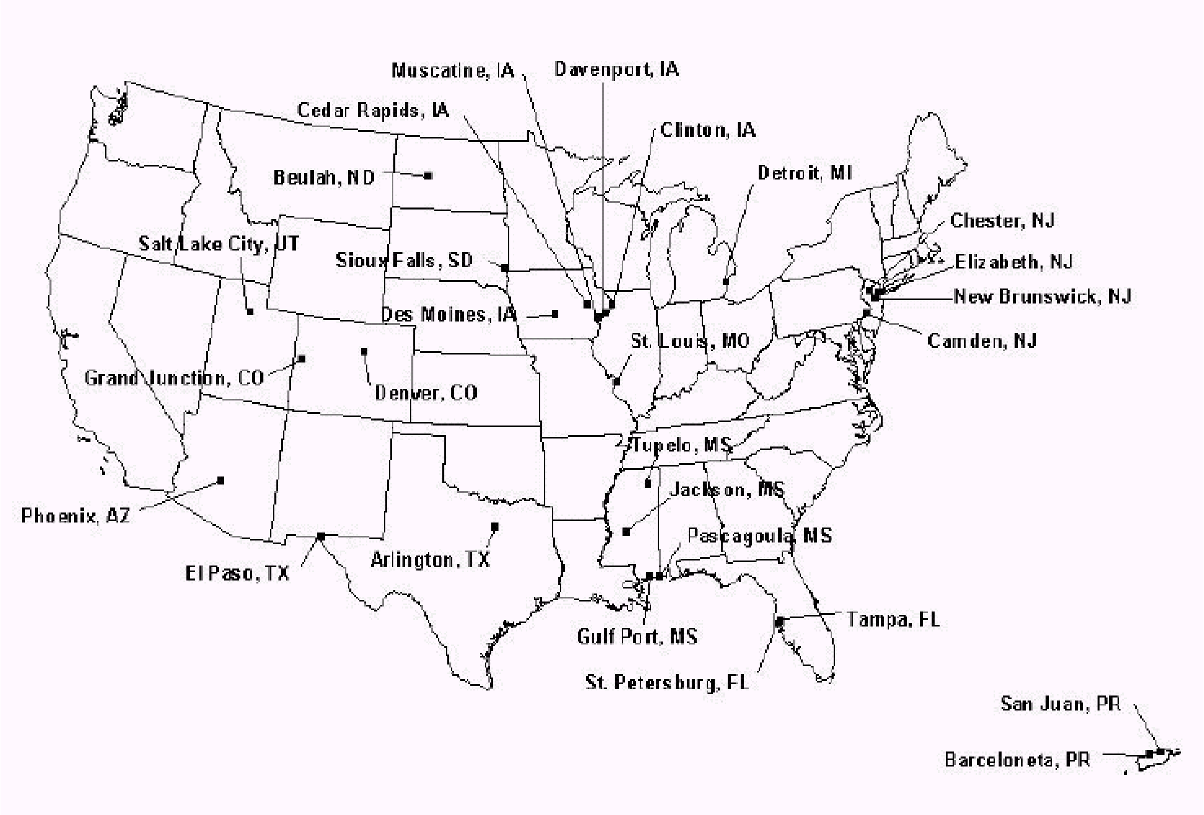
United States Environmental Protection Agency

2001 Urban Air Toxics Monitoring Program



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2001 Urban Air Toxics Monitoring Program (UATMP)

By:
Eastern Research Group
Morrisville, North Carolina

Prepared for:
Sharon Nizich, Delivery Order Manager
Monitoring and Quality Assurance Group

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LIST OF ABBREVIATIONS

AIRS	Aerometric Information and Retrieval System
AQS	Air Quality Subsystem (of the Aerometric Information and Retrieval System)
ATSDR	Agency for Toxic Substances and Disease Registry
BTEX	benzene, toluene, ethylbenzene, and xylenes (*o*-, *m*-, and *p*-xylene)
CO	carbon monoxide
DNPH	2,4-dinitrophenylhydrazine
EPA	U.S. Environmental Protection Agency
FC-43	perfluorotributylamine
FID	flame ionization detection
GC	gas chromatography
HPLC	high-performance liquid chromatography
MEK	methyl ethyl ketone
MDL	Method Detection Limit
MS	mass spectrometer
MTBE	methyl *tert*-butyl ether
NA	not applicable
ND	nondetect
NMOC	Nonmethane Organic Compounds
NO_x	oxides of nitrogen
ppbC	parts per billion Carbon
ppbv	parts per billion (by volume)
PM	particulate matter
R_{max}	maximum radius of concern
RPD	relative percent difference
SNMOC	Speciated Nonmethane Organic Compound
SVOC	Semivolatile Organic Compounds
TRI	Toxics Release Inventory
UATMP	Urban Air Toxics Monitoring Program
VOC	Volatile Organic Compound(s)

LIST OF ABBREVIATIONS (Continued)

Monitoring Stations

A2TX	Arlington, Texas
APMI	Allen Park in Detroit, Michigan
AZFL	Azalea Park in St. Petersburg, Florida
BAPR	Barceloneta, Puerto Rico
BUND	Beulah, North Dakota
C2IA	Cedar Rapids, Iowa (Site #2)
CANJ	Camden, New Jersey
CHNJ	Chester, New Jersey
CLIA	Clinton, Iowa
CRIA	Cedar Rapids, Iowa (Site #1)
DAIA	Davenport, Iowa
DECO	Denver, Colorado
DEMI	Dearborn in Detroit, Michigan
DMIA	Des Moines, Iowa
DNFL	Dunedin in St. Petersburg, Florida
E7MI	E7 Mile in Detroit, Michigan
ELFL	East Lake in St. Petersburg, Florida
ELNJ	Elizabeth, New Jersey
EPTX	El Paso, Texas
G2CO	Grand Junction, Colorado (Site #2)
GAFL	Gandy in Tampa, Florida
GJCO	Grand Junction, Colorado (Site #1)
GPMS	Gulf Port, Mississippi
JAMS	Jackson, Mississippi
LEFL	Lewis in Tampa, Florida
LOMI	Lodge in Detroit, Michigan
MUIA	Muscatine, Iowa
NBNJ	New Brunswick, New Jersey
PGMS	Pascagoula, Mississippi
PSAZ	Supersite in Phoenix, Arizona
QVAZ	Queen Valley in Phoenix, Arizona
RRMI	River Rouge in Detroit, Michigan
S2MO	St. Louis, Missouri (Site #2)
S3MO	St. Louis, Missouri (Site #3)
SFSD	Sioux Falls, South Dakota

LIST OF ABBREVIATIONS (Continued)

SIFL	Simmons in Tampa, Florida
SJPR	San Juan, Puerto Rico
SLCU	Salt Lake City, Utah
SLMO	St. Louis, Missouri (Site #1)
SPAZ	South Phoenix, Arizona
SWMI	South West High School in Detroit, Michigan
TUMS	Tupelo, Mississippi
YFMI	Yellow Freight in Detroit, Michigan

Executive Summary

This report presents the results and conclusions from the ambient air monitoring conducted as part of the 2001 Urban Air Toxics Monitoring Program (UATMP)—a program designed to characterize the magnitude and composition of potentially toxic air pollution in, or near, urban locations. The 2001 UATMP included 43 monitoring stations that collected 24-hour air samples, typically on a 6- or 12-day schedule. Twenty-nine sites analyzed ambient air samples for concentrations of 59 volatile organic compounds (VOC) and 16 carbonyl compounds. Thirteen sites also analyzed for 80 speciated nonmethane organic compounds (SNMOC). Twelve sites analyzed for the VOC, carbonyl compounds, and 92 semivolatile compounds (SVOC). Overall, nearly 230,000 ambient air concentrations were measured during the 2001 UATMP. The summary presented in this report uses various graphical, numerical, and statistical analyses to put the vast amount of ambient air monitoring data collected into perspective.

Not surprisingly, the ambient air concentrations measured during the program varied significantly from city to city and from season to season. This report describes and interprets these spatial and temporal variations separately for halogenated hydrocarbons, hydrocarbons, polar compounds, and carbonyls.

The ambient air monitoring data collected during the 2001 UATMP serve a wide range of purposes. Not only do these data characterize the nature and extent of urban air pollution close to the 43 monitoring stations participating in this study, but they also indicate some trends and patterns that may be common to all urban environments. Therefore, this report presents some results that are specific to particular monitoring locations and presents other results that are apparently common to urban environments. These results should ultimately provide additional insight into the complex nature of urban air pollution. The final data are also included in the appendices to this report.

1.0 Introduction

Air pollution in urban locations contains many components that originate from a wide range of industrial, motor vehicle, and natural emissions sources. Because some of these components include toxic compounds known or suspected to be carcinogenic, the U.S. Environmental Protection Agency (EPA) continues to encourage state and local agencies to understand and appreciate the nature and extent of potentially toxic air pollution in urban locations. To achieve this goal, EPA sponsors the Urban Air Toxics Monitoring Program (UATMP), a program designed to characterize the composition and magnitude of urban air pollution through extensive ambient air monitoring. Since the inception of the UATMP in 1987, many environmental and health agencies have participated in the UATMP to assess the causes and effects of air pollution within their jurisdictions. This report summarizes and interprets the 2001 UATMP monitoring effort, which included 12 months of six- and twelve-day measurements of ambient air quality at 43 monitoring sites in or near 27 urban locations. An additional site (E7MI) did not measure either VOCs or carbonyls but semivolatile compounds which are included in this report. Much of the analysis and data interpretation in this report focuses on compound-specific data trends.

> Note: In previous years, the UATMP sampling typically began in September and ended in August of the following calendar year. Last year, the sampling began anywhere from August to December 1999 and ERG ended all sampling at the end of December 2000. That "program year" was therefore assigned as UATMP 1999/2000. This program year consists of sampling for only the 2001 calendar year, and is referred to as UATMP 2001. The following years will be named in accordance with the year sampling was initiated (i.e., UATMP 2002, UATMP 2003, etc.).

The contents of this report provide both a qualitative overview of air pollution at selected urban locations and a quantitative analysis of the factors that appear to affect urban air quality most significantly. This report also focuses on data trends at each of the 43 different air sampling locations, a site-specific approach that allows for much more detailed analyses of the factors (e.g., motor vehicle emission sources, industrial sources, natural sources) that affect air quality differently from one urban center to the next.

Ultimately, the contents of this report should offer participating agencies useful insights into important air quality issues. For example, participating agencies can use trends and patterns in the UATMP monitoring data to determine whether levels of air pollution present public health concerns, to identify which emissions sources contribute most strongly to air pollution, or to forecast whether proposed pollution control initiatives might significantly improve air quality. Recently, EPA has been actively participating in the National-scale Air Toxics Assessment (NATA) which uses air toxic emissions to model ambient monitoring concentrations across the nation. UATMP monitoring data may be used to compare the modeling results. Though they are extensive, the analyses in this report should not be viewed as a comprehensive account of urban air pollution at every UATMP monitoring station. State and local environmental agencies are encouraged to perform additional analyses of the monitoring data so that the many factors that affect ambient air quality can be appreciated fully.

To facilitate examination of the 2001 UATMP monitoring data, the complete set of measured concentrations is presented in appendices of this report. In addition, these data are publicly available in electronic format from the Air Quality Subsystem (AQS) of EPA's Aerometric Information Retrieval System (AIRS) at http://www.epa.gov/ttn/airs/.

The remainder of this report is organized into nineteen text sections and sixteen appendices. Table 1-1 highlights the contents of each section. As with previous UATMP annual reports, all figures and tables in this report appear at the end of their respective sections (figures first, followed by tables).

Table 1-1
Organization of the 2001 UATMP Report

Report Section	Section Title	Overview of Contents
2	The 2001 UATMP	This section provides background information on the scope of the 2001 UATMP and includes information about the: • Monitoring locations • Compounds selected for monitoring • Sampling and analytical methods • Sampling schedules • Completeness of the air monitoring program.
3	Overview of Compounds	These sections present and discuss significant trends and relationships in the UATMP data. These sections characterize how ambient air concentrations varied with monitoring location and with time, then interpret the significance of the observed spatial and temporal variations.
4	Monitoring results for Phoenix, AZ (PSAZ, QVAZ, and SPAZ)	These sections summarize the 2001 UATMP monitoring data collected in the respective cities and analyze in detail ambient air concentrations of selected nitriles and oxygenated compounds.
5	Monitoring results for Denver (DECO) and Grand Junction, CO (G2CO and GJCO)	
6	Monitoring results for St. Petersburg (AZFL, DNFL, and ELFL) and Tampa, FL (GAFL, LEFL, and SIFL)	
7	Monitoring results for Cedar Rapids (C2IA and CRIA), Clinton (CLIA), Davenport (DAIA), Des Moines (DMIA), and Muscatine, IA (MUIA)	
8	Monitoring results for Detroit, MI (APMI, DEMI, E7MI, LOMI, RRMI, SWMI, and YFMI)	
9	Monitoring results for St. Louis, MO (S2MO, S3MO, and SLMO)	
10	Monitoring results for Gulfport (GPMS), Jackson (JAMS), Pascagoula (PGMS), and Tupelo, MS (TUMS)	

Table 1-1. (Continued)

Report Section	Section Title	Overview of Contents
11	Monitoring results for Beulah, ND (BUND)	These sections summarize the 2001 UATMP monitoring data collected in the respective cities and analyze in detail ambient air concentrations of selected nitriles and oxygenated compounds.
12	Monitoring results for Camden (CANJ), Chester (CHNJ), Elizabeth (ELNJ), and New Brunswick, NJ (NBNJ)	
13	Monitoring results for Barceloneta (BAPR) and San Juan, PR (SJPR)	
14	Monitoring results for Sioux Falls, SD (SFSD)	
15	Monitoring results for Arlington (A2TX) and El Paso, TX (EPTX)	
16	Monitoring results for Salt Lake City, UT (SLCU)	
17	Data Quality	This section defines and discusses the concepts of precision and accuracy. Based on quantitative and qualitative analyses, this section comments on the precision and accuracy of the 2001 UATMP ambient air monitoring data.
18	Conclusions and Recommendations	This section summarizes the most significant findings of the report and makes several recommendations for future projects that will involve ambient air monitoring in urban locations.
19	References	This section lists the references cited throughout the report.

2.0 The 2001 UATMP

The 2001 UATMP included 43 monitoring stations that collected 24-hour integrated canister and cartridge samples of ambient air for up to 12 months at six and twelve day sampling periods (some sites chose to sample on one- or three-day intervals). These samples were analyzed in a central laboratory for concentrations of selected hydrocarbons, halogenated hydrocarbons, and polar compounds from the canister samples, carbonyl compounds from the cartridge samples, and semivolatiles from the XAD-2® thimbles. The following discussion reviews the monitoring locations, the compounds selected for monitoring, the sampling schedules, the completeness of the 2001 UATMP, and the sampling and analytical methods.

2.1 Monitoring Locations

Although EPA sponsors the UATMP, EPA does not dictate where the UATMP monitoring stations are located. Rather, representatives from the state and local agencies that voluntarily participate in the program and contribute to the overall monitoring costs select the monitoring locations. Some monitors were placed near the centers of heavily populated cities (e.g., Denver and Phoenix), while others were placed in moderately populated areas (e.g., Beulah and Des Moines). The monitoring stations participating in the UATMP program are listed in Table 2-1.

Figure 2-1 shows the 27 cities participating in the 2001 program. The site descriptions in Table 2-2 and in Appendix A provide detailed information on the surroundings at the 2001 UATMP monitoring locations. Sections 4 through 16 contain topographic maps for each of the sites. Industrial facilities within 10 miles of the monitoring sites were plotted in these sections, as well. The locations and category descriptions of these industrial sites were report in the 1999 National Emission Inventory (NEI) (EPA, 2001).

As Figure 2-1 shows, the 2001 UATMP monitoring sites were distributed across the country. The monitoring data from these stations may indicate certain air quality trends that are common to all urban environments. The analyses in this report differentiate those trends that appear to be site-specific from those that appear to be common to urban environments.

Chemical concentrations measured during the 2001 UATMP varied significantly from monitoring location to monitoring location. As discussed throughout this report, the proximity of the monitoring locations to different emissions sources, especially industrial facilities and heavily traveled roadways, often explains the observed spatial variations in ambient air quality. To provide a first approximation of the respective contributions of motor vehicle emissions and industrial emissions on ambient air quality at each site, Table 2-3 lists the number of people living within 10 miles of each monitoring location, as well as the number of industrial facilities in the 1999 NEI.

At every UATMP monitoring location, the air sampling equipment was installed in a small temperature-controlled enclosure (usually a trailer or a shed) with the sampling inlet probe protruding through the roof. With this common setup, every UATMP monitor sampled ambient air at heights approximately 5 to 20 feet above local ground level.

For record keeping and reporting purposes, each of these locations was assigned:

- A unique four-character UATMP site code – used to track samples from the monitoring locations to the laboratory; and
- A unique nine-digit AIRS site code – used to index monitoring results in the AIRS database.

This report often cites these codes when presenting selected monitoring results.

2.2 Compounds Selected for Monitoring

Urban air pollution typically contains hundreds of components, including, but not limited to, volatile organic compounds (VOC), metals, inorganic acids, and particulate matter. Because sampling and analysis to monitor for every component of air pollution has been prohibitively expensive, the UATMP instead focuses on measuring ambient levels of 59 VOC (13 hydrocarbons, 37 halogenated hydrocarbons, and 9 polar compounds), 15 carbonyl compounds, 80 Speciated Nonmethane Organic Compounds (SNMOC), and 91 Semivolatile Compounds (SVOC). Tables 2-4, 2-5, 2-6, and 2-7 identify the specific compounds of interest.

2.3 Sampling Schedules

Table 2-8 presents the dates on which sampling began and ended for each monitoring location. With the following exceptions, the monitoring locations started the 2001 UATMP sampling in January 2001 and stopped sampling in December 2001. The following sites did not start at the beginning of the sampling period because the monitoring stations were not ready:

- Detroit, Michigan sites (Allen Park, Dearborn, River Rouge, Yellow Freight, Lodge) started in April 2001;
- Grand Junction, Colorado sites (1 and 2) started in May 2001;
- Jackson, Mississippi site started in May 2001;
- St. Louis, Missouri sites (1, 2, and 3) started in May 2001;
- Chester and New Brunswick, New Jersey sites started in May 2001;
- Barceloneta and San Juan, Puerto Rico sites started in May 2001;
- Phoenix, Arizona sites (supersite and Queen Valley) started in June 2001;
- Tupelo and Pascagoula, Mississippi sites started sampling in July 2001;
- South Phoenix, Arizona site started in August 2001; and
- Gulf Port, Mississippi site started in August 2001.

Four sites ended sampling before December 2001: Clinton and Muscatine, Iowa finished in October; Des Moines, Iowa finished in November; and Arlington, Texas finished in July. One site, South West High School in Detroit, Michigan had only one sample in May.

According to the UATMP schedule, 24-hour integrated samples were to be collected at every monitoring location once every 6 or 12 days and each sample collection began and ended at midnight, local standard time. At each test site, VOC and carbonyl samples were collected concurrently, except for: St. Petersburg, Florida (Azalea Park, Dunedin, and East Lake); Tampa, Florida (Gandy, Lewis and Simmons); South West High School in Detroit, Michigan; Jackson Mississippi; St. Louis sites 1 and 2; and the Phoenix sites South Phoenix, Supersite, and Queen Valley. The following sites also collected SNMOC samples:

- Barceloneta, Puerto Rico;
- Beulah, North Dakota;
- Cedar Rapids (1 and 2), Iowa;
- Clinton, Iowa;
- Davenport, Iowa;
- Denver, Colorado;
- Des Moines, Iowa;
- Muscatine, Iowa;
- Salt Lake City, Utah;
- San Juan, Puerto Rico;
- Sioux Falls, South Dakota; and
- St. Louis (Site 1), Missouri.

Twelve sites collected SVOC samples:

- All Detroit, Michigan sites (Azalea Park, Dearborn, E7 Mile, Lodge, River Rouge, South West High School, and Yellow Freight);
- All New Jersey sites (Chester, Elizabeth, New Brunswick, and Camden); and
- St. Louis (Site 1), Missouri.

As part of the sampling schedule, site operators were instructed to collect duplicate samples on roughly 10 percent of the sampling days. Sampling calendars were distributed to help site operators schedule the collection of samples, duplicates, and field blanks. In cases where monitors failed to collect valid samples on a scheduled sampling day, site operators sometimes rescheduled samples for other days. This practice explains why some monitoring locations periodically strayed from the 6- or 12-day sampling schedule. The state of Michigan prepared a schedule that allowed the Michigan's Department of Environmental Quality's laboratory to share samples with ERG's laboratory.

The 6- or 12-day sampling schedule permits cost-effective data collection for characterization (annual-average concentrations) of toxic compounds in ambient air and ensures that sampling days are evenly distributed among the 7 days of the week to allow comparison of air quality on weekdays to air quality on weekends.

2.4 Completeness

Completeness refers to the number of valid samples collected compared to the number of samples expected from a 6- or 12-day sampling cycle. Monitoring programs that consistently generate valid results have higher completeness than programs that consistently invalidate samples. The completeness of an air monitoring program, therefore, is a qualitative measure of the reliability of air sampling equipment and laboratory analytical equipment and a measure of the efficiency with which the program was managed.

Appendix B identifies samples that were invalidated and list the specific reasons why the samples were invalidated. Table 2-8 summarizes the completeness of the VOC and carbonyl data sets collected during the 2001 UATMP:

- For VOC sampling, the completeness ranged from 82 to 100 percent, with an overall completeness of 99 percent.
- For carbonyl sampling, the completeness ranged from 80 to 100 percent with an overall completeness of 98 percent.
- For SNMOC sampling, the completeness was 100 percent for all sites.
- For SVOC sampling, the completeness ranged from 71 to 100 percent with an overall completeness of 90 percent.

