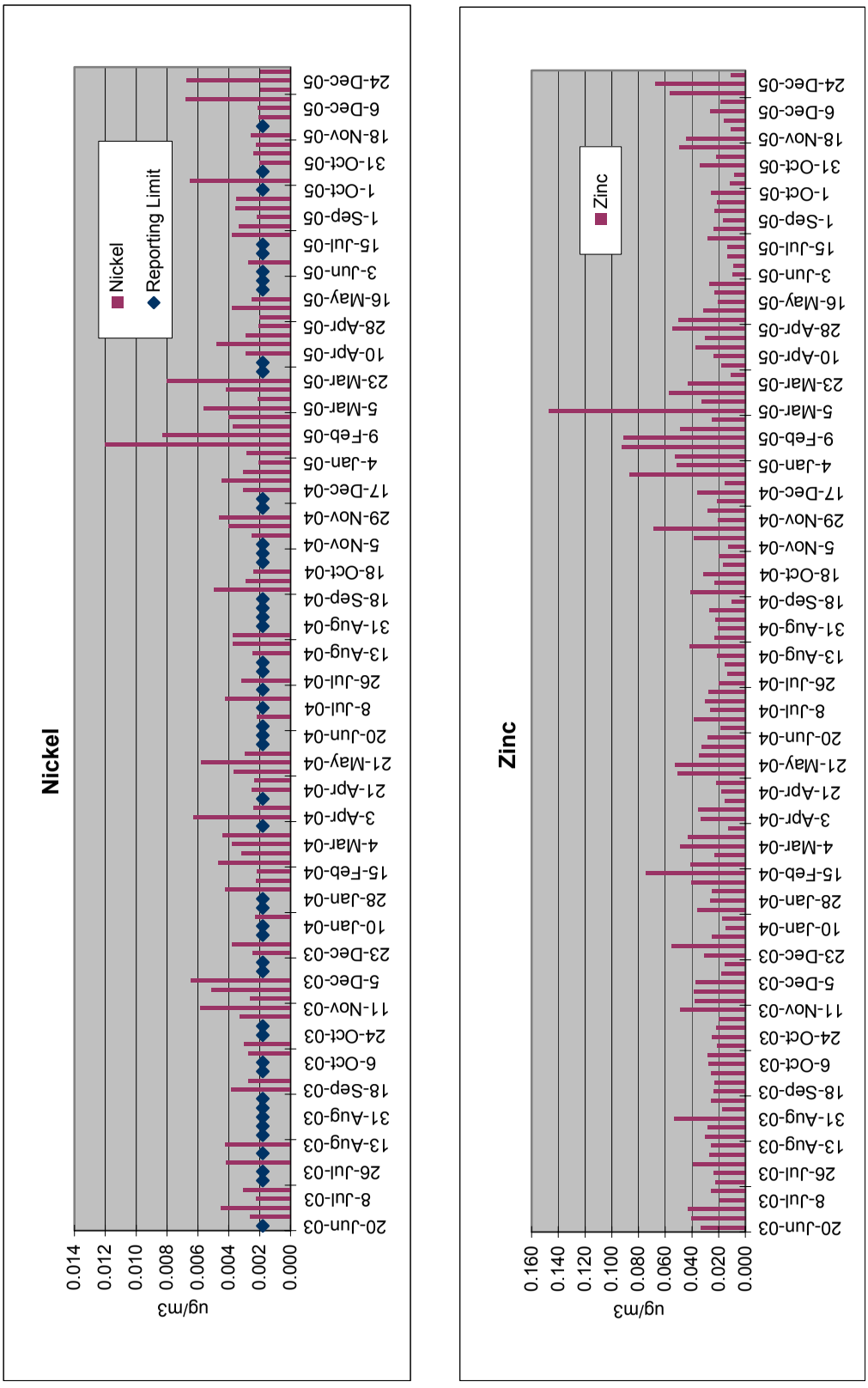


Figure 2. (continued).

