FINAL REPORT

WEST LOUISVILLE AIR TOXICS STUDY

RISK ASSESSMENT

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EXECUTIVE SUMMARY

Between April 2000 and April 2001 (Study 1), and November 2001 and December 2005 (Study 2), the Louisville Metro Air Pollution Control District (APCD), the United States Environmental Protection Agency (USEPA), The University of Louisville, the Commonwealth of Kentucky, and others worked with the West Jefferson County Community Task Force (WJCCTF) to conduct an air monitoring study of a large number of toxic air pollutants at different locations in the West Louisville, Kentucky, area. Designated the West Louisville Air Toxics Study (WLATS), the purpose of the study was to determine if residents of the area were being exposed to toxic air pollutants that may pose unacceptable risks to human health. There were 12 monitoring sites in Study 1 and 6 monitoring sites in Study 2 that were a subset of the first study. Sciences International, Inc. (Sciences) conducted a risk assessment of the air monitoring data collected from the six sites in the WLATS Study 2, and this report details the methods and findings of the assessment.

The monitoring sites of WLATS Study 2 include: Louisville Police Firearms Training (Site A), Ralph Avenue/Campground Road (Site C), University of Louisville Shelby Campus (Site E), Cane Run Elementary School (Site F), Chickasaw Park (Site I), and Farnsley Middle School (Site M).

Analytical data were summarized and chemicals of potential concern (COPCs) were selected at each monitoring location for detailed evaluation in the risk assessment. To be a COPC at a location, a chemical had to be detected in at least 10% of the samples collected at the monitor. All of the monitors in the network included analysis of volatile organic chemicals (VOCs) and a portion of these were selected as COPCs at every monitoring location.

Only exposures via inhalation were evaluated, with risks calculated on a location-specific basis for each of the WLATS monitoring areas. Both chronic (long-term) and acute (short-term) exposure scenarios were evaluated. For the purpose of evaluating the potential health effects from long term exposure, risks were estimated assuming the exposures were 24-hour, 70-year lifetime exposures. Two measures of exposure were evaluated in the chronic risk assessment – the median exposure and the 95% upper confidence limit (UCL). The median exposure was the median chemical concentration in air for each of the COPCs. The 95% UCL exposure case was based on the mean of the chemical concentrations in air at a given monitor, or the maximum chemical concentration in air if it was less than the 95% UCL of the mean. 95% UCL exposure concentrations were calculated for the monitoring years 2002-2005 but not 2001 because of the limited number of samples for 2001.

For the acute risk assessment, maximum air concentrations at each monitor location were compared to short-term health benchmarks to evaluate the potential human health impact. Toxicity criteria, for both chronic and acute health effects, were derived by the USEPA and other state, federal, and international agencies and organizations.

For each monitoring site, chemical-specific cancer risks were calculated and were also summed to determine site-specific cumulative cancer risks. The results for the chronic risk assessment indicated that cumulative cancer risks of air toxic contaminants in the samples from all six of the sampling sites in the WLATS monitoring program exceeded a 1×10^{-6} lifetime cancer risk. The USEPA provides guidelines for risk management that calculate an upper bound potential cancer risk of 1/10,000 (1×10^{-4}) to 1/1,000,000 (1×10^{-6}) that is thought to be public health protective at low doses for the range of human variation (USEPA, 2005). Additionally, the use of a 1×10^{-6} threshold for the cancer risk level is consistent with the acceptable cancer risk threshold used in the State of Kentucky and the goal in the APCD's Strategic Toxic Air Reduction (STAR) Program Regulation 5.21. A total of 11 chemicals exceeded a cancer risk of 1×10^{-6} under the median exposure case or for the 95% UCL exposure case: vinyl chloride, 1,3-butadiene, acrylonitrile, methyl t-butyl ether, chloroform, benzene, carbon tetrachloride, ethyl acrylate, tetrachloroethene, 1,4-dichlorobenzene and naphthalene. These chemicals are the focus of the cancer risk assessment of this study. However, these chemicals did not present cancer risks at every monitoring site for each monitoring year but are site-specific and year-specific. Sites A and C presented with the largest cumulative median and 95% UCL-derived cancer risks. Site E was chosen as an urban control site, and presented with the lowest cumulative median and 95% UCL-derived cancer risks.

For the median exposure case, the cumulative cancer risks ranged from a high of 1.55×10^{-4} at Site A 2001, to a low of 1.67×10^{-5} at Site E 2003, a difference of one order of magnitude (10-fold). For the 95% UCL exposure case, the cumulative cancer risks ranged from a high of 1.43×10^{-3} at Site C 2005, to a low of 2.17×10^{-5} at Site E 2003, a difference of almost two orders of magnitude (66-fold).

The non-cancer health impacts were evaluated by calculating a hazard quotient (HQ) for each COPC, and then summing the HQs at a location to determine the overall impact in the form of a Hazard Index (HI). If the value of the HQ is less than 1, then an adverse health impact from the exposure is unlikely. Similarly, if the HI for a monitor location is below a value of 1, then the cumulative impact from all of the COPCs is unlikely to result in an adverse health impact.

For the median exposure case, non-cancer HIs ranged from a high of 4.12 at Site C 2002, to a low of 0.11 at Site E 2003, representing a difference of 37-fold. For the 95% UCL exposure case, the HIs ranged from a high of 70.63 at Site C 2002, to a low of 0.16 at Site E 2003, representing a 441-fold difference.

For those sites where the median-derived HI > 1, the risk was driven primarily by chloroprene and 1,3-butadiene. Acrylonitrile also contributed some risk but much less than chloroprene and 1,3-butadiene. These were the only chemicals that were identified as risk drivers (HQ > 0.1) for non-cancer effects. For the majority of the monitoring years, neither 1,3-butadiene nor acrylonitrile had median-derived HQs > 1. Only during 2002 at Site C did the median-derived HQ for 1,3-butadiene exceed 1. The median-

derived HQs for chloroprene exceeded 1 during the years 2001 and 2002 for Site A, and all 5 years (2001-2005) for Site C.

HQs derived from the 95% UCL concentrations for 1,3-butadiene were > 1 for all monitoring years at Sites A and C. HQs derived from the 95% UCL concentrations for 1,3-butadiene exceeded 1 for 3/4 monitoring years at Sites F and I, and 2/4 monitoring years at Site M. Acrylonitrile was identified as a risk driver because its HQ was > 0.1, but its HQ never exceeded 1 indicating that it does not pose a non-cancer risk. 95% UCL-derived HQs for chloroprene exceeded 1 for all 4 years (2002-2005) at Sites A, C, F and I. 95% UCL-derived HQs for chloroprene did not exceed 1 for any year at Site E or M. A target organ-specific hazard index (TOSHI) was calculated for acrylonitrile and chloroprene because both chemicals cause nasal/olfactory epithelium effects. The 95% UCL-derived TOSHI exceeded a value of 1 at Sites A and C, indicating that together, acrylonitrile and chloroprene may pose a risk for non-cancer chronic nasal/olfactory effects. 1,3-Butadiene and chloroprene are the primary risk drivers for non-cancer health effects.

The acute risk characterization was conducted by calculating an HQ for each of the COPCs at a monitor location. The calculation of an HI for each monitor location by summing the individual HQs is not appropriate for the acute analysis. The HQs for the acute risk characterization did not exceed a value of 1 for any of the COPCs, indicating that an adverse health impact is not likely for the acute exposures.

1.0 INTRODUCTION

Between April 2000 and April 2001 (Study 1), and November 2001 and December 2005 (Study 2), the Louisville Metro Air Pollution Control District (APCD), the United States Environmental Protection Agency (USEPA), The University of Louisville, the Commonwealth of Kentucky, and others worked with the West Jefferson County Community Task Force (WJCCTF) to conduct an air monitoring study of a large number of toxic air pollutants in a number of communities in the West Louisville, Kentucky, area. Designated the West Louisville Air Toxics Study (WLATS), the purpose of the study was to determine if residents of the area were being exposed to airborne concentrations of toxic air pollutants via inhalation that may pose unacceptable risks to human health.

Sciences International, Inc. (Sciences) conducted a risk assessment of the data from Study 1 (one year), and provided a report to the APCD in 2003. Monitoring data from Study 2 consisted of 5 years of exposure information (November 2001 to December 2005). Sciences conducted a risk assessment of this air monitoring data using as primary guidance the WLATS Risk Assessment Work Plan and Quality Assurance Project Plan for Study 1 (May 24, 2002) provided to Sciences. This 2006 report presents the methodologies and findings of the Study 2 risk assessment.

1.1 Description of the Monitoring Program

The WLATS monitoring program was designed to collect ambient air data that characterized the airborne concentrations of toxic air pollutants in residential areas of West Louisville. Six monitoring sites were selected for Study 2. Table 1-1 identifies the name, location and other characteristics of the monitoring locations in Study 2, and Figure 1-1 depicts their geographic location in the study area. Each of the six monitoring sites was selected to represent a different, unique area at which exposure to airborne chemicals can occur to residents. Residential locations were selected for monitoring because exposures to residential populations could potentially occur for 24 hours per day in comparison to industrial (non-residential) locations where exposures might be greater but would not be expected to expose the same individual for 24 hours per day. For the previous WLATS risk assessment (Study 1), the USEPA Region IV performed the lab analysis of monitoring samples for Sites A, C and E, whereas the University of Louisville performed the lab analysis for Sites F, I and M. In the current WLATS risk assessment (Study 2), the University of Louisville was responsible for the lab analysis of the monitoring samples for all six sites.

A total of 7 monitors were used in the WLATS Study 2 network; a single monitor was used at each location with the exception of Site C, which had duplicate monitors. Monitoring at all locations was conducted over the same period of time, November 2001 to December 2005. To account for potential seasonal and temporal variability in air concentrations, the monitoring program was designed to collect 24-hour samples every twelfth day, resulting in approximately 30 sampling events at each location per year.

A complete list of all the chemicals that were included in the Study 2 monitoring program is presented in Table 1-2. WLATS Study 1 evaluated the concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, reactive aerosols, pesticides and polychlorinated biphenyls (PCBs) at Sites A, C and E, but not Sites F, I and M. Sites F, I and M were monitored only for VOCs. In the current WLATS Study 2, VOCs were the principal chemicals of interest and thus were analyzed for at the 6 monitoring locations and during every monitoring event (Table 1-2). The SVOCs, metals, reactive aerosols, pesticides and PCBs were not included in the monitoring program for the current WLATS Study 2.

1.2 Local Meteorology

The local meteorology in the Louisville area has a significant influence in determining where chemicals in the atmosphere are carried and their airborne concentrations. Wind speed and wind direction are two of the most important meteorological factors. Airborne chemicals are carried along in the direction that the wind is blowing. In general, as wind speeds increase, the airborne concentrations decrease due to more air being available to mix with the chemicals and dilute their concentrations. In a developed area like the location of the WLATS monitors, the vertical obstacles to air flow such as buildings and trees increase the mixing in the atmosphere as the wind goes over and around the obstacles. The atmospheric stability is another critical meteorological factor in determining the amount of mixing that can occur in the air. On hot sunny days, the sun's energy warms the air in contact with the earth's surface and this warm air then rises upwards, leading to what is called an unstable atmosphere. The rising air causes increased motion in the atmosphere, which increases the amount of air that is available to dilute chemicals in the atmosphere. In contrast, on cloudless nights with low winds, the air near the earths surface cools faster than the air above, which leads to a stable atmospheric condition where vertical motion and resulting dilution of chemicals in the atmosphere is limited.

1.3 Organization of This Report

The remainder of this report is organized into six principal sections:

- Section 2 presents an analysis of the monitoring data and selects chemicals of potential concern (COPCs) for evaluation in the risk assessment.

- Section 3 outlines the assumptions and methods used to calculate exposure concentrations at each monitoring location.

- Section 4 characterizes the types of health effects potentially associated with each of the COPCs and identifies the toxicity criteria used to assess risks.

- Section 5 summarizes and discusses the risk assessment results for each of the monitoring locations.

- Section 6 summarizes important sources of uncertainty in this assessment and their potential impact on the risk estimates.

- Section 7 presents the conclusions of the risk assessment.

References are provided in Section 8. A Glossary follows the References.

Table 1-1. WLATS monitoring site locations.*

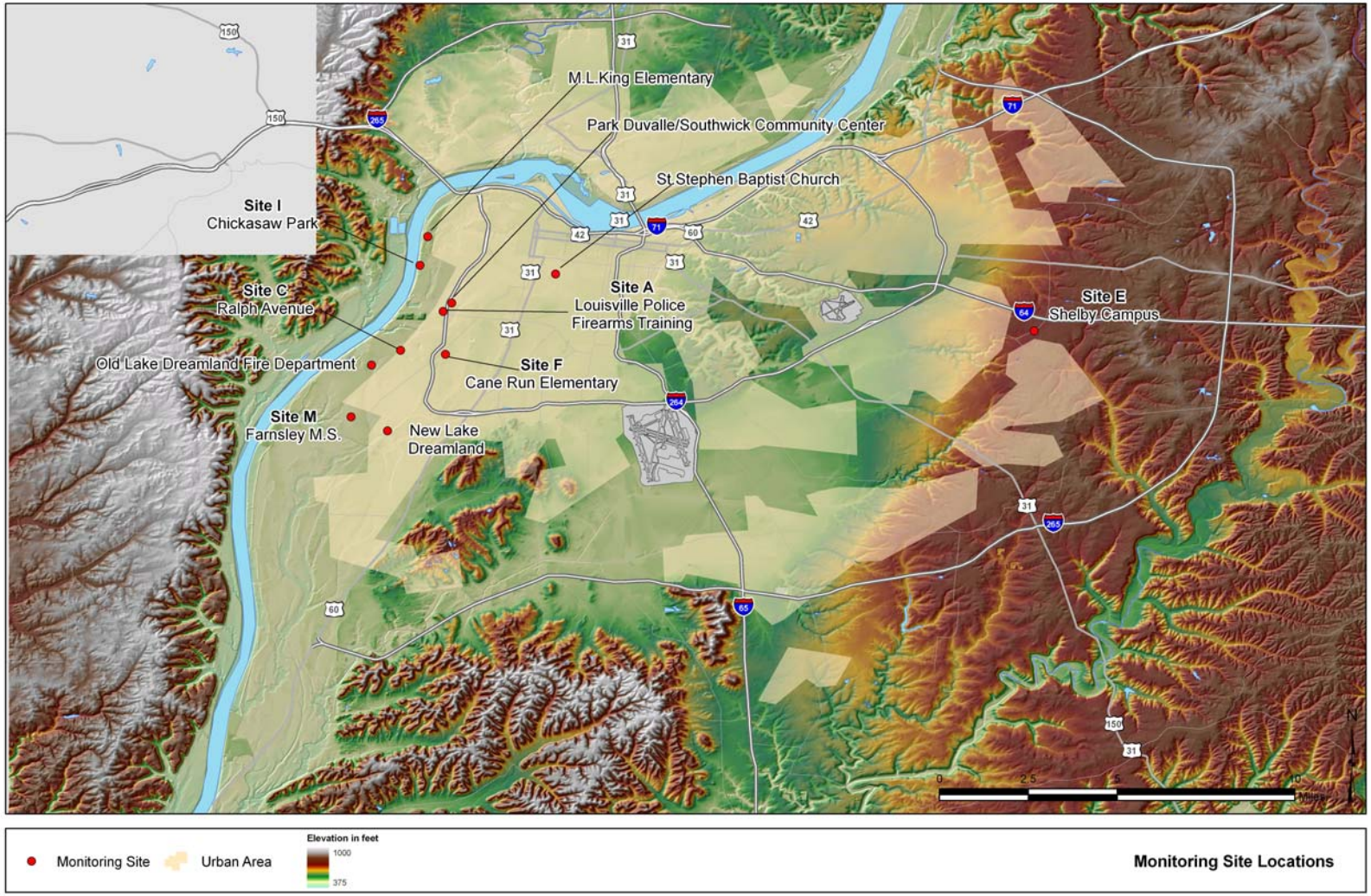
Monitoring Site Number	Site Name (Site Address)	Monitoring Target	Comments
Site Code A	Louisville Police Firearms Training (4201 Algonquin Pkwy)	Fenceline	Potential maximum impact site for BF Goodrich (now Noveon), Zeon Chemicals, Geon Chemicals (now Polyone), Marathon Ashland Petroleum LLC (now Marathon Petroleum), CITGO, BP Oil, Chevron USA Oil Terminals, Ashland Chemical, Police Firearms Training facility, and Morris Foreman POTW
Site Code C	Ralph Ave/ Campground Road (4211 Campground Rd.)	Fenceline General Neighborhood Duplicate Monitors	Potential maximum impact site for DuPont, Rohm & Haas, Elf Atochem (now Altaglas), American Synthetic Rubber Community exposure site for northern Cane Run neighborhood
Site Code E	U of L Shelby Campus (9001 Shelbyville Rd.)	Control	Urban control site to measure the impact of urban anthropogenic activities
Site Code F	Cane Run Elementary School (3951 Cane Run Road)	General Neighborhood	Community exposure site for Hallmark, Algonquin, neighborhoods
Site Code I	Chickasaw Park (private residence) (942 S. 47th Street)	General Neighborhood	Community exposure site for Chickasaw Neighborhood
Site Code M	Farnsley Middle School (3400 Lees Lane)	Fenceline General Neighborhood	Community exposure site for Cane Run, Riverside Gardens, and Shively neighborhoods

*** Source: Table 4, AIR TOXIC MONITORING SITES -West Louisville Area, QAPP (2005)**

Table 1-2. Complete list of chemicals analyzed in the monitoring study.

CHEMICAL	CAS	CHEMICAL	CAS
Freon 22 (ClF2Methane)	75456	Methyl Cyclohexane	108872
Freon 12 (Cl2F2Methane)	75718	trans-1,3-Dichloropropene	10061026
Chloromethane	74873	1,1,2-Trichloroethane	79005
Freon 114 (Cl2F4Ethane)	76142	Toluene	108883
Vinyl Chloride	75014	1,3-Dichloropropane	142289
1,3- Butadiene	106990	Methyl Butyl Ketone	591786
Bromomethane	74839	Dibromochloromethane	124481
Chloroethane	75003	1,2- Dibromoethane	106934
Acetone	67641	Tetrachloroethene	127184
Freon 11 (Cl3Fmethane)	75694	1,1,1,2 - Tetrachloroethane	79345
Acrylonitrile	107131	Chlorobenzene	108907
1,1-Dichloroethene	75354	Ethylbenzene	100414
Methylene Chloride	75092	(m and /or p) Xylene	108383/106423
Methyl Acetate	79209	Bromoform	75252
Freon 113 (Cl3F3Ethane)	76131	Butyl Acrylate	141322
Carbon Disulfide	75150	Styrene	100425
Trans-1,2-Dichlorothene	156605	1,1,2,2-Tetrachloroethane	79345
1,1-Dichloroethane	75343	o-Xylene (1,2-Dimethyl Benzene)	95476
Methyl T-Butyl Ether (MTBE)	1634044	1,2,3-Trichloropropane	96184
Methyl Ethyl Ketone	78933	Isopropylbenzene	98828
Chloroprene(2-Cl-1,3-Butadiene)	126998	Bromobenzene	108861
cis-1,2-Dichloroethene	156592	o-Chlorotoluene	95498
Hexane	110543	n-Propylbenzene	103651
Chloroform	67663	p-Chlorotoluene	106434
2,2-Dichloropropane	594207	1,3,5-Trimethylbenzene	108678
1,2- Dichloroethane	107062	tert-Butylbenzene	98066
1,1,1-Trichloroethane	71556	1,2,4-Trimethylbenzene	95636
1,1- Dichloropropene	563586	1,3-Dichlorobenzene	541731
Benzene	71432	1,4-Dichlorobenzene	106467
Carbon Tetrachloride	56235	sec-Butylbenzene	135988
Cyclohexane	110827	p-Isopropyltoluene	99876
Dibromomethane	74953	1,2-Dichlorobenzene	95501
1,2-Dichloropropane	78875	n-Butylbenzene	104518
Ethyl Acrylate	140885	1,2-Dibromo-3-chloropropan	96128
Bromodichloromethane	75274	1,2,4-Trichlorobenzene	95636
Trichloroethene	79016	Naphthalene	91203
Methyl Methacrylate	80626	1,2,3-Trichlorobenzene	87616
cis-1,3-Dichloropropene	10061015	Hexachlorobutadiene	87683
Methyl Isobutyl Ketone	108101		

Figure 1-1. Geographical location of the six monitoring sites (Sites A, C, E, F, I, and M).



2.0 DATA ANALYSIS AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

This Section summarizes the analytical data collected during the WLATS Study 2 monitoring program and selects chemicals of potential concern (COPCs) for detailed analysis in the risk assessment. For the risk assessment, each monitor location was evaluated separately, so the data analysis and selection of COPCs is presented individually for each monitor. Data are summarized for each monitor by identifying the chemicals that were selected as COPCs and calculating the frequency of detection.

Chemicals of potential concern (COPCs) are analytes identified after monitoring and data analysis as occurring above the sample quantitation limit (SQL) in a sufficient number of air samples that a further evaluation in the assessment of risk is warranted. For a substance to be classified as a COPC there must be sufficient evidence that its reported occurrence was not due to analytical error, sample contamination, or other result in ambient air monitoring.

In the WLATS Study 2, COPCs must be measured above the respective SQL in greater than or equal to l0% of the air samples obtained at a given location (e.g., 3/30 samples). This criterion is consistent with the strategy outlined in Section 2.l.l for handling non–detects and consistent with recent USEPA methodologies for risk assessment of air toxics (USEPA, l999a). That is, if greater than 90% of the monitored concentrations of a given substance at a given location are non–detects, then a risk assessment will not be conducted initially for that substance at that location. Thus a substance could be detected only 3 or 4 times during the year–long monitoring study and still be assumed to be present in the air for the entire year as a potential hazard. In WLATS Study 2, there are many instances where chemicals were detected in >10% of the monitoring samples but were not quantified (i.e. exposure estimates are less than the SQL). Since these measurements are detectable but not quantifiable, they are not counted as greater than the SQL. For example, a chemical may be detected in 50% of the samples, but if it is only quantifiable in <10% of the samples then it would not be a COPC. COPCs are selected based on quantifiable concentrations greater than the SQL in at least 10% of the monitoring samples.

In cases where an individual analyte is measured above its respective SQL on l or 2 occasions, an investigation may be conducted to ascertain potential sources for these chemicals and why such concentrations were only detected in a small subset of samples. If it is determined that there are sources that may be posing a long–term exposure potential, a knowledgeable statistician should evaluate the data sets to determine an appropriate method for deriving estimates of exposure (median and 95% UCL).

Identification of a COPC at one or more monitoring locations does not make it a COPC at all monitoring locations. Thus the list of COPCs differs at each of the monitoring locations in the study. However, in the Risk Characterization phase of this assessment (discussed below), all identified COPCs for the monitoring sites in the industrial areas

were compared to the data collected for the same COPCs at the urban, non–industrial site (University of Louisville, Shelby Campus monitoring site).

2.1 Louisville Police Firearms Training: Site A

The Louisville Police Firearms Training monitoring site (Site A) is a potential maximum impact site for BF Goodrich (now called Noveon), Zeon Chemicals, Geon Chemicals (now called PolyOne), Marathon Ashland Petroleum LLC (now called Marathon Petroleum LLC), CITGO, BP Oil, Chevron USA Oil Terminals, Ashland Chemical, Police Firearms Training facility, and Morris Foreman POTW. It is also located immediately downwind from the Rubbertown industrial complex. The summary of COPCs across the years 2001-2005 for Site A is presented in Table 2-1.

2.1.1 Data analysis and COPCs from 2001 for Site A

During 2001, only 5 sampling dates were recorded during quarter 4 (November-December). However, sampling from November 20, 2001, was not recorded because of sampler failure, leaving only 4 samples. Of the 77 chemicals that were analyzed, 33 chemicals were detected in >10% of the samples, and there were 32 COPCs selected (Table 2-1) where detections above the SQL occurred in at least 10% of the samples. Carbon tetrachloride was not selected as a COPC because its one detection was a J–qualified sample below the SQL. As described in the WLATS Work Plan (described in Section 3), J–qualified data are measurements in which the identity of the chemical is certain but its concentration is estimated with some uncertainty.

2.1.2 Data analysis and COPCs from 2002 for Site A

During 2002, there were 31 sampling dates. Power failure on September 29, 2002, prevented sampling from that date, leaving 30 total samples. All 77 chemicals were detected in >10% of the samples; 28 were selected as COPCs (Table 2-1) since detections above the SQL occurred in at least 10% of the samples.

2.1.3 Data analysis and COPCs from 2003 for Site A

During 2003, there were 37 sampling dates. There were more sampling dates during this year because of increased frequency of sampling. Sampler failure on January 27, 2003, and site closure on August 3, 2003, prevented sampling from those dates. In addition, samples from July 31, 2003, were rejected and labeled as “grab samples”, leaving a total of 34 total samples. Sampling from December 29, 2003, was J–qualified due to “high pressure”. There were 33 chemicals detected in at least 10% of the samples; 26 were selected as COPCs (Table 2-1) since detections above the SQL occurred in at least 10% of the samples.

2.1.4 Data analysis and COPCs from 2004 for Site A

During 2004, there were 30 sampling dates. Equipment problems on August 13, 2004, prevented sampling from that date, leaving a total of 29 sampling dates. There were 2 J–qualified samples: July 8, 2004, due to "low can pressure" and December 23, 2004, due to "high can pressure". There were 37 chemicals detected with a frequency >10%; 28 chemicals were selected as COPCs (Table 2-5) since detections above the SQL occurred in at least 10% of the samples.

2.1.5 Data analysis and COPCs from 2005 for Site A

During 2005, there were 31 sampling dates. There were 40 chemicals detected with a frequency >10%; 26 chemicals were selected as COPCs (Table 2-1) since detections above the SQL occurred in at least 10% of the samples.

2.1.6 Summary of COPCs for Site A

For Site A, 26-32 chemicals were selected as COPCs for the monitoring years 2001-2005. COPCs selected in all 5 monitoring years include: Freon 22, Freon 12, chloromethane, vinyl chloride, 1,3-butadiene, acetone, Freon 11, acrylonitrile, methylene chloride, methyl acetate, carbon disulfide, methyl ethyl ketone, chloroprene, hexane, chloroform, benzene, cyclohexane, methyl methacrylate, methyl isobutyl ketone, methyl cyclohexane, toluene, ethylbenzene, (m- and/or p-) xylene, o-xylene, and 1,2,4-trimethylbenzene. Carbon tetrachloride was not selected as a COPC in 2001, possibly due to the small number of samples, but was selected as a COPC in 2002-2005.

Several COPCs were only selected in the years 2001 and/or 2002, but not in the following years: Freon 113, methyl t-butyl ether, methyl butyl ketone, styrene (selected as a COPC in 2001 and 2004), n-propylbenzene, 1,3,5-trimethylbenzene (selected as a COPC in 2001 and 2004), and naphthalene.

Overall, the results from the monitoring phase of the study indicate consistency across the monitoring periods for the selection of COPCs.

Table 2-1. Summary table of COPCs for Site A.

Cmpd #	Compound	CAS	2001	2002	2003	2004	2005
2	Freon 22 (ClF2Methane)	75456	X	X	X	X	X
3	Freon 12 (Cl2F2Methane)	75718	X	X	X	X	X
4	Chloromethane	74873	X	X	X	X	X
5	Freon 114 (Cl2F4Ethane)	76142					
6	Vinyl Chloride	75014	X	X	X	X	X
7	1,3- Butadiene	106990	X	X	X	X	X
8	Bromomethane	74839					
9	Chloroethane	75003					
10	Acetone	67641	X	X	X	X	X
11	Freon 11 (Cl3Fmethane)	75694	X	X	X	X	X
12	Acrylonitrile	107131	X	X	X	X	X
13	1,1-Dichloroethene	75354					
14	Methylene Chloride	75092	X	X	X	X	X
15	Methyl Acetate	79209	X	X	X	X	X
16	Freon 113 (Cl3F3Ethane)	76131	X	X			
17	Carbon Disulfide	75150	X	X	X	X	X
18	Trans-1,2-Dichlorothene	156605					
19	1,1-Dichloroethane	75343					
20	Methyl T-Butyl Ether (MTBE)	1634044	X	X			
21	Methyl Ethyl Ketone (2-Butanone)	78933	X	X	X	X	X
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	X	X	X	X	X
23	cis-1,2-Dichloroethene	156592					
25	Hexane	110543	X	X	X	X	X
26	Chloroform	67663	X	X	X	X	X
27	2,2-Dichloropropane	594207					
29	1,2- Dichloroethane	107062					
30	1,1,1-Trichloroethane	71556					
31	1,1- Dichloropropene	563586					
32	Benzene	71432	X	X	X	X	X
33	Carbon Tetrachloride	56235		X	X	X	X
34	Cyclohexane	110827	X	X	X	X	X
35	Dibromomethane	74953					
36	1,2-Dichloropropane	78875					
37	Ethyl Acrylate	140885					
38	Bromodichloromethane	75274					
39	Trichloroethene	79016					
40	Methyl Methacrylate	80626	X	X	X	X	X
41	cis-1,3-Dichloropropene	10061015					
42	Methyl Isobutyl Ketone	108101	X	X	X	X	X
43	Methyl Cyclohexane	108872	X	X	X	X	X

Cmpd #	Compound	CAS	2001	2002	2003	2004	2005
44	trans-1,3-Dichloropropene	10061026					
45	1,1,2-Trichloroethane	79005					
47	Toluene	108883	X	X	X	X	X
48	1,3-Dichloropropane	142289					
49	Methyl Butyl Ketone	591786	X				
50	Dibromochloromethane	124481					
51	1,2- Dibromoethane	106934					
52	Tetrachloroethene	127184					
54	1,1,1,2 - Tetrachloroethane	79345					
55	Chlorobenzene	108907					
56	Ethylbenzene	100414	X	X	X	X	X
57	(m and /or p) Xylene	108383/106423	X	X	X	X	X
58	Bromoform	75252					
59	Butyl Acrylate	141322					
60	Styrene	100425	X			X	
61	1,1,2,2-Tetrachloroethane	79345					
62	o-Xylene (1,2-Dimethyl Benzene)	95476	X	X	X	X	X
63	1,2,3-Trichloropropane	96184					
65	Isopropylbenzene	98828					
66	Bromobenzene	108861					
67	o-Chlorotoluene	95498					
68	n-Propylbenzene	103651	X				
69	p-Chlorotoluene	106434					
70	1,3,5-Trimethylbenzene	108678	X			X	
71	tert-Butylbenzene	98066					
72	1,2,4-Trimethylbenzene	95636	X	X	X	X	X
73	1,3-Dichlorobenzene	541731					
74	1,4-Dichlorobenzene	106467					
75	sec-Butylbenzene	135988					
76	p-Isopropyltoluene	99876					
77	1,2-Dichlorobenzene	95501					
78	n-Butylbenzene	104518					
79	1,2-Dibromo-3-chloropropan	96128					
80	1,2,4-Trichlorobenzene	95636					
81	Naphthalene	91203	X				
82	1,2,3-Trichlorobenzene	87616					
83	Hexachlorobutadiene	87683					

2.2 Ralph Avenue/Campground Road: Site C

The Ralph Avenue/Campground Road monitoring site (Site C) is a potential maximum impact site for DuPont, Rohm & Haas, Elf Atochem (now called Altaglas), American Synthetic Rubber, and other Rubbertown industries. This site is also a community exposure site for the Cane Run neighborhood.

Site C was the only monitoring site to have duplicate monitors. In WLATS Study 1, each set of data were handled separately for the purpose of validating the experimental and laboratory methods used in the exposure assessment. Study 1 found consistent results between the duplicate monitors. In the current WLATS Study 2, monitoring data were averaged to obtain a single chemical concentration for each chemical on each sampling date. These averaged values were used for data analysis. The summary of COPCs across the years 2001-2005 for Site C is presented in Table 2-2.

2.2.1 Data analysis and COPCs from 2001 for Site C

During 2001, only 5 sampling dates were recorded during quarter 4 (November-December). However, sampling from November 20, 2001, was not recorded because of sampler failure, leaving only 4 samples. All 77 chemicals that were analyzed were detected in >10% of the samples, however, many chemicals had only 1 detection that was J–qualified resulting in many chemicals that had no detections above the SQL. There were 27 COPCs selected that had 10% or more detections greater than the SQL (Table 2-2).

2.2.2 Data analysis and COPCs from 2002 for Site C

During 2002, there were 31 sampling dates. On January 8, 2002, and May 20, 2002, the duplicate sampler failed leading to only one measurement on those dates. There were 40 chemicals that were detected in >10% of the samples. Of these, 28 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-2).

2.2.3 Data analysis and COPCs from 2003 for Site C

During 2003, there were 37 sampling dates. There were more sampling dates during this year because of increased frequency of sampling. The duplicate sampler failed on January 15, 2003, January 27, 2003, and April 21, 2003, leading to only one measurement on those dates. Both samples on February 10, 2003, failed leading to a total of 36 sampling dates. There were 36 chemicals that were detected in >10% of the samples. Of these, 24 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-2).

2.2.4 Data analysis and COPCs from 2004 for Site C

During 2004, there were 29 sampling dates. There were no occurrences of sampler failure. There were 35 chemicals that were detected in >10% of the samples. Of these, 24 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-2).

2.2.5 Data analysis and COPCs from 2005 for Site C

During 2005, there were 31 sampling dates. Both samples from September 25, 2005, were rejected because one sample canister had "low pressure" and the duplicate sample was damaged by vandals. There were 31 chemicals that were detected in >10% of the samples. Of these, 22 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-2).

2.2.6 Summary of COPCs for Site C

For Site C, 22-28 chemicals were selected as COPCs for the monitoring years 2001-2005. COPCs selected in all 5 monitoring years include: Freon 22, Freon 12, chloromethane, 1,3-butadiene, acetone, Freon 11, methylene chloride, methyl acetate, carbon disulfide, methyl ethyl ketone, chloroprene, hexane, chloroform, benzene, methyl methacrylate, toluene, (m- and/or p-) xylene, styrene, o-xylene, and 1,2,4-trimethylbenzene. Carbon tetrachloride and acrylonitrile were not selected as COPCs in 2001, possibly due to the small number of samples, but were selected as COPCs in 2002-2005.

Several COPCs were only selected in the years 2001 and/or 2002, but not in the following years: methyl t-butyl ether, cyclohexane, methyl cyclohexane, n-propylbenzene, 1,3,5-trimethylbenzene, and naphthalene. Vinyl chloride and ethyl acrylate were only selected as COPCs in the years 2002 and 2003.

Overall, the results from the monitoring phase of the study indicate consistency across the monitoring periods for the selection of COPCs.

Table 2-2. Summary table of COPCs for Site C.

Cmpd #	Compound	CAS	2001	2002	2003	2004	2005
2	Freon 22 (ClF2Methane)	75456	X	X	X	X	X
3	Freon 12 (Cl2F2Methane)	75718	X	X	X	X	X
4	Chloromethane	74873	X	X	X	X	X
5	Freon 114 (Cl2F4Ethane)	76142					
6	Vinyl Chloride	75014		X	X		
7	1,3- Butadiene	106990	X	X	X	X	X
8	Bromomethane	74839					
9	Chloroethane	75003					
10	Acetone	67641	X	X	X	X	X
11	Freon 11 (Cl3Fmethane)	75694	X	X	X	X	X
12	Acrylonitrile	107131		X	X	X	X
13	1,1-Dichloroethene	75354					
14	Methylene Chloride	75092	X	X	X	X	X
15	Methyl Acetate	79209	X	X	X	X	X
16	Freon 113 (Cl3F3Ethane)	76131				X	
17	Carbon Disulfide	75150	X	X	X	X	X
18	Trans-1,2-Dichlorothene	156605					
19	1,1-Dichloroethane	75343					
20	Methyl T-Butyl Ether (MTBE)	1634044	X	X			
21	Methyl Ethyl Ketone (2-Butanone)	78933	X	X	X	X	X
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	X	X	X	X	X
23	cis-1,2-Dichloroethene	156592					
25	Hexane	110543	X	X	X	X	X
26	Chloroform	67663	X	X	X	X	X
27	2,2-Dichloropropane	594207					
29	1,2- Dichloroethane	107062					
30	1,1,1-Trichloroethane	71556					
31	1,1- Dichloropropene	563586					
32	Benzene	71432	X	X	X	X	X
33	Carbon Tetrachloride	56235		X	X	X	X
34	Cyclohexane	110827	X				
35	Dibromomethane	74953					
36	1,2-Dichloropropane	78875					
37	Ethyl Acrylate	140885		X	X		
38	Bromodichloromethane	75274					
39	Trichloroethene	79016					
40	Methyl Methacrylate	80626	X	X	X	X	X
41	cis-1,3-Dichloropropene	10061015					
42	Methyl Isobutyl Ketone	108101					
43	Methyl Cyclohexane	108872	X				

Cmpd #	Compound	CAS	2001	2002	2003	2004	2005
44	trans-1,3-Dichloropropene	10061026					
45	1,1,2-Trichloroethane	79005					
47	Toluene	108883	X	X	X	X	X
48	1,3-Dichloropropane	142289		X			
49	Methyl Butyl Ketone	591786					
50	Dibromochloromethane	124481					
51	1,2- Dibromoethane	106934					
52	Tetrachloroethene	127184					
54	1,1,1,2 - Tetrachloroethane	79345					
55	Chlorobenzene	108907					
56	Ethylbenzene	100414	X	X		X	
57	(m and /or p) Xylene	108383/106423	X	X	X	X	X
58	Bromoform	75252					
59	Butyl Acrylate	141322					
60	Styrene	100425	X	X	X	X	X
61	1,1,2,2-Tetrachloroethane	79345					
62	o-Xylene (1,2-Dimethyl Benzene)	95476	X	X	X	X	X
63	1,2,3-Trichloropropane	96184					
65	Isopropylbenzene	98828					
66	Bromobenzene	108861					
67	o-Chlorotoluene	95498					
68	n-Propylbenzene	103651	X				
69	p-Chlorotoluene	106434					
70	1,3,5-Trimethylbenzene	108678	X	X			
71	tert-Butylbenzene	98066					
72	1,2,4-Trimethylbenzene	95636	X	X	X	X	X
73	1,3-Dichlorobenzene	541731					
74	1,4-Dichlorobenzene	106467					
75	sec-Butylbenzene	135988					
76	p-Isopropyltoluene	99876					
77	1,2-Dichlorobenzene	95501					
78	n-Butylbenzene	104518					
79	1,2-Dibromo-3-chloropropan	96128					
80	1,2,4-Trichlorobenzene	95636					
81	Naphthalene	91203	X				
82	1,2,3-Trichlorobenzene	87616					
83	Hexachlorobutadiene	87683					

2.3 University of Louisville Shelby Campus: Site E

The University of Louisville Shelby Campus monitoring site (Site E) is an anthropogenic urban activity control site. This monitoring location was selected to represent an urban site near a major traffic corridor, but not in the immediate vicinity of any manufacturing facilities, and was thus considered an urban background monitor. The summary of COPCs across the years 2001-2005 for Site E is presented in Table 2-3.

2.3.1 Data analysis and COPCs from 2001 for Site E

During 2001, only 4 sampling dates were recorded during quarter 4 (November-December). However, sampling from November 9, 2001, and December 15 were not recorded because of unavailable samplers leaving only 2 sampling dates. There were 17 chemicals that were detected in >10% of the samples. Of these, there were 16 COPCs selected that had 10% or more detections greater than the SQL (Table 2-3).

2.3.2 Data analysis and COPCs from 2002 for Site E

During 2002, there were 30 sampling dates. However, sampling from January 3, 2002, and April 2, 2002, were not available due to the sampler upgrade program and a sampler not set, leaving 28 sampling dates. There were 25 chemicals that were detected in >10% of the samples. Of these, 22 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-3).

2.3.3 Data analysis and COPCs from 2003 for Site E

During 2003, there were 31 sampling dates. Sampling from August 31, 2003, was rejected due to "low pressure" leaving 30 sampling dates. There were 21 chemicals that were detected in >10% of the samples. Of these, 15 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-3).

2.3.4 Data analysis and COPCs from 2004 for Site E

During 2004, there were 30 sampling dates. Sampling from August 13, 2004, was rejected due to equipment problems, leaving 29 sampling dates. There were 24 chemicals that were detected in >10% of the samples. Of these, 20 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-3).

2.3.5 Data analysis and COPCs from 2005 for Site E

During 2005, there were 30 sampling dates. Sampling from December 6, 2005, was unavailable due to lab error, leaving 29 sampling dates. There were 22 chemicals that were detected in >10% of the samples. Of these, 15 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-3).

2.3.6 Summary of COPCs for Site E

For Site C, 15-22 chemicals were selected as COPCs for the monitoring years 2001-2005. COPCs selected in all 5 monitoring years include: Freon 22, Freon 12, chloromethane, acetone, Freon 11, methylene chloride, methyl ethyl ketone, hexane, benzene, toluene, and (m- and/or p-) xylene. 1,3-Butadiene, Freon 113, and carbon tetrachloride were not selected as COPCs in 2001, possibly due to the small number of samples, but were selected as COPCs in 2002-2005. Several COPCs demonstrated a pattern of selection in the years 2001, 2002 and 2004 but not 2003 and 2005: acrylonitrile, ethylbenzene, o-xylene, and 1,2,4-trimethylbenzene.

Two COPCs were only selected in the years 2001 and/or 2002, but not in the following years: methyl t-butyl ether and tert-butylbenzene. Vinyl chloride and ethyl acrylate were only selected as COPCs in the years 2002 and 2003.

Overall, the results from the monitoring phase of the study indicate consistency across the monitoring periods for the selection of COPCs. The lower number of COPCs selected from this site support the selection of Site E as the control site.

Table 2-3. Summary table of COPCs for Site E.

Cmpd #	Compound	CAS	2001	2002	2003	2004	2005
2	Freon 22 (ClF2Methane)	75456	X	X	X	X	X
3	Freon 12 (Cl2F2Methane)	75718	X	X	X	X	X
4	Chloromethane	74873	X	X	X	X	X
5	Freon 114 (Cl2F4Ethane)	76142					
6	Vinyl Chloride	75014					
7	1,3- Butadiene	106990		X	X	X	X
8	Bromomethane	74839					
9	Chloroethane	75003					
10	Acetone	67641	X	X	X	X	X
11	Freon 11 (Cl3Fmethane)	75694	X	X	X	X	X
12	Acrylonitrile	107131	X	X		X	
13	1,1-Dichloroethene	75354					
14	Methylene Chloride	75092	X	X	X	X	X
15	Methyl Acetate	79209		X	X	X	
16	Freon 113 (Cl3F3Ethane)	76131		X	X	X	X
17	Carbon Disulfide	75150		X		X	X
18	Trans-1,2-Dichlorothene	156605					
19	1,1-Dichloroethane	75343					
20	Methyl T-Butyl Ether (MTBE)	1634044	X	X			
21	Methyl Ethyl Ketone (2-Butanone)	78933	X	X	X	X	X
22	Chloroprene(2-Cl-1,3-Butadiene)	126998					
23	cis-1,2-Dichloroethene	156592					
25	Hexane	110543	X	X	X	X	X
26	Chloroform	67663					
27	2,2-Dichloropropane	594207					
29	1,2- Dichloroethane	107062					
30	1,1,1-Trichloroethane	71556					
31	1,1- Dichloropropene	563586					
32	Benzene	71432	X	X	X	X	X
33	Carbon Tetrachloride	56235		X	X	X	X
34	Cyclohexane	110827					
35	Dibromomethane	74953					
36	1,2-Dichloropropane	78875					
37	Ethyl Acrylate	140885					
38	Bromodichloromethane	75274					
39	Trichloroethene	79016					
40	Methyl Methacrylate	80626					
41	cis-1,3-Dichloropropene	10061015					
42	Methyl Isobutyl Ketone	108101					
43	Methyl Cyclohexane	108872					

Cmpd #	Compound	CAS	2001	2002	2003	2004	2005
44	trans-1,3-Dichloropropene	10061026					
45	1,1,2-Trichloroethane	79005					
47	Toluene	108883	X	X	X	X	X
48	1,3-Dichloropropane	142289					
49	Methyl Butyl Ketone	591786					
50	Dibromochloromethane	124481					
51	1,2- Dibromoethane	106934					
52	Tetrachloroethene	127184					
54	1,1,1,2 - Tetrachloroethane	79345					
55	Chlorobenzene	108907					
56	Ethylbenzene	100414	X	X		X	
57	(m and /or p) Xylene	108383/106423	X	X	X	X	X
58	Bromoform	75252					
59	Butyl Acrylate	141322					
60	Styrene	100425					
61	1,1,2,2-Tetrachloroethane	79345					
62	o-Xylene (1,2-Dimethyl Benzene)	95476	X	X		X	
63	1,2,3-Trichloropropane	96184					
65	Isopropylbenzene	98828					
66	Bromobenzene	108861					
67	o-Chlorotoluene	95498					
68	n-Propylbenzene	103651					
69	p-Chlorotoluene	106434					
70	1,3,5-Trimethylbenzene	108678					
71	tert-Butylbenzene	98066		X			
72	1,2,4-Trimethylbenzene	95636	X	X		X	
73	1,3-Dichlorobenzene	541731					
74	1,4-Dichlorobenzene	106467					
75	sec-Butylbenzene	135988					
76	p-Isopropyltoluene	99876					
77	1,2-Dichlorobenzene	95501					
78	n-Butylbenzene	104518					
79	1,2-Dibromo-3-chloropropan	96128					
80	1,2,4-Trichlorobenzene	95636					
81	Naphthalene	91203					
82	1,2,3-Trichlorobenzene	87616					
83	Hexachlorobutadiene	87683					

2.4 Cane Run Elementary School: Site F

The Cane Run Elementary School monitoring site (Site F) is a neighborhood population exposure site. The objective is to characterize potential exposure of individuals living in Cane Run, Hallmark, and Algonquin communities. The summary of COPCs across the years 2001-2005 for Site F is presented in Table 2-4.

2.4.1 Data analysis and COPCs from 2001 for Site F

During 2001, there were 6 sampling dates (October-December). This sample year used duplicate monitors. However, one monitor failed for each of the following dates: October 30, 2001, November 2, 2001, November 20, 2001, December 3, 2001, and December 15, 2001. Only one sampling date (November 9, 2001) had duplicate monitors whose data were averaged. There were 32 chemicals that were detected in >10% of the samples. All 32 chemicals were selected as COPCs since detections occurred above the SQL in at least 10% of the samples (Table 2-4).

2.4.2 Data analysis and COPCs from 2002 for Site F

During 2002, there were 31 sampling dates. This sample year used duplicate monitors. However, one monitor failed for each of the following dates: January 3, 2002, January 8, 2002, January 20, 2002, June 13, 2002, and December 22, 2002. Data from the sampling dates with duplicate monitors were averaged. All 77 chemicals were detected in >10% of the samples. However, many of these detections were J–qualified data below the SQL. A total of 26 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-4).

2.4.3 Data analysis and COPCs from 2003 for Site F

During 2003, there were 38 sampling dates. There were more sampling dates during this year because of increased frequency of sampling. There were no occurrences of sampler failure. There were 47 chemicals that were detected in >10% of the samples. A total of 25 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-4).

2.4.4 Data analysis and COPCs from 2004 for Site F

During 2004, there were 30 sampling dates. Sampling from August 13, 2004, was not recorded due to equipment problems, leaving a total of 29 sampling dates. There were 32 chemicals that were detected in >10% of the samples. Of these, 24 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-4).

2.4.5 Data analysis and COPCs from 2005 for Site F

During 2005, there were 31 sampling dates. There were no occurrences of sampler failure. There were 28 chemicals that were detected in >10% of the samples. Of these, 24 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-4).

2.4.6 Summary of COPCs for Site F

For Site F, 24-32 chemicals were selected as COPCs for the monitoring years 2001-2005. COPCs selected in all 5 monitoring years include: Freon 22, Freon 12, chloromethane, vinyl chloride, 1,3-butadiene, acetone, Freon 11, acrylonitrile, methylene chloride, methyl acetate, carbon disulfide, methyl ethyl ketone, chloroprene, hexane, chloroform, benzene, toluene, ethylbenzene, (m- and/or p-) xylene, and o-xylene. Freon 113, carbon tetrachloride, and methyl methacrylate were not selected as COPCs in 2001, possibly due to the small number of samples, but were selected as COPCs in 2002-2005.

Several COPCs were only selected in the years 2001 and/or 2002, but not in the following years: methyl t-butyl ether, cyclohexane, methyl cyclohexane, methyl butyl ketone, styrene, n-propylbenzene, 1,3,5-trimethylbenzene,1,4-dichlorobenzene, and naphthalene.

Overall, the results from the monitoring phase of the study indicate consistency across the monitoring periods for the selection of COPCs.

Table 2-4. Summary table of COPCs for Site F.

Cmpd #	Compound	CAS	2001	2002	2003	2004	2005
2	Freon 22 (ClF2Methane)	75456	X	X	X	X	X
3	Freon 12 (Cl2F2Methane)	75718	X	X	X	X	X
4	Chloromethane	74873	X	X	X	X	X
5	Freon 114 (Cl2F4Ethane)	76142					
6	Vinyl Chloride	75014	X	X	X	X	X
7	1,3- Butadiene	106990	X	X	X	X	X
8	Bromomethane	74839					
9	Chloroethane	75003					
10	Acetone	67641	X	X	X	X	X
11	Freon 11 (Cl3Fmethane)	75694	X	X	X	X	X
12	Acrylonitrile	107131	X	X	X	X	X
13	1,1-Dichloroethene	75354					
14	Methylene Chloride	75092	X	X	X	X	X
15	Methyl Acetate	79209	X	X	X	X	X
16	Freon 113 (Cl3F3Ethane)	76131		X	X	X	X
17	Carbon Disulfide	75150	X	X	X	X	X
18	Trans-1,2-Dichlorothene	156605					
19	1,1-Dichloroethane	75343					
20	Methyl T-Butyl Ether (MTBE)	1634044	X	X			
21	Methyl Ethyl Ketone (2-Butanone)	78933	X	X	X	X	X
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	X	X	X	X	X
23	cis-1,2-Dichloroethene	156592					
25	Hexane	110543	X	X	X	X	X
26	Chloroform	67663	X	X	X	X	X
27	2,2-Dichloropropane	594207					
29	1,2- Dichloroethane	107062					
30	1,1,1-Trichloroethane	71556					
31	1,1- Dichloropropene	563586					
32	Benzene	71432	X	X	X	X	X
33	Carbon Tetrachloride	56235		X	X	X	X
34	Cyclohexane	110827	X				
35	Dibromomethane	74953					
36	1,2-Dichloropropane	78875					
37	Ethyl Acrylate	140885					
38	Bromodichloromethane	75274					
39	Trichloroethene	79016					
40	Methyl Methacrylate	80626		X	X	X	X
41	cis-1,3-Dichloropropene	10061015					
42	Methyl Isobutyl Ketone	108101					
43	Methyl Cyclohexane	108872	X				

Cmpd #	Compound	CAS	2001	2002	2003	2004	2005
44	trans-1,3-Dichloropropene	10061026					
45	1,1,2-Trichloroethane	79005					
47	Toluene	108883	X	X	X	X	X
48	1,3-Dichloropropane	142289					
49	Methyl Butyl Ketone	591786	X				
50	Dibromochloromethane	124481					
51	1,2- Dibromoethane	106934					
52	Tetrachloroethene	127184	X		X		X
54	1,1,1,2 - Tetrachloroethane	79345					
55	Chlorobenzene	108907					
56	Ethylbenzene	100414	X	X	X	X	X
57	(m and /or p) Xylene	108383/106423	X	X	X	X	X
58	Bromoform	75252					
59	Butyl Acrylate	141322					
60	Styrene	100425	X	X			
61	1,1,2,2-Tetrachloroethane	79345					
62	o-Xylene (1,2-Dimethyl Benzene)	95476	X	X	X	X	X
63	1,2,3-Trichloropropane	96184					
65	Isopropylbenzene	98828	X				
66	Bromobenzene	108861					
67	o-Chlorotoluene	95498					
68	n-Propylbenzene	103651	X				
69	p-Chlorotoluene	106434					
70	1,3,5-Trimethylbenzene	108678	X				
71	tert-Butylbenzene	98066					
72	1,2,4-Trimethylbenzene	95636	X	X	X	X	
73	1,3-Dichlorobenzene	541731					
74	1,4-Dichlorobenzene	106467	X				
75	sec-Butylbenzene	135988					
76	p-Isopropyltoluene	99876					
77	1,2-Dichlorobenzene	95501					
78	n-Butylbenzene	104518					
79	1,2-Dibromo-3-chloropropan	96128					
80	1,2,4-Trichlorobenzene	95636					
81	Naphthalene	91203	X				
82	1,2,3-Trichlorobenzene	87616					
83	Hexachlorobutadiene	87683					

2.5 Chickasaw Park: Site I

The Chickasaw Park monitoring site (Site I) is a neighborhood population exposure site. The objective is to characterize potential exposure of individuals living in Chickasaw, Westover, Shawnee, and Portland communities/neighborhoods. The summary of COPCs across the years 2001-2005 for Site I is presented in Table 2-5.

2.5.1 Data analysis and COPCs from 2001 for Site I

During 2001, there were 4 sampling dates in quarter 4 (November-December). A sample monitor failed on November 20, 2001, leaving only 3 sampling dates. There were 24 chemicals that were detected in >10% of the samples. Of these, 22 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-5).

2.5.2 Data analysis and COPCs from 2002 for Site I

During 2002, there were 31 sampling dates. No occurrences of sampler failure were reported. There were 33 chemicals that were detected in >10% of the samples. Of these, 20 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-5).

2.5.3 Data analysis and COPCs from 2003 for Site I

During 2003, there were 31 sampling dates. No occurrences of sampler failure were reported. All 77 chemicals were detected in at least 10% of the samples. However, many of these detections were J–qualified samples that were below the SQL. A total of 21 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-5).

2.5.4 Data analysis and COPCs from 2004 for Site I

During 2004, there were 30 sampling dates. Sampler failure or equipment problems occurred on August 13, 2004, and November 5, 2004, leaving a total of 28 sampling dates. There were 28 chemicals detected in at least 10% of the samples. Of these, a total of 21 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-5).

2.5.5 Data analysis and COPCs from 2005 for Site I

During 2005, there were 30 sampling dates. No occurrences of sampler failure were reported. There were 25 chemicals detected in at least 10% of the samples. Of these, a total of 22 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-5).

2.5.6 Summary of COPCs for Site I

For Site I, 20-22 chemicals were selected as COPCs for the monitoring years 2001-2005. COPCs selected in all 5 monitoring years include: Freon 22, Freon 12, chloromethane, 1,3-butadiene, acetone, Freon 11, acrylonitrile, methylene chloride, carbon disulfide, methyl ethyl ketone, chloroprene, hexane, chloroform, benzene, methyl methacrylate, toluene, and (m- and/or p-) xylene. Methyl acetate and carbon tetrachloride were not selected as COPCs in 2001, possibly due to the small number of samples, but were selected as COPCs in 2002-2005.

Only methyl t-butyl ether was selected as a COPC in the years 2001 and 2002, but not in the following years. Vinyl chloride was selected as a COPC only in the years 2003 and 2005.

Overall, the results from the monitoring phase of the study indicate consistency across the monitoring periods for the selection of COPCs.

Table 2-5. Summary table of COPCs for Site I.

Cmpd #	Compound	CAS	2001	2002	2003	2004	2005
2	Freon 22 (ClF2Methane)	75456	X	X	X	X	X
3	Freon 12 (Cl2F2Methane)	75718	X	X	X	X	X
4	Chloromethane	74873	X	X	X	X	X
5	Freon 114 (Cl2F4Ethane)	76142					
6	Vinyl Chloride	75014			X		X
7	1,3- Butadiene	106990	X	X	X	X	X
8	Bromomethane	74839					
9	Chloroethane	75003					
10	Acetone	67641	X	X	X	X	X
11	Freon 11 (Cl3Fmethane)	75694	X	X	X	X	X
12	Acrylonitrile	107131	X	X	X	X	X
13	1,1-Dichloroethene	75354					
14	Methylene Chloride	75092	X	X	X	X	X
15	Methyl Acetate	79209		X	X	X	X
16	Freon 113 (Cl3F3Ethane)	76131	X		X		X
17	Carbon Disulfide	75150	X	X	X	X	X
18	Trans-1,2-Dichlorothene	156605					
19	1,1-Dichloroethane	75343					
20	Methyl T-Butyl Ether (MTBE)	1634044	X	X			
21	Methyl Ethyl Ketone (2-Butanone)	78933	X	X	X	X	X
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	X	X	X	X	X
23	cis-1,2-Dichloroethene	156592					
25	Hexane	110543	X	X	X	X	X
26	Chloroform	67663	X	X	X	X	X
27	2,2-Dichloropropane	594207					
29	1,2- Dichloroethane	107062					
30	1,1,1-Trichloroethane	71556					
31	1,1- Dichloropropene	563586					
32	Benzene	71432	X	X	X	X	X
33	Carbon Tetrachloride	56235		X	X	X	X
34	Cyclohexane	110827					
35	Dibromomethane	74953					
36	1,2-Dichloropropane	78875					
37	Ethyl Acrylate	140885					
38	Bromodichloromethane	75274					
39	Trichloroethene	79016					
40	Methyl Methacrylate	80626	X	X	X	X	X
41	cis-1,3-Dichloropropene	10061015					

Cmpd #	Compound	CAS	2001	2002	2003	2004	2005
42	Methyl Isobutyl Ketone	108101					
43	Methyl Cyclohexane	108872					
44	trans-1,3-Dichloropropene	10061026					
45	1,1,2-Trichloroethane	79005					
47	Toluene	108883	X	X	X	X	X
48	1,3-Dichloropropane	142289					
49	Methyl Butyl Ketone	591786					
50	Dibromochloromethane	124481					
51	1,2- Dibromoethane	106934					
52	Tetrachloroethene	127184					
54	1,1,1,2 - Tetrachloroethane	79345					
55	Chlorobenzene	108907					
56	Ethylbenzene	100414	X			X	X
57	(m and /or p) Xylene	108383/106423	X	X	X	X	X
58	Bromoform	75252					
59	Butyl Acrylate	141322					
60	Styrene	100425					
61	1,1,2,2-Tetrachloroethane	79345					
62	o-Xylene (1,2-Dimethyl Benzene)	95476	X			X	
63	1,2,3-Trichloropropane	96184					
65	Isopropylbenzene	98828					
66	Bromobenzene	108861					
67	o-Chlorotoluene	95498					
68	n-Propylbenzene	103651					
69	p-Chlorotoluene	106434					
70	1,3,5-Trimethylbenzene	108678					
71	tert-Butylbenzene	98066					
72	1,2,4-Trimethylbenzene	95636	X				
73	1,3-Dichlorobenzene	541731					
74	1,4-Dichlorobenzene	106467					
75	sec-Butylbenzene	135988					
76	p-Isopropyltoluene	99876					
77	1,2-Dichlorobenzene	95501					
78	n-Butylbenzene	104518					
79	1,2-Dibromo-3-chloropropan	96128					
80	1,2,4-Trichlorobenzene	95636					
81	Naphthalene	91203					
82	1,2,3-Trichlorobenzene	87616					
83	Hexachlorobutadiene	87683					

2.6 Farnsley Middle School: Site M

The Farnsley Middle School monitoring site (Site M) is a neighborhood population exposure site. The objective is to characterize potential exposure of individuals living in Cane Run, Riverside Gardens, and Shively communities. The summary of COPCs across the years 2001-2005 for Site M is presented in Table 2-6.

2.6.1 Data analysis and COPCs from 2001 for Site M

During 2001, there were 6 sampling dates in quarter 4 (October-December). The samplers failed on November 9, 2001, and November 20, 2001, and the school was closed on December 27, 2001, leaving only 3 sampling dates. All 77 chemicals were detected in >10% of the samples. However, many of these detections were J–qualified data that were below the SQL. A total of 22 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-6).

2.6.2 Data analysis and COPCs from 2002 for Site M

During 2002, there were 30 sampling dates. However, school closure on April 2, 2002, and June 13, 2002, prevented sampling on those dates. In addition, data were unavailable from April 13, 2002, leaving a total of 27 sampling dates. A total of 31 chemicals were detected in >10% of the samples. Of these, 26 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-6).

2.6.3 Data analysis and COPCs from 2003 for Site M

During 2003, there were 31 sampling dates. The school was closed on April 9, 2003, and a sampler valve failed on May 15, 2003, so that data were not obtained on those dates leaving a total of 29 sampling dates. All 77 chemicals were detected in >10% of the samples. However, many detections were J–qualified data below the SQL. A total of 19 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-6).

2.6.4 Data analysis and COPCs from 2004 for Site M

During 2004, there were 30 sampling dates. No data were available for August 13, 2004, due to equipment problems, leaving a total of 29 sampling dates. There were 28 chemicals that were detected in >10% of the samples. Of these, 22 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-6).

2.6.5 Data analysis and COPCs from 2005 for Site M

During 2005, there were 31 sampling dates. Samples from April 10, 2005, and August 9, 2005, were rejected as "grab samples". There were 24 chemicals that were detected in >10% of the samples. Of these, 20 chemicals were selected as COPCs since detections above the SQL occurred in at least 10% of the samples (Table 2-6).

2.6.6 Summary of COPCs for Site M

For Site I, 19-26 chemicals were selected as COPCs for the monitoring years 2001-2005. COPCs selected in all 5 monitoring years include: Freon 22, Freon 12, chloromethane, 1,3-butadiene, acetone, Freon 11, acrylonitrile, methylene chloride, Freon 113, carbon disulfide, methyl ethyl ketone, chloroprene, hexane, benzene, carbon tetrachloride, toluene, and (m- and/or p-) xylene. Chloroform was not selected as a COPC in 2001, possibly due to the small number of samples, but was selected as a COPC in 2002-2005.

Only methyl t-butyl ether and naphthalene were selected as COPCs in the years 2001 and/or 2002, but not in the following years. Vinyl chloride was selected as a COPC only in the years 2002 and 2003.

Overall, the results from the monitoring phase of the study indicate consistency across the monitoring periods for the selection of COPCs.

Table 2-6. Summary table of COPCs for Site M.

Cmpd #	Compound	CAS	2001	2002	2003	2004	2005
2	Freon 22 (ClF2Methane)	75456	X	X	X	X	X
3	Freon 12 (Cl2F2Methane)	75718	X	X	X	X	X
4	Chloromethane	74873	X	X	X	X	X
5	Freon 114 (Cl2F4Ethane)	76142					
6	Vinyl Chloride	75014		X	X		
7	1,3- Butadiene	106990	X	X	X	X	X
8	Bromomethane	74839					
9	Chloroethane	75003					
10	Acetone	67641	X	X	X	X	X
11	Freon 11 (Cl3Fmethane)	75694	X	X	X	X	X
12	Acrylonitrile	107131	X	X	X	X	X
13	1,1-Dichloroethene	75354					
14	Methylene Chloride	75092	X	X	X	X	X
15	Methyl Acetate	79209		X			X
16	Freon 113 (Cl3F3Ethane)	76131	X	X	X	X	X
17	Carbon Disulfide	75150	X	X	X	X	X
18	Trans-1,2-Dichlorothene	156605					
19	1,1-Dichloroethane	75343					
20	Methyl T-Butyl Ether (MTBE)	1634044	X	X			
21	Methyl Ethyl Ketone (2-Butanone)	78933	X	X	X	X	X
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	X	X	X	X	X
23	cis-1,2-Dichloroethene	156592					
25	Hexane	110543	X	X	X	X	X
26	Chloroform	67663		X	X	X	X
27	2,2-Dichloropropane	594207					
29	1,2- Dichloroethane	107062					
30	1,1,1-Trichloroethane	71556					
31	1,1- Dichloropropene	563586					
32	Benzene	71432	X	X	X	X	X
33	Carbon Tetrachloride	56235	X	X	X	X	X
34	Cyclohexane	110827					
35	Dibromomethane	74953					
36	1,2-Dichloropropane	78875					
37	Ethyl Acrylate	140885					
38	Bromodichloromethane	75274					
39	Trichloroethene	79016					
40	Methyl Methacrylate	80626		X		X	
41	cis-1,3-Dichloropropene	10061015					
42	Methyl Isobutyl Ketone	108101					
43	Methyl Cyclohexane	108872					

Cmpd #	Compound	CAS	2001	2002	2003	2004	2005
44	trans-1,3-Dichloropropene	10061026					
45	1,1,2-Trichloroethane	79005					
47	Toluene	108883	X	X	X	X	X
48	1,3-Dichloropropane	142289					
49	Methyl Butyl Ketone	591786					
50	Dibromochloromethane	124481					
51	1,2- Dibromoethane	106934					
52	Tetrachloroethene	127184		X			X
54	1,1,1,2 - Tetrachloroethane	79345					
55	Chlorobenzene	108907					
56	Ethylbenzene	100414	X			X	
57	(m and /or p) Xylene	108383/106423	X	X	X	X	X
58	Bromoform	75252					
59	Butyl Acrylate	141322					
60	Styrene	100425		X			
61	1,1,2,2-Tetrachloroethane	79345					
62	o-Xylene (1,2-Dimethyl Benzene)	95476	X	X		X	
63	1,2,3-Trichloropropane	96184					
65	Isopropylbenzene	98828					
66	Bromobenzene	108861					
67	o-Chlorotoluene	95498					
68	n-Propylbenzene	103651					
69	p-Chlorotoluene	106434					
70	1,3,5-Trimethylbenzene	108678					
71	tert-Butylbenzene	98066					
72	1,2,4-Trimethylbenzene	95636	X	X		X	
73	1,3-Dichlorobenzene	541731					
74	1,4-Dichlorobenzene	106467					
75	sec-Butylbenzene	135988					
76	p-Isopropyltoluene	99876					
77	1,2-Dichlorobenzene	95501					
78	n-Butylbenzene	104518					
79	1,2-Dibromo-3-chloropropan	96128					
80	1,2,4-Trichlorobenzene	95636					
81	Naphthalene	91203	X				
82	1,2,3-Trichlorobenzene	87616					
83	Hexachlorobutadiene	87683					

3.0 EXPOSURE ASSESSMENT

Exposure assessment is the process that characterizes the route, duration, intensity, and frequency of contact with a chemical by a receptor. In this assessment, the WLATS provides a statistical analysis of the risk at specific monitoring sites via the principal exposure route of interest, inhalation. Two exposure durations are evaluated: chronic and acute. For chronic scenarios, exposure to relatively low levels of pollutants repeatedly over a prolonged period of time is evaluated. For acute scenarios, one-time exposure to the highest concentration is assumed to occur.

3.0.1 Data treatment and handling of non-detects

Calculation of summary descriptive statistics (arithmetic mean, standard deviation, median, 95% UCL) requires resolution of certain issues regarding the treatment of sampling data. Assumptions must be made regarding:

- Treatment of duplicate samples;
- Treatment of instances in which substances are not detected; and
- Use of measurements in which the identity of a substance is certain but its concentration is estimated with some uncertainty (referred to as "J–qualified" data).

Duplicate samples refer to the simultaneous collection or analysis of multiple (usually two) samples under conditions that are kept as similar as possible. Field duplicates usually refer to separate samples collected side-by-side in the field, while laboratory duplicates involve separately analyzing portions of the contents of a single sample. Both types of duplicates serve the similar purpose of providing a sense of the reliability, reproducibility, and precision of measurements. Ideally, duplicate samples should yield the same results. Large differences in the results of duplicate measurements potentially indicate uncertainty in data quality.

In the WLATS risk assessment, field duplicate samples will be treated as a single sample using the average of their results. In cases where a substance is detected in one but not all duplicates (or the data is J–qualified), the substance will be assumed to be present and the two values will be averaged using the procedure for handling non–detects as described below.

Various procedures have been used in risk assessments to treat non–detects (i.e., samples in which the substance concentration is determined to be below the respective sample quantification limit (SQL)), ranging from the assumption that the substance is absent (i.e., the true concentration is zero) to the assumption that the substance was present in a sample at a level infinitesimally beneath the detection limit (i.e., the lowest concentration that could reliably be quantified by the laboratory). Some algorithms differentiate assignment of values to non–detects based upon the frequency of a substance's detection. For example, if a substance is detected in almost all samples, a concentration equal to (or

some fraction of) the analytical detection limit is assigned to non–detects, but if the substance is detected in few or no samples, concentrations of zero are assumed for non–detects. In the present study, the following strategy was used to address the issue of non–detects:

- If greater than or equal to 10% of the monitored concentrations of a given substance at a given location are above the SQL, then a value equal to ½ of the respective SQL will be assigned to the non–detects and these values along with the detected values will be used in the calculation of summary statistics as described below.

- If greater than 90% of the monitored concentrations of a given substance at a given location are less than the respective SQL, no estimation of the statistical descriptors will be undertaken initially. If concentrations were only detected on a limited number of days (e.g., 1–3 days) then an investigation may be undertaken to assess the potential sources for these substances and the validity of the measurements.

3.0.2 Characterization of concentration data

The primary goal and output from the data analysis effort in this study is to provide a "data rich" characterization of the long–term average concentration data for subsequent use in the risk characterization phase of this assessment. USEPA's Risk Characterization Handbook (USEPA, 2000e) specifically advises against the use of a "bright line" or single point estimate in characterizing exposure (concentration) and risk, and advocates an understandable, rich description of the findings and uncertainties of the assessment. Accordingly, each set of substance/monitoring site data will be analyzed to provide both a 50^{th} percentile value and arithmetic mean with the 95^{th} percent Upper Confidence Limit (95% UCL) of the long–term average exposure concentration (as discussed below).