The UATMP data quality objectives are based on the 2001 Quality Assurance Plan, 85-100% completeness for a given monitoring station must be analyzed successfully to generate a sufficiently complete data set for estimating annual average air concentrations. The data in Table 2-8 show that 6 data sets (from a total of 96 data sets) from the 2001 UATMP monitoring stations did not meet this data quality objective. Twenty-four sites which measured carbonyls (out of 36 sites), 30 VOC sites (out of 35), 13 SMOC sites (out of 13), and 3 SVOC sites (out of 12) achieved 100% completeness.

2.5 Sampling and Analytical Methods

During the 2001 UATMP, three EPA-approved methods were used to characterize urban air pollution:

- *Compendium Method TO-15* was used to measure ambient air concentrations of 59 VOC and 80 SNMOC;
- *Compendium Method TO-11A* was used to measure ambient air concentrations of 15 carbonyl compounds; and

- *Compendium Method TO-13A* was used to collect ambient air concentrations of 91 SVOC. Analysis was performed following SW846, Method 8270 protocols.

The following discussion presents an overview of these sampling and analytical methods. For detailed descriptions of the methods, readers should refer to EPA's original documentation of the Compendium Methods (USEPA, 1999a).

2.5.1 VOC Sampling and Analytical Method

As specified in the EPA method, ambient air samples for VOC analysis were collected in passivated stainless steel canisters. The central laboratory distributed the prepared (i.e., cleaned and evacuated) canisters to the UATMP monitoring stations before each scheduled sampling event, and site operators connected the canisters to air sampling equipment prior to each sampling day. Before their use in the field, the passivated canisters had internal sea level pressures much lower than atmospheric. Because of this sea level pressure differential, ambient air naturally flowed into the canisters once they were opened, and pumps were not needed to collect ambient air for VOC analysis. A flow controller on the sampling device ensured that ambient air entered the canister at a constant rate across the collection period. At the end of the 24-hour sampling period, a solenoid valve automatically stopped ambient air from flowing into the canister, and site operators returned the canisters to the central laboratory for analysis.

By analyzing each sample with gas chromatography incorporating mass selective detection and flame ionization detection (GC/MS-FID), laboratory staff determined ambient air concentrations of 59 VOC (13 hydrocarbons, 37 halogenated hydrocarbons, and 9 polar compounds) and 80 SNMOC within the sample. Because isobutene and 1-butene as well as *m*-xylene and *p*-xylene elute from the GC column at the same time, the VOC analytical method reports only the sum of the concentrations for these compounds, and not the separate concentrations for each compound.

Table 2-4 lists the method detection limits for the laboratory analysis of the VOC samples and Table 2-6 lists the method detection limits for the SNMOC samples. Although the sensitivity of the analytical method varies from compound to compound, the detection limit for VOC reported for every compound is lower than 0.25 parts per billion by volume (ppbv); most of the detection limits were below 0.1 ppbv. For the SNMOC the detection limits reported for every compound are lower than VOC detection limits, ranging from 0.03 to 0.16 ppbv. Speciated Nonmethane Organic Compound (SNMOC) detection limits are expressed in parts per billion Carbon (ppbC) as well as ppbv.

Because nondetect results significantly limit the range of data interpretations for ambient air monitoring programs, participating agencies should note that the approach for treating nondetects may slightly affect the magnitude of the calculated central tendency concentrations, especially for compounds with a low prevalence. Following the approach used to process the 1995 - 2000 UATMP monitoring data, *data analysts replaced all nondetect observations with concentrations equal to one-half of the compound's corresponding method detection limit.* This is the approach recommended for risk assessments involving environmental monitoring data (USEPA, 1988).

This year, the reportable SNMOC analysis option was combined with the standard VOC sampling. Data analysis has begun for the SNMOC sites where data were collected. These data are presented in Appendix D, with the VOC data. Table 2-5 lists the method detection limits for the laboratory analysis of the SNMOC samples.

2.5.2 Carbonyl Sampling and Analytical Method

Following the specifications of EPA Compendium Method TO-11A, ambient air samples for carbonyl analysis were collected by passing ambient air over silica gel cartridges coated with 2,4-dinitrophenylhydrazine (DNPH), a compound known to react selectively and reversibly with many aldehydes and ketones. Carbonyl compounds in ambient air remain within the sampling cartridge, while other compounds pass through the cartridge without reacting with the DNPH-coated matrix. As with the VOC sampling, the central laboratory distributed the silica gel cartridges to the monitoring locations, and site operators connected the cartridges to the air sampling equipment. After each 24-hour sampling period, site operators returned the cartridges to the central laboratory for chemical analysis.

To quantify concentrations of carbonyls in the sampled ambient air, laboratory analysts eluted the exposed silica gel cartridges with acetonitrile. This solvent elution liberated a solution of DNPH derivatives of the aldehydes and ketones collected from the ambient air. High-performance liquid chromatography (HPLC) analysis and ultraviolet detection of these solutions determined the relative amounts of individual carbonyls present in the original air sample. Because butyraldehyde and isobutyraldehyde elute from the HPLC column at the same time, the carbonyl analytical method can report only the sum of the concentrations for these compounds, and not the separate concentrations for each compound. For the same reason, the analytical method reports only the sum of the concentrations for the three tolualdehyde isomers, as opposed to reporting separate concentrations for the three individual compounds.

Appreciating Detection Limits

The detection limit of an analytical method must be considered carefully when interpreting the corresponding ambient air monitoring data. By definition, detection limits represent the lowest concentrations at which laboratory equipment can *reliably* quantify concentrations of selected compounds to a specific confidence level. If a chemical concentration in ambient air does not exceed the method sensitivity (as gauged by the detection limit), the analytical method might not differentiate the compound from other compounds in the sample or from the random “noise” inherent in laboratory analyses. Therefore, when samples contain concentrations at levels below their respective detection limits, multiple analyses of the same sample may lead to a wide range of results, including highly variable concentrations or “nondetect” observations. *Because analytical methods do not quantify concentrations at levels below the detection limits accurately or precisely, data analysts must exercise caution when interpreting monitoring data with many reported concentrations at levels near or below the corresponding detection limits.*

Method detection limits are performed at the analytical laboratory by analyzing up to 9 replicate standards spiked on to the appropriate sample media (per analytical method).

Instrument detection limits are not determined (9 replicates of standards only) because it does not take into account sample preparation.

Table 2-6 lists the detection limits reported by the analytical laboratory for measuring concentrations of 14 carbonyl compounds. Although the sensitivity of the analytical method varies from compound to compound, the detection limit reported by the analytical laboratory for every compound is less than or equal to 0.026 ppbv. Carbonyl detection limits ranged from 0.003 to 0.026 ppbv.

When reviewing these data, readers should keep in mind that data analysts replaced all nondetect observations with concentrations equal to one-half of the compound's corresponding detection limit.

2.5.3 Semivolatile Sampling and Analytical Method

Semivolatile sampling is performed completely by the sites in accordance with EPA Compendium Method TO-13A. ERG receives the samples from the sites for analysis only. Sampling modules containing XAD-2® and petri dishes containing filters, together with Chain of Custody forms and all associated documentation, are shipped to the ERG laboratory from the field. Upon receipt at the laboratory, sample preparation and analysis procedures are based on SW-846 Method 3542 and SW-846 Method 8270.

The samples are extracted with methylene chloride using a large Soxhlet extractor. After extraction, the sample is concentrated to 2 mL. The samples are placed in storage at 4°C until analysis. Sample extracts will be analyzed for semivolatile organic compounds using the analytical procedures of SW-846 Method 8270. The mass spectrometer is tuned and masses calibrated as required using perfluorotributylamine (FC-43), as per the manufacturer's instructions.

Method 8270 calibration procedures and criteria apply. Calibration check compounds and system performance check compounds must meet the criteria outlined in Method 8270. A solvent blank is analyzed prior to sample analysis to demonstrate that the analytical system is free from contamination. Internal standard area counts for each sample analysis must be between 50 and 150% of the last daily calibration standard, in accordance with Method 8270 specifications.

Criteria for identification of the mass spectra of the compounds of interest are positive matching of the relative retention times and the mass spectra of the sample and the standard components in accordance with the specifications of Method 8270. Quantitative analysis is achieved by the use of automated procedures in the Hewlett-Packard data system.

Figure 2-1. Cities Participating in the 2001 Program

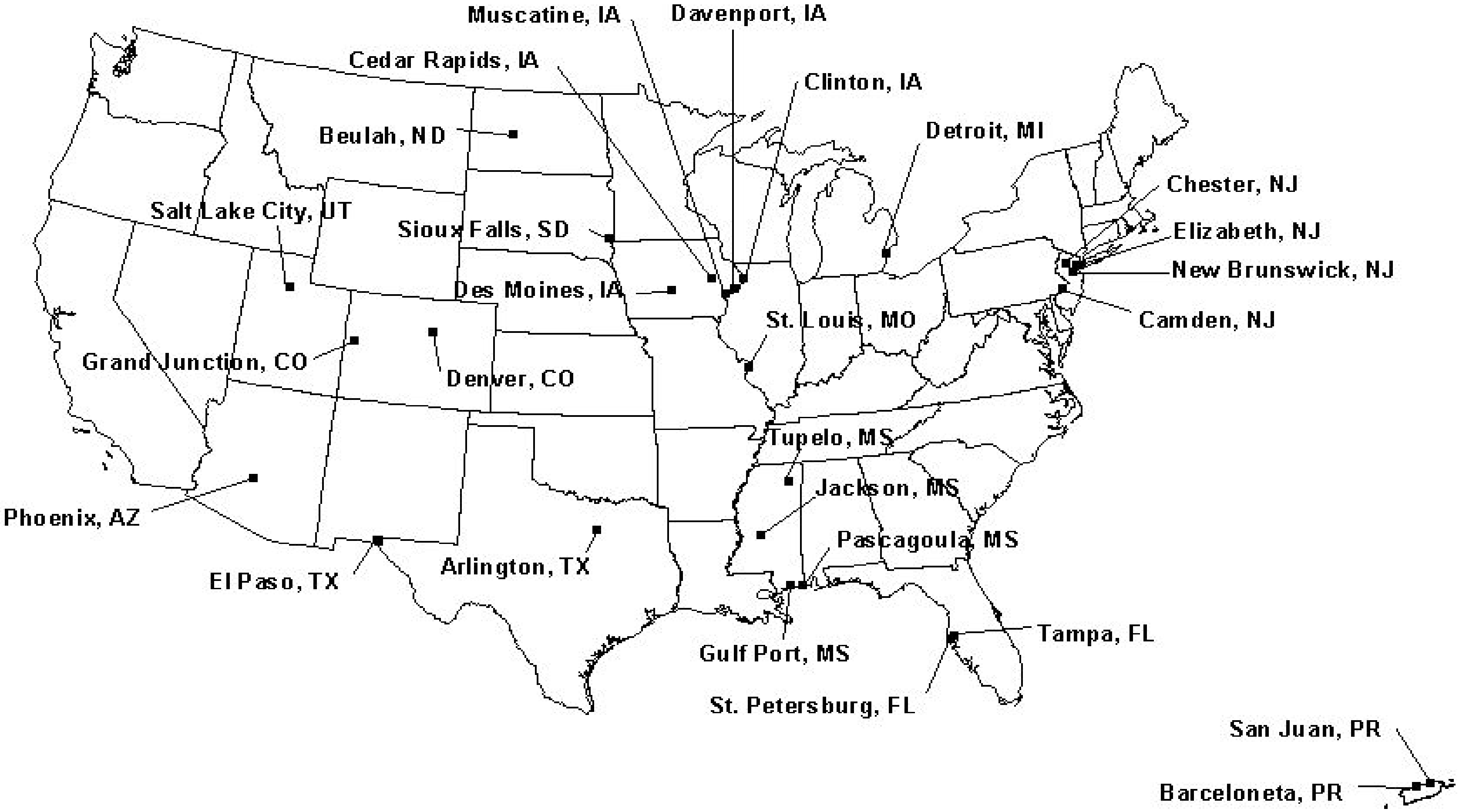


Table 2-1. Monitoring Station Past Participation in the UATMP

Monitoring Station	Program Years During Which Station Past Participated in the UATMP					
	1994	1995	1996	1997	1998	1999/ 2000
Arlington, TX (A2TX)						✓
Beulah, ND (BUND)					✓	✓
Camden, NJ (CANJ)	✓	✓	✓	✓	✓	✓
Cedar Rapids, IA (CRIA)						✓
Clinton, IA (CLIA)						✓
Davenport, IA (DAIA)						✓
Denver, CO (DECO)						✓
Des Moines, IA (DMIA)						✓
Elizabeth, NJ (ELNJ)						✓
El Paso, TX (EPTX)		✓	✓	✓	✓	✓
Muscatine, IA (MUIA)						✓
Salt Lake City, UT (SLCU)						✓
Sioux Falls, SD (SFSD)						✓

Note: Some of the stations shown in the table participated in UATMPs prior to the 1994 program. However, this report considers only ambient air monitoring data collected during the current and previous contract procurements (i.e., UATMP program years 1994 through 2001).