Table 5. Summary of 2004 annual average concentrations and excess lifetime cancer risks from inhalation of targeted metals at Pennsylvania sites sampling for metals.

	Chester		Erie		Lewisburg		Marcus Hook		Pottstown		Swarthmore	
Compound	Annual Avg[1] µg/m^3	Cancer Risk	Annual Avg µg/m^3	Cancer Risk	Annual Avg µg/m^3	Cancer Risk	Annual Avg µg/m^3	Cancer Risk	Annual Avg µg/m^3	Cancer Risk	Annual Avg µg/m^3	Cancer Risk
Arsenic	0.00096	4.1E-06	0.00100	4.3E-06	0.00115	5.0E-06	0.00117	5.0E-06	0.00117	5.0E-06	0.00088	3.8E-06
Beryllium	0.00005	1.2E-07	0.00009	2.1E-07	0.00010	2.4E-07	0.00005	1.2E-07	0.00010	2.5E-07	0.00005	1.2E-07
Cadmium	0.00021	3.7E-07	0.00023	4.2E-07	0.00025	4.5E-07	0.00029	5.1E-07	0.00038	6.9E-07	0.00018	3.2E-07
Chromium	0.00322	---------	0.00351	---------	0.00375	---------	0.00318	---------	0.00417	---------	0.00263	---------
Lead	0.00704	---------	0.00465	---------	0.00492	---------	0.00817	---------	0.00965	---------	0.00613	---------
Manganese	0.01073	---------	0.00757	---------	0.01243	---------	0.01325	---------	0.00796	---------	0.00823	---------
Nickel	0.00514	1.2E-06	0.00512	1.2E-06	0.00238	5.7E-07	0.00618	1.5E-06	0.00244	5.9E-07	0.00335	8.0E-07
Zinc	0.03011	---------	0.03145	---------	0.02586	---------	0.03758	---------	0.03010	---------	0.02690	---------
Total Risk		5.8E-06		6.1E-06		6.2E-06		7.2E-06		6.5E-06		5.0E-06

[1] Annual Avg is the arithmetic mean of valid samples using 1/2 the reporting limit substituted for non-detects.

Table 6. Summary of 2005 annual average concentrations and excess lifetime cancer risks from inhalation of targeted metals at Pennsylvania sites sampling for metals.

	Chester		Erie		Lewisburg		Marcus Hook		Pottstown		Swarthmore	
Compound	Annual Avg[1] µg/m^3	Cancer Risk	Annual Avg µg/m^3	Cancer Risk	Annual Avg µg/m^3	Cancer Risk	Annual Avg µg/m^3	Cancer Risk	Annual Avg µg/m^3	Cancer Risk	Annual Avg µg/m3	Cancer Risk
Arsenic	0.00083	3.5E-06	0.00092	4.0E-06	0.00067	2.9E-06	0.00106	4.6E-06	0.00105	4.5E-06	0.00085	3.7E-06
Beryllium	0.00005	1.2E-07	0.00011	2.5E-07	0.00010	2.5E-07	0.00005	1.2E-07	0.00010	2.4E-07	0.00005	1.2E-07
Cadmium	0.00023	4.1E-07	0.00024	4.3E-07	0.00019	3.4E-07	0.00028	5.0E-07	0.00042	7.6E-07	0.00017	3.1E-07
Chromium	0.00286	---------	0.00311	---------	0.00270	---------	0.00304	---------	0.00392	---------	0.00229	---------
Lead	0.00660	---------	0.00545	---------	0.00510	---------	0.00821	---------	0.01004	---------	0.00626	---------
Manganese	0.01177	---------	0.00957	---------	0.00804	---------	0.01696	---------	0.00919	---------	0.00924	---------
Nickel	0.00492	1.2E-06	0.00538	1.3E-06	0.00212	5.1E-07	0.00759	1.8E-06	0.00321	7.7E-07	0.00367	8.8E-07
Zinc	0.02846	---------	0.04241	---------	0.02880	---------	0.04108	---------	0.03465	---------	0.02859	---------
Total Risk		5.3E-06		5.9E-06		4.0E-06		7.0E-06		6.3E-06		5.0E-06

[1] Annual Avg is the arithmetic mean of valid samples using 1/2 the reporting limit substituted for non-detects.