One method to estimate the long–term annual average concentration would be to calculate a simple arithmetic mean for each analyte/monitor combination. The arithmetic mean or average is constructed from discrete sample measurements taken over time. Constraints on resources, however, place limits on the amount of sampling possible within the WLATS (e.g., samples could not be collected every day). Instead, consistent with other air toxicant studies, samples in the WLATS were collected generally one out of every twelve days. Statistically, samples were collected in a manner to eliminate obvious sources of bias (e.g., samples were not uniformly collected on the same day of the week, or only on weekdays or only on weekends). In addition, collecting samples for a year allows for an evaluation of seasonal variability.

All factors being equal, one would expect the database to contain equal probabilities of sampling on days when pollutant concentrations may have been relatively high as on days when pollutant concentrations may have been relatively low. Since samples were not collected every single day; however, one cannot be absolutely certain that conditions were sampled equally. The arithmetic mean concentration is thus subject to uncertainty due to a number of factors, including:

- Daily variability in concentrations;
- The ability to measure only a finite number of instances from the distribution of concentrations over time; and
- Potential inaccuracy in individual measurements of concentrations.

Given the stated uncertainties associated with the use of the arithmetic mean concentration to describe "average" exposure concentration and the need for a "data–rich" description of the underlying data, both the 50th percentile value (the median) and the 95% UCL of the mean will be calculated for each substance/monitor combination, when appropriate. While it is statistically possible that the "true" average concentration could be greater than the calculated 95% UCL (5% probability), this data descriptor represents a reasonable upper bound conservative estimator of the long–term average concentration present in the ambient air, since in many cases the 95% UCL will be close to or greater than the highest concentration value determined from the data for each year of Study 2 (see discussion of 95% UCL below).

3.1 Chronic Exposures

In this assessment, chronic exposure was evaluated based on the median and 95% UCL estimates of the long–term average concentration for each COPC, as per the requirements of the WLATS Risk Assessment Work Plan. The median value was selected to provide an estimate of the central tendency, while the 95% UCL was selected to reflect a conservative estimate of chronic exposure. The following conservative assumptions were used in the assessment of exposure at the median and 95% UCL:

- A person lives, works, and otherwise stays near a given monitoring location for a 70-year lifetime.

- The air that the person breathes, both while indoors and outdoors, contains the same concentrations of pollutants measured in the WLATS study.

- Air quality, as reflected by the WLATS monitoring results, was assumed to remain relatively constant over the entire 70-year lifetime of a person living in the area.

Analytical data for COPCs were processed to derive exposure concentrations.

The first step was to process all chemical results reported as non-detects. A non-detect indicates that the measurement equipment could not positively identify the chemical. This does not mean the chemical is not present; rather, if it is present it is at a concentration lower than the instrument can detect. As per the WLATS Work Plan guidance, and standard practice in conducting risk assessments, all samples reported as non-detects were assigned a value of ½ the lowest concentration that the instrument can detect, known as the sample quantitation limit or SQL.

After treatment of non-detects was completed, descriptive statistics were calculated for each monitor for each year of Study 2. For each chemical reported at a monitor, the following information was determined:

- the frequency at which the chemical was detected at the monitor;
- the maximum and minimum detected concentrations;
- for chemicals with non-detects at the monitor (i.e., frequency of detection less than 100%), the range of SQLs was determined; and,
- the arithmetic mean, median and standard deviation of the chemical data was calculated as follows.

The arithmetic mean was calculated as:

$$\bar{c} = \frac{\sum_{i=1}^{n} c_i}{n} \qquad \text{Equation 3-1}$$

where:

$\bar{c}$ = the arithmetic mean concentration;
c_i = an individual sample measurement; and
n = the total number of sample measurements.

The standard deviation was calculated as:

$$s = \sqrt{\frac{\sum_{i=1}^{n} (c_i - \bar{c})^2}{n-1}} \qquad \text{Equation 3-2}$$

where:

s = the standard deviation of the concentration data;
$\bar{c}$ = the arithmetic mean concentration;
c_i = an individual sample measurement; and
n = the total number of sample measurements.

As per the WLATS Risk Assessment Work Plan, a median value was calculated for each chemical and monitor for each year of Study 2. The median value reflects the midpoint of the data; half of the values are above the median and half of the values are below. This value was selected to represent the central tendency of concentrations a person may be exposed to via inhalation. The median concentration was calculated by first arranging the sampling results for a given chemical at a single monitor in order from the smallest to the largest value. If the number of samples being evaluated was an even number, then the median was calculated as the arithmetic average of the two middle values. For example, if the sample values were 3, 6, 8, and 11, the median would be calculated as (6 + 8)/2, which gives a median value of 7. When the number of samples was odd, the median value is in the middle. For example, the median value for the numbers 1, 3, 5, 7, and 9 is 5. This procedure is outlined as follows:

Let c_1, c_2, ..., c_n represent the n concentrations of a given substance at a given monitoring site. To compute the p^{th} percentile, y(p), the concentrations are ordered from smallest to largest and labeled so that $c_{(1)}$ is the smallest, $c_{(2)}$ is the second smallest, ..., $c_{(n)}$ is the largest. Let t = p/100, and multiply the sample size n by t. Divide the result into the integer part and the fractional part, i.e., let nt = j + g where j is the integer part and g is the fraction part. Then the p^{th} percentile, y(p), is calculated by:

$$y(p) = [c_{(j)} + c_{(j+1)}]/2 \quad \text{if } g = 0 \qquad \text{Equation 3-3}$$

$$y(p) = [c_{(j+1)}] \quad \text{otherwise} \qquad \text{Equation 3-4}$$

In addition to these summary statistics, the data analysis also included various statistical calculations typically used in risk assessments. First, a statistical test was conducted to determine the distribution of the chemical data for a monitoring location. Following USEPA guidance, the Shapiro-Wilke test was conducted to test the hypothesis that the data were normally distributed. If this hypothesis proved true according to the test results, then the arithmetic mean and standard deviation calculated above were used to calculate the 95^{th} percentile upper confidence limit, abbreviated as the 95^{th} UCL. The 95^{th} UCL is typically used as a conservative estimate of the true average concentration. Theoretically, the 95^{th} UCL provides a value that 95% of the time equals or exceeds the true mean of the data. The 95% UCL value for normally distributed data was calculated using the following formula:

$$\bar{c}_{95} = c + \frac{s \bullet t_{95}}{\sqrt{n}} \qquad \text{Equation 3-5}$$

where:

$\bar{c}_{95}$ = 95^{th} percentile upper confidence limit on the mean;
$\bar{c}$ = the arithmetic mean concentration;
s = the standard deviation of the concentration data;
t_{95} = student's t statistic based on n-1 degree of freedom; and
n = the total number of sample measurements.

If the Shapiro-Wilke test did not indicate that the data were normally distributed, then the assumption was made that the data were lognormal and a different equation was used to calculate the 95% UCL. First the data was log transformed by calculating the natural logarithm of each of the sample values. Then equations 1 and 2 above were used to compute the mean and standard deviation of the log transformed values. Finally, the 95% UCL was calculated using the following equation as per USEPA (1992a) guidance.

$$\bar{c}_{95} = e^{\bar{c}_t + 0.5 s_t + \left(\frac{s_t H}{\sqrt{n-1}} \right)}$$ Equation 3-6

where:

$\bar{c}_{95}$ = 95th percentile upper confidence limit on the mean;
$\bar{c}_t$ = the arithmetic mean concentration of the log transformed values;
s_t = the standard deviation of the log transformed concentration data;
H = the H statistic (See Gilbert, 1987); and
n = the total number of sample measurements.

It is statistically possible for the 95% UCL confidence limit of the mean to exceed the maximum measured concentration for a substance. If this occurs, the maximum concentration of the substance will be used in place of the 95% UCL as the exposure concentration. This procedure is consistent with risk assessment guidance (USEPA, 1992b).

3.2 Acute Exposures

Acute (short–term) health effects from air pollutants are also possible if concentrations are sufficiently high. Health effects that persons may experience due to short–term exposures to airborne contaminants can vary significantly from those experienced after long-term exposure to low doses, depending on the contaminant and its concentration. For example, a substance that produces an increase in cancer rates after exposure to low concentrations for a long period of time might also cause immediate and severe eye irritation if present at sufficiently high levels for a short period of time.

Methods to assess acute health effects, however, are not well established. As a conservative approach for this study, the highest concentrations of pollutants measured (during each individual year of monitoring) at each location were compared to acute benchmark concentrations. Reliance on maximum measured concentrations to evaluate the potential for adverse effects from acute exposures, as opposed to upper confidence limits of means, treats each sample independently, and thus averts the potential to "average out" spikes in concentration.

3.3 Exposure Assessment for Louisville Police Firearms Training: Site A

3.3.1 Summary statistics of COPCs from 2001 for Site A

There were 32 COPCs selected for this monitoring year (Table 3-1).

The COPCs with the highest median concentrations were Freon 22 (23.51 μg/m^3), acetone (18.39 μg/m^3), and toluene (7.07 μg/m^3). With regard to the maximum detected concentrations, the COPCs with the highest were Freon 22 (58.34 μg/m^3), acetone (42.15 μg/m^3), methyl ethyl ketone (25.10 μg/m^3), and toluene (29.90 μg/m^3).

The 95% UCL was not calculated for this data set because of the limited number of sampling dates. This calculation would have been unreliable as a representation of the full year.

3.3.2 Summary statistics of COPCs from 2002 for Site A

There were 28 COPCs selected for this monitoring year (Table 3-2).

Similar to 2001, the highest median COPC concentrations were for Freon 22 (8.69 μg/m^3), acetone (10.66 μg/m^3), and toluene (8.50 μg/m^3). The COPCs with the highest maximum detected concentrations were Freon 22 (123.26 μg/m^3), 1,3-butadiene (10.63 μg/m^3), acetone (56.76 μg/m^3), methyl t-butyl ether (22.60 μg/m^3), methyl ethyl ketone (25.22 μg/m^3), chloroprene (10.61 μg/m^3), hexane (10.27 μg/m^3), cyclohexane (7.46 μg/m^3), methyl isobutyl ketone (6.56 μg/m^3), methyl cyclohexane (19.94 μg/m^3), toluene (56.70 μg/m^3), and (m- and/or p-) xylene (11.51 μg/m^3).

Forty nine of the chemicals, though detected at a frequency >10%, were below their sample quantitation limit (SQL). Closer inspection of the data indicates that 5 sampling dates from January-February were J–qualified data because of "high pressure".

The data distribution of the COPCs failed normality tests, such that the 95% UCL was derived after the data were log transformed. The highest 95% UCL concentrations were for Freon 22 (44.71 μg/m^3), 1,3-butadiene (7.77 μg/m^3), acetone (29.09 μg/m^3), methyl t-butyl ether (4.94 μg/m^3), methyl ethyl ketone (10.12 μg/m^3), chloroprene (4.81 μg/m^3), hexane (4.30 μg/m^3), toluene (19.66 μg/m^3), and (m- and/or p-) xylene (3.69 μg/m^3).

3.3.3 Summary statistics of COPCs from 2003 for Site A

There were 26 COPCs selected for this monitoring year (Table 3-3).

The highest median COPC concentrations were for Freon 22 (10.02 μg/m^3), acetone (17.97 μg/m^3), methyl ethyl ketone (5.94 μg/m^3), and toluene (10.84 μg/m^3). The COPCs with the highest maximum detected concentrations were Freon 22 (504.95 μg/m^3), 1,3-butadiene (14.63 μg/m^3), acetone (157.20 μg/m^3), methyl ethyl ketone (175.73 μg/m^3), chloroprene (9.05 μg/m^3), hexane (12.88 μg/m^3), benzene (5.90 μg/m^3), methyl isobutyl ketone (9.27 μg/m^3), methyl cyclohexane (18.29 μg/m^3), toluene (68.54 μg/m^3), and m- and or p-xylene (17.68 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 2 COPCs (chloromethane and chloroform) that were normally distributed. The highest 95% UCL concentrations were for Freon 22 (87.05 μg/m^3), 1,3-butadiene

(9.15 µg/m^3), acetone (65.01 µg/m^3), methyl ethyl ketone (49.83 µg/m^3), chloroprene (4.38 µg/m^3), hexane (7.07 µg/m^3), toluene (38.37 µg/m^3), and (m- and/or p-) xylene (7.23 µg/m^3).

3.3.4 Summary statistics of COPCs from 2004 for Site A

There were 28 COPCs selected for this monitoring year (Table 3-4).

The highest median COPC concentrations were for Freon 22 (7.82 µg/m^3), acetone (8.47 µg/m^3), methyl ethyl ketone (4.57 µg/m^3), and toluene (7.35 µg/m^3). The COPCs with the highest maximum detected concentrations were Freon 22 (70.45 µg/m^3), 1,3-butadiene (11.67 µg/m^3), acetone (103.55 µg/m^3), methyl ethyl ketone (48.41 µg/m^3), chloroprene (27.44 µg/m^3), hexane (25.49 µg/m^3), benzene (12.95 µg/m^3), methyl isobutyl ketone (17.34 µg/m^3), methyl cyclohexane (13.23 µg/m^3), toluene (44.41 µg/m^3), and (m- and/or p-) xylene (18.24 µg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 2 COPCs (Freon 12 and Freon 11) that were normally distributed. The highest 95% UCL concentrations were for Freon 22 (41.99 µg/m^3), 1,3-butadiene (3.92 µg/m^3), acetone (28.52 µg/m^3), methyl ethyl ketone (29.76 µg/m^3), chloroprene (6.29 µg/m^3), hexane (9.77 µg/m^3), methyl cyclohexane (5.39 µg/m^3), toluene (41.92 µg/m^3), and (m- and/or p-) xylene (9.00 µg/m^3).

3.3.5 Summary statistics of COPCs from 2005 for Site A

There were 26 COPCs selected for this monitoring year (Table 3-5).

The highest median COPC concentrations were for acetone (10.81 µg/m^3) and toluene (6.64 µg/m^3). The COPCs with the highest maximum detected concentrations were Freon 22 (38.90 µg/m^3), Freon 12 (7.52 µg/m^3), vinyl chloride (15.74 µg/m^3), 1,3-butadiene (10.36 µg/m^3), acetone (130.76 µg/m^3), methyl ethyl ketone (45.31 µg/m^3), chloroprene (11.33 µg/m^3), hexane (27.32 µg/m^3), methyl cyclohexane (9.53 µg/m^3), toluene (63.83 µg/m^3), and naphthalene (9.64 µg/m^3).

The 95% UCL was derived from log transformed data. The highest 95% UCL concentrations were for Freon 22 (14.84 µg/m^3), 1,3-butadiene (7.81 µg/m^3), acetone (43.34 µg/m^3), methyl ethyl ketone (30.84 µg/m^3), chloroprene (3.96 µg/m^3), hexane (7.37 µg/m^3), toluene (34.78 µg/m^3), and (m- and/or p-) xylene (6.49 µg/m^3).

Table 3-1. Summary statistics for COPCs from Site A 2001.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	3.43	58.34	27.20	23.51	26.54	N/A	
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.97	4.16	3.34	3.12	0.55	N/A	
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.97	1.53	1.22	1.19	0.24	N/A	
6	Vinyl Chloride	75014	25%	0.26-0.26	75.00%	0.13	0.54	0.23	0.13	0.20	N/A	
7	1,3- Butadiene	106990	100%	0.22-0.22	0.00%	0.40	4.84	1.91	1.19	2.03	N/A	
10	Acetone	67641	75%	0.24-0.24	25.00%	0.12	42.15	18.39	15.64	17.70	N/A	
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.35	1.85	1.59	1.57	0.23	N/A	
12	Acrylonitrile	107131	75%	0.22-0.22	25.00%	0.11	1.97	1.12	1.20	0.90	N/A	
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.45	0.52	0.48	0.47	0.03	N/A	
15	Methyl Acetate	79209	25%	0.31-0.31	75.00%	0.15	0.33	0.20	0.15	0.09	N/A	
16	Freon 113 (Cl3F3Ethane)	76131	50%	0.77-0.77	50.00%	0.38	1.00	0.65	0.61	0.32	N/A	
17	Carbon Disulfide	75150	75%	0.31-0.31	25.00%	0.16	6.62	1.94	0.50	3.13	N/A	
20	Methyl T-Butyl Ether (MTBE)	1634044	100%	0.36-0.36	0.00%	1.12	6.35	2.98	2.22	2.31	N/A	
21	Methyl Ethyl Ketone (2-Butanone)	78933	100%	0.30-0.30	0.00%	0.97	25.10	8.19	3.35	11.41	N/A	
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	75%	0.37-0.37	25.00%	0.18	2.53	1.47	1.57	1.18	N/A	
25	Hexane	110543	100%	0.36-0.36	0.00%	1.16	7.20	3.12	2.05	2.78	N/A	
26	Chloroform	67663	75%	0.49-0.49	25.00%	0.24	4.20	1.42	0.61	1.87	N/A	
32	Benzene	71432	100%	0.32-0.32	0.00%	1.02	3.35	1.90	1.61	1.01	N/A	
34	Cyclohexane	110827	75%	0.35-0.35	25.00%	0.17	6.19	1.86	0.53	2.90	N/A	
40	Methyl Methacrylate	80626	25%	0.41-0.41	75.00%	0.20	1.10	0.43	0.20	0.45	N/A	
42	Methyl Isobutyl Ketone	108101	75%	0.41-0.41	25.00%	0.21	5.58	1.99	1.09	2.44	N/A	
43	Methyl Cyclohexane	108872	75%	0.41-0.41	25.00%	0.20	4.70	1.67	0.88	2.06	N/A	
47	Toluene	108883	100%	0.38-0.38	0.00%	5.32	29.90	12.34	7.07	11.74	N/A	
49	Methyl Butyl Ketone	591786	25%	0.41-0.41	75.00%	0.21	0.86	0.37	0.21	0.33	N/A	
56	Ethylbenzene	100414	100%	0.44-0.44	0.00%	0.52	2.21	1.12	0.87	0.77	N/A	
57	(m and /or p) Xylene	108383/ 106423	100%	0.44-0.44	0.00%	1.71	6.83	3.48	2.69	2.37	N/A	
60	Styrene	100425	50%	0.43-0.43	50.00%	0.21	0.89	0.54	0.53	0.38	N/A	

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL ($\mu g/m^3$)	% Samples < SQL	Min. Conc. ($\mu g/m^3$)	Max. Conc. ($\mu g/m^3$)	Arithmetic Mean ($\mu g/m^3$)	Median Conc. ($\mu g/m^3$)	Standard Deviation ($\mu g/m^3$)	95% UCL ($\mu g/m^3$)	Basis of 95% UCL
62	o-Xylene (1,2-Dimethyl Benzene)	95476	100%	0.44-0.44	0.00%	0.52	2.08	1.09	0.87	0.69	N/A	
68	n-Propylbenzene	103651	25%	0.50-0.50	75.00%	0.25	0.49	0.31	0.25	0.12	N/A	
70	1,3,5-Trimethylbenzene	108678	25%	0.50-0.50	75.00%	0.25	0.79	0.38	0.25	0.27	N/A	
72	1,2,4-Trimethylbenzene	95636	75%	0.50-0.50	25.00%	0.25	2.26	1.14	1.03	0.83	N/A	
81	Naphthalene	91203	25%	0.53-0.50	75.00%	0.26	0.52	0.33	0.26	0.13	N/A	

Table 3-2. Summary statistics for COPCs from Site A 2002.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.85	123.26	19.10	8.69	30.76	44.71	Log normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.38	4.16	2.97	2.92	0.37	3.08	Log normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.97	1.68	1.34	1.29	0.21	1.41	Log normal
6	Vinyl Chloride	75014	43%	0.26-0.26	80.00%	0.13	2.59	0.34	0.13	0.55	0.56	Log normal
7	1,3- Butadiene	106990	87%	0.22-0.22	30.00%	0.11	10.63	2.27	1.31	2.75	7.77	Log normal
10	Acetone	67641	100%	0.24-0.24	0.00%	1.05	56.76	15.95	10.66	14.35	29.09	Log normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.18	2.19	1.57	1.52	0.22	1.65	Log normal
12	Acrylonitrile	107131	53%	0.22-0.22	76.67%	0.11	3.10	0.38	0.11	0.67	0.52	Log normal
14	Methylene Chloride	75092	97%	0.35-0.35	23.33%	0.17	1.18	0.45	0.42	0.23	0.56	Log normal
15	Methyl Acetate	79209	57%	0.31-0.31	76.67%	0.15	1.12	0.25	0.15	0.22	0.30	Log normal
16	Freon 113 (Cl3F3Ethane)	76131	73%	0.77-0.77	83.33%	0.38	1.00	0.47	0.38	0.20	0.69	Log normal
17	Carbon Disulfide	75150	70%	0.31-0.31	53.33%	0.16	4.54	0.55	0.16	0.83	0.98	Log normal
20	Methyl T-Butyl Ether (MTBE)	1634044	93%	0.36-0.36	13.33%	0.18	22.60	2.61	0.87	4.40	4.94	Log normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	100%	0.30-0.30	3.33%	0.15	25.22	5.32	3.13	6.06	10.12	Log normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	70%	0.37-0.37	40.00%	0.18	10.61	1.84	1.00	2.47	4.81	Log normal
25	Hexane	110543	100%	0.36-0.36	0.00%	0.35	10.27	2.89	1.82	2.35	4.30	Log normal
26	Chloroform	67663	70%	0.49-0.49	60.00%	0.24	2.10	0.52	0.24	0.45	0.68	Log normal
32	Benzene	71432	100%	0.32-0.32	0.00%	0.54	5.01	1.73	1.47	1.04	2.13	Log normal
33	Carbon Tetrachloride	56235	87%	0.64-0.64	56.67%	0.31	0.69	0.46	0.31	0.17	0.62	Log normal
34	Cyclohexane	110827	87%	0.35-0.35	46.67%	0.17	7.46	0.81	0.34	1.53	1.39	Log normal
40	Methyl Methacrylate	80626	47%	0.41-0.41	70.00%	0.20	2.49	0.48	0.20	0.55	0.72	Log normal
42	Methyl Isobutyl Ketone	108101	67%	0.41-0.41	50.00%	0.21	6.56	0.88	0.33	1.28	1.68	Log normal
43	Methyl Cyclohexane	108872	80%	0.41-0.41	43.33%	0.20	19.94	1.57	0.56	3.96	2.52	Log normal
47	Toluene	108883	100%	0.38-0.38	0.00%	0.94	56.70	12.12	8.50	11.72	19.66	Log normal
56	Ethylbenzene	100414	87%	0.44-0.44	30.00%	0.22	3.65	0.75	0.61	0.69	1.06	Log normal

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
57	(m and /or p) Xylene	108383/ 106423	97%	0.44-0.44	3.33%	0.22	11.51	2.53	1.97	2.21	3.69	Log normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	87%	0.44-0.44	33.33%	0.22	2.56	0.71	0.54	0.56	0.99	Log normal
72	1,2,4-Trimethylbenzene	95636	80%	0.50-0.50	50.00%	0.25	2.56	0.66	0.39	0.61	1.03	Log normal

Table 3-3. Summary statistics for COPCs from Site A 2003.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.78	504.95	36.10	10.02	94.22	87.05	Log normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	1.88	5.69	2.99	2.92	0.61	3.21	Log normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.52	2.71	1.37	1.35	0.41	1.41	Normal
6	Vinyl Chloride	75014	50%	0.26-0.26	74.29%	0.13	2.84	0.36	0.13	0.56	0.48	Log normal
7	1,3- Butadiene	106990	94%	0.22-0.22	17.14%	0.11	14.63	3.39	1.56	4.28	9.15	Log normal
10	Acetone	67641	100%	0.24-0.24	0.00%	1.79	157.20	32.50	17.97	35.11	65.01	Log normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.12	3.20	1.68	1.60	0.36	1.78	Log normal
12	Acrylonitrile	107131	59%	0.22-0.22	40.00%	0.11	4.88	0.85	0.30	1.12	1.82	Log normal
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.35	1.01	0.53	0.49	0.15	0.58	Log normal
15	Methyl Acetate	79209	82%	0.31-0.31	51.43%	0.15	1.18	0.36	0.23	0.28	0.49	Log normal
17	Carbon Disulfide	75150	79%	0.31-0.31	62.86%	0.16	2.61	0.53	0.16	0.63	0.70	Log normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	94%	0.30-0.30	8.57%	0.15	175.73	14.30	5.94	32.28	49.83	Log normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	74%	0.37-0.37	37.14%	0.18	9.05	1.94	0.85	2.33	4.38	Log normal
25	Hexane	110543	100%	0.36-0.36	8.57%	0.18	12.88	3.65	2.89	3.17	7.07	Log normal
26	Chloroform	67663	82%	0.49-0.49	57.14%	0.24	1.07	0.46	0.24	0.27	0.54	Normal
32	Benzene	71432	100%	0.32-0.32	0.00%	0.32	5.90	1.50	1.21	1.08	1.90	Log normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	25.71%	0.31	0.69	0.56	0.63	0.15	0.69	Log normal/ Maximum
34	Cyclohexane	110827	82%	0.35-0.35	48.57%	0.17	3.51	0.70	0.40	0.77	1.05	Log normal
40	Methyl Methacrylate	80626	41%	0.41-0.41	74.29%	0.20	2.41	0.42	0.20	0.48	0.54	Log normal
42	Methyl Isobutyl Ketone	108101	62%	0.41-0.41	54.29%	0.21	9.27	1.41	0.21	2.22	2.52	Log normal
43	Methyl Cyclohexane	108872	79%	0.41-0.41	42.86%	0.20	18.29	1.90	0.78	3.29	3.50	Log normal
47	Toluene	108883	100%	0.38-0.38	0.00%	0.64	68.54	17.33	10.84	17.63	38.37	Log normal
56	Ethylbenzene	100414	85%	0.44-0.44	34.29%	0.22	3.30	0.76	0.48	0.77	1.03	Log normal
57	(m and /or p) Xylene	108383/ 106423	97%	0.44-0.44	11.43%	0.22	17.68	3.79	2.41	4.29	7.23	Log normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	85%	0.44-0.44	37.14%	0.22	3.39	0.83	0.56	0.85	1.15	Log normal
72	1,2,4-Trimethylbenzene	95636	68%	0.50-0.50	60.00%	0.25	2.66	0.55	0.25	0.56	0.70	Log normal

Table 3-4. Summary statistics for COPCs from Site A 2004.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.74	70.45	17.32	7.82	20.58	41.99	Log normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.33	3.66	2.92	2.92	0.34	3.03	Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.77	2.05	1.17	1.12	0.26	1.25	Log normal
6	Vinyl Chloride	75014	31%	0.26-0.26	86.21%	0.13	2.61	0.24	0.13	0.46	0.27	Log normal
7	1,3- Butadiene	106990	76%	0.22-0.22	31.03%	0.11	11.67	1.62	0.35	2.69	3.92	Log normal
10	Acetone	67641	100%	0.24-0.24	0.00%	1.36	103.55	17.32	8.47	22.09	28.52	Log normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.18	1.97	1.62	1.57	0.21	1.68	Normal
12	Acrylonitrile	107131	41%	0.22-0.22	72.41%	0.11	3.62	0.47	0.11	0.90	0.62	Log normal
14	Methylene Chloride	75092	100%	0.35-0.35	17.24%	0.17	1.18	0.47	0.42	0.23	0.56	Log normal
15	Methyl Acetate	79209	48%	0.31-0.31	86.21%	0.15	0.52	0.18	0.15	0.09	0.20	Log normal
17	Carbon Disulfide	75150	83%	0.31-0.31	51.72%	0.16	4.70	0.68	0.16	0.97	1.04	Log normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	93%	0.30-0.30	6.90%	0.15	48.41	8.57	4.57	11.64	29.76	Log normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	55%	0.37-0.37	51.72%	0.18	27.44	2.50	0.18	5.30	6.29	Log normal
25	Hexane	110543	100%	0.36-0.36	3.45%	0.18	25.49	4.84	1.94	5.83	9.77	Log normal
26	Chloroform	67663	59%	0.49-0.49	62.07%	0.24	1.81	0.54	0.24	0.47	0.71	Log normal
32	Benzene	71432	100%	0.32-0.32	0.00%	0.41	12.95	2.03	1.21	2.44	2.70	Log normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	48.28%	0.31	0.69	0.49	0.63	0.17	0.69	Log normal/ Maximum
34	Cyclohexane	110827	76%	0.35-0.35	48.28%	0.17	5.13	0.81	0.34	1.07	1.29	Log normal
40	Methyl Methacrylate	80626	41%	0.41-0.41	65.52%	0.20	6.05	0.68	0.20	1.19	0.92	Log normal
42	Methyl Isobutyl Ketone	108101	59%	0.41-0.41	51.72%	0.21	17.34	1.75	0.21	3.45	3.41	Log normal
43	Methyl Cyclohexane	108872	72%	0.41-0.41	41.38%	0.20	13.23	2.18	1.05	2.87	5.39	Log normal
47	Toluene	108883	100%	0.38-0.38	0.00%	0.45	44.41	13.87	7.35	13.90	41.92	Log normal
56	Ethylbenzene	100414	79%	0.44-0.44	37.93%	0.22	6.03	1.11	0.61	1.33	1.74	Log normal
57	(m and /or p) Xylene	108383/ 106423	97%	0.44-0.44	13.79%	0.22	18.24	3.96	2.58	4.19	9.00	Log normal
60	Styrene	100425	34%	0.43-0.43	89.66%	0.21	0.47	0.24	0.21	0.07	0.27	Log normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	79%	0.44-0.44	41.38%	0.22	3.99	0.92	0.56	0.96	1.39	Log normal
70	1,3,5-Trimethylbenzene	108678	41%	0.50-0.50	89.66%	0.25	1.03	0.30	0.25	0.18	0.37	Log normal

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
72	1,2,4-Trimethylbenzene	95636	69%	0.50-0.50	58.62%	0.25	2.51	0.64	0.25	0.61	0.92	Log normal

Table 3-5. Summary statistics for COPCs from Site A 2005.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.46	38.90	8.12	4.25	9.18	14.84	Log normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	3.23%	0.25	7.52	3.01	2.97	1.01	3.52	Log normal
4	Chloromethane	74873	100%	0.21-0.21	3.23%	0.10	2.69	1.32	1.30	0.42	1.60	Log normal
6	Vinyl Chloride	75014	45%	0.26-0.26	61.29%	0.13	15.74	0.93	0.13	2.86	0.95	Log normal
7	1,3- Butadiene	106990	81%	0.22-0.22	25.81%	0.11	10.36	2.32	1.75	2.57	7.81	Log normal
10	Acetone	67641	100%	0.24-0.24	0.00%	0.62	130.76	23.64	10.81	28.88	43.34	Log normal
11	Freon 11 (Cl3Fmethane)	75694	97%	0.57-0.57	3.23%	0.28	2.14	1.60	1.57	0.32	1.82	Log normal
12	Acrylonitrile	107131	45%	0.22-0.22	61.29%	0.11	5.64	0.66	0.11	1.26	1.01	Log normal
14	Methylene Chloride	75092	100%	0.35-0.35	3.23%	0.17	1.56	0.65	0.56	0.32	0.74	Log normal
15	Methyl Acetate	79209	71%	0.31-0.31	61.29%	0.15	1.00	0.29	0.15	0.23	0.38	Log normal
17	Carbon Disulfide	75150	81%	0.31-0.31	58.06%	0.16	2.95	0.44	0.16	0.60	0.57	Log normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	97%	0.30-0.30	6.45%	0.15	45.31	9.37	3.66	12.89	30.84	Log normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	74%	0.37-0.37	32.26%	0.18	11.33	1.88	0.94	2.56	3.96	Log normal
25	Hexane	110543	100%	0.36-0.36	9.68%	0.18	27.32	3.88	2.01	5.24	7.37	Log normal
26	Chloroform	67663	68%	0.49-0.49	61.29%	0.24	2.73	0.56	0.24	0.60	0.71	Log normal
32	Benzene	71432	100%	0.32-0.32	3.23%	0.16	4.75	1.67	1.37	1.21	2.30	Log normal
33	Carbon Tetrachloride	56235	97%	0.64-0.64	32.26%	0.31	0.82	0.55	0.63	0.17	0.66	Log normal
34	Cyclohexane	110827	74%	0.35-0.35	54.84%	0.17	2.65	0.51	0.17	0.57	0.69	Log normal
40	Methyl Methacrylate	80626	26%	0.41-0.41	77.42%	0.20	3.19	0.40	0.20	0.56	0.47	Log normal
42	Methyl Isobutyl Ketone	108101	58%	0.41-0.41	51.61%	0.21	4.39	0.84	0.21	0.97	1.29	Log normal
43	Methyl Cyclohexane	108872	81%	0.41-0.41	32.26%	0.20	9.53	1.84	0.72	2.45	3.53	Log normal
47	Toluene	108883	100%	0.38-0.38	3.23%	0.19	63.83	13.13	6.64	16.10	34.78	Log normal
56	Ethylbenzene	100414	84%	0.44-0.44	29.03%	0.22	3.39	0.92	0.52	0.90	1.33	Log normal
57	(m and /or p) Xylene	108383/ 106423	97%	0.44-0.44	9.68%	0.22	11.20	3.28	2.01	3.25	6.49	Log normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	84%	0.44-0.44	41.94%	0.22	2.78	0.72	0.48	0.68	1.01	Log normal
72	1,2,4-Trimethylbenzene	95636	65%	0.50-0.50	64.52%	0.25	2.02	0.50	0.25	0.45	0.65	Log normal

3.4 Exposure Assessment for Ralph Avenue/Campground Road: Site C

3.4.1 Summary statistics of COPCs from 2001 for Site C

There were 27 COPCs selected for this monitoring year (Table 3-6).

The COPCs with the highest median concentrations were acetone (6.15 μg/m^3) and toluene (8.88 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (15.42 μg/m^3), acetone (7.83 μg/m^3), methyl t-butyl ether (17.44 μg/m^3), chloroprene (14.28 μg/m^3), toluene (12.52 μg/m^3), and (m- and/or p-) xylene (8.23 μg/m^3).

The 95% UCL was not calculated for this data set because of the limited number of sampling dates. This calculation would have been unreliable as a representation of the full year.

3.4.2 Summary statistics of COPCs from 2002 for Site C

There were 28 COPCs selected for this monitoring year (Table 3-7).

The COPCs with the highest median concentrations were Freon 22 (14.14 μg/m^3), acetone (6.95 μg/m^3), and toluene (12.87 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (772.07 μg/m^3), Freon 12 (13.66 μg/m^3), 1,3-butadiene (62.00 μg/m^3), acetone (11.32 μg/m^3), Freon 11 (9.84 μg/m^3), carbon disulfide (6.06 μg/m^3), methyl t-butyl ether (7.44 μg/m^3), chloroprene (75.66 μg/m^3), chloroform (8.32 μg/m^3), methyl methacrylate (32.84 μg/m^3), toluene (120.79 μg/m^3), and (m- and/or p-) xylene (5.69 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 2 COPCs (acetone and methyl ethyl ketone) that were normally distributed. The highest 95% UCL concentrations were for Freon 22 (166.08 μg/m^3), 1,3-butadiene (21.63 μg/m^3), acetone (7.78 μg/m^3), methyl t-butyl ether (3.96 μg/m^3), chloroprene (59.28 μg/m^3), methyl methacrylate (26.24 μg/m^3), and toluene (30.56 μg/m^3).

3.4.3 Summary statistics of COPCs from 2003 for Site C

There were 24 COPCs selected for this monitoring year (Table 3-8).

The COPCs with the highest median concentrations were Freon 22 (5.78 μg/m^3), acetone (8.69 μg/m^3), and toluene (10.80 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (184.89 μg/m^3), 1,3-butadiene (34.37 μg/m^3), acetone (14.54 μg/m^3), methylene chloride (8.31 μg/m^3), carbon disulfide (5.02 μg/m^3), chloroprene (28.53 μg/m^3), hexane (6.35 μg/m^3), chloroform (7.81 μg/m^3), methyl methacrylate (78.65 μg/m^3), and toluene (58.17 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 5 COPCs (Freon 12, chloromethane, acetone, Freon 11, and methyl acetate) that were normally distributed. The highest 95% UCL concentrations were for Freon 22 (103.17 μg/m^3), 1,3-butadiene (19.50 μg/m^3), acetone (9.16 μg/m^3), chloroprene (23.55 μg/m^3), methyl methacrylate (13.93 μg/m^3), and toluene (29.91 μg/m^3).

3.4.4 Summary statistics of COPCs from 2004 for Site C

There were 24 COPCs selected for this monitoring year (Table 3-9).

The COPCs with the highest median concentrations were acetone (7.20 μg/m^3) and toluene (8.46 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (102.22 μg/m^3), 1,3-butadiene (27.06 μg/m^3), acetone (11.31 μg/m^3), carbon disulfide (8.35 μg/m^3), chloroprene (55.30 μg/m^3), chloroform (9.56), methyl methacrylate (29.10 μg/m^3), and toluene (57.83).

The 95% UCL was derived from log transformed data for the most part, with the exception of 4 COPCs (Freon 12, chloromethane, acetone, and methyl ethyl ketone) that were normally distributed. The highest 95% UCL concentrations were for Freon 22 (39.48 μg/m^3), 1,3-butadiene (11.94 μg/m^3), acetone (7.55 μg/m^3), chloroprene (55.30 μg/m^3), methyl methacrylate (24.03 μg/m^3), and toluene (23.38 μg/m^3).

3.4.5 Summary statistics of COPCs from 2005 for Site C

There were 22 COPCs selected for this monitoring year (Table 3-10).

The COPCs with the highest median concentrations were acetone (8.53 μg/m^3) and toluene (9.39 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (136.11 μg/m^3), Freon 12 (5.49 μg/m^3), 1,3-butadiene (62.93 μg/m^3), acetone (25.57 μg/m^3), carbon disulfide (5.21 μg/m^3), methyl ethyl ketone (15.59 μg/m^3), chloroprene (42.32 μg/m^3), hexane (6.74 μg/m^3), methyl methacrylate (5.66 μg/m^3), and toluene (61.70 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 4 COPCs (Freon 12, chloromethane, acetone, and methyl ethyl ketone) that were normally distributed. The highest 95% UCL concentrations were for Freon 22 (40.01 μg/m^3), 1,3-butadiene (45.66 μg/m^3), acetone (10.01 μg/m^3), chloroprene (42.32 μg/m^3), and toluene (25.22 μg/m^3).

Table 3-6. Summary statistics for COPCs from Site C 2001.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	2.58	15.42	7.24	3.72	7.10	N/A	
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	3.12	3.42	3.25	3.22	0.15	N/A	
4	Chloromethane	74873	100%	0.21-0.21	0.00%	1.14	1.26	1.19	1.16	0.07	N/A	
7	1,3- Butadiene	106990	100%	0.22-0.22	0.00%	0.38	1.15	0.67	0.49	0.42	N/A	
10	Acetone	67641	100%	0.24-0.24	33.33%	0.12	7.83	4.70	6.15	4.06	N/A	
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.41	1.77	1.55	1.46	0.20	N/A	
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.38	0.49	0.44	0.45	0.05	N/A	
15	Methyl Acetate	79209	67%	0.31-0.31	66.67%	0.15	0.36	0.25	0.23	0.11	N/A	
17	Carbon Disulfide	75150	67%	0.31-0.31	33.33%	0.16	0.68	0.43	0.45	0.26	N/A	
20	Methyl T-Butyl Ether (MTBE)	1634044	100%	0.36-0.36	33.33%	0.18	17.44	7.09	3.66	9.12	N/A	
21	Methyl Ethyl Ketone (2-Butanone)	78933	100%	0.30-0.30	0.00%	0.77	2.17	1.31	1.00	0.75	N/A	
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	100%	0.37-0.37	0.00%	0.62	14.28	5.50	1.59	7.62	N/A	
25	Hexane	110543	100%	0.36-0.36	0.00%	0.81	5.72	2.82	1.94	2.57	N/A	
26	Chloroform	67663	67%	0.49-0.49	66.67%	0.24	2.78	1.09	0.24	1.47	N/A	
32	Benzene	71432	100%	0.32-0.32	0.00%	0.83	4.47	2.36	1.79	1.89	N/A	
34	Cyclohexane	110827	100%	0.35-0.35	33.33%	0.17	0.72	0.39	0.28	0.29	N/A	
40	Methyl Methacrylate	80626	67%	0.41-0.41	33.33%	0.20	0.92	0.59	0.65	0.36	N/A	
43	Methyl Cyclohexane	108872	67%	0.41-0.41	66.67%	0.20	0.92	0.44	0.20	0.42	N/A	
47	Toluene	108883	100%	0.38-0.38	0.00%	3.20	12.52	8.20	8.88	4.69	N/A	
56	Ethylbenzene	100414	100%	0.44-0.44	33.33%	0.22	2.26	1.06	0.72	1.06	N/A	
57	(m and /or p) Xylene	108383/ 106423	100%	0.44-0.44	0.00%	0.74	8.23	3.77	2.34	3.94	N/A	
60	Styrene	100425	67%	0.43-0.43	66.67%	0.21	0.55	0.33	0.21	0.20	N/A	
62	o-Xylene (1,2-Dimethyl Benzene)	95476	100%	0.44-0.44	33.33%	0.22	2.86	1.35	0.98	1.36	N/A	
68	n-Propylbenzene	103651	67%	0.50-0.50	66.67%	0.25	0.49	0.33	0.25	0.14	N/A	
70	1,3,5-Trimethylbenzene	108678	100%	0.50-0.50	33.33%	0.25	0.74	0.54	0.64	0.26	N/A	
72	1,2,4-Trimethylbenzene	95636	100%	0.50-0.50	33.33%	0.25	2.95	1.85	2.34	1.42	N/A	
81	Naphthalene	91203	67%	0.53-0.53	66.67%	0.26	0.52	0.35	0.26	0.15	N/A	

Table 3-7. Summary statistics for COPCs from Site C 2002.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL ($\mu g/m^3$)	% Samples < SQL	Min. Conc. ($\mu g/m^3$)	Max. Conc. ($\mu g/m^3$)	Arithmetic Mean ($\mu g/m^3$)	Median Conc. ($\mu g/m^3$)	Standard Deviation ($\mu g/m^3$)	95% UCL ($\mu g/m^3$)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	1.04	772.07	51.53	14.14	141.55	166.08	Log normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.26	13.66	3.20	2.92	1.96	3.43	Log normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.90	3.26	1.35	1.28	0.38	1.43	Log normal
6	Vinyl Chloride	75014	26%	0.26-0.26	87.10%	0.13	2.51	0.23	0.13	0.43	0.24	Log normal
7	1,3- Butadiene	106990	97%	0.22-0.22	6.45%	0.11	62.00	6.48	2.55	11.92	21.63	Log normal
10	Acetone	67641	100%	0.24-0.24	0.00%	3.18	11.32	6.98	6.95	2.64	7.78	Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.22	9.84	1.83	1.57	1.50	1.97	Log normal
12	Acrylonitrile	107131	65%	0.22-0.22	45.16%	0.11	1.95	0.46	0.28	0.50	0.70	Log normal
14	Methylene Chloride	75092	97%	0.35-0.35	6.45%	0.17	1.41	0.50	0.47	0.21	0.57	Log normal
15	Methyl Acetate	79209	74%	0.31-0.31	35.48%	0.15	1.14	0.37	0.38	0.24	0.48	Log normal
17	Carbon Disulfide	75150	77%	0.31-0.31	45.16%	0.16	6.06	0.93	0.53	1.25	1.44	Log normal
20	Methyl T-Butyl Ether (MTBE)	1634044	90%	0.36-0.36	12.90%	0.18	7.44	2.15	1.50	2.11	3.96	Log normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	100%	0.30-0.30	0.00%	0.41	2.35	1.23	1.03	0.56	1.40	Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	74%	0.37-0.37	29.03%	0.18	75.66	9.10	2.61	15.73	59.28	Log normal
25	Hexane	110543	97%	0.36-0.36	6.45%	0.18	4.34	1.22	0.90	0.94	1.64	Log normal
26	Chloroform	67663	68%	0.49-0.49	48.39%	0.24	8.32	1.09	0.41	1.72	1.58	Log normal
32	Benzene	71432	100%	0.32-0.32	0.00%	0.53	4.61	1.24	1.00	0.78	1.44	Log normal
33	Carbon Tetrachloride	56235	71%	0.64-0.64	61.29%	0.31	3.59	0.56	0.47	0.58	0.70	Log normal
37	Ethyl Acrylate	140885	32%	0.41-0.41	77.42%	0.20	1.47	0.37	0.20	0.34	0.46	Log normal
40	Methyl Methacrylate	80626	74%	0.41-0.41	29.03%	0.20	32.84	6.10	2.33	8.37	26.24	Log normal
47	Toluene	108883	100%	0.38-0.38	0.00%	1.68	120.79	19.23	12.87	22.24	30.56	Log normal
48	1,3-Dichloropropane	142289	35%	0.47-0.47	83.87%	0.23	1.39	0.29	0.23	0.21	0.32	Log normal
56	Ethylbenzene	100414	55%	0.44-0.44	74.19%	0.22	1.65	0.34	0.22	0.28	0.42	Log normal
57	(m and /or p) Xylene	108383/ 106423	97%	0.44-0.44	6.45%	0.22	5.69	1.22	1.01	1.01	1.58	Log normal
60	Styrene	100425	68%	0.43-0.43	51.61%	0.21	1.70	0.46	0.21	0.39	0.60	Log normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	68%	0.44-0.44	48.39%	0.22	1.78	0.46	0.43	0.34	0.60	Log normal
70	1,3,5-Trimethylbenzene	108678	29%	0.50-0.50	80.65%	0.25	1.13	0.33	0.25	0.20	0.38	Log normal

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
72	1,2,4-Trimethylbenzene	95636	71%	0.50-0.50	38.71%	0.25	3.94	0.92	0.52	0.90	1.40	Log normal

Table 3-8. Summary statistics for COPCs from Site C 2003.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.89	184.89	31.78	5.78	50.45	103.17	Log normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.60	3.56	3.08	3.07	0.25	3.14	Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	1.05	2.12	1.39	1.37	0.24	1.45	Normal
6	Vinyl Chloride	75014	25%	0.26-0.26	86.11%	0.13	0.93	0.19	0.13	0.19	0.23	Log normal
7	1,3- Butadiene	106990	97%	0.22-0.22	5.56%	0.11	34.37	7.06	1.92	10.21	19.50	Log normal
10	Acetone	67641	100%	0.24-0.24	0.00%	1.55	14.54	8.37	8.69	3.27	9.16	Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.41	2.30	1.68	1.63	0.19	1.73	Normal
12	Acrylonitrile	107131	67%	0.22-0.22	41.67%	0.11	1.76	0.32	0.22	0.32	0.41	Log normal
14	Methylene Chloride	75092	100%	0.35-0.35	2.78%	0.31	8.31	0.77	0.53	1.30	0.78	Log normal
15	Methyl Acetate	79209	97%	0.31-0.31	58.33%	0.15	0.56	0.24	0.15	0.11	0.30	Normal
17	Carbon Disulfide	75150	86%	0.31-0.31	41.67%	0.16	5.02	0.94	0.59	1.06	1.62	Log normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	97%	0.30-0.30	2.78%	0.15	4.07	1.14	0.91	0.83	1.48	Log normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	75%	0.37-0.37	30.56%	0.18	28.53	5.03	2.43	6.77	23.55	Log normal
25	Hexane	110543	100%	0.36-0.36	11.11%	0.18	6.35	1.34	0.97	1.23	1.86	Log normal
26	Chloroform	67663	92%	0.49-0.49	33.33%	0.24	7.81	1.16	0.83	1.40	1.69	Log normal
32	Benzene	71432	100%	0.32-0.32	5.56%	0.16	3.84	1.01	0.91	0.64	1.19	Log normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	19.44%	0.31	0.82	0.61	0.64	0.14	0.67	Log normal
37	Ethyl Acrylate	140885	22%	0.41-0.41	86.11%	0.20	1.39	0.27	0.20	0.22	0.30	Log normal
40	Methyl Methacrylate	80626	81%	0.41-0.41	30.56%	0.20	78.65	7.46	1.00	18.39	13.93	Log normal
47	Toluene	108883	100%	0.38-0.38	0.00%	0.45	58.17	16.11	10.80	15.43	29.91	Log normal
57	(m and /or p) Xylene	108383/ 106423	94%	0.44-0.44	33.33%	0.22	3.41	0.78	0.49	0.72	1.05	Log normal
60	Styrene	100425	58%	0.43-0.43	88.89%	0.21	1.38	0.27	0.21	0.20	0.32	Log normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	67%	0.44-0.44	77.78%	0.22	1.13	0.34	0.22	0.25	0.42	Log normal
72	1,2,4-Trimethylbenzene	95636	56%	0.50-0.50	61.11%	0.25	3.52	0.70	0.25	0.78	0.94	Log normal

Table 3-9. Summary statistics for COPCs from Site C 2004.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.97	102.22	15.29	2.92	22.07	39.48	Log normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.23	4.08	3.05	3.04	0.36	3.16	Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.85	1.81	1.25	1.20	0.24	1.33	Normal
7	1,3- Butadiene	106990	100%	0.22-0.22	13.79%	0.11	27.06	4.11	0.63	7.00	11.94	Log normal
10	Acetone	67641	100%	0.24-0.24	0.00%	2.39	11.31	6.88	7.20	2.13	7.55	Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.24	2.02	1.68	1.66	0.17	1.74	Log normal
12	Acrylonitrile	107131	52%	0.22-0.22	68.97%	0.11	0.91	0.22	0.11	0.20	0.29	Log normal
14	Methylene Chloride	75092	100%	0.35-0.35	6.90%	0.26	0.82	0.50	0.49	0.14	0.55	Log normal
15	Methyl Acetate	79209	93%	0.31-0.31	82.76%	0.15	0.97	0.24	0.15	0.22	0.32	Log normal
16	Freon 113 (Cl3F3Ethane)	76131	100%	0.77-0.77	89.66%	0.38	0.77	0.46	0.38	0.12	0.81	Log normal
17	Carbon Disulfide	75150	79%	0.31-0.31	48.28%	0.16	8.35	1.28	0.23	2.09	2.36	Log normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	97%	0.30-0.30	3.45%	0.15	2.12	0.92	0.75	0.53	1.09	Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	72%	0.37-0.37	31.03%	0.18	55.30	11.93	2.21	16.99	55.30	Log normal/ Maximum
25	Hexane	110543	97%	0.36-0.36	13.79%	0.18	3.55	1.01	0.69	0.83	1.46	Log normal
26	Chloroform	67663	76%	0.49-0.49	51.72%	0.24	9.56	1.24	0.24	1.92	1.96	Log normal
32	Benzene	71432	100%	0.32-0.32	3.45%	0.24	1.91	0.88	0.80	0.47	1.08	Log normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	20.69%	0.31	0.79	0.61	0.63	0.12	0.79	Log normal/ Maximum
40	Methyl Methacrylate	80626	79%	0.41-0.41	37.93%	0.20	29.10	5.57	0.80	8.51	24.03	Log normal
47	Toluene	108883	100%	0.38-0.38	0.00%	0.62	57.83	11.97	8.46	12.91	23.38	Log normal
56	Ethylbenzene	100414	48%	0.44-0.44	82.76%	0.22	0.76	0.28	0.22	0.15	0.34	Log normal
57	(m and /or p) Xylene	108383/ 106423	93%	0.44-0.44	41.38%	0.22	2.54	0.74	0.57	0.65	1.07	Log normal
60	Styrene	100425	55%	0.43-0.43	75.86%	0.21	2.41	0.49	0.21	0.61	0.64	Log normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	55%	0.44-0.44	68.97%	0.22	0.95	0.34	0.22	0.20	0.40	Log normal
72	1,2,4-Trimethylbenzene	95636	52%	0.50-0.50	72.41%	0.25	1.65	0.48	0.25	0.43	0.65	Log normal

Table 3-10. Summary statistics for COPCs from Site C 2005.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.99	136.11	18.53	4.50	30.53	40.01	Log normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.10	5.49	3.15	3.13	0.54	3.32	Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.65	2.01	1.29	1.29	0.23	1.36	Normal
7	1,3- Butadiene	106990	90%	0.22-0.22	13.33%	0.11	62.93	8.36	1.60	13.55	45.66	Log normal
10	Acetone	67641	100%	0.24-0.24	0.00%	3.31	25.57	8.75	8.53	4.05	10.01	Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.24	2.05	1.66	1.67	0.18	1.72	Log normal
12	Acrylonitrile	107131	33%	0.22-0.22	73.33%	0.11	0.38	0.15	0.11	0.08	0.18	Log normal
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.36	0.95	0.56	0.54	0.12	0.59	Log normal
15	Methyl Acetate	79209	80%	0.31-0.31	60.00%	0.15	0.59	0.25	0.15	0.13	0.32	Log normal
17	Carbon Disulfide	75150	80%	0.31-0.31	50.00%	0.16	5.21	0.79	0.24	1.44	1.05	Log normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	97%	0.30-0.30	6.67%	0.15	15.59	1.81	1.25	2.70	2.65	Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	70%	0.37-0.37	30.00%	0.18	42.32	8.64	2.85	11.34	42.32	Log normal/ Maximum
25	Hexane	110543	100%	0.36-0.36	6.67%	0.18	6.74	1.48	0.99	1.42	2.06	Log normal
26	Chloroform	67663	87%	0.49-0.49	43.33%	0.24	3.12	0.77	0.50	0.80	1.07	Log normal
32	Benzene	71432	100%	0.32-0.32	0.00%	0.38	3.35	1.11	1.00	0.70	1.37	Log normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	6.67%	0.31	2.20	0.77	0.66	0.37	0.87	Log normal
40	Methyl Methacrylate	80626	73%	0.41-0.41	50.00%	0.20	5.66	1.02	0.36	1.46	1.59	Log normal
47	Toluene	108883	100%	0.38-0.38	0.00%	0.92	61.70	15.39	9.39	15.87	25.22	Log normal
57	(m and /or p) Xylene	108383/ 106423	97%	0.44-0.44	33.33%	0.22	2.78	0.78	0.58	0.65	1.07	Log normal
60	Styrene	100425	43%	0.43-0.43	73.33%	0.21	1.68	0.36	0.21	0.31	0.43	Log normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	53%	0.44-0.44	80.00%	0.22	0.89	0.30	0.22	0.16	0.37	Log normal
72	1,2,4-Trimethylbenzene	95636	50%	0.50-0.50	70.00%	0.25	1.43	0.41	0.25	0.28	0.50	Log normal

3.5 Exposure Assessment for University of Louisville Shelby Campus: Site E

3.5.1 Summary statistics of COPCs from 2001 for Site E

There were 16 COPCs selected for this monitoring year (Table 3-11).

The COPCs with the highest median concentrations were Freon 22 (2.67 μg/m^3), Freon 12 (2.95 μg/m^3), acetone (2.94 μg/m^3), and toluene (2.13 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (2.94 μg/m^3), Freon 12 (3.12 μg/m^3), acetone (5.76 μg/m^3), and toluene (2.64 μg/m^3).

The 95% UCL was not calculated for this data set because of the limited number of sampling dates. This calculation would have been unreliable as a representation of the full year.

3.5.2 Summary statistics of COPCs from 2002 for Site E

There were 22 COPCs selected for this monitoring year (Table 3-12).

The COPCs with the highest median concentrations were Freon 22 (2.12 μg/m^3), Freon 12 (2.95 μg/m^3), and acetone (5.76 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (13.91 μg/m^3), Freon 12 (4.60 μg/m^3), acetone (12.85 μg/m^3), and toluene (3.69 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 3 COPCs (chloromethane, acetone, and methyl ethyl ketone) that were normally distributed. The highest 95% UCL concentrations were for Freon 22 (3.57 μg/m^3), Freon 12 (3.19 μg/m^3), and acetone (6.55 μg/m^3).

3.5.3 Summary statistics of COPCs from 2003 for Site E

There were 15 COPCs selected for this monitoring year (Table 3-13).

The COPCs with the highest median concentrations were Freon 12 (3.07 μg/m^3) and acetone (4.87 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (3.43 μg/m^3), Freon 12 (3.91 μg/m^3), chloromethane (2.19 μg/m^3), acetone (24.51 μg/m^3), Freon 11 (2.75 μg/m^3), methyl acetate (12.06 μg/m^3), and toluene (2.22 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 2 COPCs (Freon 12 and chloromethane) that were normally distributed. The highest 95% UCL concentrations were Freon 12 (3.20 μg/m^3) and acetone (7.43 μg/m^3).

3.5.4 Summary statistics of COPCs from 2004 for Site E

There were 20 COPCs selected for this monitoring year (Table 3-14).

The COPCs with the highest median concentrations were Freon 22 (2.19 μg/m^3), Freon 12 (2.97 μg/m^3), and acetone (6.47 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (12.32 μg/m^3), Freon 12 (8.27 μg/m^3), chloromethane (3.33 μg/m^3), acetone (38.75 μg/m^3), Freon 11 (4.38 μg/m^3), methyl acetate (4.39 μg/m^3), carbon disulfide (4.39 μg/m^3), methyl ethyl ketone (4.96 μg/m^3), and toluene (3.58 μg/m^3).

The 95% UCL was derived from log transformed data. The highest 95% UCL concentrations were for Freon 22 (3.69 μg/m^3), Freon 12 (4.00 μg/m^3), and acetone (10.41 μg/m^3).

3.5.5 Summary statistics of COPCs from 2005 for Site E

There were 15 COPCs selected for this monitoring year (Table 3-15).

The COPCs with the highest median concentrations were Freon 12 (3.07 μg/m^3) and acetone (9.12 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (6.12 μg/m^3), Freon 12 (8.17 μg/m^3), chloromethane (3.19 μg/m^3), acetone (46.58 μg/m^3), carbon disulfide (3.83 μg/m^3), methyl ethyl ketone (32.39 μg/m^3), and toluene (4.83 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 2 COPCs (hexane and benzene) that were normally distributed. The highest 95% UCL concentrations were for Freon 12 (3.43 μg/m^3), acetone (12.36 μg/m^3), and methyl ethyl ketone (3.51 μg/m^3).

Table 3-11. Summary statistics for COPCs from Site E 2001.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	2.41	2.94	2.67	2.67	0.38	N/A	
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.77	3.12	2.95	2.95	0.25	N/A	
4	Chloromethane	74873	100%	0.21-0.21	0.00%	1.24	1.41	1.32	1.32	0.12	N/A	
10	Acetone	67641	50%	0.24-0.24	50.00%	0.12	5.76	2.94	2.94	3.99	N/A	
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.46	1.80	1.63	1.63	0.24	N/A	
12	Acrylonitrile	107131	50%	0.22-0.22	50.00%	0.11	0.24	0.17	0.17	0.09	N/A	
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.49	0.66	0.57	0.57	0.12	N/A	
20	Methyl T-Butyl Ether (MTBE)	1634044	100%	0.36-0.36	0.00%	0.51	1.05	0.78	0.78	0.38	N/A	
21	Methyl Ethyl Ketone (2-Butanone)	78933	100%	0.30-0.30	0.00%	0.77	0.83	0.80	0.80	0.04	N/A	
25	Hexane	110543	100%	0.36-0.36	0.00%	0.64	0.92	0.78	0.78	0.20	N/A	
32	Benzene	71432	100%	0.32-0.32	0.00%	0.96	1.44	1.20	1.20	0.34	N/A	
47	Toluene	108883	100%	0.38-0.38	0.00%	1.62	2.64	2.13	2.13	0.72	N/A	
56	Ethylbenzene	100414	50%	0.44-0.44	50.00%	0.22	0.61	0.41	0.41	0.28	N/A	
57	(m and /or p) Xylene	108383/ 106423	100%	0.44-0.44	0.00%	0.83	1.93	1.38	1.38	0.77	N/A	
62	o-Xylene (1,2-Dimethyl Benzene)	95476	50%	0.44-0.44	50.00%	0.22	0.69	0.46	0.46	0.34	N/A	
72	1,2,4-Trimethylbenzene	95636	100%	0.50-0.50	0.00%	0.64	0.79	0.71	0.71	0.10	N/A	

Table 3-12. Summary statistics for COPCs from Site E 2002.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	96%	0.36-0.36	3.57%	0.18	13.91	2.54	2.12	2.48	3.57	Log normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.43	4.60	3.05	2.95	0.44	3.19	Log normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.81	2.11	1.37	1.30	0.28	1.46	Normal
7	1,3- Butadiene	106990	43%	0.22-0.22	78.57%	0.11	0.82	0.19	0.11	0.17	0.23	Log normal
10	Acetone	67641	96%	0.24-0.24	3.57%	0.12	12.85	5.66	5.76	2.77	6.55	Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.12	2.36	1.59	1.57	0.24	1.67	Log normal
12	Acrylonitrile	107131	25%	0.22-0.22	89.29%	0.11	0.28	0.12	0.11	0.04	0.14	Log normal
14	Methylene Chloride	75092	89%	0.35-0.35	17.86%	0.17	1.11	0.43	0.42	0.19	0.51	Log normal
15	Methyl Acetate	79209	39%	0.31-0.31	78.57%	0.15	0.58	0.21	0.15	0.12	0.24	Log normal
16	Freon 113 (Cl3F3Ethane)	76131	68%	0.77-0.77	82.14%	0.38	1.00	0.48	0.38	0.20	0.68	Log normal
17	Carbon Disulfide	75150	36%	0.31-0.31	89.29%	0.16	0.65	0.19	0.16	0.11	0.22	Log normal
20	Methyl T-Butyl Ether (MTBE)	1634044	68%	0.36-0.36	39.29%	0.18	1.66	0.51	0.45	0.37	0.72	Log normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	89%	0.30-0.30	17.86%	0.15	1.50	0.68	0.62	0.40	0.82	Normal
25	Hexane	110543	75%	0.36-0.36	35.71%	0.18	1.41	0.45	0.41	0.32	0.58	Log normal
32	Benzene	71432	100%	0.32-0.32	0.00%	0.35	2.11	0.70	0.61	0.36	0.79	Log normal
33	Carbon Tetrachloride	56235	82%	0.64-0.64	57.14%	0.31	0.75	0.46	0.31	0.17	0.61	Log normal
47	Toluene	108883	96%	0.38-0.38	3.57%	0.19	3.69	1.24	0.98	0.96	1.66	Log normal
56	Ethylbenzene	100414	32%	0.44-0.44	89.29%	0.22	0.74	0.26	0.22	0.13	0.29	Log normal
57	(m and /or p) Xylene	108383/ 106423	68%	0.44-0.44	46.43%	0.22	2.76	0.61	0.44	0.62	0.82	Log normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	32%	0.44-0.44	89.29%	0.22	0.82	0.26	0.22	0.14	0.29	Log normal
71	tert-Butylbenzene	98066	18%	0.55-0.55	89.29%	0.27	1.15	0.34	0.27	0.21	0.37	Log normal
72	1,2,4-Trimethylbenzene	95636	36%	0.50-0.50	78.57%	0.25	1.57	0.38	0.25	0.30	0.46	Log normal

Table 3-13. Summary statistics for COPCs from Site E 2003.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.74	3.43	1.63	1.50	0.73	1.89	Log normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.43	3.91	3.10	3.07	0.32	3.20	Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.87	2.19	1.49	1.47	0.31	1.59	Normal
7	1,3- Butadiene	106990	63%	0.22-0.22	80.00%	0.11	0.35	0.15	0.11	0.08	0.18	Log normal
10	Acetone	67641	100%	0.24-0.24	0.00%	1.83	24.51	6.13	4.87	4.34	7.43	Log normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.35	2.75	1.75	1.74	0.26	1.83	Log normal
14	Methylene Chloride	75092	100%	0.35-0.35	3.33%	0.17	0.76	0.48	0.45	0.10	0.52	Log normal
15	Methyl Acetate	79209	70%	0.31-0.31	83.33%	0.15	12.06	0.59	0.15	2.17	0.45	Log normal
16	Freon 113 (Cl3F3Ethane)	76131	100%	0.77-0.77	90.00%	0.38	0.92	0.43	0.38	0.13	0.68	Log normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	97%	0.30-0.30	16.67%	0.15	2.07	0.53	0.41	0.39	0.65	Log normal
25	Hexane	110543	93%	0.36-0.36	63.33%	0.18	0.99	0.31	0.18	0.23	0.41	Log normal
32	Benzene	71432	100%	0.32-0.32	6.67%	0.16	1.37	0.53	0.48	0.26	0.61	Log normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	26.67%	0.31	0.75	0.57	0.63	0.16	0.75	Log normal/ Maximum
47	Toluene	108883	100%	0.38-0.38	13.33%	0.19	2.22	0.80	0.66	0.57	1.03	Log normal
57	(m and /or p) Xylene	108383/ 106423	60%	0.44-0.44	86.67%	0.22	0.88	0.29	0.22	0.20	0.36	Log normal

Table 3-14. Summary statistics for COPCs from Site E 2004.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.81	12.32	2.91	2.19	2.26	3.69	Log normal
3	Freon 12 (Cl2F2Methane)	75718	97%	0.50-0.50	0.00%	1.93	8.27	3.23	2.97	1.09	4.00	Log normal
4	Chloromethane	74873	97%	0.21-0.21	0.00%	0.85	3.33	1.34	1.22	0.49	1.68	Log normal
7	1,3- Butadiene	106990	48%	0.22-0.22	86.21%	0.11	0.42	0.14	0.11	0.08	0.18	Log normal
10	Acetone	67641	100%	0.24-0.24	0.00%	1.50	38.75	7.85	6.47	7.00	10.41	Log normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.12	4.38	1.82	1.74	0.56	1.97	Log normal
12	Acrylonitrile	107131	28%	0.22-0.22	89.66%	0.11	0.46	0.13	0.11	0.08	0.15	Log normal
14	Methylene Chloride	75092	97%	0.35-0.35	0.00%	0.35	1.15	0.53	0.49	0.19	0.59	Log normal
15	Methyl Acetate	79209	48%	0.31-0.31	82.76%	0.15	4.39	0.32	0.15	0.79	0.20	Log normal
16	Freon 113 (Cl3F3Ethane)	76131	100%	0.77-0.77	79.31%	0.38	1.76	0.51	0.38	0.30	0.77	Log normal
17	Carbon Disulfide	75150	76%	0.31-0.31	55.17%	0.16	4.39	0.73	0.16	1.15	1.08	Log normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	83%	0.30-0.30	17.24%	0.15	4.96	0.94	0.65	1.00	1.17	Log normal
25	Hexane	110543	83%	0.36-0.36	44.83%	0.18	1.48	0.45	0.35	0.33	0.60	Log normal
32	Benzene	71432	100%	0.32-0.32	6.90%	0.16	1.66	0.63	0.54	0.32	0.75	Log normal
33	Carbon Tetrachloride	56235	97%	0.64-0.64	48.28%	0.31	1.70	0.54	0.63	0.29	0.70	Log normal
47	Toluene	108883	97%	0.38-0.38	13.79%	0.19	3.58	1.10	0.79	0.88	1.60	Log normal
56	Ethylbenzene	100414	41%	0.44-0.44	89.66%	0.22	0.69	0.25	0.22	0.11	0.29	Log normal
57	(m and /or p) Xylene	108383/ 106423	76%	0.44-0.44	48.28%	0.22	2.06	0.57	0.44	0.51	0.77	Log normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	38%	0.44-0.44	89.66%	0.22	0.74	0.26	0.22	0.13	0.30	Log normal
72	1,2,4-Trimethylbenzene	95636	34%	0.50-0.50	86.21%	0.25	0.93	0.32	0.25	0.19	0.37	Log normal

Table 3-15. Summary statistics for COPCs from Site E 2005.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.92	6.12	2.38	1.98	1.25	2.87	Log normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.23	8.17	3.21	3.07	1.00	3.43	Log normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.85	3.19	1.44	1.39	0.40	1.55	Log normal
7	1,3- Butadiene	106990	55%	0.22-0.22	72.41%	0.11	1.79	0.23	0.11	0.33	0.28	Log normal
10	Acetone	67641	100%	0.24-0.24	0.00%	3.21	46.58	10.27	9.12	8.54	12.36	Log normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.18	2.14	1.69	1.74	0.20	1.77	Log normal
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.35	0.94	0.57	0.52	0.16	0.63	Log normal
16	Freon 113 (Cl3F3Ethane)	76131	100%	0.77-0.77	68.97%	0.38	0.92	0.52	0.38	0.20	0.74	Log normal
17	Carbon Disulfide	75150	41%	0.31-0.31	86.21%	0.16	3.83	0.41	0.16	0.90	0.43	Log normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	100%	0.30-0.30	17.24%	0.15	32.39	2.47	1.12	5.99	3.51	Log normal
25	Hexane	110543	97%	0.36-0.36	41.38%	0.18	1.20	0.46	0.42	0.31	0.58	Normal
32	Benzene	71432	100%	0.32-0.32	20.69%	0.16	1.53	0.61	0.64	0.33	0.72	Normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	37.93%	0.31	0.75	0.52	0.63	0.17	0.63	Log normal
47	Toluene	108883	97%	0.38-0.38	10.34%	0.19	4.83	1.14	0.79	1.02	1.58	Log normal
57	(m and /or p) Xylene	108383/ 106423	76%	0.44-0.44	62.07%	0.22	1.79	0.46	0.22	0.43	0.62	Log normal

3.6 Exposure Assessment for Cane Run Elementary School: Site F

3.6.1 Summary statistics of COPCs from 2001 for Site F

There were 32 COPCs selected for this monitoring year (Table 3-16).