Table 2-2. Text Descriptions of the 2001 UATMP Monitoring Locations

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic	Traffic Year	Description of the Immediate Surroundings
A2TX	Arlington, TX	Residential	Urban	17,472	1998	Arlington, Texas is located in Tarrant County, approximately 20 miles west of Dallas. A roadway that averages more than 17,000 vehicles per day is 73 meters from the site. The monitoring site is located in a residential and light commercial area of up to one and a half miles. The monitor itself is located in the TNRCC building with the probe through the top of the roof, approximately 15 feet from the ground.
APMI	Allen Park, Detroit, MI	Commercial	Suburban	60,000	Unknown	The Allen Park site is an intermediate site located in a residential neighborhood 300 feet away from Interstate 75. Historically, this site has been used to detect impacts from mobile sources. There are no major industrial sources near the site. Of all the population-oriented sites in the Detroit MSA, it has the highest PM_{10} levels. Therefore, it has been selected as the $PM_{2.5}$ trend speciation site and the collocated site for the federal reference method (FRM) monitors. Other criteria pollutant measurements that are collected at Allen Park include CO, O_3, SO_2, and PM_{10}.
AZFL	Azalea Park, St. Petersburg, FL	Residential	Suburban	51,000	Unknown	A neighborhood spatial scale of representativeness characterizes this monitoring site selected for the Tampa Bay pilot project. This monitor is sited in an area of high population density with uniform, mixed land use, consisting of residential, commercial, and industrial properties. Major point sources are located approximately 8 to 15 kilometers from the monitoring site. In addition, this site is at least 150 meters from major roadways. However, given the proximity of motor vehicle traffic it is expected that mobile sources will appreciably contribute to the measured samples.
BAPR	Barceloneta, PR	Residential	Rural	10	1994	The Barceloneta site is a residential area surrounded by 5 pharmaceutical plants. The greater area outside the city is rural in character, and the city itself is within 2 miles of the Atlantic Ocean.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic	Traffic Year	Description of the Immediate Surroundings
BUND	Beulah, ND	Agricultural	Rural	1,350	1998	Beulah, North Dakota, located in Mercer County, is a rural, agricultural area with primarily wheat, small grains, and cattle farms. There are six lignite coal-fired power plants within thirty miles of Beulah, one to the east-southeast; one to the northeast; two to the east; one to the northwest; and one to the southwest. There are a petroleum refinery and a lignite coal-fired power plant fifty miles southeast of Beulah. There is a lignite coal mine located north of the town, one to the south-southwest of town and one to the southeast of town. The monitoring station is located in the approximate area of two coal-fired power plants and a coal gasification plant (the only functioning one in the nation). There is one power plant seven miles to the southwest of the monitoring station; another is six miles to the northwest; and the gasification plant is five miles to the northwest.
C2IA	Cedar Rapids, IA (Site #2)	Residential	Urban	1,500	1994	This site is considered an EPA Urban Scale site within residential population . It is a community wide exposure area where spatial uniformity in comparison to the CRIA site is important. This site is located at the Army Reserve Government buliding - on the roof top with $PM_{2.5}$ samplers. This site is on the northeast quadrant of Cedar Rapids.
CANJ	Camden, NJ	Residential	Suburban	62,000	1986	Although this monitoring site in Camden, NJ is in a residential area, numerous industrial facilities and busy roadways are located within a ten mile radius. The monitors are situated in a parking lot of a business complex.
CHNJ	Chester, NJ	Agricultural	Rural	12,623	1995	The Chester, NJ site is located in a rural-agricultural, residential section of town and is topographically rolling. It is located near Lucent Laboratory Building #1. There is potential population, ozone, NO_2, and SO_2 exposure.
CLIA	Clinton, IA	Residential	Suburban	500	1997	The Clinton, Iowa site, located in Clinton County, is in a residential section of town. A large grain processing plant is located two miles to the south. Normal small city traffic patterns are observed around this site. The site is located only 200 yards from the Mississippi River.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic	Traffic Year	Description of the Immediate Surroundings
CRIA	Cedar Rapids, IA	Industrial	Urban	15,600	1999	This site is considered an EPA Middle Scale site within an industrial and traffic corridor setting, located on a city-owned area in a southwest quadrant called Hawkeye Downs. The site was set up for maximum concentration and source oriented. This site was set up to compare spatial concentrations and is considered an EPA Urban toxics site which is more representative of typical population exposure to levels detected. This site is located in the southwest quadrant of Cedar Rapids.
DAIA	Davenport, IA	Residential	Urban	1,000	Unknown	The Davenport, Iowa site, located in Scott County, in a metropolitan area that is approximately 650 yards from the Mississippi valley, is considered a major residential/general commercial site. This is a core site for $PM_{2.5}$ monitoring. A meat processing plant, as well as a military manufacturing arsenal, is within five miles of the sampling site. An aluminum roll processing plant is located within 10 miles of the site.
DECO	Denver, CO	Commercial	Urban	44,200	1995	The Denver site, called the Denver-CAMP site by the State of Colorado, is on the northern edge of downtown Denver on a small triangle of land bounded by Broadway, Champa St. and 21st St. The site was originally established in 1965 as a maximum concentration site for the Denver downtown area. The site provides a measure of the air pollution levels to which a large working population is exposed. Being next to a major road in the downtown Denver area, the primary influences on the site are from motor vehicles. There are some industrial facilities to the north of the site, but no large facilities within a one or two mile radius. Residential areas are located a quarter to a half mile to the northeast and east.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic	Traffic Year	Description of the Immediate Surroundings
DEMI	Dearborn in Detroit, MI	Industrial	Suburban	12,791	1990	Dearborn, MI, is an addition to the State network. The site is located in a residential neighborhood with industrial impacts. An auto and steel manufacturing plant is located in close proximity to the monitoring station. Previous violations of the PM_{10} standard have also occurred at this site. The site lies between Interstate 75 and Interstate 94. This site is expected to show some of the highest levels of air toxics in the Detroit Pilot program area. The SO_2 and PM_{10} measurements are also made there.
DMIA	Des Moines, IA	Commercial	Urban	12,400	1996	The Des Moines site is located in Polk County, Iowa, located centrally to the downtown area and on top of a one-story building. The elevation is slightly higher than the surrounding terrain. It is approximately a half mile from an Interstate highway. No major manufacturers are in the area, 2-3 miles away from a major facility.
DNFL	Dunedin in St. Petersburg, FL	Residential	Suburban	16,281	1997	The neighborhood spatial scale of representativeness characterizes this monitoring site for the Tampa Bay pilot project. This monitor is in an area of high population density with less commercial and industrial influences at the neighborhood scale. Major point sources are located approximately 8 to 15 kilometers from the monitoring site and at least 150 meters from major roadways. Given the proximity of motor vehicle traffic it is expected that mobile sources will contribute appreciably to the measured samples.
E7MI	E7 Mile in Detroit, MI	Residential	Suburban	6,999	Unknown	The East 7 Mile site represents a location downwind from the Detroit urban center city area and is located in a residential neighborhood near Interstate 94. Criteria pollutants that include NO_2, O_3, SO_2, $PM_{2.5}$, and PAMS are also measured at East 7 Mile.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic	Traffic Year	Description of the Immediate Surroundings
ELFL	East Lake in St. Petersburg, FL	Residential	Rural	14,000	1990	A neighborhood spatial scale of representativeness characterizes this monitoring site selected for the Tampa Bay Region Air Toxics Study Monitoring Stations (TBRATS) pilot project. East Lake monitor is in an area of low population density and is representative of urban background concentrations for the Tampa Bay metropolitan area. Major point sources are located approximately 8 to 15 kilometers from the monitoring site. Since the emission points from these sources are elevated and not proximate to the monitor, it is expected that concentrations measured during this study will not be dominated by a single source. In addition, this site is at least 150 meters from major roadways.
ELNJ	Elizabeth, NJ	Industrial	Suburban	170,000	Unknown	Elizabeth is located in Union County, NJ, at an urban-industrial site where the topography is relatively smooth. The monitoring site is located 75 yards away from the Toll Plaza and about one mile from Bayway Refinery. The neighborhood scale is at maximum concentration. The location has a PM_{10} filter analyzer for sulfates and nitrates as well as the UATMP site.
EPTX	El Paso, TX	Commercial	Urban	3,790	1992	Located in western Texas, just across the border from Mexico and near the border of New Mexico, the region surrounding the El Paso monitoring station has the second highest population density of the 1999/2000 UATMP monitoring location. The monitoring site is located downtown, in a high-traffic area.
G2CO	Grand Junction, CO (Site #2)	Industrial	Urban	2,200	2001	This site is located at the Mesa County Health Department north of the Grand Junction downtown area, a residential area that is exposed to major roadways. A hospital is located next door to the facility and is the only significant point source in the surrounding area. The site is also the primary neighborhood PM_{10} and $PM_{2.5}$ monitoring stie for Grand Junction.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic	Traffic Year	Description of the Immediate Surroundings
GAFL	Gandy in Tampa, FL	Commercial	Suburban	81,460	Unknown	A neighborhood spatial scale of representativeness characterizes this monitoring site selected for the Tampa Bay Region Air Toxics Study Monitoring Stations (TBRATS) pilot project. This monitor is sited in an area of high population density with uniform, mixed land use, consisting of residential, commercial, and industrial properties. Major point sources are located approximately 8 to 15 kilometers from the monitoring site. Since the emission points from these sources are elevated and not proximate to the monitor, it is expected that concentrations measured during this study will not be dominated by a single source. In addition, this site is at least 150 meters from major roadways. However, given the proximity of motor vehicle traffic it is expected that mobile sources will contribute appreciably to the measured samples.
GJCO	Grand Junction, CO (Site #1)	Residential	Suburban	10,000	Unknown	This site is southeast of the Grand Junction downtown area at the Mesa County Traffic Services. It is located in a light industrial area that contains pockets of residential areas. A variety of industrial uses are in the area, including a cement plant, metal fabricators, plating operations, a linen cleaner, a pump repair facility, and oil and chemical distributors. This site represents a maximum concentration neighborhood scale for Grand Junction.
GPMS	Gulf Port, MS	Commercial	Rural	17,000	1995	The Gulf Port site is in a light commercial and residential area. This site was selected because this area is believed to have high ambient air toxic concentrations based upon information from the NATA study and Mississippi's major source emission inventories.
JAMS	Jackson, MS	Commercial	Suburban	12,500	Unknown	The Jackson site is in a light commercial and residential area. This site was selected because this area is believed to have high ambient air toxic concentrations based upon information from the NATA study and Mississippi's major source emission inventories.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic	Traffic Year	Description of the Immediate Surroundings
LEFL	Lewis in Tampa, FL	Residential	Urban	1,055	1999	This monitor is in an area of moderate population density with fewer commercial and industrial influences at the neighborhood scale. Major point sources are located approximately 8 to 15 kilometers and at least 150 meters from major roadways. Given the proximity of motor vehicle traffic it is expected that mobile sources will contribute appreciably to the measured samples.
LOMI	Lodge in Detroit, MI	Mobile	Urban	100,000	1990	This is a mobile source oriented site that is established in Southfield, in the southeast portion of Oakland County. The site is located at the nexus of 696, Telegraph Road, and the Lodge Freeway.
MUIA	Muscatine, IA	Industrial	Suburban	2,800	Unknown	The Muscatine site is located in Muscatine County, IA, in a park in a residential section of town. Two hundred yards north of the site is a grain elevator that offloads to the Mississippi River to the west. The large grain processing plant fed by the elevator is located a quarter mile to the south of the site.
NBNJ	New Brunswick, NJ	Agricultural	Rural	63,000	Unknown	The New Brunswick site is located in a suburban-agricultural, residential area and is topographically smooth. The actual site location is in Rutgers University's Horticultural Farm.
PGMS	Pascagoula, MS	Commercial	Urban	8,600	2,000	The Pascagoula site is mostly in a commercial area and is in proximity to perhaps the largest industrial area in Mississippi. The industries near the Pascagoula site include chemical processes, petroleum refining, and ship building.
PSAZ	Supersite in Phoenix, AZ	Residential	Urban	250	1993	Maricopa County established the South Phoenix site at its current location in 1999 and operates carbon monoxide, ozone and PM_{10} monitors. The state of Arizona also operates PAMS and air toxics monitors. The site is at the edge of a residential area, but also borders on a mixture of commercial properties (retail stores, restaurants and offices). There are industrial areas approximately one mile north of the site.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic	Traffic Year	Description of the Immediate Surroundings
QVAZ	Queen Valley in Phoenix, AZ	Desert	Rural	200	2001	The state of Arizona established the Queen Valley Water Tank site in 2001, near the Superstition Wilderness Class I area, as a state Class I visibility monitoring location and a PAMS Type 3 monitoring location. The Queen Valley site consists of an IMPROVE aerosol sampler, a nephelometer and meteorological monitoring equipment. The state also operates ozone, trace level NO$_{x/y}$, PAMS and air toxics monitors. The area surrounding the site is primarily undeveloped desert. The town of Queen Valley is located approximately 0.5 miles north of the site.
RRMI	River Rouge in Detroit, MI	Industrial	Suburban	500	Unknown	River Rouge, in Detroit, MI has been part of the state of Michigan's network since the end of 1993. It is located in a residential neighborhood that is also impacted by industrial sources, near Interstate 75 and Southwest High School. Emissions from a steel plant, which occupies a few miles along the riverfront, impact the site. There are drywall manufacturing companies, the waste water treatment plant, a sewage incinerator, an asphalt plant, an oil refinery, coke batteries, coke by-product production facilities, various types of power generation plants, coal and oil fired combustion sources, paint shops, and assembly plants. The SO$_2$ and PM$_{10}$ are also monitored at this location.
S2MO	St. Louis, MO (Site #2)	Residential	Urban	1,000	1999	The St. Louis, Grant Street site has residential influences to the east and commercial influences to the north/northeast. Wind speed, direction, temperature, relative humidity, solar radiation, and barometric pressure are also measured at this site.
S3MO	St. Louis, MO (Site #3)	Residential	Urban	8,532	1998	The site at Keokuk Street in St. Louis is a residential site. Volatile organic compounds were the only compounds being monitored in 2001.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic	Traffic Year	Description of the Immediate Surroundings
SIFL	Simmons in Tampa, FL	NA	NA	18,700	Unknown	Neighborhood spatial scale of representativeness characterizes this monitoring site selected for the Tampa Bay pilot project. East Lake monitor is in an area of low population density and is representative of urban background concentrations for the Tampa Bay metropolitan area. Major point sources are located approximately 8 to 15 kilometers and at 150 meters from major roadways.
SJPR	San Juan, PR	Commercial	Suburban	51,000	Unknown	The Site at the Bayamon Regional Jail, in San Juan, conducts monitoring for VOC and carbonyls. The prevailing sources within a 3 mile radius of the site include the San Juan power plant, highways with a nearby toll gate, an asphalt plant, a sewage authority facility, and industry. Additionally, the San Juan area has a large number of automobiles.
SFSD	Sioux Falls, SD	Residential	Urban	4,320	1999	The monitoring site is located in Sioux Falls, SD the largest city in the state, near 2 grade schools north of the site and residential areas on the west, east, and south. The area within 1 mile of the site is mostly residential with a few retail businesses. The main industrial area of the city is about 3 miles northwest and 2 miles to the west of the site. The site was selected because it represents population exposure to chemical and particulate emissions from the industrial parts of the city. The predominant wind direction is northwest for most of the year with southeast winds during the summer months.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic	Traffic Year	Description of the Immediate Surroundings
SLCU	Salt Lake City, UT	Residential	Suburban	20,485	1995	The West Valley site, where the UATMP sampler is located, is in the southeast corner of the staff parking lot behind Hillsdale Elementary School. The sampler is north of the school playground and west of a large, open residential lot. The site is a neighborhood scale SLAMS site for $PM_{2.5}$, CO, and ozone sampling, not near any point sources of air toxics, but approximately 100 yards from the nearest street - 12,000 cars per day on average. The site is several city blocks away from the nearest major street or freeway. A variety of light industries and trucking companies are also located in the area, but not within 2 or 3 blocks.
SLMO	St. Louis, MO (Site #1)	Residential	Urban	15,016	2,000	The site at Grant School in St. Louis is a residential site. Commercial influences are approximately 200 yards east. Volatile organic compounds, carbonyls, hydrocarbons, MET, metals, and $PM_{2.5}$ speciation were conducted in 2001 at this site.
SPAZ	South Phoenix, AZ	Residential	Urban	50,000	1995	The Supersite is intended to represent the central core of the Phoenix metropolitan area in a high emissions area, and is a PAMS Type 2 site. The site is used to house a variety of air monitoring equipment including criteria pollutant samplers and analyzers, PAMS and air toxics, total NMHC, meteorology, visibility/urban haze, and has been selected for several state and national air monitoring studies. The area surrounding the site is primarily residential neighborhoods. There is an interstate highway approximately one mile west of the site, as well as commercial and industrial areas within five miles of the site.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic	Traffic Year	Description of the Immediate Surroundings
SWMI	South West High School in Detroit, MI	Commercial	Urban	18,437	Unknown	Southwest High School has been part of the Michigan network since 1990 and serves as the long term trend location for the air toxics network. It is located in a residential neighborhood that is impacted by industrial sources, near Interstate 75. The major sources include two steel mills, a used oil reclamation plant, and various manufacturing companies. The recent empowerment zone status achieved by the area will bring in new industries and businesses. The Detroit Waste Water Treatment plant is also close. Measurements for $PM_{2.5}$, SO_2 and PM_{10} are also collected at the site.
TUMS	Tupelo, MS	Commercial	Suburban	4,900	1997/1995	The Tupelo site is in a light commercial and residential area. This site was selected because this area is believed to have high ambient air toxic concentrations based upon information from the NATA study and Mississippi's major source emission inventories.
YFMI	Yellow Freight, MI	Industrial	Urban	500	Unknown	The Yellow Freight site is currently being used to collect SO_2 measurements and is located in the center of a highly industrialized area. The primary influence is from a nearby tar battery plant. The site is about 2.25 miles away from the Dearborn and 0.75 miles away from the Southwest High School sites. Its inclusion in the study provides information about the degree of heterogeneity of toxic air contaminants across a small scale.

Table 2-3. Site Descriptions for the 2001 UATMP Monitoring Stations

2001 UATMP Code	AIRS Site Code	Location	Population Residing Within 10 Miles of the Monitoring Station [a]	County-level Stationary Source HAP Emissions in the 1999 NEI[b] (tpy)	Closest National Weather Service Station
A2TX	48-439-0057	Arlington, TX	721,819	4,027	Dallas Fort Worth International Airport
APMI	26-163-0001	Allen Park in Detroit, MI	1,033,740	7,281	Detroit/Metropolitan Airport
AZFL	12-103-0018	Azalea Park in St. Petersburg, FL	596,939	1,744	St. Petersburg/Whitted
BAPR	72-017-0003	Barceloneta, PR	26,644[c]	1,322	San Juan, PR
BUND	38-057-004	Beulah, ND	6,204	1,324	Bismarck Municipal Airport
C2IA	19-113-0037	Cedar Rapids, IA (Site #2)	174,385	825	Cedar Rapids Municipal
CANJ	34-007-0003	Camden, NJ	2,113,778	1,071	Philadelphia, PA
CHNJ	34-027-3001	Chester, NJ	239,072	865	Somerville, NJ
CLIA	19-045-0021	Clinton, IA	42,478	529	Davenport Municipal Airport
CRIA	19-113-0039	Cedar Rapids, IA (Site #1)	175,333	825	Cedar Rapids Municipal Airport
DAIA	19-163-0015	Davenport, IA	274,768	365	Davenport Nexrad
DECO	08-031-0002	Denver, CO	1,261,437	7,040	Denver International Airport

Table 2-3. (Continued)

2001 UATMP Code	AIRS Site Code	Location	Population Residing Within 10 Miles of the Monitoring Station [a]	County-level Stationary Source HAP Emissions in the 1999 NEI[b] (tpy)	Closest National Weather Service Station
DEMI	26-163-0033	Dearborn in Detroit, MI	1,241,008	7,281	Detroit City Airport
DMIA	19-153-0030	Des Moines, IA	379,063	1,417	Des Moines International Airport
DNFL	12-103-1008	Dunedin in St. Petersburg, FL	452,739	1,744	New Port Ritchie, FL
E7MI	26-163-0019	E7 Mile in Detroit, MI	1,154,868	7,281	Detroit City Airport
ELFL	12-103-5002	East Lake in St. Petersburg, FL	495,457	1,744	New Port Ritchie, FL
ELNJ	34-039-0004	Elizabeth, NJ	2,093,628	3,227	Newark International
EPTX	48-141-0027	El Paso, TX [d]	423,488	1,947	El Paso International Airport
G2CO	08-077-0016	Grand Junction, CO (Site #2)	102,230	1,880	Grand Junction, CO
GAFL	12-057-1065	Gandy in Tampa, FL	458,547	2,082	Tampa, FL International
GJCO	08-077-0003	Grand Junction, CO (Site #1)	111,385	1,880	Grand Junction, CO
GPMS	28-047-0008	Gulf Port, MS	177,534	938	Gulf Port, MS
JAMS	28-049-0010	Jackson, MS	265,530	1,062	Jackson/Allen C. Thompson Field
LEFL	12-057-1075	Lewis in Tampa, FL	589,756	2,082	New Port Ritchie, FL

Table 2-3. (Continued)

2001 UATMP Code	AIRS Site Code	Location	Population Residing Within 10 Miles of the Monitoring Station [a]	County-level Stationary Source HAP Emissions in the 1999 NEI[b] (tpy)	Closest National Weather Service Station
LOMI	26-125-0010	Lodge in Detroit, MI	1,115,500	6,348	Pontiac, MI
MUIA	19-139-0020	Muscatine, IA	33,956	2,372	Iowa City, IA
NBNJ	34-023-0006	New Brunswick, NJ	841,801	2,897	Somerville, NJ
PGMS	28-059-0006	Pascagoula, MS	59,236	3,073	Pascagoula, MS
PSAZ	04-013-9997	Supersite in Phoenix, AZ	1,313,315	7,170	Phoenix/Deer Valley Municipal Airport
QVAZ	04-021-8001	Queen Valley in Phoenix, AZ	87,354	910	Phoenix/Sky Harbor Airport
RRMI	26-163-0005	River Rouge in Detroit, MI	905,107	7,281	Detroit City Airport
S2MO	29-510-0090	St. Louis, MO (Site #2)	807,997	1,980	Cahokia/St. Louis
S3MO	29-510-0091	St. Louis, MO (Site #3)	725,662	1,980	Cahokia/St. Louis
SFSD	46-099-0007	Sioux Falls, SD	148,462	363	Joe Foss Field Airport
SIFL	12-057-0081	Simmons in Tampa, FL	672,150	2,082	St. Petersburg/Whitfed
SJPR	72-127-0006	San Juan, PR	436,334[c]	901	San Juan, PR
SLCU	49-035-3007	Salt Lake City, UT	819,703	2,658	Salt Lake City International Airport

Table 2-3. (Continued)

2001 UATMP Code	AIRS Site Code	Location	Population Residing Within 10 Miles of the Monitoring Station [a]	County-level Stationary Source HAP Emissions in the 1999 NEI[b] (tpy)	Closest National Weather Service Station
SLMO	29-510-0089	St. Louis, MO (Site # 1)	807,997	1,980	Cahokia/St Louis
SPAZ	04-013-4003	South Phoenix, AZ	807,330	7,170	Phoenix - Deer Valley Municipal Airport
SWMI	26-163-0015	South West High School in Detroit, MI	1,196,371	7,281	Detroit City Airport
TUMS	28-081-0005	Tupelo, MS	70,981	3,981	Tupelo, MS
YFMI	26-163-0027	Yellow Freight in Detroit, MI	1,196,371	7,281	Detroit City Airport

[a] Reference: http://link-usa.com/zipcode/pop.htm

[b] Reference: NEI, 2001.

[c] For the two Puerto Rico sites, population estimates were only available for 1997. These data reflect county-level population.

[d] The El Paso, Texas, monitoring station is located less than 10 miles from the United States–Mexico border. Because only U.S. census and industry data were reviewed for this study, the listed site characteristics may understate the actual population and number of industrial sources near these monitoring stations.

Table 2-4. VOC Method Detection Limits

Compound	Method Detection Limit (ppbv)
Hydrocarbons	
Acetylene	0.13
Benzene	0.04
1,3-Butadiene	0.07
Ethylbenzene	0.04
n-Octane	0.06
Propylene	0.05
Styrene	0.07
Toluene	0.06
1,2,4-Trimethylbenzene	0.07
1,3,5-Trimethylbenzene	0.07
m-,p-Xylene	0.05
o-Xylene	0.05
Halogenated Hydrocarbons	
Bromochloromethane	0.12
Bromodichloromethane	0.06
Bromoform	0.08
Bromomethane	0.09
Carbon Tetrachloride	0.08
Chlorobenzene	0.06
Chloroethane	0.08
Chloroform	0.05
Chloromethane	0.05
Chloromethylbenzene	0.07
Chloroprene	0.10
Dibromochloromethane	0.08
1,2-Dibromoethane	0.08
m-Dichlorobenzene	0.05
o-Dichlorobenzene	0.06
p-Dichlorobenzene	0.09
1,1-Dichloroethane	0.08
1,2-Dichloroethane	0.06
1,1-Dichloroethene	0.10
cis-1,2-Dichloroethylene	0.10
trans-1,2-Dichloroethylene	0.06
1,2-Dichloropropane	0.07
cis-1,3-Dichloropropene	0.10

Table 2-4. (Continued)

Compound	Method Detection Limit (ppbv)
Halogenated Hydrocarbons (Continued)	
trans-1,3-Dichloropropene	0.11
Dichlorodifluoromethane	0.04
Dichlorotetrafluoroethane	0.05
Hexachloro-1,3-Butadiene	0.06
Methylene Chloride	0.06
1,1,2,2-Tetrachloroethane	0.06
Tetrachloroethylene	0.06
1,2,4-Trichlorobenzene	0.06
1,1,1-Trichloroethane	0.06
1,1,2-Trichloroethane	0.06
Trichloroethylene	0.07
Trichlorofluoromethane	0.04
Trichlorotrifluoroethane	0.07
Vinyl Chloride	0.06
Polar Compounds	
Acetonitrile	0.25
Acrylonitrile	0.21
Ethyl Acrylate	0.16
Ethyl *tert*-Butyl Ether	0.15
Methyl Ethyl Ketone (MEK)	0.15
Methyl Isobutyl Ketone	0.15
Methyl Methacrylate	0.18
Methyl *tert*-Butyl Ether (MTBE)	0.18
tert-Amyl Methyl Ether	0.12

Because *m*-xylene and *p*-xylene elute from the GC column at the same time, the VOC analytical method can only report the sum of *m*-xylene and *p*-xylene concentrations and not concentrations of the individual compounds.

Table 2-5. SNMOC Method Detection Limits

Compound	Method Detection Limit ppbC	Compound	Method Detection Limit ppbC
Acetylene	1.12	3-Methyl-1-Butene	0.73
Benzene	0.86	Methylcyclohexane	0.80
1,3-Butadiene	0.61	Methylcyclopentane	0.64
n-Butane	0.72	2-Methylheptane	0.66
cis-2-Butene	0.97	3-Methylheptane	0.65
trans-2-Butene	0.58	2-Methylhexane	0.58
Cyclohexane	1.00	3-Methylhexane	0.62
Cyclopentane	0.44	2-Methylpentane	0.50
Cyclopentene	0.81	3-Methylpentane	1.04
n-Decane	0.57	2-Methyl-1-Pentene	1.04
1-Decene	0.57	4-Methyl-1-Pentene	0.93
m-Diethylbenzene	1.32	*n*-Nonane	0.69
p-Diethylbenzene	0.92	1-Nonene	0.69
2,2-Dimethylbutane	0.92	*n*-Octane	0.86
2,3-Dimethylbutane	1.23	1-Octene	0.65
2,3-Dimethylpentane	1.18	*n*-Pentane	0.55
2,4-Dimethylpentane	1.07	1-Pentene	0.53
n-Dodecane	0.85	*cis*-2-Pentene	0.81
1-Dodecene	0.85	*trans*-2-Pentene	0.54
Ethane	0.87	α-Pinene	0.57
2-Ethyl-1-Butene	1.04	β-Pinene	0.57
Ethylbenzene	0.66	Propane	0.77
Ethylene	0.70	*n*-Propylbenzene	1.08

Table 2-5. (Continued)

Compound	Method Detection Limit	Compound	Method Detection Limit
	ppbC		ppbC
m-Ethyltoluene	1.03	Propylene	0.80
o-Ethyltoluene	1.10	Propyne	0.76
p-Ethyltoluene	1.30	Styrene	0.82
n-Heptane	0.69	Toluene	1.02
1-Heptene	0.62	*n*-Tridecane	0.85
n-Hexane	0.78	1-Tridecene	0.85
1-Hexene	1.04	1,2,3-Trimethylbenzene	1.0
cis-2-Hexene	0.78	1,2,4-Trimethylbenzene	1.85
trans-2-Hexene	0.78	1,3,5-Trimethylbenzene	1.14
Isobutane	0.61	2,2,3-Trimethylpentane	0.69
Isobutene/1-Butene	0.62	2,2,4-Trimethylpentane	0.74
Isopentane	0.73	2,3,4-Trimethylpentane	0.69
Isoprene	0.67	*n*-Undecane	0.85
Isopropylbenzene	1.21	1-Undecene	0.85
2-Methyl-1-Butene	0.53	*m-,p*-Xylene	1.03
2-Methyl-2-Butene	0.81	*o*-Xylene	0.71

Concentration in ppbC = concentration in ppbv x number of carbon atoms in compound.

Because Isobutene and 1-Butene elute from the GC column at the same time, the SNMOC analytical method can only report the sum of concentrations for these two compounds and not concentrations of the individual compounds. For the same reason, the *m*-xylene and *p*-xylene concentrations are reported together as a sum.

Table 2-6. Carbonyl Method Detection Limits

Compound	Method Detection Limit (ppbv)
Acetaldehyde	0.005
Acetone	0.002
Benzaldehyde	0.003
Butyr/Isobutyraldehyde	0.011
Crotonaldehyde	0.005
2,5-Dimethylbenzaldehyde	0.004
Formaldehyde	0.016
Hexaldehyde	0.003
Isovaleraldehyde	0.004
Propionaldehyde	0.005
Tolualdehydes	0.009
Valeraldehyde	0.005

Notes: The carbonyl detection limits are based on a sample volume of 500 liters of ambient air.