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, so other sources, such as the Boilers and Industrial Furnaces (BIF) Regulation, had to be referenced. Table 11 in Appendix C lists the URFs and RfCs, and summarizes their sources. EPA revised some of the risk factors since publication of the original Pottstown report in 2004 and these changes are listed in Table 12. A total of 35 of the targeted VOCs, and 8 of the metals, had data for either the inhalation reference dose or inhalation cancer slope factor (from which the RfC and URF are derived).

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. (For more details on these calculations, see Appendix C.) 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.

The excess lifetime cancer risk numbers are written in an exponential format (e.g. 1.0E-04). Refer to Table 7 when interpreting these numbers. For example, an excess lifetime cancer risk of 1.9E-04 means that 1.9 more people in a population of 10,000 are likely to develop cancer.

Table 7. Interpreting the risk numbers.

Risk	Exponential	Decimal	Read as…
1.0E-08	$1x10^{-8}$	0.00000001	1 in 100 million
1.0E-07	$1x10^{-7}$	0.0000001	1 in 10 million
1.0E-06	$1x10^{-6}$	0.000001	1 in 1 million
1.0E-05	$1x10^{-5}$	0.00001	1 in 100,000
1.0E-04	$1x10^{-4}$	0.0001	1 in 10,000
1.0E-03	$1x10^{-3}$	0.001	1 in 1,000
1.0E-02	$1x10^{-2}$	0.01	1 in 100
1.0E-01	$1x10^{-1}$	0.1	1 in 10

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 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 are based on limited data and 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.

Tables 3 and 4 show the excess lifetime cancer risks for inhalation exposure calculated using 2004 and 2005 annual average VOC concentrations. The total risk for each site includes compounds that were not detected. As explained earlier, it is accepted practice to include non-detected compounds in risk calculations by substituting a concentration defined as one-half the MDL. 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 a "worst-case-scenario" risk calculation. To emphasize this practice, note that the highlighted concentrations for Pottstown in Tables 3 and 4 were never detected, but are reported at one-half the MDL.

Tables 5 and 6 show the excess lifetime cancer risk for inhalation exposure calculated using 2004 and 2005 annual average metal concentrations.

Excess Lifetime Cancer Risk

The original Pottstown report stated the total excess lifetime cancer risk for inhalation using annual average concentration of VOCs detected in 2002 was significantly higher than other monitoring sites across Pennsylvania. This was mainly driven by a higher concentration of trichloroethylene (TCE) in the Pottstown area, a chemical primarily used to clean and degrease metals. Also stated in the original report was that the 2003 total risk fell due to reduced TCE concentrations in Pottstown's air in 2003. That trend continued into 2004 and 2005. The total excess lifetime cancer risk in Pottstown is comparable to most other monitoring sites in the state (Table 8). The two exceptions are the Trappe and Evansburg sites, which began sampling in 2005 and have significantly higher risk, also driven by higher TCE concentrations. This is discussed further in the next section.

The annual average TCE concentration at Pottstown was 0.04 ppbv in 2005, down from 0.22 ppbv in 2002. In comparison, most other Pennsylvania sites in 2005 were near or below the 0.04 ppbv detection limit. The excess lifetime cancer risk in Pottstown due to TCE was 0.23 in 10,000 in 2005, down from 1.3 in 10,000 in 2002 (Table 9).

It is important to note that the laboratory MDLs for VOCs in 2005 were higher than MDLs in 2002 due to changes in the GC/MS analytical equipment. Because any compound that was not detected was given a value of one-half the MDL for excess lifetime cancer risk calculations (as explained in the previous section), the calculated risks across all sites are greater in 2005 than in 2002 (Table 8).