The COPCs with the highest median concentrations were Freon 22 (5.06 μg/m^3), Freon 12 (3.38 μg/m^3), acetone (5.19 μg/m^3), methyl t-butyl ether (4.63 μg/m^3), hexane (2.18 μg/m^3), benzene (2.66 μg/m^3), toluene (7.97 μg/m^3), and m- and or p-xylene (3.99 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (21.98 μg/m^3), Freon 12 (4.46 μg/m^3), acetone (9.45 μg/m^3), methyl t-butyl ether (12.27 μg/m^3), methyl ethyl ketone (3.10 μg/m^3), chloroprene (4.67 μg/m^3), hexane (5.37 μg/m^3), benzene (5.30 μg/m^3), toluene (11.57 μg/m^3), ethylbenzene (3.30 μg/m^3), m- and or p-xylene (9.89 μg/m^3), o-xylene (3.30 μg/m^3), and 1,2,4-trimethylbenzene (3.35 μg/m^3).

The 95% UCL was not calculated for this data set because of the limited number of sampling dates. This calculation would have been unreliable as a representation of the full year.

3.6.2 Summary statistics of COPCs from 2002 for Site F

There were 26 COPCs selected for this monitoring year (Table 3-17).

The COPCs with the highest median concentrations were Freon 22 (3.88 μg/m^3), Freon 12 (3.09 μg/m^3), acetone (6.20 μg/m^3), and toluene (4.56 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (971.43 μg/m^3), Freon 12 (3.44 μg/m^3), 1,3-butadiene (15.49 μg/m^3), acetone (15.71 μg/m^3), methylene chloride (3.30 μg/m^3), carbon disulfide (5.21 μg/m^3), methyl t-butyl ether (6.30 μg/m^3), methyl ethyl ketone (5.75 μg/m^3), chloroprene (17.23 μg/m^3), hexane (2.61 μg/m^3), chloroform (3.64 μg/m^3), benzene (2.41 μg/m^3), toluene (19.15 μg/m^3), m- and or p-xylene (2.78 μg/m^3), and styrene (2.60 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 2 COPCs (benzene and m- and/or p-xylene) that were normally distributed. The highest 95% UCL concentrations were for Freon 22 (70.20 μg/m^3), 1,3-butadiene (3.31 μg/m^3), acetone (10.71 μg/m^3), chloroprene (4.83 μg/m^3), and toluene (8.69 μg/m^3).

3.6.3 Summary statistics of COPCs from 2003 for Site F

There were 25 COPCs selected for this monitoring year (Table 3-18).

The COPCs with the highest median concentrations were Freon 22 (2.62 μg/m^3), Freon 12 (3.29 μg/m^3), acetone (7.27 μg/m^3), and toluene (4.02 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (56.32 μg/m^3), Freon 12 (5.40 μg/m^3), chloromethane (3.46 μg/m^3), vinyl chloride (2.25 μg/m^3), 1,3-butadiene (11.25 μg/m^3),

acetone (13.14 μg/m^3), Freon 11 (2.92 μg/m^3), methylene chloride (3.47 μg/m^3), methyl acetate (3.06 μg/m^3), methyl ethyl ketone (9.41 μg/m^3), chloroprene (8.76 μg/m^3), hexane (6.32 μg/m^3), benzene (4.94 μg/m^3), methyl methacrylate (3.52 μg/m^3), toluene (16.63 μg/m^3), m- and or p-xylene (6.65 μg/m^3), and 1,2,4-trimethylbenzene (2.71).

The 95% UCL was derived from log transformed data for the most part, with the exception of 1 COPC (acetone) that was normally distributed. The highest 95% UCL concentrations were for Freon 22 (9.87 μg/m^3), Freon 12 (3.47 μg/m^3), acetone (8.37 μg/m^3), and toluene (7.58 μg/m^3).

3.6.4 Summary statistics of COPCs from 2004 for Site F

There were 24 COPCs selected for this monitoring year (Table 3-19).

The COPCs with the highest median concentrations were Freon 22 (3.96 μg/m^3), Freon 12 (3.12 μg/m^3), acetone (6.40 μg/m^3), and toluene (3.05 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (24.11 μg/m^3), Freon 12 (4.06 μg/m^3), 1,3-butadiene (4.82 μg/m^3), acetone (13.45 μg/m^3), methyl ethyl ketone (5.46 μg/m^3), chloroprene (8.07 μg/m^3), toluene (9.65 μg/m^3), and (m- and/or p-) xylene (3.15 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 5 COPCs (Freon 12, acetone, Freon 11, benzene and toluene) that were normally distributed. The highest 95% UCL concentrations were for Freon 22 (9.38 μg/m^3), acetone (6.78 μg/m^3), and toluene (4.06 μg/m^3).

3.6.5 Summary statistics of COPCs from 2005 for Site F

There were 24 COPCs selected for this monitoring year (Table 3-20).

The COPCs with the highest median concentrations were Freon 22 (2.97 μg/m^3), Freon 12 (3.32 μg/m^3), acetone (8.38 μg/m^3), and toluene (3.02 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (47.19 μg/m^3), Freon 12 (6.83 μg/m^3), vinyl chloride (9.47 μg/m^3), 1,3-butadiene (16.22 μg/m^3), acetone (31.08 μg/m^3), acrylonitrile (4.19 μg/m^3), methylene chloride (2.98 μg/m^3), methyl ethyl ketone (15.58 μg/m^3), chloroprene (6.19 μg/m^3), hexane (4.91 μg/m^3), benzene (2.68 μg/m^3), toluene (22.58 μg/m^3), and (m- and/or p-) xylene (4.94 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 1 COPC (Freon 11) that was normally distributed. The highest 95% UCL concentrations were for Freon 22 (8.05 μg/m^3), Freon 12 (3.55 μg/m^3), 1,3-butadiene (4.75 μg/m^3), acetone (10.39 μg/m^3), and toluene (6.08 μg/m^3).

Table 3-16. Summary statistics for COPCs from Site F 2001.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	2.02	21.98	8.03	5.06	7.41	N/A	
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.87	4.46	3.54	3.38	0.62	N/A	
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.97	1.26	1.14	1.16	0.11	N/A	
6	Vinyl Chloride	75014	33%	0.26-0.26	66.67%	0.13	0.49	0.24	0.13	0.18	N/A	
7	1,3- Butadiene	106990	83%	0.22-0.22	16.67%	0.11	1.59	0.89	0.93	0.51	N/A	
10	Acetone	67641	83%	0.24-0.24	16.67%	0.12	9.45	5.28	5.19	3.05	N/A	
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.29	1.69	1.57	1.60	0.15	N/A	
12	Acrylonitrile	107131	83%	0.22-0.22	16.67%	0.11	0.78	0.47	0.51	0.25	N/A	
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.35	0.73	0.63	0.69	0.14	N/A	
15	Methyl Acetate	79209	50%	0.31-0.31	50.00%	0.15	0.64	0.28	0.23	0.19	N/A	
17	Carbon Disulfide	75150	67%	0.31-0.31	50.00%	0.16	3.48	1.01	0.28	1.35	N/A	
20	Methyl T-Butyl Ether (MTBE)	1634044	100%	0.36-0.36	0.00%	0.47	12.27	5.42	4.63	4.38	N/A	
21	Methyl Ethyl Ketone (2-Butanone)	78933	100%	0.30-0.30	0.00%	0.56	3.10	1.57	1.08	1.05	N/A	
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	67%	0.37-0.37	33.33%	0.18	4.67	1.72	0.61	2.07	N/A	
25	Hexane	110543	100%	0.36-0.36	0.00%	0.74	5.37	2.51	2.18	1.71	N/A	
26	Chloroform	67663	17%	0.49-0.49	83.33%	0.24	0.59	0.30	0.24	0.14	N/A	
32	Benzene	71432	100%	0.32-0.32	0.00%	0.73	5.30	2.88	2.66	1.77	N/A	
34	Cyclohexane	110827	50%	0.35-0.35	50.00%	0.17	0.86	0.40	0.34	0.28	N/A	
43	Methyl Cyclohexane	108872	50%	0.41-0.41	50.00%	0.20	0.80	0.43	0.38	0.26	N/A	
47	Toluene	108883	100%	0.38-0.38	0.00%	1.17	11.57	7.24	7.97	3.66	N/A	
49	Methyl Butyl Ketone	591786	17%	0.41-0.41	83.33%	0.21	1.03	0.34	0.21	0.33	N/A	
52	Tetrachloroethene	127184	50%	0.69-0.69	50.00%	0.34	0.95	0.61	0.58	0.30	N/A	
56	Ethylbenzene	100414	83%	0.44-0.44	16.67%	0.22	3.30	1.51	1.14	1.24	N/A	
57	(m and /or p) Xylene	108383/ 106423	100%	0.44-0.44	0.00%	0.57	9.89	4.45	3.99	3.38	N/A	
60	Styrene	100425	33%	0.43-0.43	66.67%	0.21	1.45	0.45	0.21	0.49	N/A	

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL ($\mu g/m^3$)	% Samples < SQL	Min. Conc. ($\mu g/m^3$)	Max. Conc. ($\mu g/m^3$)	Arithmetic Mean ($\mu g/m^3$)	Median Conc. ($\mu g/m^3$)	Standard Deviation ($\mu g/m^3$)	95% UCL ($\mu g/m^3$)	Basis of 95% UCL
62	o-Xylene (1,2-Dimethyl Benzene)	95476	83%	0.44-0.44	16.67%	0.22	3.30	1.54	1.39	1.14	N/A	
65	Isopropylbenzene	98828	17%	0.50-0.50	83.33%	0.25	0.69	0.32	0.25	0.18	N/A	
68	n-Propylbenzene	103651	33%	0.50-0.50	66.67%	0.25	0.59	0.34	0.25	0.16	N/A	
70	1,3,5-Trimethylbenzene	108678	50%	0.50-0.50	50.00%	0.25	0.89	0.49	0.42	0.29	N/A	
72	1,2,4-Trimethylbenzene	95636	83%	0.50-0.50	16.67%	0.25	3.35	1.66	1.49	1.19	N/A	
74	1,4-Dichlorobenzene	106467	33%	0.61-0.61	66.67%	0.30	1.14	0.50	0.30	0.35	N/A	
81	Naphthalene	91203	33%	0.53-0.53	66.67%	0.26	1.05	0.51	0.26	0.38	N/A	

Table 3-17. Summary statistics for COPCs from Site F 2002.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.67	971.43	47.81	3.88	174.75	70.20	Log Normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	1.34	3.44	3.03	3.09	0.38	3.20	Log Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.62	1.88	1.35	1.39	0.24	1.45	Log Normal
6	Vinyl Chloride	75014	55%	0.26-0.26	67.74%	0.13	1.57	0.27	0.13	0.31	0.35	Log Normal
7	1,3- Butadiene	106990	97%	0.22-0.22	9.68%	0.11	15.49	1.78	0.73	2.88	3.31	Log Normal
10	Acetone	67641	100%	0.24-0.24	3.23%	0.12	15.71	6.79	6.20	3.52	10.71	Log Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	0.79	2.02	1.59	1.63	0.23	1.68	Log Normal
12	Acrylonitrile	107131	100%	0.22-0.22	22.58%	0.11	2.09	0.53	0.36	0.45	0.82	Log Normal
14	Methylene Chloride	75092	94%	0.35-0.35	6.45%	0.17	3.30	0.92	0.75	0.65	1.19	Log Normal
15	Methyl Acetate	79209	74%	0.31-0.31	58.06%	0.15	0.68	0.25	0.15	0.15	0.33	Log Normal
16	Freon 113 (Cl3F3Ethane)	76131	71%	0.77-0.77	87.10%	0.38	1.00	0.45	0.38	0.18	0.66	Log Normal
17	Carbon Disulfide	75150	90%	0.31-0.31	38.71%	0.16	5.21	0.92	0.34	1.27	1.48	Log Normal
20	Methyl T-Butyl Ether (MTBE)	1634044	94%	0.36-0.36	19.35%	0.18	6.30	1.62	1.16	1.49	3.04	Log Normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	94%	0.30-0.30	6.45%	0.15	5.75	1.72	1.56	1.13	2.57	Log Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	68%	0.37-0.37	48.39%	0.18	17.23	2.04	0.33	3.97	4.83	Log Normal
25	Hexane	110543	94%	0.36-0.36	6.45%	0.18	2.61	0.95	0.79	0.56	1.24	Log Normal
26	Chloroform	67663	55%	0.49-0.49	77.42%	0.24	3.64	0.47	0.24	0.66	0.55	Log Normal
32	Benzene	71432	100%	0.32-0.32	0.00%	0.38	2.41	1.09	0.94	0.51	1.25	Normal
33	Carbon Tetrachloride	56235	74%	0.64-0.64	58.06%	0.31	0.69	0.46	0.47	0.15	0.59	Log Normal
40	Methyl Methacrylate	80626	65%	0.41-0.41	54.84%	0.20	1.84	0.49	0.20	0.42	0.68	Log Normal
47	Toluene	108883	100%	0.38-0.38	0.00%	0.60	19.15	5.82	4.56	4.54	8.69	Log Normal
56	Ethylbenzene	100414	71%	0.44-0.44	58.06%	0.22	0.72	0.35	0.22	0.18	0.45	Log Normal
57	(m and /or p) Xylene	108383/ 106423	94%	0.44-0.44	12.90%	0.22	2.78	1.21	1.18	0.76	1.45	Normal
60	Styrene	100425	68%	0.43-0.43	67.74%	0.21	2.60	0.44	0.21	0.56	0.55	Log Normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	74%	0.44-0.44	51.61%	0.22	0.91	0.41	0.22	0.23	0.53	Log Normal
72	1,2,4-Trimethylbenzene	95636	71%	0.50-0.50	58.06%	0.25	0.98	0.43	0.25	0.24	0.55	Log Normal

Table 3-18. Summary statistics for COPCs from Site F 2003.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.89	56.32	7.09	2.62	10.58	9.87	Log Normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.18	5.40	3.34	3.29	0.52	3.47	Log Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.75	3.46	1.51	1.44	0.43	1.63	Log Normal
6	Vinyl Chloride	75014	45%	0.26-0.26	73.68%	0.13	2.25	0.32	0.13	0.47	0.43	Log Normal
7	1,3- Butadiene	106990	100%	0.22-0.22	21.05%	0.11	11.25	1.59	0.51	2.44	2.97	Log Normal
10	Acetone	67641	100%	0.24-0.24	2.63%	0.12	13.14	7.35	7.27	3.75	8.37	Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	2.63%	0.28	2.92	1.71	1.69	0.36	1.82	Log Normal
12	Acrylonitrile	107131	55%	0.22-0.22	57.89%	0.11	1.67	0.28	0.11	0.31	N/A	
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.38	3.47	0.86	0.66	0.66	0.98	Log Normal
15	Methyl Acetate	79209	89%	0.31-0.31	73.68%	0.15	3.06	0.31	0.15	0.50	0.37	Log Normal
16	Freon 113 (Cl3F3Ethane)	76131	100%	0.77-0.77	89.47%	0.38	1.00	0.43	0.38	0.14	1.00	Log Normal/ Maximum
17	Carbon Disulfide	75150	74%	0.31-0.31	57.89%	0.16	1.96	0.34	0.16	0.35	0.43	Log Normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	92%	0.30-0.30	10.53%	0.15	9.41	1.18	0.89	1.51	1.56	Log Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	61%	0.37-0.37	60.53%	0.18	8.76	0.96	0.18	1.84	1.32	Log Normal
25	Hexane	110543	97%	0.36-0.36	15.79%	0.18	6.32	1.04	0.72	1.03	1.40	Log Normal
26	Chloroform	67663	55%	0.49-0.49	81.58%	0.24	1.12	0.36	0.24	0.25	0.43	Log Normal
32	Benzene	71432	100%	0.32-0.32	5.26%	0.16	4.94	0.95	0.78	0.77	1.12	Log Normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	13.16%	0.31	0.75	0.62	0.63	0.13	0.75	Log Normal/ Maximum
40	Methyl Methacrylate	80626	42%	0.41-0.41	81.58%	0.20	3.52	0.41	0.20	0.60	0.47	Log Normal
47	Toluene	108883	100%	0.38-0.38	2.63%	0.19	16.63	4.69	4.02	3.86	7.58	Log Normal
52	Tetrachloroethene	127184	47%	0.69-0.69	89.47%	0.34	1.02	0.39	0.34	0.15	0.43	Log Normal
56	Ethylbenzene	100414	55%	0.44-0.44	89.47%	0.22	1.52	0.28	0.22	0.23	0.33	Log Normal
57	(m and /or p) Xylene	108383/ 106423	89%	0.44-0.44	39.47%	0.22	6.65	0.86	0.53	1.16	1.16	Log Normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	58%	0.44-0.44	89.47%	0.22	2.04	0.30	0.22	0.31	0.35	Log Normal
72	1,2,4-Trimethylbenzene	95636	47%	0.50-0.50	89.47%	0.25	2.71	0.34	0.25	0.41	0.37	Log Normal

Table 3-19. Summary statistics for COPCs from Site F 2004.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.96	24.11	5.94	3.96	5.66	9.38	Log Normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.43	4.06	3.14	3.12	0.37	3.26	Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.85	1.93	1.26	1.20	0.28	1.35	Log Normal
6	Vinyl Chloride	75014	28%	0.26-0.26	89.66%	0.13	0.77	0.17	0.13	0.13	0.19	Log Normal
7	1,3- Butadiene	106990	97%	0.22-0.22	24.14%	0.11	4.82	0.93	0.35	1.20	1.56	Log Normal
10	Acetone	67641	100%	0.24-0.24	0.00%	2.09	13.45	6.18	6.40	2.54	6.78	Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.24	2.02	1.69	1.63	0.18	1.75	Normal
12	Acrylonitrile	107131	90%	0.22-0.22	51.72%	0.11	2.24	0.28	0.11	0.40	0.36	Log Normal
14	Methylene Chloride	75092	100%	0.35-0.35	3.45%	0.17	2.05	0.70	0.62	0.38	0.76	Log Normal
15	Methyl Acetate	79209	79%	0.31-0.31	79.31%	0.15	0.64	0.22	0.15	0.14	0.27	Log Normal
16	Freon 113 (Cl3F3Ethane)	76131	100%	0.77-0.77	75.86%	0.38	1.00	0.49	0.38	0.19	0.72	Log Normal
17	Carbon Disulfide	75150	66%	0.31-0.31	68.97%	0.16	1.71	0.40	0.16	0.42	0.57	Log Normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	93%	0.30-0.30	10.34%	0.15	5.46	1.10	0.86	1.09	1.58	Log Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	62%	0.37-0.37	55.17%	0.18	8.07	1.36	0.18	2.15	2.77	Log Normal
25	Hexane	110543	100%	0.36-0.36	17.24%	0.18	1.87	0.87	0.74	0.55	1.12	Log Normal
26	Chloroform	67663	52%	0.49-0.49	79.31%	0.24	1.51	0.39	0.24	0.33	0.46	Log Normal
32	Benzene	71432	100%	0.32-0.32	0.00%	0.32	1.82	0.84	0.77	0.39	0.92	Normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	13.79%	0.31	0.75	0.62	0.63	0.13	0.75	Log Normal
40	Methyl Methacrylate	80626	52%	0.41-0.41	65.52%	0.20	1.10	0.38	0.20	0.28	0.48	Log Normal
47	Toluene	108883	100%	0.38-0.38	0.00%	0.53	9.65	3.55	3.05	2.29	4.06	Normal
56	Ethylbenzene	100414	52%	0.44-0.44	72.41%	0.22	0.91	0.31	0.22	0.18	0.35	Log Normal
57	(m and /or p) Xylene	108383/ 106423	97%	0.44-0.44	37.93%	0.22	3.15	0.88	0.61	0.76	1.23	Log Normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	52%	0.44-0.44	65.52%	0.22	0.87	0.34	0.22	0.19	0.38	Log Normal
72	1,2,4-Trimethylbenzene	95636	45%	0.50-0.50	68.97%	0.25	0.89	0.38	0.25	0.22	0.44	Log Normal

Table 3-20. Summary statistics for COPCs from Site F 2005.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	1.06	47.19	5.98	2.97	8.54	8.05	Log Normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.57	6.83	3.38	3.32	0.69	3.55	Log Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.95	2.55	1.41	1.41	0.28	1.49	Log Normal
6	Vinyl Chloride	75014	35%	0.26-0.26	80.65%	0.13	9.47	0.50	0.13	1.67	0.44	Log Normal
7	1,3- Butadiene	106990	97%	0.22-0.22	16.13%	0.11	16.22	2.21	0.69	3.47	4.75	Log Normal
10	Acetone	67641	100%	0.24-0.24	0.00%	3.55	31.08	8.92	8.38	5.02	10.39	Log Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.29	2.08	1.72	1.74	0.17	1.77	Normal
12	Acrylonitrile	107131	48%	0.22-0.22	54.84%	0.11	4.19	0.50	0.11	0.82	0.72	Log Normal
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.42	2.98	0.85	0.66	0.53	0.98	Log Normal
15	Methyl Acetate	79209	74%	0.31-0.31	77.42%	0.15	0.73	0.20	0.15	0.12	0.26	Log Normal
16	Freon 113 (Cl3F3Ethane)	76131	100%	0.77-0.77	64.52%	0.38	1.30	0.54	0.38	0.24	0.77	Log Normal
17	Carbon Disulfide	75150	68%	0.31-0.31	74.19%	0.16	1.40	0.29	0.16	0.30	0.36	Log Normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	97%	0.30-0.30	3.23%	0.15	15.58	1.74	1.24	2.64	2.21	Log Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	48%	0.37-0.37	54.84%	0.18	6.19	0.95	0.18	1.48	1.46	Log Normal
25	Hexane	110543	100%	0.36-0.36	3.23%	0.18	4.91	1.13	0.92	0.85	1.39	Log Normal
26	Chloroform	67663	45%	0.49-0.49	77.42%	0.24	1.07	0.34	0.24	0.20	0.41	Log Normal
32	Benzene	71432	100%	0.32-0.32	0.00%	0.32	2.68	0.99	0.93	0.54	1.20	Log Normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	12.90%	0.31	1.45	0.67	0.69	0.20	0.74	Log Normal
40	Methyl Methacrylate	80626	32%	0.41-0.41	87.10%	0.20	0.82	0.25	0.20	0.13	0.28	Log Normal
47	Toluene	108883	100%	0.38-0.38	0.00%	0.49	22.58	4.26	3.02	4.32	6.08	Log Normal
52	Tetrachloroethene	127184	35%	0.69-0.69	83.87%	0.34	1.56	0.43	0.34	0.25	0.48	Log Normal
56	Ethylbenzene	100414	65%	0.44-0.44	87.10%	0.22	1.22	0.28	0.22	0.20	0.33	Log Normal
57	(m and /or p) Xylene	108383/ 106423	90%	0.44-0.44	25.81%	0.22	4.94	0.89	0.61	0.93	1.20	Log Normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	55%	0.44-0.44	87.10%	0.22	1.30	0.29	0.22	0.22	0.36	Log Normal

3.7 Exposure Assessment for Chickasaw Park: Site I

3.7.1 Summary statistics of COPCs from 2001 for Site I

There were 22 COPCs selected for this monitoring year (Table 3-21).

The COPCs with the highest median concentrations were Freon 22 (5.73 μg/m^3), Freon 12 (3.02 μg/m^3), acetone (4.02 μg/m^3), and toluene (4.90 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (8.96 μg/m^3), Freon 12 (3.91 μg/m^3), 1,3-butadiene (4.82 μg/m^3), acetone (4.09 μg/m^3), methyl t-butyl ether (5.09 μg/m^3), chloroform (2.78 μg/m^3), and toluene (11.27 μg/m^3).

The 95% UCL was not calculated for this data set because of the limited number of sampling dates. This calculation would have been unreliable as a representation of the full year.

3.7.2 Summary statistics of COPCs from 2002 for Site I

There were 20 COPCs selected for this monitoring year (Table 3-22).

The COPCs with the highest median concentrations were Freon 22 (2.12 μg/m^3), Freon 12 (2.92 μg/m^3), acetone (4.55 μg/m^3), and toluene (2.45 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (27.33 μg/m^3), Freon 12 (3.71 μg/m^3), 1,3-butadiene (7.65 μg/m^3), acetone (8.76 μg/m^3), methylene chloride (4.03 μg/m^3), chloroprene (4.16 μg/m^3), chloroform (3.37 μg/m^3), and toluene (13.16 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 4 COPCs (acetone, Freon 11, methyl ethyl ketone, and hexane) that were normally distributed. The highest 95% UCL concentrations were for Freon 22 (7.45 μg/m^3), acetone (5.22 μg/m^3), and toluene (5.86 μg/m^3).

3.7.3 Summary statistics of COPCs from 2003 for Site I

There were 21 COPCs selected for this monitoring year (Table 3-23).

The COPCs with the highest median concentrations were Freon 22 (2.41 μg/m^3), Freon 12 (3.12 μg/m^3), acetone (6.62 μg/m^3), and toluene (2.53 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (68.04 μg/m^3), Freon 12 (5.05 μg/m^3), 1,3-butadiene (16.00 μg/m^3), acetone (13.38 μg/m^3), methyl ethyl ketone (3.54 μg/m^3), chloroprene (3.73 μg/m^3), and toluene (13.53 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 4 COPCs (chloromethane, acetone, methylene chloride, and methyl acetate) that were normally distributed. The highest 95% UCL concentrations were for Freon 22

(8.78 μg/m^3), 1,3-butadiene (8.14 μg/m^3), acetone (7.89 μg/m^3), and toluene (10.91 μg/m^3).

3.7.4 Summary statistics of COPCs from 2004 for Site I

There were 21 COPCs selected for this monitoring year (Table 3-24).

The COPCs with the highest median concentrations were Freon 12 (2.99 μg/m^3) and acetone (5.87 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (122.94 μg/m^3), Freon 12 (4.01 μg/m^3), 1,3-butadiene (7.14 μg/m^3), acetone (12.90 μg/m^3), carbon disulfide (2.95 μg/m^3), chloroprene (7.38 μg/m^3), chloroform (4.64 μg/m^3), methyl methacrylate (10.31 μg/m^3), and toluene (9.80 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 4 COPCs (Freon 12, chloromethane, acetone, and methyl ethyl ketone) that were normally distributed. The highest 95% UCL concentrations were for Freon 22 (6.20 μg/m^3), acetone (6.59 μg/m^3), and toluene (4.91 μg/m^3).

3.7.5 Summary statistics of COPCs from 2005 for Site I

There were 22 COPCs selected for this monitoring year (Table 3-25).

The COPCs with the highest median concentrations were Freon 22 (2.48 μg/m^3), Freon 12 (3.14 μg/m^3), acetone (7.75 μg/m^3), and toluene (2.58 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (34.59 μg/m^3), Freon 12 (7.57 μg/m^3), chloromethane (2.86 μg/m^3), vinyl chloride (4.81 μg/m^3), 1,3-butadiene (20.73 μg/m^3), acetone (422.95 μg/m^3), methyl ethyl ketone (8.47 μg/m^3), chloroprene (4.49 μg/m^3), hexane (12.04 μg/m^3), chloroform (4.15 μg/m^3), toluene (12.86 μg/m^3), ethylbenzene (3.99 μg/m^3), and (m- and/or p-) xylene (12.73 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 1 COPC (Freon 11) that was normally distributed. The highest 95% UCL concentrations were for Freon 22 (9.59 μg/m^3), acetone (27.63 μg/m^3), and toluene (7.77 μg/m^3).

Table 3-21. Summary statistics for COPCs from Site I 2001.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	1.95	8.96	5.55	5.73	3.51	N/A	
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.97	3.91	3.30	3.02	0.53	N/A	
4	Chloromethane	74873	100%	0.21-0.21	0.00%	1.16	1.51	1.28	1.18	0.20	N/A	
7	1,3- Butadiene	106990	67%	0.22-0.22	33.33%	0.11	4.82	1.89	0.73	2.56	N/A	
10	Acetone	67641	67%	0.24-0.24	33.33%	0.12	4.09	2.74	4.02	2.27	N/A	
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.41	1.85	1.61	1.57	0.23	N/A	
12	Acrylonitrile	107131	33%	0.22-0.22	66.67%	0.11	0.43	0.22	0.11	0.19	N/A	
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.38	0.62	0.46	0.38	0.14	N/A	
16	Freon 113 (Cl3F3Ethane)	76131	33%	0.77-0.77	66.67%	0.38	1.00	0.59	0.38	0.35	N/A	
17	Carbon Disulfide	75150	100%	0.31-0.31	0.00%	0.34	0.37	0.36	0.37	0.02	N/A	
20	Methyl T-Butyl Ether (MTBE)	1634044	67%	0.36-0.36	33.33%	0.18	5.09	2.01	0.76	2.68	N/A	
21	Methyl Ethyl Ketone (2-Butanone)	78933	67%	0.30-0.30	33.33%	0.15	1.09	0.73	0.94	0.51	N/A	
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	67%	0.37-0.37	33.33%	0.18	2.06	0.95	0.62	0.99	N/A	
25	Hexane	110543	100%	0.36-0.36	0.00%	0.56	1.62	0.99	0.78	0.56	N/A	
26	Chloroform	67663	33%	0.49-0.49	66.67%	0.24	2.78	1.09	0.24	1.47	N/A	
32	Benzene	71432	100%	0.32-0.32	0.00%	0.89	1.79	1.22	0.99	0.49	N/A	
40	Methyl Methacrylate	80626	67%	0.41-0.41	33.33%	0.20	1.27	0.64	0.45	0.56	N/A	
47	Toluene	108883	100%	0.38-0.38	0.00%	1.85	11.27	6.01	4.90	4.81	N/A	
56	Ethylbenzene	100414	33%	0.44-0.44	66.67%	0.22	0.52	0.32	0.22	0.18	N/A	
57	(m and /or p) Xylene	108383/ 106423	100%	0.44-0.44	0.00%	0.61	1.53	1.12	1.23	0.47	N/A	
62	o-Xylene (1,2-Dimethyl Benzene)	95476	33%	0.44-0.44	66.67%	0.22	0.56	0.33	0.22	0.20	N/A	
72	1,2,4-Trimethylbenzene	95636	67%	0.50-0.50	33.33%	0.25	0.74	0.54	0.64	0.26	N/A	

Table 3-22. Summary statistics for COPCs from Site I 2002.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL ($\mu g/m^3$)	% Samples < SQL	Min. Conc. ($\mu g/m^3$)	Max. Conc. ($\mu g/m^3$)	Arithmetic Mean ($\mu g/m^3$)	Median Conc. ($\mu g/m^3$)	Standard Deviation ($\mu g/m^3$)	95% UCL ($\mu g/m^3$)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.64	27.33	5.07	2.12	6.68	7.45	Log Normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	1.14	3.71	2.91	2.92	0.45	3.11	Log Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.35	1.68	1.33	1.35	0.26	1.47	Log Normal
7	1,3- Butadiene	106990	58%	0.22-0.22	58.06%	0.11	7.65	1.19	0.11	1.84	3.08	Log Normal
10	Acetone	67641	100%	0.24-0.24	0.00%	1.67	8.76	4.64	4.55	1.91	5.22	Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.07	2.14	1.58	1.57	0.22	1.65	Normal
12	Acrylonitrile	107131	52%	0.22-0.22	61.29%	0.11	0.76	0.20	0.11	0.14	0.25	Log Normal
14	Methylene Chloride	75092	94%	0.35-0.35	22.58%	0.17	4.03	0.54	0.42	0.68	0.65	Log Normal
15	Methyl Acetate	79209	68%	0.31-0.31	51.61%	0.15	0.97	0.34	0.15	0.24	0.45	Log Normal
17	Carbon Disulfide	75150	58%	0.31-0.31	83.87%	0.16	1.15	0.23	0.16	0.21	0.31	Log Normal
20	Methyl T-Butyl Ether (MTBE)	1634044	65%	0.36-0.36	45.16%	0.18	2.13	0.57	0.40	0.51	0.81	Log Normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	94%	0.30-0.30	9.68%	0.15	1.42	0.73	0.65	0.37	0.84	Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	42%	0.37-0.37	64.52%	0.18	4.16	0.71	0.18	1.04	1.05	Log Normal
25	Hexane	110543	84%	0.36-0.36	22.58%	0.18	1.48	0.57	0.49	0.33	0.67	Normal
26	Chloroform	67663	55%	0.49-0.49	74.19%	0.24	3.37	0.48	0.24	0.61	0.65	Log Normal
32	Benzene	71432	100%	0.32-0.32	0.00%	0.32	1.72	0.77	0.73	0.31	0.87	Log Normal
33	Carbon Tetrachloride	56235	77%	0.64-0.64	54.84%	0.31	0.63	0.46	0.31	0.16	0.59	Log Normal
40	Methyl Methacrylate	80626	32%	0.41-0.41	74.19%	0.20	2.05	0.40	0.20	0.41	0.49	Log Normal
47	Toluene	108883	100%	0.38-0.38	3.23%	0.19	13.16	3.61	2.45	3.57	5.86	Log Normal
57	(m and /or p) Xylene	108383/ 106423	65%	0.44-0.44	45.16%	0.22	1.27	0.52	0.48	0.34	0.69	Log Normal

Table 3-23. Summary statistics for COPCs from Site I 2003.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	3.23%	0.18	68.04	6.45	2.41	12.52	8.78	Log Normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	3.23%	0.25	5.05	3.13	3.12	0.73	3.37	Log Normal
4	Chloromethane	74873	100%	0.21-0.21	3.23%	0.10	2.36	1.48	1.45	0.44	1.61	Normal
6	Vinyl Chloride	75014	35%	0.26-0.26	87.10%	0.13	1.31	0.22	0.13	0.28	0.26	Log Normal
7	1,3- Butadiene	106990	87%	0.22-0.22	22.58%	0.11	16.00	2.71	0.44	4.36	8.14	Log Normal
10	Acetone	67641	100%	0.24-0.24	0.00%	2.09	13.38	6.93	6.62	3.14	7.89	Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.41	2.75	1.78	1.74	0.28	1.87	Log Normal
12	Acrylonitrile	107131	68%	0.22-0.22	58.06%	0.11	1.02	0.28	0.11	0.27	0.41	Log Normal
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.35	0.73	0.51	0.49	0.09	0.54	Normal
15	Methyl Acetate	79209	90%	0.31-0.31	64.52%	0.15	0.58	0.24	0.15	0.13	0.30	Normal
16	Freon 113 (Cl3F3Ethane)	76131	100%	0.77-0.77	80.65%	0.38	1.07	0.47	0.38	0.19	0.71	Log Normal
17	Carbon Disulfide	75150	77%	0.31-0.31	48.39%	0.16	2.77	0.61	0.31	0.69	0.93	Log Normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	100%	0.30-0.30	6.45%	0.15	3.54	0.80	0.62	0.62	1.02	Log Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	58%	0.37-0.37	51.61%	0.18	3.73	0.78	0.18	0.90	1.22	Log Normal
25	Hexane	110543	97%	0.36-0.36	38.71%	0.18	2.40	0.55	0.46	0.47	0.73	Log Normal
26	Chloroform	67663	68%	0.49-0.49	64.52%	0.24	1.66	0.50	0.24	0.41	0.64	Log Normal
32	Benzene	71432	100%	0.32-0.32	6.45%	0.16	2.04	0.62	0.51	0.35	0.72	Log Normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	19.35%	0.31	0.82	0.60	0.63	0.15	0.67	Log Normal
40	Methyl Methacrylate	80626	42%	0.41-0.41	77.42%	0.20	1.06	0.32	0.20	0.25	0.39	Log Normal
47	Toluene	108883	100%	0.38-0.38	6.45%	0.19	13.53	4.62	2.53	4.36	10.91	Log Normal
57	(m and /or p) Xylene	108383/ 106423	74%	0.44-0.44	67.74%	0.22	2.84	0.45	0.22	0.52	0.63	Log Normal

Table 3-24. Summary statistics for COPCs from Site I 2004.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL ($\mu g/m^3$)	% Samples < SQL	Min. Conc. ($\mu g/m^3$)	Max. Conc. ($\mu g/m^3$)	Arithmetic Mean ($\mu g/m^3$)	Median Conc. ($\mu g/m^3$)	Standard Deviation ($\mu g/m^3$)	95% UCL ($\mu g/m^3$)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.71	122.94	6.82	1.70	22.84	6.20	Log Normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.38	4.01	3.04	2.99	0.38	3.16	Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.56	1.76	1.22	1.20	0.25	1.30	Normal
7	1,3- Butadiene	106990	71%	0.22-0.22	53.57%	0.11	7.14	0.86	0.11	1.47	1.65	Log Normal
10	Acetone	67641	96%	0.24-0.24	3.57%	0.12	12.90	5.68	5.87	2.82	6.59	Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	0.96	2.14	1.67	1.69	0.24	1.76	Log Normal
12	Acrylonitrile	107131	43%	0.22-0.22	89.29%	0.11	0.50	0.14	0.11	0.10	0.17	Log Normal
14	Methylene Chloride	75092	100%	0.35-0.35	10.71%	0.17	1.21	0.48	0.43	0.22	0.55	Log Normal
15	Methyl Acetate	79209	79%	0.31-0.31	82.14%	0.15	1.24	0.24	0.15	0.25	0.30	Log Normal
17	Carbon Disulfide	75150	68%	0.31-0.31	64.29%	0.16	2.95	0.47	0.16	0.62	0.67	Log Normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	82%	0.30-0.30	28.57%	0.15	1.68	0.58	0.44	0.41	0.72	Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	46%	0.37-0.37	71.43%	0.18	7.38	0.76	0.18	1.58	1.03	Log Normal
25	Hexane	110543	86%	0.36-0.36	50.00%	0.18	1.34	0.48	0.26	0.39	0.68	Log Normal
26	Chloroform	67663	50%	0.49-0.49	67.86%	0.24	4.64	0.58	0.24	0.86	0.72	Log Normal
32	Benzene	71432	100%	0.32-0.32	21.43%	0.16	1.88	0.56	0.49	0.37	0.72	Log Normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	32.14%	0.31	0.75	0.56	0.63	0.17	0.66	Log Normal
40	Methyl Methacrylate	80626	39%	0.41-0.41	75.00%	0.20	10.31	0.82	0.20	2.00	0.96	Log Normal
47	Toluene	108883	96%	0.38-0.38	21.43%	0.19	9.80	2.31	1.17	2.69	4.91	Log Normal
56	Ethylbenzene	100414	39%	0.44-0.44	85.71%	0.22	0.69	0.26	0.22	0.12	0.31	Log Normal
57	(m and /or p) Xylene	108383/ 106423	61%	0.44-0.44	57.14%	0.22	2.14	0.57	0.22	0.54	0.78	Log Normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	39%	0.44-0.44	85.71%	0.22	0.61	0.26	0.22	0.10	0.30	Log Normal

Table 3-25. Summary statistics for COPCs from Site I 2005.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.89	34.59	6.27	2.48	9.49	9.59	Log Normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.52	7.57	3.28	3.14	0.85	3.47	Log Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.93	2.86	1.42	1.39	0.33	1.51	Log Normal
6	Vinyl Chloride	75014	20%	0.26-0.26	90.00%	0.13	4.81	0.31	0.13	0.86	0.30	Log Normal
7	1,3- Butadiene	106990	77%	0.22-0.22	30.00%	0.11	20.73	1.96	0.67	3.84	5.16	Log Normal
10	Acetone	67641	100%	0.24-0.24	0.00%	0.83	422.95	25.53	7.75	76.33	27.63	Log Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.41	2.19	1.71	1.71	0.18	1.76	Normal
12	Acrylonitrile	107131	30%	0.22-0.22	80.00%	0.11	1.54	0.23	0.11	0.34	0.27	Log Normal
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.42	0.83	0.56	0.52	0.11	0.59	Log Normal
15	Methyl Acetate	79209	77%	0.31-0.31	76.67%	0.15	0.52	0.20	0.15	0.09	0.25	Log Normal
16	Freon 113 (Cl3F3Ethane)	76131	100%	0.77-0.77	86.67%	0.38	0.92	0.44	0.38	0.15	0.92	Log Normal/ Maximum
17	Carbon Disulfide	75150	67%	0.31-0.31	60.00%	0.16	1.62	0.39	0.16	0.41	0.52	Log Normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	93%	0.30-0.30	13.33%	0.15	8.47	1.27	0.89	1.51	1.91	Log Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	47%	0.37-0.37	53.33%	0.18	4.49	1.14	0.18	1.41	2.22	Log Normal
25	Hexane	110543	97%	0.36-0.36	16.67%	0.18	12.04	1.51	0.78	2.33	2.25	Log Normal
26	Chloroform	67663	57%	0.49-0.49	60.00%	0.24	4.15	0.68	0.24	0.92	0.88	Log Normal
32	Benzene	71432	100%	0.32-0.32	13.33%	0.16	1.66	0.74	0.67	0.40	0.92	Log Normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	16.67%	0.31	0.88	0.62	0.63	0.15	0.68	Log Normal
40	Methyl Methacrylate	80626	33%	0.41-0.41	80.00%	0.20	1.92	0.37	0.20	0.40	0.44	Log Normal
47	Toluene	108883	97%	0.38-0.38	10.00%	0.19	12.86	3.52	2.58	3.47	7.77	Log Normal
56	Ethylbenzene	100414	37%	0.44-0.44	90.00%	0.22	3.99	0.37	0.22	0.69	0.38	Log Normal
57	(m and /or p) Xylene	108383/ 106423	73%	0.44-0.44	53.33%	0.22	12.73	0.96	0.22	2.30	1.11	Log Normal

3.8 Exposure Assessment for Farnsley Middle School: Site M

3.8.1 Summary statistics of COPCs from 2001 for Site M

There were 22 COPCs selected for this monitoring year (Table 3-26).

The COPCs with the highest median concentrations were Freon 22 (3.36 μg/m^3), Freon 12 (3.27 μg/m^3), acetone (4.81 μg/m^3), methyl t-butyl ether (2.85 μg/m^3), toluene (4.52 μg/m^3), and (m- and/or p-) xylene (2.84 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (5.42 μg/m^3), Freon 12 (4.70 μg/m^3), acetone (5.12 μg/m^3), methyl t-butyl ether (3.57 μg/m^3), benzene (2.23 μg/m^3), toluene (6.82 μg/m^3), and (m- and/or p-) xylene (3.41 μg/m^3).

The 95% UCL was not calculated for this data set because of the limited number of sampling dates. This calculation would have been unreliable as a representation of the full year.

3.8.2 Summary statistics of COPCs from 2002 for Site M

There were 26 COPCs selected for this monitoring year (Table 3-27).

The COPCs with the highest median concentrations were Freon 12 (3.02 μg/m^3), acetone (5.55 μg/m^3), and toluene (2.53 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (68.22 μg/m^3), Freon 12 (4.16 μg/m^3), 1,3-butadiene (13.92 μg/m^3), acetone (8.45 μg/m^3), methyl ethyl ketone (2.57 μg/m^3), chloroprene (2.68 μg/m^3), toluene (14.02 μg/m^3), and (m- and/or p-) xylene (2.41 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 7 COPCs (Freon 12, chloromethane, Freon 11, methyl ethyl ketone, hexane, benzene, and m- and/or p-xylene) that were normally distributed. The highest 95% UCL concentrations were for Freon 22 (7.81 μg/m^3), 1,3-butadiene (6.34 μg/m^3), acetone (8.45 μg/m^3), and toluene (7.21 μg/m^3).

3.8.3 Summary statistics of COPCs from 2003 for Site M

There were 19 COPCs selected for this monitoring year (Table 3-28).

The COPCs with the highest median concentrations were Freon 12 (2.92 μg/m^3) and acetone (5.14 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (43.97 μg/m^3), Freon 12 (6.34 μg/m^3), 1,3-butadiene (8.86 μg/m^3), acetone (10.12 μg/m^3), and toluene (15.31 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 4 COPCs (chloromethane, acetone, Freon 11, and methyl ethyl ketone) that

were normally distributed. The highest 95% UCL concentrations were for Freon 22 (4.54 μg/m^3), acetone (5.85 μg/m^3), and toluene (4.59 μg/m^3).

3.8.4 Summary statistics of COPCs from 2004 for Site M

There were 22 COPCs selected for this monitoring year (Table 3-29).

The COPCs with the highest median concentrations were Freon 12 (3.12 μg/m^3) and acetone (4.07 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (57.53 μg/m^3), Freon 12 (4.65 μg/m^3), 1,3-butadiene (2.81 μg/m^3), acetone (11.69 μg/m^3), toluene (8.44 μg/m^3), and (m- and/or p-) xylene (4.03 μg/m^3).

The 95% UCL was derived from log transformed data. The highest 95% UCL concentrations were for Freon 22 (3.92 μg/m^3), acetone (5.99 μg/m^3), and toluene (4.36 μg/m^3).

3.8.5 Summary statistics of COPCs from 2005 for Site M

There were 20 COPCs selected for this monitoring year (Table 3-30).

The COPCs with the highest median concentrations were Freon 12 (3.12 μg/m^3) and acetone (7.14 μg/m^3). COPCs with the highest maximum concentrations were Freon 22 (12.74 μg/m^3), Freon 12 (9.75 μg/m^3), chloromethane (3.39 μg/m^3), 1,3-butadiene (7.43 μg/m^3), acetone (19.75 μg/m^3), methyl ethyl ketone (11.95 μg/m^3), chloroprene (3.37 μg/m^3), benzene (2.26 μg/m^3), carbon tetrachloride (2.70 μg/m^3), toluene (6.94 μg/m^3), and tetrachloroethene (2.98 μg/m^3).

The 95% UCL was derived from log transformed data for the most part, with the exception of 1 COPC (Freon 11) that was normally distributed. The highest 95% UCL concentrations were for Freon 22 (2.94 μg/m^3), Freon 12 (3.59 μg/m^3), acetone (9.02 μg/m^3), and toluene (3.55 μg/m^3).

Table 3-26. Summary statistics for COPCs from Site M 2001.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL ($\mu g/m^3$)	% Samples < SQL	Min. Conc. ($\mu g/m^3$)	Max. Conc. ($\mu g/m^3$)	Arithmetic Mean ($\mu g/m^3$)	Median Conc. ($\mu g/m^3$)	Standard Deviation ($\mu g/m^3$)	95% UCL ($\mu g/m^3$)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	1.38	5.42	3.39	3.36	2.02	N/A	
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	3.07	4.70	3.68	3.27	0.89	N/A	
4	Chloromethane	74873	100%	0.21-0.21	0.00%	1.14	1.43	1.25	1.18	0.16	N/A	
7	1,3- Butadiene	106990	100%	0.22-0.22	0.00%	0.40	0.69	0.57	0.62	0.15	N/A	
10	Acetone	67641	100%	0.24-0.24	0.00%	1.24	5.12	3.72	4.81	2.16	N/A	
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.52	1.91	1.67	1.57	0.21	N/A	
12	Acrylonitrile	107131	67%	0.22-0.22	33.33%	0.11	0.50	0.30	0.28	0.20	N/A	
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.52	1.11	0.81	0.80	0.30	N/A	
16	Freon 113 (Cl3F3Ethane)	76131	67%	0.77-0.77	66.67%	0.38	1.00	0.59	0.38	0.35	N/A	
17	Carbon Disulfide	75150	67%	0.31-0.31	33.33%	0.16	0.53	0.38	0.47	0.20	N/A	
20	Methyl T-Butyl Ether (MTBE)	1634044	100%	0.36-0.36	0.00%	1.05	3.57	2.49	2.85	1.30	N/A	
21	Methyl Ethyl Ketone (2-Butanone)	78933	100%	0.30-0.30	0.00%	0.56	0.83	0.69	0.68	0.13	N/A	
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	33%	0.37-0.37	66.67%	0.18	0.51	0.29	0.18	0.19	N/A	
25	Hexane	110543	100%	0.36-0.36	0.00%	0.95	1.84	1.46	1.59	0.46	N/A	
32	Benzene	71432	100%	0.32-0.32	0.00%	1.02	2.23	1.75	2.01	0.65	N/A	
33	Carbon Tetrachloride	56235	100%	0.64-0.64	66.67%	0.31	0.63	0.42	0.31	0.18	N/A	
47	Toluene	108883	100%	0.38-0.38	0.00%	3.24	6.82	4.86	4.52	1.81	N/A	
56	Ethylbenzene	100414	67%	0.44-0.44	33.33%	0.22	1.00	0.67	0.78	0.40	N/A	
57	(m and /or p) Xylene	108383/ 106423	100%	0.44-0.44	0.00%	0.74	3.41	2.33	2.84	1.41	N/A	
62	o-Xylene (1,2-Dimethyl Benzene)	95476	67%	0.44-0.44	33.33%	0.22	1.26	0.84	1.04	0.55	N/A	
72	1,2,4-Trimethylbenzene	95636	67%	0.50-0.50	33.33%	0.25	1.18	0.84	1.08	0.51	N/A	
81	Naphthalene	91203	67%	0.53-0.53	66.67%	0.26	0.52	0.35	0.26	0.15	N/A	

Table 3-27. Summary statistics for COPCs from Site M 2002.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.78	68.22	5.77	1.84	12.95	7.81	Log Normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.28	4.16	3.03	3.02	0.39	3.15	Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.93	1.80	1.37	1.32	0.22	1.44	Normal
6	Vinyl Chloride	75014	15%	0.26-0.26	88.89%	0.13	1.36	0.21	0.13	0.27	0.23	Log Normal
7	1,3- Butadiene	106990	59%	0.22-0.22	44.44%	0.11	13.92	1.98	0.24	3.50	6.34	Log Normal
10	Acetone	67641	93%	0.24-0.24	7.41%	0.12	8.45	4.95	5.55	2.33	8.45	Log Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.07	2.25	1.54	1.52	0.23	1.62	Normal
12	Acrylonitrile	107131	59%	0.22-0.22	51.85%	0.11	1.50	0.26	0.11	0.29	0.34	Log Normal
14	Methylene Chloride	75092	100%	0.35-0.35	7.41%	0.17	1.18	0.50	0.45	0.21	0.57	Log Normal
15	Methyl Acetate	79209	44%	0.31-0.31	74.07%	0.15	0.79	0.22	0.15	0.15	0.27	Log Normal
16	Freon 113 (Cl3F3Ethane)	76131	67%	0.77-0.77	88.89%	0.38	1.00	0.44	0.38	0.17	0.65	Log Normal
17	Carbon Disulfide	75150	52%	0.31-0.31	55.56%	0.16	0.84	0.31	0.16	0.21	0.40	Log Normal
20	Methyl T-Butyl Ether (MTBE)	1634044	74%	0.36-0.36	37.04%	0.18	1.91	0.77	0.51	0.59	1.24	Log Normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	96%	0.30-0.30	3.70%	0.15	2.57	1.18	0.91	0.66	1.40	Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	37%	0.37-0.37	62.96%	0.18	2.68	0.58	0.18	0.69	0.85	Log Normal
25	Hexane	110543	89%	0.36-0.36	18.52%	0.18	1.52	0.72	0.78	0.40	0.85	Normal
26	Chloroform	67663	33%	0.49-0.49	81.48%	0.24	0.88	0.33	0.24	0.18	0.39	Log Normal
32	Benzene	71432	100%	0.32-0.32	3.70%	0.16	1.98	0.87	0.86	0.41	1.01	Normal
33	Carbon Tetrachloride	56235	81%	0.64-0.64	40.74%	0.31	1.70	0.66	0.63	0.38	0.85	Log Normal
40	Methyl Methacrylate	80626	30%	0.41-0.41	74.07%	0.20	1.39	0.40	0.20	0.38	0.51	Log Normal
47	Toluene	108883	100%	0.38-0.38	0.00%	0.38	14.02	3.71	2.53	3.83	7.21	Log Normal
52	Tetrachloroethene	127184	30%	0.69-0.69	85.19%	0.34	1.02	0.41	0.34	0.19	0.48	Log Normal
57	(m and /or p) Xylene	108383/ 106423	78%	0.44-0.44	29.63%	0.22	2.41	0.82	0.70	0.59	1.02	Normal
60	Styrene	100425	37%	0.43-0.43	88.89%	0.21	0.81	0.26	0.21	0.14	0.31	Log Normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	48%	0.44-0.44	74.07%	0.22	0.78	0.31	0.22	0.16	0.38	Log Normal
72	1,2,4-Trimethylbenzene	95636	48%	0.50-0.50	85.19%	0.25	0.74	0.30	0.25	0.15	0.37	Log Normal

Table 3-28. Summary statistics for COPCs from Site M 2003.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.67	43.97	3.74	1.24	8.14	4.54	Log Normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	1.53	6.34	2.97	2.92	0.83	3.23	Log Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.41	2.24	1.34	1.28	0.45	1.48	Normal
6	Vinyl Chloride	75014	28%	0.26-0.26	86.21%	0.13	0.61	0.16	0.13	0.10	0.19	Log Normal
7	1,3- Butadiene	106990	86%	0.22-0.22	44.83%	0.11	8.86	1.08	0.24	1.95	2.31	Log Normal
10	Acetone	67641	100%	0.24-0.24	0.00%	2.02	10.12	5.15	5.14	2.23	5.85	Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	0.90	2.19	1.65	1.63	0.31	1.75	Normal
12	Acrylonitrile	107131	41%	0.22-0.22	79.31%	0.11	1.35	0.23	0.11	0.32	0.31	Log Normal
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.35	0.90	0.51	0.49	0.13	0.55	Log Normal
16	Freon 113 (Cl3F3Ethane)	76131	100%	0.77-0.77	89.66%	0.38	0.84	0.43	0.38	0.14	0.66	Log Normal
17	Carbon Disulfide	75150	72%	0.31-0.31	82.76%	0.16	0.84	0.22	0.16	0.17	0.27	Log Normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	97%	0.30-0.30	27.59%	0.15	1.24	0.48	0.41	0.32	0.59	Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	48%	0.37-0.37	89.66%	0.18	1.56	0.27	0.18	0.29	0.35	Log Normal
25	Hexane	110543	90%	0.36-0.36	48.28%	0.18	1.77	0.46	0.35	0.38	0.63	Log Normal
26	Chloroform	67663	59%	0.49-0.49	86.21%	0.24	0.73	0.29	0.24	0.13	0.37	Log Normal
32	Benzene	71432	100%	0.32-0.32	13.79%	0.16	1.98	0.65	0.51	0.44	0.82	Log Normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	20.69%	0.31	0.94	0.64	0.69	0.18	0.73	Log Normal
47	Toluene	108883	100%	0.38-0.38	17.24%	0.19	15.31	2.40	1.32	2.97	4.59	Log Normal
57	(m and /or p) Xylene	108383/ 106423	79%	0.44-0.44	68.97%	0.22	2.14	0.46	0.22	0.50	0.67	Log Normal

Table 3-29. Summary statistics for COPCs from Site M 2004.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL ($\mu g/m^3$)	% Samples < SQL	Min. Conc. ($\mu g/m^3$)	Max. Conc. ($\mu g/m^3$)	Arithmetic Mean ($\mu g/m^3$)	Median Conc. ($\mu g/m^3$)	Standard Deviation ($\mu g/m^3$)	95% UCL ($\mu g/m^3$)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.74	57.53	3.93	1.91	10.36	3.92	Log Normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	1.34	4.65	3.12	3.12	0.58	3.35	Log Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.60	2.21	1.21	1.18	0.29	1.31	Log Normal
7	1,3- Butadiene	106990	59%	0.22-0.22	48.28%	0.11	2.81	0.71	0.24	0.88	1.36	Log Normal
10	Acetone	67641	100%	0.24-0.24	0.00%	0.98	11.69	4.71	4.07	2.65	5.99	Log Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	0.90	2.08	1.68	1.74	0.22	1.77	Log Normal
12	Acrylonitrile	107131	45%	0.22-0.22	89.66%	0.11	1.00	0.15	0.11	0.17	0.18	Log Normal
14	Methylene Chloride	75092	100%	0.35-0.35	10.34%	0.17	0.73	0.45	0.45	0.14	0.50	Log Normal
16	Freon 113 (Cl3F3Ethane)	76131	100%	0.77-0.77	86.21%	0.38	1.00	0.45	0.38	0.17	0.70	Log Normal
17	Carbon Disulfide	75150	59%	0.31-0.31	89.66%	0.16	0.84	0.19	0.16	0.13	0.24	Log Normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	79%	0.30-0.30	34.48%	0.15	2.01	0.54	0.44	0.47	0.78	Log Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	38%	0.37-0.37	75.86%	0.18	1.41	0.31	0.18	0.29	0.39	Log Normal
25	Hexane	110543	93%	0.36-0.36	37.93%	0.18	1.48	0.56	0.46	0.40	0.79	Log Normal
26	Chloroform	67663	41%	0.49-0.49	89.66%	0.24	0.98	0.29	0.24	0.16	0.34	Log Normal
32	Benzene	71432	100%	0.32-0.32	17.24%	0.16	1.60	0.70	0.67	0.41	0.89	Log Normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	24.14%	0.31	1.01	0.61	0.63	0.19	0.70	Log Normal
40	Methyl Methacrylate	80626	38%	0.41-0.41	89.66%	0.20	0.86	0.24	0.20	0.13	0.28	Log Normal
47	Toluene	108883	100%	0.38-0.38	13.79%	0.19	8.44	2.33	1.62	2.29	4.36	Log Normal
56	Ethylbenzene	100414	41%	0.44-0.44	86.21%	0.22	1.26	0.28	0.22	0.21	0.34	Log Normal
57	(m and /or p) Xylene	108383/ 106423	69%	0.44-0.44	58.62%	0.22	4.03	0.68	0.22	0.82	0.97	Log Normal
62	o-Xylene (1,2-Dimethyl Benzene)	95476	45%	0.44-0.44	82.76%	0.22	0.78	0.28	0.22	0.15	0.33	Log Normal
72	1,2,4-Trimethylbenzene	95636	34%	0.50-0.50	86.21%	0.25	0.59	0.29	0.25	0.11	0.33	Log Normal

Table 3-30. Summary statistics for COPCs from Site M 2005.

Cmpd #	Compound	CAS	Frequency of Detection	Range of SQL (µg/m^3)	% Samples < SQL	Min. Conc. (µg/m^3)	Max. Conc. (µg/m^3)	Arithmetic Mean (µg/m^3)	Median Conc. (µg/m^3)	Standard Deviation (µg/m^3)	95% UCL (µg/m^3)	Basis of 95% UCL
2	Freon 22 (ClF2Methane)	75456	100%	0.36-0.36	0.00%	0.96	12.74	2.46	1.81	2.28	2.94	Log Normal
3	Freon 12 (Cl2F2Methane)	75718	100%	0.50-0.50	0.00%	2.48	9.75	3.36	3.12	1.26	3.59	Log Normal
4	Chloromethane	74873	100%	0.21-0.21	0.00%	0.97	3.39	1.41	1.32	0.42	1.51	Log Normal
7	1,3- Butadiene	106990	86%	0.22-0.22	27.59%	0.11	7.43	0.98	0.49	1.43	1.84	Log Normal
10	Acetone	67641	100%	0.24-0.24	0.00%	3.55	19.75	7.82	7.14	3.50	9.02	Log Normal
11	Freon 11 (Cl3Fmethane)	75694	100%	0.57-0.57	0.00%	1.24	2.19	1.74	1.69	0.19	1.80	Normal
12	Acrylonitrile	107131	45%	0.22-0.22	89.66%	0.11	0.22	0.12	0.11	0.03	0.15	Log Normal
14	Methylene Chloride	75092	100%	0.35-0.35	0.00%	0.35	0.73	0.54	0.52	0.10	0.58	Log Normal
15	Methyl Acetate	79209	79%	0.31-0.31	89.66%	0.15	0.64	0.18	0.15	0.10	0.22	Log Normal
16	Freon 113 (Cl3F3Ethane)	76131	100%	0.77-0.77	72.41%	0.38	0.92	0.50	0.38	0.19	0.73	Log Normal
17	Carbon Disulfide	75150	62%	0.31-0.31	72.41%	0.16	0.96	0.25	0.16	0.20	0.30	Log Normal
21	Methyl Ethyl Ketone (2-Butanone)	78933	97%	0.30-0.30	10.34%	0.15	11.95	1.82	0.83	2.66	2.84	Log Normal
22	Chloroprene(2-Cl-1,3-Butadiene)	126998	21%	0.37-0.37	86.21%	0.18	3.37	0.34	0.18	0.60	0.37	Log Normal
25	Hexane	110543	97%	0.36-0.36	20.69%	0.18	1.84	0.64	0.49	0.45	0.84	Log Normal
26	Chloroform	67663	45%	0.49-0.49	82.76%	0.24	1.27	0.34	0.24	0.25	0.39	Log Normal
32	Benzene	71432	100%	0.32-0.32	6.90%	0.16	2.26	0.79	0.67	0.48	1.00	Log Normal
33	Carbon Tetrachloride	56235	100%	0.64-0.64	3.45%	0.31	2.70	0.78	0.69	0.41	0.86	Log Normal
47	Toluene	108883	100%	0.38-0.38	6.90%	0.19	6.94	2.14	1.55	1.72	3.55	Log Normal
52	Tetrachloroethene	127184	14%	0.69-0.69	89.66%	0.34	2.98	0.49	0.34	0.54	0.55	Log Normal
57	(m and /or p) Xylene	108383/ 106423	76%	0.44-0.44	58.62%	0.22	1.84	0.47	0.22	0.40	0.63	Log Normal

4.0 HAZARD IDENTIFICATION AND DOSE-RESPONSE ASSESSMENT

Generally recognized definitions of risk assessment include two components that depend on the core risk assessment disciplines of toxicology and epidemiology. These two components are known as hazard identification and dose-response assessment. Hazard identification is the process of determining whether exposure to a chemical can cause an increase in the incidence of an adverse health consequence in humans. Dose-response assessment is the process of characterizing the relationship between exposure and the incidence of an adverse health effect in the exposed population.

This assessment utilized toxicology reviews conducted by the USEPA, the Agency for Toxic Substances and Disease Registry (ATSDR), the State of California, the International Agency for Research on Cancer (IARC), and other government bodies to describe both the hazard and dose-response characteristics of the COPCs. These evaluations were conducted separately for health effects that could be caused following chronic (or long-term) exposures and those that could be caused following acute (one-time or short-term) exposures. Toxicity benchmarks, or levels of pollutants at or below a value assumed not to cause harmful effects to human health, were developed for chronic and acute exposures by various government bodies. These distinctions were made due to the uniqueness of the toxic response that can occur following short-term exposure to relatively high concentrations compared to that which can occur following long-term, lower-level exposure.

The remainder of this section describes the general types of health effects that were considered, details the type and source of the dose-response criteria that were utilized, and provides summary tables of the quantitative toxicity criteria that were used in the risk assessment.

4.1 Chronic Toxicity

Two distinct types of chronic health effects were considered in this assessment: cancer and non-cancer effects. To evaluate health effects and establish toxicity benchmarks in this study, the general hierarchy of data sources and methodologies outlined in the Risk Assessment Work Plan and advocated by the USEPA's Office of Air Quality Planning and Standards in the National Air Toxics Assessment (NATA) were used. Wherever available, USEPA inhalation unit risk estimates (URE) for cancer and USEPA reference concentrations (RfCs) for non-cancer effects were used as benchmark concentrations. When these values were not available, other values were used as benchmark concentrations in the following hierarchical preference: (i) minimal risk levels (MRLs) developed by ATSDR, (ii) California EPA inhalation unit risks and reference exposure levels (RELs), and (iii) USEPA's health effects assessment summary tables (HEAST).

Some toxics currently lack inhalation assessments from these sources and, therefore, oral potency estimates were used to calculate the inhalation toxicity values. The equations

used are described in Sections 4.1.1 and 4.1.2. The same toxicity data source hierarchy outlined above was used to select oral toxicity values. The use of oral toxicity values as the basis of inhalation values introduces uncertainty into the overall risk assessment. This approach was nevertheless adopted here to provide some evaluation of the degree of potential risk from chemical exposure, instead of excluding a detected chemical completely from the evaluation. The uncertainty section of the risk assessment documents the use of oral data to represent inhalation risks and discusses the effect on the overall risk estimates.

Established toxicity data were not available for all COPCs using the general hierarchy of data sources and methodologies outlined in the Risk Assessment Work Plan and, therefore, no risk estimates were generated for these compounds. The potential consequences of this to the overall risk estimate are discussed in the uncertainty analysis.

4.1.1 Cancer effects

A cancer toxicity criterion is a health assessment value that can be matched with environmental exposure data to estimate health risk. For carcinogens, toxicity measurements are generally expressed as a risk per unit concentration (e.g., an inhalation URE in units of risk per mg/m^3) or as a risk per daily intake (e.g., an oral carcinogenic potency slope factor, or CPS_o, in units of risk per mg/kg–day).

In hazard identification of carcinogens under the 1986 USEPA guidelines, human data, animal data, and supporting evidence are combined to characterize the weight–of–evidence (WOE) regarding the agent's potential as a human carcinogen into one of several categories:

Group A – Carcinogenic to Humans: Agents with adequate human data to demonstrate the causal association of the agent with human cancer (typically epidemiological data).

Group B – Probably Carcinogenic to Humans: Agents with sufficient evidence (i.e., indicative of a causal relationship) from animal bioassay data, but either limited (i.e., indicative of a possible causal relationship, but not exclusive of alternative explanations) human evidence (Group B1), or with little or no human data (Group B2).

Group C – Possibly Carcinogenic to Humans: Agents with limited animal evidence and little or no human data.

Group D – Not Classifiable as to Human Carcinogenicity: Agents without adequate data either to suggest or refute the suggestion of human carcinogenicity.

Group E – Evidence of Non–carcinogenicity for Humans: Agents that show no evidence for carcinogenicity in at least two adequate animal tests in

different species or in both adequate epidemiologic and animal studies.

The USEPA has released a final version of the Guidelines for Carcinogen Risk Assessment (2005). The cancer hazard descriptors in this final Guideline is slightly different than previous versions. Most notably, the "Group" classifications are no longer recommended:

"Carcinogenic to humans,"

"Likely to be carcinogenic to humans,"

"Suggestive evidence of carcinogenic potential,"

"Inadequate information to assess carcinogenic potential,"

"Not likely to be carcinogenic to humans."

These hazard descriptors are characterized by similar WOE narrative as the previous Guidelines with the exception that the Hill criteria for establishing causality (Hill, 1965; USEPA, 2005) are incorporated into the framework for carcinogen analysis. Since the chemicals analyzed in this risk assessment were evaluated in the USEPA IRIS program prior to the release of the final Guidelines for Carcinogen Risk Assessment, the prior WOE characterizations and hazard descriptors were used.

Weight-of-evidence determinations for carcinogenicity developed by the International Agency for Research on Cancer (IARC) were used for carcinogens not characterized by USEPA. Carcinogens are categorized by IARC as Group 1 (agents carcinogenic to humans), Group 2A (probable human carcinogen), and Group 2B (possible human carcinogen).

Only those substances that are known or suspected human carcinogens were considered in calculating incremental cancer risks (USEPA WOE groups A, B, or C, or IARC classifications of 1, 2A or 2B).

Inhalation UREs were used if available. The URE represents an estimate of the increased cancer risk from a lifetime (assumed to be 70 years) continuous exposure to a concentration of one unit of exposure.

If no URE was available for a known or suspected human carcinogen, CPS_os were converted to a URE by the following equation:

$$URE = \frac{CPS_o \, x \, IR}{BW} \qquad \text{Equation 4-1}$$

where:

URE	=	unit risk estimate (1/mg/m^3)
CPS_o	=	oral carcinogenic potency slope factor, equal to risk per mg/kg-day
IR	=	standard inhalation rate for an adult, equal to 20 m^3/day; and
BW	=	standard assumption for average adult body weight, equal to 70 kg.

Table 4-1 contains the chronic carcinogenic toxicity values for the chemicals analyzed in this study. There are 3 chemicals identified as carcinogens for which UREs or CPS_o were not calculated: 1,1-dichloroethene, chloroprene, and styrene. Without UREs or CPS_o, from the general hierarchy of data sources and methodologies outlined in the Risk Assessment Work Plan these chemicals were not included in the cancer risk assessment.

4.1.2 Non-cancer effects

For non–cancer effects, toxicity benchmarks are generally expressed as a concentration in air (e.g., an inhalation reference concentration or RfC in units of mg/m^3 air) or as a daily intake (e.g., an oral reference dose or RfD_o in units of mg/kg–day).

RfCs are generally used for evaluating the inhalation route of exposure and were given preference for this study. The reference concentration is an exposure that is believed to be without significant risk of adverse non-cancer health effects in a chronically exposed population, including sensitive individuals.

If no RfC was available, RfD_os were converted to RFCs using the following equation:

$$RfC = \frac{RfD \, x \, BW}{IR} \qquad \text{Equation 4-2}$$

where:

RfC	=	Inhalation reference concentration (mg/m^3);
RfD	=	Oral reference dose (mg/kg–day);
IR	=	Standard inhalation rate for an adult, equal to 20 m^3/day; and
BW	=	Standard assumption for average adult body weight, 70 kg.

Table 4-2 contains the chronic non-carcinogenic toxicity values for the chemicals analyzed in this study. There is a difference from Study 1 regarding the non–cancer toxicity benchmark for chloroprene. The WLATS Study 1 used the HEAST value of 0.007 mg/m^3 instead of a value of 0.001 mg/m^3 listed by California EPA (OEHHA), which is ranked higher in the general hierarchy of data sources and methodologies outlined in the Risk Assessment Work Plan. Any comparisons of the current WLATS Study 2 with Study 1 must bear in mind that the non–cancer toxicity benchmarks are

different; if Study 1 had used the California EPA value of 0.001 mg/m^3 instead of the HEAST value, then the non–cancer risk values would be 7-fold greater.

Table 4-3 contains the chronic non-carcinogenic target organ information for the chemicals analyzed in this study.

4.2 Acute Toxicity

In addition to long-term toxicity data, the potential for short-term acute effects from exposure to airborne COPCs also was evaluated. There is no simple or widely accepted method for estimating the risks from routine short-term exposures to the concentrations of most toxic substances found in ambient air samples. As such, there are no uniformly accepted short–term air concentration benchmarks for emissions from facilities and other common emission sources such as area and mobile sources.