Because butyraldehyde and isobutyraldehyde elute from the HPLC column at the same time, the carbonyl analytical method can only report the sum of concentrations for these two compounds and not concentrations of the individual compounds. For the same reason, the analytical method also reports only the sum of concentrations for the three tolualdehyde isomers, as opposed to reporting separate concentrations for the three individual compounds.

Table 2-7. Semivolatile Organic Compound Method Detection Limits

Compound	Method Detection Limit Total µg/m^3	Compound	Method Detection Limit Total µg/m^3
Acenaphthene	0.03	2,4-Dinitrophenol	0.05
Acenaphthylene	0.04	2,4-Dinitrotoluene	0.05
Acetophenone	0.07	2,6-Dinitrotoluene	0.04
2-Acetylaminofluorene	0.24	Diphenylamine	0.12
4-Aminobiphenyl	0.05	Ethyl methanesulfonate	0.14
Aniline	0.08	Fluoranthene	0.07
Anthracene	0.08	Fluorene	0.05
Azobenzene	0.08	Hexachlorobenzene	0.07
Benzidine	0.24	Hexachlorobutadiene	0.06
Benzo(a)anthracene	0.04	Hexachlorocyclopentadiene	0.10
Benzo(a)pyrene	0.09	Hexachloroethane	0.03
Benzo(b)fluoranthene	0.08	Hexachloropropene	0.24
Benzo(g,h,i)perylene	0.07	Indeno(1,2,3-cd)pyrene	0.07
Benzo(k)fluoranthene	0.11	Isodrin	0.24
Benzoic acid	0.06	Isophorone	0.11
Benzyl alcohol	0.04	Isosafrole	0.24
bis(2-Chloroethyl)ether	0.06	3-Methylcholanthrene	0.24
bis(2-Chloroethoxy)methane	0.07	Methyl methanesulfonate	0.08
bis(2-Chloroisopropyl)ether	0.05	2-Methylnaphthalene	0.05
bis(2-Ethylhexyl)phthalate	0.06	Naphthalene	0.07
4-Bromophenyl phenyl ether	0.05	1,4-Naphthoquinone	0.24
Butyl benzyl phthalate	0.06	1-Naphthylamine	0.03
Carbazole	0.06	2-Naphthylamine	0.05
4-Chloroaniline	0.08	2-Nitroaniline	0.06
Chlorobenzilate	0.24	3-Nitroaniline	0.04
4-Chloro-3-methylphenol	0.08	4-Nitroaniline	0.05
1-Chloronaphthalene	0.15	Nitrobenzene	0.12
2-Chloronaphthalene	0.09	2-Nitrophenol	0.50
2-Chlorophenol	0.05	4-Nitrophenol	0.04

Table 2-7. (Continued)

Compound	Method Detection Limit Total µg/m^3	Compound	Method Detection Limit Total µg/m^3
4-Chlorophenyl-phenyl ether	0.03	N-Nitrosodibutylamine	0.11
Chrysene	0.05	N-Nitrosodiethylamine	0.24
o-Cresol (2-Methylphenol)	0.05	N-Nitrosomethylethylamine	0.24
o-Toludine	0.24	N-Nitrosodimethylamine	0.12
p-Cresol (3,4-Methylphenol)	0.04	N-Nitrosodipropylamine	0.10
Diallate	0.24	N-Nitrosopiperidine	0.08
Dibenz(a,h)anthracene	0.08	N-Nitrosopyrrolidine	0.24
Dibenzofuran	0.04	5 Nitro-o-Toluidine	0.24
Di-*n*-butyl phthalate	0.07	Pentachlorobenzene	0.05
Di-*n*-octyl phthalate	0.06	Pentachloroethane	0.24
Dinoseb	0.24	Pentachloronitrobenzene	0.05
1,2-Dichlorobenzene	0.05	Pentachlorophenol	0.07
1,3-Dichlorobenzene	0.06	Phenacetin	0.08
1,4-Dichlorobenzene	0.05	Phenanthrene	0.05
3,3'-Dichlorobenzidine	0.04	Phenol	0.11
2,4-Dichlorophenol	0.07	1,4-Phenylenediamine	0.14
2,6-Dichlorophenol	0.09	2-Picoline	0.05
Diethyl phthalate	0.03	Pronamide	0.06
4-Dimethylaminoazobenzene	0.06	Pyrene	0.05
7,12-Dimethylbenz(a)anthracene	0.09	Pyridine	0.24
3.3'-Dimethylbenzidine	0.24	Safrole	0.24
α,α-Dimethylphenethylamine	0.05	1,2,4,5-Tetrachlorobenzene	0.05
2,4-Dimethylphenol	0.08	2,3,4,6-Tetrachlorophenol	0.05
Dimethyl phthalate	0.04	1,2,4-Trichlorobenzene	0.07
1,3-Dintrobenzene	0.24	2,4,5-Trichlorophenol	0.03
4,6-Dinitro-2-methylphenol	0.05	2,4,6-Trichlorophenol	0.03

Table 2-8. Sampling Schedules and Completeness

Code	Monitoring Location	Sampling Period		Carbonyl Data			VOC Data			SNMOC			SVOC		
		Starting Date	Ending Date	A	B	C	A	B	C	A	B	C	A	B	C
A2TX	Arlington, TX	1/7/01	7/6/01	15	14	93	14	14	100	---	---	---	---	---	---
APMI	Allen Park in Detroit, MI	4/19/01	12/27/01	22	22	100	24	24	100	---	---	---	22	19	86
AZFL	Azalea Park in St. Petersburg, FL	1/1/01	12/27/01	66	66	100	---	---	---	---	---	---	---	---	---
BAPR	Barceloneta, PR	5/31/01	12/27/01	22	22	100	19	19	100	19	19	100	---	---	---
BUND	Beulah, ND	1/1/01	12/27/01	64	61	95	61	61	100	60	60	100	---	---	---
C2IA	Cedar Rapids, IA (Site #2)	1/4/01	12/30/01	119	119	100	114	114	100	110	110	100	---	---	---
CANJ	Camden, NJ	1/19/01	12/27/01	49	44	90	45	45	100	---	---	---	33	33	100
CHNJ	Chester, NJ	5/25/01	12/27/01	36	36	100	32	32	100	---	---	---	30	30	100
CLIA	Clinton, IA	1/1/01	10/16/01	27	25	93	25	25	100	24	24	100	---	---	---
CRIA	Cedar Rapids, IA	1/1/01	12/2701	61	57	93	58	58	100	57	57	100	---	---	---
DAIA	Davenport, IA	1/1/01	12/27/01	33	31	94	31	31	100	30	30	100	---	---	---
DECO	Denver, CO	1/1/01	12/27/01	62	60	97	59	59	100	58	58	100	---	---	---
DEMI	Dearborn in Detroit, MI	4/19/01	12/31/01	223	223	100	213	213	100	---	---	---	43	34	79
DMIA	Des Moines, IA	1/1/01	11/19/01	30	24	80	25	25	100	24	24	100	---	---	---

Table 2-8. (Continued)

Code	Monitoring Location	Sampling Period		Carbonyl Data			VOC Data			SNMOC			SVOC		
		Starting Date	Ending Date	A	B	C	A	B	C	A	B	C	A	B	C
DNFL	Dunedin in St. Petersburg, FL	1/1/01	12/27/01	62	62	100	---	---	---	---	---	---	---	---	---
E7MI	E7 Mile in Detroit, MI	4/19/01	12/27/01	---	---	---	---	---	---	---	---	---	21	15	71
ELFL	East Lake in St. Petersburg, FL	1/1/01	12/27/01	62	62	100	---	---	---	---	---	---	---	---	---
ELNJ	Elizabeth, NJ	1/7/01	12/27/01	49	47	96	48	48	100	---	---	---	31	30	97
EPTX	El Paso, TX	1/7/01	12/21/01	30	28	93	30	30	100	---	---	---	---	---	---
G2CO	Grand Junction, CO (Site #2)	5/7/01	12/27/01	40	40	100	39	39	100	---	---	---	---	---	---
GAFL	Gandy in Tampa, FL	1/1/01	12/27/01	64	64	100	---	---	---	---	---	---	---	---	---
GJCO	Grand Junction, CO (Site #1)	5/7/01	12/27/01	39	39	100	39	39	100	---	---	---	---	---	---
GPMS	Gulf Port, MS	8/17/01	12/27/01	13	13	100	13	13	100	---	---	---	---	---	---
JAMS	Jackson, MS	5/13/01	12/27/01	16	16	100	21	21	100	---	---	---	---	---	---
LEFL	Lewis in Tampa, FL	1/1/01	12/27/01	63	63	100	---	---	---	---	---	---	---	---	---
LOMI	Lodge in Detroit, MI	4/19/01	12/27/01	21	21	100	41	41	100	---	---	---	43	39	91
MUIA	Muscatine, IA	1/1/01	10/28/01	29	27	93	27	27	100	26	26	100	---	---	---

Table 2-8. (Continued)

Code	Monitoring Location	Sampling Period		Carbonyl Data			VOC Data			SNMOC			SVOC		
		Starting Date	Ending Date	A	B	C	A	B	C	A	B	C	A	B	C
NBNJ	New Brunswick, NJ	5/25/01	12/27/01	39	39	100	36	36	100	---	---	---	33	32	97
PGMS	Pascagoula, MS	7/24/01	12/27/01	17	17	100	15	15	100	---	---	---	---	---	---
PSAZ	Supersite in Phoenix, AZ	6/6/01	12/27/01	---	---	---	35	32	91	---	---	---	---	---	---
QVAZ	Queen Valley in Phoenix, AZ	6/6/01	12/27/01	---	---	---	32	27	89	---	---	---	---	---	---
RRMI	River Rouge in Detroit, MI	4/19/01	12/27/01	1	1	100	21	21	100	---	---	---	22	20	91
S2MO	St. Louis, MO (Site #2)	5/13/01	12/21/01	---	---	---	37	37	100	---	---	---	---	---	---
S3MO	St. Louis, MO (Site #3)	5/13/01	12/27/01	---	---	---	35	35	100	---	---	---	---	---	---
SFSD	Sioux Falls, SD	1/1/01	12/27/01	---	---	---	61	60	98	60	60	100	---	---	---
SIFL	Simmons in Tampa, FL	1/1/01	12/27/01	66	66	100	---	---	---	---	---	---	---	---	---
SJPR	San Juan, PR	5/31/01	12/27/01	22	22	100	17	17	100	17	17	100	---	---	---
SLCU	Salt Lake City, UT	1/7/01	12/27/01	59	53	90	54	54	100	53	53	100	---	---	---
SLMO	St. Louis, MO (Site #1)	5/13/01	12/27/01	38	38	100	28	28	100	---	---	---	---	---	---

Table 2-8. (Continued)

Code	Monitoring Location	Sampling Period		Carbonyl Data			VOC Data			SNMOC			SVOC		
		Starting Date	Ending Date	A	B	C	A	B	C	A	B	C	A	B	C
SPAZ	South Phoenix, AZ	8/5/01	12/27/01	---	---	---	25	21	84	26	26	100	32	32	100
SWMI	South West High School in Detroit, MI	4/19/01	12/27/01	1	1	100	---	---	---	---	---	---	22	19	86
TUMS	Tupelo, MS	7/24/01	12/27/01	17	17	100	17	14	82	---	---	---	---	---	---
YFMI	Yellow Freight in Detroit, MI	4/19/01	12/27/01	41	41	100	38	38	100	---	---	---	43	36	84
---	**Overall**	**---**	**—**	**1,618**	**1,581**	**98**	**1,429**	**1,413**	**99**	**564**	**564**	**100**	**375**	**339**	**90**

A = Days When Samples Were Collected
B = Days With Valid Samples
C = Completeness (%)

Note: The completeness data only indicate the number of days when samples were collected.

3.0 Summary of the 2001 UATMP Data

This section summarizes the data gathered during the 2001 UATMP reporting year. A total of 70 VOC and carbonyl compounds were sampled during this program reporting year. (Unlike previous years, acrolein was not analyzed.) Within the VOCs, three distinct groups of compounds were identified: 1) hydrocarbons; 2) halogenated hydrocarbons; and 3) polar compounds. All four of the these compound groups (including carbonyls) are discussed in greater detail in Sections 3.2 through 3.5.

This reporting year includes urban air toxic concentration data beginning on January 1, 2001 across thirteen sites and ending on December 31, 2001 at the Dearborn site in Detroit, Michigan (DEMI). A complete presentation of the data is found in Appendices C through N. Specifically:

- Appendix C: 2001 Summary Tables for VOC Monitoring;
- Appendix D: 2001 Summary Tables for SNMOC Monitoring;
- Appendix E: 2001 Summary Tables for Carbonyl Monitoring;
- Appendix F: 2001 Summary Tables for SVOC Monitoring;
- Appendix G: 2001 Summary Tables for Metals Monitoring;
- Appendix H: 2001 Summary Tables for Hexavalent Chromium Monitoring;
- Appendix I: 2001 VOC Raw Monitoring Data;
- Appendix J: 2001 SNMOC Raw Monitoring Data;
- Appendix K: 2001 Carbonyl Raw Monitoring Data;
- Appendix L: 2001 SVOC Raw Monitoring Data;
- Appendix M: 2001 Metal Raw Monitoring Data; and
- Appendix N: 2001 Hexavalent Chromium Raw Monitoring Data.

Nearly 127,200 urban air toxics data concentrations (including duplicate and replicate samples) were collected at the forty-two sites for the 2001 UATMP reporting year. Additionally, thirteen sites chose to sample for speciated nonmethane organic compounds (SNMOC) accounting for another 57,200 data concentrations. Finally, semivolatile data were collected at twelve sites totaling nearly 48,500 data concentrations, and those data are listed in Appendix F. These data will be analyzed on a site-specific basis in sections four through eleven of this document. Although there are forty-three stations listed in Section 2 of this document, two sites did not sample for either VOCs or carbonyls (SFSD and E7MI).

3.1 Data Summary Parameters

The summary tables in Appendices F through I were uploaded into a database for air quality analysis. This section will examine five different data summary parameters: 1) number of sampling detects; 2) concentration range; 3) geometric means; 4) prevalence; and 5) correlation. The following paragraphs review the basic findings indicated by the summary tables.

3.1.1 Number of Sampling Detects

Tables 3-1 and 3-2 are sampling detect summaries of the seventy VOC and carbonyl concentrations. Less than 55 % of the pollutants sampled were found to be above the method detection limit (MDL). Of those that were detected:

- 33.7% were hydrocarbons;
- 25.4% were halogenated hydrocarbons;
- 5.2% were polar compounds; and
- 35.7% were carbonyl compounds.

Formaldehyde and Acetaldehyde had the greatest number of detectable values reported in samples (2,012 and 1,978, respectively), while eight compounds had zero detects (see Tables 3-1 and 3-2).

3.1.2 Concentration Range

Nearly 83% of the detects had concentration values less than 1 ppbv. Less than 2% had concentration values greater than 5 ppbv. Carbonyl compounds had the highest number of samples greater than 5 ppbv (463); halogenated hydrocarbons had the lowest (76). There was at least one compound sampled at greater than 5 ppbv on 110 of 295 total sampling days. An interesting note is that 22 of the seventy compounds never exceeded 1 ppbv.

The range of detectable values for each site is listed in Table 3-3. The APMI, BAPR, CLIA, GPMS, LOMI, and NBNJ sites had maximum values of over 100 ppbv, unusually high when compared to the other sites. DEMI, which sampled nearly every day from beginning in April, had the greatest number of detects (8,996) and G2CO had the greatest number of samples greater than 5 ppbv (125).

3.1.3 Geometric Means

The geometric mean is the central tendency of lognormally distributed data, and can be calculated by taking the “nth” root of the product of the “n” concentrations. The geometric mean is a useful parameter for calculating a central tendency of a concentration data set, whose arithmetic mean may be skewed by an usually high concentration value. Geometric means for each site of the four different pollutant groups are presented in Table 3-4 and shown graphically in Figure 3-1. The BAPR site had the highest geometric mean for total polar compounds (9.19 ppbv); the GJCO had the highest geometric mean for total hydrocarbons (21.04 ppbv). The highest total halogenated hydrocarbon geometric mean was at APMI (19.28 ppbv). The G2JO site has the highest total carbonyl geometric mean (12.42 ppbv). Although RRMI and SWMI calculated geometric means greater than 26 ppbv each, that was based on one sample day.

3.1.4 Prevalence

In the context of the UATMP, *prevalence* refers to the frequency with which an air pollutant is found at levels detectable by the corresponding sampling and analytical method. By indicating the frequency of detection, prevalence can help participating agencies identify compounds of concern in urban air pollution. Because part of this report is organized to evaluate trends in ambient air quality primarily on the basis of compound groups, the prevalent compounds are identified on a program-wide, not site-specific, basis. More importantly, the number of nondetects for a given compound (indicated by low prevalence) must be considered when interpreting air monitoring results. Specifically, annual average concentrations cannot be accurately estimated for compounds that are not detected in a majority of samples.

When reviewing the data summary tables, readers should note that a prevalence of zero does not necessarily indicate that a compound is not present in ambient air. Rather, compounds with a prevalence of zero may be present in the air, but at levels consistently below method detection limits.

For the purposes of this report, a group of program-wide prevalent compounds was identified for each of the compound groups listed in Section 3.0. These groups of program-wide prevalent compounds are discussed in detail in Sections 3.2 through 3.5, and throughout the remaining chapters of this report. Because the UATMP does not characterize every component of air pollution, many compounds known to be prevalent in urban air (e.g., ozone and nitrous oxides) are not considered in this report. Readers should be careful not to confuse the most prevalent compounds program-wide identified by the 2001 UATMP with the most prevalent compounds in urban air pollution.

In previous UATMP reports, program-wide prevalent compounds were identified using two statistical parameters: the count of the number of nondetects (ND); and the percent contribution of their mass concentrations. If a compound was detected in at least 75 percent of all the samples, and if the compound contributed to at least 90 percent of the mass concentration within a compound group, then that compound was considered "program-wide prevalent". Due to the significant increase in the number of participating sites from the previous year (from 15 to 41), this identification scheme needed to be re-evaluated to ensure capture of the prevalent compounds. The historical scheme worked well for the carbonyls, and identified the same three prevalent compounds from the previous year. However, only twelve VOC compounds were identified using the first criterion, and only a handful of these satisfied the second criterion. To ensure that an acceptable number of VOC prevalent compounds are identified, both criterion were revised: 1) to be considered prevalent, the compound must be in at least 60% of samples collected by a site; 2) the compounds must satisfy the first criterion in 28 of the 34 sites sampling for VOCs; 3) the compounds satisfying the first and second criterion must contribute to at least 90% of their compound group's mass concentration; and 4) the third criterion must satisfy 28 of the 34 sites sampling for VOCs. Fourteen compounds met both of these criteria (3 halogenated hydrocarbons, 7 hydrocarbons, 1 polar compound, and 3 carbonyl compounds).

For the 2001 UATMP, the program-wide prevalent VOC are:

- **HYDROCARBONS**
  - Acetylene
  - Benzene
  - Ethylbenzene
  - *o*-xylene
  - Propylene
  - Toluene
- **HALOGENATED HYDROCARBONS**
  - Chloromethane
  - Dichlorodifluoromethane
  - Methylene Chloride
- **POLAR COMPOUNDS**
  - Methyl Ethyl Ketone
- **CARBONYL COMPOUNDS**
  - Acetaldehyde
  - Acetone
  - Formaldehyde

Because these compounds were consistently present at detectable levels, the UATMP monitoring data characterize ambient levels for these compounds much more accurately than they characterize ambient levels for the VOCs and carbonyls with lower prevalence. Further, the high prevalence allows for a meaningful statistical analysis of data correlations and a thorough review of spatial variations and temporal variations in ambient air quality.

Readers interested in closer examination of data trends for the less program-wide prevalent compounds should refer to the summary tables in Appendices F through I, and the raw monitoring data in Appendices J through M. However, the reader should note the limitations posed by data sets with many nondetect observations.

Figures 3-2 through 3-15 illustrate how geometric mean concentrations for the program-wide prevalent VOCs and carbonyls varied from one monitoring location to the next.

3.1.5 Pearson Correlations

This report uses Pearson correlation coefficients to measure the degree of correlation between two variables. By definition, Pearson correlation coefficients always lie between -1 and +1. Three qualification statements may be made:

- A correlation coefficient of -1 indicates a perfectly "negative" relationship, indicating that increases in the magnitude of one variable are associated with proportionate decreases in the magnitude of the other variable, and vice versa;
- A correlation coefficient of +1 indicates a perfectly "positive" relationship, indicating that the magnitudes of two variables both increase and both decrease proportionately.
- Data that are completely uncorrelated have Pearson correlation coefficients of zero.

Therefore, the sign (positive or negative) and magnitude of the Pearson correlation coefficient indicate the direction and strength, respectively, of data correlations.

When calculating correlations among the UATMP data, several measures were taken to identify spurious correlations and to avoid introducing bias to the correlations:

- The statistical significance of the Pearson correlation coefficients was evaluated using a standard t-test—a test commonly used for this purpose (Harnett, 1982). In this report, Pearson correlation coefficients were tested for statistical significance using the 5 percent level of significance. Whenever possible, a 95 percent confidence interval was calculated around the estimated correlation coefficient. If zero did not fall within the interval, the coefficient was considered statistically significantly different from zero.

- Data correlations were calculated only for the most program-wide prevalent compounds listed in this report. Because the UATMP monitoring data are least precise for compounds having many nondetect observations (see Section 17), eliminating the less program-wide prevalent compounds improves the correlation analysis.