Compared to VOCs, the excess lifetime cancer risk from breathing metals in particulates is much lower. The excess lifetime cancer risk in Pottstown was 0.065 in 10,000 in 2004 and 0.063 in 10,000 in 2005. Again, this was within the range found at other sites in Pennsylvania (Table 10).

Non-Cancer Health Effects

There were no VOC annual average concentrations in Pottstown above their respective RfC. The same holds true for the eight metal averages. Additionally, none of the lead or beryllium averages were near their respective ambient standards. (For lead, the federal standard is 1.5 $\mu g/m^3$ over a 3-month average. For beryllium, the Pennsylvania standard is 0.01 $\mu g/m^3$ over a 30-day average.) Therefore, non-cancer health effects are not expected from breathing the air in Pottstown.

Table 8. Excess lifetime cancer risk for inhalation of ambient VOC concentrations per population of 10,000.

Site	Excess Lifetime Cancer Risk per 10,000 (Total VOC)			
	2002	2003	2004	2005
Arendtsville	0.73	1.2	1.3	1.6
Chester	0.82	1.3	1.5	1.8
Erie	0.79	1.2	1.3	1.7
Evansburg	----------	----------	----------	2.4
Lancaster	0.79	1.3	1.4	1.7
Lewisburg	----------	----------	1.4	1.7
Marcus Hook	0.93	1.3	1.4	1.8
Pottstown	2.00	1.6	1.5	1.9
Swarthmore	0.81	1.3	1.4	1.8
Trappe	----------	----------	----------	3.1

Table 9. Excess lifetime cancer risk for inhalation of ambient trichloroethylene (TCE) concentrations per population of 10,000.

Site	Excess Lifetime Cancer Risk per 10,000 (TCE)			
	2002	2003	2004	2005
Arendtsville	0.12	0.12	0.12	0.12
Chester	0.17	0.15	0.17	0.17
Erie	0.20	0.12	0.12	0.14
Evansburg	----------	----------	----------	0.88
Lancaster	0.13	0.13	0.14	0.12
Lewisburg	----------	----------	0.14	0.15
Marcus Hook	0.15	0.13	0.14	0.16
Pottstown	1.30	0.42	0.26	0.23
Swarthmore	0.12	0.13	0.18	0.19
Trappe	----------	----------	----------	1.60

Table 10. Excess lifetime cancer risk for inhalation of metals in total suspended particulates per population of 10,000.

Site	Excess Lifetime Cancer Risk per 10,000 (Total Metals)	
	2004	2005
Chester	0.058	0.053
Erie	0.061	0.059
Lewisburg	0.062	0.040
Marcus Hook	0.072	0.070
Pottstown	0.065	0.063
Swarthmore	0.050	0.050

Next Steps

Because Pottstown TCE levels are now comparable with concentrations seen at other sites across the state (Figure 3), the DEP intends to halt sampling in the Pottstown area. The DEP plans to move the Pottstown station to the Reading Airport, west of Pottstown. Because sampling with our mobile air monitoring unit in 2003 and 2004 indicated increased TCE levels when the wind was blowing from the west, the relocation may provide information to account for the higher TCE concentrations observed in Pottstown in 2002 and 2003.