In addition, acute benchmarks cover a wide spectrum of potential health effects, ranging from mild irritation to life-threatening conditions. Several acute benchmarks may be available for the same substance to address different short–term effects on health. Consistent with the screening level nature of acute health effects assessment, the lowest, or most conservative, acute benchmark was chosen for a given substance to evaluate all possible short–term health effects (generally, levels protective of mild effects).

Methods to develop acute benchmarks are ongoing in the USEPA, and the most recent recommendations from USEPA Region IV were used in the WLATS. The following sources of benchmarks were recommended as most appropriate for this analysis (listed in their order of preference):

ATSDR Acute Minimum Risk Levels (MRLs) - ATSDR derives benchmark values for airborne substances that are protective of exposures lasting from 24 hours to 14 days. Since this period includes the 24-hour averaging time of the samples collected in the WLATS, MRLs were used, assuming a 24 hour averaging time, for screening samples for potential acute health effects (ATSDR, 2002).

California Acute Reference Exposure Levels (RELs) - The acute RELs are recently derived benchmarks designed to be protective of a resident's short-term exposure to routine emissions from industrial facilities. RELs are generally derived for a 1-hour averaging period and were adjusted (using Haber's Law – see below) to match the 24-hour averaging period of the WLATS measurements (CalEPA, 2002).

Acute Exposure Guideline Levels (AEGLs) - AEGLs, developed by the National Advisory Committee of the USEPA Office of Pollution Prevention and Toxics (USEPA, 1997d), may correspond to exposure periods of 1/2, 1, 4, or 8 hours. AEGLs are currently under review, and were used with discretion.

ERPGs, CEELs and SPEGLs - Emergency Response Planning Guidelines (ERPGs), Community Emergency Exposure Levels (CEELs), and Short–Term Public Emergency Guidance Levels (SPEGLs) are developed by various regulatory authorities and research institutions; these acute benchmarks are designed to evaluate the potential consequences of accidental, catastrophic releases of chemicals. ERPGs are available on–line from the Department of Energy (www.scapa.bnl.gov) and in a published handbook (AIHA, 2001). CEELs (NRC, 1993) and SPEGLs (NRC, 1985) were developed and published by the National Research Council. ERPGs are derived for a 1-hour averaging period and were adjusted to a 24-hour averaging period using Haber's Law (see Equation 4-3).

Some time periods that correspond to particular acute benchmarks required adjustment to the 24-hour averaging time of the WLATS measurements. Where necessary, acute benchmarks (AB) were adjusted using Haber's Law (ten Berge et al., 1986) which states:

$$AB_{24} = AB\tau \text{ x } \left(\frac{\tau}{24}\right)^{1/n} \qquad \text{Equation 4-3}$$

where:

AB_{24}	=	acute benchmark concentration based on a 24–hour averaging period (appropriate for use in the WLATS risk assessment);
AB_τ	=	acute benchmark derived for a time–averaging period of τ hours;
τ	=	the averaging period (in hours) that corresponds to the acute benchmark concentration AB_τ; and
n	=	an empirical exponent assumed to have a value of 1 for this risk assessment (values typically range from 1 to 2.5).

In applying the above equation, the acute benchmark concentrations AB_{24} and AB_τ must be expressed in the same units. Also, a value of 1 was assumed for the coefficient n. If there were multiple time values to choose from, the value protective of the mildest effect and most closely matching the desired 24–hour averaging time was used as a starting point for extrapolation.

Given the uncertainties associated with performing acute risk analysis, a continuing evaluation of acute assessment methodologies was undertaken during the course of this risk assessment. However, no updated or alternate acute benchmarks or methodologies were identified that were found to be more appropriate than those identified above.

Table 4-4 contains the acute toxicity values for the chemicals analyzed in this study.

Table 4-1. Chronic carcinogenicity toxicity values for all of the chemicals in the study.

COMPOUND	CAS NO.	Oral CSF			Inh URE			WOE [1]
		1/(mg/kg-d)	Source	Date	1/(mg/m^3)	Source	Date	
FREON 22 (CHLORODIFLUOROMETHANE)	75456	--	--	--	--	--	--	3
FREON 12 (DICHLORODIFLUOROMETHANE)	75718	--	--	--	--	--	--	--
CHLOROMETHANE	74873	--	--	--	--	--	--	D
FREON 114 (DICHLOROTETRAFLUOROETHANE, 1,2-)	76142	--	--	--	--	--	--	--
VINYL CHLORIDE	75014	1.50E+00	IRIS	8/7/2000	8.80E-03	IRIS	8/7/2000	A
BUTADIENE, 1,3-	106990	3.40E-01	CAL EPA	12/19/2002	3.00E-02	IRIS	11/5/2002	B2
BROMOMETHANE	74839	--	--	--	--	--	--	D
CHLOROETHANE	75003	--	--	--	--	--	--	3
ACETONE	67641	--	--	--	--	--	--	D
FREON 11 (TRICHLOROFLUOROMETHANE)	75694	--	--	--	--	--	--	--
ACRYLONITRILE	107131	5.40E-01	IRIS	1/1/1991	6.80E-02	IRIS	1/1/1991	B1
DICHLOROETHENE, 1,1-	75354	--	--	--	--	--	--	C
METHYLENE CHLORIDE	75092	7.50E-03	IRIS	2/1/1995	4.70E-04	IRIS	2/1/1995	B2
METHYL ACETATE	79209	--	--	--	--	--	--	--
FREON 113 (TRICHLORO-1,2,2-TRIFLUOROETHANE, 1,1,2-)	76131	--	--	--	--	--	--	--
CARBON DISULFIDE	75150	--	--	--	--	--	--	--
DICHLOROETHENE, TRANS-1,2-	156605	--	--	--	--	--	--	--
DICHLOROETHANE, 1,1-	75343	5.70E-03	CAL EPA	4/1/1999	1.60E-03	CALEPA	4/1/1999	C
METHYL T-BUTYL ETHER	1634044	1.80E-03	CAL EPA	11/1/1999	2.60E-04	CALEPA	11/1/1999	3
METHYL ETHYL KETONE	78933	--	--	--	--	--	--	D
CHLOROPRENE (CHLORO-1,3-BUTADIENE, 2-)	126998	--	--	--	--	--	--	2B
DICHLOROETHENE, CIS-1,2-	156592	--	--	--	--	--	--	D
HEXANE	110543	--	--	--	--	--	--	--
CHLOROFORM	67663	3.10E-02	CAL EPA	9/1/1990	2.30E-02	IRIS	10/19/2001	B2

COMPOUND	CAS NO.	Oral CSF			Inh URE			WOE [1]
		1/(mg/kg-d)	Source	Date	1/(mg/m^3)	Source	Date	
DICHLOROPROPANE, 2,2-	594207	--	--	--	--	--	--	--
DICHLOROETHANE, 1,2-	107062	9.10E-02	IRIS	1/1/1991	2.60E-02	IRIS	1/1/1991	B2
TRICHLOROETHANE, 1,1,1-	71556	--	--	--	--	--	--	D
DICHLOROPROPENE, 1,1-	563586	--	--	--	--	--	--	--
BENZENE	71432	1.5E-2 to 5.0E-2	IRIS	1/19/2000	2.2E-3 to 7.8E-3	IRIS	1/19/2000	A
CARBON TETRACHLORIDE	56235	1.30E-01	IRIS	6/1/1991	1.50E-02	IRIS	6/1/1991	B2
CYCLOHEXANE	110827	--	--	--	--	--	--	--
DIBROMOMETHANE	74953	--	--	--	--	--	--	--
DICHLOROPROPANE, 1,2-	78875	6.80E-02	HEAST	7/1/1997	1.90E-02	Calculated	--	B2
ETHYL ACRYLATE	140885	4.80E-02	HEAST	7/1/1997	1.40E-02	Calculated	--	B2
BROMODICHLOROMETHANE	75274	6.20E-02	IRIS	3/1/1993	1.80E-02	Calculated	--	B2
TRICHLOROETHENE	79016	1.30E-02	CAL EPA	10/1/1990	2.00E-03	CAL EPA	10/1/1990	2A
METHYL METHACRYLATE	80626	--	--	--	--	--	--	E
DICHLOROPROPENE, CIS-1,3-	10061015	--	--	--	--	--	--	--
METHYL ISOBUTYL KETONE	108101	--	--	--	--	--	--	--
METHYLCYCLOHEXANE	108872	--	--	--	--	--	--	--
DICHLOROPROPENE, TRANS-1,3-	10061026	1.0E-01 [2]	IRIS	5/25/2000	4.00E-03	IRIS	5/25/2000	B2
TRICHLOROETHANE, 1,1,2-	79005	5.70E-02	IRIS	2/1/1994	1.60E-02	IRIS	2/1/1994	C
TOLUENE	108883	--	--	--	--	--	--	D
DICHLOROPROPANE, 1,3-	142289	--	--	--	--	--	--	--
METHYL BUTYL KETONE	591786	--	--	--	--	--	--	--
DIBROMOCHLOROMETHANE	124481	8.40E-02	IRIS	1/1/1992	2.40E-02	Calculated	--	C
DIBROMOMETHANE, 1,2-	106934	2.00E+00	IRIS	7/29/2004	6.00E-01	IRIS	7/29/2004	2A
TETRACHLOROETHENE	127184	5.40E-01	CAL EPA	8/1/2001	5.90E-03	CAL EPA	8/1/2001	2A
TETRACHLOROETHANE, 1,1,1,2-	630206	2.60E-02	IRIS	1/1/1991	7.40E-03	IRIS	1/1/1991	C
CHLOROBENZENE	108907	--	--	--	--	--	--	D
ETHYL BENZENE	100414	--	--	--	--	--	--	D
XYLENE, m-	108383/106423	--	--	--	--	--	--	D

COMPOUND	CAS NO.	Oral CSF			Inh URE			WOE [1]
		1/(mg/kg-d)	Source	Date	1/(mg/m^3)	Source	Date	
XYLENE, p-	106423	--	--	--	--	--	--	D
BROMOFORM	75252	7.90E-03	IRIS	1/1/1991	1.10E-03	IRIS	1/1/1991	B2
BUTYL ACRYLATE	141322	--	--	--	--	--	--	3
STYRENE	100425	--	--	--	--	--	--	2B
1,1,2,2-TETRACHLOROETHANE	79345	2.00E-01	IRIS	2/1/1994	5.80E-02	IRIS	2/1/1994	C
XYLENE, o-	95476	--	--	--	--	--	--	D
TRICHLOROPROPANE, 1,2,3-	96184	7.00E+00	HEAST	7/1/1997	2.00E+00	Calculated	--	B2
ISOPROPYLBENZENE	98828	--	--	--	--	--	--	D
BROMOBENZENE	108861	--	--	--	--	--	--	--
CHLOROTOLUENE, o-	95498	--	--	--	--	--	--	--
PROPYLBENZENE, N-	103651	--	--	--	--	--	--	--
CHLOROTOLUENE, p-	106434	--	--	--	--	--	--	--
TRIMETHYLBENZENE, 1,3,5-	108678	--	--	--	--	--	--	--
BUTYLBENZENE, TERT-	98066	--	--	--	--	--	--	--
TRIMETHYLBENZENE, 1,2,4-	95636	--	--	--	--	--	--	--
DICHLOROBENZENE, 1,3-	541731	--	--	--	--	--	--	--
DICHLOROBENZENE, 1,4-	106467	5.40E-03	CAL EPA	12/1/1997	1.10E-02	CAL EPA	12/1/1997	2B
BUTYLBENZENE, SEC-	135988	--	--	--	--	--	--	--
ISOPROPYLTOLUENE, p-	99876	--	--	--	--	--	--	--
DICHLOROBENZENE, 1,2-	95501	--	--	--	--	--	--	D
BUTYLBENZENE, N-	104518	--	--	--	--	--	--	--
DIBROMO-3-CHLOROPROPANE, 1,2-	96128	7.00E+00	CAL EPA	2/1/1999	1.90E+00	CAL EPA	2/1/1999	2B
TRICHLOROBENZENE, 1,2,4-	120821	3.60E-03	CAL EPA	2/1/1999	--	--	--	D
NAPHTHALENE	91203	1.20E-01	CAL EPA	8/3/2004	3.40E-02	CALEPA	8/3/2004	C
TRICHLOROBENZENE, 1,2,3-	87616	--	--	--	--	--	--	--
HEXACHLOROBUTADIENE	87683	7.80E-02	IRIS	4/1/1991	2.20E-02	IRIS	4/1/1991	C

[1] EPA (1986)/IARC Weight-of-evidence codes: A/1, Known human carcinogen; B1 or B2/2A, Probable human carcinogen; C/2B, Possible human carcinogen; D/3, Not classifiable; E/4, Evidence of noncarcinogenicity/Probably not carcinogenic.

[2] Values for 1,3-dichloropropene (CAS 542756).

Table 4-2. Non-cancer chronic toxicity values for all of the chemicals in the study.

COMPOUND	CAS NO.	Oral RfD				Inh RfC			
		(mg/kg-d)	Source	Date	UF / MF [1]	(mg/m^3)	Source	Date	UF / MF [1]
FREON 22 (CHLORODIFLUOROMETHANE)	75456	--	--	--	--	5.00E+01	IRIS	11/1/1993	100 / 1
FREON 12 (DICHLORODIFLUOROMETHANE)	75718	2.00E-01	IRIS	11/1/1995	100 / 1	7.00E-01	Calculated	--	--
CHLOROMETHANE	74873	--	--	--	--	9.00E-02	IRIS	7/17/2001	1000 / 1
FREON 114 (DICHLOROTETRAFLUOROETHANE, 1,2-)	76142	--	--	--	--	--	--	--	--
VINYL CHLORIDE	75014	3.00E-03	IRIS	8/7/2000	30 / 1	1.00E-01	IRIS	8/7/2000	30 / 1
BUTADIENE, 1,3-	106990	--	--	--	--	2.00E-03	IRIS	11/5/2002	1000 / 1
BROMOMETHANE	74839	1.40E-03	IRIS	7/1/1991	1000 / 1	5.00E-03	IRIS	10/1/1992	100 / 1
CHLOROETHANE	75003	--	--	--	--	1.00E+01	IRIS	4/1/1991	300 / 1
ACETONE	67641	9.00E-01	IRIS	7/31/2003	1000 / 1	3.10E+01	ATSDR	5/1/1994	--
FREON 11 (TRICHLOROFLUOROMETHANE)	75694	3.00E-01	IRIS	8/1/1992	1000 / 1	1.10E+00	Calculated	--	--
ACRYLONITRILE	107131	4.00E-02	ATSDR	12/1990	--	2.00E-03	IRIS	12/1/1991	1000 / 1
DICHLOROETHENE, 1,1-	75354	5.00E-02	IRIS	8/13/2002	100 / 1	2.00E-01	IRIS	8/13/2002	30 / 1
METHYLENE CHLORIDE	75092	6.00E-02	IRIS	3/1/1988	100 / 1	1.00E+00	ATSDR	9/1/2000	30
METHYL ACETATE	79209	1.00E+00	HEAST	7/1/1997	1000	3.50E+00	Calculated	--	--
FREON 113 (TRICHLORO-1,2,2-TRIFLUOROETHANE, 1,1,2-)	76131	3.00E+01	IRIS	2/1/1996	10 / 1	1.10E+02	Calculated	--	--
CARBON DISULFIDE	75150	1.00E-01	IRIS	9/1/1990	100 / 1	7.00E-01	IRIS	8/1/1995	30 / 1
DICHLOROETHENE, TRANS-1,2-	156605	2.00E-02	IRIS	1/1/1989	1000 / 1	7.90E-01 [2]	ATSDR	8/1/1996	1000
DICHLOROETHANE, 1,1-	75343	--	--	--	--	--	--	--	--
METHYL T-BUTYL ETHER	1634044	0.3 [2]	ATSDR	8/1/1996	--	3.00E+00	IRIS	9/1/1993	100 / 1
METHYL ETHYL KETONE	78933	6.00E-01	IRIS	9/26/2003	1000 / 1	5.00E+00	IRIS	9/26/2003	300 / 1
CHLOROPRENE (CHLORO-1,3-BUTADIENE, 2-)	126998	--	--	--	--	1.00E+00	CAL EPA	1/1992	--
DICHLOROETHENE, CIS-1,2-	156592	1.00E-02	HEAST	7/1/1997	3000	3.50E-02	Calculated	--	--
HEXANE	110543	6.00E-02	HEAST	7/1/1997	10000	7.00E-01	IRIS	12/23/2005	300 / 1

COMPOUND	CAS NO.	Oral RfD				Inh RfC			
		(mg/kg-d)	Source	Date	UF / MF [1]	(mg/m^3)	Source	Date	UF / MF [1]
CHLOROFORM	67663	1.00E-02	IRIS	10/19/2001	100 / 1	9.80E-02	ATSDR	9/1/1997	100
DICHLOROPROPANE, 2,2-	594207	--	--	--	--	--	--	--	--
DICHLOROETHANE, 1,2-	107062	--	--	--	--	2.40E+00	ATSDR	9/1/2001	90
TRICHLOROETHANE, 1,1,1-	71556	--	--	--	--	--	--	--	--
DICHLOROPROPENE, 1,1-	563586	--	--	--	--	--	--	--	--
BENZENE	71432	4.00E-03	IRIS	4/17/2003	300 / 1	3.00E-02	IRIS	4/17/2003	300 / 1
CARBON TETRACHLORIDE	56235	7.00E-04	IRIS	6/1/1991	1000 / 1	4.00E-02	CAL EPA	1/1/2001	300
CYCLOHEXANE	110827	--	--	--	--	--	--	--	--
DIBROMOMETHANE	74953	--	--	--	--	--	--	--	--
DICHLOROPROPANE, 1,2-	78875	9.00E-02	ATSDR	12/1989	--	4.00E-03	IRIS	12/1/1991	300 / 1
ETHYL ACRYLATE	140885	--	--	--	--	--	--	--	--
BROMODICHLOROMETHANE	75274	2.00E-02	IRIS	3/1/1991	1000 / 1	7.00E-02	Calculated	--	--
TRICHLOROETHENE	79016	--	--	--	--	6.00E-01	CAL EPA	4/1/2000	100
METHYL METHACRYLATE	80626	1.40E+00	IRIS	3/2/1998	100 / 1	7.00E-01	IRIS	3/2/1998	10 / 1
DICHLOROPROPENE, CIS-1,3-	10061015	--	--	--	--	--	--	--	--
METHYL ISOBUTYL KETONE	108101	8.00E-02	HEAST	7/1/1997	3000	2.80E-01	Calculated	--	--
METHYLCYCLOHEXANE	108872	--	--	--	--	3.00E+00	HEAST	7/1/1997	100
DICHLOROPROPENE, TRANS-1,3-	10061026	3.0E-02 [3]	IRIS	5/25/2000	100 / 1	2.00E-02	IRIS	5/25/2000	30 / 1
TRICHLOROETHANE, 1,1,2-	79005	4.00E-03	IRIS	2/1/1995	1000 / 1	1.40E-02	Calculated	--	--
TOLUENE	108883	8.00E-02	IRIS	9/23/2005	3000 / 1	5.00E+00	IRIS	9/23/2005	10 / 1
DICHLOROPROPANE, 1,3-	142289	--	--	--	--	--	--	--	--
METHYL BUTYL KETONE	591786	--	--	--	--	--	--	--	--
DIBROMOCHLOROMETHANE	124481	2.00E-02	IRIS	3/1/1991	1000 / 1	7.00E-02	Calculated	--	--
DIBROMOMETHANE, 1,2-	106934	9.00E-03	IRIS	7/29/2004	3000 / 1	9.00E-03	IRIS	7/29/2003	300
TETRACHLOROETHENE	127184	1.00E-02	IRIS	3/1/1988	1000 / 1	2.70E-01	ATSDR	9/1/1997	100
TETRACHLOROETHANE, 1,1,1,2-	630206	3.00E-02	IRIS	12/1/1996	3000 / 1	1.10E-01	Calculated	--	--
CHLOROBENZENE	108907	2.00E-02	IRIS	7/1/1993	1000 / 1	1.00E+00	CAL EPA	1/1/2001	100
ETHYL BENZENE	100414	1.00E-01	IRIS	6/1/1991	1000 / 1	1.00E+00	IRIS	3/1/1991	300 / 1
XYLENE, m-	108383/ 106423	2.0E-01 [4]	IRIS	2/21/2003	1000 / 1	1.00E-01	IRIS	2/21/2003	300 / 1

COMPOUND	CAS NO.	Oral RfD				Inh RfC			
		(mg/kg-d)	Source	Date	UF / MF [1]	(mg/m^3)	Source	Date	UF / MF [1]
XYLENE, p-	106423	2.0E-01 [4]	IRIS	2/21/2003	1000 / 1	1.0E-01 [4]	IRIS	2/21/2003	300 / 1
BROMOFORM	75252	2.00E-02	IRIS	3/1/1991	1000 / 1	7.00E-02	Calculated	--	--
BUTYL ACRYLATE	141322	--	--	--	--	--	--	--	--
STYRENE	100425	2.00E-01	IRIS	9/1/1990	1000 / 1	1.00E+00	IRIS	7/1/1993	30 / 1
TETRACHLOROETHANE, 1,1,2,2-	79345	4.00E-02	ATSDR	8/1996	1000	--	--	--	--
XYLENE, o-	95476	2.0E-01 [4]	IRIS	2/21/2003	1000 / 1	1.00E-01	IRIS	2/21/2003	300 / 1
TRICHLOROPROPANE, 1,2,3-	96184	6.00E-03	IRIS	8/1/1990	1000 / 1	2.10E-02	Calculated	--	--
ISOPROPYLBENZENE	98828	1.00E-01	IRIS	8/1/1997	1000 / 1	4.00E-01	IRIS	8/1/1997	1000 / 1
BROMOBENZENE	108861	--	--	--	--	--	--	--	--
CHLOROTOLUENE, o-	95498	2.00E-02	IRIS	2/1/1990	1000 / 1	--	--	--	--
PROPYLBENZENE, N-	103651	--	--	--	--	--	--	--	--
CHLOROTOLUENE, p-	106434	--	--	--	--	--	--	--	--
TRIMETHYLBENZENE, 1,3,5-	108678	--	--	--	--	--	--	--	--
BUTYLBENZENE, TERT-	98066	--	--	--	--	--	--	--	--
TRIMETHYLBENZENE, 1,2,4-	95636	--	--	--	--	--	--	--	--
DICHLOROBENZENE, 1,3-	541731	--	--	--	--	8.00E-01	IRIS	11/1/1996	100 / 1
DICHLOROBENZENE, 1,4-	106467	--	--	--	--	8.00E-01	IRIS	11/1/1996	100 / 1
BUTYLBENZENE, SEC-	135988	--	--	--	--	--	--	--	--
ISOPROPYLTOLUENE, p-	99876	--	--	--	--	--	--	--	--
DICHLOROBENZENE, 1,2-	95501	9.00E-02	IRIS	3/1/1991	1000 / 1	3.2E-01	Calculated	--	--
BUTYLBENZENE, N-	104518	--	--	--	--	--	--	--	--
DIBROMO-3-CHLOROPROPANE, 1,2-	96128	--	--	--	--	2.00E-04	IRIS	10/1/1991	1000 / 1
TRICHLOROBENZENE, 1,2,4-	120821	1.00E-02	IRIS	11/1/1996	1000 / 1	2.00E-01	HEAST	7/1/1997	1000
NAPHTHALENE	91203	2.00E-02	IRIS	9/17/1998	3000 / 1	3.00E-03	IRIS	9/17/1998	3000 / 1
TRICHLOROBENZENE, 1,2,3-	87616	--	--	--	--	--	--	--	--
HEXACHLOROBUTADIENE	87683	2.00E-04	HEAST	7/1/1997	1000	7.00E-04	Calculated	--	--

[1] UF/MF: Uncertainty factor/modifying factor

[2] Intermediate MRL

[3] Values for 1,3-dichloropropene (CAS 542756)

[4] Values for xylene mixture (CAS 1330207)

Table 4-3. Non-cancer critical effects for all of the chemicals in the study.

COMPOUND	Source	Critical Effect for Derivation of Toxicity Value	Target Organs for Other Inhalation Chronic Effects									
			NEUR	RSP	CARD	DEV	SKIN	HEM	IMM	RPR	REN	HEP
FREON 22 (CHLORODIFLUOROMETHANE)	IRIS	Increased kidney, adrenal and pituitary weights (other effect: Reduced maternal weight gain)										
FREON 12 (DICHLORODIFLUOROMETHANE)												
CHLOROMETHANE	IRIS	Cerebellar lesions	X									
FREON 114 (DICHLOROTETRAFLUOROETHANE, 1,2-)												
VINYL CHLORIDE	IRIS	Liver cell polymorphism	X									X
BUTADIENE, 1,3-	IRIS	Ovarian atrophy		X		X				X		
BROMOMETHANE	IRIS	Degenerative and proliferative lesions of the olfactory epithelium of the nasal cavity	X	X								
CHLOROETHANE	IRIS	Delayed fetal ossification				X						
ACETONE	ATSDR	Neurological endpoint	X									
FREON 11 (TRICHLOROFLUOROMETHANE)												
ACRYLONITRILE	IRIS	Degeneration and inflammation of nasal respiratory epithelium; hyperplasia of mucous secreting cells		X		X						
DICHLOROETHENE, 1,1-	IRIS	Liver toxicity (fatty change)									X	X
METHYLENE CHLORIDE	ATSDR	Hepatic endpoint										X
METHYL ACETATE												
FREON 113 (TRICHLORO-1,2,2-TRIFLUOROETHANE, 1,1,2-)												
CARBON DISULFIDE	IRIS	Peripheral nervous system dysfunction	X		X	X				X		
DICHLOROETHENE, TRANS-1,2-	ATSDR	Hepatic endpoint										

COMPOUND	Source	Critical Effect for Derivation of Toxicity Value	Target Organs for Other Inhalation Chronic Effects									
			NEUR	RSP	CARD	DEV	SKIN	HEM	IMM	RPR	REN	HEP
DICHLOROETHANE, 1,1-												
METHYL T-BUTYL ETHER	IRIS	Increased absolute and relative liver and kidney weights and increased severity of spontaneous renal lesions (females), increased prostration (females), and swollen periocular tissue (males and females)									X	
METHYL ETHYL KETONE	IRIS	Decreased fetal birth weight										
CHLOROPRENE (CHLORO-1,3-BUTADIENE, 2-)	HEAST/Cal EPA	Olfactory epithelial degeneration		X	X				X		X	X
DICHLOROETHENE, CIS-1,2-	ATSDR	Hepatic endpoint										
HEXANE	IRIS	Neurotoxicity; electrophysiological alterations (other effect: Epithelial lesions in the nasal cavity)	X									
CHLOROFORM	ATSDR	Hepatic endpoint										X
DICHLOROPROPANE, 2,2-												
DICHLOROETHANE, 1,2-	ATSDR	Hepatic endpoint										X
TRICHLOROETHANE, 1,1,1-	CAL EPA	Neurotoxicity										
DICHLOROPROPENE, 1,1-												
BENZENE	CAL EPA	Lowered red and white blood cell counts in occupationally exposed humans	X					X	X			
CARBON TETRACHLORIDE	CAL EPA	Increased liver weight and hepatic fatty infiltration in guinea pigs										X
CYCLOHEXANE												
DIBROMOMETHANE												
DICHLOROPROPANE, 1,2-	IRIS	Hyperplasia of the nasal mucosa										X
ETHYL ACRYLATE												
BROMODICHLOROMETHANE												
TRICHLOROETHENE	CAL EPA	Drowsiness, fatigue, headache, and eye irritation	X									

COMPOUND	Source	Critical Effect for Derivation of Toxicity Value	Target Organs for Other Inhalation Chronic Effects									
			NEUR	RSP	CARD	DEV	SKIN	HEM	IMM	RPR	REN	HEP
METHYL METHACRYLATE	IRIS	Degeneration/ atrophy of olfactory epithelium (male rats)										
DICHLOROPROPENE, CIS-1,3-	IRIS	Hypertrophy/ hyperplasia of the nasal respiratory epithelium										
METHYL ISOBUTYL KETONE												
METHYLCYCLOHEXANE												
DICHLOROPROPENE, TRANS-1,3-	IRIS	Hypertrophy/ hyperplasia of the nasal respiratory epithelium										
TRICHLOROETHANE, 1,1,2-												
TOLUENE	IRIS	Neurological effects (other effect: Degeneration of nasal epithelium)	X	X								
DICHLOROPROPANE, 1,3-												
METHYL BUTYL KETONE												
DIBROMOCHLOROMETHANE												
DIBROMOETHANE, 1,2-	IRIS	Nasal inflammation								X		X
TETRACHLOROETHENE	ATSDR	Neurological endpoint	X									
TETRACHLOROETHANE, 1,1,1,2-												
CHLOROBENZENE	CAL EPA	Increased liver weights, hepatocellular hypertrophy, renal degeneration and inflammation, and testicular degeneration in rats	X								X	X
ETHYL BENZENE	IRIS	Developmental toxicity		X							X	X
XYLENE, m-	CAL EPA	Dose related increase in the prevalence of eye irritation, sore throat, floating sensation, and poor appetite.	X									
XYLENE, p-	CAL EPA	Dose related increase in the prevalence of eye irritation, sore throat, floating sensation, and poor appetite.	X									
BROMOFORM											X	X
BUTYL ACRYLATE												

COMPOUND	Source	Critical Effect for Derivation of Toxicity Value	Target Organs for Other Inhalation Chronic Effects									
			NEUR	RSP	CARD	DEV	SKIN	HEM	IMM	RPR	REN	HEP
STYRENE	IRIS	CNS effects	X									
TETRACHLOROETHANE, 1,1,2,2-												
XYLENE, o-	CAL EPA	Dose related increase in the prevalence of eye irritation, sore throat, floating sensation, and poor appetite.	X									
TRICHLOROPROPANE, 1,2,3-												
ISOPROPYLBENZENE	IRIS	Increased kidney weights in female rats and adrenal weights in male and female rats										
BROMOBENZENE												
CHLOROTOLUENE, o-												
PROPYLBENZENE, N-												
CHLOROTOLUENE, p-												
TRIMETHYLBENZENE, 1,3,5-												
BUTYLBENZENE, TERT-												
TRIMETHYLBENZENE, 1,2,4-												
DICHLOROBENZENE, 1,3-												
DICHLOROBENZENE, 1,4-	IRIS	Increased liver weight										
BUTYLBENZENE, SEC-												
ISOPROPYLTOLUENE, p-												
DICHLOROBENZENE, 1,2-												
BUTYLBENZENE, N-												
DIBROMO-3-CHLOROPROPANE, 1,2-	IRIS	Testicular effects										
TRICHLOROBENZENE, 1,2,4-												
NAPHTHALENE	IRIS	Nasal effects: hyperplasia and metaplasia in respiratory and olfactory epithelium, respectively		X								
TRICHLOROBENZENE, 1,2,3-	HEAST	Liver weight changes										
HEXACHLOROBUTADIENE												

COMPOUND	Source	Critical Effect for Derivation of Toxicity Value	Target Organs for Other Inhalation Chronic Effects									
			NEUR	RSP	CARD	DEV	SKIN	HEM	IMM	RPR	REN	HEP

Chronic Effects Codes:
NEUR Neurological
RSP Respiratory
CARD Cardiovascular
DEV Developmental
SKIN Skin
HEM Hematological
IMM Immunological
RPR Reproductive
REN Renal
HEP Hepatic

Table 4-4. Non-cancer acute toxicity values for all of the chemicals in the study.

		Acute Inhalation Toxicity Values				
COMPOUND	**CAS NO.**	**(mg/m^3)**	**Source**	**Date**	**Exposure Duration (hrs)**	**24 hr (mg/m^3)**
FREON 22 (CHLORODIFLUOROMETHANE)	75456	--	--	--	--	--
FREON 12 (DICHLORODIFLUOROMETHANE)	75718	--	--	--	--	--
CHLOROMETHANE	74873	1.00E+00	ATSDR	12/1/1998	24	1.00E+00
FREON 114 (DICHLOROTETRAFLUOROETHANE, 1,2-)	76142	--	--	--	--	--
VINYL CHLORIDE	75014	1.30E+00	ATSDR	9/1/1997	24	1.30E+00
BUTADIENE, 1,3-	106990	1.48E+03	AEGL-1	proposed	8	4.93E+02
BROMOMETHANE	74839	1.90E-01	ATSDR	9/1/1992	24	1.90E-01
CHLOROETHANE	75003	4.00E+01	ATSDR	12/1/1998	24	4.00E+01
ACETONE	67641	6.20E+01	ATSDR	5/1/1994	24	6.20E+01
FREON 11 (TRICHLOROFLUOROMETHANE)	75694	--	--	--	--	--
ACRYLONITRILE	107131	2.20E-01	ATSDR	12/1/1990	24	2.20E-01
DICHLOROETHENE, 1,1-	75354	--	--	--	--	--
METHYLENE CHLORIDE	75092	2.10E+00	ATSDR	9/1/2000	24	2.10E+00
METHYL ACETATE	79209	--	--	--	--	--
FREON 113 (TRICHLORO-1,2,2-TRIFLUOROETHANE, 1,1,2-)	76131	--	--	--	--	--
CARBON DISULFIDE	75150	6.20E+00	CAL EPA	5/1/2000	6	1.60E+00
DICHLOROETHENE, TRANS-1,2-	156605	1.11E+03	AEGL-1	12/8/1999	8	3.70E+02
DICHLOROETHANE, 1,1-	75343	--	--	--	--	--
METHYL T-BUTYL ETHER	1634044	7.20E+00	ATSDR	8/1/1996	24	7.20E+00
METHYL ETHYL KETONE	78933	1.30E+01	CAL EPA	5/1/2000	1	5.40E-01
CHLOROPRENE (CHLORO-1,3-BUTADIENE, 2-)	126998	--	--	--	--	--

		Acute Inhalation Toxicity Values				
COMPOUND	CAS NO.	(mg/m^3)	Source	Date	Exposure Duration (hrs)	24 hr (mg/m^3)
DICHLOROETHENE, CIS-1,2-	156592	5.54E+02	AEGL-1	12/8/1999	8	1.85E+02
HEXANE	110543	1.16E+04	AEGL-2	proposed	8	3.88E+03
CHLOROFORM	67663	4.90E-01	ATSDR	9/1/1997	24	4.90E-01
DICHLOROPROPANE, 2,2-	594207	--	--	--	--	--
DICHLOROETHANE, 1,2-	107062	2.00E+02	ERPG-1	12/1/2002	1	8.30E+00
TRICHLOROETHANE, 1,1,1-	71556	1.10E+01	ATSDR	8/1/1995	24	1.10E+01
DICHLOROPROPENE, 1,1-	563586	--	--	--	--	--
BENZENE	71432	2.80E-02	ATSDR	9/1/2005	24	2.80E-02
CARBON TETRACHLORIDE	56235	1.88E-01	ATSDR	9/1/2005	24	1.88E-01
CYCLOHEXANE	110827	--	--	--	--	--
DIBROMOMETHANE	74953	--	--	--	--	--
DICHLOROPROPANE, 1,2-	78875	2.30E-01	ATSDR	12/1/1989	24	2.30E-01
ETHYL ACRYLATE	140885	3.39E+01	AEGL-1	proposed	8	1.13E+01
BROMODICHLOROMETHANE	75274	--	--	--	--	--
TRICHLOROETHENE	79016	1.10E+01	ATSDR	9/1/1997	24	1.10E+01
METHYL METHACRYLATE	80626	6.95E+01	AEGL-1	proposed	8	2.32E+01
DICHLOROPROPENE, CIS-1,3-	10061015	--	--	--	--	--
METHYL ISOBUTYL KETONE	108101	--	--	--	--	--
METHYLCYCLOHEXANE	108872	--	--	--	--	--
DICHLOROPROPENE, TRANS-1,3-	10061026	--	--	--	--	--
TRICHLOROETHANE, 1,1,2-	79005	--	--	--	--	--
TOLUENE	108883	3.80E+00	ATSDR	9/1/2000	24	3.80E+00
DICHLOROPROPANE, 1,3-	142289	--	--	--	--	--
METHYL BUTYL KETONE	591786	--	--	--	--	--
DIBROMOCHLOROMETHANE	124481	--	--	--	--	--
DIBROMOETHANE, 1,2-	106934	7.69E+01	AEGL-3	proposed	8	2.63E+00
TETRACHLOROETHENE	127184	1.40E+00	ATSDR	9/1/1997	24	1.40E+00
TETRACHLOROETHANE, 1,1,1,2-	630206	--	--	--	--	--

		Acute Inhalation Toxicity Values				
COMPOUND	CAS NO.	(mg/m^3)	Source	Date	Exposure Duration (hrs)	24 hr (mg/m^3)
CHLOROBENZENE	108907	--	--	--	--	--
ETHYL BENZENE	100414	--	--	--	--	--
XYLENE, m-	108383/106423	8.75 [1]	ATSDR	9/1/2005	24	8.75E+00
XYLENE, p-	106423	8.75 [1]	ATSDR	9/1/2005	24	8.75E+00
BROMOFORM	75252	--	--	--	--	--
BUTYL ACRYLATE	141322	4.35E+01	AEGL-1	proposed	8	1.45E+01
STYRENE	100425	2.10E+01	CAL EPA	5/1/2000	1	8.80E-01
TETRACHLOROETHANE, 1,1,2,2-	79345	--	--	--	--	--
XYLENE, o-	95476	8.75 [1]	ATSDR	9/1/2005	24	8.75E+00
TRICHLOROPROPANE, 1,2,3-	96184	1.80E-03	ATSDR	9/1/1992	24	1.80E-03
ISOPROPYLBENZENE	98828	2.46E+02	AEGL-1	proposed	8	8.20E+01
BROMOBENZENE	108861	--	--	--	--	--
CHLOROTOLUENE, o-	95498	--	--	--	--	--
PROPYLBENZENE, N-	103651	--	--	--	--	--
CHLOROTOLUENE, p-	106434	--	--	--	--	--
TRIMETHYLBENZENE, 1,3,5-	108678	--	--	--	--	--
BUTYLBENZENE, TERT-	98066	--	--	--	--	--
TRIMETHYLBENZENE, 1,2,4-	95636	--	--	--	--	--
DICHLOROBENZENE, 1,3-	541731	4.00E-01	ATSDR	10/1/2004	24	1.40E+00
DICHLOROBENZENE, 1,4-	106467	1.20E+01	ATSDR	10/1/2004	24	1.20E+01
BUTYLBENZENE, SEC-	135988	--	--	--	--	--
ISOPROPYLTOLUENE, p-	99876	--	--	--	--	--
DICHLOROBENZENE, 1,2-	95501	8.00E-01	ATSDR	10/1/2004	24	2.80E+00
BUTYLBENZENE, N-	104518	--	--	--	--	--
DIBROMO-3-CHLOROPROPANE, 1,2-	96128	--	--	--	--	--
TRICHLOROBENZENE, 1,2,4-	120821	--	--	--	--	--
NAPHTHALENE	91203	--	--	--	--	--
TRICHLOROBENZENE, 1,2,3-	87616	--	--	--	--	--

		Acute Inhalation Toxicity Values				
COMPOUND	**CAS NO.**	**(mg/m^3)**	**Source**	**Date**	**Exposure Duration (hrs)**	**24 hr (mg/m^3)**
HEXACHLOROBUTADIENE	87683	1.07E+01	ERPG-1	12/1/2002	1	4.40E-01

[1] Values for xylene mixture (CAS 1330207)

5.0 RISK CHARACTERIZATION

The risk characterization integrates the information from the exposure assessment and toxicity assessment steps in the risk assessment to provide an estimate of the magnitude of potential risks, and the strength of the conclusions based on the uncertainty in the information used to generate these estimates. For this risk assessment the risk characterization means combining the exposure concentrations with the chronic and acute toxicity data to provide a quantitative estimate of the potential health impacts. Both chronic and acute exposures are evaluated in this risk characterization. The chronic evaluation addresses both cancer and non-cancer health effects. Within the discussion of chronic exposures the cancer estimates will be followed by the non-cancer evaluation for each monitoring site. A detailed assessment of the uncertainty in the risk characterization is provided in the Uncertainty Section (i.e., Section 6).

5.1 Risk Characterization for Chronic Exposures

The risk characterization for the chronic exposures was conducted by comparing the relevant toxicity criteria to the exposure concentration estimated from the WLATS monitoring data. Two different estimates of the potential risk were calculated: a central tendency case based on the median air concentration; and a 95% UCL exposure case selected to represent a conservative estimate of exposure based on the 95% UCL concentration of the COPC in air.

In this assessment, risk estimates for COPCs with a cancer endpoint were expressed in terms of the probability of contracting cancer from a lifetime of continuous exposure (70 year lifespan) to a constant air concentration of the COPC. Cancer risk for each COPC at a monitoring location was derived as follows:

$$Risk_x = EC_x \times IUR_x \qquad \text{Equation 5-1}$$

Where:

$Risk_x$ = the risk of the X^{th} COPC at a monitor:
EC_x = the exposure concentration of the substance (i.e., median or 95% UCL air concentration); and
IUR_x = the inhalation unit risk of the substance.

Estimates of cancer risk were expressed as a probability, represented in scientific notation as a negative exponent of 10. For example, an additional lifetime risk of contracting cancer of 1 chance in 1,000,000 (or one additional person in 1,000,000) is written as 1×10^{-6} or lE–06 (explained in Appendix A).

In contrast to cancer risks, non-cancer hazards are not expressed as a probability of an individual suffering an adverse effect. Instead, non-cancer hazard to individuals is expressed in terms of the hazard quotient (HQ), defined as the ratio between the

estimated exposure to an individual and the Reference Concentration (RfC). For a given air toxic, exposures below the reference level (HQ<1) are not likely to be associated with adverse health effects. With exposures increasingly greater than the reference concentration, the potential for adverse effects increases. HQs were calculated as follows:

$$HQ_x = \frac{ECx}{RfC_x} \qquad \text{Equation 5-2}$$

Where:

HQ_x = the hazard quotient of the X^{th} COPC at a monitor;
EC_x = the exposure concentration of the substance (i.e., median or 95% UCL air concentration); and
RfC_x = the reference concentration of the substance.

When multiple noncarcinogens were present simultaneously, the individual HQs were summed to create a hazard index (HI), as:

$$HI = \sum_{x=1}^{n} \frac{ECx}{RfCx} \qquad \text{Equation 5-3}$$

Where:

HI = the hazard index of the n^{th} COPCs at a monitor;
EC_x = the exposure concentration of the individual substances; and
RfC_x = the reference concentration of the individual substances.

The HI is a measure of the potential for an adverse health effect from all of the COPCs combined. Different pollutants, however, may cause completely different adverse health effects or act via completely different mechanisms of action, so it is often inappropriate to sum HQs associated with different endpoints (USEPA, 2001). Therefore, when the hazard index at a site exceeded a value of 1, the aggregate risk from exposure to multiple COPCs was assessed by adding the individual HQs for materials that act by a similar mechanism of action or the same target organ for the critical effect. Unless otherwise noted, the hazard indices presented in this Section are the sum of all HQs for the COPCs at a monitor, which conservatively assumes that all of the COPCs have similarities in the mechanism of action or the target organ for the critical effect. Any deviations from this conservative HI will identify the similarity on which the HI was based and the COPCs that were included.

Aggregate risk from exposure to multiple COPCs was assessed by adding the individual HQs for materials that act by a similar mode of action or that affect the same target organ. Consistent with recent USEPA methodologies for air toxics (USEPA, 200l), a "target–organ–specific hazard index" (TOSHI), defined as the sum of hazard quotients for

individual air toxics that affect the same organ or organ system, will be calculated when the HI for all non–carcinogens at a monitor is greater than or equal to one.

In the risk discussion for each monitor, the total cancer risk and HI is presented based on all COPCs selected for the monitor.

For each monitor, the risk drivers will be identified based on COPCs that exceed a cancer risk level of 1×10^{-6} or an HQ of 0.1. The use of risk drivers helps to focus the risk assessment on those COPCs with the greatest potential to impact human health. The use of a 1×10^{-6} threshold for the cancer risk level is consistent with the acceptable cancer risk threshold used in the State of Kentucky and the goal in the APCD's Strategic Toxic Air Reduction (STAR) Program Regulation 5.21. An HQ of 0.1 for a COPC would indicate that adverse health effects are unlikely as a result of the exposure evaluated. However, using an HQ value of 0.1 as a threshold for the risk drivers provides a means to identify any COPCs that significantly contribute to an HI that exceeds a value of 1, at which there is a potential for an adverse health effect.

5.2 Acute Risk Characterization

Risks of acute health effects were estimated in much the same way as risks of non-cancer health effects. Maximum detected concentrations of each contaminant (CA_{max}) were compared to acute benchmark (AB) concentrations through the calculation of acute hazard quotients (HQ_{acute}):

$$HQ_{acute} = \frac{CA_{max}}{AB} \qquad \text{Equation 5-4}$$

where both CA_{max} and AB are expressed in the same units. Unlike chronic hazard quotients, however, HQ_{acute} values of individual substances were not added together because acute health effects vary widely from one chemical to another.

The acute toxicity characterization was based on a comparison of the maximum detected concentration for each COPC at a given monitor. As stated earlier, the assessment of acute risks is not as well developed as the chronic evaluation, leading to a relatively higher degree of uncertainty in the risk estimates. An HQ was calculated for each COPC at each monitor. None of the COPCs evaluated for any monitor had an HQ greater than 1. A value of 1 was used as the threshold for risk drivers for the acute risk assessment because the exposure is based on using the maximum COPC concentration in air, and not some measure of the mean concentration in air (i.e., median, or 95% UCL of the mean) as was done in the chronic risk assessment where an HQ of 0.1 was used as the risk driver threshold.

5.3 Louisville Police Firearms Training: Site A

The Louisville Police Firearms Training monitoring site (Site A) is a potential maximum impact site for BF Goodrich (now called Noveon), Zeon Chemicals, Geon Chemicals (now called Polyone), Marathon Ashland Petroleum LLC (now called Marathon Petroleum LLC), CITGO, BP Oil, Chevron USA Oil Terminals, Ashland Chemical, Police Firearms Training facility, and Morris Foreman POTW. It is also located immediately downwind from the Rubbertown industrial complex.

The total cancer risk for the years 2001-2005 for Site A are presented in Table 5-1 and Figure 5-1. The cancer risk caused by "known human carcinogens" for the years 2001-2005 are presented in Table 5-2 and Figure 5-2. The cancer risk caused by "probable/possible human carcinogens" for the years 2001-2005 are presented in Table 5-3 and Figure 5-3. The non-cancer data (HQ and HI) for the years 2001-2005 are presented in Table 5-4 and Figure 5-4.

5.3.1 Risk characterization from 2001 for Site A

The cumulative total cancer risk of the COPCs medians was 1.55×10^{-4} (Table 5-1 and Figure 5-1). The risk drivers that provided > 10^{-5} risk were 1,3-butadiene, acrylonitrile, chloroform, and benzene. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were vinyl chloride and naphthalene. Vinyl chloride, though selected as a COPC, had a median concentration value that was ½ the SQL which was used to calculate cancer risk. Naphthalene was not a risk driver in the years after 2001. Carbon tetrachloride was not a risk driver in 2001, but was a risk driver in 2002-2005.

The "known human carcinogens" were vinyl chloride, 1,3-butadiene, and benzene (Table 5-2 and Figure 5-2). 1,3-Butadiene was the largest contributor among the known human carcinogens. The "probable/possible human carcinogens" were acrylonitrile, chloroform, and naphthalene (Table 5-3 and Figure 5-3). Methyl t-butyl ether is classified by IARC as a group 3 carcinogen, "not classifiable as to its carcinogenicity in humans."

The 95% UCL was not calculated for the COPCs from this year because the sample numbers were too small to provide a meaningful derivation of this statistic.

The non-cancer median HI was 2.99 (Table 5-4 and Figure 5-4), and was driven by 1,3-butadiene, acrylonitrile, and chloroprene. Only chloroprene had an HQ > 1, indicating that its chronic inhalation RfCs was exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is also olfactory epithelium. A TOSHI for nasal epithelium was calculated for acrylonitrile and chloroprene by summing the HQs for these two COPCs: 2.17. This TOSHI is > 1, indicating that chronic effects on nasal epithelium are possible.

5.3.2 Risk characterization from 2002 for Site A

The cumulative total cancer risk of the COPCs medians was 7.01×10^{-5} (Table 5-1 and Figure 5-1). The risk drivers that provided > 10^{-5} risk were 1,3-butadiene and benzene. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were vinyl chloride, acrylonitrile, chloroform, and carbon tetrachloride. Vinyl chloride, though selected as a COPC, had a median concentration value that was ½ the SQL which was used to calculate cancer risk.

The "known human carcinogens" were vinyl chloride, 1,3-butadiene, and benzene (Table 5-2 and Figure 5-2). 1,3-Butadiene and benzene were the largest contributors among the known human carcinogens. The "probable/possible human carcinogens" were acrylonitrile, chloroform, and carbon tetrachloride (Table 5-3 and Figure 5-3). Methyl t-butyl ether is classified by IARC as a group 3 carcinogen, "not classifiable as to its carcinogenicity in humans."

The cumulative total cancer risk using the 95% UCL exposure statistic was 3.17×10^{-4} (Table 5-1 and Figure 5-1). 1,3-Butadiene was the largest risk driver using the 95% UCL providing > 10^{-4} risk. Acrylonitrile, chloroform, and benzene all provided > 10^{-5} risk but < 10^{-4} risk on the basis of the 95% UCL. Methyl t-butyl ether provided > 10^{-6} risk but < 10^{-5} risk. This was the only year that methyl t-butyl ether had a 95% UCL-derived cancer risk that was > 10^{-6}.

The non-cancer median HI was 1.82, and was driven by 1,3-butadiene and chloroprene (Table 5-4 and Figure 5-4). Only chloroprene had an HQ ≥ 1, indicating that chronic inhalation RfCs were exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The median-derived TOSHI for acrylonitrile and chloroprene was 1.05; since the TOSHI is > 1, chronic effects of nasal epithelium are possible.

The HI derived from the 95% UCL was 9.16, with 1,3-butadiene and chloroprene providing the largest HQs. Both 1,3-butadiene and chloroprene had 95% UCL-derived HQs >1, indicating exceedances of the RfC. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 5.07; since this TOSHI is > 1, chronic effects of nasal epithelium are possible.

5.3.3 Risk characterization from 2003 for Site A

The cumulative total cancer risk of the COPCs medians was 9.33×10^{-5} (Table 5-1 and Figure 5-1). The risk drivers that provided > 10^{-5} risk were 1,3-butadiene and acrylonitrile. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were vinyl chloride, chloroform, benzene, and carbon tetrachloride. Vinyl chloride, though selected

as a COPC, had a median concentration value that was ½ the SQL which was used to calculate cancer risk.

The "known human carcinogens" were vinyl chloride, 1,3-butadiene, and benzene (Table 5-2 and Figure 5-2). 1,3-Butadiene and benzene were the largest contributors among the known human carcinogens. The "probable/possible human carcinogens" were acrylonitrile, chloroform, and carbon tetrachloride (Table 5-3 and Figure 5-3).

The cumulative total cancer risk using the 95% UCL exposure statistic was 4.40×10^{-4} (Table 5-1 and Figure 5-1). 1,3-Butadiene and acrylonitrile were the largest risk drivers using the 95% UCL providing > 10^{-4} risk. Chloroform, benzene, and carbon tetrachloride all provided > 10^{-5} risk but < 10^{-4} risk on the basis of the 95% UCL.

The non-cancer median HI was 1.90, and was driven by 1,3-butadiene, acrylonitrile and chloroprene (Table 5-4 and Figure 5-4). None of these COPCs had an HQ > 1, indicating that chronic inhalation RfCs were not exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The median-derived TOSHI for acrylonitrile and chloroprene was 1.0; since the TOSHI is ≥ 1, chronic effects of nasal epithelium are possible.

The HI derived from the 95% UCL was 10.11, with 1,3-butadiene and chloroprene providing the largest HQs. Both 1,3-butadiene and chloroprene had 95% UCL-derived HQs > 1, indicating that RfC were exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 4.62; since this TOSHI is > 1, chronic effects are indicated by this conservative derivation of non-cancer risk.

5.3.4 Risk characterization from 2004 for Site A

The cumulative total cancer risk of the COPCs medians was 4.38×10^{-5} (Table 5-1 and Figure 5-1). The risk driver that provided > 10^{-5} risk was 1,3-butadiene. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were vinyl chloride, acrylonitrile, chloroform, benzene, and carbon tetrachloride. Vinyl chloride, though selected as a COPC, had a median concentration value that was ½ the SQL which was used to calculate cancer risk.

The "known human carcinogens" were vinyl chloride, 1,3-butadiene, and benzene (Table 5-2 and Figure 5-2). 1,3-Butadiene and benzene were the largest contributors among the known human carcinogens. The "probable/possible human carcinogens" were acrylonitrile, chloroform, and carbon tetrachloride (Table 5-3 and Figure 5-3).

The cumulative total cancer risk using the 95% UCL exposure statistic was 2.10×10^{-4} (Table 5-1 and Figure 5-1). 1,3-Butadiene was the largest risk driver using the 95% UCL

providing > 10^{-4} risk. Acrylonitrile, chloroform, benzene, and carbon tetrachloride all provided > 10^{-5} risk but < 10^{-4} risk on the basis of the 95% UCL.

The non-cancer median HI was 0.53, and was driven by 1,3-butadiene and chloroprene (Table 5-4 and Figure 5-4). None of the COPCs had an HQ > 1, indicating that chronic inhalation RfCs were not exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The median-derived TOSHI for acrylonitrile and chloroprene was 0.23; since the TOSHI is < 1, chronic effects are not expected.

The HI derived from the 95% UCL was 8.85, with 1,3-butadiene and chloroprene providing the largest HQs. Both 1,3-butadiene and chloroprene had 95% UCL-derived HQs > 1, indicating that RfCs were exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 6.60; since this TOSHI is > 1, chronic effects are indicated by this conservative derivation of non-cancer risk.

5.3.5 Risk characterization from 2005 for Site A

The cumulative total cancer risk of the COPCs medians was 8.69×10^{-5} (Table 5-1 and Figure 5-1). The risk drivers that provided > 10^{-5} risk were 1,3-butadiene and benzene. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were vinyl chloride, acrylonitrile, chloroform, and carbon tetrachloride. Vinyl chloride, though selected as a COPC, had a median concentration value that was ½ the SQL which was used to calculate cancer risk.

The "known human carcinogens" were vinyl chloride, 1,3-butadiene, and benzene (Table 5-2 and Figure 5-2). 1,3-Butadiene and benzene were the largest contributors among the known human carcinogens. The "probable/possible human carcinogens" were acrylonitrile, chloroform, and carbon tetrachloride (Table 5-3 and Figure 5-3).

The cumulative total cancer risk using the 95% UCL exposure statistic was 3.56×10^{-4} (Table 5-1 and Figure 5-1). 1,3-Butadiene was the largest risk driver using the 95% UCL providing > 10^{-4} risk. Acrylonitrile, chloroform, and benzene all provided > 10^{-5} risk but < 10^{-4} risk on the basis of the 95% UCL.

The non-cancer median HI was 1.99, and was driven by 1,3-butadiene and chloroprene (Table 5-4 and Figure 5-4). Neither of these COPCs had an HQ > 1, indicating that chronic inhalation RfCs were not exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The median-derived TOSHI for acrylonitrile and chloroprene was 0.99; since the TOSHI is < 1, chronic effects are not expected.

The HI derived from the 95% UCL was 8.61, with 1,3-butadiene and chloroprene providing the largest HQs. Both 1,3-butadiene and chloroprene had 95% UCL-derived HQs > 1, indicating that RfCs were exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 4.46; since this TOSHI is > 1, chronic effects are indicated by this conservative derivation of non-cancer risk.

5.3.6 Summary of risk characterization for Site A

Site A is a potential maximum impact site. Cumulative median cancer risks ranged from a low of 4.38×10^{-5} for 2004 to a high of 1.55×10^{-4} for 2001. Vinyl chloride was a risk driver in all 5 years of the risk characterization although many of its detections were below the SQL and a median of ½ SQL was used for the cancer risk calculations. 1,3-Butadiene, a known human carcinogen, contributed the most towards the cumulative cancer risk. Acrylonitrile contributed the most towards the cumulative cancer risk among the probable/possible human carcinogens.

Cumulative 95% UCL-derived cancer risks ranged from a low of 2.10×10^{-4} for 2004 to a high of 4.40×10^{-4} for 2003. This range is approximately 2.8-4.8-fold greater than the cumulative median cancer risks. The largest risk drivers were 1,3-butadiene, a known human carcinogen, and acrylonitrile, a probable/possible human carcinogen.

For median concentrations, HQs were ≥ 1 for chloroprene for the years 2001 and 2002, indicating exceedances of the inhalation RfC. Although the cumulative HI did exceed 1 for some years during the monitoring period, the differences in non-cancer target organ specificity indicate that the HI may not accurately represent the risk of non-cancer effects. Median-derived TOSHI values for acrylonitrile and chloroprene were ≥ 1 for the years 2001, 2002 and 2003; the 95% UCL-derived TOSHI values for acrylonitrile and chloroprene were > 1 during the 2002-2005 years. The 95% UCL-derived HQs for 1,3-butadiene and chloroprene exceeded a value of 1, indicating exceedances of the RfC. These results indicate that 1,3-butadiene presents the greatest cancer risks, and that both 1,3-butadiene and chloroprene present the greatest non-cancer risks.

Chloroprene is classified by IARC as a 2B possible human carcinogen. However, no cancer slope factor is currently cited for chloroprene by IRIS so that it was not assessed for cancer risk. However, IRIS developed a cancer slope factor that underwent peer review. Although IRIS did not publish this number, it was reviewed by the State of Michigan and is used there. Following the hierarchy in APCD Regulation 5.20, this cancer slope number (actually the resulting concentration representing a cancer risk of 10^{-6}, referred to as a benchmark ambient concentration [BAC], 0.001 $\mu g/m^3$) is used in the STAR Program. This cancer slope factor is $1/(mg/m^3)$. Using this cancer slope factor, chloroprene cancer risks were calculated, and are presented and discussed in Section 6.5 Risk Characterization of the Uncertainty Analysis (Section 6.0).

Acute non-cancer toxicity values were not exceeded by any of the COPCs.

Table 5-1. Site A total cancer risk.

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014	1.13E-06	0.73%	1.13E-06	1.61%	1.13E-06	1.21%	1.13E-06	2.57%	1.13E-06	1.30%
1,3- Butadiene	106990	3.58E-05	23.08%	3.94E-05	56.24%	4.67E-05	50.12%	1.06E-05	24.21%	5.24E-05	60.28%
Acrylonitrile	107131	8.19E-05	52.79%	7.38E-06	10.52%	2.07E-05	22.15%	7.38E-06	16.84%	7.38E-06	8.49%
Methyl T-Butyl Ether (MTBE)	1634044										
Chloroform	67663	1.40E-05	9.04%	5.61E-06	8.00%	5.61E-06	6.02%	5.61E-06	12.81%	5.61E-06	6.46%
Benzene	71432	1.26E-05	8.10%	1.14E-05	16.32%	9.46E-06	10.14%	9.46E-06	21.58%	1.07E-05	12.31%
Carbon Tetrachloride	56235			4.72E-06	6.72%	9.44E-06	10.12%	9.44E-06	21.54%	9.44E-06	10.86%
Naphthalene	91203	8.91E-06	5.74%								
All other chemicals		7.97E-07	0.51%	4.21E-07	0.60%	2.28E-07	0.24%	1.96E-07	0.45%	2.61E-07	0.30%
Cumulative Total Risk		1.55E-04	100.00%	7.01E-05	100.00%	9.33E-05	100.00%	4.38E-05	100.00%	8.69E-05	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014			4.95E-06	1.56%	4.23E-06	0.96%	2.37E-06	1.13%	8.35E-06	2.35%
1,3- Butadiene	106990			2.33E-04	73.55%	2.74E-04	62.34%	1.18E-04	55.99%	2.34E-04	65.85%
Acrylonitrile	107131			3.57E-05	11.27%	1.24E-04	28.10%	4.20E-05	19.99%	6.87E-05	19.30%
Methyl T-Butyl Ether (MTBE)	1634044			1.28E-06	0.41%						
Chloroform	67663			1.57E-05	4.96%	1.24E-05	2.81%	1.64E-05	7.81%	1.64E-05	4.60%
Benzene	71432			1.66E-05	5.24%	1.48E-05	3.37%	2.11E-05	10.03%	1.79E-05	5.04%
Carbon Tetrachloride	56235			9.28E-06	2.93%	1.04E-05	2.36%	1.04E-05	4.94%	9.83E-06	2.76%
Naphthalene	91203										
All other chemicals				2.64E-07	0.08%	2.73E-07	0.06%	2.62E-07	0.12%	3.47E-07	0.10%
Cumulative Total Risk				3.17E-04	100.00%	4.40E-04	100.00%	2.10E-04	100.00%	3.56E-04	100.00%

Figure 5-1. Site A total cancer risk.

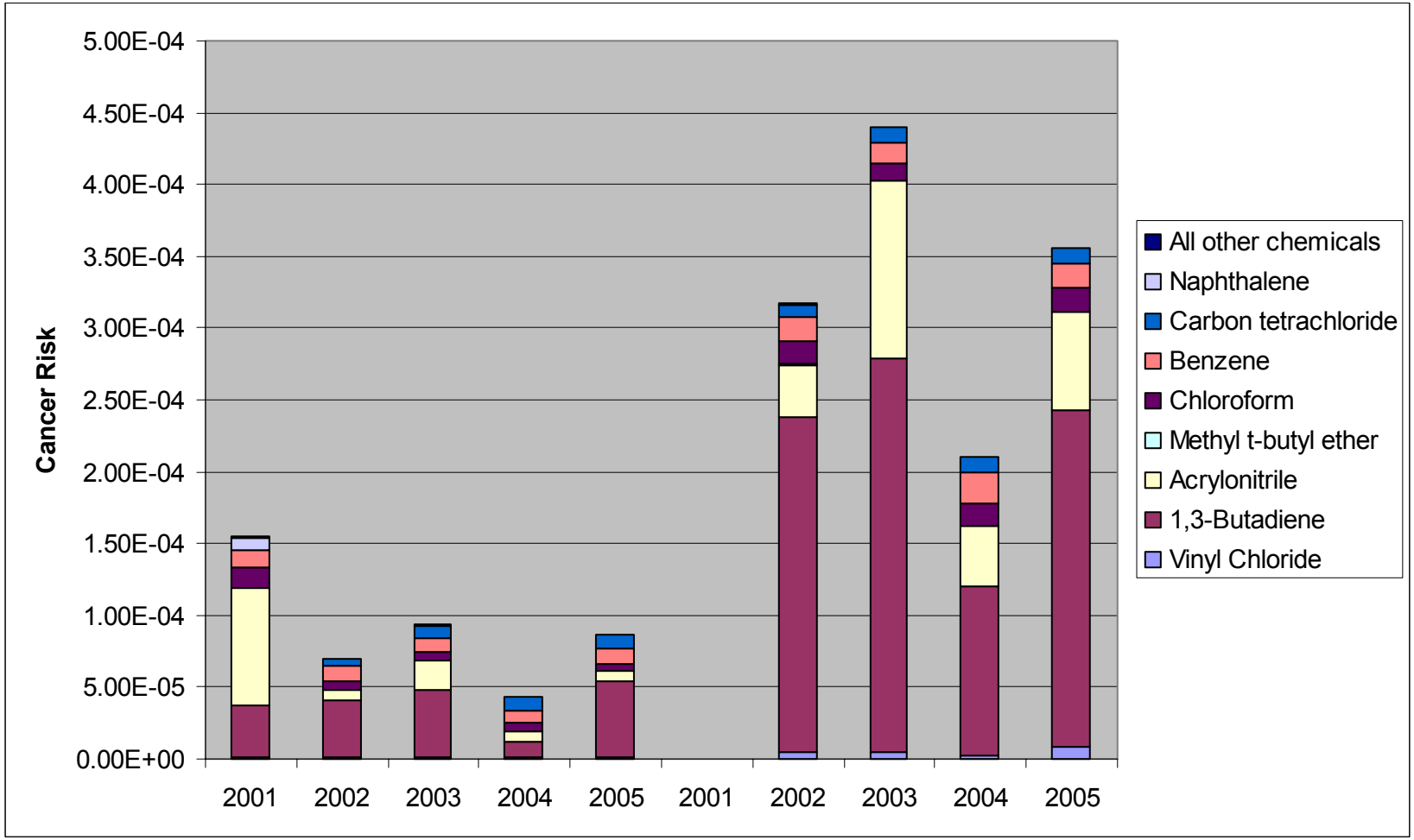


Table 5-2. Site A cancer risk of "known human carcinogens".

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014	1.13E-06	2.28%	1.13E-06	2.17%	1.13E-06	2.17%	1.13E-06	5.32%	1.13E-06	1.75%
1,3- Butadiene	106990	3.58E-05	72.34%	3.94E-05	75.83%	4.67E-05	75.83%	1.06E-05	50.06%	5.24E-05	81.58%
Benzene	71432	1.26E-05	25.39%	1.14E-05	22.00%	9.46E-06	22.00%	9.46E-06	44.62%	1.07E-05	16.66%
Cumulative Risk of Known Human Carcinogens		4.95E-05	100.00%	5.20E-05	100.00%	5.73E-05	100.00%	2.12E-05	100.00%	6.42E-05	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014	0.00E+00		4.95E-06	1.95%	4.23E-06	1.44%	2.37E-06	1.68%	8.35E-06	3.20%
1,3- Butadiene	106990	0.00E+00		2.33E-04	91.53%	2.74E-04	93.51%	1.18E-04	83.39%	2.34E-04	89.92%
Benzene	71432	0.00E+00		1.66E-05	6.53%	1.48E-05	5.05%	2.11E-05	14.94%	1.79E-05	6.88%
Cumulative Risk of Known Human Carcinogens				2.55E-04	100.00%	2.93E-04	100.00%	1.41E-04	100.00%	2.61E-04	100.00%

Figure 5-2. Site A cancer risk of "known human carcinogens".

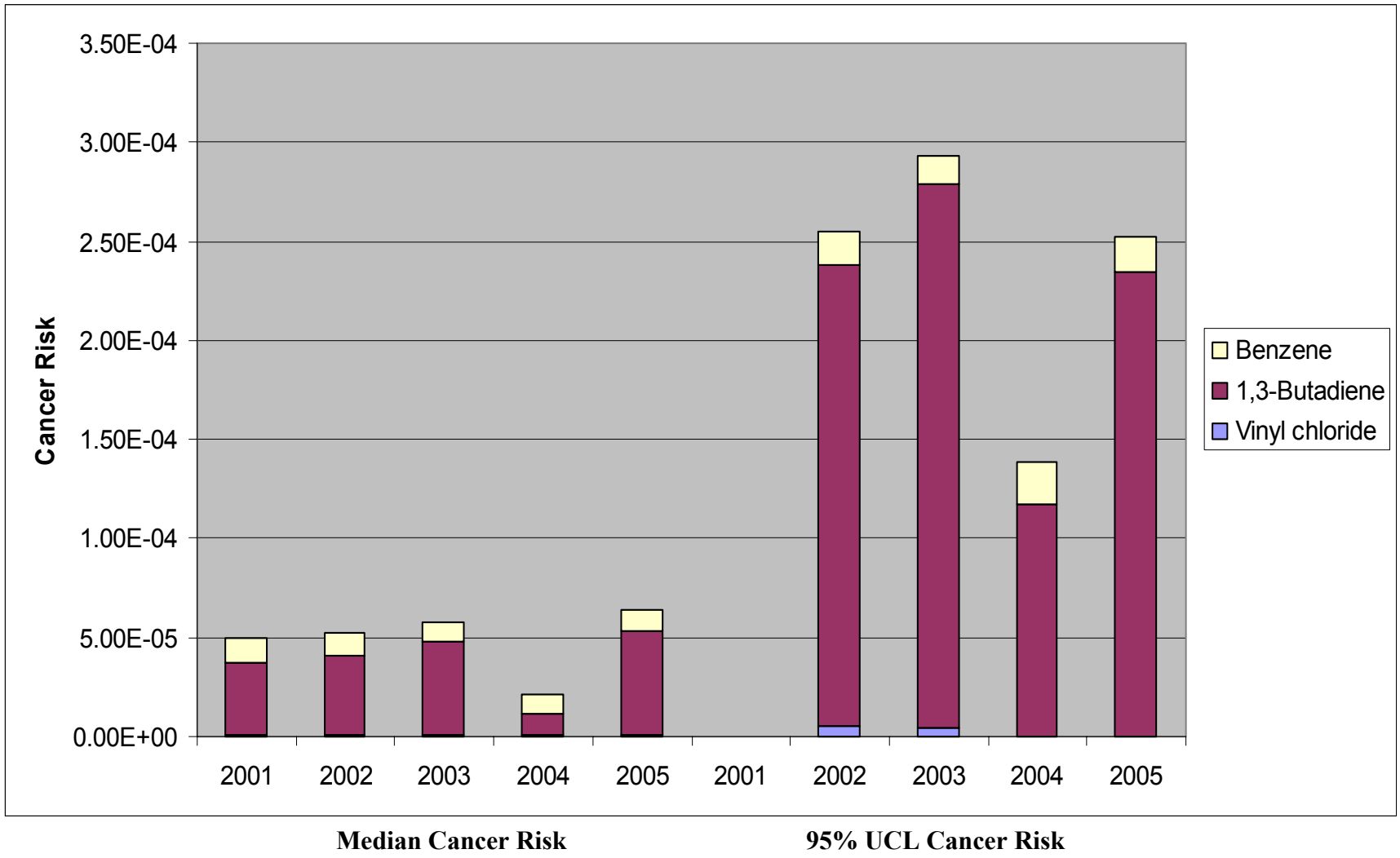


Table 5-3. Site A cancer risk of "probable/possible human carcinogens".