- Correlations were calculated from the processed UATMP monitoring database in which each compound has just one numerical concentration for each successful sampling date. Nondetect observations, duplicate sampling events, and replicate laboratory analyses were all replaced with appropriate surrogate values. With these data quality measures, data analysts ensured that the calculated correlations characterize actual trends in the UATMP air monitoring data.

3.2 UATMP Compound Groups

The seventy UATMP compounds listed in section 2 are grouped into four compound groups: hydrocarbons; halogenated hydrocarbons; polar compounds; and carbonyls. Each member of the compound groups shares similar chemical makeup, as well as exhibits similar tendencies.

3.2.1 Hydrocarbons

Hydrocarbons are organic compounds that contain only carbon and hydrogen. Hydrocarbons are derived mostly from crude petroleum and also from coal tar and plant sources and are classified according to the arrangement of the atoms, as alicyclic, aliphatic, and aromatic. Hydrocarbons are of prime economic importance because they encompass the constituents of the major fossil fuels, petroleum and natural gas, as well as plastics, waxes, and oils. In urban air pollution, these components--along with oxides of nitrogen (NO_x) and sunlight--contribute to the formation of tropospheric ozone.

As stated above, hydrocarbons in the atmosphere originate from natural sources and from various anthropogenic sources, such as combustion of fuel and biomass, petroleum refining, petrochemical manufacturing, solvent use, and gas and oil production and use. Studies have shown that emissions from different anthropogenic sources vary significantly from location to location. For example, on a nationwide basis, EPA estimates that 50 percent of anthropogenic nonmethane volatile organic compound releases in 1996 came from industrial processes, 42 percent from transportation, 6 percent from fuel combustion, and the rest from other sources (USEPA, 1997). In urban areas, however, the estimated contributions of different source categories differ from these national averages. For instance, a 1987 study in the Los Angeles area estimated that 49 percent of nonmethane hydrocarbon emissions come from vehicle exhaust, 11 percent from liquid gasoline, 10 percent from gasoline vapor, and 30 percent from sources other than motor vehicles (Fujita et al., 1994). These figures suggest that motor vehicles may play a greater role in hydrocarbon emissions in urban areas than national statistics indicate.

3.2.2 Halogenated Hydrocarbons

Halogenated hydrocarbons are organic compounds that contain carbon, hydrogen, and halogens - the chemical group that includes chlorine, bromine, and fluorine. Most halogenated hydrocarbons are used for industrial purposes and as solvents, though some are produced naturally (Godish, 1997). Once emitted to the air, many volatile halogenated hydrocarbons resist photochemical breakdown and therefore persist in the atmosphere for relatively long periods of time (Godish, 1997; Ramamoorthy and Ramamoorthy, 1997). These compounds can cause chronic health effects as well as contribute to the formation of tropospheric ozone. Like hydrocarbons, only the halogenated hydrocarbons with lower molecular weights are volatile, and the sampling and analytical methods used in the 1999-2000 UATMP measure a subset of 37 of these volatile compounds.

3.2.3 Polar Compounds

Polar compounds (i.e., oxygenated compounds such as methyl *tert*-butyl ether, methyl ethyl ketone, etc.) were added to the UATMP analyte list that included the volatile halogenated hydrocarbons and selected hydrocarbons because of the nation-wide use of these types of compounds as gasoline additives and the toxicity of these gasoline additives. Because of the prevalence of compounds characteristic of motor vehicle emissions, any compounds used as gasoline additives would be expected to be correspondingly prevalent. Other polar compounds such as acetonitrile were added to the analyte list because the compounds were observed at high concentrations at one or more monitoring sites.

3.2.4 Carbonyl Compounds

Carbonyl compounds are organic compounds characterized by their composition of carbon, hydrogen, and oxygen, and by the presence of at least one carbon-oxygen double bond. Several different factors are known to affect ambient air concentrations of carbonyl compounds, but most notably:

- Combustion sources, motor vehicles, and various industrial processes that emit carbonyl compounds directly to the atmosphere;
- Photochemical reactions that *form* carbonyl compounds in the air, typically from airborne hydrocarbons; and
- Photochemical reactions that *consume* carbonyl compounds from the air, generally by photolysis or by reaction with hydroxyl radicals (Seinfeld, 1986).

3.3 Correlations with Selected Meteorological Parameters

Ambient air concentration tendencies often correlate favorably with ambient meteorological observations. The following three sections summarize how each of the prevalent compound concentrations correlated with seven meteorological parameters: maximum daily temperature; average daily temperature; average daily dew point temperature; average daily wet bulb temperature; average daily relative humidity; and average wind information.

3.3.1 Maximum and Average Temperature

Temperature is often a component to high ambient air concentrations for some compounds, such as ozone. The temperature will help speed up the kinetics as compounds react with each other. According to Table 3-5, the program-wide prevalent compounds had very weak correlations with maximum temperature and average temperature. Toluene had the strongest correlation with maximum temperature (0.18), while methyl ethyl ketone had the strongest correlation with average temperature (0.19).

The poor correlation across all sites is not surprising due to the complex and diverse local meteorology associated with the states. In the previous UATMP report, eleven of the fifteen sites were in four states. For this report, 43 sites are spread across eleven states and one U.S. territory. As seen in Sections 4 through 16, the temperature parameters correlate much better at the individual sites.

3.3.2 Moisture Parameters

Three moisture parameters were used in this study for correlation with the prevalent compounds. The *dew point temperature* is the temperature to which moist air must be cooled for it to reach saturation with respect to water. The *wet-bulb temperature* is the temperature to which moist air must be cooled by evaporating water into it at constant pressure until saturation is reached. The *relative humidity* is the ratio of the mixing ratio to its saturation value at the same temperature and pressure (Rogers and Yau, 1989). All three of these parameters provide an indication of how much moisture is presently in the air.

As can be seen in Table 3-5, the three moisture parameters had very weak correlations with the prevalent compounds across all 43 sites, consistent with the above temperature observations. The sites used for sampling in this program year were located in different climatic zones ranging from a desert climate (Arizona) to a very moist climate (Florida). Acetone concentrations had the strongest correlation with the three moisture parameters (-0.29 with dew point temperature; -0.15 with wet-bulb temperature; and -0.32 with relative humidity). As seen in Sections 4 through 16, the moisture parameters correlate much better at the individual sites.

3.3.3 Wind Information

Surface wind observations include two primary components: wind speed and wind direction. *Wind speed*, by itself, is a scalar value and is usually measured in nautical miles or knots. *Wind direction* describes where the wind is coming from, and is measured in degrees where 0° is from the north, 90° is from the east, 180° is from the south, and 270° is from the west. Together, the wind speed and wind direction are described as a vector, and the hourly values can now be averaged.

The *u-component* of the wind speed is the vector value traveling toward the x-axis in a Cartesian grid coordinate system. The u-component is calculated as follows:

u-component = -1* (wind speed) * sin(wind direction, degrees)

Similarly, the *v-component* of the wind speed is the vector value traveling toward the y-axis in a Cartesian grid coordinate system. The v-component is calculated as follows:

v-component = -1* (wind speed) * cos(wind direction, degrees)

Using the u- and v- components of the wind speed enables averaging and correlation analyses with the measured concentrations.

As can be seen in Table 3-5, the u- and v- components of the wind speed have very weak correlations with the prevalent compounds across all sites, consistent with the temperature and moisture parameter observations. Geographical features such as mountains influence wind speed and wind direction. The sites used for sampling in this program year were located in different geographic zones ranging from a mountainous region (Colorado) to a plains region (Iowa). Additionally, sites located downwind may correlate better with the measured concentrations than sites upwind. Acetaldehyde concentrations had the strongest negative correlation with the v-component of the wind speed (0.12), while *o*-xylene had the strongest correlation with the v-component of the wind speed (-0.12). As seen in Sections 4 through 16, the u- and v-components correlate much better at the individual sites.

3.4 The Impact of Motor Vehicle Emissions on Spatial Variations

Motor vehicles significantly contribute to air pollution in urban environments. Pollutants found in motor vehicle exhaust generally result from incomplete combustion of vehicle fuels. Although modern vehicles and, more recently, vehicle fuels have been engineered to minimize air emissions, all motor vehicles with internal combustion engines emit a wide range of chemical pollutants. The magnitude of these emissions in urban areas primarily depends on the volume of traffic, while the chemical profile of these emissions depends more on vehicle design and fuel content. This report uses three parameters to evaluate the impact of motor vehicle emissions on ambient air quality:

- Motor Vehicle ownership data;
- Motor vehicle emissions profiles; and,
- Estimated daily traffic estimates.

3.4.1 Motor Vehicle Ownership Data

As an indicator of motor vehicle emissions near the UATMP monitoring locations, Table 3-6 presents estimates of the number of cars owned by residents within 10 miles of each monitoring location. The total number of motor vehicles owned within a 10-mile radius was estimated based on a ratio of 0.74 cars per person (U.S. population of 275,000,000 and total number of motor vehicles in U.S. of 203,500,000).

For purposes of comparison, both motor vehicle ownership data and the geometric mean of total program-wide prevalent hydrocarbons are presented in Table 3-6. The data in the table indicate a positive linear correlation between motor vehicle ownership and ambient air concentrations of hydrocarbons. However, readers should keep in mind other factors that might impact the reliability of motor vehicle ownership data as an indicator of ambient air monitoring data results:

- Estimates of higher car ownership within a 10-mile radius do not necessarily imply increased motor vehicle use in the immediate vicinity of a monitoring location. Conversely, sparsely populated regions often contain heavily traveled roadways.
- Emissions sources in the area other than motor vehicles may significantly affect levels of hydrocarbons in the ambient air.

3.4.2 Motor Vehicles Emissions Profiles

The *magnitude* of emissions from motor vehicles generally depends on the volume of traffic in urban areas, but the *composition* of these emissions depends more on vehicle design. Because the distribution of vehicle design (i.e., the relative number of motor vehicles of different styles) is probably quite similar from one urban area to the next, the composition of air pollution resulting from motor vehicle emissions is not expected to exhibit significant spatial variations. In support of this hypothesis, previous air monitoring studies have observed relatively constant composition of ambient air samples collected along heavily traveled urban roadways (Conner et al., 1995). Roadside studies have found particularly consistent proportions of four hydrocarbons (benzene, toluene, ethylbenzene, and the xylene isomers - the "BTEX" compounds) both in motor vehicle exhaust and in ambient air near roadways.

To examine the impact of motor vehicle emissions on air quality at the 2001 UATMP monitoring sites, Figure 3-16 compares concentration ratios for the BTEX compounds measured during the 2001 UATMP to the ratios reported in a roadside study (Conner et al., 1995). This comparison provides a qualitative depiction of how greatly motor vehicle emissions affect air quality at the UATMP monitoring locations: the more similar the concentration ratios at a particular monitoring location are to those of the roadside study, the more likely that motor vehicle emissions impact ambient levels of hydrocarbons at that location.

As Figure 3-16 shows, the concentration ratios for BTEX compounds measured at every UATMP monitoring station bear some resemblance to the ratios reported in the roadside study. The BTEX ratios at the G2CO monitoring site appear to be the most similar to the roadside study profile. For all monitoring locations the toluene:ethylbenzene ratio is clearly the largest value of the four ratios, with the exceptions to this ratio at SLMO and YFMI; the xylene:ethylbenzene ratio is clearly the smallest value of the ratios, with the exceptions of BAPR, CHNJ, JAMS, NBNJ, PGMS, SJPR, and SLMO . These observations suggest, though certainly do not prove, that emissions from motor vehicles significantly affect levels of hydrocarbons in urban ambient air.

3.4.3 Estimated Traffic Data

When a site is being characterized, a parameter often recorded is the number of vehicles which daily pass the monitor. For 37 of the forty-three UATMP monitors, traffic data were available; for the unknown traffic data count, local agencies were contacted to provide an estimation. Table 3-6 contains the estimated daily traffic values, as well as county-level on-road and non-road HAP emissions.

Both ELNJ and LOMI experience high amounts of traffic, yet their hydrocarbon geometric means rank 11th and 21st across the sites, respectively. The highest geometric means were at GJCO, PGMS, and JAMS, yet the traffic count is ranked 22nd, 24th, and 25th, respectively. Specific characterizations for these sites appears in the separate state sections. Estimated county HAP emissions were highest in Maricopa County, AZ, which is the location of two monitoring sites: PSAZ and SPAZ. Interestingly, the two sites have similar geometric hydrocarbon concentrations (PSAZ, 7.49 ppbv; SPAZ, 8.02 ppbv), yet their exposure to passing traffic is very different. Nearly 50,000 cars daily pass the SPAZ site (traffic ranking 9th), while only 250 motor vehicle daily pass the PSAZ site (traffic ranking 41st). There does not appear to be any direct correlation between traffic counts and geometric hydrocarbon concentrations.

3.5 Variability Analysis

Two types of variability were analyzed for this report. The first type examines the coefficient of variance analysis for each of the prevalence across the UATMP sites. Figures 3-17 to 3-30 are graphical displays of site standard deviation versus average concentration. Most of the prevalent compounds are either in a cluster (such as *m*-,*p*-xylene), exhibit a positive linear correlation (such as propylene), or are spread randomly (such as toluene). The coefficient of variance provides a relative measure of variability by expressing variations to the magnitude of the arithmetic mean. This analysis is better suited for comparing variability across data distributions for different sites and compounds.

Seasonal variability was the second type of variability analyzed in this report. The UATMP concentration data were divided into the four seasons: spring (March, April, May);

summer (June, July, August); fall (September, October, November); and winter (December, January, and February). Figures 3-31 to 3-44 are a graphical display of the average concentrations by season for the prevalent compounds. There appears to be no consistency across the sites as to which season predominantly has higher concentrations. A quick review of the profiles reveals most compounds experienced noticeable “spikes” across all sites, while few exhibited a uniform profile (acetaldehyde and chloromethane, for example). This observation validates the variabilities for each of the sites.