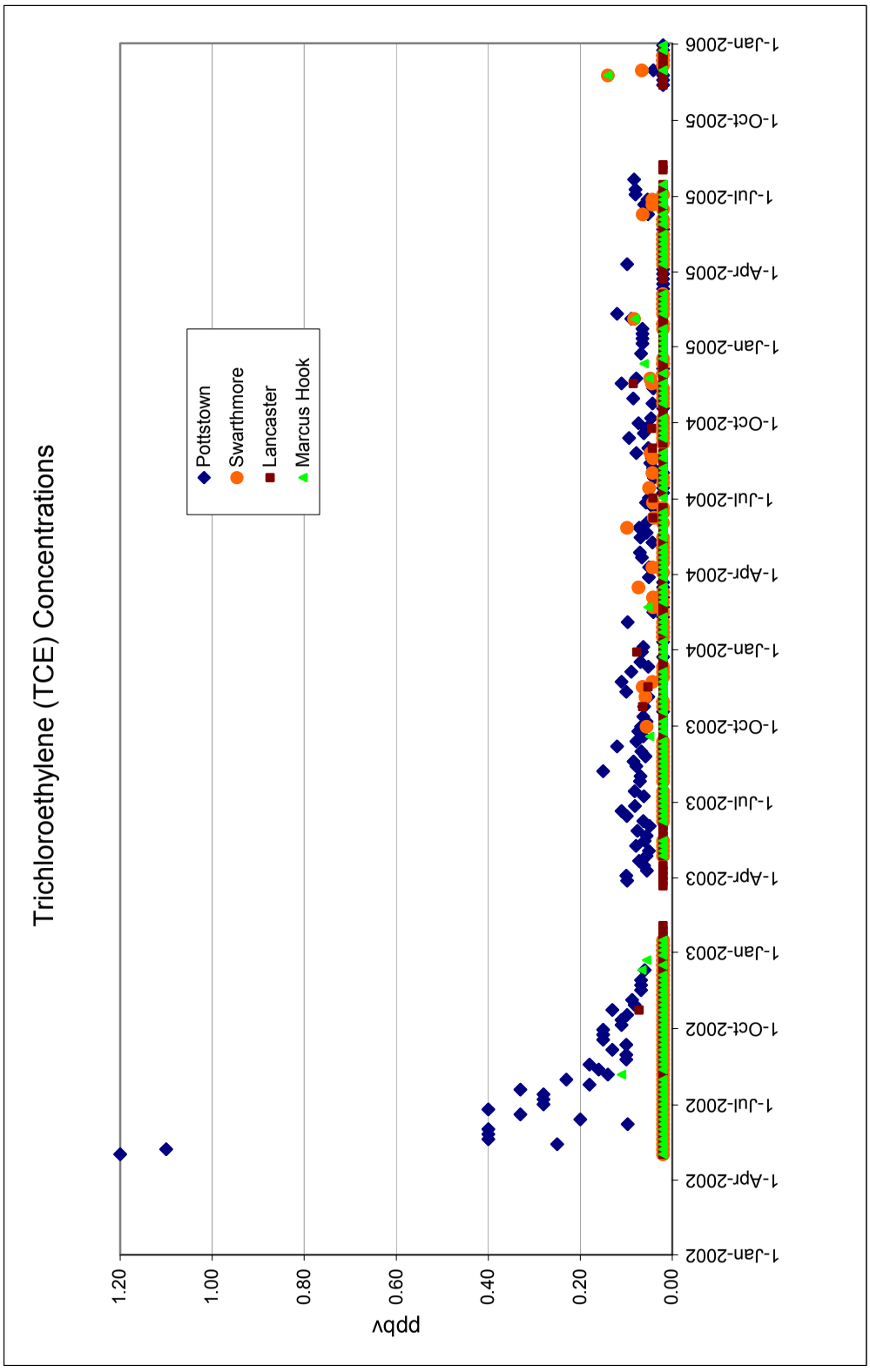


Figure 3. Comparison of trichloroethylene (TCE) concentrations at selected sites in Pennsylvania from 2002 through 2005.

Appendix

A. Monitoring

Equipment

Canister Sampler - Andersen Instruments, Inc. AVOCS

Canisters - Six-liter, SUMMA-polished from various suppliers

Wind Sensors - Climatronics model F460 low-threshold anemometer and tail vane, 10-meter tower height, wind direction referenced to True North

Temperature and Relative Humidity - Vaisala model HMP-45

Solar Radiation: Silicon Cell, Matrix, Inc. model Mk 1-G

Precipitation - Texas Electronics, Inc. model TE-525 tipping bucket, 0.01 inches per tip, unheated, rain only

Datalogger: Campbell Scientific model CR-10X, 10-second measurement interval, calculates 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 model GMWL-2000 housing with Sierra Andersen model 352 critical volume flow control orifice, 8" x 10" quartz fiber filters

Canister Analysis - Entech 7000 or 7100A sample concentrator, Agilent 6890 gas chromatograph, 5973 quadrupole mass spectrometer

Metals Analysis - ELAN 6000 Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) system

Samples were collected over a 24-hour period once every six days. This same schedule is used at other toxic monitoring sites across the state to allow for comparison between sites. An additional nine random samples were taken from November 2004, to June 2005, to identify any ambient concentration patterns.