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Acrylonitrile	107131	8.19E-05	78.12%	7.38E-06	41.67%	2.07E-05	57.86%	7.38E-06	32.90%	7.38E-06	32.90%
Chloroform	67663	1.40E-05	13.38%	5.61E-06	31.69%	5.61E-06	15.72%	5.61E-06	25.03%	5.61E-06	25.03%
Carbon Tetrachloride	56235			4.72E-06	26.64%	9.44E-06	26.42%	9.44E-06	42.07%	9.44E-06	42.07%
Naphthalene	91203	8.91E-06	8.50%								
Cumulative Risk of Probable/Possible Human Carcinogens		1.05E-04	100.00%	1.77E-05	100.00%	3.57E-05	100.00%	2.24E-05	100.00%	2.24E-05	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Acrylonitrile	107131			3.57E-05	58.81%	1.24E-04	84.48%	4.20E-05	61.06%	6.87E-05	72.37%
Chloroform	67663			1.57E-05	25.90%	1.24E-05	8.44%	1.64E-05	23.85%	1.64E-05	17.27%
Carbon Tetrachloride	56235			9.28E-06	15.29%	1.04E-05	7.09%	1.04E-05	15.09%	9.83E-06	10.36%
Naphthalene	91203										
Cumulative Risk of Probable/Possible Human Carcinogens				6.07E-05	100.00%	1.46E-04	100.00%	6.88E-05	100.00%	9.49E-05	100.00%

Figure 5-3. Site A cancer risk of "probable/possible human carcinogens".

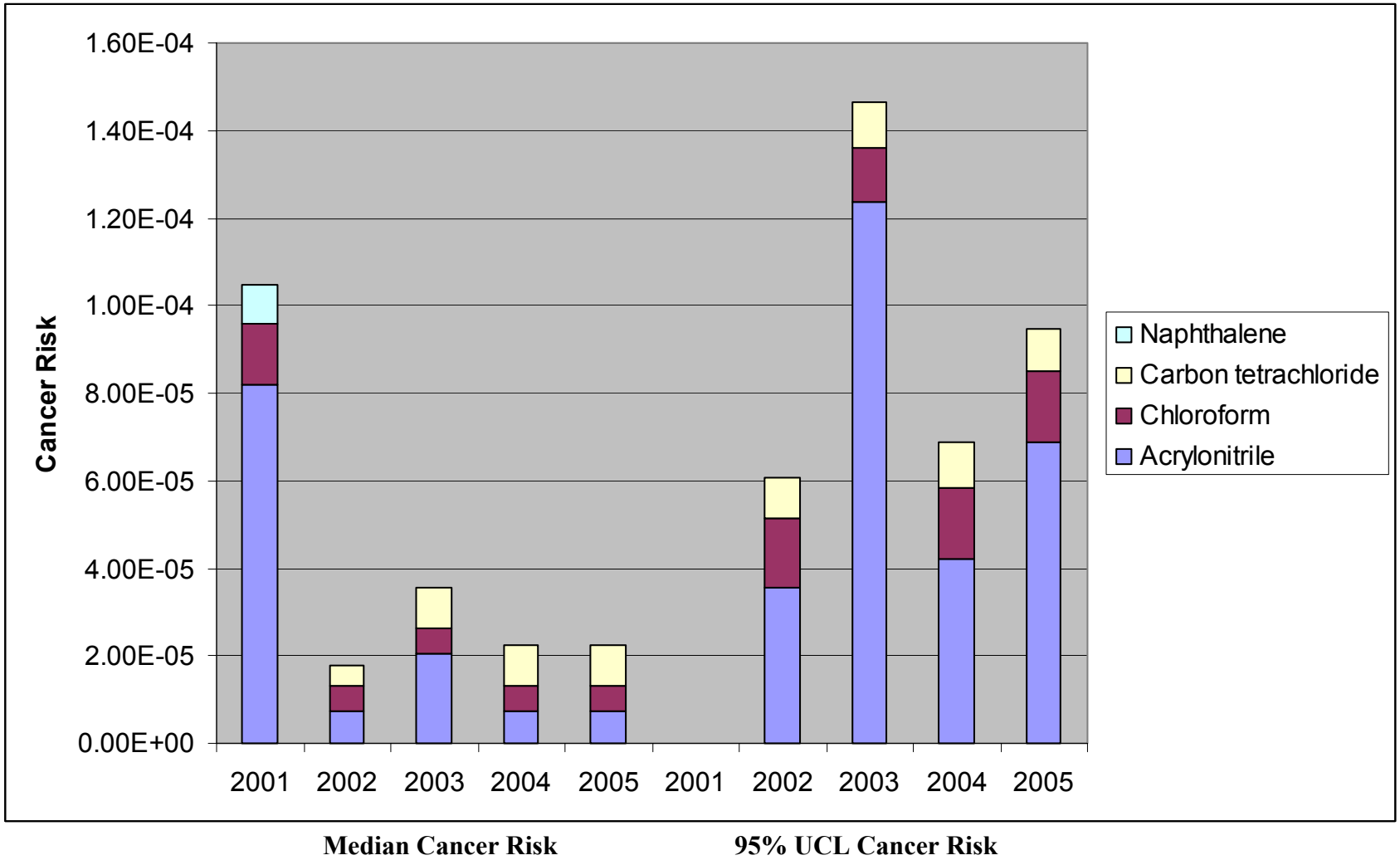
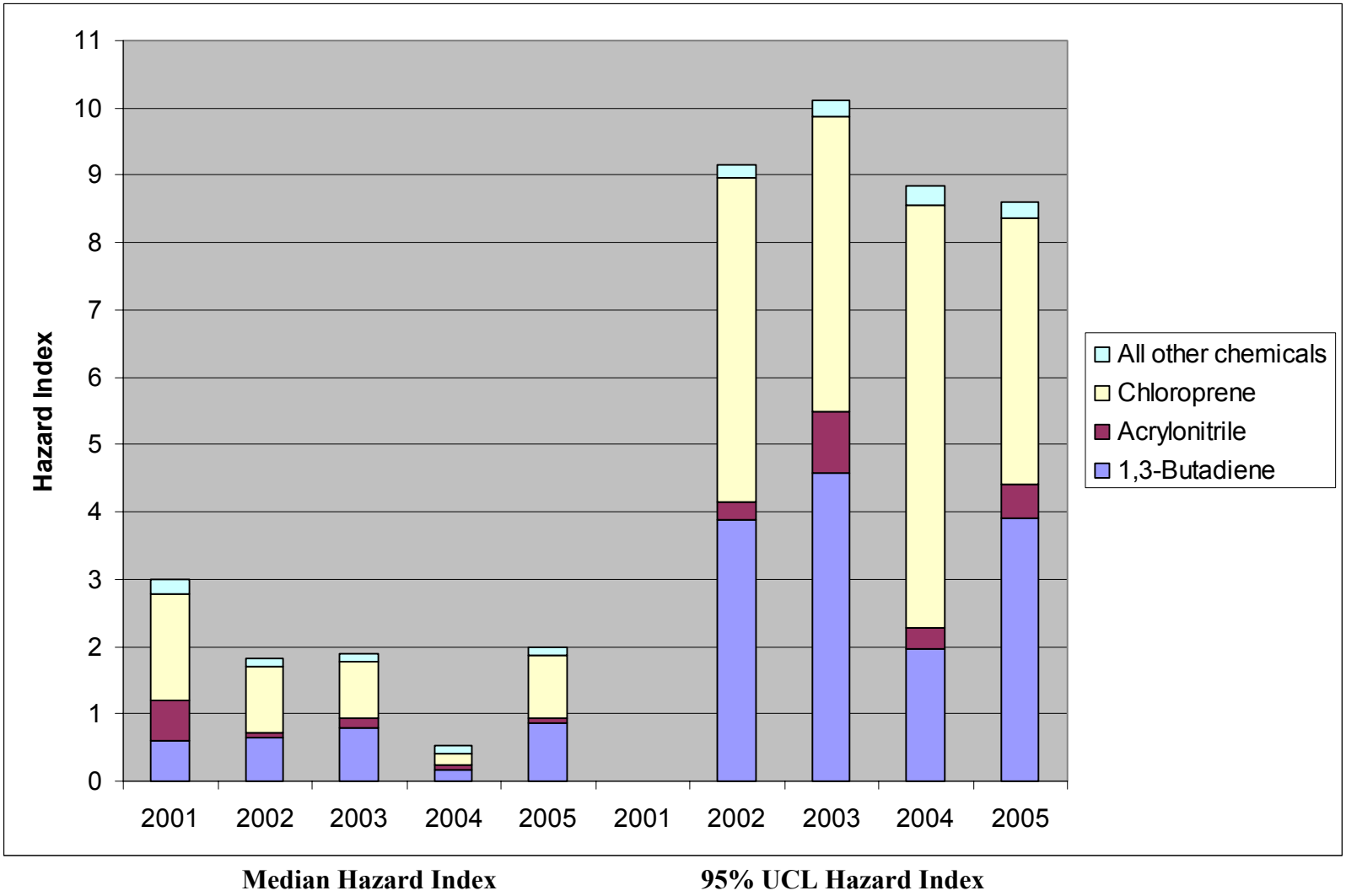


Table 5-4. Site A non-cancer hazard index (HI).

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI
1,3- Butadiene	106990	0.60	19.95%	0.66	36.10%	0.78	40.94%	0.18	33.37%	0.87	43.94%
Acrylonitrile	107131	0.60	20.14%	0.05	2.98%	0.15	7.98%	0.05	10.24%	0.05	2.73%
Chloroprene	126998	1.57	52.65%	1.00	54.65%	0.85	44.71%	0.18	34.16%	0.94	47.38%
All other chemicals		0.22	7.26%	0.11	6.27%	0.12	6.36%	0.12	22.24%	0.12	5.95%
Hazard Index (HI)		2.99	100.00%	1.82	100.00%	1.90	100.00%	0.53	100.00%	1.99	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI
1,3- Butadiene	106990			3.88	42.42%	4.57	45.24%	1.96	22.14%	3.90	45.33%
Acrylonitrile	107131			0.26	2.87%	0.91	9.00%	0.31	3.49%	0.50	5.86%
Chloroprene	126998			4.81	52.59%	4.38	43.37%	6.29	71.09%	3.96	45.98%
All other chemicals				0.19	2.12%	0.24	2.39%	0.29	3.28%	0.24	2.83%
Hazard Index (HI)				9.16	100.00%	10.11	100.00%	8.85	100.00%	8.61	100.00%

Figure 5-4. Site A non-cancer hazard index (HI).



5.4 Ralph Avenue/Campground Road: Site C

The Ralph Avenue/Campground Road monitoring site (Site C) is a potential maximum impact site for DuPont, Rohm & Haas, Elf Atochem (now called Altaglas), American Synthetic Rubber, and other Rubbertown industries. This site is also a community exposure site for the Cane Run neighborhood.

The total cancer risk for the years 2001-2005 for Site C are presented in Table 5-5 and Figure 5-5. The cancer risk caused by "known human carcinogens" for the years 2001-2005 are presented in Table 5-6 and Figure 5-6. The cancer risk caused by "probable/possible human carcinogens" for the years 2001-2005 are presented in Table 5-7 and Figure 5-7. The non-cancer data (HQ and HI) for the years 2001-2005 are presented in Table 5-8 and Figure 5-8.

5.4.1 Risk characterization from 2001 for Site C

The cumulative total cancer risk of the COPCs medians was 4.42×10^{-5} (Table 5-5 and Figure 5-5). The risk drivers that provided > 10^{-5} risk were 1,3-butadiene and benzene. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were chloroform and naphthalene. Naphthalene was not a risk driver in the years after 2001. Carbon tetrachloride was not a risk driver in 2001, but was a risk driver in 2002-2005.

The "known human carcinogens" were 1,3-butadiene and benzene (Table 5-6 and Figure 5-6). The "probable/possible human carcinogens" were chloroform and naphthalene (Table 5-7 and Figure 5-7). Methyl t-butyl ether is classified by IARC as a group 3 carcinogen, "not classifiable as to its carcinogenicity in humans."

The 95% UCL was not calculated for the COPCs from this year because the sample numbers were too small to provide a meaningful derivation of this statistic.

The non-cancer median HI was 2.05 (Table 5-8 and Figure 5-8), and was driven by 1,3-butadiene and chloroprene. Chloroprene had an HQ of 1.59, indicating that the inhalation RfC was exceeded. 1,3-Butadiene did not have an HQ > 1, indicating that its chronic inhalation RfC was not exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organ for chloroprene is olfactory epithelium. The TOSHI for chloroprene and acrylonitrile (both target nasal epithelium) was the HQ for chloroprene (1.59) since acrylonitrile had an HQ of 0. Since the TOSHI for chloroprene and acrylonitrile was > 1, nasal epithelium effects are possible.

5.4.2 Risk characterization from 2002 for Site C

The cumulative total cancer risk of the COPCs medians was 1.25×10^{-4} (Table 5-5 and Figure 5-5). The risk drivers that provided > 10^{-5} risk were 1,3-butadiene and acrylonitrile. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were vinyl

chloride, chloroform, benzene, carbon tetrachloride, and ethyl acrylate. Vinyl chloride and ethyl acrylate were risk drivers only in 2002 and 2003. Vinyl chloride, though selected as a COPC, had a median concentration value that was ½ the SQL which was used to calculate cancer risk.

The "known human carcinogens" were vinyl chloride, 1,3-butadiene, and benzene (Table 5-6 and Figure 5-6). The "probable/possible human carcinogens" were acrylonitrile, chloroform, carbon tetrachloride, and ethyl acrylate (Table 5-7 and Figure 5-7). Methyl t-butyl ether is classified by IARC as a group 3 carcinogen, "not classifiable as to its carcinogenicity in humans."

The cumulative total cancer risk using the 95% UCL exposure statistic was 7.64×10^{-4} (Table 5-5 and Figure 5-5). 1,3-Butadiene was the largest risk driver using the 95% UCL providing > 10^{-4} risk. Acrylonitrile, chloroform, benzene, and carbon tetrachloride all provided > 10^{-5} risk but < 10^{-4} risk on the basis of the 95% UCL. Vinyl chloride, methyl t-butyl ether and ethyl acrylate provided risk in the 10^{-6} range based on the 95% UCL. Methyl t-butyl ether was a risk driver based on the 95% UCL only for this year.

The non-cancer median HI was 4.12 (Table 5-8 and Figure 5-8), and was driven by 1,3-butadiene, acrylonitrile, and chloroprene. 1,3-Butadiene and chloroprene had HQs that exceeded 1, indicating that these COPCs were present at concentrations above their chronic inhalation RfCs. Acrylonitrile and all other chemicals combined had HQs < 1. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The TOSHI for ovarian atrophy is 1.28, which is the HQ for 1,3-butadiene. The TOSHI for acrylonitrile and chloroprene (nasal/olfactory epithelium) was 2.75.

The HI derived from the 95% UCL was 70.63, with 1,3-butadiene and chloroprene providing the largest HQs (10.81 and 59.28, respectively). 1,3-Butadiene and chloroprene both had 95% UCL-derived HQs > 1, indicating that their chronic inhalation RfCs were exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 59.63 indicating possible chronic effects.

5.4.3 Risk characterization from 2003 for Site C

The cumulative total cancer risk of the COPCs medians was 1.13×10^{-4} (Table 5-5 and Figure 5-5). The risk drivers that provided > 10^{-5} risk were 1,3-butadiene, acrylonitrile, and chloroform. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were vinyl chloride, benzene, carbon tetrachloride, and ethyl acrylate. Vinyl chloride and ethyl acrylate were risk drivers only in 2002 and 2003. Vinyl chloride, though selected as a COPC, had a median concentration value that was ½ the SQL which was used to calculate cancer risk.

The "known human carcinogens" were vinyl chloride, 1,3-butadiene, and benzene (Table 5-6 and Figure 5-6). The "probable/possible human carcinogens" were acrylonitrile, chloroform, carbon tetrachloride, and ethyl acrylate (Table 5-7 and Figure 5-7).

The cumulative total cancer risk using the 95% UCL exposure statistic was 6.77×10^{-4} (Table 5-5 and Figure 5-5). 1,3-Butadiene was the largest risk driver using the 95% UCL providing > 10^{-4} risk. Acrylonitrile, chloroform, and carbon tetrachloride all provided > 10^{-5} risk but < 10^{-4} risk on the basis of the 95% UCL. Vinyl chloride, benzene, and ethyl acrylate provided risk in the 10^{-6} range based on the 95% UCL.

The non-cancer median HI was 3.59 (Table 5-8 and Figure 5-8), and was driven by 1,3-butadiene, acrylonitrile, and chloroprene. Only chloroprene had an HQ > 1, indicating that its chronic inhalation RfC was exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The TOSHI for acrylonitrile and chloroprene was 2.54; since this TOSHI is > 1, chronic effects on nasal/olfactory epithelium are possible.

The HI derived from the 95% UCL was 33.64, with 1,3-butadiene and chloroprene providing the largest HQs (9.75 and 23.55, respectively). 1,3-Butadiene and chloroprene had 95% UCL-derived HQs > 1, indicating that their chronic inhalation RfCs were exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 23.75 indicating possible chronic effects on nasal epithelium.

5.4.4 Risk characterization from 2004 for Site C

The cumulative total cancer risk of the COPCs medians was 4.78×10^{-5} (Table 5-5 and Figure 5-5). The risk driver that provided > 10^{-5} risk was 1,3-butadiene. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were acrylonitrile, chloroform, benzene, and carbon tetrachloride.

The "known human carcinogens" were 1,3-butadiene and benzene (Table 5-6 and Figure 5-6). The "probable/possible human carcinogens" were acrylonitrile, chloroform, and carbon tetrachloride (Table 5-7 and Figure 5-7).

The cumulative total cancer risk using the 95% UCL exposure statistic was 4.44×10^{-4} (Table 5-5 and Figure 5-5). 1,3-Butadiene was the largest risk driver using the 95% UCL providing > 10^{-4} risk. Acrylonitrile, chloroform, and carbon tetrachloride all provided > 10^{-5} risk but < 10^{-4} risk on the basis of the 95% UCL. Benzene provided risk in the 10^{-6} range based on the 95% UCL.

The non-cancer median HI was 2.65 (Table 5-8 and Figure 5-8), and was driven by 1,3-butadiene and chloroprene. Chloroprene had an HQ > 1, indicating that its chronic inhalation RfC was exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and

nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The TOSHI for nasal/olfactory epithelium was 2.26; since this TOSHI is > 1, chronic effects on nasal epithelium are possible.

The HI derived from the 95% UCL was 61.57, with 1,3-butadiene and chloroprene providing the largest HQs (5.97 and 55.30, respectively). 1,3-Butadiene and chloroprene both had 95% UCL-derived HQs > 1, indicating that their chronic inhalation RfCs were exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 55.45 indicating possible chronic effects on nasal epithelium.

5.4.5 Risk characterization 2005 for Site C

The cumulative total cancer risk of the COPCs medians was 8.69×10^{-5} (Table 5-5 and Figure 5-5). The risk drivers that provided > 10^{-5} risk were 1,3-butadiene and chloroform. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were acrylonitrile, benzene, carbon tetrachloride, and tetrachloroethene. Tetrachloroethene was only a risk driver in this year, and not the previous years.

The "known human carcinogens" were 1,3-butadiene and benzene (Table 5-6 and Figure 5-6). 1,3-Butadiene provided the greatest risk of the known human carcinogens. The "probable/possible human carcinogens" were acrylonitrile, chloroform, carbon tetrachloride, and tetrachloroethene (Table 5-7 and Figure 5-7).

The cumulative total cancer risk using the 95% UCL exposure statistic was 1.43×10^{-3} (Table 5-5 and Figure 5-5). 1,3-Butadiene was the largest risk driver using the 95% UCL providing > 10^{-3} risk. Acrylonitrile, chloroform, benzene, and carbon tetrachloride all provided > 10^{-5} risk but < 10^{-4} risk on the basis of the 95% UCL. Tetrachloroethene provided risk in the 10^{-6} range based on the 95% UCL.

The non-cancer median HI was 3.80 (Table 5-8 and Figure 5-8), and was driven by 1,3-butadiene and chloroprene. Chloroprene had an HQ > 1, indicating that its chronic inhalation RfC was exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The TOSHI for acrylonitrile and chloroprene was 2.90 indicating that chronic nasal/olfactory epithelium effects are possible.

The HI derived from the 95% UCL was 65.37, with 1,3-butadiene and chloroprene providing the largest HQs (22.83 and 42.32, respectively). Both 1,3-butadiene and chloroprene had 95% UCL-derived HQs > 1, indicating that their chronic inhalation RfCs were exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 42.41 indicating possible chronic effects on nasal epithelium.

5.4.6 Summary of risk characterization for Site C

Site C is a potential maximum impact site. Cumulative median cancer risks ranged from a low of 4.78×10^{-5} for 2004 to a high of 1.25×10^{-4} for 2002. Vinyl chloride was a risk driver in years 2002 and 2003 of the risk characterization although many of its detections were below the SQL and a median of ½ SQL was used for the cancer risk calculations. 1,3-Butadiene, a known human carcinogen, contributed the most towards the cumulative cancer risk. Acrylonitrile, chloroform, and carbon tetrachloride all contributed substantially towards the cumulative cancer risk among the probable/possible human carcinogens.

Cumulative 95% UCL-derived cancer risks ranged from a low of 4.44×10^{-4} for 2004 to a high of 1.43×10^{-3} for 2005. This cumulative cancer risk range is approximately 10-fold greater than the range calculated using median exposure concentrations. These risks were largely driven by 1,3-butadiene. Acylonitrile, benzene, chloroform, and carbon tetrachloride all contributed substantially towards the cumulative 95% UCL-derived cancer risks.

For median concentrations, 1,3-butadiene and chloroprene had HQs > 1, indicating exceedances of their inhalation RfCs. The cumulative HI exceeded 1 for all years of the monitoring period, and were primarily driven by chloroprene. The median-derived TOSHIs for acrylonitrile and chloroprene exceeded 1 in all monitoring years indicating that chronic nasal/olfactory epithelium effects are possible. The 95% UCL-derived HQs for 1,3-butadiene and chloroprene exceeded a value of 1 and were very high values, indicating that this conservative exposure estimate results in increased non-cancer risk. These results indicate that 1,3-butadiene presents the greatest cancer risk, and that 1,3-butadiene and chloroprene present the greatest non-cancer risks.

Chloroprene is classified by IARC as a 2B possible human carcinogen. However, no cancer slope factor is currently cited for chloroprene by IRIS so that it was not assessed for cancer risk. However, IRIS developed a cancer slope factor that underwent peer review. Although IRIS did not publish this number, it was reviewed by the State of Michigan and is used there. Following the hierarchy in APCD Regulation 5.20, this cancer slope number (actually the resulting concentration representing a cancer risk of 10^{-6}, referred to as a benchmark ambient concentration [BAC], 0.001 $\mu g/m^3$) is used in the STAR Program. This cancer slope factor is $1/(mg/m^3)$. Using this cancer slope factor, chloroprene cancer risks were calculated, and are presented and discussed in Section 6.5 Risk Characterization of the Uncertainty Analysis (Section 6.0).

Acute non-cancer toxicity values were not exceeded by any of the COPCs.

Table 5-5. Site C total cancer risk.

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014			1.13E-06	0.90%	1.13E-06	1.00%				
1,3- Butadiene	106990	1.46E-05	33.00%	7.66E-05	61.45%	5.77E-05	51.26%	1.89E-05	39.56%	4.81E-05	55.28%
Acrylonitrile	107131			1.92E-05	15.39%	1.48E-05	13.11%	7.38E-06	15.45%	7.38E-06	8.49%
Methyl T-Butyl Ether (MTBE)	1634044										
Chloroform	67663	5.61E-06	12.70%	9.35E-06	7.51%	1.91E-05	16.96%	5.61E-06	11.75%	1.15E-05	13.23%
Benzene	71432	1.39E-05	31.52%	7.84E-06	6.29%	7.09E-06	6.30%	6.22E-06	13.02%	7.84E-06	9.01%
Carbon Tetrachloride	56235			7.08E-06	5.68%	9.67E-06	8.59%	9.44E-06	19.75%	9.91E-06	11.39%
Ethyl Acrylate	140885			2.86E-06	2.30%	2.86E-06	2.54%				
Tetrachloroethene	127184									2.00E-06	2.30%
Naphthalene	91203	8.91E-06	20.15%								
All other chemicals		1.16E-06	2.63%	6.10E-07	0.49%	2.49E-07	0.22%	2.28E-07	0.48%	2.53E-07	0.29%
Cumulative Total Risk		4.42E-05	100.00%	1.25E-04	100.00%	1.13E-04	100.00%	4.78E-05	100.00%	8.69E-05	100.00%
Compound	**CAS**	**2001 95% UCL**		**2002 95% UCL**		**2003 95% UCL**		**2004 95% UCL**		**2005 95% UCL**	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014			2.10E-06	0.27%	2.01E-06	0.30%				
1,3- Butadiene	106990			6.49E-04	84.92%	5.85E-04	86.36%	3.58E-04	80.75%	1.37E-03	95.58%
Acrylonitrile	107131			4.74E-05	6.21%	2.77E-05	4.08%	1.97E-05	4.45%	1.20E-05	0.84%
Methyl T-Butyl Ether (MTBE)	1634044			1.03E-06	0.13%						
Chloroform	67663			3.62E-05	4.74%	3.88E-05	5.73%	4.51E-05	10.18%	2.46E-05	1.71%
Benzene	71432			1.12E-05	1.47%	9.29E-06	1.37%	8.45E-06	1.91%	1.07E-05	0.75%
Carbon Tetrachloride	56235			1.05E-05	1.38%	1.01E-05	1.48%	1.18E-05	2.66%	1.30E-05	0.91%
Ethyl Acrylate	140885			6.37E-06	0.83%	4.21E-06	0.62%				
Tetrachloroethene	127184									2.78E-06	0.19%
Naphthalene	91203										
All other chemicals				2.69E-07	0.04%	3.65E-07	0.05%	2.60E-07	0.06%	2.78E-07	0.02%
Cumulative Total Risk				7.64E-04	100.00%	6.77E-04	100.00%	4.44E-04	100.00%	1.43E-03	100.00%

Figure 5-5. Site C total cancer risk.

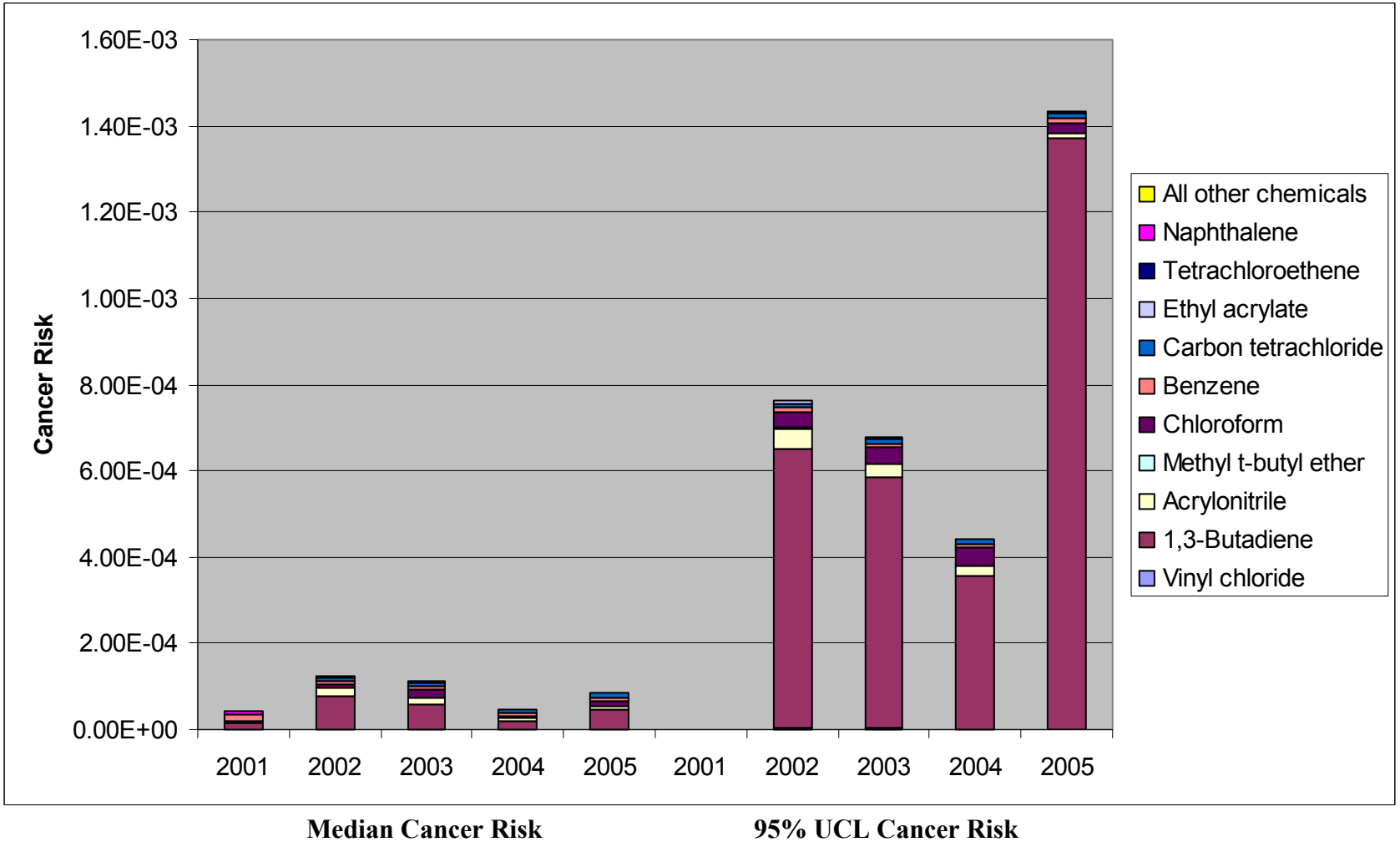


Table 5-6. Site C cancer risk of "known human carcinogens".

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014			1.13E-06	1.32%	1.13E-06	1.71%				
1,3- Butadiene	106990	1.46E-05	51.14%	7.66E-05	89.52%	5.77E-05	87.53%	1.89E-05	75.23%	4.81E-05	85.98%
Benzene	71432	1.39E-05	48.86%	7.84E-06	9.16%	7.09E-06	10.76%	6.22E-06	24.77%	7.84E-06	14.02%
Cumulative Risk of Known Human Carcinogens		2.85E-05	100.00%	8.55E-05	100.00%	6.59E-05	100.00%	2.51E-05	100.00%	5.59E-05	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014			2.10E-06	0.32%	2.01E-06	0.34%				
1,3- Butadiene	106990			6.49E-04	97.99%	5.85E-04	98.10%	3.58E-04	97.69%	1.37E-03	99.22%
Benzene	71432			1.12E-05	1.69%	9.29E-06	1.56%	8.45E-06	2.31%	1.07E-05	0.78%
Cumulative Risk of Known Human Carcinogens				6.62E-04	100.00%	5.96E-04	100.00%	3.67E-04	100.00%	1.38E-03	100.00%

Figure 5-6. Site C cancer risk of "known human carcinogens".

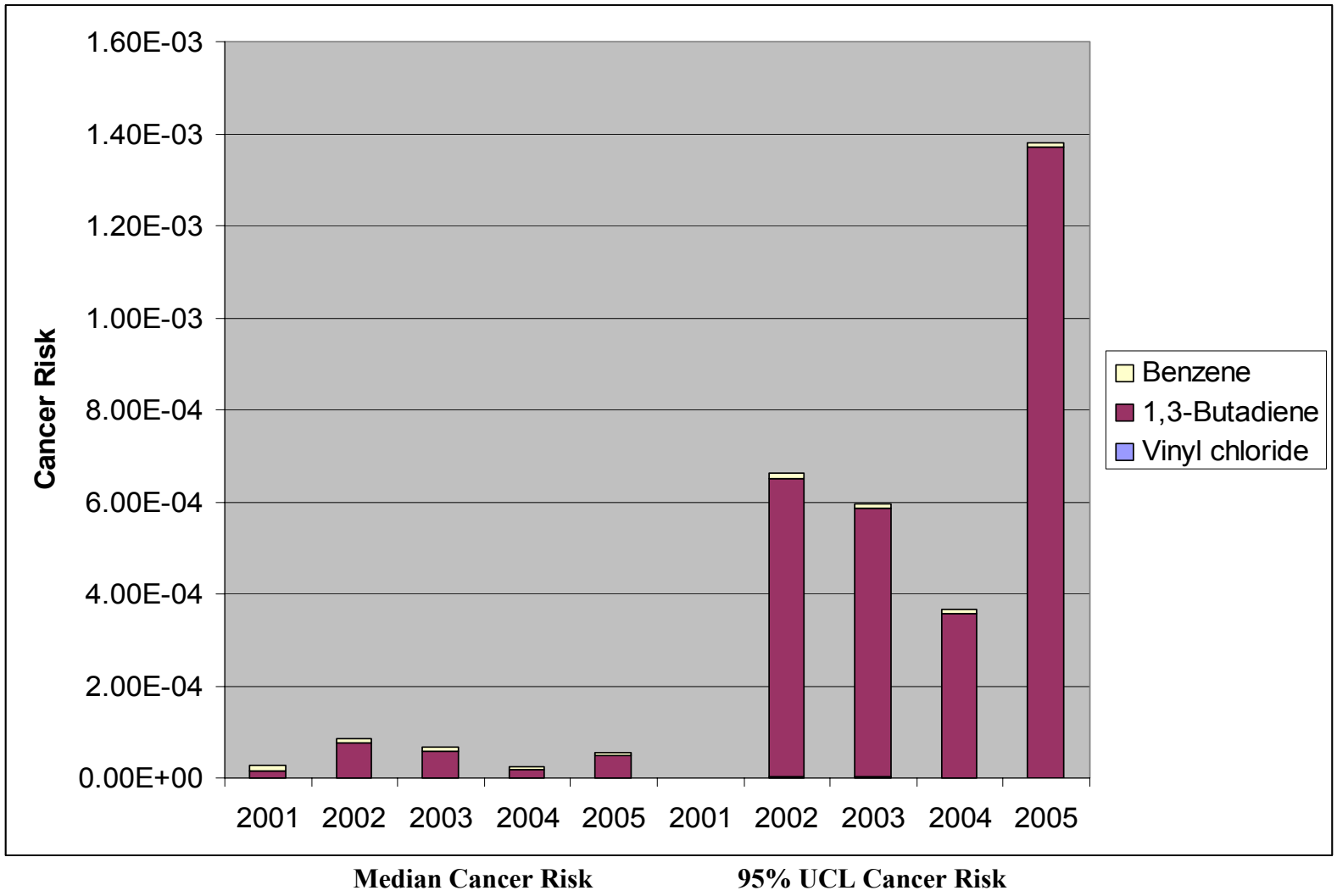


Table 5-7. Site C cancer risk of "probable/possible human carcinogens".

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Acrylonitrile	107131			1.92E-05	49.86%	1.48E-05	31.82%	7.38E-06	32.90%	7.38E-06	23.96%
Chloroform	67663	5.61E-06	38.65%	9.35E-06	24.31%	1.91E-05	41.15%	5.61E-06	25.03%	1.15E-05	37.37%
Carbon Tetrachloride	56235			7.08E-06	18.39%	9.67E-06	20.86%	9.44E-06	42.07%	9.91E-06	32.18%
Ethyl Acrylate	140885			2.86E-06	7.44%	2.86E-06	6.17%				
Tetrachloroethene	127184									2.00E-06	6.50%
Naphthalene	91203	8.91E-06	61.35%								
Cumulative Risk of Probable/Possible Human Carcinogens		1.45E-05	100.00%	3.85E-05	100.00%	4.64E-05	100.00%	2.24E-05	100.00%	3.08E-05	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Acrylonitrile	107131			4.74E-05	47.15%	2.77E-05	34.26%	1.97E-05	25.75%	1.20E-05	22.90%
Chloroform	67663			3.62E-05	36.05%	3.88E-05	48.07%	4.51E-05	58.87%	2.46E-05	46.92%
Carbon Tetrachloride	56235			1.05E-05	10.46%	1.01E-05	12.46%	1.18E-05	15.38%	1.30E-05	24.87%
Ethyl Acrylate	140885			6.37E-06	6.34%	4.21E-06	5.21%				
Tetrachloroethene	127184									2.78E-06	5.31%
Naphthalene	91203										
Cumulative Risk of Probable/Possible Human Carcinogens				1.01E-04	100.00%	8.07E-05	100.00%	7.67E-05	100.00%	5.24E-05	100.00%

Figure 5-7. Site C cancer risk of "probable/possible human carcinogens".

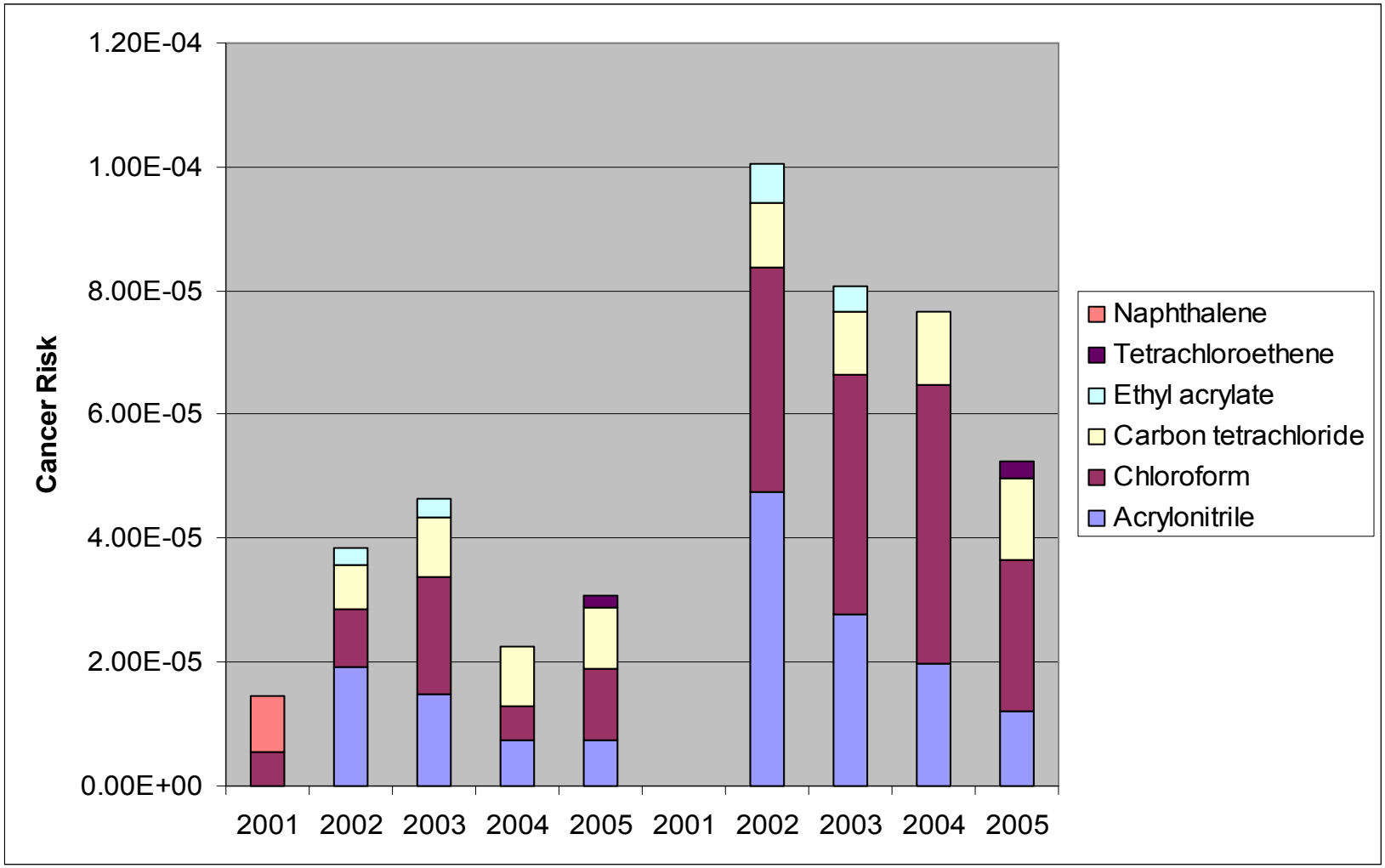
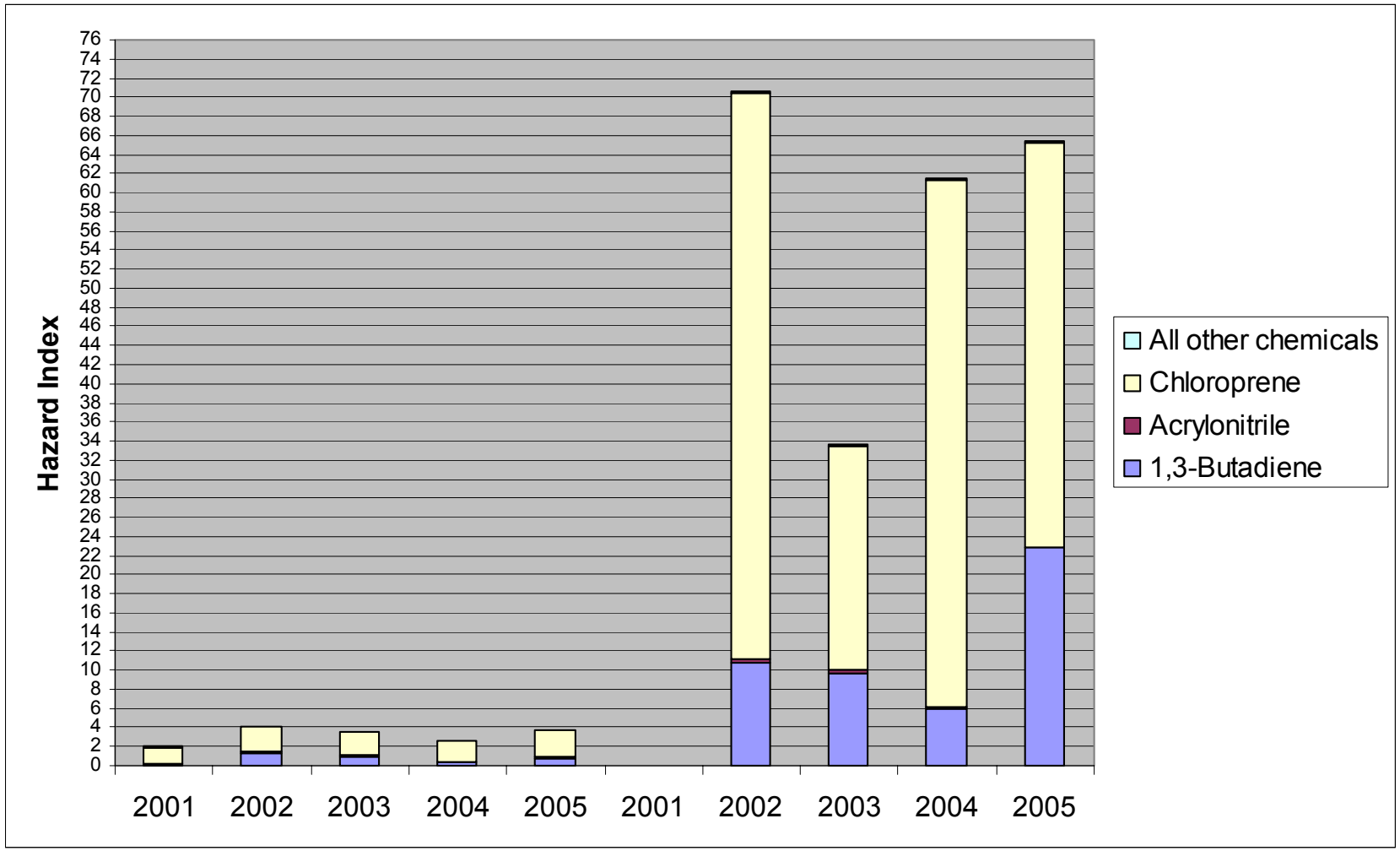


Table 5-8. Site C non-cancer hazard index (HI).

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI
1,3- Butadiene	106990	0.24	11.88%	1.28	30.99%	0.96	26.80%	0.31	11.86%	0.80	21.10%
Acrylonitrile	107131	0.00	0.00%	0.14	3.42%	0.11	3.02%	0.05	2.04%	0.05	1.43%
Chloroprene	126998	1.59	77.83%	2.61	63.28%	2.43	67.62%	2.21	83.18%	2.85	75.09%
All other chemicals		0.21	10.29%	0.10	2.31%	0.09	2.55%	0.08	2.92%	0.09	2.38%
Hazard Index (HI)		2.05	100.00%	4.12	100.00%	3.59	100.00%	2.65	100.00%	3.80	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI
1,3- Butadiene	106990			10.81	15.31%	9.75	28.97%	5.97	9.69%	22.83	34.93%
Acrylonitrile	107131			0.35	0.49%	0.20	0.60%	0.15	0.24%	0.09	0.13%
Chloroprene	126998			59.28	83.94%	23.55	69.98%	55.30	89.81%	42.32	64.74%
All other chemicals				0.18	0.26%	0.15	0.44%	0.16	0.26%	0.13	0.20%
Hazard Index (HI)				70.63	100.00%	33.64	100.00%	61.57	100.00%	65.37	100.00%

Figure 5-8. Site C non-cancer hazard index (HI).



5.5 University of Louisville Shelby Campus: Site E

The University of Louisville Shelby Campus monitoring site (Site E) is an anthropogenic urban activity control site. The objective of this site is to determine the air quality in the residential areas of east Jefferson County that should not be impacted by the emissions from the Rubbertown industrial complex. This monitoring location was selected to represent an urban site near a major traffic corridor.

The total cancer risk for the years 2001-2005 for Site E are presented in Table 5-9 and Figure 5-9. The cancer risk caused by "known human carcinogens" for the years 2001-2005 are presented in Table 5-10 and Figure 5-10. The cancer risk caused by "probable/possible human carcinogens" for the years 2001-2005 are presented in Table 5-11 and Figure 5-11. The non-cancer data (HQ and HI) for the years 2001-2005 are presented in Table 5-12 and Figure 5-12.

5.5.1 Risk characterization from 2001 for Site E

The cumulative total cancer risk of the COPCs medians was 2.16×10^{-5} (Table 5-9 and Figure 5-9). The risk driver that provided > 10^{-5} risk was acrylonitrile. The risk driver that provided > 10^{-6} risk but < 10^{-5} risk was benzene. 1,3-Butadiene and carbon tetrachloride were not risk drivers in 2001, but were risk drivers in 2002-2005.

The "known human carcinogens" risk driver was benzene (Table 5-10 and Figure 5-10). The "probable/possible human carcinogens" risk driver was acrylonitrile (Table 5-11 and Figure 5-11).

The 95% UCL was not calculated for the COPCs from this year because the sample numbers were too small to provide a meaningful derivation of this statistic.

The non-cancer median HI was 0.17 (Table 5-12 and Figure 5-12). Using an HQ value of 0.1 as a threshold to identify risk drivers, no COPCs exceeded this value. Therefore, no non-cancer toxicity factors were exceeded for 2001.

5.5.2 Risk characterization from 2002 for Site E

The cumulative total cancer risk of the COPCs medians was 2.05×10^{-5} (Table 5-9 and Figure 5-9). No risk drivers provided > 10^{-5} risk. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were 1,3-butadiene, acrylonitrile, benzene, and carbon tetrachloride.

The "known human carcinogens" were 1,3-butadiene and benzene (Table 5-10 and Figure 5-10). The "probable/possible human carcinogens" were acrylonitrile and carbon tetrachloride (Table 5-11 and Figure 5-11).

The cumulative total cancer risk using the 95% UCL exposure statistic was 3.22×10^{-5} (Table 5-9 and Figure 5-9). All of the COPCs identified as risk drivers provided risk in

the 10^{-6} range based on the 95% UCL, including 1,3-butadiene, acrylonitrile, benzene, and carbon tetrachloride.

The non-cancer median HI was 0.17 (Table 5-12 and Figure 5-12). Using an HQ value of 0.1 as a threshold to identify risk drivers, no COPCs exceeded this value. Therefore, no non-cancer toxicity factors were exceeded for 2002.

The HI derived from the 95% UCL was 0.27, with 1,3-butadiene providing the largest HQ. None of the 95% UCL-derived HQs exceeded 1, indicating that non-cancer toxicity values were not exceeded.

5.5.3 Risk characterization from 2003 for Site E

The cumulative total cancer risk of the COPCs medians was 1.67×10^{-5} (Table 5-9 and Figure 5-9). No risk drivers provided > 10^{-5} risk. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were 1,3-butadiene, benzene, and carbon tetrachloride.

The "known human carcinogens" were 1,3-butadiene and benzene (Table 5-10 and Figure 5-10). The only "probable/possible human carcinogen" was carbon tetrachloride (Table 5-11 and Figure 5-11).

The cumulative total cancer risk using the 95% UCL exposure statistic was 2.17×10^{-5} (Table 5-9 and Figure 5-9). Based on the 95% UCL, carbon tetrachloride provided > 10^{-5} risk. 1,3-Butadiene and benzene provided risk in the 10^{-6} range based on the 95% UCL.

The non-cancer median HI was 0.11 (Table 5-12 and Figure 5-12). Using an HQ value of 0.1 as a threshold to identify risk drivers, no COPCs exceeded this value. Therefore, no non-cancer toxicity factors were exceeded for 2003.

The HI derived from the 95% UCL was 0.16, with 1,3-butadiene providing the largest HQ. None of the 95% UCL-derived HQs exceeded 1, indicating that non-cancer toxicity values were not exceeded.

5.5.4 Risk characterization from 2004 for Site E

The cumulative total cancer risk of the COPCs medians was 3.02×10^{-5} (Table 5-9 and Figure 5-9). No risk drivers provided > 10^{-5} risk. The risk drivers that provided > 10^{-6} risk were 1,3-butadiene, acrylonitrile, chloroform, benzene, and carbon tetrachloride. Chloroform was a risk driver only in this year.

The "known human carcinogens" were 1,3-butadiene and benzene (Table 5-10 and Figure 5-10). The "probable/possible human carcinogens" were acrylonitrile, chloroform, and carbon tetrachloride (Table 5-11 and Figure 5-11).

The cumulative total cancer risk using the 95% UCL exposure statistic was 3.83×10^{-5} (Table 5-9 and Figure 5-9). Based on the 95% UCL, acrylonitrile and carbon tetrachloride provided > 10^{-5} risk. 1,3-Butadiene, chloroform, and benzene provided risk in the 10^{-6} range based on the 95% UCL.

The non-cancer median HI was 0.17 (Table 5-12 and Figure 5-12). Using an HQ value of 0.1 as a threshold to identify risk drivers, no COPCs exceeded this value. Therefore, no non-cancer toxicity factors were exceeded for 2004.

The HI derived from the 95% UCL was 0.25, with 1,3-butadiene providing the largest HQ. None of the 95% UCL-derived HQs exceeded 1, indicating that non-cancer toxicity values were not exceeded.

5.5.5 Risk characterization from 2005 for Site E

The cumulative total cancer risk of the COPCs medians was 1.80×10^{-5} (Table 5-9 and Figure 5-9). No risk drivers provided > 10^{-5} risk. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were 1,3-butadiene, benzene, and carbon tetrachloride.

The "known human carcinogens" were 1,3-butadiene and benzene (Table 5-10 and Figure 5-10). The only "probable/possible human carcinogen" was carbon tetrachloride (Table 5-11 and Figure 5-11).

The cumulative total cancer risk using the 95% UCL exposure statistic was 2.38×10^{-5} (Table 5-9 and Figure 5-9). Based on the 95% UCL, no COPCs provided > 10^{-5} risk. 1,3-Butadiene, benzene, and carbon tetrachloride provided risk in the 10^{-6} range based on the 95% UCL.

The non-cancer HI was 0.12 (Table 5-12 and Figure 5-12). Using an HQ value of 0.1 as a threshold to identify risk drivers, no COPCs exceeded this value. Therefore, no non-cancer toxicity factors were exceeded for 2005.

The HI derived from the 95% UCL was 0.21, with 1,3-butadiene providing the largest HQ. None of the 95% UCL-derived HQs exceeded 1, indicating that non-cancer toxicity values were not exceeded.

5.5.6 Summary of risk characterization for Site E

Site E is an urban control site that was chosen due to its location close to a major traffic corridor but distant from the Rubbertown area. Cumulative median cancer risks ranged from a low of 1.67×10^{-5} for 2003 to a high of 3.02×10^{-5} for 2004. 1,3-Butadiene and benzene, known human carcinogens, contributed risks in the 10^{-6} range. Of the probable/possible human carcinogens, carbon tetrachloride was the only probable/possible human carcinogen that was a risk driver in the years 2002-2005.

Chloroform was only a risk driver in 2004, and acrylonitrile was a risk driver in 2001, 2002, and 2004.

Cumulative 95% UCL-derived cancer risks ranged from a low of 2.17×10^{-5} for 2003 to a high of 3.83×10^{-5} for 2004. This range is approximately 1.3-fold greater than the cancer risk range using median exposure concentrations. The primary risk drivers were 1,3-butadiene, benzene, carbon tetrachloride, and acrylonitrile (when present).

For median concentrations and 95% UCL concentrations, no COPCs exceeded the HQ value of 1, indicating no exceedances of the inhalation RfC. These results indicate that cancer risks for the area around Site E are much lower than the other monitoring sites, and that non-cancer toxicity is unexpected.

Chloroprene is classified by IARC as a 2B possible human carcinogen. However, no cancer slope factor is currently cited for chloroprene by IRIS so that it was not assessed for cancer risk. However, IRIS developed a cancer slope factor that underwent peer review. Although IRIS did not publish this number, it was reviewed by the State of Michigan and is used there. Following the hierarchy in APCD Regulation 5.20, this cancer slope number (actually the resulting concentration representing a cancer risk of 10^{-6}, referred to as a benchmark ambient concentration [BAC], 0.001 $\mu g/m^3$) is used in the STAR Program. This cancer slope factor is $1/(mg/m^3)$. Using this cancer slope factor, chloroprene cancer risks were calculated, and are presented and discussed in Section 6.5 Risk Characterization of the Uncertainty Analysis (Section 6.0).

Acute non-cancer toxicity values were not exceeded by any of the COPCs.

Table 5-9. Site E total cancer risk.

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
1,3- Butadiene	106990			3.32E-06	16.21%	3.32E-06	19.86%	3.32E-06	10.98%	3.32E-06	18.45%
Acrylonitrile	107131	1.18E-05	54.64%	7.38E-06	36.08%			7.38E-06	24.43%		
Chloroform	67663							5.61E-06	18.58%		
Benzene	71432	9.33E-06	43.19%	4.73E-06	23.12%	3.73E-06	22.36%	4.23E-06	14.01%	4.98E-06	27.69%
Carbon Tetrachloride	56235	0.00E+00		4.72E-06	23.07%	9.44E-06	56.52%	9.44E-06	31.24%	9.44E-06	52.50%
All other chemicals		4.71E-07	2.18%	3.13E-07	1.53%	2.12E-07	1.27%	2.28E-07	0.76%	2.45E-07	1.36%
Cumulative Total Risk		2.16E-05	100.00%	2.05E-05	100.00%	1.67E-05	100.00%	3.02E-05	100.00%	1.80E-05	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
1,3- Butadiene	106990			7.04E-06	21.87%	5.39E-06	24.80%	5.33E-06	13.90%	8.41E-06	35.32%
Acrylonitrile	107131			9.45E-06	29.34%			1.04E-05	27.15%		
Chloroform	67663							6.02E-06	15.69%		
Benzene	71432			6.18E-06	19.20%	4.79E-06	22.01%	5.86E-06	15.29%	5.61E-06	23.56%
Carbon Tetrachloride	56235			9.10E-06	28.25%	1.13E-05	52.07%	1.04E-05	27.24%	9.50E-06	39.88%
All other chemicals				4.26E-07	1.32%	2.42E-07	1.11%	2.78E-07	0.73%	2.96E-07	1.24%
Cumulative Total Risk				3.22E-05	100.00%	2.17E-05	100.00%	3.83E-05	100.00%	2.38E-05	100.00%

Figure 5-9. Site E total cancer risk.

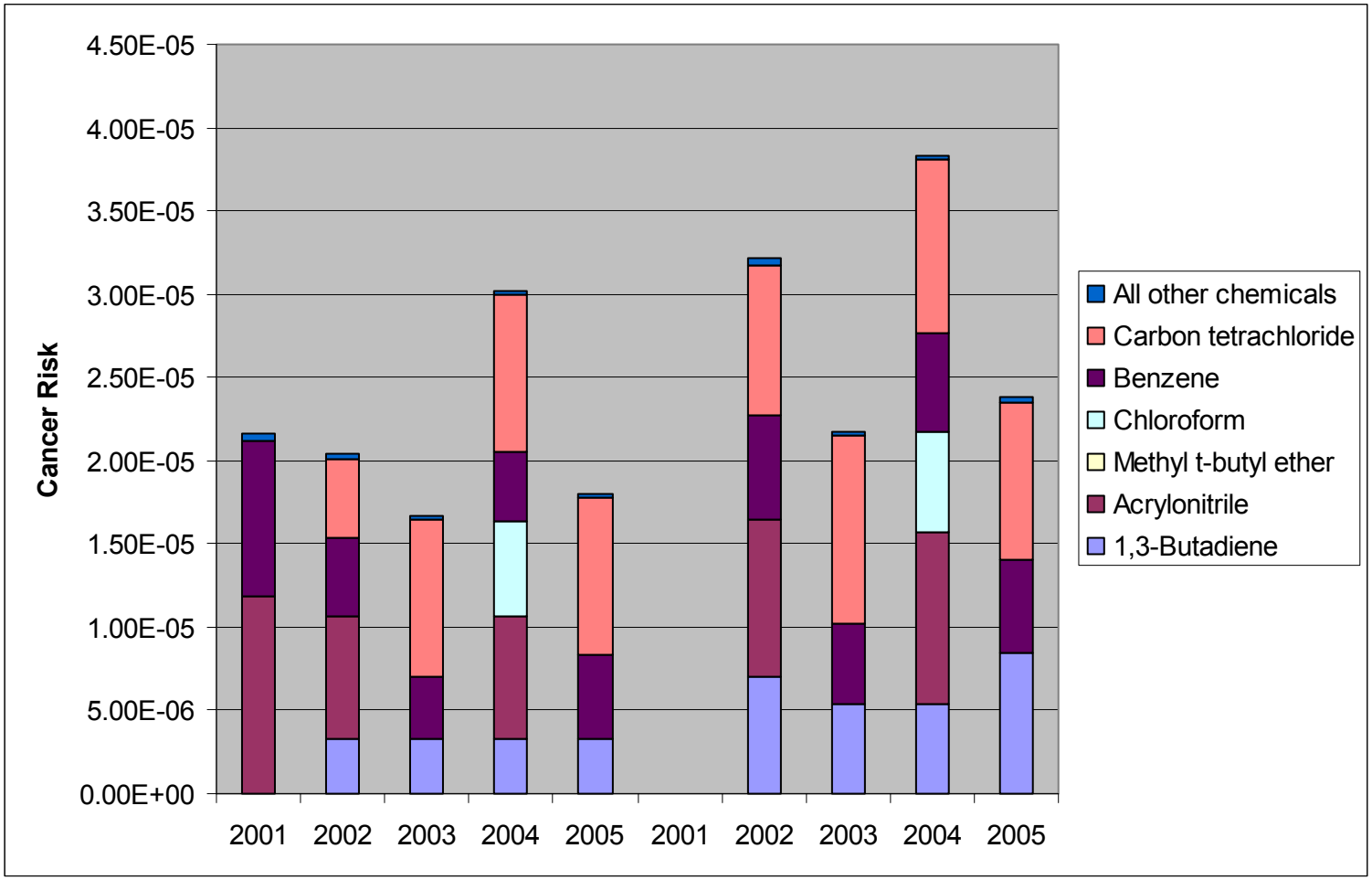


Table 5-10. Site E cancer risk of "known human carcinogens".

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
1,3- Butadiene	106990			3.32E-06	41.22%	3.32E-06	47.04%	3.32E-06	43.94%	3.32E-06	39.98%
Benzene	71432	9.33E-06	100.00%	4.73E-06	58.78%	3.73E-06	52.96%	4.23E-06	56.06%	4.98E-06	60.02%
Cumulative Risk of Known Human Carcinogens		9.33E-06	100.00%	8.04E-06	100.00%	7.05E-06	100.00%	7.54E-06	100.00%	8.29E-06	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
1,3- Butadiene	106990			7.04E-06	53.25%	5.39E-06	52.98%	5.33E-06	47.63%	8.41E-06	59.98%
Benzene	71432			6.18E-06	46.75%	4.79E-06	47.02%	5.86E-06	52.37%	5.61E-06	40.02%
Cumulative Risk of Known Human Carcinogens				1.32E-05	100.00%	1.02E-05	100.00%	1.12E-05	100.00%	1.40E-05	100.00%

Figure 5-10. Site E cancer risk of "known human carcinogens".

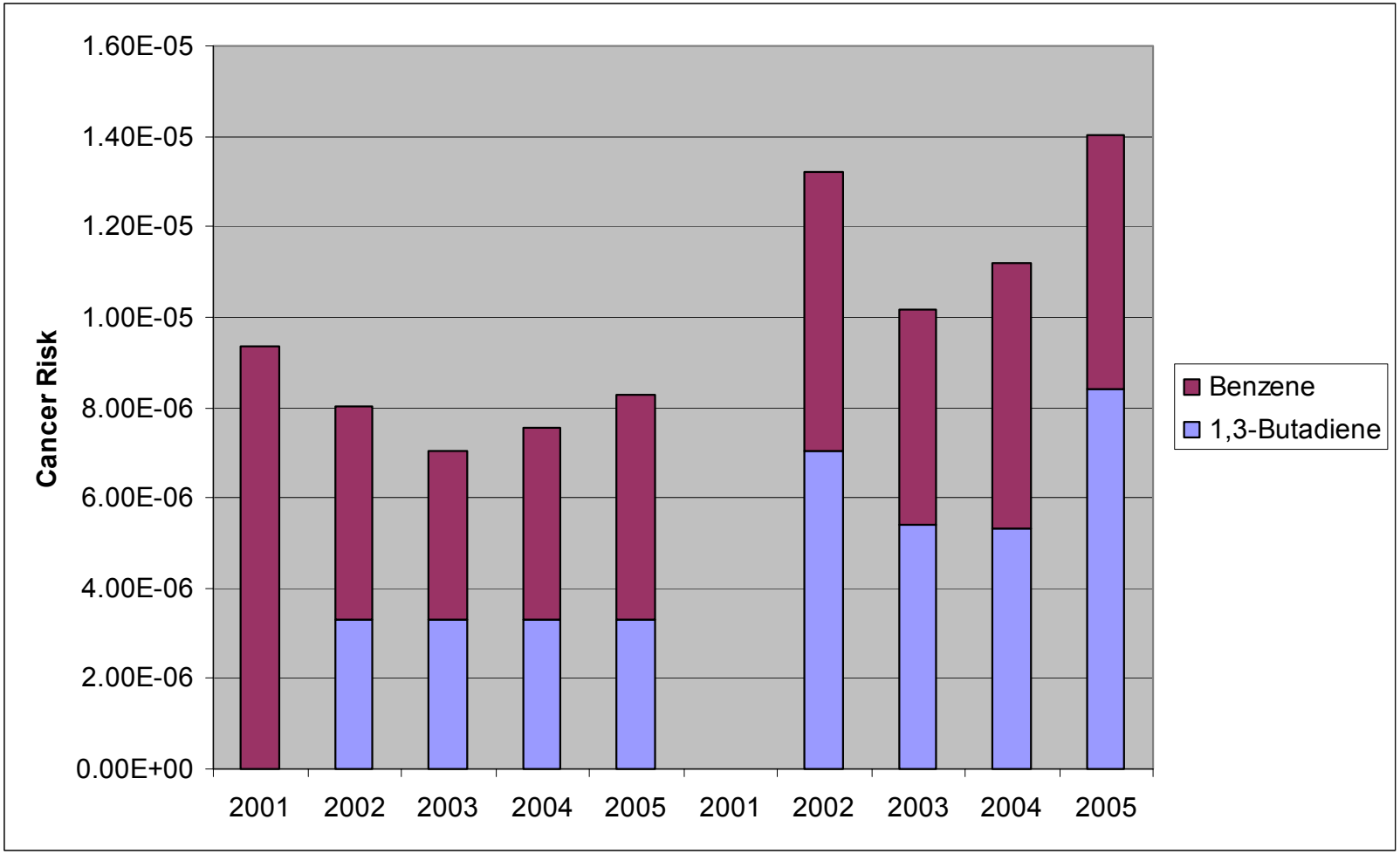


Table 5-11. Site E cancer risk of "probable/possible human carcinogens".

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Acrylonitrile	107131	1.18E-05	100.00%	7.38E-06	61.00%			7.38E-06	32.90%		
Chloroform	67663							5.61E-06	25.03%		
Carbon Tetrachloride	56235			4.72E-06	39.00%	9.44E-06	100.00%	9.44E-06	42.07%	9.44E-06	100.00%
Cumulative Risk of Probable/Possible Human Carcinogens		1.18E-05	100.00%	1.21E-05	100.00%	9.44E-06	100.00%	2.24E-05	100.00%	9.44E-06	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Acrylonitrile	107131			9.45E-06	50.95%			1.04E-05	38.74%		
Chloroform	67663							6.02E-06	22.39%		
Carbon Tetrachloride	56235			9.10E-06	49.05%	1.13E-05	100.00%	1.04E-05	38.87%	9.50E-06	100.00%
Cumulative Risk of Probable/Possible Human Carcinogens				1.85E-05	100.00%	1.13E-05	100.00%	2.69E-05	100.00%	9.50E-06	100.00%

Figure 5-11. Site E cancer risk of "probable/possible human carcinogens".