Figure 3-1: Comparison of the Geometric Means of the Compound Groups

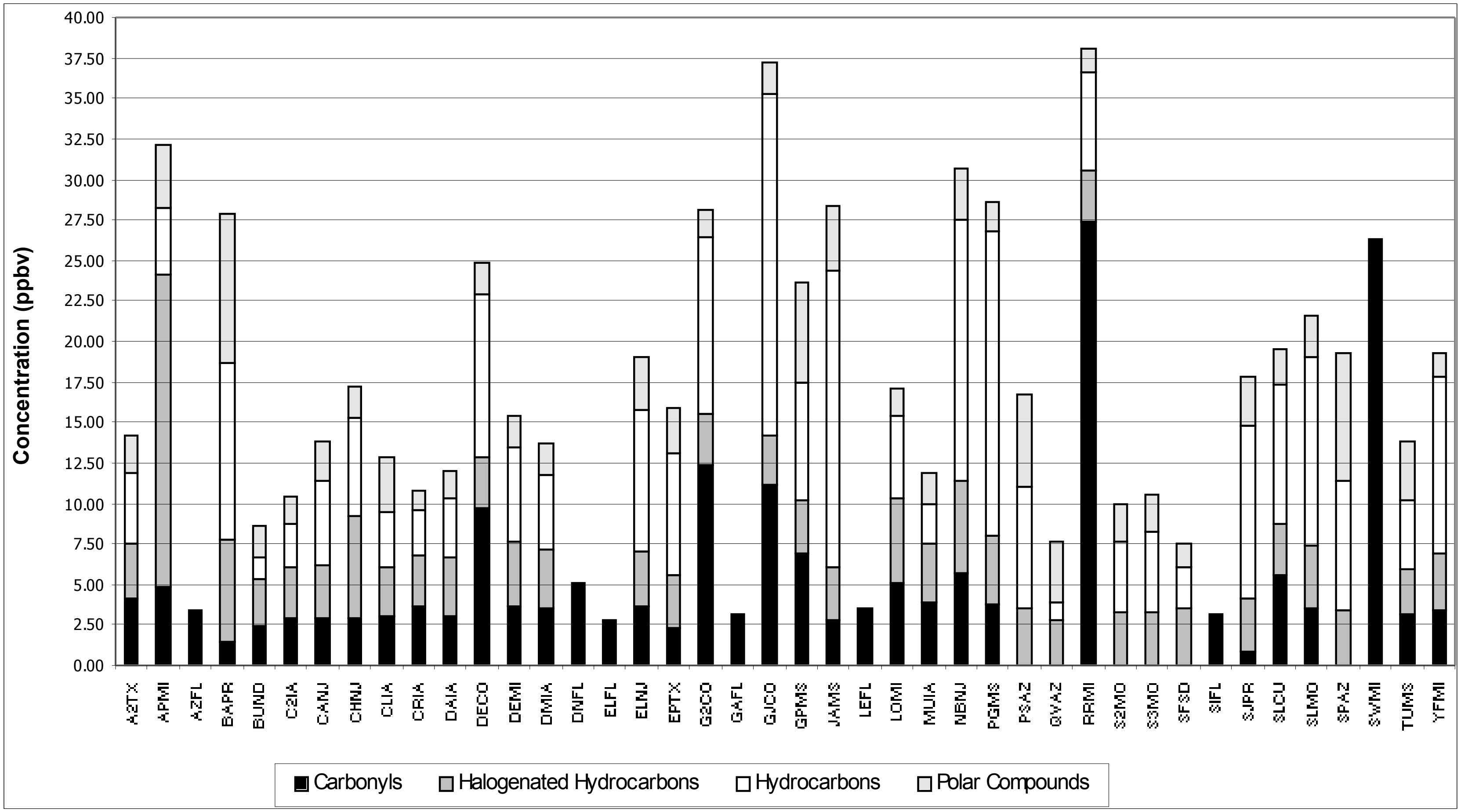


Figure 3-2: Geometric Mean of Acetaldehyde by Monitoring Location

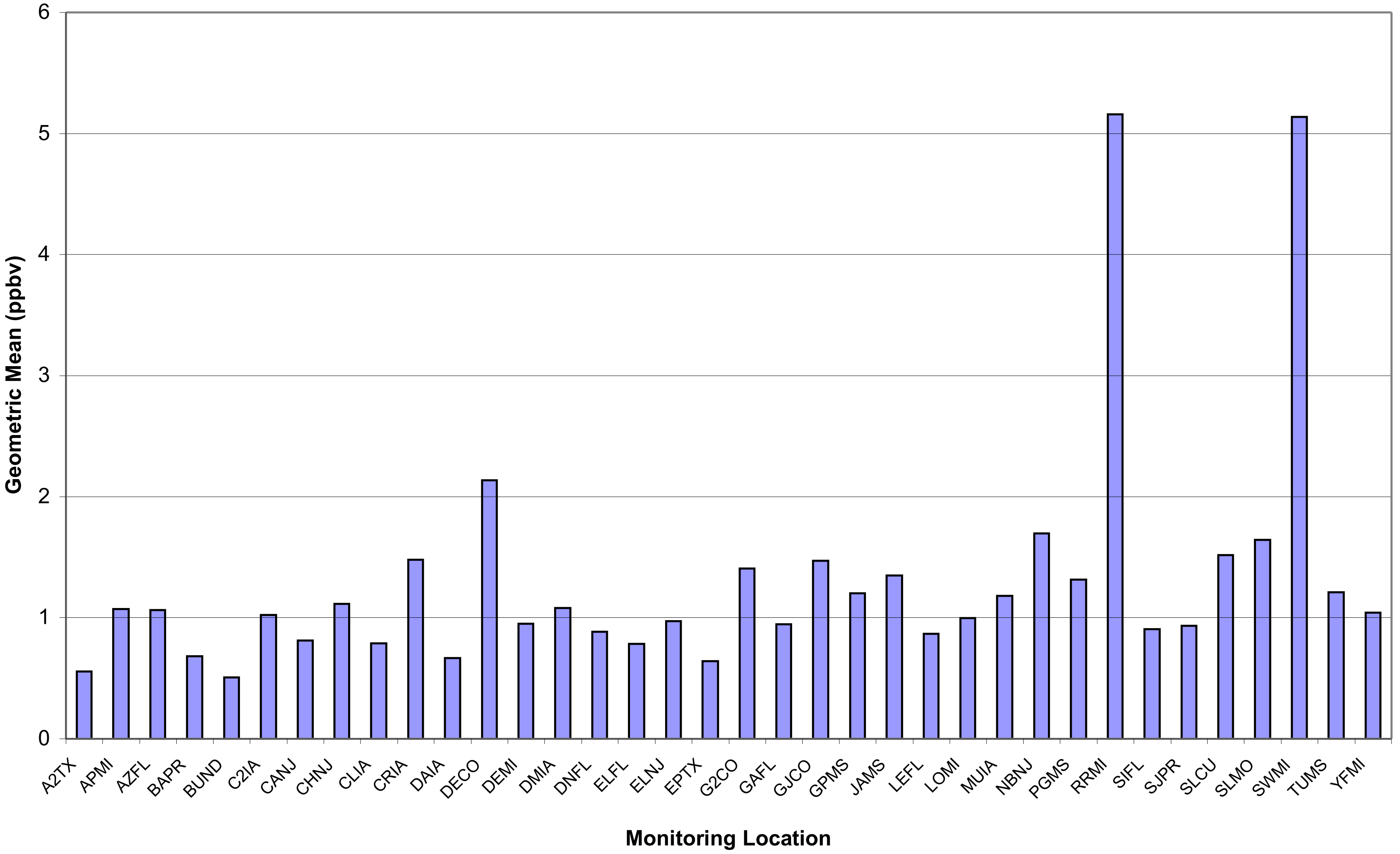


Figure 3-3: Geometric Mean of Acetone by Monitoring Location

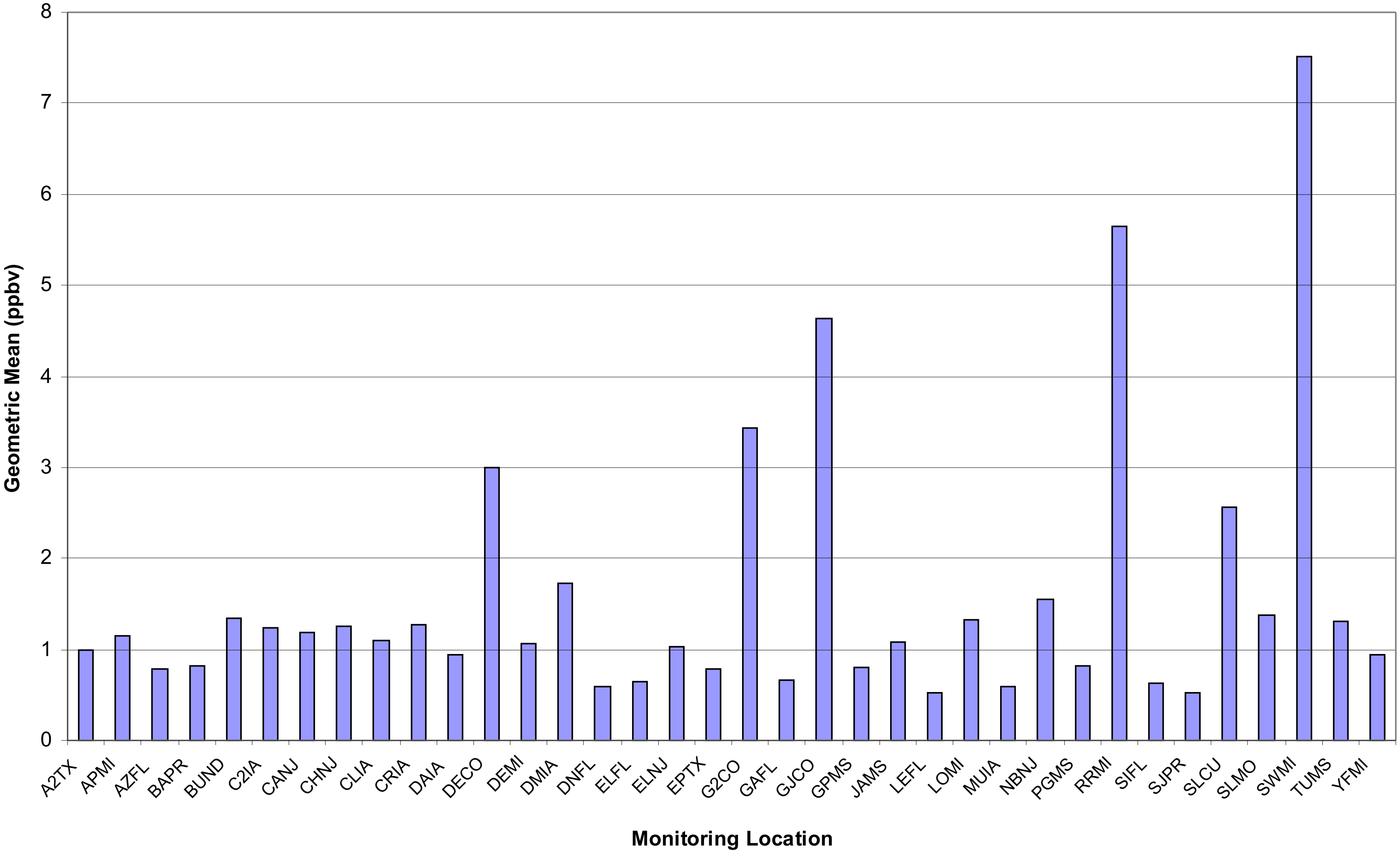


Figure 3-4: Geometric Mean of Acetylene by Monitoring Location

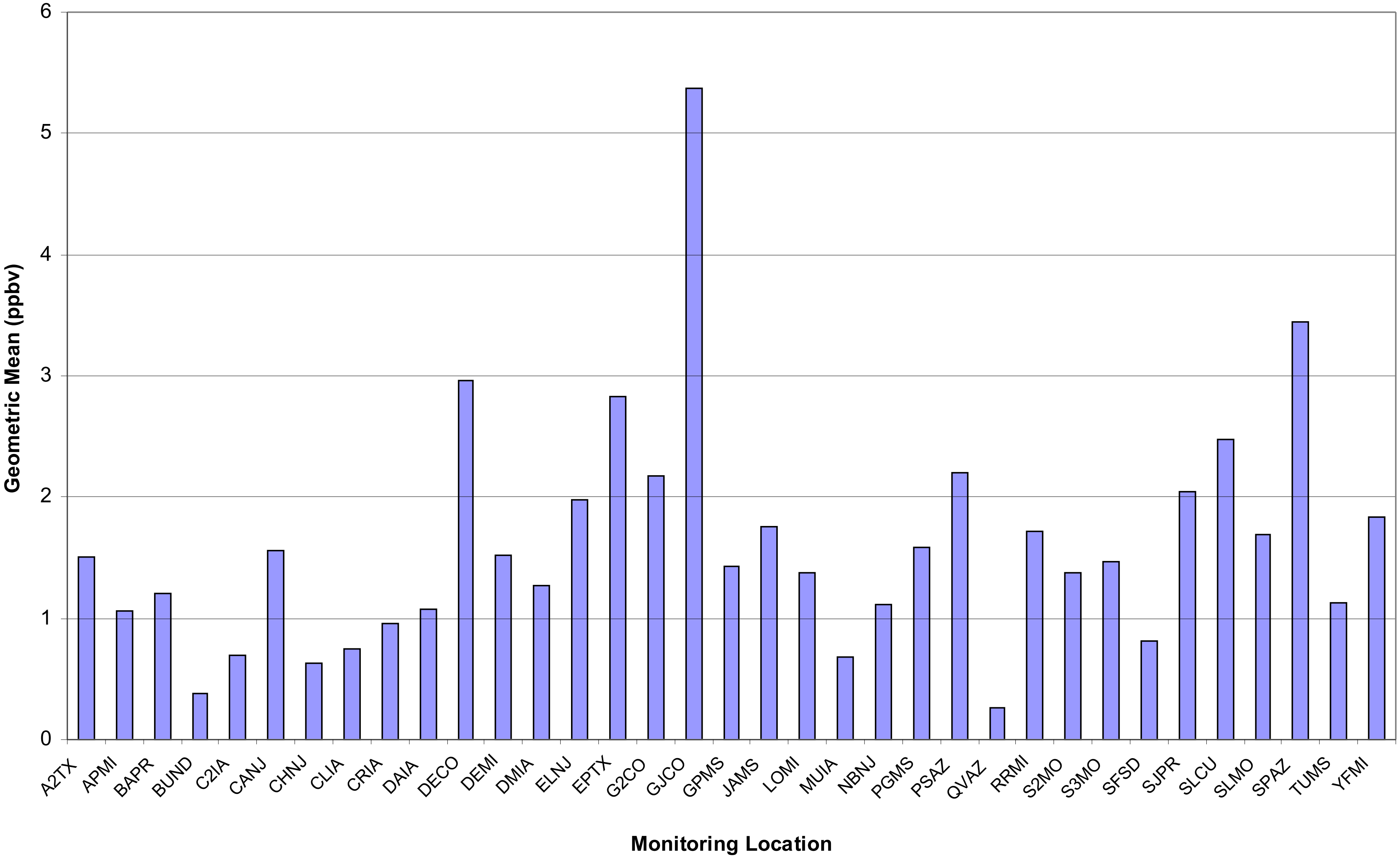


Figure 3-5: Geometric Mean of Benzene by Monitoring Location

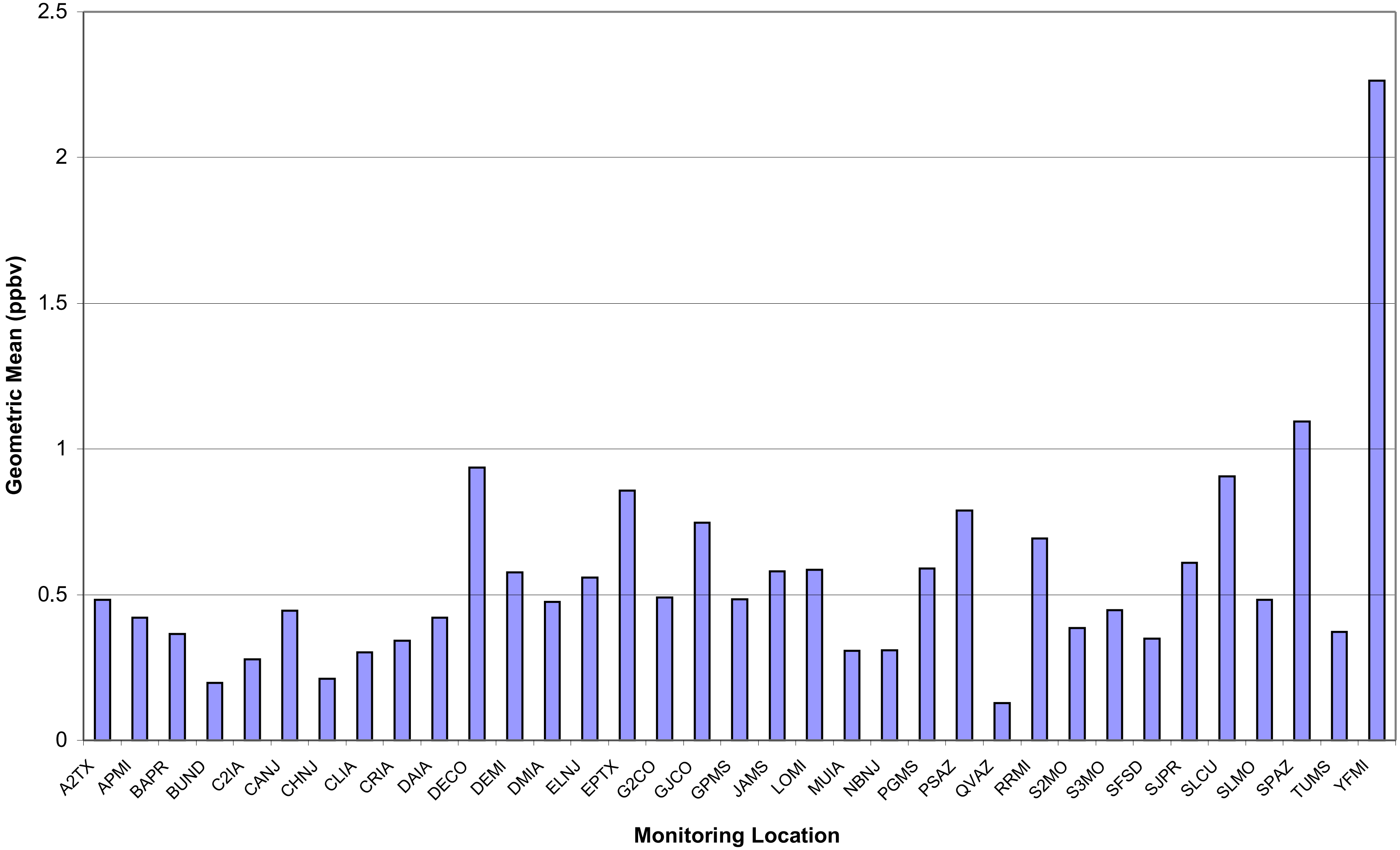


Figure 3-6: Geometric Mean of Chloromethane by Monitoring Location

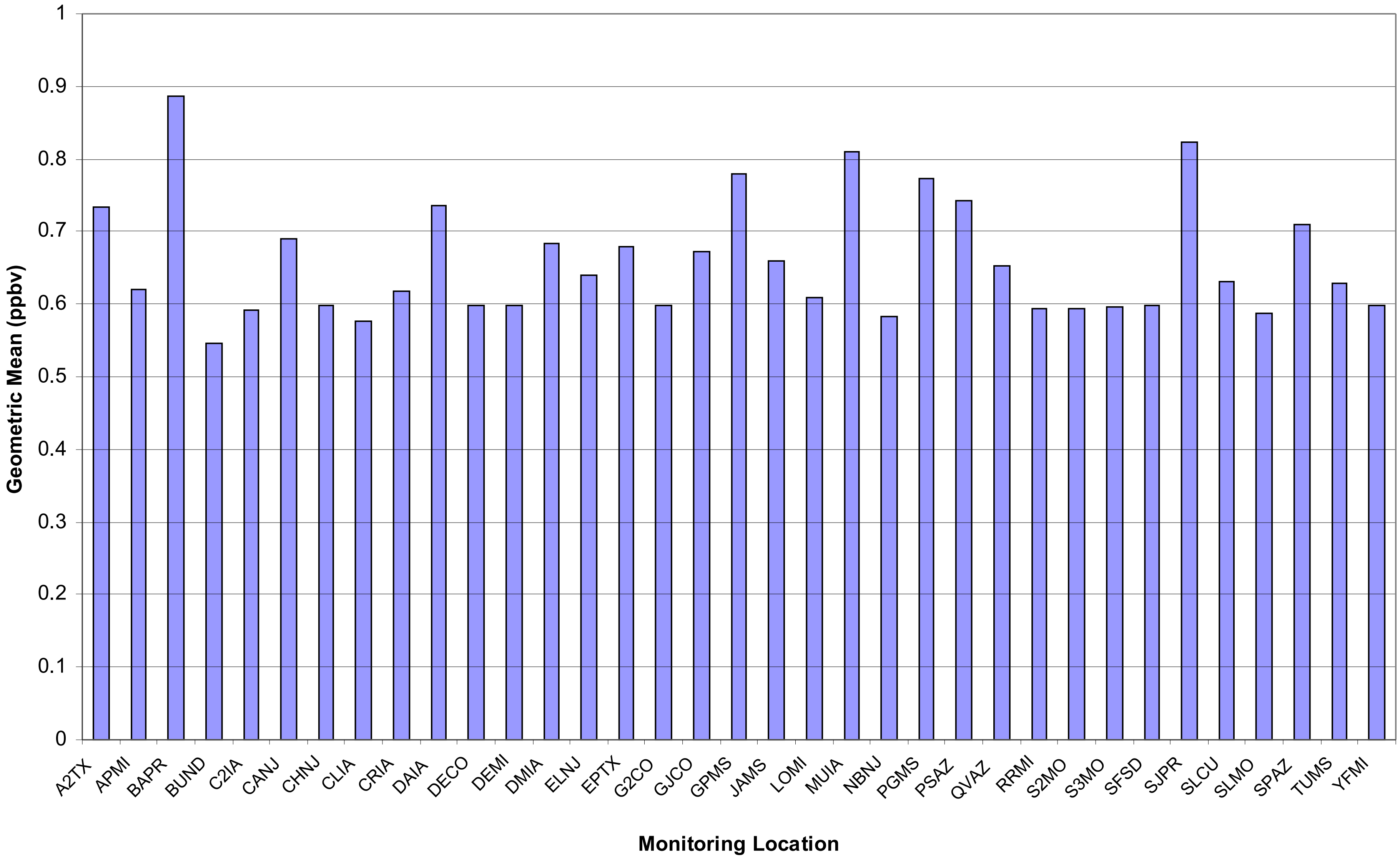