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 sampler pumps air from the manifold into an evacuated stainless steel canister, at a constant flow rate, over a 24-hour sampling period. The filled canister is returned the DEP laboratory for analysis.

Calibration and Analysis

The laboratory GC/MS system is calibrated using working standards prepared from a 500 ppbv, 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.

The GMWL-2000 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

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 — Occurs 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.

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

Method Detection Limit (MDL) — The MDLs are determined by a standard laboratory quality control procedure (40 CFR Part 136, Appendix B). The definition of MDL is "the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte".

Microgram — A microgram is one millionth of a gram weight. (The symbol μg is commonly used for microgram). Ambient air concentrations are commonly expressed in micrograms per cubic meter of air ($\mu g/m^3$). 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).

Particulates — 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.

Reference Air Concentration (RfC) — The concentration of a specific chemical in the air below which no (non-cancer) adverse health affects are expected to occur over a lifetime of continuous exposure.

Reporting Limit (RL) — The RL of a compound is approximately ten times its MDL. Concentrations at or above the RL are considered quantifiably accurate. If data is between the RL and the MDL, there is confidence that the compound is actually present, but less certainty in the accuracy of the reported concentration.

Unit Risk Factor (URF) — A measure of the probability of an individual developing cancer as a result of exposure to a specified unit concentration of a specific chemical. In air, the unit concentration is 1.0 $\mu g/m^3$. 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 $\mu g/m^3$, three of the 10,000 may develop cancer as a result of the exposure.

Volatile Organic Chemical (VOC) — 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 chemical compounds was calculated using unit risk factors (URFs), and the risk for non-cancer health effects was calculated using reference air concentrations (RfCs) (Table 11). 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 Slope Factor (CSFo), and 4) Inhalation Cancer Slope Factor (CSFi). For this study, only the RfDi and CSFi 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 RfC are derived from the CSFi 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. 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. If the result is less than 1, non-cancer health effects are not expected.

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

$$(\text{kg-day})/\text{mg} \times (1/70\ \text{kg}) \times (20\ m^3/\text{day}) \times (\text{mg}/1000\mu\text{g}) = m^3/\mu\text{g}$$

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

$$\text{mg}/(\text{kg-day}) \times (70\ \text{kg}) \times (\text{day}/20\ m^3) \times (1000\mu\text{g}/\text{mg}) = \mu\text{g}/m^3$$

Table 11. Cancer Unit Risk Factors and Reference Air Concentrations in 2006.

Compound	Unit Risk Factor $m^3/\mu g$	Reference Air Concentration $\mu g/m^3$	Molecular Weight	Source URF[1]	Source RfC[1]
1,3-Butadiene	3.00E-05	2.00E+00	54.1	I	I
1,2-Dibromoethane	5.71E-04	9.00E+00	187.9	I	I
cis-1,3-Dichloro-1-propene	2.86E-06	2.00E+01	111.0	I	I
1,2-Dichlorobenzene	-	1.40E+02	147.0		O
1,4-Dichlorobenzene	6.29E-06	8.00E+02	147.0	O	I
1,1-Dichloroethane	1.60E-06	5.00E+02	99.0	O	O
1,2-Dichloroethane	2.60E-05	2.45E+03	99.0	I	O
1,1-Dichloroethene	-	2.00E+02	97.0		I
1,2-Dichloropropane	-	4.00E+00	113.0		I
1,1,2,2-Tetrachloroethane	5.80E-05	-	167.9	I	
1,1,2-Trichloro-1,2,2-trifluoroethane	-	3.00E+04	187.4		O
1,2,4-Trichlorobenzene	-	3.50E+00	181.4		O
1,1,1-Trichloroethane	-	-	133.4		
1,1,2-Trichloroethane	1.60E-05	-	133.4	I	

Table 11. (continued).