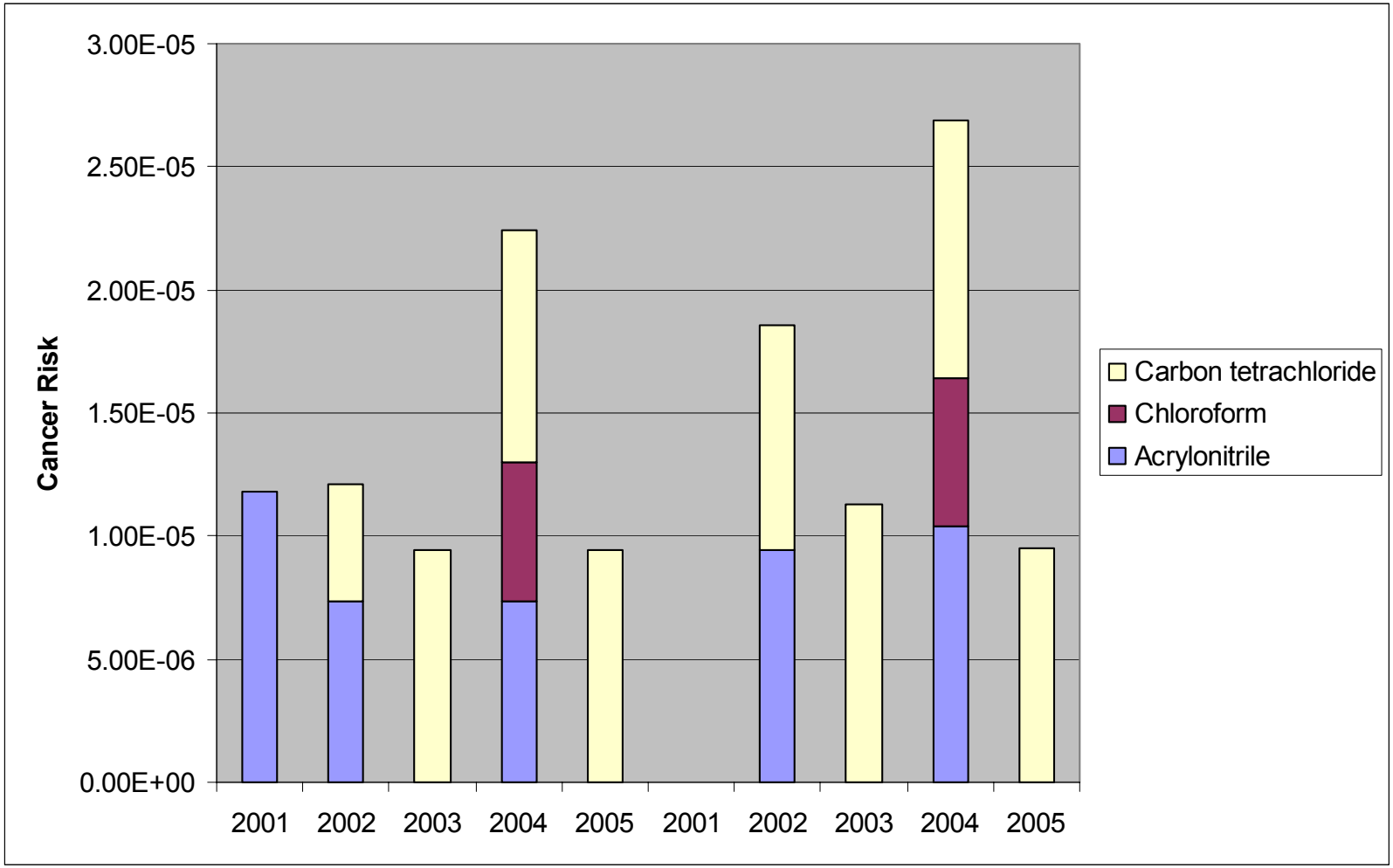
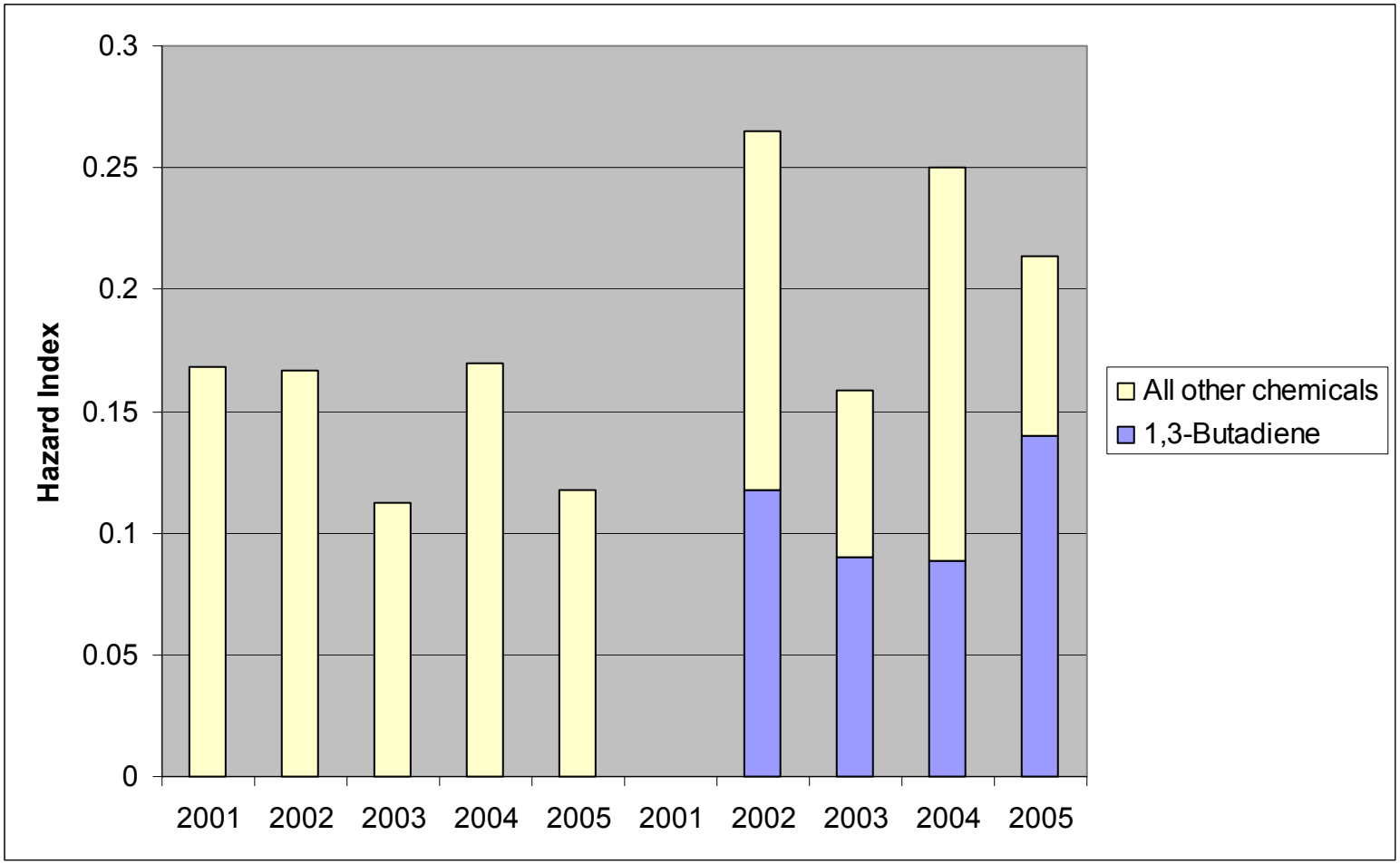


Table 5-12. Site E non-cancer hazard index (HI).

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI
No chemicals HQ>0.1											
Hazard Index (HI)		0.17	100%	0.17	100%	0.11	100%	0.17	100%	0.12	0.17
Compound	**CAS**	**2001 95% UCL**		**2002 95% UCL**		**2003 95% UCL**		**2004 95% UCL**		**2005 95% UCL**	
		Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI
1,3- Butadiene	106990			0.12	44.30%	0.09	56.71%	0.09	35.53%	0.14	65.67%
All other chemicals				0.15	55.70%	0.07	43.29%	0.16	64.47%	0.07	34.33%
Hazard Index (HI)				0.27	100.00%	0.16	100.00%	0.25	100.00%	0.21	100.00%

Figure 5-12. Site E non-cancer hazard index (HI).



5.6 Cane Run Elementary School: Site F

The Cane Run Elementary School monitoring site (Site F) is a neighborhood population exposure site. The objective is to characterize potential exposure of individuals living in Cane Run, Hallmark, and Algonquin communities.

The total cancer risk for the years 2001-2005 for Site F are presented in Table 5-13 and Figure 5-13. The cancer risk caused by "known human carcinogens" for the years 2001-2005 are presented in Table 5-14 and Figure 5-14. The cancer risk caused by "probable/possible human carcinogens" for the years 2001-2005 are presented in Table 5-15 and Figure 5-15. The non-cancer data (HQ and HI) for the years 2001-2005 are presented in Table 5-16 and Figure 5-16.

5.6.1 Risk characterization from 2001 for Site F

The cumulative total cancer risk of the COPCs medians was 1.07×10^{-4} (Table 5-13 and Figure 5-13). The risk drivers that provided > 10^{-5} risk were 1,3-butadiene, acrylonitrile, and benzene. The risk drivers that provided > 10^{-6} risk but < 10^{-5} were vinyl chloride, methyl t-butyl ether, chloroform, tetrachloroethene, 1,4-dichlorobenzene, and naphthalene. Methyl t-butyl ether was a risk driver only in 2001. 1,4-Dichlorobenzene and naphthalene were risk drivers only in 2001, and risks for these COPCs were calculated using a median value that was ½ SQL because of many of its detections below the SQL. Vinyl chloride was a risk driver in all monitoring years; however its cancer risk was also based on a median value that was ½ SQL because of many of its detections below the SQL.

The "known human carcinogens" risk drivers were vinyl chloride, 1,3-butadiene, and benzene (Table 5-14 and Figure 5-14). The "probable/possible human carcinogens" risk drivers were acrylonitrile, chloroform, tetrachloroethene, 1,4-dichlorobenzene, and naphthalene (Table 5-15 and Figure 5-15). Methyl t-butyl ether is classified by IARC as a group 3 carcinogen, "not classifiable as to its carcinogenicity in humans."

The 95% UCL was not calculated for the COPCs from this year because the sample numbers were too small to provide a meaningful derivation of this statistic.

The non-cancer median HI was 1.6 (Table 5-16 and Figure 5-16). 1,3-Butadiene, acrylonitrile, and chloroprene were the HI risk drivers with HQ > 0.1. However, HQs did not exceed 1, indicating that non-cancer toxicity factors were not exceeded for 2001.

5.6.2 Risk characterization from 2002 for Site F

The cumulative total cancer risk of the COPCs medians was 6.80×10^{-5} (Table 5-13 and Figure 5-13). The risk drivers that provided > 10^{-5} risk were 1,3-butadiene and acrylonitrile. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were vinyl chloride, chloroform, benzene, and carbon tetrachloride.

The "known human carcinogens" were vinyl chloride, 1,3-butadiene, and benzene (Table 5-14 and Figure 5-14). 1,3-Butadiene contributed the most risk (> 10^{-5}) of the known human carcinogens. The "probable/possible human carcinogens" were acrylonitrile, chloroform, and carbon tetrachloride (Table 5-15 and Figure 5-15). Acrylonitrile contributed the most risk (> 10^{-5}) of the probable/possible human carcinogens.

The cumulative total cancer risk using the 95% UCL exposure statistic was 1.90×10^{-4} (Table 5-13 and Figure 5-13). 1,3-Butadiene, acrylonitrile, and chloroform were the largest risk drivers using the 95% UCL providing > 10^{-5} risk. Vinyl chloride, benzene, and carbon tetrachloride all provided > 10^{-6} risk but < 10^{-5} risk on the basis of the 95% UCL.

The non-cancer median HI was 0.96 (Table 5-16 and Figure 5-16), and was driven by 1,3-butadiene and chloroprene. 1,3-Butadiene, acrylonitrile, and chloroprene were identified as non-cancer risk drivers because of HQs > 0.1; however, none of the chemicals had HQs >1, indicating that inhalation RfCs were not exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The TOSHI for acrylonitrile and chloroprene was 0.51, indicating that non-cancer nasal epithelium effects are not expected.

The HI derived from the 95% UCL was 7.02, with 1,3-butadiene and chloroprene providing the largest HQs. Both 1,3-butadiene and chloroprene had 95% UCL-derived HQs > 1, indicating that their chronic inhalation RfCs were exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 5.24, indicating possible chronic nasal/olfactory epithelium effects.

5.6.3 Risk characterization from 2003 for Site F

The cumulative total cancer risk of the COPCs medians was 4.72×10^{-5} (Table 5-13 and Figure 5-13). The risk driver that provided > 10^{-5} risk was 1,3-butadiene. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were vinyl chloride, acrylonitrile, chloroform, benzene, carbon tetrachloride, and tetrachloroethene. Tetrachloroethene cancer risk was derived using a median that was ½ SQL since there were many detections < SQL.

The "known human carcinogens" were vinyl chloride, 1,3-butadiene, and benzene (Table 5-14 and Figure 5-14). 1,3-Butadiene contributed the most risk (> 10^{-5}) of the known human carcinogens. The "probable/possible human carcinogens" were acrylonitrile, chloroform, carbon tetrachloride, and tetrachloroethene (Table 5-15 and Figure 5-15), and all contributed risks in the 10^{-6} range.

The cumulative total cancer risk using the 95% UCL exposure statistic was 1.52×10^{-4} (Table 5-13 and Figure 5-13). 1,3-Butadiene, acrylonitrile, and carbon tetrachloride were the largest risk drivers using the 95% UCL providing > 10^{-5} risk. Vinyl chloride, chloroform, benzene, and tetrachloroethene all provided > 10^{-6} risk but < 10^{-5} risk on the basis of the 95% UCL.

The non-cancer median HI was 0.57 (Table 5-16 and Figure 5-16), and was driven by 1,3-butadiene and chloroprene. Both 1,3-butadiene and chloroprene were identified as non-cancer risk drivers because of HQs > 0.1; however, neither HQ was > 1, indicating that their inhalation RfCs were not exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The TOSHI for acrylonitrile and chloroprene was 0.23, indicating that non-cancer nasal epithelium effects are not expected.

The HI derived from the 95% UCL was 3.11, with 1,3-butadiene and chloroprene providing the largest HQs. Both 1,3-butadiene and chloroprene had 95% UCL-derived HQs > 1, indicating that their chronic inhalation RfC was exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 1.51 indicating that non-cancer chronic effects on nasal epithelium are possible.

5.6.4 Risk characterization from 2004 for Site F

The cumulative total cancer risk of the COPCs medians was 4.04×10^{-5} (Table 5-13 and Figure 5-13). The risk driver that provided > 10^{-5} risk was 1,3-butadiene. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were vinyl chloride, acrylonitrile, chloroform, benzene, and carbon tetrachloride.

The "known human carcinogens" were vinyl chloride, 1,3-butadiene, and benzene (Table 5-14 and Figure 5-14). 1,3-Butadiene contributed the most risk (> 10^{-5}) of the known human carcinogens. The "probable/possible human carcinogens" were acrylonitrile, chloroform, and carbon tetrachloride, (Table 5-15 and Figure 5-15), and all contributed risks in the 10^{-6} range.

The cumulative total cancer risk using the 95% UCL exposure statistic was 1.03×10^{-4} (Table 5-13 and Figure 5-13). 1,3-Butadiene, acrylonitrile, chloroform, and carbon tetrachloride were the largest risk drivers using the 95% UCL providing > 10^{-5} risk. Vinyl chloride and benzene provided > 10^{-6} risk but < 10^{-5} risk on the basis of the 95% UCL.

The non-cancer median HI was 0.49 (Table 5-16 and Figure 5-16), and was driven by 1,3-butadiene and chloroprene. Both 1,3-butadiene and chloroprene were identified as non-cancer risk drivers because of HQs > 0.1; however, the HQs were not > 1, indicating

that their inhalation RfCs were not exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene was olfactory epithelium. The TOSHI for acrylonitrile and chloroprene was 0.23, indicating that non-cancer nasal epithelium effects are not expected.

The HI derived from the 95% UCL was 3.83, with 1,3-butadiene and chloroprene providing the largest HQs. Neither 1,3-butadiene nor acrylonitrile had 95% UCL-derived HQs > 1, indicating that their chronic inhalation RfCs were not exceeded. However, the 95% UCL HQ for chloroprene was 2.77, indicating exceedance of the RfC. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 2.95 indicating that chronic non-cancer nasal epithelium effects are possible.

5.6.5 Risk characterization from 2005 for Site F

The cumulative total cancer risk of the COPCs medians was 5.46×10^{-5} (Table 5-13 and Figure 5-13). The risk drivers that provided > 10^{-5} risk were 1,3-butadiene and carbon tetrachloride. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were vinyl chloride, acrylonitrile, chloroform, benzene, and tetrachloroethene. Tetrachloroethene cancer risk was derived using a median that was ½ SQL since there were many detections < SQL.

The "known human carcinogens" were vinyl chloride, 1,3-butadiene, and benzene (Table 5-14 and Figure 5-14). 1,3-Butadiene contributed the most risk (> 10^{-5}) of the known human carcinogens. The "probable/possible human carcinogens" were acrylonitrile, chloroform, carbon tetrachloride, and tetrachloroethene (Table 5-15 and Figure 5-15). Only carbon tetrachloride of the "probable/possible human carcinogens" contributed risk in the 10^{-5} range.

The cumulative total cancer risk using the 95% UCL exposure statistic was 2.28×10^{-4} (Table 5-13 and Figure 5-13). 1,3-Butadiene was the largest risk driver using the 95% UCL providing > 10^{-4} risk. Acrylonitrile and carbon tetrachloride contributed risks in the 10^{-5} range. Vinyl chloride, chloroform, benzene, and tetrachloroethene provided > 10^{-6} risks but < 10^{-5} risk on the basis of the 95% UCL.

The non-cancer median HI was 0.67 (Table 5-16 and Figure 5-16), and was driven by 1,3-butadiene and chloroprene. Both 1,3-butadiene and chloroprene were identified as non-cancer risk drivers because of HQs > 0.1; however, the HQs were not > 1, indicating that their inhalation RfCs were not exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The TOSHI for acrylonitrile and

chloroprene was 0.23, indicating that non-cancer nasal epithelium effects are not expected.

The HI derived from the 95% UCL was 4.30, with 1,3-butadiene and chloroprene providing the largest HQs. The 95% UCL-derived HQs for 1,3-butadiene and chloroprene exceeded 1, indicating that their chronic inhalation RfCs were exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 1.82 indicating that chronic non-cancer nasal epithelium effects are possible.

5.6.6 Summary of risk characterization for Site F

Site F is a community exposure site. Cumulative median cancer risks ranged from a low of 4.04×10^{-5} for 2004 to a high of 1.07×10^{-4} for 2001. Vinyl chloride was a risk driver in all 5 years of the risk characterization although many of its detections were below the SQL and a median of ½ SQL was used for the cancer risk calculations. 1,3-Butadiene contributed the most towards the cumulative cancer risk among the known human carcinogens. Acrylonitrile contributed the most towards the cumulative cancer risk among the probable/possible human carcinogens.

Cumulative 95% UCL-derived cancer risks ranged from a low of 1.03×10^{-4} for 2004 to a high of 2.28×10^{-4} for 2005. This range is approximately 2-2.5-fold greater than the cumulative median cancer risk range. The primary risk drivers were 1,3-butadiene, acrylonitrile, chloroform, benzene, and carbon tetrachloride.

For median concentrations, no COPCs exceeded the HQ value of 1, indicating that concentrations did not exceed inhalation RfCs. The cumulative median HI exceeded 1 only in 2001. The 95% UCL-derived HQs for 1,3-butadiene and chloroprene exceeded a value of 1, indicating that chronic non-cancer effects are possible. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was > 1 during all monitoring years, indicating that chronic nasal/olfactory epithelium effects are possible based on this conservative exposure estimate. These results indicate that 1,3-butadiene presents the greatest cancer risk, and that 1,3-butadiene and chloroprene present the greatest non-cancer risks.

Chloroprene is classified by IARC as a 2B possible human carcinogen. However, no cancer slope factor is currently cited for chloroprene by IRIS so that it was not assessed for cancer risk. However, IRIS developed a cancer slope factor that underwent peer review. Although IRIS did not publish this number, it was reviewed by the State of Michigan and is used there. Following the hierarchy in APCD Regulation 5.20, this cancer slope number (actually the resulting concentration representing a cancer risk of 10^{-6}, referred to as a benchmark ambient concentration [BAC], 0.001 $\mu g/m^3$) is used in the STAR Program. This cancer slope factor is $1/(mg/m^3)$. Using this cancer slope factor, chloroprene cancer risks were calculated, and are presented and discussed in Section 6.5 Risk Characterization of the Uncertainty Analysis (Section 6.0).

Acute non-cancer toxicity values were not exceeded by any of the COPCs.

Table 5-13. Site F total cancer risk.

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014	1.13E-06	1.05%	1.13E-06	1.66%	1.13E-06	2.39%	1.13E-06	2.79%	1.13E-06	2.06%
1,3- Butadiene	106990	2.78E-05	26.00%	2.19E-05	32.16%	1.52E-05	32.30%	1.06E-05	26.24%	2.06E-05	37.66%
Acrylonitrile	107131	3.47E-05	32.37%	2.43E-05	35.79%	7.38E-06	15.63%	7.38E-06	18.25%	7.38E-06	13.52%
Methyl T-Butyl Ether (MTBE)	1634044	1.20E-06	1.12%								
Chloroform	67663	5.61E-06	5.24%	5.61E-06	8.25%	5.61E-06	11.89%	5.61E-06	13.88%	5.61E-06	10.28%
Benzene	71432	2.07E-05	19.34%	7.34E-06	10.79%	6.10E-06	12.91%	5.97E-06	14.77%	7.22E-06	13.22%
Carbon Tetrachloride	56235			7.08E-06	10.40%	9.44E-06	19.99%	9.44E-06	23.34%	1.04E-05	19.02%
Tetrachloroethene	127184	3.40E-06	3.17%			2.00E-06	4.24%			2.00E-06	3.66%
1,4-Dichlorobenzene	106467	3.31E-06	3.09%								
Naphthalene	91203	8.91E-06	8.32%								
All other chemicals		3.22E-07	0.30%	6.51E-07	0.96%	3.10E-07	0.66%	2.94E-07	0.73%	3.10E-07	0.57%
Cumulative Total Risk		1.07E-04	100.00%	6.80E-05	100.00%	4.72E-05	100.00%	4.04E-05	100.00%	5.46E-05	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014			3.08E-06	1.62%	3.81E-06	2.51%	1.69E-06	1.65%	3.85E-06	1.69%
1,3- Butadiene	106990			9.93E-05	52.13%	8.90E-05	58.49%	4.68E-05	45.65%	1.42E-04	62.40%
Acrylonitrile	107131			5.56E-05	29.20%	2.65E-05	17.39%	2.45E-05	23.90%	4.89E-05	21.44%
Methyl T-Butyl Ether (MTBE)	1634044										
Chloroform	67663			1.26E-05	6.60%	9.82E-06	6.45%	1.07E-05	10.43%	9.34E-06	4.09%
Benzene	71432			9.73E-06	5.11%	8.77E-06	5.76%	7.15E-06	6.98%	9.33E-06	4.09%
Carbon Tetrachloride	56235			8.83E-06	4.64%	1.13E-05	7.44%	1.13E-05	11.04%	1.11E-05	4.86%
Tetrachloroethene	127184					2.53E-06	1.66%			2.83E-06	1.24%
1,4-Dichlorobenzene	106467										
Naphthalene	91203										
All other chemicals				5.60E-07	0.71%	4.62E-07	0.30%	3.56E-07	0.35%	4.60E-07	0.20%
Cumulative Total Risk				1.90E-04	100.00%	1.52E-04	100.00%	1.03E-04	100.00%	2.28E-04	100.00%

Figure 5-13. Site F total cancer risk.

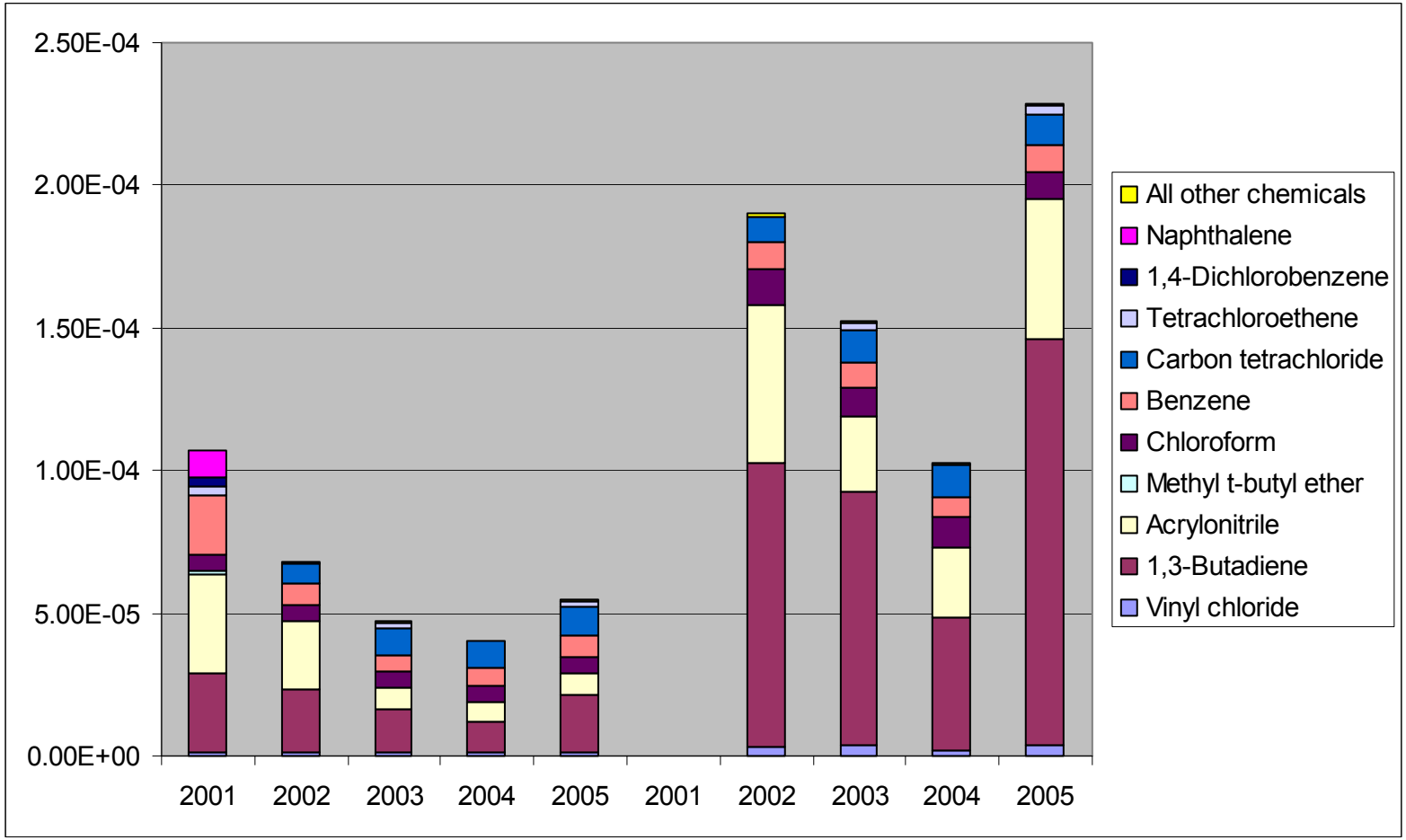


Table 5-14. Site F cancer risk of "known human carcinogens".

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014	1.13E-06	2.27%	1.13E-06	3.71%	1.13E-06	5.01%	1.13E-06	6.36%	1.13E-06	3.90%
1,3- Butadiene	106990	2.78E-05	56.04%	2.19E-05	72.10%	1.52E-05	67.86%	1.06E-05	59.91%	2.06E-05	71.13%
Benzene	71432	2.07E-05	41.69%	7.34E-06	24.19%	6.10E-06	27.13%	5.97E-06	33.73%	7.22E-06	24.97%
Cumulative Risk of Known Human Carcinogens		4.97E-05	100.00%	3.03E-05	100.00%	2.25E-05	100.00%	1.77E-05	100.00%	2.89E-05	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014	0.00E+00		3.08E-06	2.75%	3.81E-06	3.75%	1.69E-06	3.04%	3.85E-06	2.47%
1,3- Butadiene	106990	0.00E+00		9.93E-05	88.57%	8.90E-05	87.61%	4.68E-05	84.11%	1.42E-04	91.53%
Benzene	71432	0.00E+00		9.73E-06	8.68%	8.77E-06	8.63%	7.15E-06	12.85%	9.33E-06	5.99%
Cumulative Risk of Known Human Carcinogens				1.12E-04	100.00%	1.02E-04	100.00%	5.56E-05	100.00%	1.56E-04	100.00%

Figure 5-14. Site F cancer risk of "known human carcinogens".

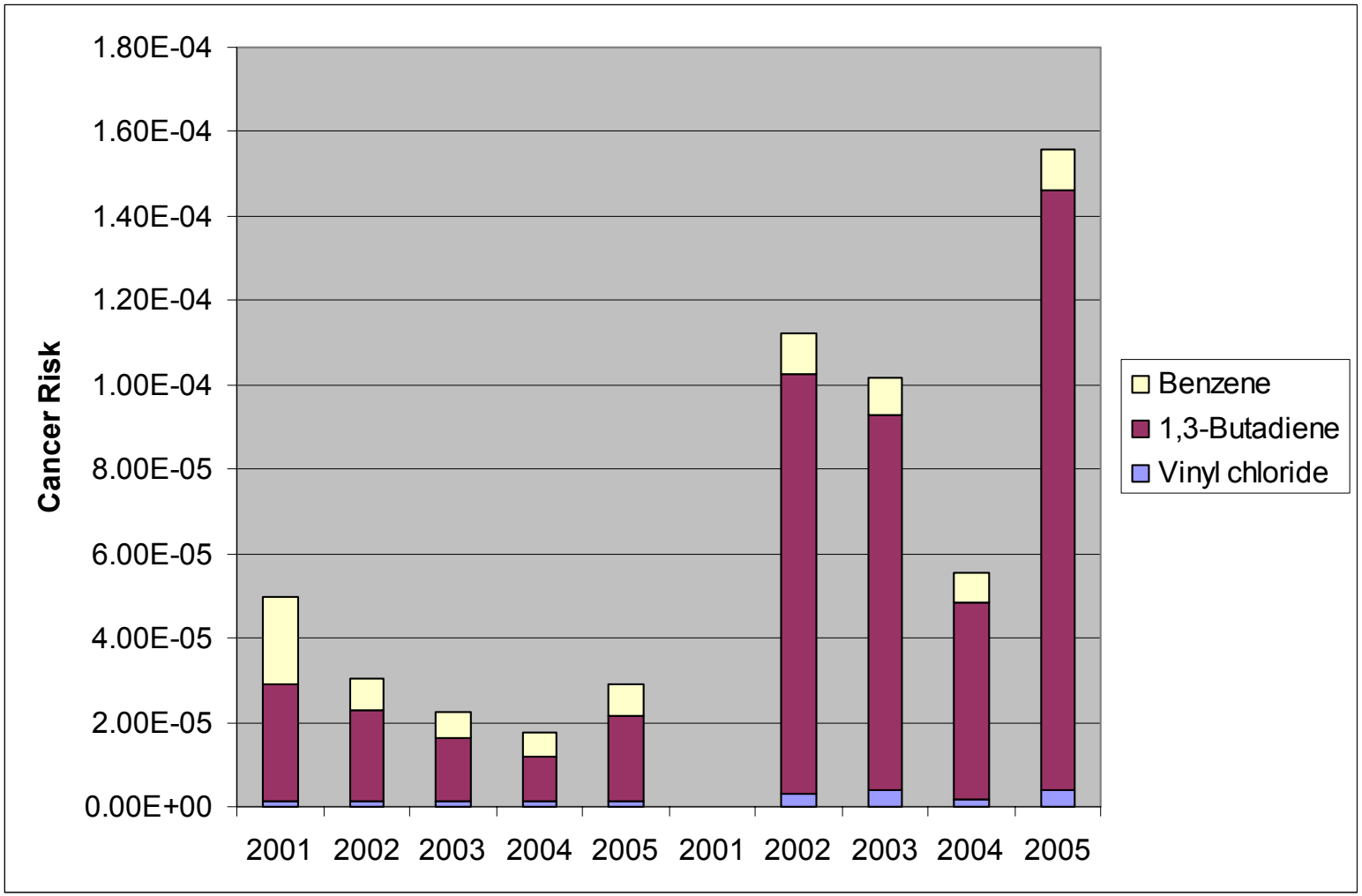


Table 5-15. Site F cancer risk of "probable/possible human carcinogens".

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Acrylonitrile	107131	3.47E-05	62.03%	2.43E-05	65.74%	7.38E-06	30.21%	7.38E-06	32.90%	7.38E-06	29.08%
Chloroform	67663	5.61E-06	10.04%	5.61E-06	15.15%	5.61E-06	22.98%	5.61E-06	25.03%	5.61E-06	22.12%
Carbon Tetrachloride	56235			7.08E-06	19.11%	9.44E-06	38.63%	9.44E-06	42.07%	1.04E-05	40.91%
Tetrachloroethene	127184	3.40E-06	6.08%			2.00E-06	8.19%			2.00E-06	7.88%
1,4-Dichlorobenzene	106467	3.31E-06	5.91%								
Naphthalene	91203	8.91E-06	15.93%								
Cumulative Risk of Probable/Possible Human Carcinogens		5.59E-05	100.00%	3.70E-05	100.00%	2.44E-05	100.00%	2.24E-05	100.00%	2.54E-05	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Acrylonitrile	107131			5.56E-05	72.22%	2.65E-05	52.79%	2.45E-05	52.68%	4.89E-05	67.79%
Chloroform	67663			1.26E-05	16.31%	9.82E-06	19.59%	1.07E-05	22.98%	9.34E-06	12.93%
Carbon Tetrachloride	56235			8.83E-06	11.47%	1.13E-05	22.58%	1.13E-05	24.34%	1.11E-05	15.36%
Tetrachloroethene	127184					2.53E-06	5.04%			2.83E-06	3.92%
1,4-Dichlorobenzene	106467										
Naphthalene	91203										
Cumulative Risk of Probable/Possible Human Carcinogens				7.70E-05	100.00%	5.01E-05	100.00%	4.65E-05	100.00%	7.22E-05	100.00%

Figure 5-15. Site F cancer risk of "probable/possible human carcinogens".

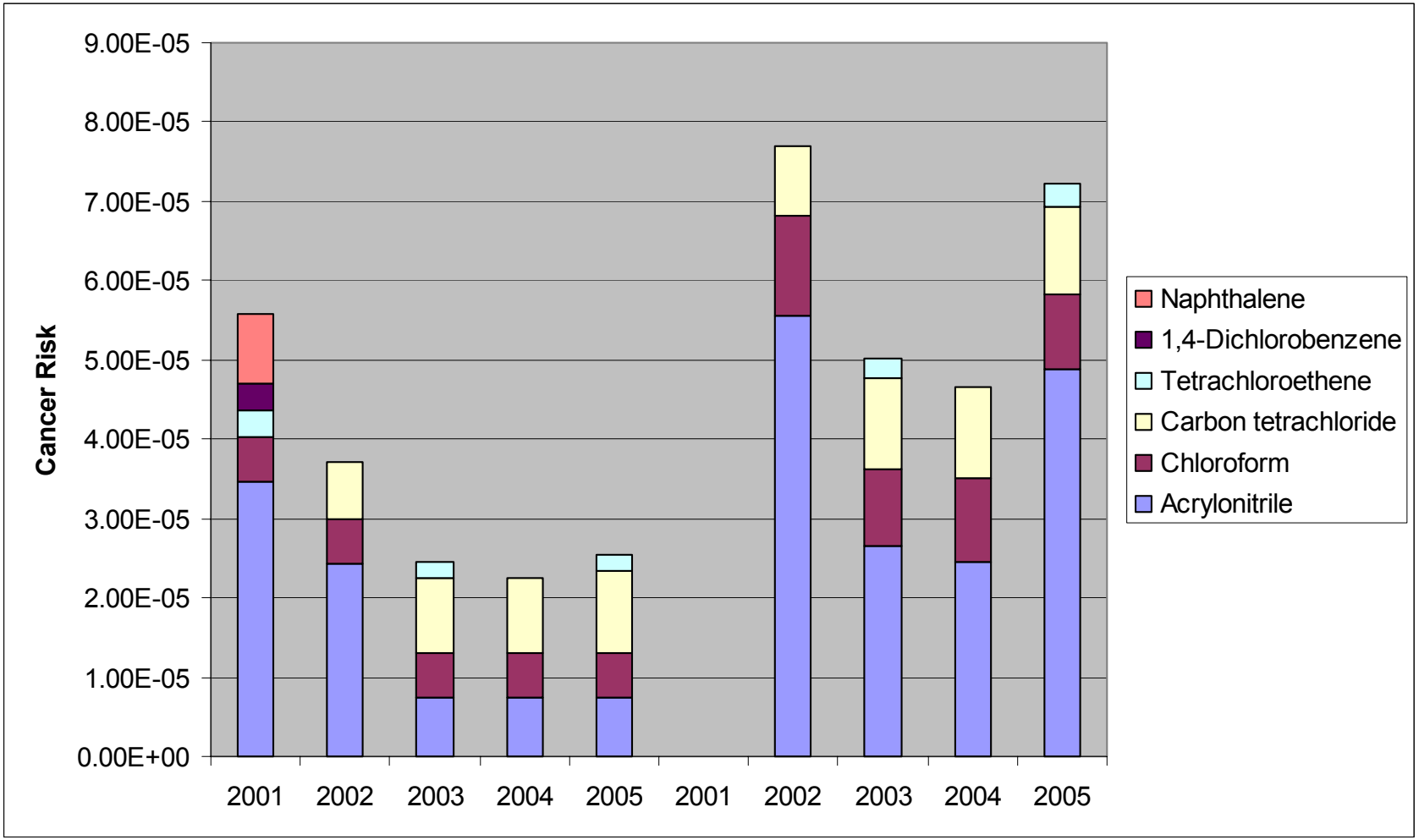
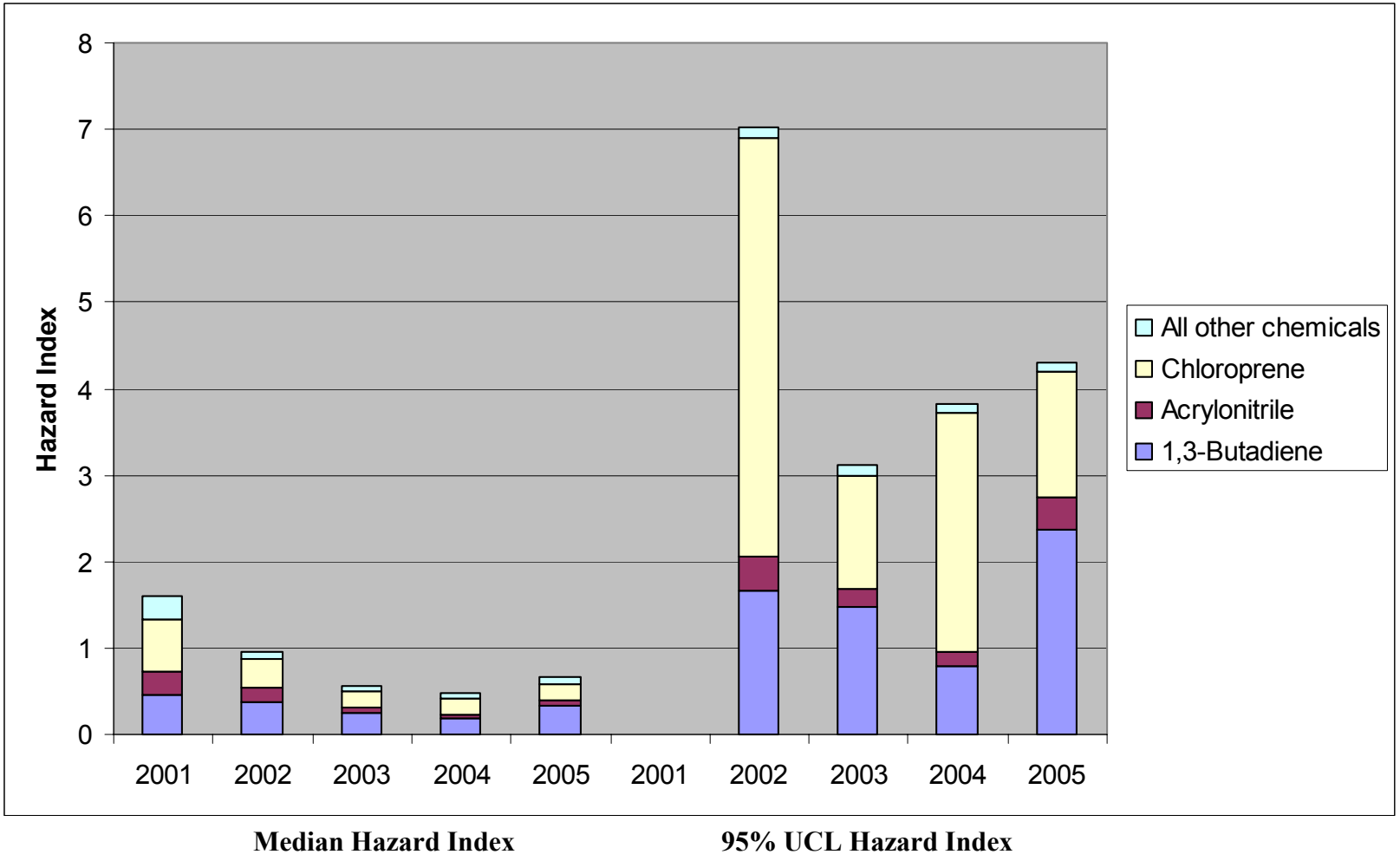


Table 5-16. Site F non-cancer hazard index (HI).

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI
1,3- Butadiene	106990	0.46	29.18%	0.36	38.11%	0.25	44.62%	0.18	36.22%	0.34	51.50%
Acrylonitrile	107131	0.25	16.03%	0.18	18.71%	0.05	9.52%	0.05	11.11%	0.05	8.16%
Chloroprene	126998	0.61	38.12%	0.33	34.05%	0.18	31.78%	0.18	37.08%	0.18	27.21%
All other chemicals		0.27	16.67%	0.09	9.12%	0.08	14.08%	0.08	15.59%	0.09	13.13%
Hazard Index (HI)		1.59	100.00%	0.96	100.00%	0.57	100.00%	0.49	100.00%	0.67	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI
1,3- Butadiene	106990			1.65	23.58%	1.48	47.66%	0.78	20.38%	2.37	55.16%
Acrylonitrile	107131			0.41	5.83%	0.19	6.25%	0.18	4.71%	0.36	8.36%
Chloroprene	126998			4.83	68.89%	1.32	42.44%	2.77	72.32%	1.46	33.83%
All other chemicals				0.12	1.70%	0.11	3.65%	0.10	2.60%	0.11	2.65%
Hazard Index (HI)				7.02	100.00%	3.11	100.00%	3.83	100.00%	4.30	100.00%

Figure 5-16. Site F non-cancer hazard index (HI).



5.7 Chickasaw Park: Site I

The Chickasaw Park monitoring site (Site I) is a neighborhood population exposure site. The objective is to characterize potential exposure of individuals living in Chickasaw, Westover, Shawnee, and Portland communities/neighborhoods.

The total cancer risks for the years 2001-2005 for Site I are presented in Table 5-17 and Figure 5-17. The cancer risk caused by "known human carcinogens" for the years 2001-2005 are presented in Table 5-18 and Figure 5-18. The cancer risk caused by "probable/possible human carcinogens" for the years 2001-2005 are presented in Table 5-19 and Figure 5-19. The non-cancer data (HQ and HI) for the years 2001-2005 are presented in Table 5-20 and Figure 5-20.

5.7.1 Risk characterization from 2001 for Site I

The cumulative total cancer risk of the COPCs medians was 4.30×10^{-5} (Table 5-17 and Figure 5-17). The risk driver that provided > 10^{-5} risk was 1,3-butadiene. The risk drivers that provided > 10^{-6} risk but < 10^{-5} were acrylonitrile, chloroform, and benzene. Methyl t-butyl ether was only a risk driver in 2001 and 2002.

The "known human carcinogens" risk drivers were 1,3-butadiene and benzene (Table 5-18 and Figure 5-18). The "probable/possible human carcinogens" risk drivers were acrylonitrile and chloroform (Table 5-19 and Figure 5-19).

The 95% UCL was not calculated for the COPCs from this year because the sample numbers were too small to provide a meaningful derivation of this statistic.

The non-cancer median HI was 1.11 (Table 5-20 and Figure 5-20). Both 1,3-butadiene and chloroprene had HQs > 0.1 that identified them as risk drivers. However, their HQs did not exceed 1, indicating that non-cancer toxicity factors were not exceeded for 2001.

5.7.2 Risk characterization from 2002 for Site I

The cumulative total cancer risk of the COPCs medians was 2.70×10^{-5} (Table 5-17 and Figure 5-17). No risk drivers provided > 10^{-5} risk. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were 1,3-butadiene, acrylonitrile, chloroform, benzene, and carbon tetrachloride.

The "known human carcinogens" were 1,3-butadiene and benzene (Table 5-18 and Figure 5-18) and both contributed risks in the 10^{-6} range. The "probable/possible human carcinogens" were acrylonitrile, chloroform, and carbon tetrachloride (Table 5-19 and Figure 5-19), and all contributed risks in the 10^{-6} range.

The cumulative total cancer risk using the 95% UCL exposure statistic was 1.40×10^{-4} (Table 5-17 and Figure 5-17). 1,3-Butadiene, acrylonitrile, and chloroform were the

largest risk drivers using the 95% UCL providing > 10^{-5} risk. Benzene and carbon tetrachloride provided > 10^{-6} risk but < 10^{-5} risk on the basis of the 95% UCL.

The non-cancer median HI was 0.35 (Table 5-20 and Figure 5-20), and was driven by 1,3-butadiene and chloroprene. No COPCs had HQs > 1, indicating such that no RfCs were exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The median TOSHI for acrylonitrile and chloroprene was 0.18, indicating that chronic nasal epithelium effects are unlikely.

The HI derived from the 95% UCL was 2.80, with 1,3-butadiene and chloroprene providing the largest HQs. The 95% UCL-derived HQs for 1,3-butadiene and chloroprene were both > 1, indicating that their chronic inhalation RfCs were exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 1.17, indicating that chronic nasal/olfactory epithelium effects are possible.

5.7.3 Risk characterization from 2003 for Site I

The cumulative total cancer risk of the COPCs medians was 4.10×10^{-5} (Table 5-17 and Figure 5-17). 1,3-Butadiene was the only risk driver to contribute > 10^{-5} risk. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were vinyl chloride, acrylonitrile, chloroform, benzene, and carbon tetrachloride. Vinyl chloride was a risk driver only for this year, and not for the other years. The median cancer risk for vinyl chloride was derived from a concentration value of ½ SQL because of many of its detections below the SQL.

The "known human carcinogens" were vinyl chloride, 1,3-butadiene, and benzene (Table 5-18 and Figure 5-18). Only 1,3-butadiene contributed risks in the 10^{-5} range. The "probable/possible human carcinogens" were acrylonitrile, chloroform, and carbon tetrachloride (Table 5-19 and Figure 5-19), and all contributed risks in the 10^{-6} range.

The cumulative total cancer risk using the 95% UCL exposure statistic was 3.05×10^{-4} (Table 5-17 and Figure 5-17). 1,3-Butadiene was the largest risk driver with a 95% UCL-derived risk value of > 10^{-4}. Acrylonitrile, chloroform, and carbon tetrachloride provided risk values in the > 10^{-5} range. Vinyl chloride and benzene provided > 10^{-6} risk but < 10^{-5} risk on the basis of the 95% UCL.

The non-cancer median HI was 0.52 (Table 5-20 and Figure 5-20), and was driven by 1,3-butadiene and chloroprene. Both 1,3-butadiene and chloroprene had HQs > 0.1, although the HQs did not exceed 1 indicating that chronic inhalation RfCs were not exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is

olfactory epithelium. The median TOSHI for acrylonitrile and chloroprene was 0.18, indicating that chronic nasal epithelium effects are unlikely.

The HI derived from the 95% UCL was 5.58, with 1,3-butadiene and chloroprene providing the largest HQs. The 95% UCL-derived HQs for 1,3-butadiene and chloroprene were > 1, indicating that their chronic inhalation RfCs were exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 1.43 indicating that chronic nasal/olfactory epithelium effects are possible.

5.7.4 Risk characterization from 2004 for Site I

The cumulative total cancer risk of the COPCs medians was 2.98×10^{-5} (Table 5-17 and Figure 5-17). No risk drivers contributed > 10^{-5} risk. The risk drivers that provided > 10^{-6} risk were 1,3-butadiene, acrylonitrile, chloroform, benzene, and carbon tetrachloride.

The "known human carcinogens" were 1,3-butadiene and benzene (Table 5-18 and Figure 5-18). Both contributed risks in the 10^{-6} range. The "probable/possible human carcinogens" were acrylonitrile, chloroform, and carbon tetrachloride (Table 5-19 and Figure 5-19), and all contributed risks in the 10^{-6} range.

The cumulative total cancer risk using the 95% UCL exposure statistic was 9.33×10^{-5} (Table 5-17 and Figure 5-17). 1,3-Butadiene, acrylonitrile, and chloroform provided risk values in the > 10^{-5} range. Benzene and carbon tetrachloride provided > 10^{-6} risks on the basis of the 95% UCL.

The non-cancer median HI was 0.35 (Table 5-20 and Figure 5-20), and was driven by 1,3-butadiene and chloroprene. Neither chemical had HQs > 1, indicating that their chronic inhalation RfCs were not exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The median TOSHI for acrylonitrile and chloroprene was 0.18, indicating that chronic nasal epithelium effects are unlikely.

The HI derived from the 95% UCL was 2.03, with 1,3-butadiene and chloroprene providing the largest HQs. The 95% UCL-derived HQ for 1,3-butadiene was > 0.1, although its chronic inhalation RfC was not exceeded. The 95% UCL-derived HQ for chloroprene was > 1, indicating an exceedance of the RfC. Acrylonitrile was not identified as a risk driver based on the 95% UCL-derived HQ < 0.1. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 1.11, indicating that chronic nasal/olfactory epithelium effects are possible.

5.7.5 Risk characterization from 2005 for Site I

The cumulative total cancer risk of the COPCs medians was 4.81×10^{-5} (Table 5-17 and Figure 5-17). The only risk driver to contribute > 10^{-5} risk was 1,3-butadiene. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were acrylonitrile, chloroform, benzene, and carbon tetrachloride.

The "known human carcinogens" were 1,3-butadiene and benzene (Table 5-18 and Figure 5-18). 1,3-Butadiene contributed a risk in the 10^{-5} range while benzene contributed risk in the 10^{-6} range. The "probable/possible human carcinogens" were acrylonitrile, chloroform, and carbon tetrachloride (Table 5-19 and Figure 5-19), and all contributed risks in the 10^{-6} range.

The cumulative total cancer risk using the 95% UCL exposure statistic was 2.11×10^{-4} (Table 5-17 and Figure 5-17). 1,3-Butadiene contributed risk in the 10^{-4} range. Acrylonitrile, chloroform, and carbon tetrachloride provided risk values in the 10^{-5} range. Benzene provided risk in the 10^{-6} range on the basis of the 95% UCL.

The non-cancer median HI was 0.64 (Table 5-20 and Figure 5-20), and was driven by 1,3-butadiene and chloroprene (HQs > 0.1). However, their HQs did not exceed 1 indicating that chronic inhalation RfCs were not exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The median TOSHI for acrylonitrile and chloroprene was 0.18, indicating that chronic nasal epithelium effects are unlikely.

The HI derived from the 95% UCL was 5.04, with 1,3-butadiene providing the largest HQ. The 95% UCL-derived HQs for 1,3-butadiene and chloroprene were > 1, indicating that their chronic inhalation RfCs were exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 2.35 indicating that chronic nasal/olfactory epithelium effects are possible.

5.7.6 Summary of risk characterization for Site I

Site I is a community exposure site. Cumulative median cancer risks ranged from a low of 2.70×10^{-5} for 2002 to a high of 4.81×10^{-5} for 2005. Vinyl chloride was a risk driver in year 2003 of the risk characterization although many of its detections were below the SQL and a median of ½ SQL was used for the cancer risk calculations. 1,3-Butadiene contributed the most towards the cumulative cancer risk among the known human carcinogens. Acrylonitrile, chloroform, and carbon tetrachloride contributed similar risks towards the cumulative cancer risk among the probable/possible human carcinogens.

Cumulative 95% UCL-derived cancer risks ranged from a low of 9.33×10^{-5} for 2004 to a high of 3.05×10^{-4} for 2003. This range is approximately 3.3-6.3-fold greater than the

cumulative cancer risk range. The primary risk drivers were 1,3-butadiene, acrylonitrile, chloroform, benzene, and carbon tetrachloride.

For median concentrations, no COPCs exceeded the HQ value of 1, indicating that concentrations did not exceed the inhalation RfC. The cumulative HI exceeded 1 only during for 2001. The 95% UCL-derived HQ for 1,3-butadiene exceeded a value of 1 in years 2002, 2003, and 2005. The 95% UCL-derived HQ for chloroprene exceeded a value of 1 for all of the monitoring years. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene were > 1, indicating that chronic nasal/olfactory epithelium effects are possible. These results indicate that 1,3-butadiene presents the greatest cancer risk, and that 1,3-butadiene and chloroprene present the greatest non-cancer risks.

Chloroprene is classified by IARC as a 2B possible human carcinogen. However, no cancer slope factor is currently cited for chloroprene by IRIS so that it was not assessed for cancer risk. However, IRIS developed a cancer slope factor that underwent peer review. Although IRIS did not publish this number, it was reviewed by the State of Michigan and is used there. Following the hierarchy in APCD Regulation 5.20, this cancer slope number (actually the resulting concentration representing a cancer risk of 10^{-6}, referred to as a benchmark ambient concentration [BAC], 0.001 $\mu g/m^3$) is used in the STAR Program. This cancer slope factor is $1/(mg/m^3)$. Using this cancer slope factor, chloroprene cancer risks were calculated, and are presented and discussed in Section 6.5 Risk Characterization of the Uncertainty Analysis (Section 6.0).

Acute non-cancer toxicity values were not exceeded by any of the COPCs.

Table 5-17. Site I total cancer risk.

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014					1.13E-06	2.75%				
1,3- Butadiene	106990	2.19E-05	50.93%	3.32E-06	12.26%	1.33E-05	32.33%	3.32E-06	11.12%	2.02E-05	42.03%
Acrylonitrile	107131	7.38E-06	17.17%	7.38E-06	27.28%	7.38E-06	17.99%	7.38E-06	24.76%	7.38E-06	15.33%
Chloroform	67663	5.61E-06	13.06%	5.61E-06	20.75%	5.61E-06	13.68%	5.61E-06	18.83%	5.61E-06	11.66%
Benzene	71432	7.71E-06	17.96%	5.72E-06	21.16%	3.98E-06	9.71%	3.86E-06	12.94%	5.23E-06	10.86%
Carbon Tetrachloride	56235			4.72E-06	17.44%	9.44E-06	23.00%	9.44E-06	31.66%	9.44E-06	19.61%
All other chemicals		3.77E-07	0.88%	2.99E-07	1.11%	2.28E-07	0.56%	2.04E-07	0.68%	2.45E-07	0.51%
Cumulative Total Risk		4.30E-05	100.00%	2.70E-05	100.00%	4.10E-05	100.00%	2.98E-05	100.00%	4.81E-05	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014					2.27E-06	0.75%				
1,3- Butadiene	106990			9.23E-05	65.88%	2.44E-04	80.00%	4.95E-05	53.07%	1.55E-04	73.33%
Acrylonitrile	107131			1.67E-05	11.92%	2.81E-05	9.20%	1.15E-05	12.33%	1.83E-05	8.69%
Chloroform	67663			1.49E-05	10.67%	1.47E-05	4.83%	1.65E-05	17.72%	2.03E-05	9.60%
Benzene	71432			6.81E-06	4.86%	5.60E-06	1.84%	5.62E-06	6.02%	7.20E-06	3.41%
Carbon Tetrachloride	56235			8.82E-06	6.30%	1.01E-05	3.30%	9.87E-06	10.57%	1.02E-05	4.84%
All other chemicals				5.17E-07	0.37%	2.52E-07	0.08%	2.59E-07	0.28%	2.77E-07	0.13%
Cumulative Total Risk				1.40E-04	100.00%	3.05E-04	100.00%	9.33E-05	100.00%	2.11E-04	100.00%

Figure 5-17. Site I total cancer risk.

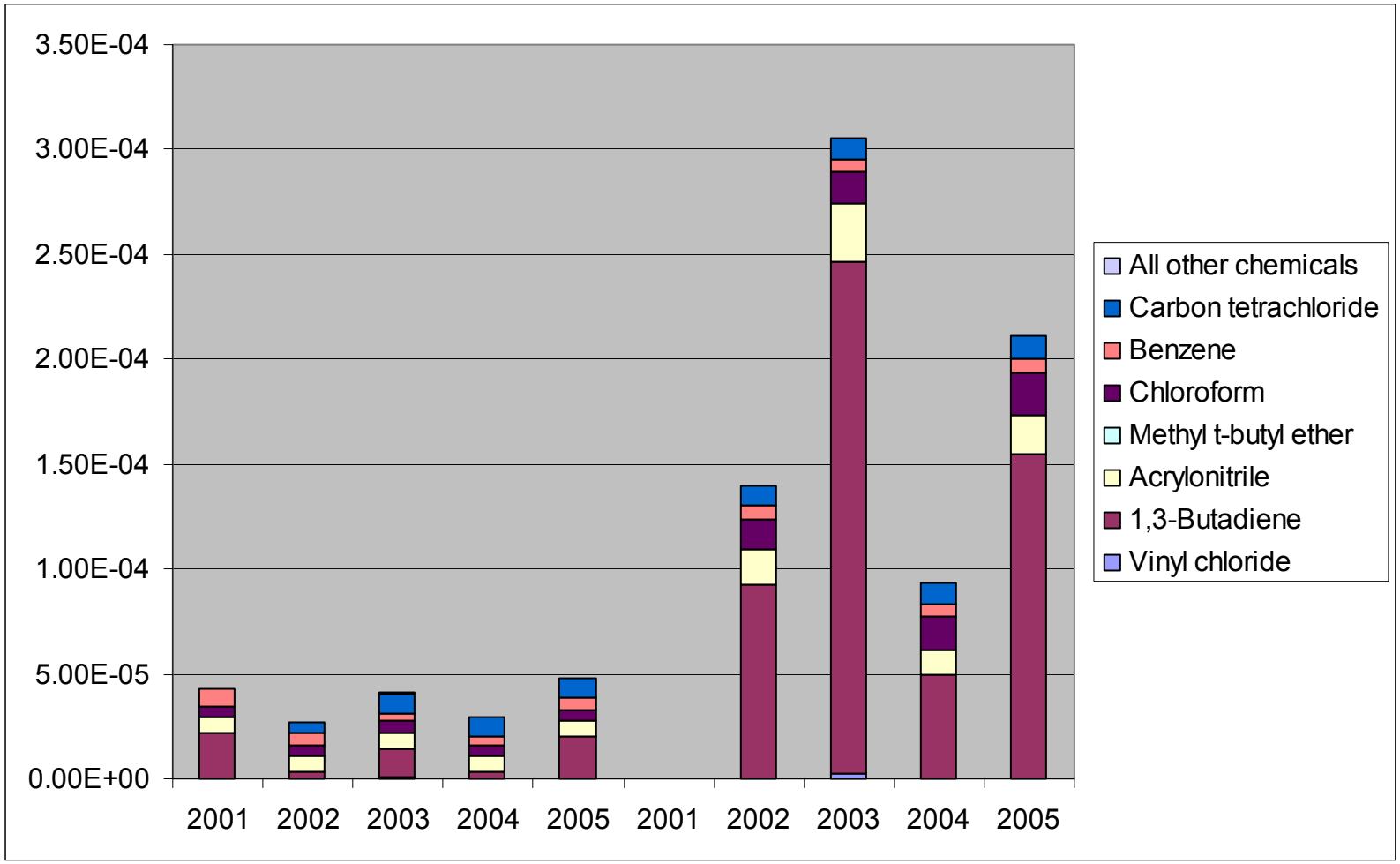


Table 5-18. Site I cancer risk of "known human carcinogens".

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014					1.13E-06	6.13%				
1,3- Butadiene	106990	2.19E-05	73.93%	3.32E-06	36.68%	1.33E-05	72.19%	3.32E-06	46.22%	2.02E-05	79.47%
Benzene	71432	7.71E-06	26.07%	5.72E-06	63.32%	3.98E-06	21.67%	3.86E-06	53.78%	5.23E-06	20.53%
Cumulative Risk of Known Human Carcinogens		2.96E-05	100.00%	9.04E-06	100.00%	1.84E-05	100.00%	7.17E-06	100.00%	2.54E-05	100.00%
Compound	**CAS**	**2001 95% UCL**		**2002 95% UCL**		**2003 95% UCL**		**2004 95% UCL**		**2005 95% UCL**	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014					2.27E-06	0.90%				
1,3- Butadiene	106990			9.23E-05	93.13%	2.44E-04	96.87%	4.95E-05	89.81%	1.55E-04	95.55%
Benzene	71432			6.81E-06	6.87%	5.60E-06	2.22%	5.62E-06	10.19%	7.20E-06	4.45%
Cumulative Risk of Known Human Carcinogens				9.91E-05	100.00%	2.52E-04	100.00%	5.51E-05	100.00%	1.62E-04	100.00%

Figure 5-18. Site I cancer risk of "known human carcinogens".

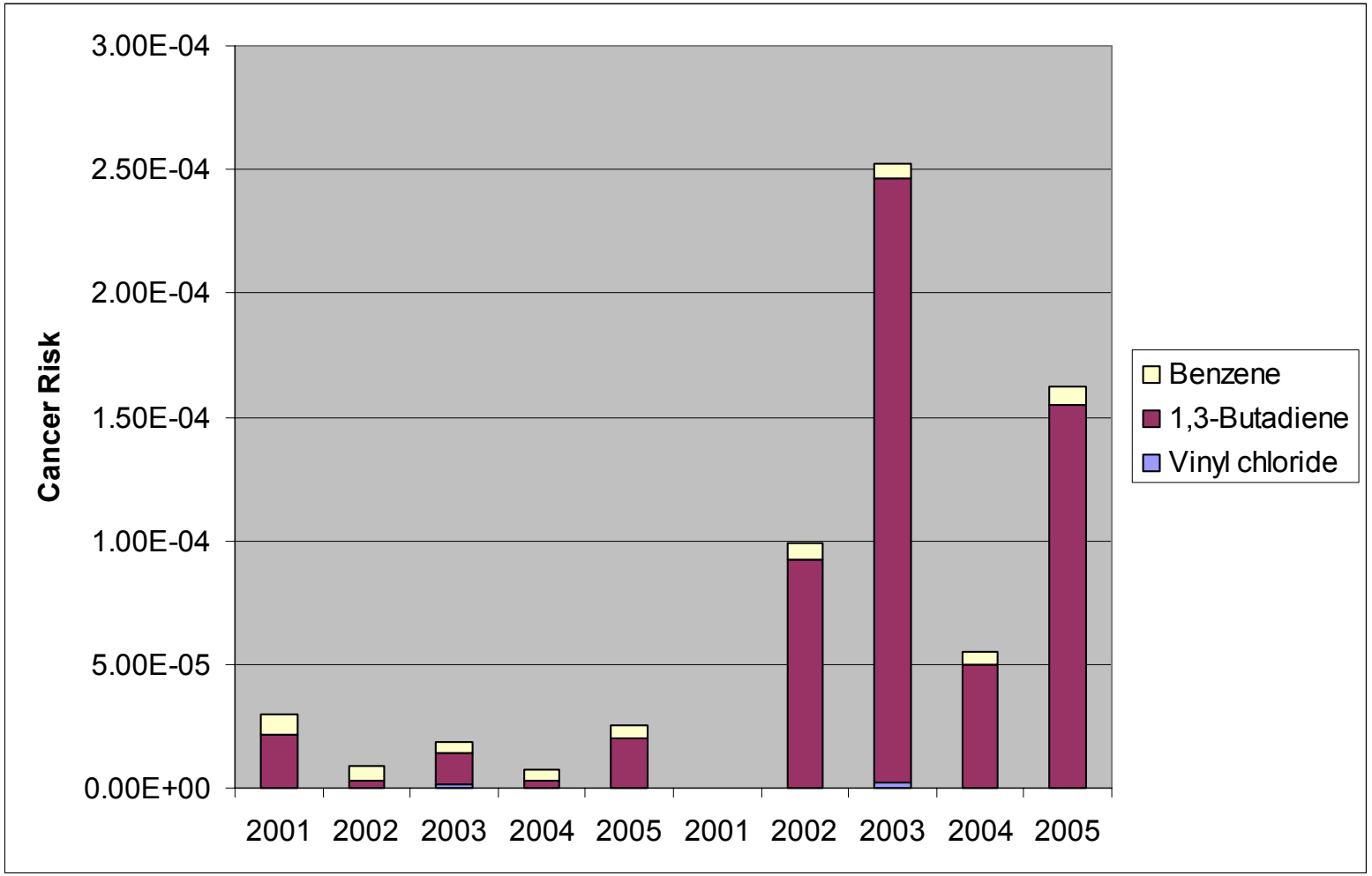


Table 5-19. Site I cancer risk of "probable/possible human carcinogens".

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Acrylonitrile	107131	7.38E-06	56.80%	7.38E-06	41.67%	7.38E-06	32.90%	7.38E-06	32.90%	7.38E-06	32.90%
Chloroform	67663	5.61E-06	43.20%	5.61E-06	31.69%	5.61E-06	25.03%	5.61E-06	25.03%	5.61E-06	25.03%
Carbon Tetrachloride	56235			4.72E-06	26.64%	9.44E-06	42.07%	9.44E-06	42.07%	9.44E-06	42.07%
Cumulative Risk of Probable/Possible Human Carcinogens		1.30E-05	100.00%	1.77E-05	100.00%	2.24E-05	100.00%	2.24E-05	100.00%	2.24E-05	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Acrylonitrile	107131			1.67E-05	41.26%	2.81E-05	53.09%	1.15E-05	30.36%	1.83E-05	37.56%
Chloroform	67663			1.49E-05	36.94%	1.47E-05	27.86%	1.65E-05	43.62%	2.03E-05	41.50%
Carbon Tetrachloride	56235			8.82E-06	21.80%	1.01E-05	19.06%	9.87E-06	26.03%	1.02E-05	20.94%
Cumulative Risk of Probable/Possible Human Carcinogens				4.05E-05	100.00%	5.29E-05	100.00%	3.79E-05	100.00%	4.88E-05	100.00%

Figure 5-19. Site I cancer risk of "probable/possible human carcinogens".

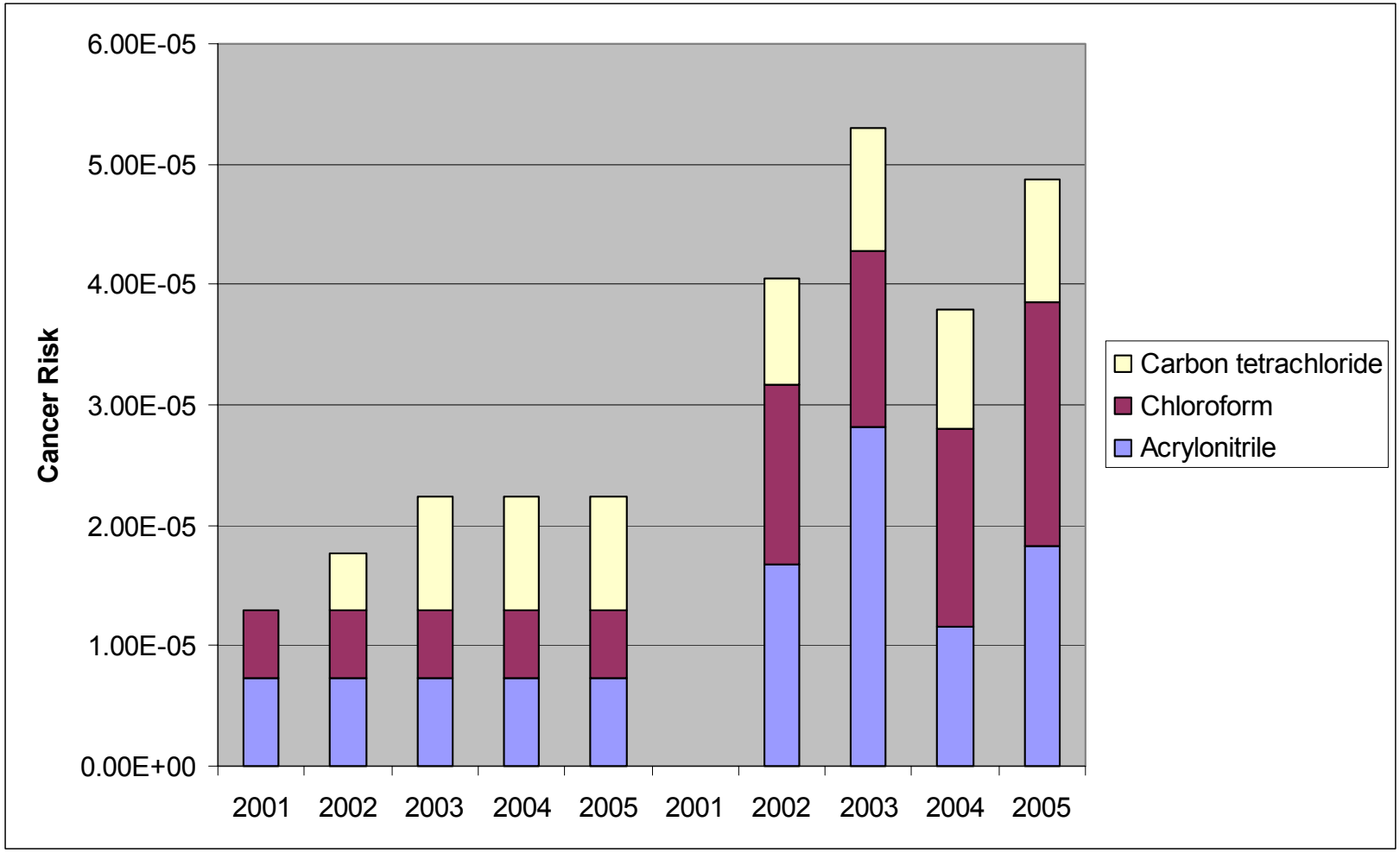
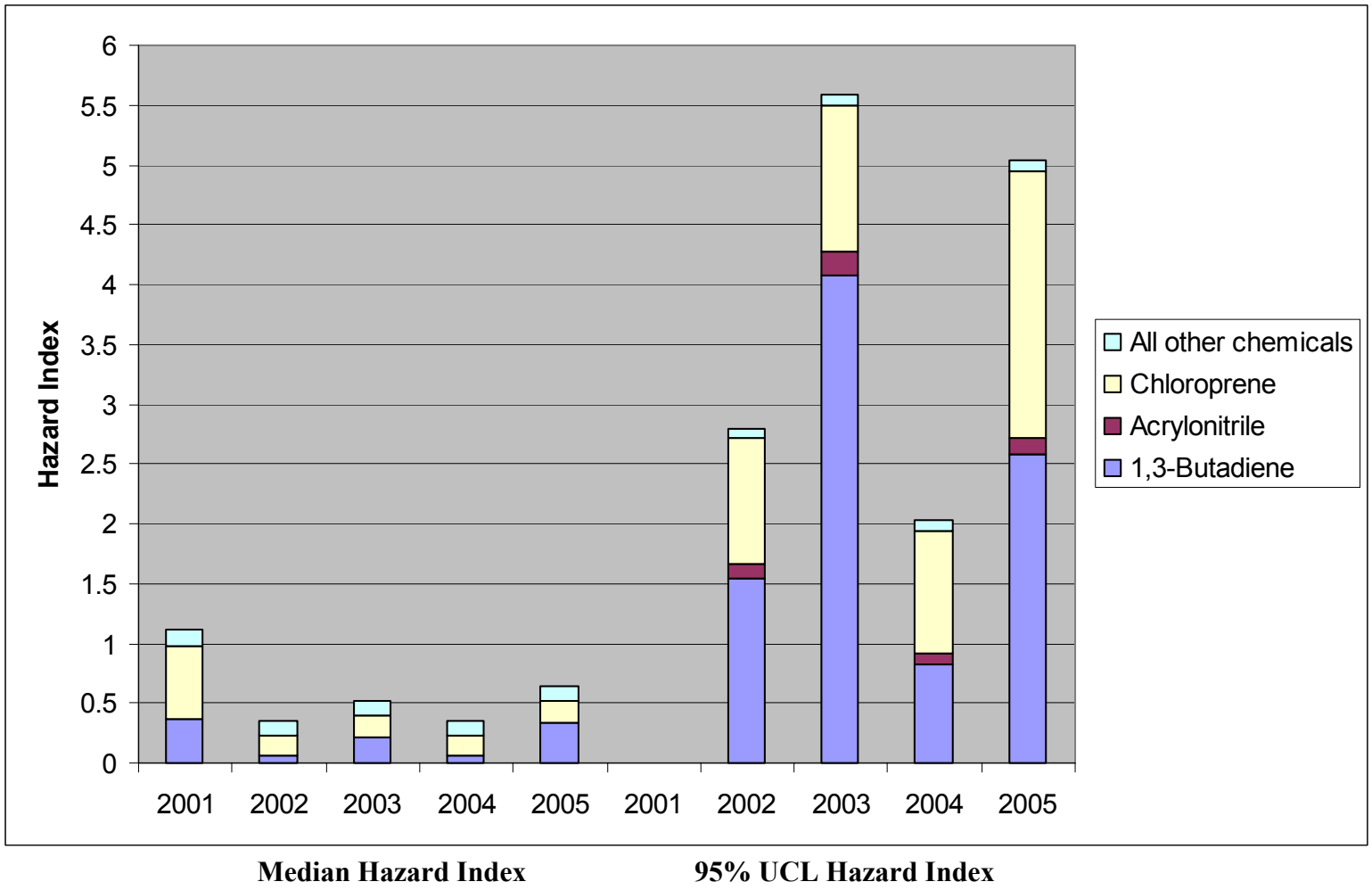


Table 5-20. Site I non-cancer hazard index (HI).