Figure 3-7: Geometric Mean of Dichlorodifluoromethane by Monitoring Location

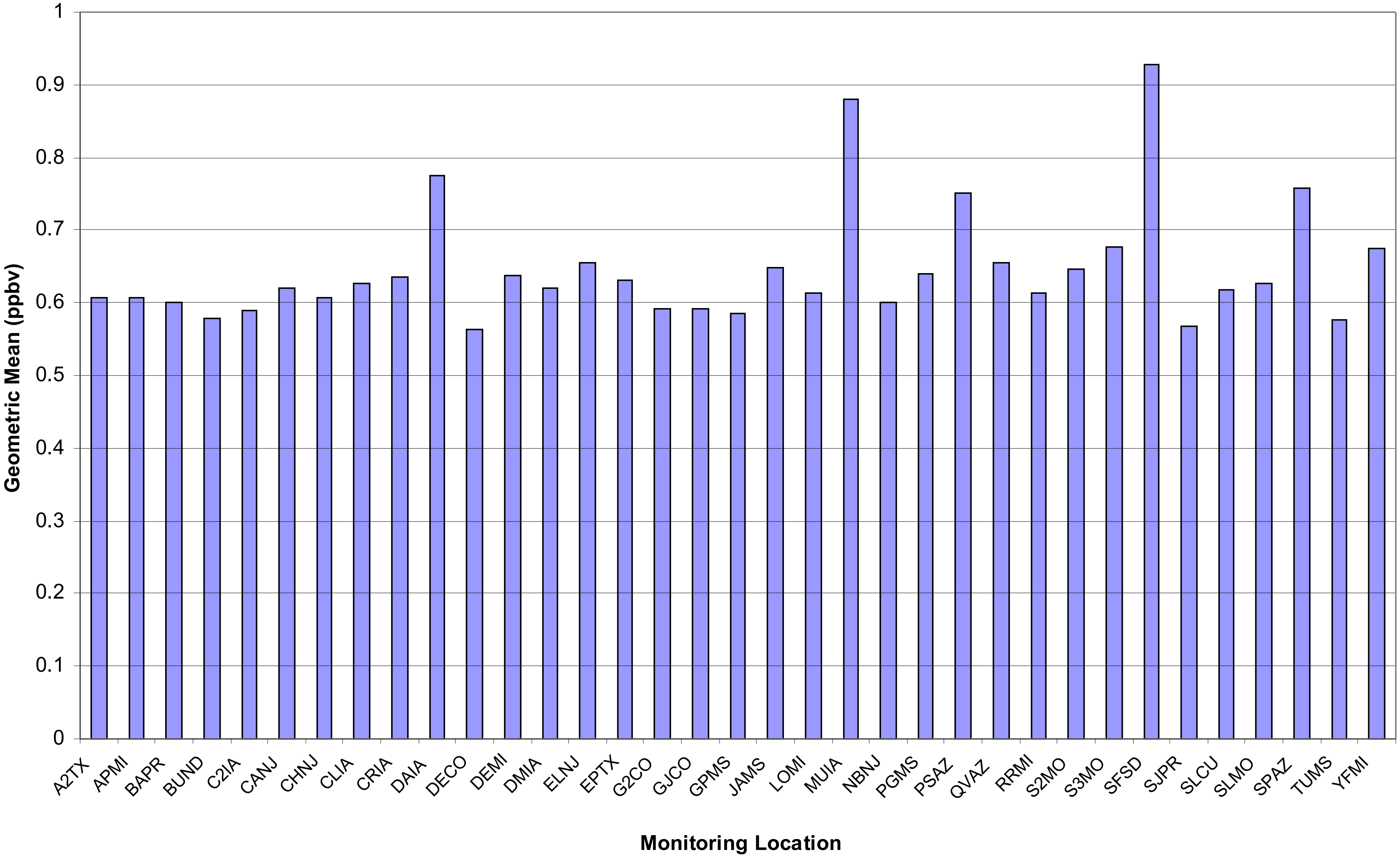


Figure 3-8: Geometric Mean of Ethylbenzene by Monitoring Location

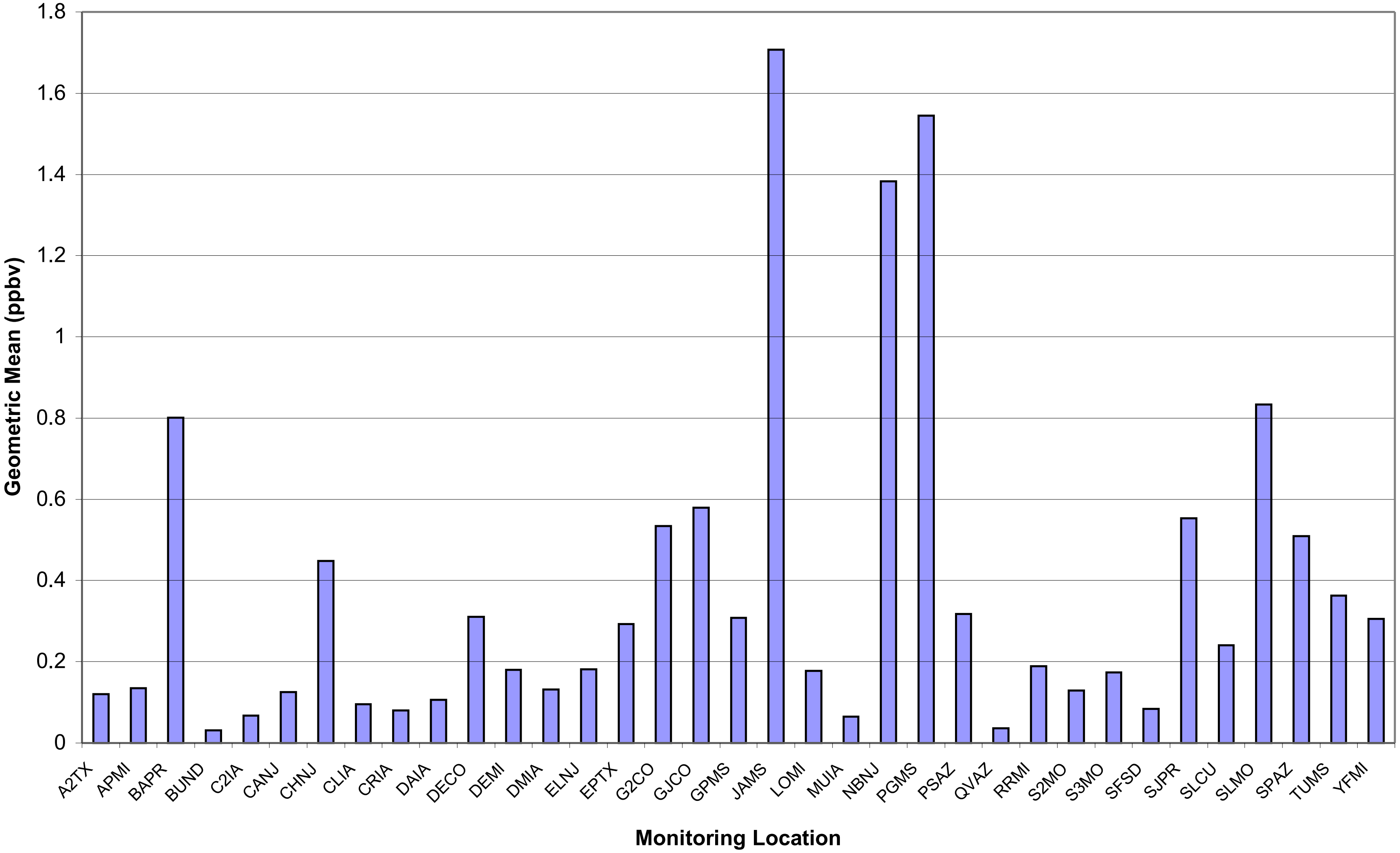


Figure 3-9: Geometric Mean of Formaldehyde by Monitoring Location

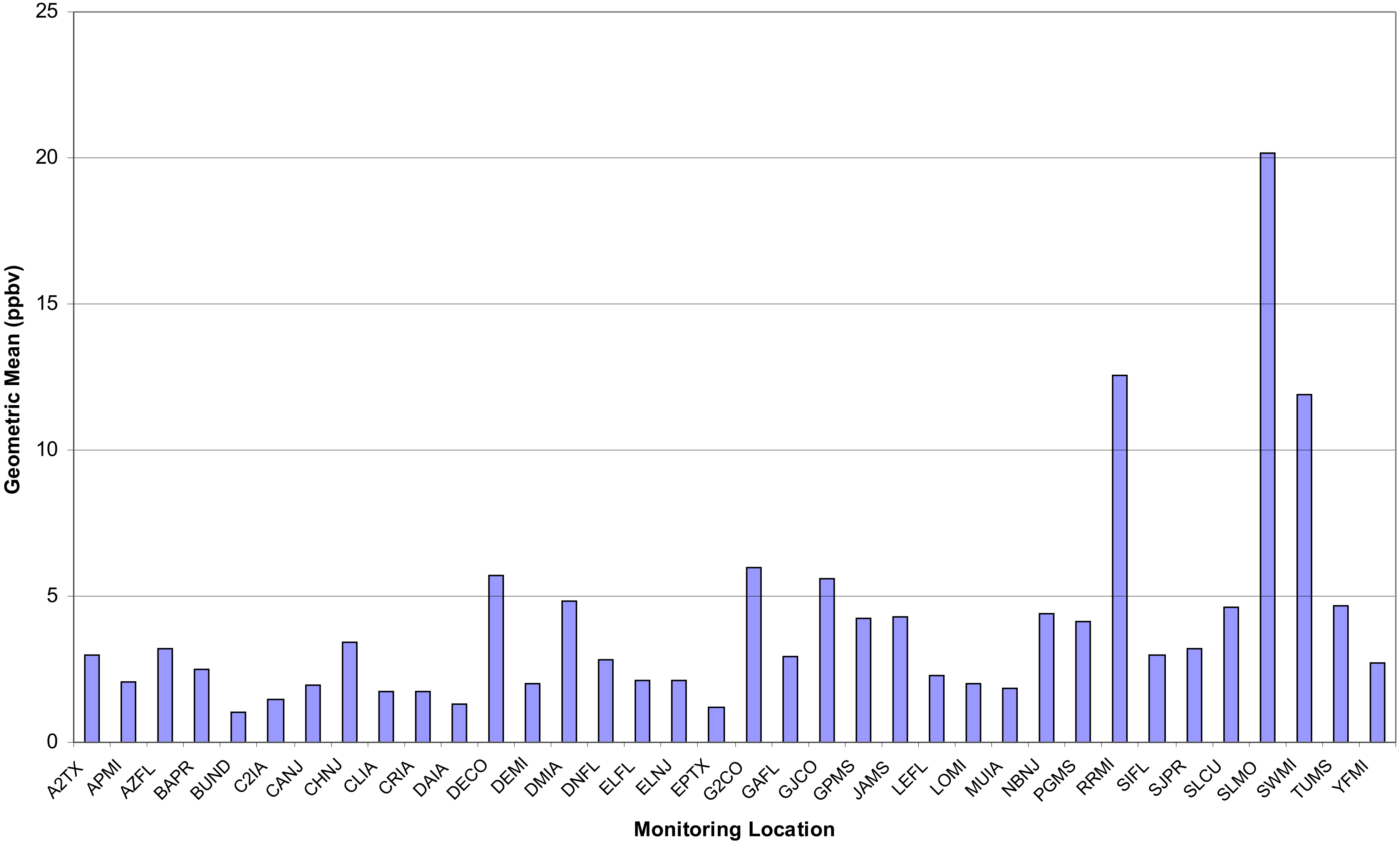


Figure 3-10: Geometric Mean of *m-,p-* Xylene by Monitoring Location

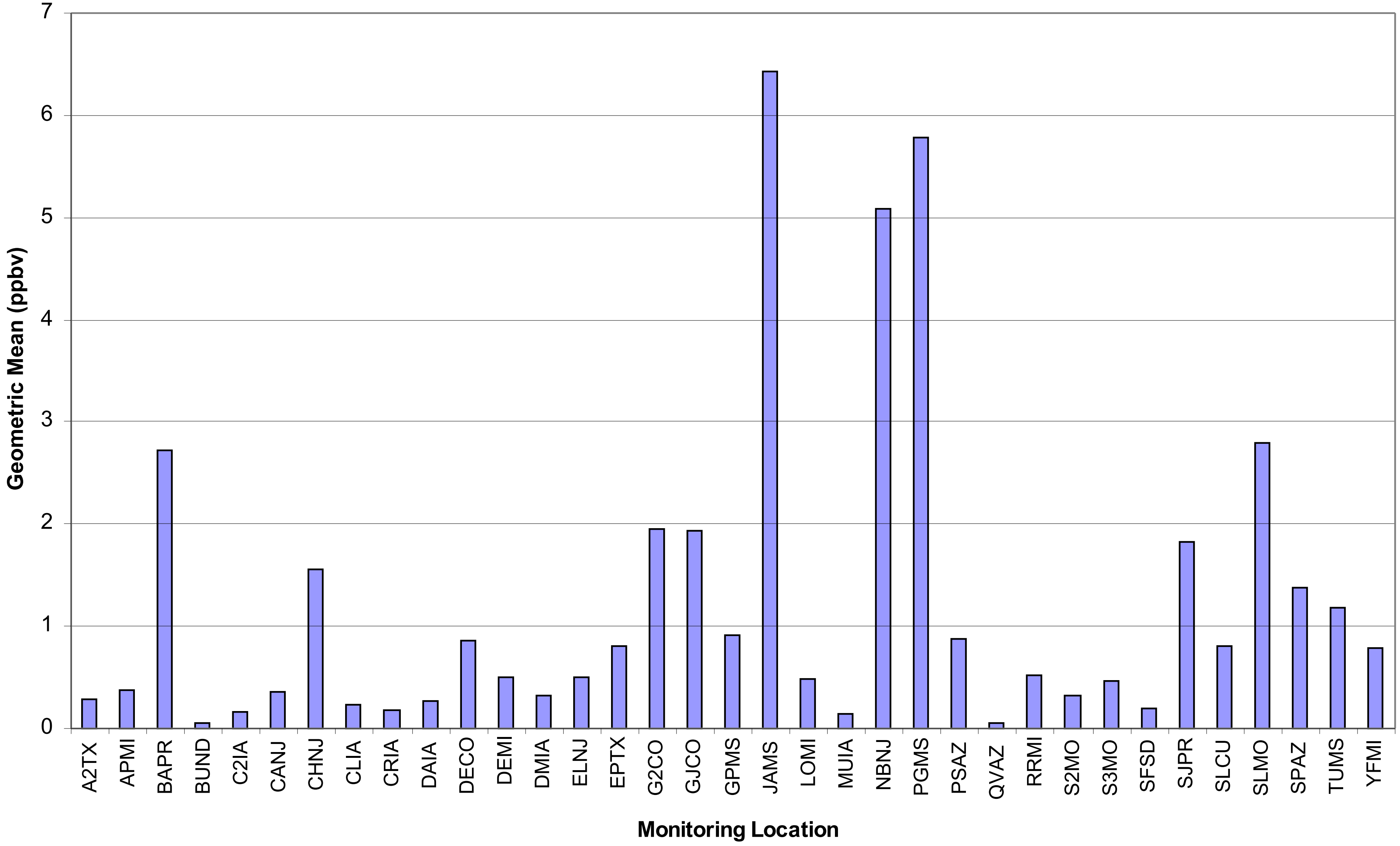


Figure 3-11: Geometric Mean of Methyl Ethyl Ketone by Monitoring Location

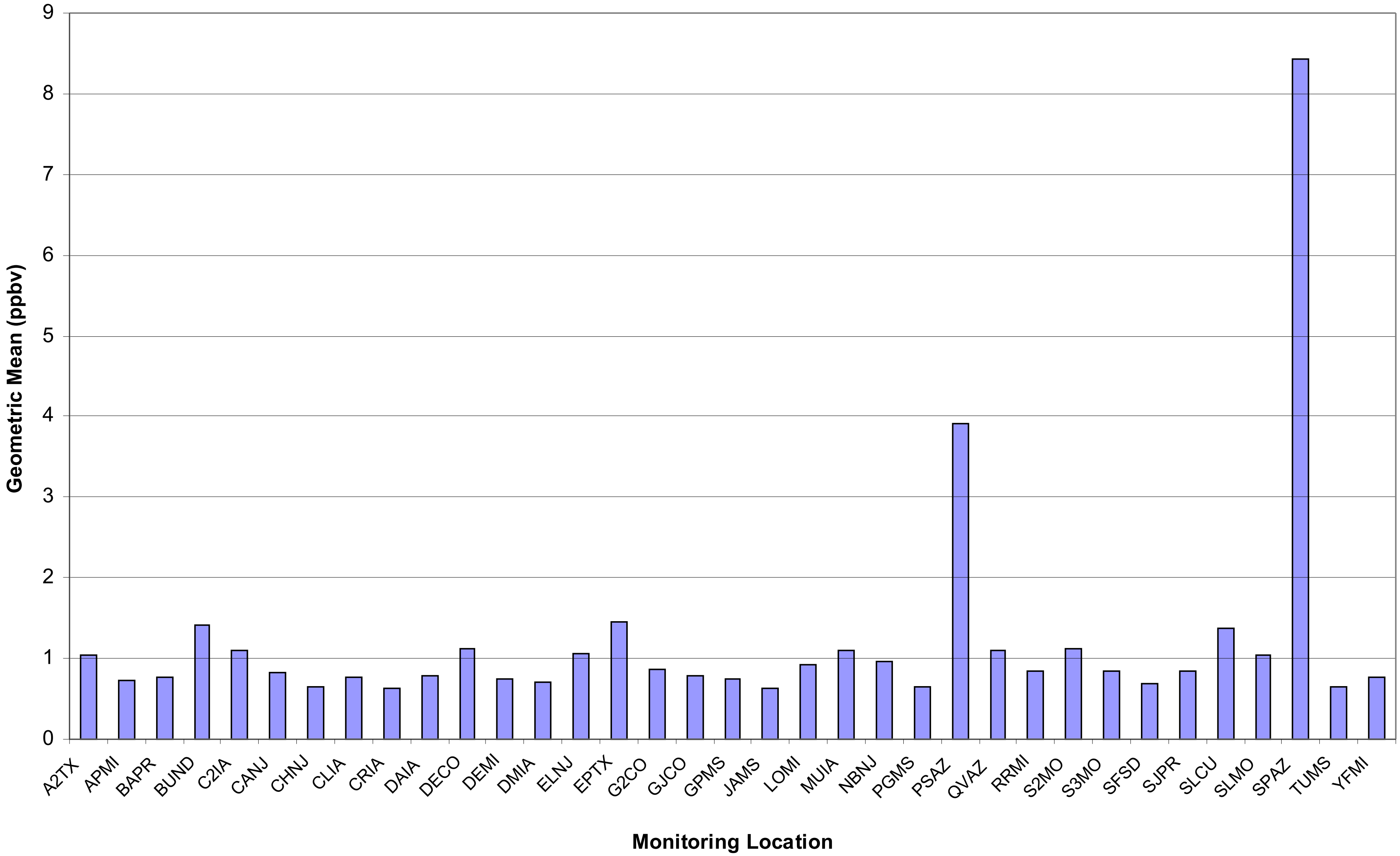


Figure 3-12: Geometric Mean of Methylene Chloride by Monitoring Location

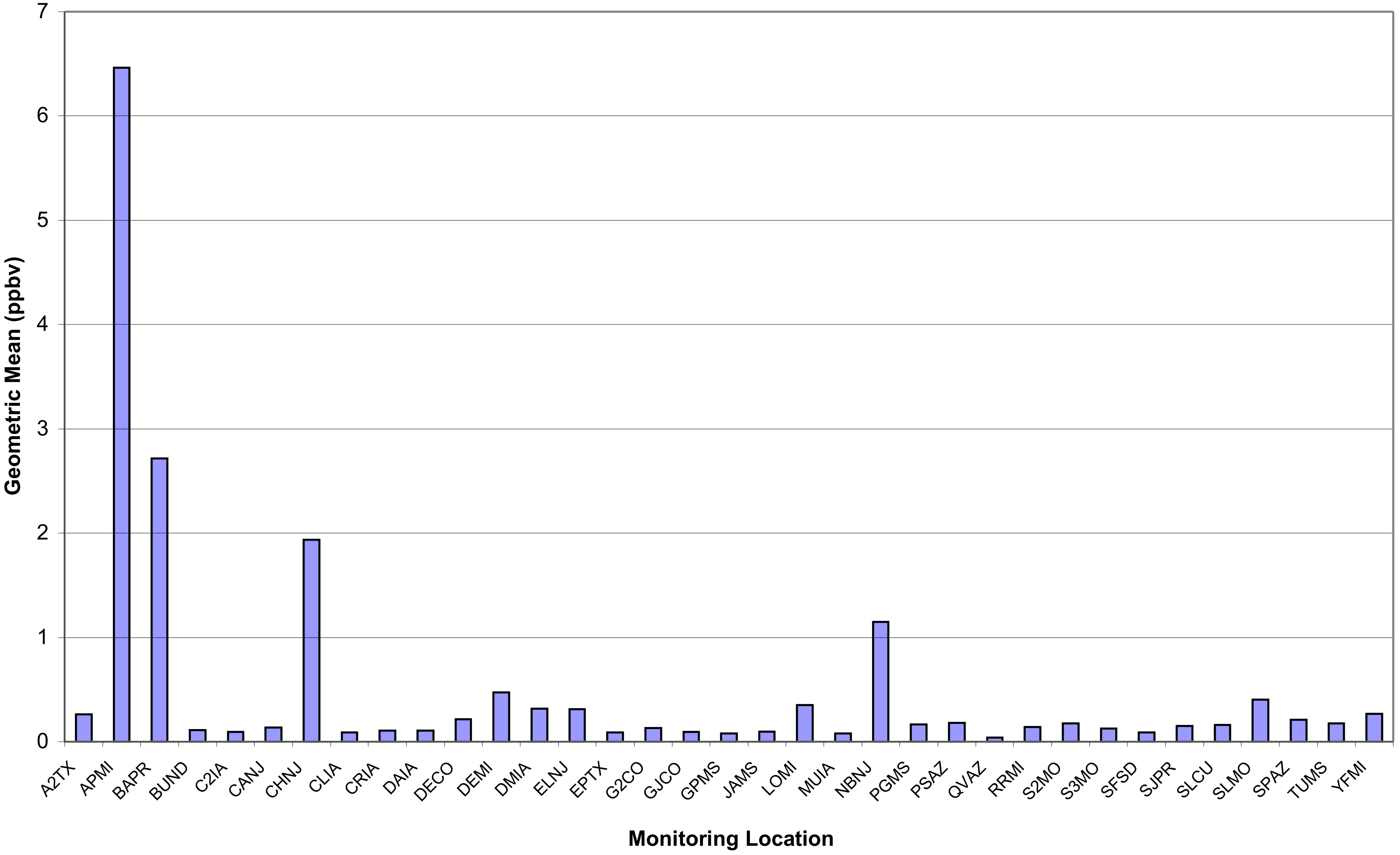