Compound	Unit Risk Factor $m^3/\mu g$	Reference Air Concentration $\mu g/m^3$	Molecular Weight	Source URF[1]	Source RfC[1]
1,2,4-Trimethylbenzene	-	-	120.2		
1,3,5-Trimethylbenzene	-	-	120.2		
Benzene	7.80E-06	3.00E+01	78.1	I	I
Bromoform	1.11E-06	-	252.7	I	
Bromomethane	-	5.00E+00	95.0		I
Carbon Tetrachloride	1.50E-05	1.75E+02	153.8	I	O
Chlorobenzene	-	6.00E+01	112.6		O
Chloroethane	-	1.00E+04	64.5		I
Chloroethene	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		I
Cyclohexane	-	6.00E+03	84.2		I
Dichlorodifluoromethane	-	1.75E+02	120.9		O
Ethylbenzene	-	1.00E+03	106.2		I
Hexachloro-1,3-butadiene	2.20E-05	-	260.7	I	
Methylene Chloride	4.70E-07	1.00E+03	84.9	I	O
Styrene	-	1.00E+03	104.2		I
Tetrachloroethylene	5.71E-06	2.80E+02	165.8	O	O
Tetrahydrofuran	1.94E-06	3.00E+02	72.1	O	O
Toluene	-	4.90E+03	92.1		I
Trichloroethylene (TCE)	1.14E-04	3.50E+01	131.4	O	O
Trichlorofluoromethane	-	7.00E+02	137.4		O
m,p-Xylene	-	1.00E+02	106.2		I
o-Xylene	-	1.00E+02	106.2		I
Arsenic	4.30E-03	3.00E-02	74.9	I	O
Beryllium	2.40E-03	2.00E-02	9.0	I	I
Cadmium	1.80E-03	2.00E-01	112.4	I	O
Chromium +VI[2]	1.20E-02	1.00E-01	52.0	I	I
Lead	-	9.00E-02	207.2		B
Manganese	-	5.00E-02	54.9		I
Nickel[3]	2.40E-04	5.00E-02	58.7	I	O
Zinc	-	3.50E+01	65.4		O

[1] I - Integrated Risk Information System (IRIS)
B - Boiler and Industrial Furnace Regulations (BIF)
O - Other sources

[2] DEP analyzes for total chromium therefore does not use this URF and RfC in risk calculations.

[3] The URF is for nickel as refinery dust.

Table 12. Changes in Unit Risk Factors and Reference Air Concentrations since 2004.

Compound	Change	Source
1,2-Dibromoethane	URF changed from 2.20E-04 to 5.71E-04 R_fC changed from 2.00E-01 to 9.00E+00	Change in IRIS Added to IRIS
1,2-Dichloroethane	R_fC changed from 5.00E+00 to 2.45E+03	Change in ATSDR
1,3-Dichloropropene	URF changed from 4.00E-06 to 2.86E-06	Change in IRIS
1,1,1-Trichloroethane	R_fC deleted	Change in EPA-NCEA
1,2,4-Trimethylbenzene	R_fC deleted	
1,3,5-Trimethylbenzene	R_fC deleted	
Benzene	R_fC changed from 6.00E+00 to 3.00E+01	Added to IRIS
Carbon Tetrachloride	R_fC changed from 2.00E+00 to 1.75E+02	Change in ATSDR
Methylene Chloride	R_fC changed from 3.00E+03 to 1.00E+03	Change in ATSDR
Tetrachloroethene	R_fC changed from 5.00E+02 to 2.80E+02	Change in ATSDR
Toluene	R_fC changed from 4.00E+02 to 4.90E+03	Change in IRIS
Trichloroethylene (TCE)	R_fC added	Change in EPA-NCEA
Chromium^{+6}	R_fC changed from 8.00E-03 to 1.00E-01	Change in IRIS