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI
1,3- Butadiene	106990	0.36	32.92%	0.06	15.64%	0.22	42.51%	0.06	15.75%	0.34	52.69%
Acrylonitrile	107131										
Chloroprene	126998	0.62	55.56%	0.18	51.23%	0.18	34.81%	0.18	51.59%	0.18	28.30%
All other chemicals		0.13	11.51%	0.12	33.13%	0.12	22.68%	0.11	32.66%	0.12	19.01%
Hazard Index (HI)		1.11	100.00%	0.35	100.00%	0.52	100.00%	0.35	100.00%	0.64	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI
1,3- Butadiene	106990			1.54	55.01%	4.07	72.88%	0.83	40.76%	2.58	51.20%
Acrylonitrile	107131			0.12	4.39%	0.21	3.70%	0.08	4.18%	0.13	2.68%
Chloroprene	126998			1.05	37.58%	1.22	21.86%	1.03	50.87%	2.22	44.15%
All other chemicals				0.08	3.02%	0.09	1.56%	0.08	4.19%	0.10	1.97%
Hazard Index (HI)				2.80	100.00%	5.58	100.00%	2.03	100.00%	5.04	100.00%

Figure 5-20. Site I non-cancer hazard index (HI).



5.8 Farnsley Middle School: Site M

The Farnsley Middle School monitoring site (Site M) is a neighborhood population exposure site. The objective is to characterize potential exposure of the Cane Run, Riverside Gardens, and Shively communities.

The total cancer risk for the years 2001-2005 for Site M are presented in Table 5-21 and Figure 5-21. The cancer risk caused by "known human carcinogens" for the years 2001-2005 are presented in Table 5-22 and Figure 5-22. The cancer risk caused by "probable/possible human carcinogens" for the years 2001-2005 are presented in Table 5-23 and Figure 5-23. The non-cancer data (HQ and HI) for the years 2001-2005 are presented in Table 5-24 and Figure 5-24.

5.8.1 Risk characterization from 2001 for Site M

The cumulative total cancer risk of the COPCs medians was 6.82×10^{-5} (Table 5-21 and Figure 5-21). The risk drivers that provided > 10^{-5} risk were 1,3-butadiene, acrylonitrile, and benzene. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were carbon tetrachloride and naphthalene. Naphthalene was a risk driver in 2001 but not the following years.

The "known human carcinogens" risk drivers were 1,3-butadiene and benzene (Table 5-22 and Figure 5-22), both contributing > 10^{-5} risks. The "probable/possible human carcinogens" risk drivers were acrylonitrile, carbon tetrachloride, and naphthalene (Table 5-23 and Figure 5-23). Acrylonitrile contributed > 10^{-5} risk while carbon tetrachloride and naphthalene contributed > 10^{-6} risks.

The 95% UCL was not calculated for the COPCs from this year because the sample numbers were too small to provide a meaningful derivation of this statistic.

The non-cancer median HI was 0.86 (Table 5-24 and Figure 5-24). 1,3-Butadiene, acrylonitrile, and chloroprene were the HI risk drivers with HQ > 0.1. However, their HQs did not exceed 1, indicating that non-cancer toxicity factors were not exceeded for 2001.

5.8.2 Risk characterization from 2002 for Site M

The cumulative total cancer risk of the COPCs medians was 3.99×10^{-5} (Table 5-21 and Figure 5-21). No risk drivers contributed > 10^{-5} risk. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were vinyl chloride, 1,3-butadiene, acrylonitrile, chloroform, benzene, carbon tetrachloride, and tetrachloroethene. Vinyl chloride was a risk driver only in the monitoring years 2002 and 2003. Tetrachloroethene was a risk driver only in the monitoring years 2002 and 2005. The median cancer risks for vinyl chloride and

tetrachloroethene were derived from a concentration value of ½ SQL because of their many detections below the SQL.

The "known human carcinogens" were vinyl chloride, 1,3-butadiene, and benzene (Table 5-22 and Figure 5-22). All three risk drivers contributed risk in the 10^{-6} range. The "probable/possible human carcinogens" were acrylonitrile, chloroform, carbon tetrachloride, and naphthalene (Table 5-23 and Figure 5-23), and all contributed risks in the 10^{-6} range.

The cumulative total cancer risk using the 95% UCL exposure statistic was 2.49×10^{-4} (Table 5-21 and Figure 5-21). 1,3-Butadiene contributed risk in the 10^{-4} range. Acrylonitrile and carbon tetrachloride provided risk values in the $> 10^{-5}$ range. Vinyl chloride, chloroform, benzene, and tetrachloroethene provided $> 10^{-6}$ risks but $< 10^{-5}$ risks on the basis of the 95% UCL.

The non-cancer median HI was 0.44 (Table 5-24 and Figure 5-24), and was driven by 1,3-butadiene and chloroprene. Both 1,3-butadiene and chloroprene had HQs > 0.1, although the HQs did not exceed 1 indicating that their chronic inhalation RfCs were not exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The median TOSHI for acrylonitrile and chloroprene was 0.23, indicating that chronic nasal epithelium effects are unlikely.

The HI derived from the 95% UCL was 4.29, with 1,3-butadiene providing the largest HQ. The 95% UCL-derived HQ for 1,3-butadiene was > 1, indicating that its chronic inhalation RfC was exceeded. Acrylonitrile and chloroprene were identified as risk drivers based on the 95% UCL-derived HQs > 0.1; however, their chronic inhalation RfCs were not exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 1.02 indicating that chronic non-cancer nasal/olfactory epithelium effects are possible.

5.8.3 Risk characterization from 2003 for Site M

The cumulative total cancer risk of the COPCs medians was 3.60×10^{-5} (Table 5-21 and Figure 5-21). Only carbon tetrachloride contributed $> 10^{-5}$ risk. The risk drivers that provided $> 10^{-6}$ risk but $< 10^{-5}$ risk were vinyl chloride, 1,3-butadiene, acrylonitrile, chloroform, and benzene. Vinyl chloride was a risk driver only in the monitoring years 2002 and 2003. The median cancer risk for vinyl chloride was derived from a concentration value of ½ SQL because of its many detections below the SQL.

The "known human carcinogens" were vinyl chloride, 1,3-butadiene, and benzene (Table 5-22 and Figure 5-22). All three risk drivers contributed risk in the 10^{-6} range. The "probable/possible human carcinogens" were acrylonitrile, chloroform, and carbon

tetrachloride (Table 5-23 and Figure 5-23). Carbon tetrachloride contributed a risk in the 10^{-5} range, while acrylonitrile and chloroform contributed risks in the 10^{-6} range.

The cumulative total cancer risk using the 95% UCL exposure statistic was 1.18×10^{-4} (Table 5-21 and Figure 5-21). 1,3-Butadiene, acrylonitrile, and carbon tetrachloride provided risk values in the $> 10^{-5}$ range. Vinyl chloride, chloroform, and benzene provided $> 10^{-6}$ risks but $< 10^{-5}$ risks on the basis of the 95% UCL.

The non-cancer median HI was 0.42 (Table 5-24 and Figure 5-24), and was driven by 1,3-butadiene and chloroprene. Both 1,3-butadiene and chloroprene had HQs > 0.1, although the HQs did not exceed 1 indicating that their chronic inhalation RfCs were not exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The median TOSHI for acrylonitrile and chloroprene was 0.23, indicating that chronic nasal epithelium effects are unlikely.

The HI derived from the 95% UCL was 1.74, with 1,3-butadiene providing the largest HQ. The 95% UCL-derived HQ for 1,3-butadiene was > 1, indicating that its chronic inhalation RfC was exceeded. Acrylonitrile and chloroprene were identified as risk drivers based on the 95% UCL-derived HQ > 0.1; however, their chronic inhalation RfCs were not exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 0.50 indicating that chronic non-cancer nasal/olfactory epithelium effects are unlikely.

5.8.4 Risk characterization from 2004 for Site M

The cumulative total cancer risk of the COPCs medians was 3.52×10^{-5} (Table 5-21 and Figure 5-21). No risk drivers contributed $> 10^{-5}$ risk. The risk drivers that provided $> 10^{-6}$ risk but $< 10^{-5}$ risk were 1,3-butadiene, acrylonitrile, chloroform, benzene, and carbon tetrachloride.

The "known human carcinogens" were 1,3-butadiene and benzene (Table 5-22 and Figure 5-22). Both risk drivers contributed risk in the 10^{-6} range. The "probable/possible human carcinogens" were acrylonitrile, chloroform, and carbon tetrachloride (Table 5-23 and Figure 5-23). All three risk drivers contributed risks in the 10^{-6} range.

The cumulative total cancer risk using the 95% UCL exposure statistic was 7.87×10^{-5} (Table 5-21 and Figure 5-21). 1,3-Butadiene, acrylonitrile, and carbon tetrachloride provided risk values in the $> 10^{-5}$ range. Chloroform and benzene provided $> 10^{-6}$ risks but $< 10^{-5}$ risks on the basis of the 95% UCL.

The non-cancer median HI was 0.42 (Table 5-24 and Figure 5-24), and was driven by 1,3-butadiene and chloroprene. Both 1,3-butadiene and chloroprene had HQs > 0.1, although the HQs did not exceed 1 indicating that their chronic inhalation RfCs were not

exceeded. The primary target organ for 1,3-butadiene non-cancer effects is reproductive tissue (ovarian atrophy) with secondary effects on cardiovascular and blood endpoints. The primary target organs for acrylonitrile are nasal epithelium and nervous system (brain; central nervous system depression). The primary target organ for chloroprene is olfactory epithelium. The median TOSHI for acrylonitrile and chloroprene was 0.23, indicating that chronic nasal epithelium effects are unlikely.

The HI derived from the 95% UCL was 1.25, with 1,3-butadiene providing the largest HQ. The 95% UCL-derived HQ for 1,3-butadiene was not > 1, indicating that its chronic inhalation RfC was not exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 0.48 indicating that chronic non-cancer nasal/olfactory epithelium effects are unlikely.

5.8.5 Risk characterization from 2005 for Site M

The cumulative total cancer risk of the COPCs medians was 4.54×10^{-5} (Table 5-21 and Figure 5-21). Risk drivers that contributed > 10^{-5} risks were 1,3-butadiene and carbon tetrachloride. The risk drivers that provided > 10^{-6} risk but < 10^{-5} risk were acrylonitrile, chloroform, benzene, and tetrachloroethene. Tetrachloroethene was a risk driver only in the monitoring years 2002 and 2005. The median cancer risk for tetrachloroethene was derived from a concentration value of ½ SQL because of its many detections below the SQL.

The "known human carcinogens" were 1,3-butadiene and benzene (Table 5-22 and Figure 5-22). 1,3-Butadiene contributed risk in the 10^{-5} range; benzene contributed risk in the 10^{-6} range. The "probable/possible human carcinogens" were acrylonitrile, chloroform, carbon tetrachloride, and tetrachloroethene (Table 5-23 and Figure 5-23). Carbon tetrachloride contributed risk in the 10^{-5} range, while acrylonitrile, chloroform, and tetrachloroethene contributed risks in the 10^{-6} range.

The cumulative total cancer risk using the 95% UCL exposure statistic was 9.91×10^{-5} (Table 5-21 and Figure 5-21). 1,3-Butadiene, acrylonitrile, and carbon tetrachloride provided risk values in the > 10^{-5} range. Chloroform, benzene, and tetrachloroethene provided > 10^{-6} risks but < 10^{-5} risks on the basis of the 95% UCL.

The non-cancer HI was 0.55 (Table 5-24 and Figure 5-24), and was driven by 1,3-butadiene and chloroprene. Both 1,3-butadiene and chloroprene had HQs > 0.1, although the HQs did not exceed 1 indicating that their chronic inhalation RfCs were not exceeded. The HI derived from the 95% UCL was 1.46, with 1,3-butadiene providing the largest HQ. The 95% UCL-derived HQ for 1,3-butadiene was > 0.1 identifying it as a risk driver, but the HQ was not > 1 indicating that its chronic inhalation RfC was not exceeded. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene was 0.45 indicating that chronic non-cancer nasal/olfactory epithelium effects are unlikely.

5.8.6 Summary of risk characterization for Site M

Site M is a community exposure site. Cumulative median cancer risks ranged from a low of 3.52×10^{-5} for 2004 to a high of 6.82×10^{-5} for 2001. Vinyl chloride was a risk driver in years 2002 and 2003 of the risk characterization although many of its detections were below the SQL and a median of ½ SQL was used for the cancer risk calculations. Tetrachloroethene was a risk driver in years 2002 and 2005, although many of its detections were below the SQL and a median of ½ SQL was used for the cancer risk calculations. Naphthalene was a risk driver only in 2001 and not the following years. 1,3-Butadiene contributed the most towards the cumulative cancer risk among the known human carcinogens. Acrylonitrile, chloroform, and carbon tetrachloride contributed similar risks towards the cumulative cancer risk among the probable/possible human carcinogens.

Cumulative 95% UCL-derived cancer risks ranged from a low of 7.87×10^{-5} for 2004 to a high of 2.49×10^{-4} for 2002. This range is approximately 2.2-3.3-fold greater than the range of cumulative median cancer risks. The largest risk drivers were 1,3-butadiene, acrylonitrile, chloroform, benzene, and carbon tetrachloride.

For median concentrations, no COPCs exceeded the HQ value of 1, indicating that concentrations did not exceed the inhalation RfC. The cumulative HI did not exceed 1 during any of the years of the monitoring period. Only the 95% UCL-derived HQ for 1,3-butadiene exceeded an HI value of 1 in years 2002 and 2003. The 95% UCL-derived TOSHI for acrylonitrile and chloroprene were > 1 for the year 2002, indicating that chronic nasal/olfactory epithelium effects were possible during that year. These results indicate that 1,3-butadiene presents the greatest cancer and non-cancer risks.

Chloroprene is classified by IARC as a 2B possible human carcinogen. However, no cancer slope factor is currently cited for chloroprene by IRIS so that it was not assessed for cancer risk. However, IRIS developed a cancer slope factor that underwent peer review. Although IRIS did not publish this number, it was reviewed by the State of Michigan and is used there. Following the hierarchy in APCD Regulation 5.20, this cancer slope number (actually the resulting concentration representing a cancer risk of 10^{-6}, referred to as a benchmark ambient concentration [BAC], 0.001 $\mu g/m^3$) is used in the STAR Program. This cancer slope factor is $1/(mg/m^3)$. Using this cancer slope factor, chloroprene cancer risks were calculated, and are presented and discussed in Section 6.5 Risk Characterization of the Uncertainty Analysis (Section 6.0).

Acute non-cancer toxicity values were not exceeded by any of the COPCs.

Table 5-21. Site M total cancer risk.

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014			1.13E-06	2.82%	1.13E-06	3.13%				
1,3- Butadiene	106990	1.86E-05	27.23%	7.29E-06	18.28%	7.29E-06	20.26%	7.29E-06	20.75%	1.46E-05	32.11%
Acrylonitrile	107131	1.92E-05	28.14%	7.38E-06	18.49%	7.38E-06	20.50%	7.38E-06	20.99%	7.38E-06	16.24%
Methyl T-Butyl Ether (MTBE)	1634044										
Chloroform	67663			5.61E-06	14.06%	5.61E-06	15.59%	5.61E-06	15.96%	5.61E-06	12.35%
Benzene	71432	1.57E-05	23.00%	6.72E-06	16.83%	3.98E-06	11.06%	5.23E-06	14.86%	5.23E-06	11.50%
Carbon Tetrachloride	56235	4.72E-06	6.92%	9.44E-06	23.64%	1.04E-05	28.83%	9.44E-06	26.84%	1.04E-05	22.85%
Tetrachloroethene	127184			2.00E-06	5.01%					2.00E-06	4.40%
Naphthalene	91203	8.91E-06	13.07%								
All other chemicals		1.12E-06	1.64%	3.43E-07	0.86%	2.28E-07	0.63%	2.12E-07	0.60%	2.45E-07	0.54%
Cumulative Total Risk		6.82E-05	100.00%	3.99E-05	100.00%	3.60E-05	100.00%	3.52E-05	100.00%	4.54E-05	100.00%
Compound	**CAS**	**2001 95% UCL**		**2002 95% UCL**		**2003 95% UCL**		**2004 95% UCL**		**2005 95% UCL**	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014			2.03E-06	0.82%	1.68E-06	1.43%				
1,3- Butadiene	106990			1.90E-04	76.48%	6.93E-05	58.79%	4.07E-05	51.68%	5.53E-05	55.82%
Acrylonitrile	107131			2.33E-05	9.38%	2.09E-05	17.68%	1.25E-05	15.93%	1.05E-05	10.59%
Methyl T-Butyl Ether (MTBE)	1634044										
Chloroform	67663			9.07E-06	3.65%	8.52E-06	7.23%	7.79E-06	9.89%	9.06E-06	9.14%
Benzene	71432			7.86E-06	3.16%	6.39E-06	5.41%	6.98E-06	8.86%	7.79E-06	7.86%
Carbon Tetrachloride	56235			1.28E-05	5.15%	1.09E-05	9.24%	1.05E-05	13.35%	1.29E-05	13.05%
Tetrachloroethene	127184			2.80E-06	1.13%					3.24E-06	3.26%
Naphthalene	91203										
All other chemicals				5.94E-07	0.24%	2.61E-07	0.22%	2.34E-07	0.30%	2.70E-07	0.27%
Cumulative Total Risk				2.49E-04	100.00%	1.18E-04	100.00%	7.87E-05	100.00%	9.91E-05	100.00%

Figure 5-21. Site M total cancer risk.

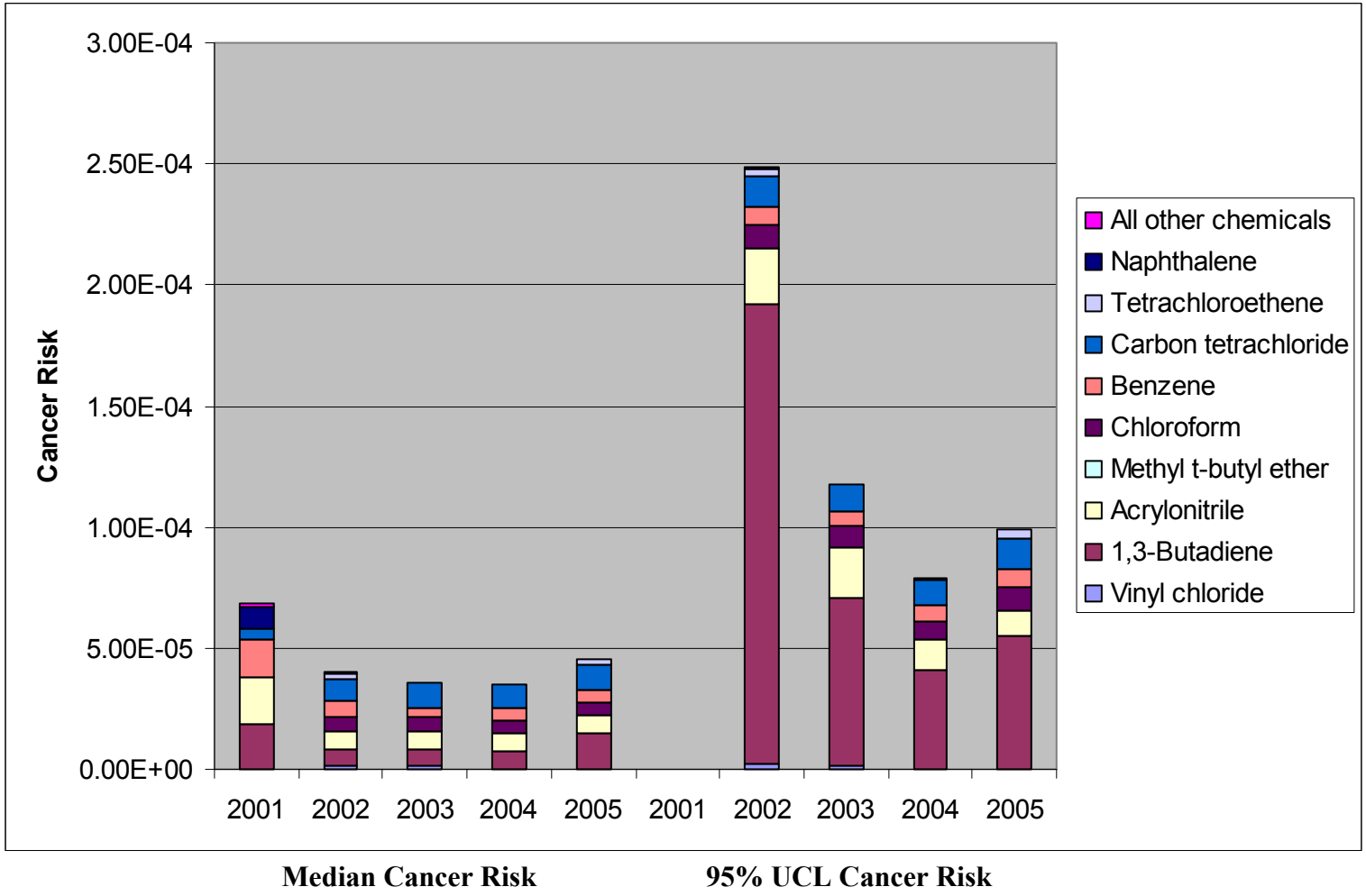


Table 5-22. Site M cancer risk of "known human carcinogens".

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014			1.13E-06	7.44%	1.13E-06	9.08%				
1,3- Butadiene	106990	1.86E-05	54.22%	7.29E-06	48.18%	7.29E-06	58.81%	7.29E-06	58.26%	1.46E-05	73.62%
Benzene	71432	1.57E-05	45.78%	6.72E-06	44.38%	3.98E-06	32.10%	5.23E-06	41.74%	5.23E-06	26.38%
Cumulative Risk of Known Human Carcinogens		3.42E-05	100.00%	1.51E-05	100.00%	1.24E-05	100.00%	1.25E-05	100.00%	1.98E-05	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Vinyl Chloride	75014			2.03E-06	1.01%	1.68E-06	2.18%				
1,3- Butadiene	106990			1.90E-04	95.06%	6.93E-05	89.57%	4.07E-05	85.37%	5.53E-05	87.65%
Benzene	71432			7.86E-06	3.93%	6.39E-06	8.25%	6.98E-06	14.63%	7.79E-06	12.35%
Cumulative Risk of Known Human Carcinogens				2.00E-04	100.00%	7.74E-05	100.00%	4.77E-05	100.00%	6.31E-05	100.00%

Figure 5-22. Site M cancer risk of "known human carcinogens".

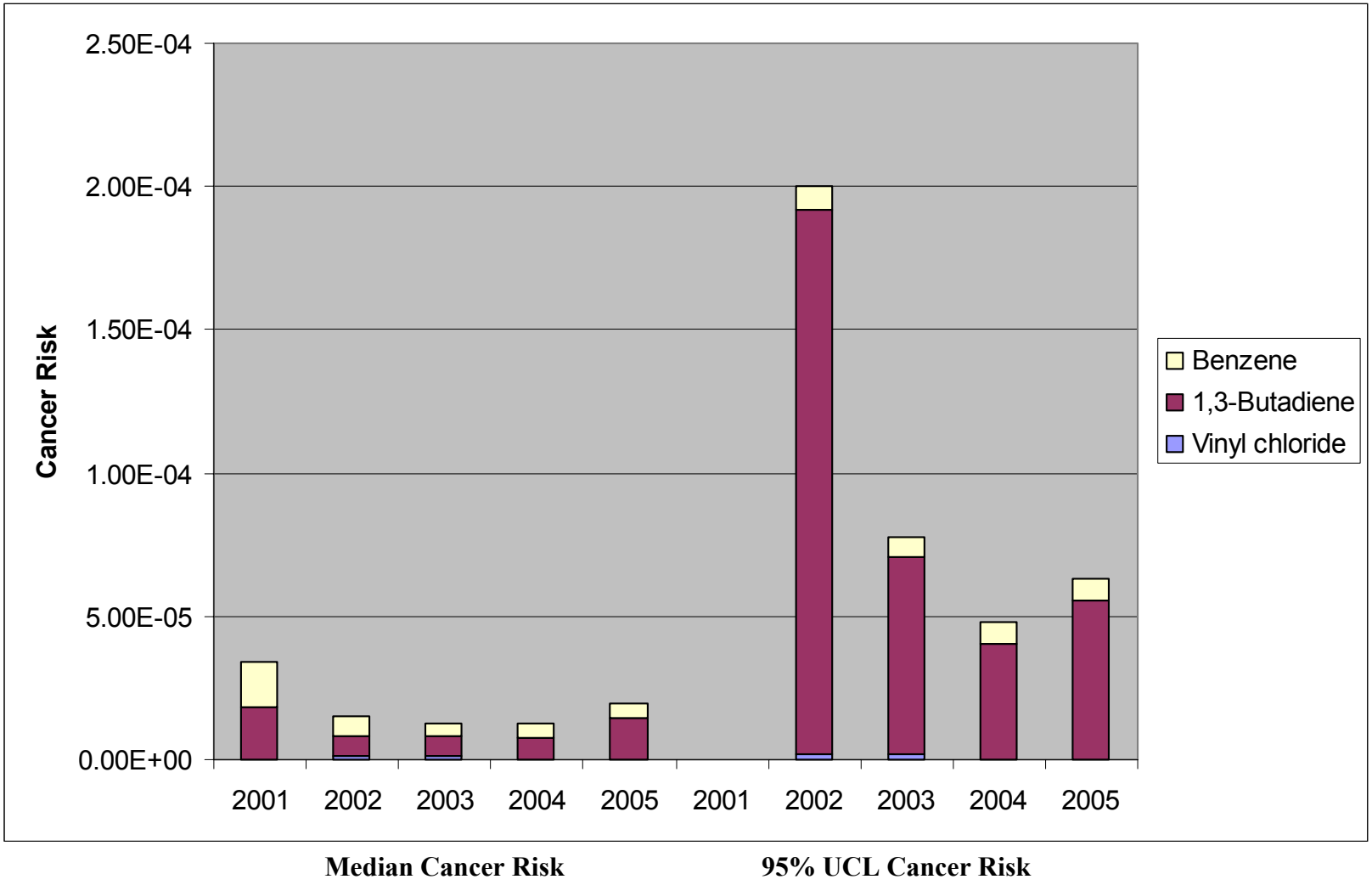


Table 5-23. Site M cancer risk of "probable/possible human carcinogens".

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Acrylonitrile	107131	1.92E-05	58.47%	7.38E-06	30.21%	7.38E-06	31.57%	7.38E-06	32.90%	7.38E-06	29.08%
Chloroform	67663			5.61E-06	22.98%	5.61E-06	24.02%	5.61E-06	25.03%	5.61E-06	22.12%
Carbon Tetrachloride	56235	4.72E-06	14.38%	9.44E-06	38.63%	1.04E-05	44.41%	9.44E-06	42.07%	1.04E-05	40.91%
Tetrachloroethene	127184			2.00E-06	8.19E-02					2.00E-06	7.88%
Naphthalene	91203	8.91E-06	27.15%								
Cumulative Risk of Probable/Possible Human Carcinogens		3.28E-05	100.00%	2.44E-05	100.00%	2.34E-05	100.00%	2.24E-05	100.00%	2.54E-05	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk	Cancer Risk	% of Cumulative Risk
Acrylonitrile	107131			2.33E-05	48.57%	2.09E-05	51.79%	1.25E-05	40.67%	1.05E-05	29.38%
Chloroform	67663			9.07E-06	18.92%	8.52E-06	21.16%	7.79E-06	25.25%	9.06E-06	25.35%
Carbon Tetrachloride	56235			1.28E-05	26.67%	1.09E-05	27.05%	1.05E-05	34.08%	1.29E-05	36.22%
Tetrachloroethene	127184			2.80E-06	5.85%					3.24E-06	9.06%
Naphthalene	91203										
Cumulative Risk of Probable/Possible Human Carcinogens				4.80E-05	100.00%	4.03E-05	100.00%	3.08E-05	100.00%	3.57E-05	100.00%

Figure 5-23. Site M cancer risk of "probable/possible human carcinogens".

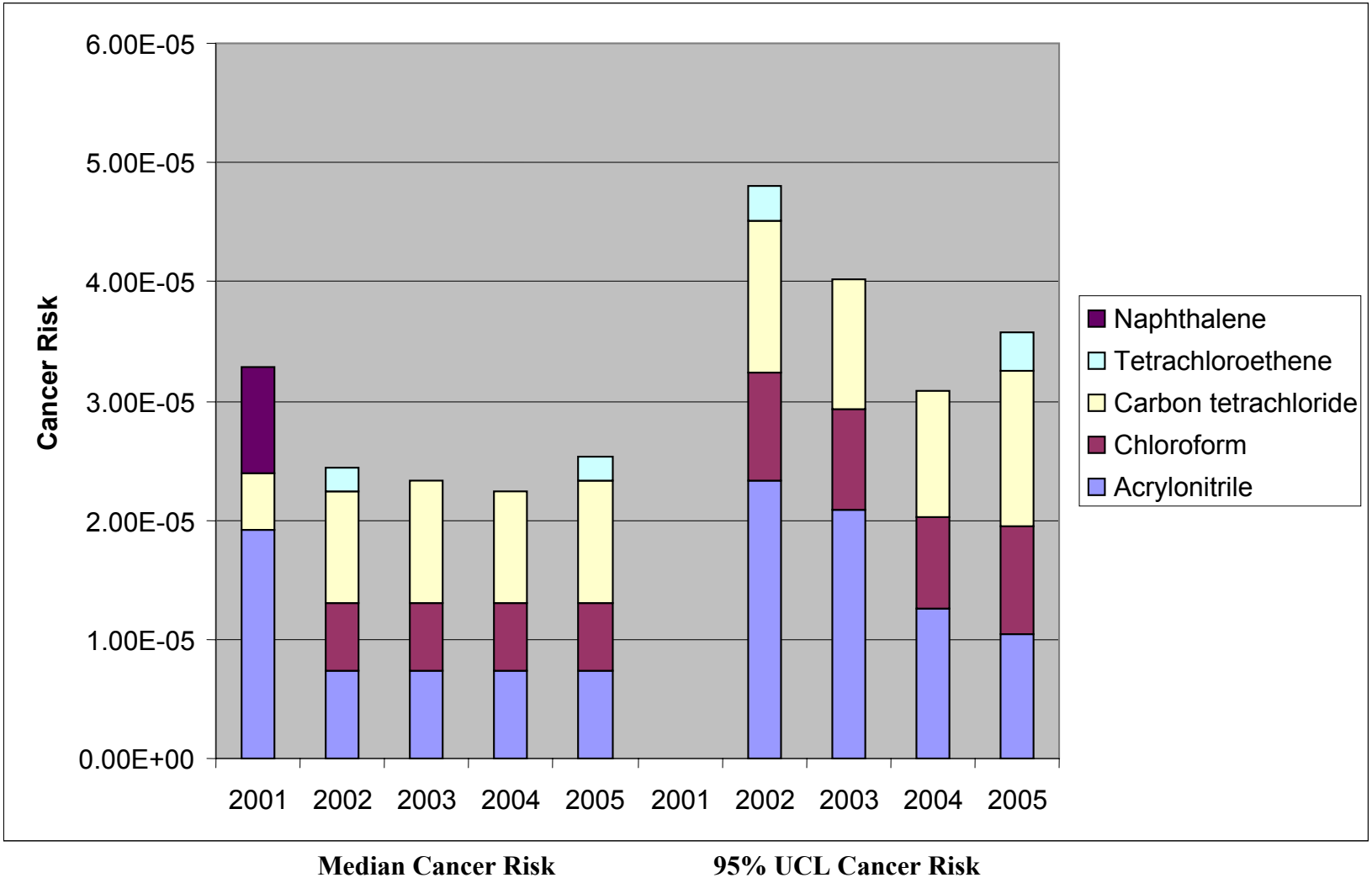
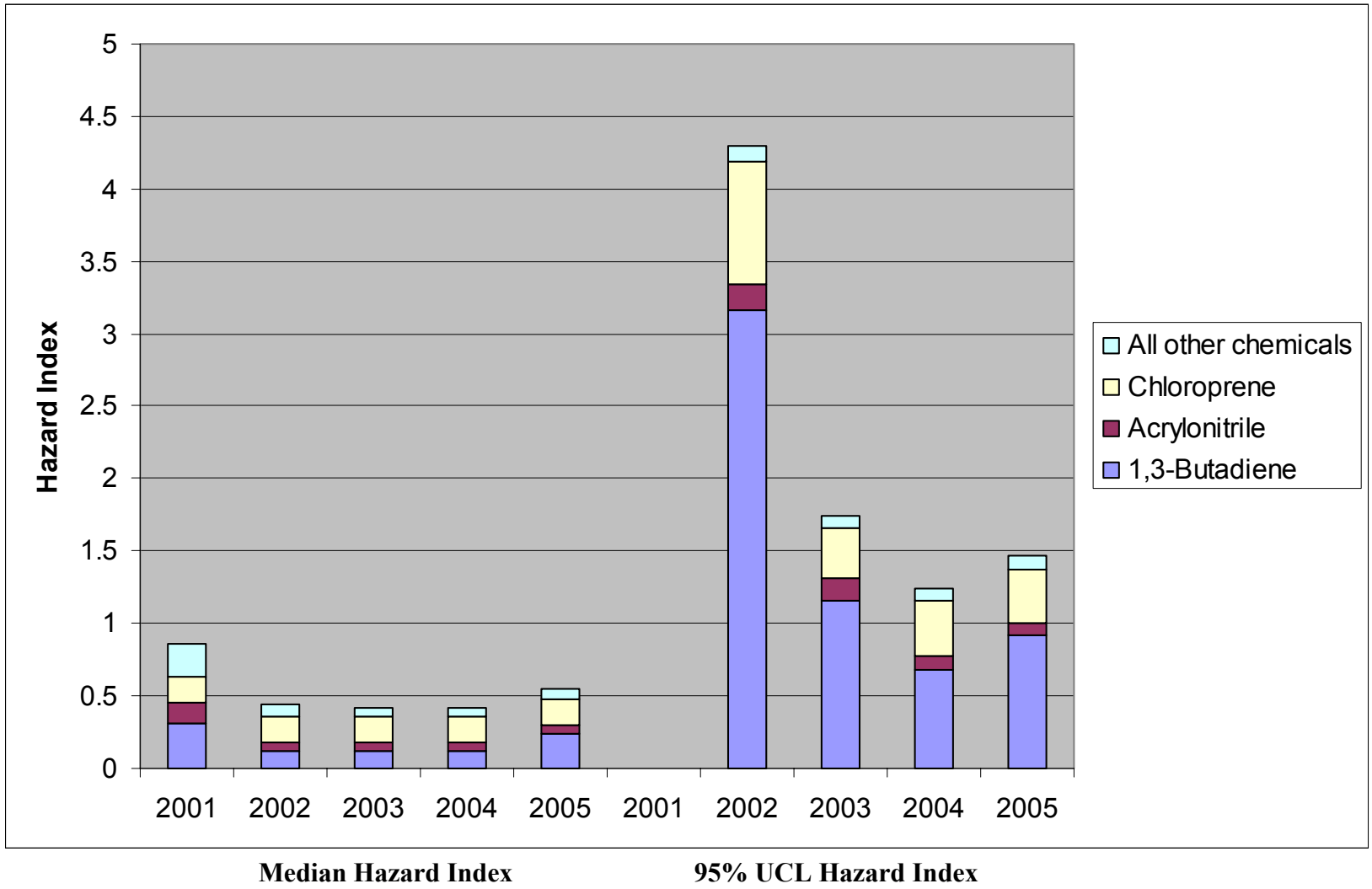


Table 5-24. Site M non-cancer hazard index (HI).

Compound	CAS	2001 Median		2002 Median		2003 Median		2004 Median		2005 Median	
		Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI
1,3- Butadiene	106990	0.31	36.04%	0.12	27.67%	0.12	29.03%	0.12	28.72%	0.24	44.45%
Acrylonitrile	107131	0.14	16.43%	0.05	12.35%	0.05	12.96%	0.05	12.82%	0.05	9.92%
Chloroprene	126998	0.18	21.09%	0.18	41.21%	0.18	43.23%	0.18	42.76%	0.18	33.10%
All other chemicals		0.23	26.44%	0.08	18.77%	0.06	14.79%	0.07	15.70%	0.07	12.53%
Hazard Index (HI)		0.86	100.00%	0.44	100.00%	0.42	100.00%	0.42	100.00%	0.55	100.00%

Compound	CAS	2001 95% UCL		2002 95% UCL		2003 95% UCL		2004 95% UCL		2005 95% UCL	
		Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI	Hazard Quotient (HQ)	% Contribution to HI
1,3- Butadiene	106990			3.17	73.83%	1.16	66.51%	0.68	54.43%	0.92	63.00%
Acrylonitrile	107131			0.17	3.99%	0.15	8.83%	0.09	7.40%	0.08	5.27%
Chloroprene	126998			0.85	19.73%	0.35	19.86%	0.39	31.04%	0.37	25.25%
All other chemicals				0.11	2.45%	0.08	4.80%	0.09	7.13%	0.09	6.47%
Hazard Index (HI)				4.29	100.00%	1.74	100.00%	1.25	100.00%	1.46	100.00%

Figure 5-24. Site M non-cancer hazard index (HI).



5.9 Trend Analysis

Trend analysis was performed on COPCs that were identified as risk drivers for cancer risks $\geq 10^{-6}$ (derived from median concentrations) and on COPCs that were identified as risk drivers for non-cancer risks based on HQs > 0.1. Trend analysis was performed to evaluate the changes in overall cancer and non-cancer risk estimates over time. COPCs that were identified as risk drivers for either cancer or non-cancer risks were subjected to this analysis. The data that were available for each monitoring site spanned October 2001 through December 2005. In addition, exposure data from the previous WLATS risk assessment (Study 1) were included in the trend analysis. Study 1 data were collected from April 2000 through April 2001. The monitoring data for these risk drivers were divided into quarters, so that there were 22 quarters in the monitoring period beginning with quarter 2 of 2000 (Q2 2000) and ending with quarter 4 of 2005 (Q4 2005). There was no data from Q3 of 2001 (July-September 2001); exposure data for Q2 of 2001 consisted only of measurements during the month of April since data from May and June of 2001 were not collected. A median concentration for each risk driver was derived for each quarter according to the protocol described in Section 3.0 Exposure Assessment. These quarterly median concentrations were then subjected to the risk characterization procedures described in Section 5.1 Risk Characterization. The procedure resulted in cancer risk calculations and HQ calculations for each quarter of each risk driver. These results are discussed in the following sections according to monitoring site.

5.9.1 Trend analysis of Site A: Louisville Police Firearms Training

The samples for this site were analyzed by USEPA (in Study 1) and by the University of Louisville (in Study 2). There were differences in the reported SQLs by USEPA and University of Louisville, resulting in different data handling for these two monitoring periods. Therefore, the trend analysis and comparisons between the two monitoring periods should be interpreted with caution.

The trend analysis for cancer risk drivers is presented in Figure 5-25. The cancer risks calculated from the April 2000–April 2001 data set (Study 1) did not demonstrate any clear pattern. This data set did not find any cancer risk associated with acrylonitrile, although the October 2001–December 2005 data set (Study 2) clearly indicates a cyclical pattern of peaks for acrylonitrile cancer risk. The primary risk drivers are 1,3-butadiene and acrylonitrile. Both chemicals displayed a seasonal cyclical pattern. 1,3-Butadiene cancer risk peaked in Q2 of each year (quarter 3 of year 2005), with a large peak in Q4 of 2003. Acrylonitrile cancer risk peaked in Q4 of each year, although no peak occurred in 2004. Acrylonitrile cancer risk peaked in Q1 of 2003 instead of Q4 of 2002. The cancer risks of the other risk drivers were on a much lower scale, and it is difficult to discern any obvious pattern.

The trend analysis for non-cancer risk drivers is presented in Figure 5-26. There were 3 non-cancer risk drivers: 1,3-butadiene, acrylonitrile, and chloroprene. The pattern of HQs followed the same pattern as the trend analysis for cancer risk drivers, since the HQs

are derived from the same median concentrations as was the cancer risk. 1,3-Butadiene crossed the threshold of HQ > 1 in Q2-Q3 of 2002, Q4 of 2003, and Q2-Q3 of 2005, indicating an exceedance of the inhalation RfC during these periods. Chloroprene peaked in Q2 of 2000, Q1 of 2001, Q2 of 2002, Q3 of 2003, Q2 of 2004 and Q2-Q3 of 2005, indicating a seasonal cyclical pattern. These peaks were all HQs > 1, indicating exceedances of the inhalation RfC. Acrylonitrile never exceeded a HQ > 1.

5.9.2 Trend analysis of Site C: Ralph Avenue/Campground Road

The samples for this site were analyzed by USEPA (in Study 1) and by the University of Louisville (in Study 2). There were differences in the reported SQLs by USEPA and University of Louisville, resulting in different data handling for these two monitoring periods. Therefore, the trend analysis and comparisons between the two monitoring periods should be interpreted with caution.

The trend analysis for cancer risk drivers is presented in Figure 5-27. 1,3-Butadiene is the most obvious of the risk drivers. 1,3-Butadiene cancer risks peaked in Q2 of 2000, Q2 of 2001, Q1 of 2002, Q1 and Q4 of 2003, Q4 of 2004, and Q3 of 2005. Acrylonitrile demonstrated considerable cancer risks in the April 2000–April 2001 monitoring period (Study 1), but much lower cancer risks in the October 2001–December 2005 monitoring period (Study 2). The cancer risks of the other risk drivers were on a much lower scale, and it is difficult to discern any obvious pattern.

The trend analysis for non-cancer risk drivers is presented in Figure 5-28. The risk drivers for non-cancer effects were 1,3-butadiene, acrylonitrile, and chloroprene. The pattern of HQs followed the same pattern as the trend analysis for cancer risk drivers, since the HQs are derived from the same median concentrations as was the cancer risk. 1,3-Butadiene HQs crossed the threshold of HQ > 1 in Q2 of 2000, Q2 of 2001, Q1-Q2 of 2002, Q1-Q2 of 2003, Q4 of 2003, and Q2-Q3 of 2005, indicating an exceedance of the inhalation RfC during these periods. Chloroprene HQs were > 1 for most of the quarters analyzed in the temporal analysis, with the exception of Q4 of 2000 and Q1 of 2003, indicating exceedances of the inhalation RfC during the majority of the monitoring periods. Chloroprene HQs peaked in Q3 of 2000, Q2 of 2001, Q1 of 2002, Q3 of 2002, Q2 of 2003, Q3 of 2004, Q1 of 2005, and Q4 of 2005. Acrylonitrile HQs were > 1 only in the April 2000–April 2001 monitoring period (Study 1), during Q3 of 2000 and Q2 of 2001.

5.9.3 Trend analysis of Site E: University of Louisville Shelby Campus

The samples for this site were analyzed by USEPA (in Study 1) and by the University of Louisville (in Study 2). There were differences in the reported SQLs by USEPA and University of Louisville, resulting in different data handling for these two monitoring periods. Therefore, the trend analysis and comparisons between the two monitoring periods should be interpreted with caution.

The trend analysis for cancer risk drivers is presented in Figure 5-29. Because of the much lower magnitude of cancer risks for this monitoring site compared to the other sites, the y-axis scale is much lower. There is no obvious pattern to the cancer risks of the risk drivers for this site since the magnitude of differences between quarters is small.

Trend analysis for non-cancer risk drivers was not performed for this site because no risk drivers were identified (COPCs with median HQs > 0.1).

5.9.4 Trend analysis of Site F: Cane Run Elementary School

The trend analysis for cancer risk drivers is presented in Figure 5-30. 1,3-Butadiene and acrylonitrile are the most obvious of the risk drivers. 1,3-Butadiene cancer risks peaked in Q2 of 2000, Q2 of 2001, Q1 of 2002, Q2 and Q4 of 2003, Q2 of 2004, and Q2 of 2005. Acrylonitrile cancer risks peaked in Q3 of 2000, Q2 of 2001, Q1 of 2002, Q2 of 2003, Q3 of 2004, and Q3 of 2005. The cancer risks of the other risk drivers were on a much lower scale, and it is difficult to discern any obvious pattern.

The trend analysis for non-cancer risk drivers is presented in Figure 5-31. 1,3-Butadiene, acrylonitrile, and chloroprene were the risk drivers. The pattern of HQs followed the same pattern as the trend analysis for cancer risk drivers, since the HQs are derived from the same median concentrations as was the cancer risk. The risk drivers 1,3-butadiene and acrylonitrile never exceeded a HQ of 1, indicating that their inhalation RfCs were not exceeded during the study. However, chloroprene's HQ was > 1 for Q3 and Q4 of 2000, Q1 of 2001, Q3 of 2002, and Q4 of 2004, indicating exceedances of the inhalation RfC during these periods.

5.9.5 Trend analysis of Site I: Chickasaw Park

The trend analysis for cancer risk drivers is presented in Figure 5-32. There were no valid exposure data for the first quarter of 2001 (Q1 2001). 1,3-Butadiene is the most obvious of the risk drivers. 1,3-Butadiene cancer risks peaked in Q2 of 2002, Q1 and Q4 of 2003, Q2 of 2004, and Q2 of 2005. Acrylonitrile cancer risks peaked in Q3 of 2000, Q1 of 2002 and Q1 of 2003, and were then derived from an exposure concentration of ½ SQL for the remainder of the monitoring period. Chloroform cancer risks peaked in Q4 of 2000, but were largely derived from an exposure concentration of ½ SQL for the remainder of the monitoring period. The cancer risks of the other risk drivers were on a much lower scale, and it is difficult to discern any obvious pattern.

The trend analysis for non-cancer risk drivers is presented in Figure 5-33. 1,3-Butadiene and chloroprene were identified as risk drivers. The pattern of HQs followed the same pattern as the trend analysis for cancer risk drivers, since the HQs are derived from the same median concentrations as was the cancer risk. 1,3-Butadiene crossed the threshold of HQ > 1 during Q4 of 2003. Chloroprene also crossed the threshold of HQ > 1 during Q4 of 2003. Otherwise, the inhalation RfCs for 1,3-butadiene and chloroprene were not exceeded.

5.9.6 Trend analysis of Site M: Farnsley Middle School

The trend analysis for cancer risk drivers is presented in Figures 5-34 and 5-35. These two figures are the same, with the exception that Figure 5-35 does not include the tetrachloroethene outlier from Q2 of 2000 so that readability of the y-axis scale is improved. Tetrachloroethene exhibited a large cancer risk peak in Q2 of 2000, but was either zero or based on an exposure concentrations of ½ SQL for the remainder of the monitoring periods. It is unclear if this large exposure concentration in Q2 of 2000 is real or an anomaly. 1,3-Butadiene cancer risks peaked in Q3 of 2000, Q2 of 2001, Q3-Q4 of 2002, Q3 of 2003, Q1 of 2004, and Q1 of 2005. Acrylonitrile cancer risks peaked in Q3 of 2000, and Q2-Q3 of 2002. Naphthalene cancer risks were high in Q3 of 2000 through Q2 of 2001, although its cancer risk values were derived from an exposure concentration of ½ SQL. Naphthalene cancer risks were zero for the remainder of the monitoring period. The cancer risks of the other risk drivers were on a much lower scale, and it is difficult to discern any obvious pattern.

The trend analysis for non-cancer risk drivers is presented in Figure 5-36. The pattern of HQs followed the same pattern as the trend analysis for cancer risk drivers, since the HQs are derived from the same median concentrations as was the cancer risk. Neither 1,3-butadiene, acrylonitrile, nor chloroprene exceeded a HQ of 1, indicating that inhalation RfCs were not exceeded during the study.

5.9.7 Conclusions of the trend analysis

1,3-Butadiene demonstrated the largest year-to-year variation and consistently contributes the greatest cancer risk at all sites with the exception of the control site, Site E. 1,3-Butadiene is produced through petroleum processing and is primarily used in the production of synthetic rubber. It is also found in smaller amounts in plastics and fuel. Sites A, C, F, I, and M are located in areas where industrial emissions (i.e., Rubbertown) are expected to have a large influence on the ambient levels of air toxic contaminants. Site E is located farther east, and was chosen as an urban anthropogenic control site. 1,3-Butadiene was measured in much lower concentrations at Site E compared to the other sites due to its distance from the Rubbertown industrial plants. Therefore, the measure data are consistent with onsite observations.

Acrylonitrile demonstrated large variation at all sites. Acrylonitrile is an important industrial chemical used in the production of acrylic and modacrylic fibers and other important chemicals and resins. It is also found in other sources, such as auto exhaust.

Chloroprene is a chemical intermediate in the manufacture of artificial rubber. This risk assessment found that chloroprene was a non-cancer risk driver in Sites A and C; these locations are the high impact sites for industrial emissions. Sites F and I had a few instances of HQs > 1, indicating exceedances of the RfC.

All of the other risk drivers demonstrated less variation than 1,3-butadiene, acrylonitrile and chloroprene. The trend analyses demonstrate that risk drivers at Sites A, C, F, I, and

M exhibit similar patterns. Again, this is due to the proximity of these sites with industrial zones such as Rubbertown, whereas Site E is located farther east.

Figure 5-25. Site A: Temporal analysis of chemicals with median cancer risks ≥ 10^{-6}.

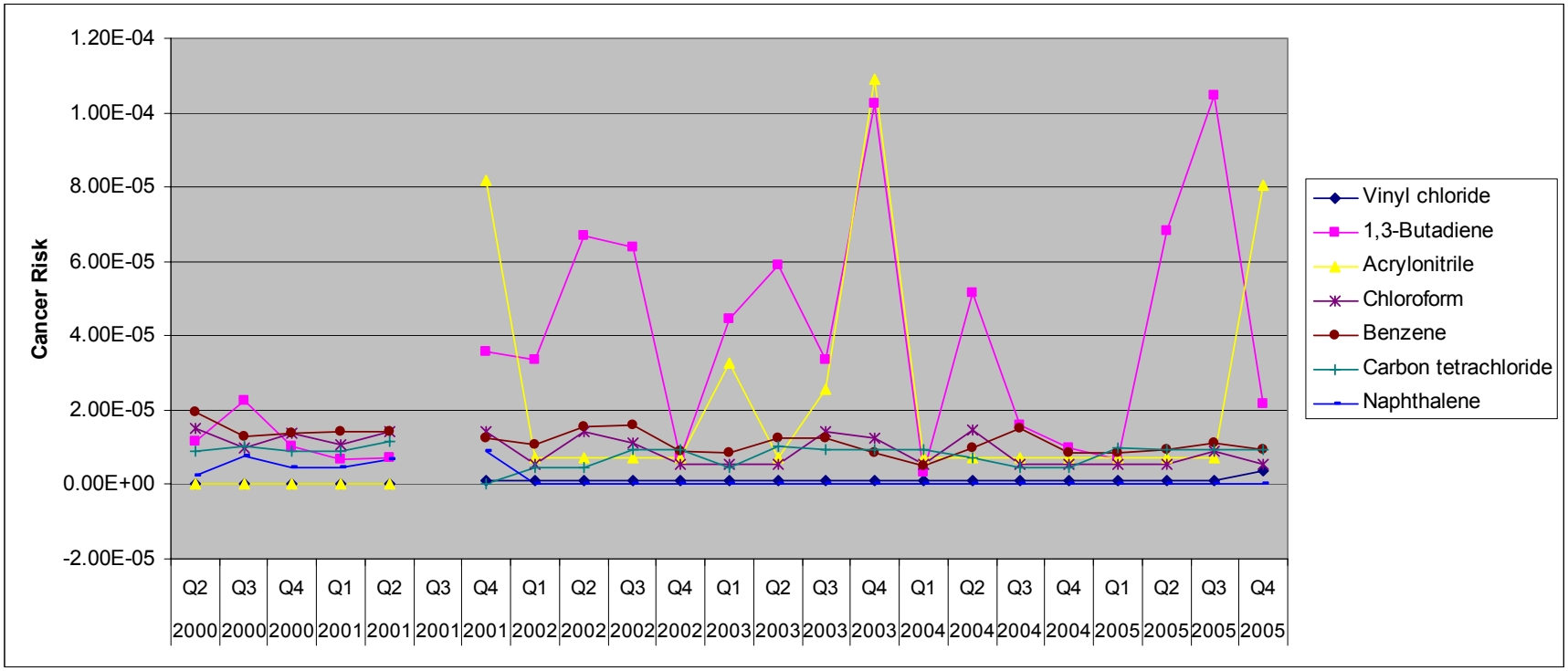


Figure 5-26. Site A: Temporal analysis of chemicals with median HQs > 0.1.

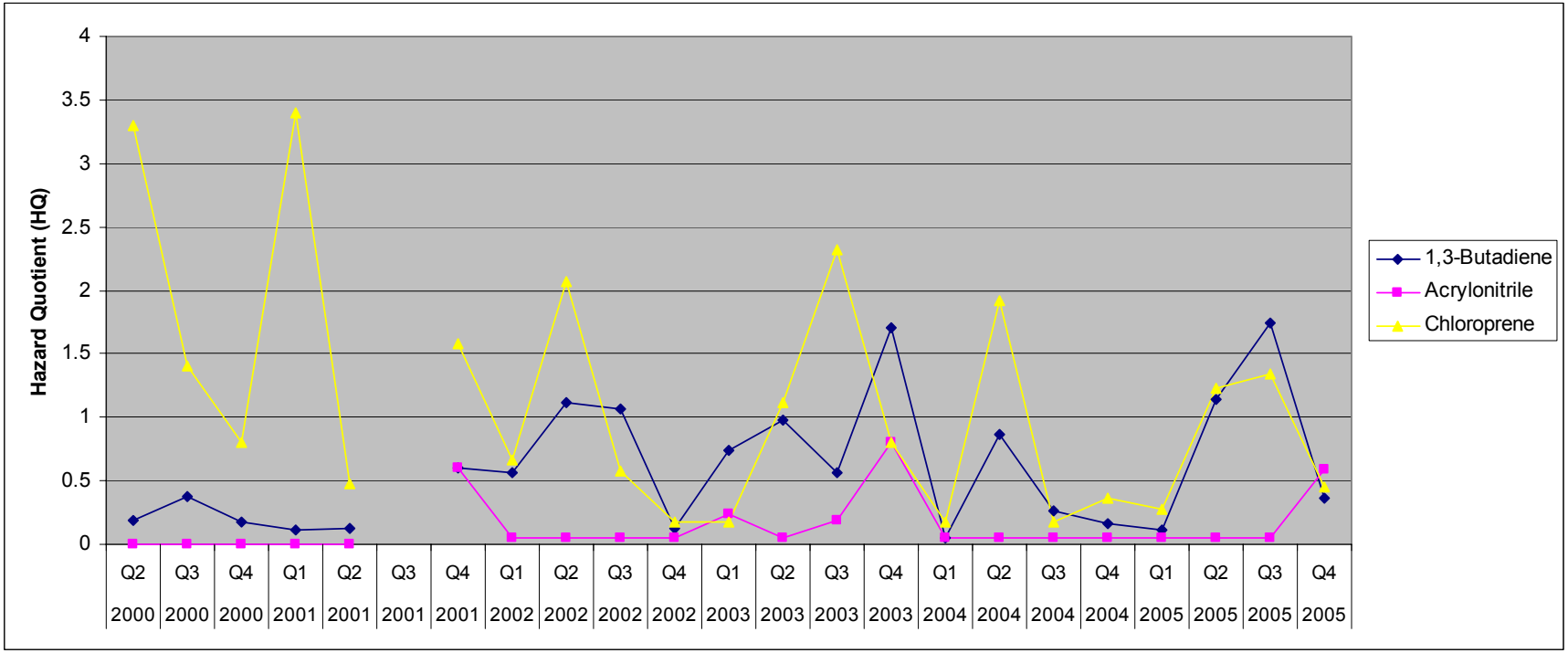


Figure 5-27. Site C: Temporal analysis of chemicals with median cancer risks ≥ 10^{-6}.

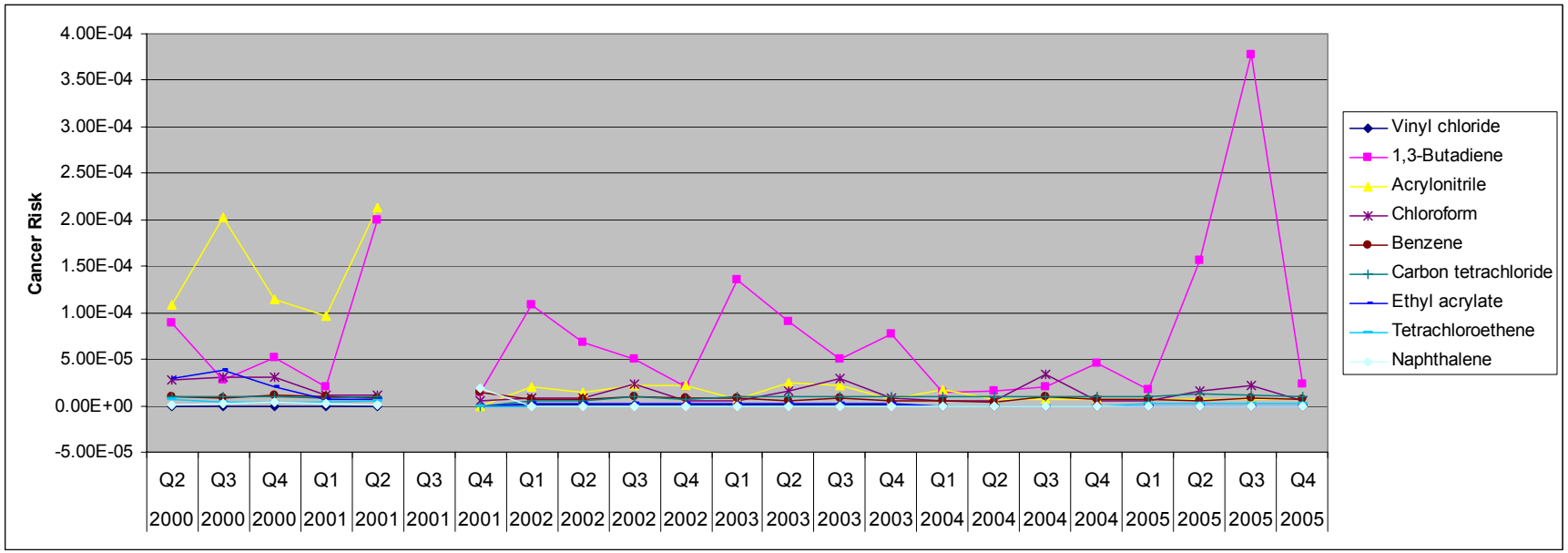


Figure 5-28. Site C: Temporal analysis of chemicals with median HQs > 0.1.

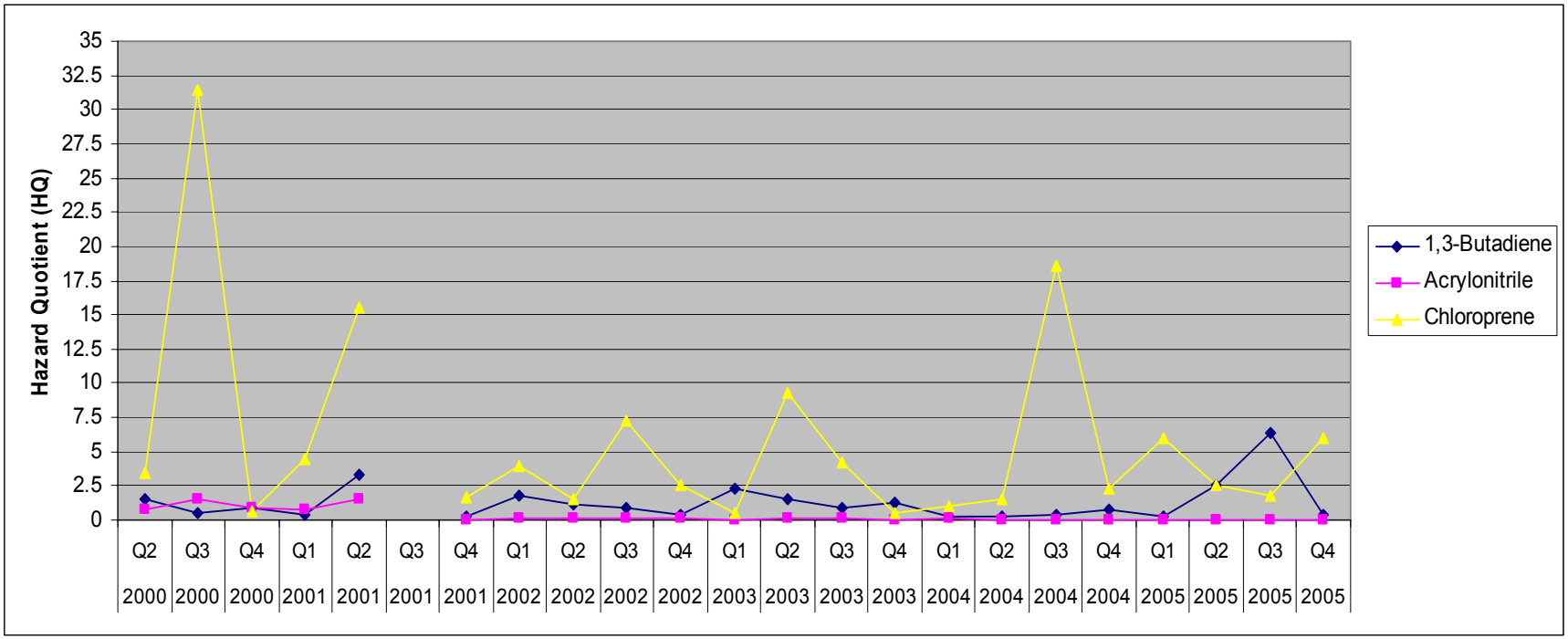


Figure 5-29. Site E: Temporal analysis of chemicals with median cancer risks ≥ 10^{-6}.

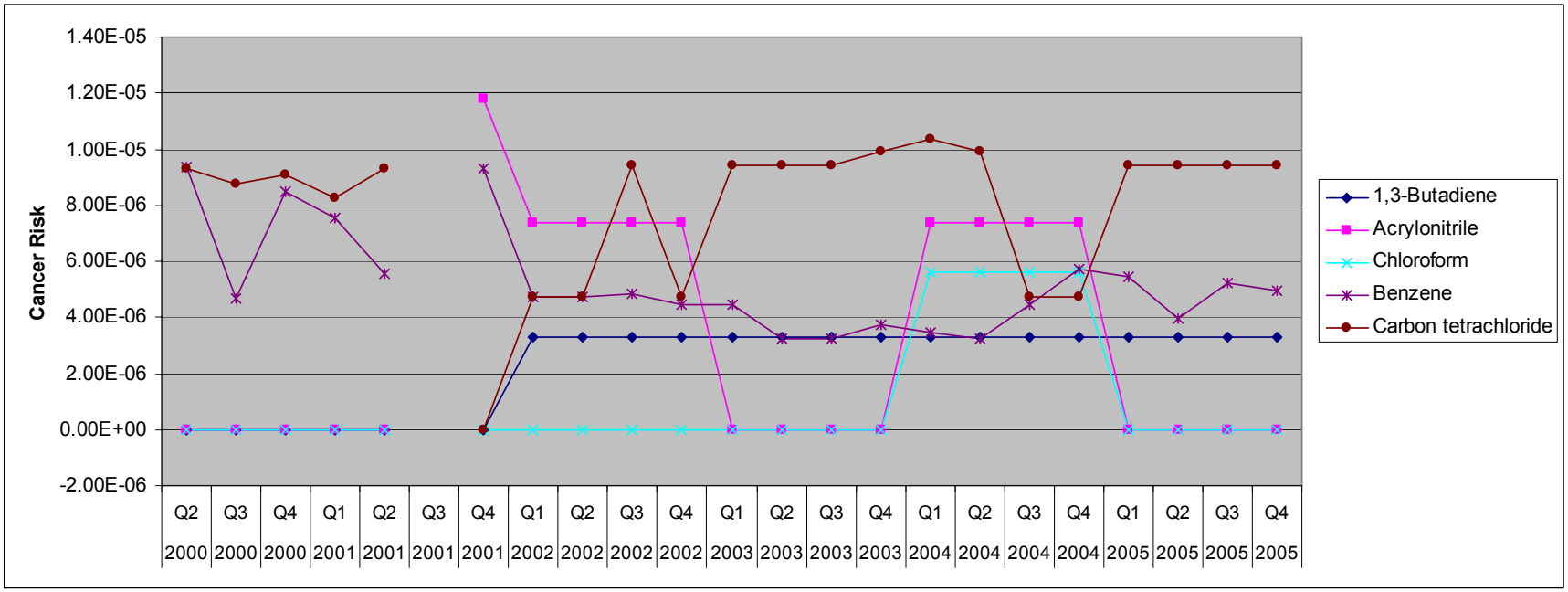


Figure 5-30. Site F: Temporal analysis of chemicals with median cancer risks ≥ 10^{-6}.

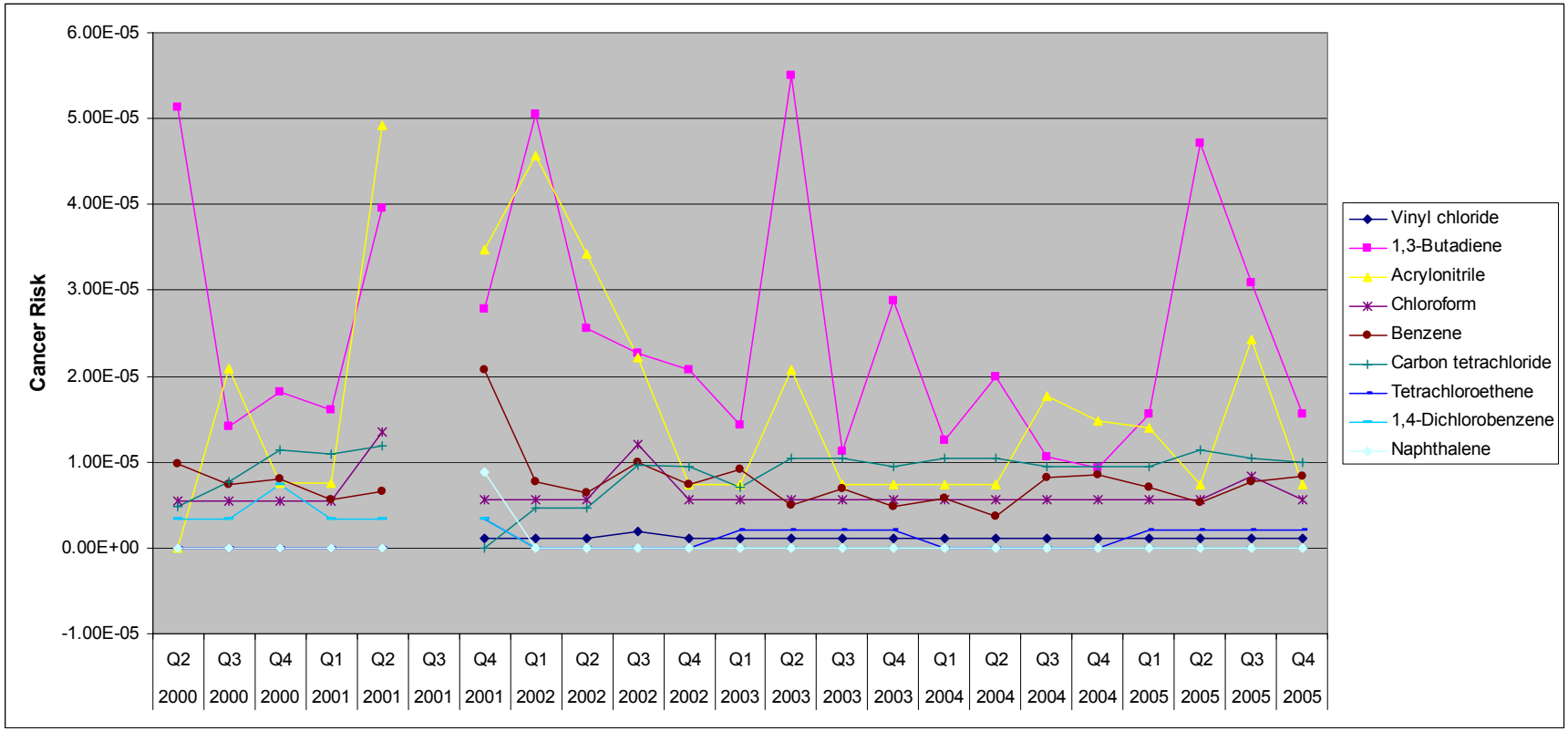


Figure 5-31. Site F: Temporal analysis of chemicals with median HQs > 0.1.

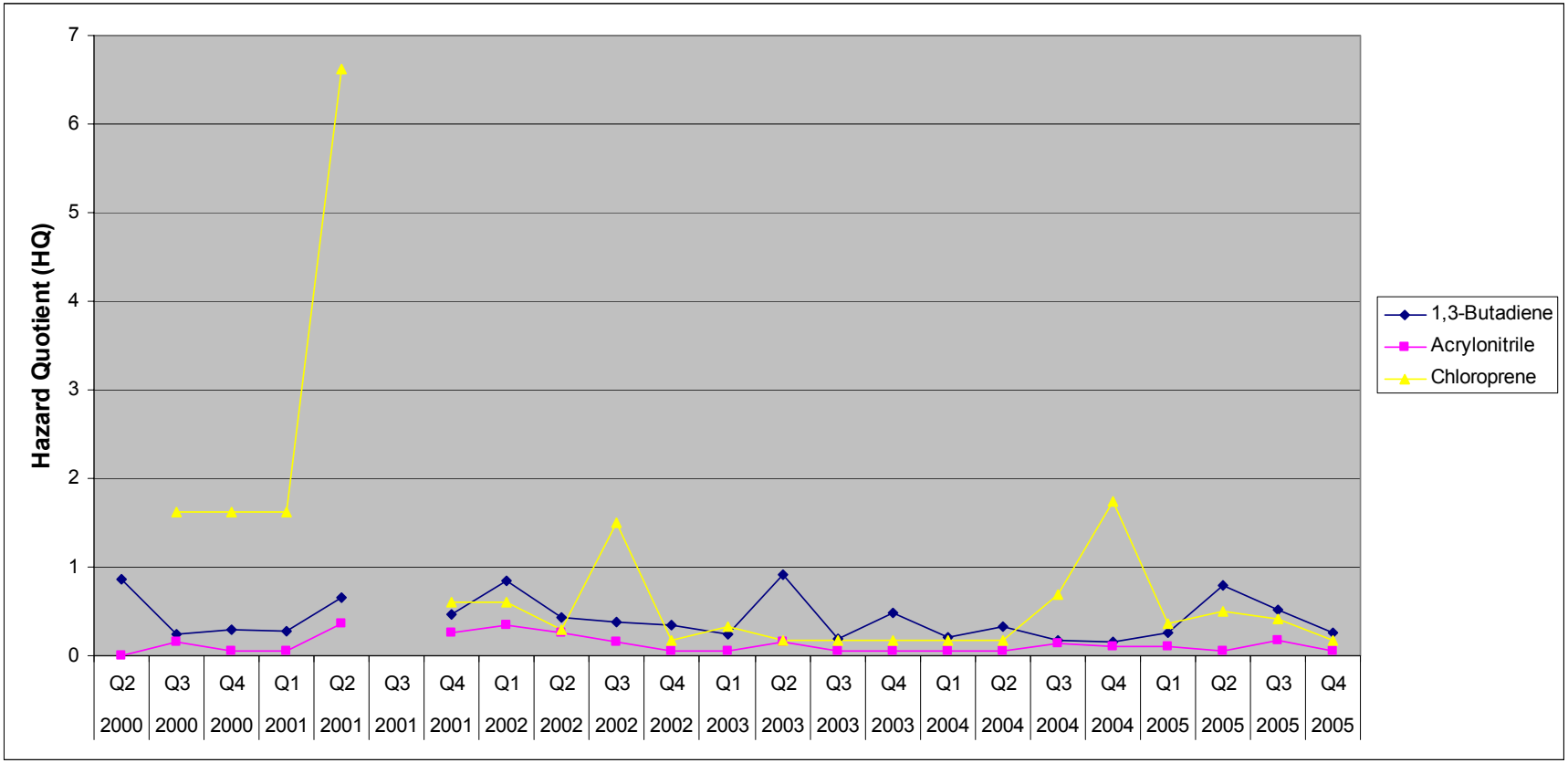


Figure 5-32. Site I: Temporal analysis of chemicals with median cancer risks ≥ 10^{-6}.

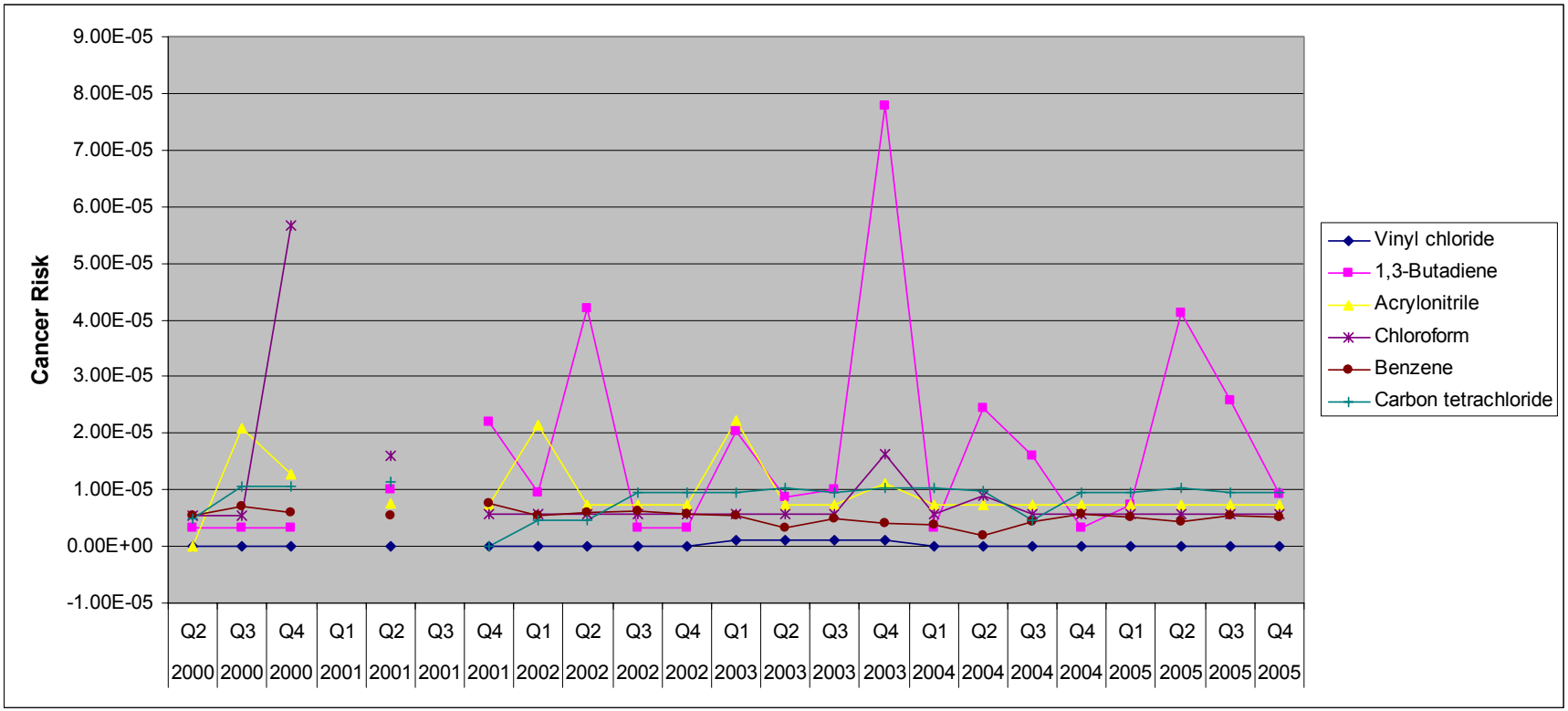


Figure 5-33. Site I: Temporal analysis of chemicals with median HQs > 0.1.

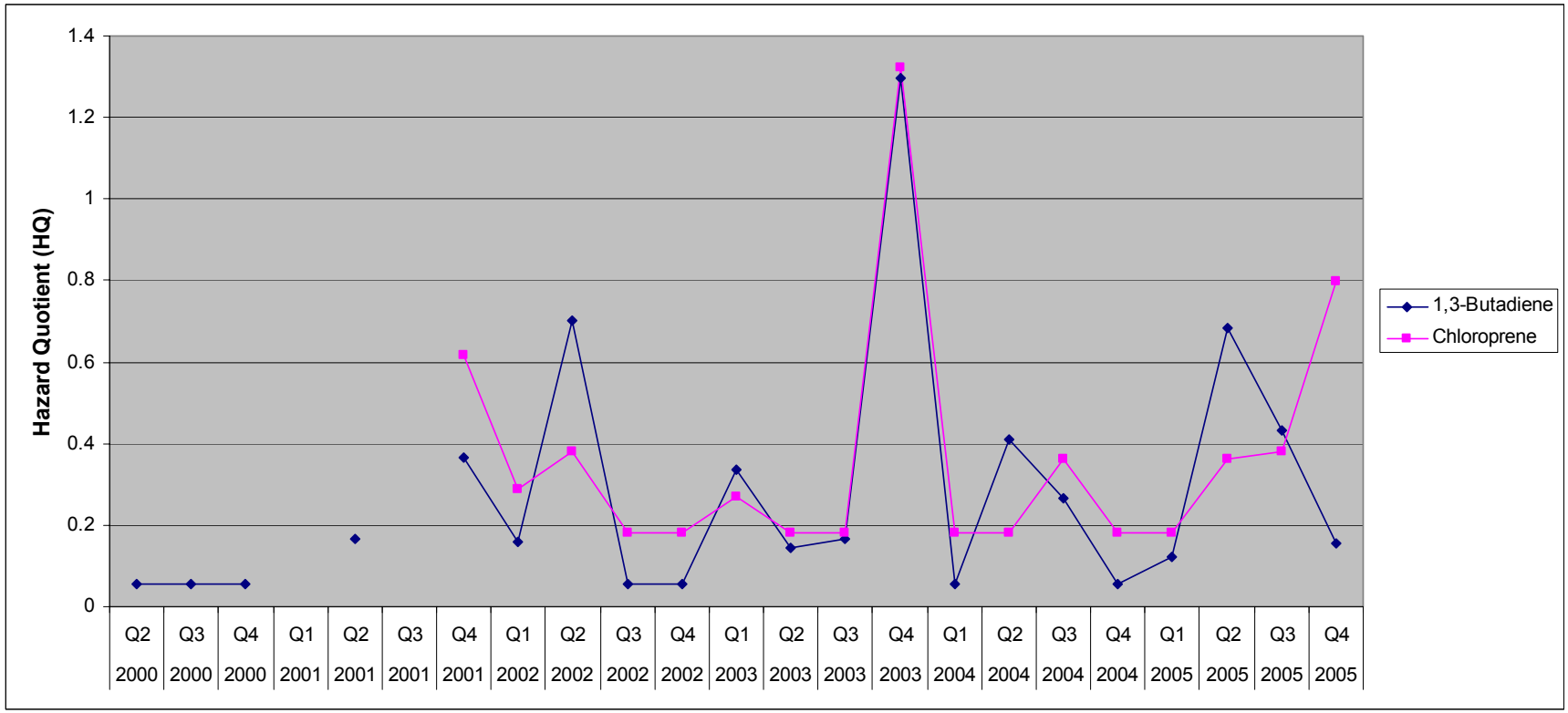


Figure 5-34. Site M: Temporal analysis of chemicals with median cancer risks ≥ 10^{-6}.

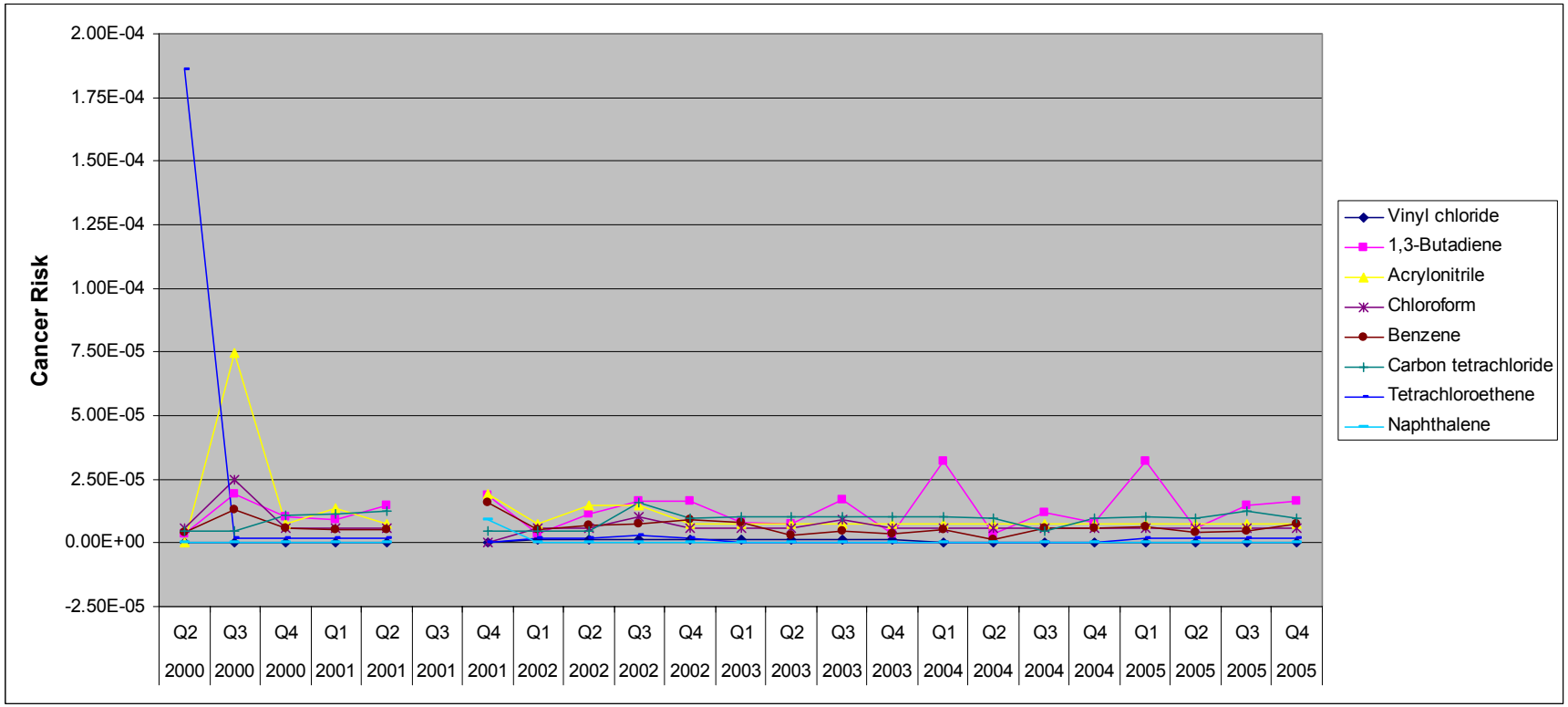


Figure 5-35. Site M: Temporal analysis of chemicals with median cancer risks ≥ 10^{-6} without the tetrachloroethene outlier in Q2 of 2000.

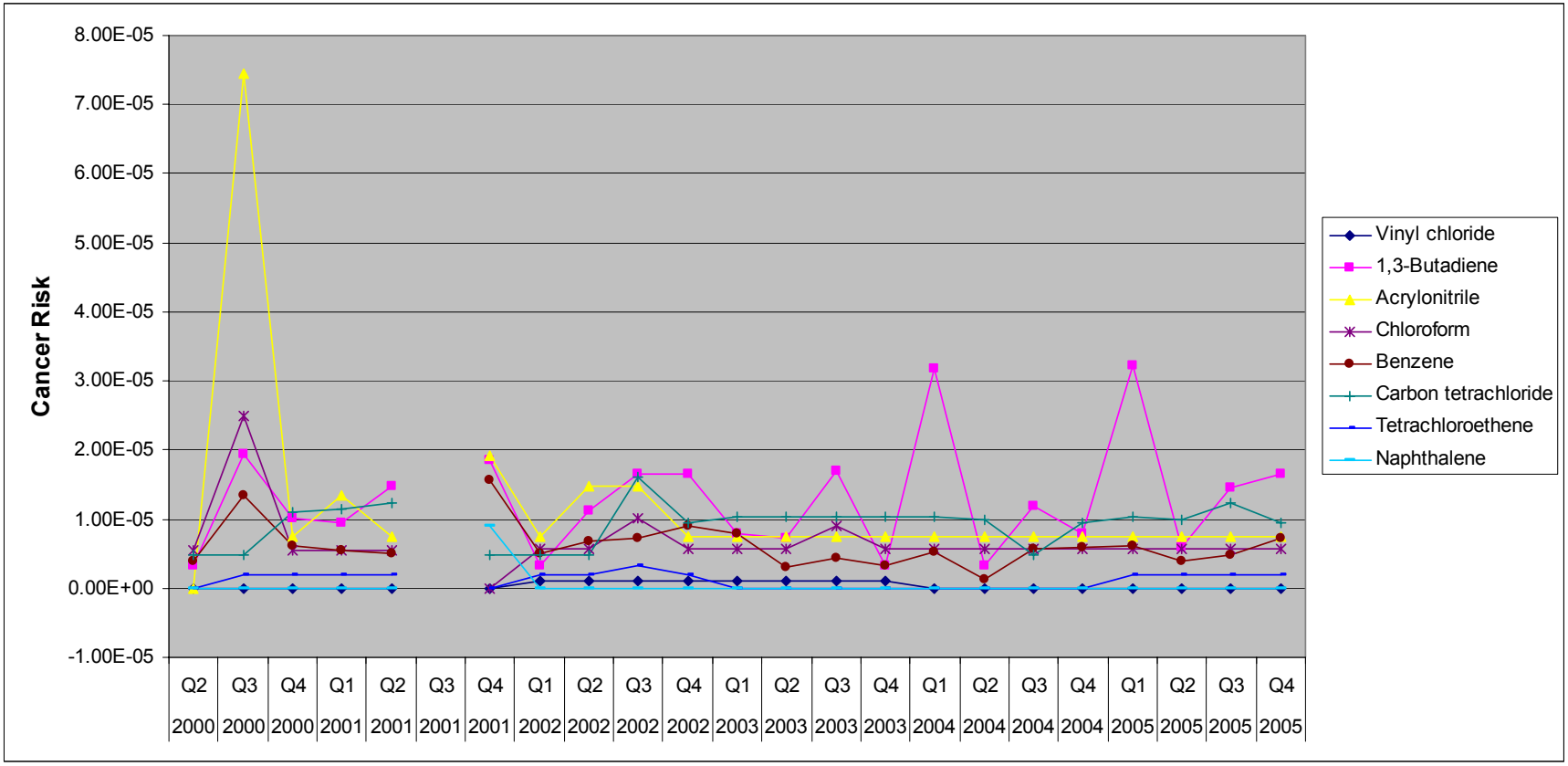
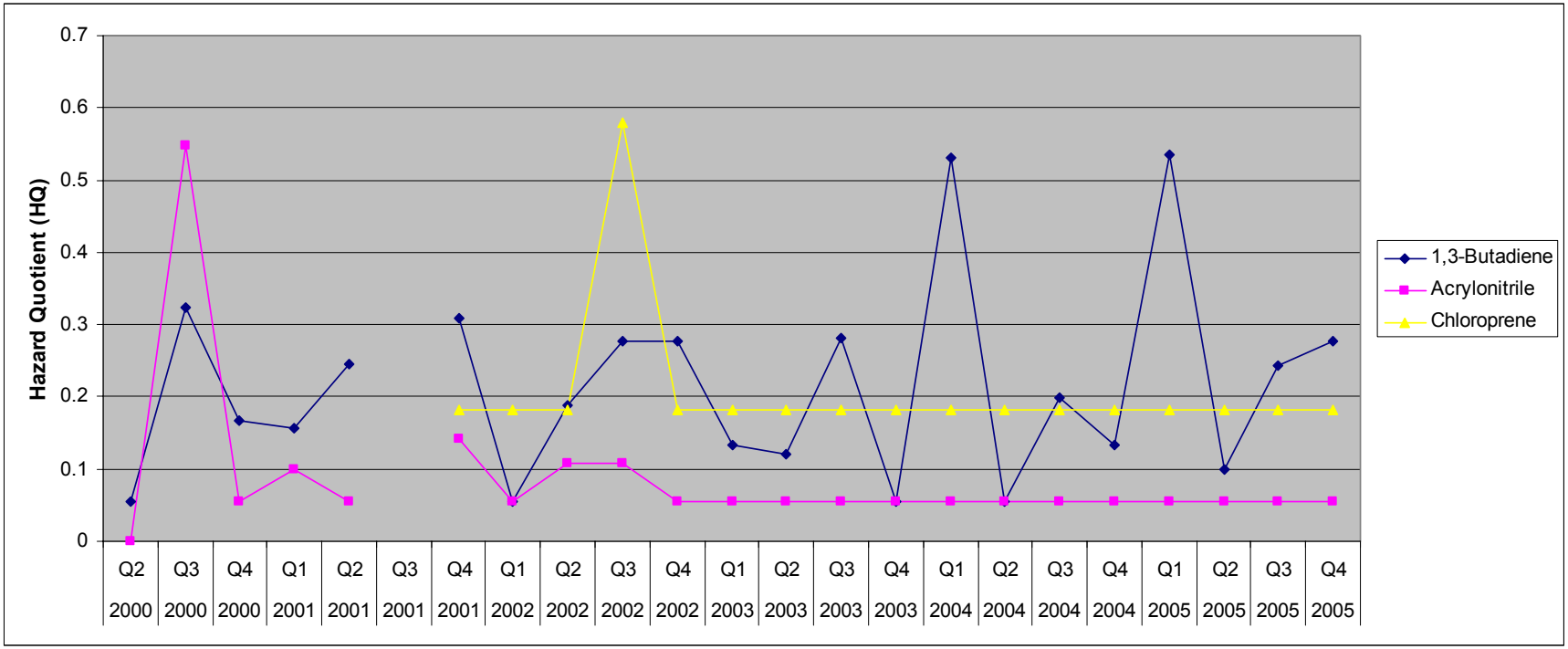


Figure 5-36. Site M: Temporal analysis of chemicals with median HQs > 0.1.



5.10 Population Analysis

The purpose of the population analysis is to look for hot spots in the data set or common factors in determining exposure and risks for monitors as a single group/population or logical subpopulations. Cancer risk impact on a population is often referred to as cancer burden. The cancer burden is the estimated increase in the occurrence of cancer cases in a population as a result of exposures to air toxic contaminant emissions. The cancer burden for a population unit (city, census tract, sub-area, or grid) is the product of the number of persons in the population and the estimated individual risk from air toxic contaminants. The cancer burden only needs to be calculated if the cancer risk is greater than 10^{-6}. The cancer burden was calculated by multiplying the number of persons in a defined area (census tract or zip code) by the average of the median cumulative cancer risks or the average of the 95% UCL cumulative cancer risks over the 2001-2005 monitoring years. Table 5-25 presents the 2000 U.S. Census data for the monitoring sites of the WLATS. Table 5-26 shows the estimated cancer burden at each monitoring site by census tract population and by zip code population.

Most local air pollution control agencies with air toxics programs are, for the most part, implementing a state air toxics program. Thus few local agencies have established cancer burden limits. However, the South Coast Air Quality Management District (SCAQMD) in the Los Angeles area set a cancer burden limit of 0.5, which means that the estimated increase in the occurrence of cancer cases in a population being exposed to the toxic air contaminant emissions shall not exceed 0.5. This cancer burden limit of 0.5 is used in this risk assessment as a benchmark for comparing the cancer risk impact on the WLATS population.

Census tract population numbers provide a fairly accurate approximation of the number of people that are exposed to the toxic air contaminants detected at each monitor. As demonstrated in Table 5-26, the cancer burden using census tract population and the average of the median cumulative cancer risks does not result in any cancer burdens > 0.5. Cancer burden rankings from highest to lower are Site F > Site C > Site M > Site A > Site E > Site I. Although Site A has the highest average median cumulative cancer risks, its low population results in a lower cancer burden relative to the other sites. The conservative approach of using the average of the 95% UCL cumulative cancer risks results in several sites that demonstrate cancer burdens > 0.5: Site C, Site F, and Site M.

Zip code population numbers are a gross approximation of the number of people that are exposed to the toxic air contaminants detected at each monitor. Using the zip code population and the average of the median cumulative cancer risks, the cancer burdens at all sites with the exception of Site E exceed 0.5. The conservative approach of using the average of the 95% UCL cumulative cancer risks results in cancer burdens exceeding 0.5 at all sites. Using zip code population numbers to calculate cancer burdens may be inaccurate due to the uncertainty of the air dispersion of the toxic air contaminants over the zip code area.

Table 5-25. 2000 U.S. Census data for the monitoring sites of the WLATS.

Monitoring Site Number	Site Name Address	AIRS ID Number (Site ID Code) (POC Number)	Latitude/ Longitude	Census Tract	Population	Zip Code	Population
Site A	Louisville Police Firearms Training 4201 Algonquin Pkwy Louisville, KY 40211	21 111 1041 (FT) (1)	N 38 13 37.0 W 85 49 24.0	14	1355	40211	23,553
Site C	Ralph Avenue 4211 Campground Road Louisville, KY 40216	21 111 0054 (RC) (1 – main station; 2 – duplicate station)	N 38 12 40.3 W 85 50 26.2	127.01	4147	40216	39,924
Site E	Shelby Campus, University of Louisville 9001Shelbyville Road, Louisville, KY 40222	21 111 0057 (SC) (1)	N 38 13 09.0 W 85 34 59.0	101.02	4196	40222	20860
Site F	Cane Run Elementary 3951 Cane Run Rd. Louisville, KY 40216	21 111 0062 (CR) (1)	N 38 12 34.8 W 85 49 20.8	126.01	6392	40211	23,553
Site I	Chickasaw Park 942 S. 47th St. Louisville, KY 40211 (Private Residence)	21 111 0060 (CP) (1)	N 38 14 44.7 W 85 49 58.1	11	3673	40211	23,553
Site M	Farnsley M. S. 3400 Lees Lane Louisville, KY 40216	21 111 0058 (FM) (1)	N 38 11 03.2 W 85 51 39.0	127.02	2259	40216	39,924

Table 5-26. Estimated cancer burden at each monitoring site by census tract and zip code.

Site	Average Median Cancer Risks	Average 95% UCL Cancer Risks	Census Tract			Zip Code		
			Population by Census Tract	Cancer Burden by Median	Cancer Burden by 95% UCL	Population by Zip Code	Cancer Burden by Median	Cancer Burden by 95% UCL
Site A	8.98E-05	3.31E-04	1355	1.22E-01	4.48E-01	23,553	2.12E+00	7.79E+00
Site C	8.32E-05	8.30E-04	4147	3.45E-01	3.44E+00	39,924	3.32E+00	3.31E+01
Site E	2.14E-05	2.90E-05	4196	8.97E-02	1.22E-01	20860	4.46E-01	6.05E-01
Site F	6.35E-05	1.68E-04	6392	4.06E-01	1.08E+00	23,553	1.49E+00	3.97E+00
Site I	3.78E-05	1.87E-04	2259	8.54E-02	4.23E-01	39,924	1.51E+00	7.48E+00
Site M	4.49E-05	1.36E-04	3673	1.65E-01	5.00E-01	23,553	1.06E+00	3.21E+00

5.11 Spatial Analysis

This analysis serves to identify monitors where chemical concentrations are correlated. Earlier analysis focused on the potential for trends based on seasons of the year. This analysis will focus on spatial relationships for the monitors, but will include some aspect of seasonal variability, for example changes in the predominant wind direction based on the season of the year.

A quantitative spatial and temporal analysis can only be performed by air dispersion modeling. However, air dispersion modeling requires data on how the air toxic contaminants are emitted at the sources. For example, information on emissions rates, stack heights, exit velocities, and temperatures at each emission source are necessary to perform quantitative air dispersion modeling to predict ground-level concentrations at each monitoring site and the surrounding area. Since the WLATS was not designed to compile the necessary data, only qualitative air dispersion modeling can be performed.

Cancer risk is estimated using annual average ground-level concentrations of toxic air contaminants. The ground-level toxic air contaminant concentrations were measured in a 24-hour period. The 24-hour values can be converted to annual average concentrations using the algorithm recommended by Turner (1994). However, for this project, the 24-hour values were used to derive yearly median concentrations. This assumption normally provides a more conservative cancer risk, because 24-hour average values are usually higher than the annual average. The median cancer risks for each year (presented in Section 5) were multiplied by 10^6 to present the number of persons at risk per million people, and are summarized in Table 5-27.

Analyses of the data showed that the highest risk is detected in Site A and lowest risk is at Site E. As discussed in Section 3, Sites A, C, F, I, and M are approximately located in the same industrial areas, while Site E is located farther away. Higher risks are expected in Sites A, C, F, I, and M. Therefore, the calculated cancer risk is consistent with observation.

The local meteorology in the Louisville area has a significant influence in determining where chemicals in the atmosphere are carried and their airborne concentrations. Wind speed and wind direction are two of the most important meteorological factors. Airborne chemicals are carried along in the direction that the wind is blowing. In general, as wind speeds increase the airborne concentrations will decrease due to more air being available to mix with the chemicals and dilute their concentrations.

Based on data collected at the National Weather Service (NWS) station at the Louisville International Airport, the overall prevalent winds are from the southwest. This means that airborne chemicals will move from southwest to northeast. The NWS station is approximately five miles or less to the southeast of the WLATS community monitoring locations.

Sites A, C, and F are located generally northeast of the Rubbertown industries. Site M is located to the south of most of the Rubbertown industries. Ground-level concentrations of toxic air contaminants, and thus health risks, are expected to be higher at these 3 sites than at Site M. Review of the risks summarized in Table 5-27 showed that this is indeed the measured result.

Table 5-27. Summary of median cancer risks by year.

Site	2001 Median	2002 Median	2003 Median	2004 Median	2005 Median	Average
A	155.1	70.1	93.3	43.8	86.9	89.8
C	44.2	124.6	112.5	47.8	86.9	83.2
E	21.6	20.5	16.7	30.2	18.0	21.4
F	107.1	68.0	47.2	40.4	54.6	63.4
I	42.9	27.0	41.0	29.8	48.1	37.7
M	68.2	39.9	36.0	35.2	45.4	44.9

6.0 UNCERTAINTY ANALYSIS

All risk assessments involve the use of assumptions, judgment, and incomplete data to varying degrees. The way in which these uncertainties are addressed and incorporated into the risk assessment can significantly affect the degree of conservatism in the risk assessment. An uncertainty analysis provides a means to review the factors that contribute to the risk assessment and gain a better perspective on the risk estimates that are presented. A logical way to discuss the uncertainty of the risk assessment is to go through each of the major components and identify the key variables and assumptions that have the most impact on the uncertainty in the risk assessment. Whenever possible, the discussion will present examples of how much the risk estimates could change with changes in the assumptions or methodology. Steps that could be taken to reduce the uncertainty are also identified when alternatives are available. The remainder of this discussion will follow the major Sections of the Risk Assessment presented thus far.

6.1 Monitoring Program

One of the primary uncertainties in this study was the use of monitoring data to estimate the potential human health exposures and risks. The uncertainty stems from the inability to realistically monitor continuously at all places of interest. Thus a decision is made to monitor a portion of the time and in specific locations and apply the results to a broader situation. One means to reduce the uncertainty in monitor placement is to conduct air modeling to identify relevant locations based on local meteorology and information about the sources of the airborne chemicals.

A large number of chemicals were selected for monitoring in the WLATS program. However, it is possible that important chemicals were not evaluated because of a lack of resources or because test procedures were not available for the chemicals. Clearly, limiting the number of chemicals analyzed in the monitoring program can result in an underestimation of risk, which could in some case be reduced by monitoring for a larger group of chemicals. Many of the chemicals selected for monitoring were based on an assessment of the likely or known chemicals released into the air from major sources in the Louisville area, which helps to reduce the uncertainty associated when selecting the set of chemicals to be evaluated.

A thorough review of the equipment and quality assurance used for the monitoring program was not conducted as part of this investigation. However, it appears that standard equipment and methods were used for the monitoring program. The standard equipment and methods for sample collection and handling are typically tested to ensure that accurate and reliable results will be obtained. This would include discarding sampling data if the method was not followed closely enough. Rejecting data from the monitoring program could lead to an over- or underestimation of the potential health impacts.

6.2 Data Analysis and Selection of Chemicals of Potential Concern

A validated data set of analytical results for the monitors in the WLATS program was provided as the basis for the risk assessment. This dataset contained the airborne concentrations for various chemicals detected during the years of monitoring. In some cases, the laboratory could not definitively determine the chemical responsible for the measured air concentration. The air concentrations were then assigned to a chemical that most closely matched characteristics of the unknown chemical, based on the laboratory tests. Because the chemical cannot be definitively determined, it is classified as a tentatively identified compound (TIC). Because of the uncertainty associated with the TICs, they were not evaluated in this risk assessment. This may lead to an underestimation of the health impacts. Conversely, evaluating a TIC as a more potent chemical for causing adverse health effects than may actually be the case would overestimate the potential health impacts. Additional monitoring or different techniques applied in the laboratory might reduce this uncertainty.

The frequency at which positively identified chemicals in the dataset were detected at a monitor was calculated and used as a means to focus the risk assessment on the most significant chemicals. Any chemical that was not detected in at least 10% of the samples reported for a location was removed from further analysis in the risk assessment. Application of this 10% rule for each monitor location led to the selection of the chemicals of potential concern (COPCs) for evaluation in the chronic and acute risk assessment. Eliminating chemicals that were infrequently detected could lead to an underestimate of the health impacts.

The potential to underestimate the health impacts might be reduced if all of the chemicals detected in the monitoring program were included in the risk assessment. Then a decision must be made whether to use only the detected concentrations to estimate what people could be exposed to, or to assume some value for all cases where the concentration was not detected and then combine these with the detected concentrations to calculate an exposure concentration using all of the samples. Using only the detected concentrations would tend to overestimate the potential health impacts associated with the true exposure. Similarly, it could be argued that the true concentration of the chemical is overestimated when the data without detections is used with an assumed value if the true value is significantly lower than the assumed value because it is only there in extremely small concentrations most of the time.

6.3 Exposure Assessment

For this risk assessment, the exposure assessment consisted of conducting statistical tests on the dataset and then calculating exposure point air concentrations using the most appropriate method as defined by the test results. The statistical tests were used to determine the shape of the distribution. If the data for a chemical at a monitor were normally distributed, then the 95% UCL of the mean air concentration was calculated using normal statistics (see Equation 3-5). Otherwise a lognormal distribution was

assumed, and the 95% UCL of the mean air concentration was calculated using lognormal statistics (see Equation 3-6).

If the assumption of lognormality was incorrect, this would introduce uncertainty into the risk estimates for the 95% UCL exposure case. As part of the risk assessment, the validity of the lognormal assumption was tested for all chemicals that were risk drivers and were not normally distributed. This analysis indicated that many of the risk drivers did not fit either a normal or a lognormal distribution. The impact of this uncertainty is unknown. The application of more advanced statistical techniques could reduce the uncertainty.

In calculating the air concentrations for the median and 95% UCL exposure cases for COPCs, a value of ½ the detection limit was used for samples where the actual concentration was not detectable. As discussed in Section 6.2, the potential impact of this uncertainty on the risk estimates could be to over- or underestimate the actual health impacts.

The use of a median and 95% UCL of the mean for the exposure point air concentrations was designed to reflect a central tendency and a reasonably conservative estimate of the true exposure. While the median concentration is unlikely to overestimate the true exposure, the 95% UCL of the mean may in fact be an overestimate. By definition, the 95% UCL of the mean implies that there is a 95% probability that the true mean of the air concentration is lower, and only a 5% probability that the true mean is higher. Another conservative aspect of the 95% UCL exposure case occurred when the calculated 95% UCL of the mean was greater than the maximum detected air concentration for the monitor. In this case, the maximum air concentration for the monitor was used to calculate the risk estimates for the 95% UCL exposure case. Air modeling could be used to attempt to reduce the uncertainty in the exposure point air concentrations.

A standard component of an exposure assessment is analysis that determines all of the routes of exposure associated with a COPC. This risk assessment evaluated the inhalation exposure route for the airborne chemicals detected in the WLATS monitors. There is no doubt that people in the vicinity of the WLATS monitoring program are breathing the chemicals found in the air monitors. Therefore, this is an actual exposure pathway. There may be other exposure pathways that are also complete in the sense that people could actually be exposed to the chemicals by another means. For example, airborne chemicals could deposit onto soil or surface water and lead to exposures via dermal or ingestion pathways. The true health impacts may be underestimates by an unknown amount as a result of ignoring these pathways. A more thorough multi-pathway risk assessment based on additional monitoring and/or modeling data could reduce this uncertainty.

Another typical aspect of an exposure assessment is calculating the dose that an individual could receive as a result of the exposure evaluated. Factors such as the frequency and duration of the exposure are selected to match the behavior of the population being modeled. For this risk assessment, it was assumed that an individual

was exposed for 24 hours per day, 365 day a year, for 70 years, as per the Risk Assessment Work Plan. These assumptions may underestimate potential health impacts if the air concentrations increase over time. Because a person is likely to have movements in and out of the area, the person's exposure may either increase or decrease when in a different area. Thus, the potential health impacts for an individual person are likely to be different. Conducting an analysis of the behaviors and activity patterns of the residents, and developing more site-specific values for the frequency and duration of the exposure could reduce this uncertainty.

6.4 Hazard Identification and Dose-Response Assessment

The Hazard Identification and Dose-Response portion of the risk assessment is designed to identify the potential health hazards associated with the COPCs selected for the risk assessment, and to obtain a toxicity value which provides a numerical expression of the incidence of adverse health effects based on the dose received. The risk characterization step then combines the toxicity values with the dose estimates made for the receptors being evaluated in the risk assessment, to develop estimates of risk for public health. The primary source of the toxicity values used in this risk assessment was the EPA Integrated Risk Information System (IRIS). The nature of the uncertainties in the toxicity values from IRIS also apply to the other sources of toxicity data used in this assessment (i.e., Cal EPA).

Uncertainties in the toxicity values used for this risk assessment stem from a number of sources. The first area of uncertainty is in the adequacy of the database available to assess the dose-response relationship. A number of techniques are available to derive a toxicity value using the dose-response relationship, and each imparts some level of uncertainty as well. An additional factor in this risk assessment was that toxicity values did not exist for some COPCs, which meant that the chemicals were either eliminated from further analysis in the risk assessment, or surrogate data were used. Use of either alternative will introduce another degree of uncertainty into the risk estimates.

The need for an adequate toxicity database from which to develop the dose-relationship is essential for deriving a representative toxicity value. In most cases dose-response data are not available for human exposures. Therefore animal studies are used to represent the potential effects in humans. In addition, the number of studies available for a chemical may not be sufficient to provide a clear picture of the true dose-response, especially in the region where the exposure is to low doses. In many cases the toxicity studies are based on exposures to animals at high doses of the chemical, doses that are less than a chronic duration, or doses that do not reach a no-effect level. Regardless of whether the dose is in animals or humans, there is uncertainty regarding the effect on especially sensitive populations that are not considered in the dose-response relationship. For non-cancer toxicity values, uncertainty and modifying factors are used to account for these factors. For cancer toxicity values, which are estimates of the probability to develop cancer as a result of a given exposure, the value is based on a linear extrapolation to zero or the

background dose, from a point of departure on the dose-response curve, or it is based on the use of uncertainty and modifying factors similar to the method used for noncarcinogens. The intent in both cases is to provide toxicity values that tend to overestimate the risks in the face of uncertainty in the derivation of the value.

An example of the uncertainty in the IRIS toxicity values is the case of acrylonitrile, which is a risk driver in this risk assessment. The current IRIS value for acrylonitrile was used to assess the potential for cancer health effects, as per the Risk Assessment Work Plan guidance. The database of toxicity studies used for the IRIS acrylonitrile value was developed in 1983. A screening-level review conducted for IRIS by an EPA contractor in September of 2002 identified one or more significant new studies in the more recent toxicology literature pertinent to the cancer assessment for acrylonitrile (IRIS, 2003). The International Agency for Research on Cancer (IARC) conducted an evaluation of acrylonitrile in 1999 using more recent occupational exposure toxicity studies and concluded there was not a credible association between acrylonitrile and lung cancer (IARC, 1999). IARC stated that the new human studies corrected for actual or potential problems in the previous studies used to assess acrylonitrile carcinogenicity. As a result of including the new human epidemiology studies into the analysis of acrylonitrile carcinogenicity, IARC lowered their classification of acrylonitrile to a 2B (i.e., possibly carcinogenic in humans) indicating that there is inadequate evidence in humans. The previous IARC classification for acrylonitrile had been as a 2A, which is used for probable human carcinogens. It should be noted, however, that while IARC lowered its classification of acrylonitrile from 2A to 2B, it did not classify acrylonitrile as a 3 (not classifiable) or a 4 (not a carcinogen). IRIS currently classifies acrylonitrile as a probable human carcinogen (B1).

Toxicity data were not available for some chemicals detected in the WLATS monitoring program. In some cases, a surrogate value was used for these chemicals based on a similar chemical for which toxicity data were available. The chemicals for which surrogates were applied are noted in the summary tables provided in Section 4. Similarly, for some chemicals the only toxicity value available was related to exposures via oral ingestion rather than inhalation, which was the focus of this risk assessment. In these cases, an inhalation toxicity value was developed from the oral value using a route-to-route extrapolation. While the use of the surrogate data and route-to-route extrapolations to fill gaps in the toxicity database will introduce additional uncertainty into the risk estimates, this conservative approach will tend to overestimate the potential health impacts relative to ignoring chemicals without toxicity data entirely. Reducing this uncertainty would require additional toxicity research and studies.

6.5 Risk Characterization

In the risk characterization, the toxicity and exposure assessments were combined to develop a quantitative description of the potential for adverse human health effects. Thus all of the uncertainties related to the steps in the exposure and toxicity assessments affect these risk estimates. In addition, there are uncertainties related to how the risk

characterization is presented and interpreted. For example, for both carcinogenic and non-cancer risk estimates, the cancer risk and HQs for individual COPCs were added to obtain an indication of the total health impact at a monitor location. This assumption ignores the potential for synergisms or antagonisms among chemicals, effectively assuming that all of the chemicals have a similar mechanism of action and metabolism in the human body. This assumption would tend to overestimate true risks if antagonistic effects occurred, and would underestimate risks if synergistic effects were to occur. Information to evaluate these effects for carcinogens is generally lacking. For noncarcinogens, it is possible to develop HIs that group together chemicals with similar target organs for the critical health effect. For this risk assessment, most HIs calculated without regard to target organ were less than 1, indicating that an adverse health effect was unlikely. Thus, summing the HI on the basis of target organ would not be useful. In the cases where the HI summed for all chemicals did exceed a value of 1, the primary contributor to the exceedance typically exceeded a value of 1 by itself, so that the prediction for the potential of an adverse health effect would not change.

The risk estimates for exposure to the airborne concentration found in the WLATS monitoring programs assumes that an individual is continuously exposed at the same location for 70 years. As discussed earlier, the actual behaviors and activities of the residents may result in lower or higher exposures, in which case the risk estimates may overestimate or underestimate, respectively, the true risks. Information on the actual population of interest could reduce this uncertainty.

The WLATS monitoring data used in the risk assessment reflects several years of chemical concentrations in air. It is uncertain how well this dataset reflects the lifetime exposure assumed in this risk assessment as changes in meteorology and chemical emissions could lead to lower or higher concentrations in air from year-to-year. This uncertainty could be reduced by additional monitoring years, or modeling based on changes in meteorology and chemical emissions.

The risk estimates provided in this assessment were based on monitoring results from 6 locations throughout the Louisville area. It is not clear how well these locations represent any other receptors in the Louisville area. An inspection of the total risk graphs presented in Section 5 shows the variability across the monitoring network. Assuming that a monitor was representative of any location beyond where it was sited would introduce an uncertainty that may over- or underestimate the true health impacts at the unmonitored locations. The sites that were selected to represent potential maximum impact locations in fact had either the highest (in the case of Site A) or among the highest (in the case of Site C) risk estimates for the exposure evaluated in this assessment.

Another source of uncertainty in the risk estimates were the missing sample dates for a number of monitors. A detailed statistical analysis was not conducted to evaluate the impact of the missing sample dates on the risk estimates. The missing sample dates may tend to lead to an overestimate of the true risks at the site, especially for the 95% UCL exposure case.

6.5.1 Cancer Risk Characterization for Chloroprene

Chloroprene is identified as an IARC 2B carcinogen. Currently, there is no cancer slope factor or inhalation unit risk estimate published in IRIS, Cal OEHHA, or HEAST. However, IRIS had developed a cancer slope factor that underwent peer-review. It is unclear as to why this URE is unpublished. The State of Michigan reviewed this IRIS value, and currently uses it in risk assessment practice. The chloroprene cancer slope factor is defined as a benchmark ambient concentration (BAC) of 0.001 $\mu g/m^3$ that results in a cancer risk of 10^{-6} (one in a million). This is equivalent to a cancer inhalation URE of $1/(mg/m^3)$. Following the hierarchy in APCD Regulation 5.20, this cancer slope number is used in the STAR Program.

Compared to the inhalation UREs in Table 4-1 that range mostly from 10^{-3} to 10^{-1}, the chloroprene URE is very high. If it was included in the site-specific risk characterizations of Section 5, chloroprene would have been the major risk driver for cancer. The chloroprene cancer risks for all sites in WLATS Study 2 are presented in Table 6-1 and Figures 6-1 and 6-2. The highest cancer risks are from Sites A and C, which are the potential maximum impact sites. To place the chloroprene-specific cancer risks in perspective, the median- and 95% UCL-derived chloroprene cancer risks are compared, below, to the highest cumulative cancer risks (both median- and 95% UCL-derived) at each Site.

Median chloroprene cancer risks from Site A ranged from 1.81×10^{-4} (derived from an exposure concentration of ½ SQL) to 9.96×10^{-4}. To consider this range in the appropriate context, the highest cumulative median cancer risk for Site A was 1.60×10^{-4} for 2001. Therefore, the low end of the range for chloroprene cancer risk (1.81×10^{-4}) is greater than the highest cumulative median cancer risk. The upper end of the range for chloroprene cancer risk (9.96×10^{-4}) is 6-fold greater than the highest cumulative median cancer risk. 95% UCL chloroprene cancer risks from Site A ranged from 3.96×10^{-3} to 6.29×10^{-3}. The highest cumulative 95% UCL cancer risk from Site A was 4.4×10^{-4} from 2003. The 95% UCL cancer risk range for chloroprene is greater than the highest cumulative 95% UCL Site A cancer risk by 9-fold on the lower end and by 14.3-fold on the upper end.

Median chloroprene cancer risks from Site C ranged from 1.59×10^{-3} to 2.85×10^{-3}. The highest cumulative median cancer risk for Site C was 1.28×10^{-4} for 2002. The low end of the median chloroprene cancer risk (1.59×10^{-3}) is 12.4-fold greater than the highest cumulative median cancer risk for Site C. The upper end of the chloroprene cancer risk (2.85×10^{-3}) is 22.2-fold greater than the highest cumulative median cancer risk. The calculated 95% UCL chloroprene cancer risks, based upon the URE, from Site C ranged from 2.35×10^{-2} to 5.93×10^{-2}. The highest cumulative 95% UCL cancer risk from Site C was 1.43×10^{-3} from 2005. The low end of the 95% UCL chloroprene cancer risk (2.35×10^{-2}) is 16.4-fold greater than the highest cumulative 95% UCL cancer risk. The upper end of the 95% UCL chloroprene cancer risk (5.93×10^{-2}) is 41.4-fold greater than the highest cumulative 95% UCL cancer risk. However, it should be noted that when the

calculated risk exceeds 1×10^{-2}, it is generally not appropriate to use the URE to calculate cancer risk. Thus, it is more appropriate to indicate that the 95% UCL chloroprene risks exceeded 1×10^{-2} and were many-fold greater than the highest 95% UCL cancer risk from Site C, instead of using the calculated value.

Chloroprene was not detected at Site E.

Median chloroprene cancer risks from Site F ranged from 1.81×10^{-4} (derived from an exposure concentration of ½ SQL) to 6.06×10^{-4}. The highest cumulative median cancer risk for Site F was 1.18×10^{-4} for 2001. The low end of the median chloroprene cancer risk (1.81×10^{-4}) is greater than the highest cumulative median cancer risk for Site F. The upper end of the median chloroprene cancer risk (6.06×10^{-4}) is 5.1-fold greater than the highest cumulative median cancer risk. 95% UCL chloroprene cancer risks ranged from 1.32×10^{-3} to 4.83×10^{-3}. The highest 95% UCL cumulative cancer risk for Site F was 2.28×10^{-4} for 2005. The low end of the 95% UCL chloroprene cancer risk (1.32×10^{-3}) is 5.8-fold greater than the highest 95% UCL cumulative cancer risk. The upper end of the 95% UCL chloroprene cancer risk (4.83×10^{-3}) is 21.2-fold greater than the highest 95% UCL cumulative cancer risk.

Median chloroprene cancer risks from Site I ranged from 1.81×10^{-4} (derived from an exposure concentration of ½ SQL) to 6.15×10^{-4}. The highest cumulative median cancer risk for Site I was 4.81×10^{-5} for 2005. The low end of the median chloroprene cancer risk (1.81×10^{-4}) is 3.8-fold greater than the highest cumulative median cancer risk for Site I. The upper end of the median chloroprene cancer risk (6.15×10^{-4}) is 12.8-fold greater than the highest cumulative median cancer risk. 95% UCL chloroprene cancer risks ranged from 1.03×10^{-3} to 2.22×10^{-3}. The highest 95% UCL cumulative cancer risk for Site I was 3.05×10^{-4} for 2003. The low end of the 95% UCL chloroprene cancer risk (1.03×10^{-3}) is 3.4-fold greater than the highest 95% UCL cumulative cancer risk. The upper end of the 95% UCL chloroprene cancer risk (2.22×10^{-3}) is 7.3-fold greater than the highest 95% UCL cumulative cancer risk.

Median chloroprene cancer risks from Site M for every year was 1.81×10^{-4} (derived from an exposure concentration of ½ SQL). The highest cumulative median cancer risk for Site M was 7.48×10^{-5} for 2001. The median chloroprene cancer risk (1.81×10^{-4}) is 2.4-fold greater than the highest cumulative median cancer risk for Site M. 95% UCL chloroprene cancer risks ranged from 3.45×10^{-4} to 8.46×10^{-4}. The highest 95% UCL cumulative cancer risk for Site M was 2.51×10^{-4} for 2002. The low end of the 95% UCL chloroprene cancer risk (3.45×10^{-4}) is 1.4-fold greater than the highest 95% UCL cumulative cancer risk. The upper end of the 95% UCL chloroprene cancer risk (8.46×10^{-4}) is 3.4-fold greater than the highest 95% UCL cumulative cancer risk.

These results indicate that if the chloroprene inhalation URE of $1/(mg/m^3)$ is used to calculate chloroprene cancer risks, they would contribute greatly to the cumulative cancer

risk. For Sites A, C, F and I, the chloroprene cancer risks are many-fold greater than even the highest cumulative cancer risks calculated in Section 5.

Table 6-1. Cancer risks for chloroprene.

	2001		2002		2003		2004		2005	
	Median Risk	95% UCL Risk	Median Risk	95% UCL Risk	Median Risk	95% UCL Risk	Median Risk	95% UCL Risk	Median Risk	95% UCL Risk
Site A	1.57E-03		9.96E-04	4.81E-03	8.51E-04	4.38E-03	1.81E-04	6.29E-03	9.41E-04	3.96E-03
Site C	1.59E-03		2.61E-03	5.93E-02*	2.43E-03	2.35E-02*	2.21E-03	5.53E-02*	2.85E-03	4.23E-02*
Site E							1.81E-04	2.90E-04		
Site F	6.06E-04		3.26E-04	4.83E-03	1.81E-04	1.32E-03	1.81E-04	2.77E-03	1.81E-04	1.46E-03
Site I	6.15E-04		1.81E-04	1.05E-03	1.81E-04	1.22E-03	1.81E-04	1.03E-03	1.81E-04	2.22E-03
Site M	1.81E-04		1.81E-04	8.46E-04	1.81E-04	3.45E-04	1.81E-04	3.87E-04	1.81E-04	3.70E-04

* It should be noted that when the calculated risk exceeds 1 x 10^{-2}, it is generally not appropriate to use the URE to calculate cancer risk. Thus, it is more appropriate to indicate that the 95% UCL chloroprene cancer risks exceeded 1 x 10^{-2} and not use the calculated value.

Figure 6-1. Median cancer risks for chloroprene.

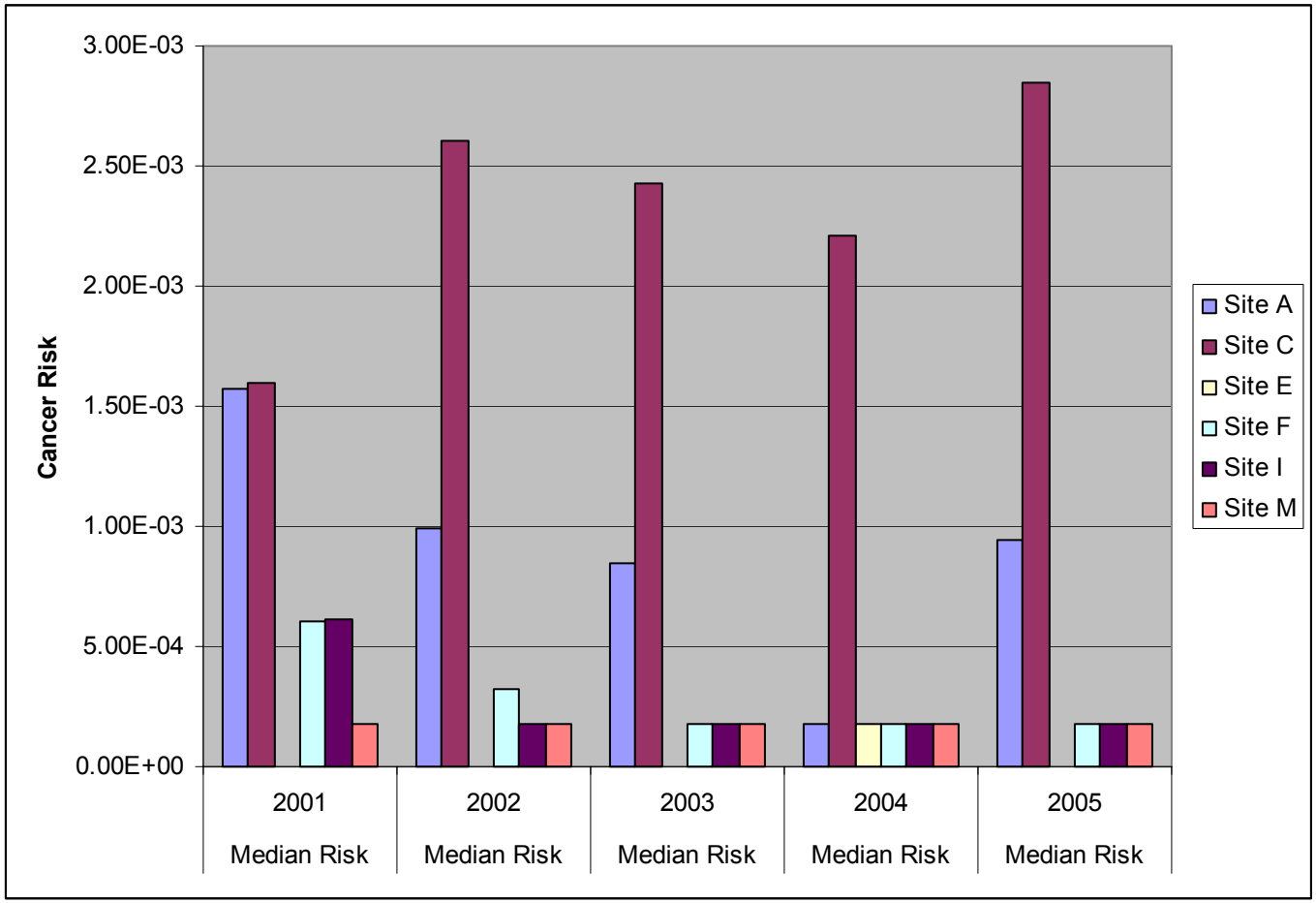
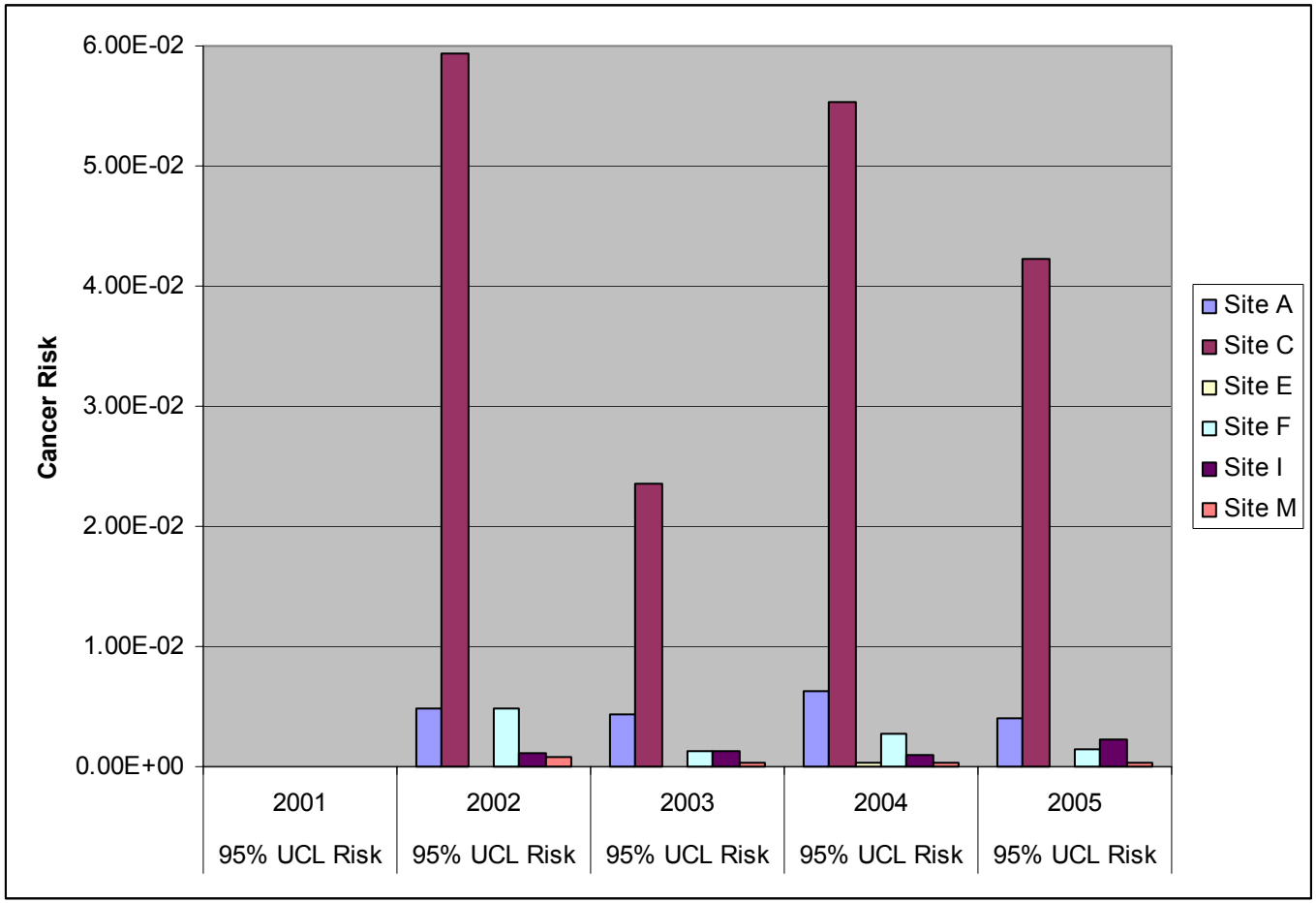


Figure 6-2. 95% UCL cancer risks for chloroprene.



7.0 CONCLUSIONS

A risk assessment of the potential human health impacts from inhalation of air toxics has been conducted using data collected during the WLATS air-monitoring program in the Metropolitan Louisville, KY area. In general, this risk assessment can be considered a conservative estimate on the basis of the exposure assessment. For example, it was assumed for the chronic risk estimates that an individual would be exposed to the monitored concentrations for 24 hours per day over 70 years. The potential human health implications of these chronic exposures were characterized for both cancer and non-cancer health effects. In addition, an acute risk characterization, representing a 24-hour exposure to elevated concentrations in air, was performed by comparing the maximum concentrations measured at the monitor location to the relevant acute toxicity criteria. The remainder of this Section provides the conclusions of the chronic and then the acute risk assessments.

7.1 Chronic Risk Characterization

The cancer risks for the WLATS Study 2 exceeded a value of 1×10^{-6} for all WLATS monitoring sites, for both the median and 95% UCL exposure cases. A cancer risk of 1×10^{-6} is used in the State of Kentucky and is the goal in the APCD's Strategic Toxic Air Reduction (STAR) Program Regulation 5.21 as the threshold for acceptable risks. The rankings from highest to lowest of the average of the median cumulative cancer risks were Site A > Site C > Site F > Site M > Site I > Site E. The maximum impact for the entire WLATS monitoring network occurred at Site A. Site C was selected as a maximum impact site and exhibited the 2nd highest median cancer risks and the highest 95% UCL-derived cancer risks. Sites F, I, and M were selected as community exposure sites, although their proximity to industrial areas (particularly Rubbertown) characterizes these sites as maximum impact sites of different neighborhoods. Site E was selected as an anthropogenic urban activity control site and is located east of the downtown Louisville area. As expected, Site E presented the lowest median and 95% UCL-derived cancer risks.

There were a total of 11 COPCs that exceeded a cancer risk of 1×10^{-6} for at least one monitoring site and monitoring year for both the median exposure case or 95% UCL case: vinyl chloride, 1,3-butadiene, acrylonitrile, methyl t-butyl ether, chloroform, benzene, carbon tetrachloride, naphthalene, tetrachloroethene, 1,4-dichlorobenzene, and ethyl acrylate. A caveat to these cancer risk drivers is the selection of vinyl chloride. Though it was detected in sufficient proportions to qualify it as a COPC, the median cancer risks for vinyl chloride were calculated on a concentration that was ½ SQL. This was due to the parameters of the exposure assessment that provided the assumptions used in this study. 1,4-Dichlorobenzene was selected as a risk driver only for year 2001 of Site F. The median cancer risk was calculated on a concentration that was ½ SQL.

For the non-cancer health assessment, a median-derived HI of 1 was exceeded during 4/5 monitoring years at Site A, 5/5 monitoring years at Site C, 1/5 monitoring years for Sites

F and I, and no exceedances during any monitoring years for Sites E and M. The 95% UCL-derived HI of 1 was exceeded during all 4 monitoring years (95% UCL was not calculated for monitoring year 2001) at Sites A, C, F, I, and M. Site E had no exceedances for either the median-derived or 95% UCL-derived HI. The HIs for sites with exceedances were driven primarily by 1,3-butadiene and chloroprene; acrylonitrile also contributed to the HI. These were the only chemicals that were identified as risk drivers (HQ > 0.1) for non-cancer effects. However, 1,3-butadiene targets different tissues/organs than acrylonitrile and chloroprene, indicating that the cumulative HI may slightly overestimate the risk of adverse non-cancer health outcomes. For this reason, a target organ-specific hazard index (TOSHI) was calculated by summing the HQs for acrylonitrile and chloroprene. Acrylonitrile and chloroprene both target nasal/olfactory epithelium.

For the majority of the monitoring years at Sites A and C, neither 1,3-butadiene nor acrylonitrile had median-derived HQs > 1. Only during 2002 at Site C did the HQ for 1,3-butadiene exceed 1. HQs derived from the 95% UCL concentrations for 1,3-butadiene were > 1 for all monitoring years at Sites A and C, 3/4 years at Sites F and I, and 2/4 years at Site M. 95% UCL-derived HQs for chloroprene exceeded 1 for all 4 years for Sites A, C, F and I. No HQ exceedances of 1 were observed at Sites E and M for the 95% UCL-derived HQs for chloroprene.

The 95% UCL-derived TOSHIs for acrylonitrile and chloroprene were > 1 at sites A, C, F, and I indicating possible nasal/olfactory epithelium effects. The 95% UCL-derived TOSHI was > 1 for only the year 2002 at Site M.

Chloroprene is identified as an IARC 2B carcinogen. Currently, there is no cancer slope factor or inhalation unit risk estimate published in IRIS, Cal OEHHA, or HEAST. However, IRIS had developed a cancer slope factor that underwent peer-review. It is unclear as to why this URE is unpublished. The State of Michigan reviewed this IRIS value, and currently uses it in risk assessment practice. The chloroprene cancer slope factor is defined as a benchmark ambient concentration (BAC) of 0.001 $\mu g/m^3$ that results in a cancer risk of 10^{-6} (one in a million). This is equivalent to a cancer inhalation URE of $1/(mg/m^3)$. Following the hierarchy in APCD Regulation 5.20, this cancer slope number is used in the STAR Program. Using this cancer inhalation URE for chloroprene, a separate analysis of cancer risks indicate that chloroprene would be the major cancer risk factor. For Sites A, C, F and I, the chloroprene cancer risks are many-fold greater than even the highest cumulative cancer risks calculated in Section 5.

7.2 Acute Risk Characterization

The acute risk characterization indicates that none of the COPCs exceed their respective acute toxicity criteria. This result indicates that acute health impacts are not likely to occur in the area. However, this conclusion reflects considerable uncertainty as acute toxicity criteria were not available for all of the chemicals detected in the monitoring network. Furthermore, the risk characterization was based on the maximum detected air

concentration over a 24-period, as measured every 12 days. If the actual maximum occurred on a day when monitoring was not conducted, the true maximum may in fact be underestimated.

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GLOSSARY

AEGLs	Acute Exposure Guidance Levels
ATSDR	Agency for Toxic Substances and Disease Registry
BW	Body weight
CARD	Cardiovascular effects
CAS	Chemical Abstract Service
COPCs	Chemicals of potential concern
CPS_o	Oral cancer potency slope
DEV	Developmental effects
ERPGs	Emergency Response Planning Guidelines
HCl	Hydrochloric acid
HEAST	Health Effects Assessment Summary Table
HEM	Hematological effect
HEP	Hepatic effect
HI	Hazard Index
HQ	Hazard Quotient
IARC	International Agency for Research on Cancer
IR	Inhalation rate
IMM	Immunological effect
MLAPCD	Metro Louisville Air Pollution Control Board
MRLs	Minimum Risk Levels
NATA	National Air Toxics Assessment
NEUR	Neurological effect
PCBs	Polychlorinated biphenyls
QA	Quality assurance
QC	Quality control
RELs	Reference Exposure Levels
RfC	Reference concentration
RfD_o	Oral reference dose
RME	Reasonable Maximum Exposure
RPR	Reproductive effect
RSP	Respiratory effect
SCAPA	Subcommittee on Consequence Assessment and Protective Action
SKIN	Skin effect
SQL	Sample Quantitation Limit
SVOCs	Semi-volatile organic compounds
TICs	Tentatively identified compounds
UCL	Upper Confidence Limit
URE	Unit risk estimate
VOCs	Volatile organic compounds
WLATS	West Louisville Air Toxics Study
WJCCTF	West Jefferson County Community Task Force
WOE	Weight of Evidence

Appendix A: Explanation of number formats

This report uses several formats for numbers. Below is a chart that shows the different ways that numbers may be presented in the report.

Number	Exponent of 10	Scientific Format	Exp. of 10/Scientific format spoken as:	If representing risk, it means:
123	1.23×10^{2}	1.23E +02	1.23 times ten to the second	A hazard quotient of 123
12.3	1.23×10^{1}	1.23E +01	1.23 times ten to the first	A hazard quotient of 12.3
1.23	1.23×10^{0}	1.23E +00	1.23 times ten to the zero	A hazard quotient of 1.23
0.123	1.23×10^{-1}	1.23E -01	1.23 times ten to the minus one	A hazard quotient of 0.123
0.0123	1.23×10^{-2}	1.23E -02	1.23 times ten to the minus two	A cancer risk of 12,300 in one million
0.00123	1.23×10^{-3}	1.23E -03	1.23 times ten to the minus three	A cancer risk of 1,230 in one million
0.000123	1.23×10^{-4}	1.23E -04	1.23 times ten to the minus four	A cancer risk of 123 in one million
0.0000123	1.23×10^{-5}	1.23E -05	1.23 times ten to the minus five	A cancer risk of 12.3 in one million
0.00000123	1.23×10^{-6}	1.23E -06	1.23 times ten to the minus six	A cancer risk of 1.23 in one million