Figure 3-13: Geometric Mean of *o*-Xylene by Monitoring Location

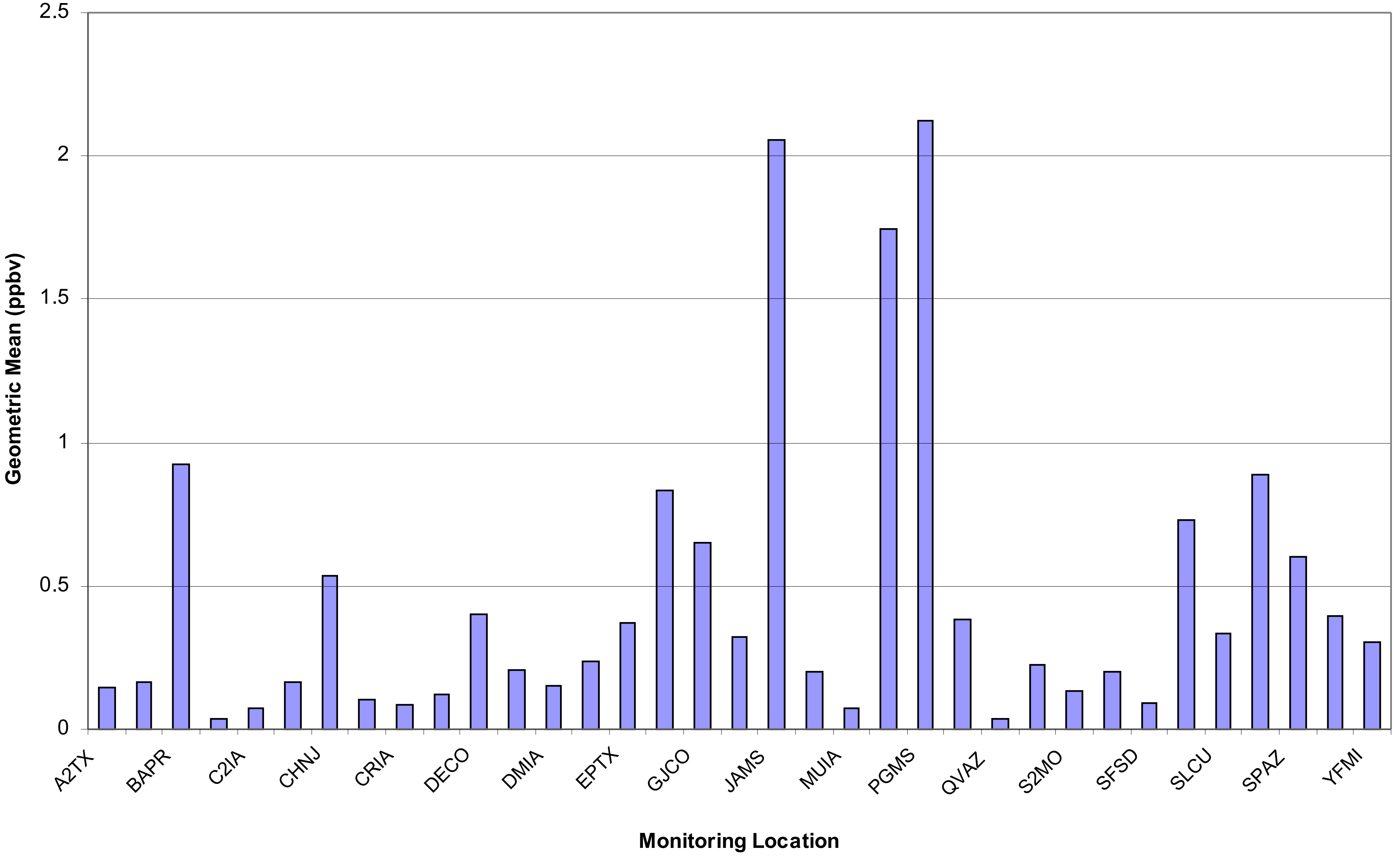


Figure 3-14: Geometric Mean of Propylene by Monitoring Location

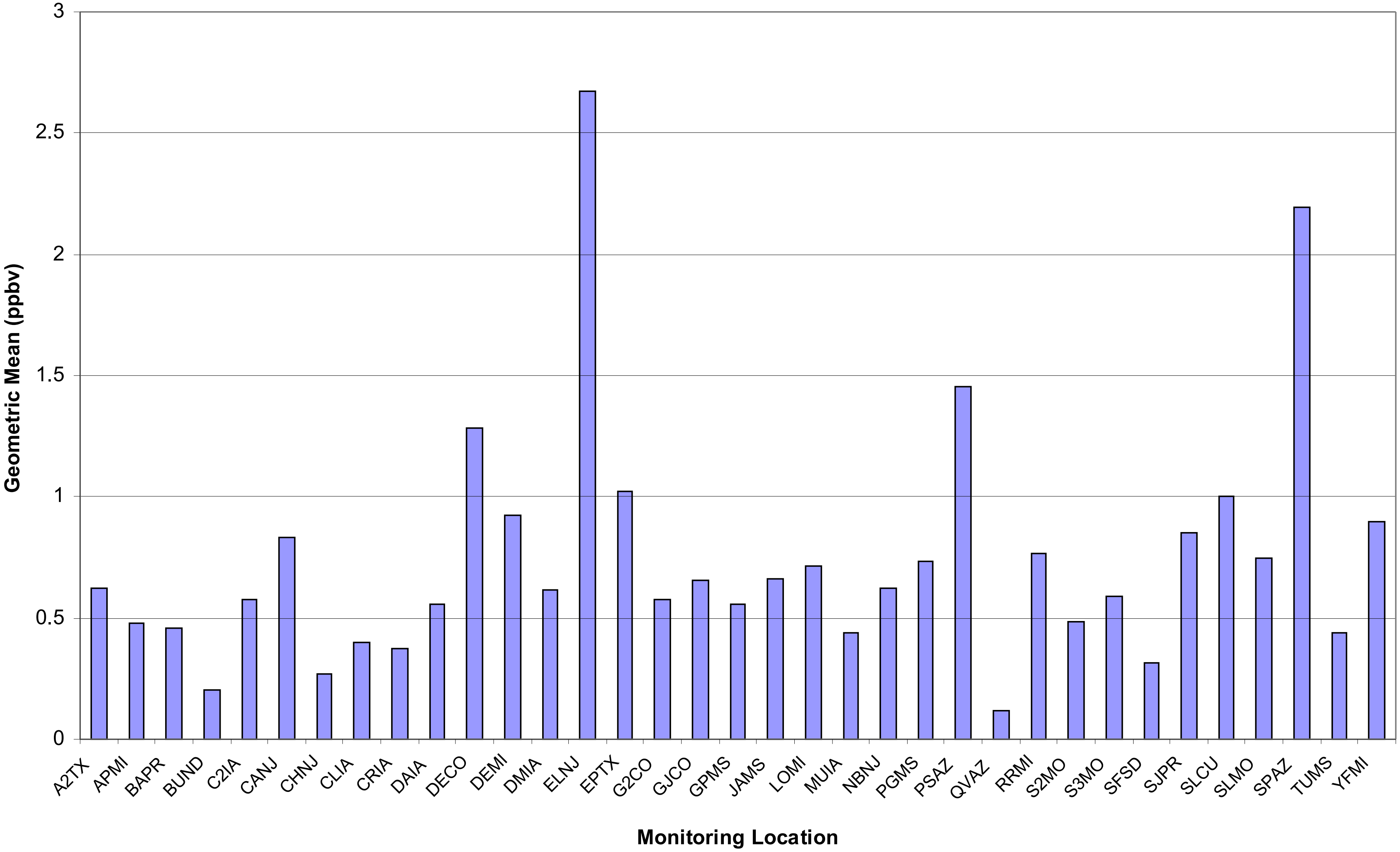


Figure 3-15: Geometric Mean of Toluene by Monitoring Location

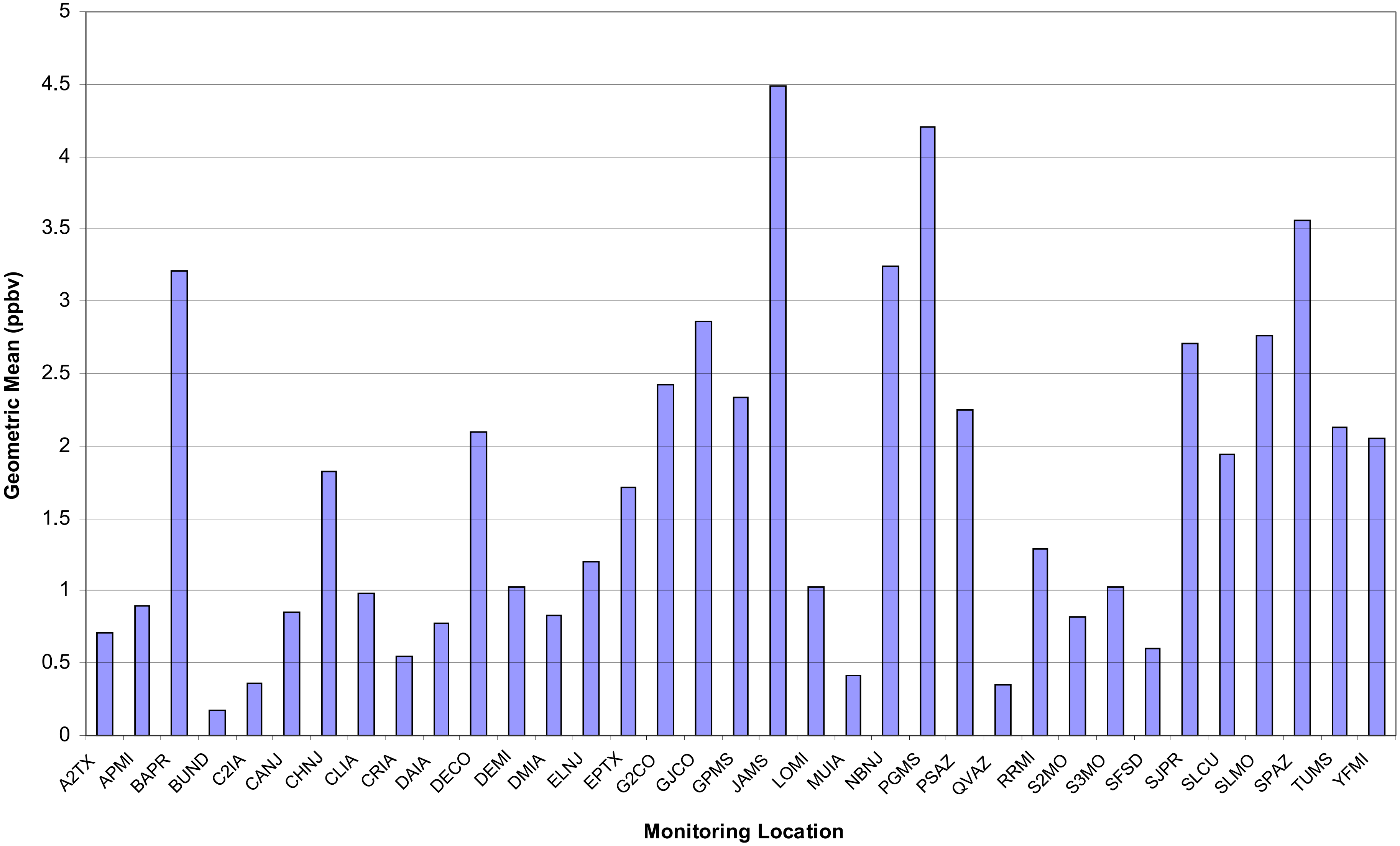


Figure 3-16: Comparison of Concentration Ratios for BTEX Compounds vs. Roadside Study

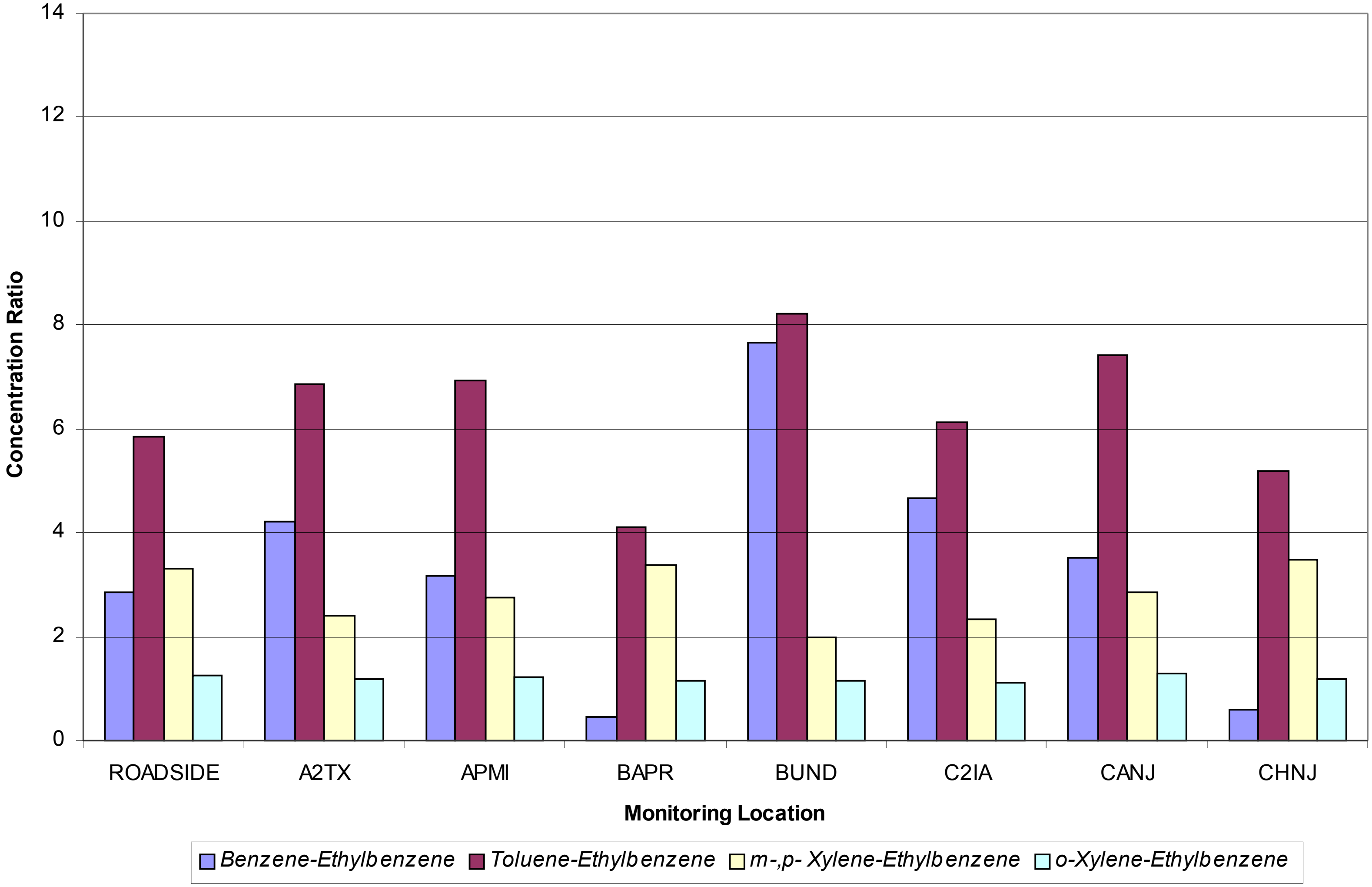


Figure 3-16 (Continued)

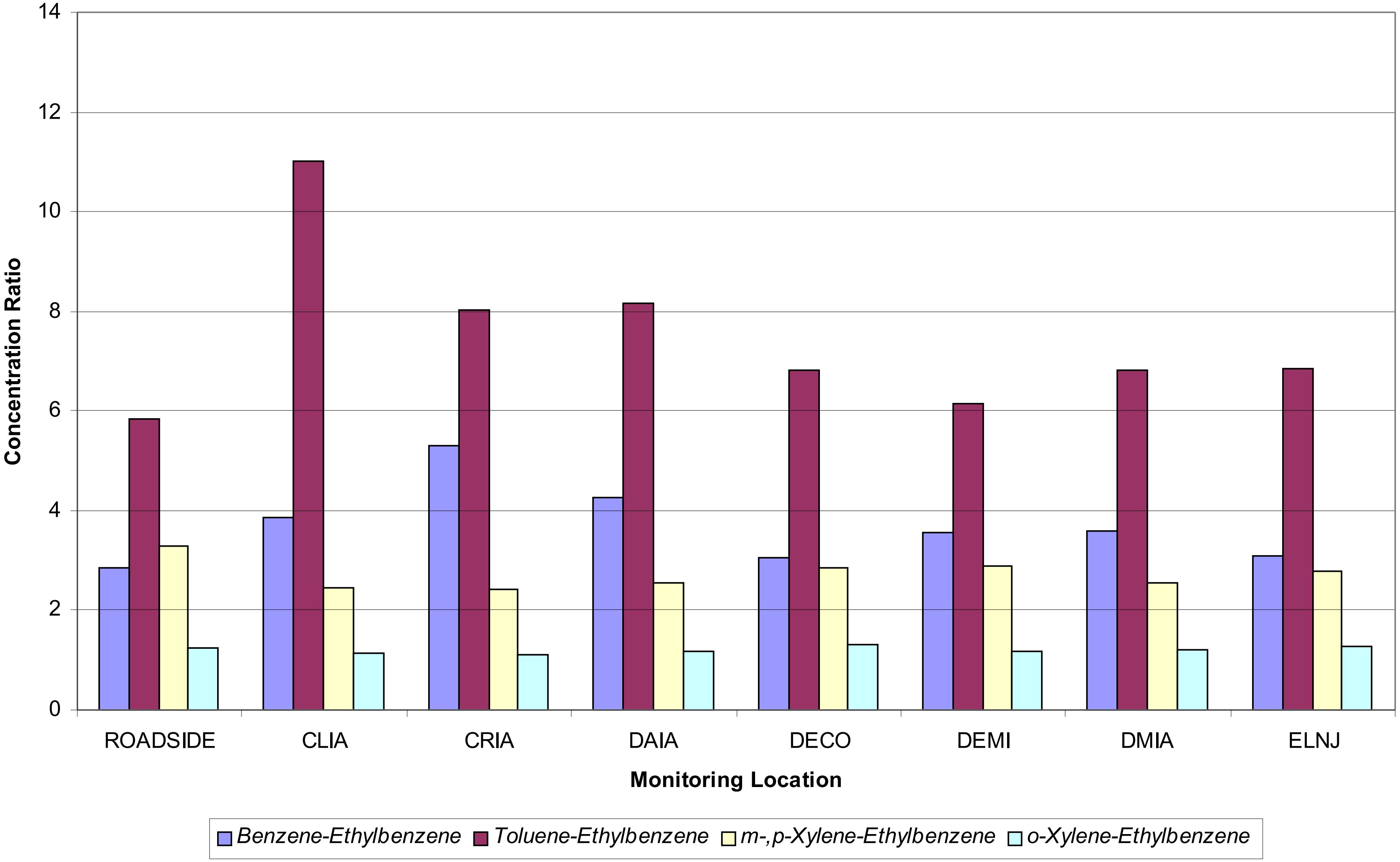
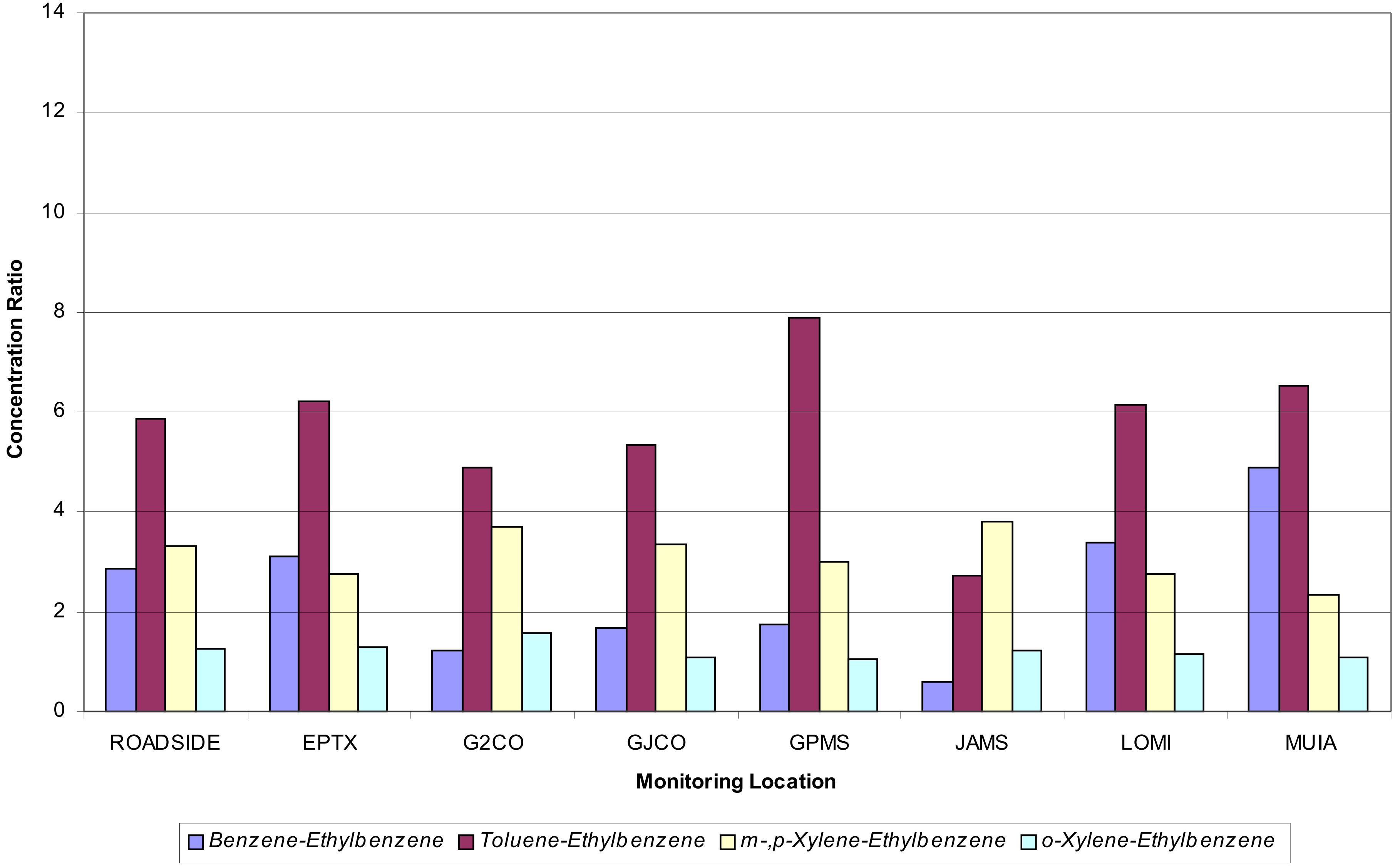


Figure 3-16 (Continued)



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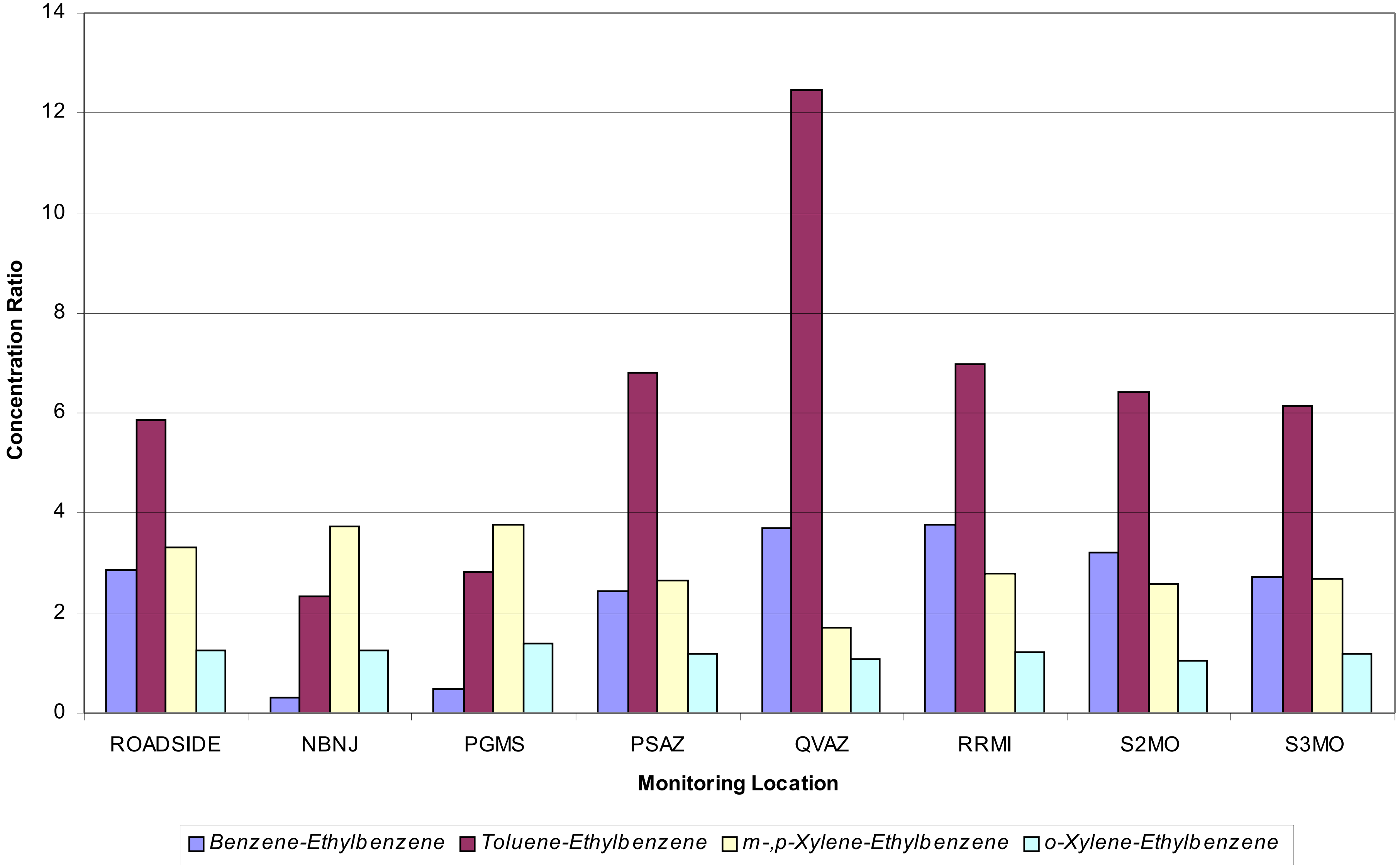


Figure 3-16 (Continued)

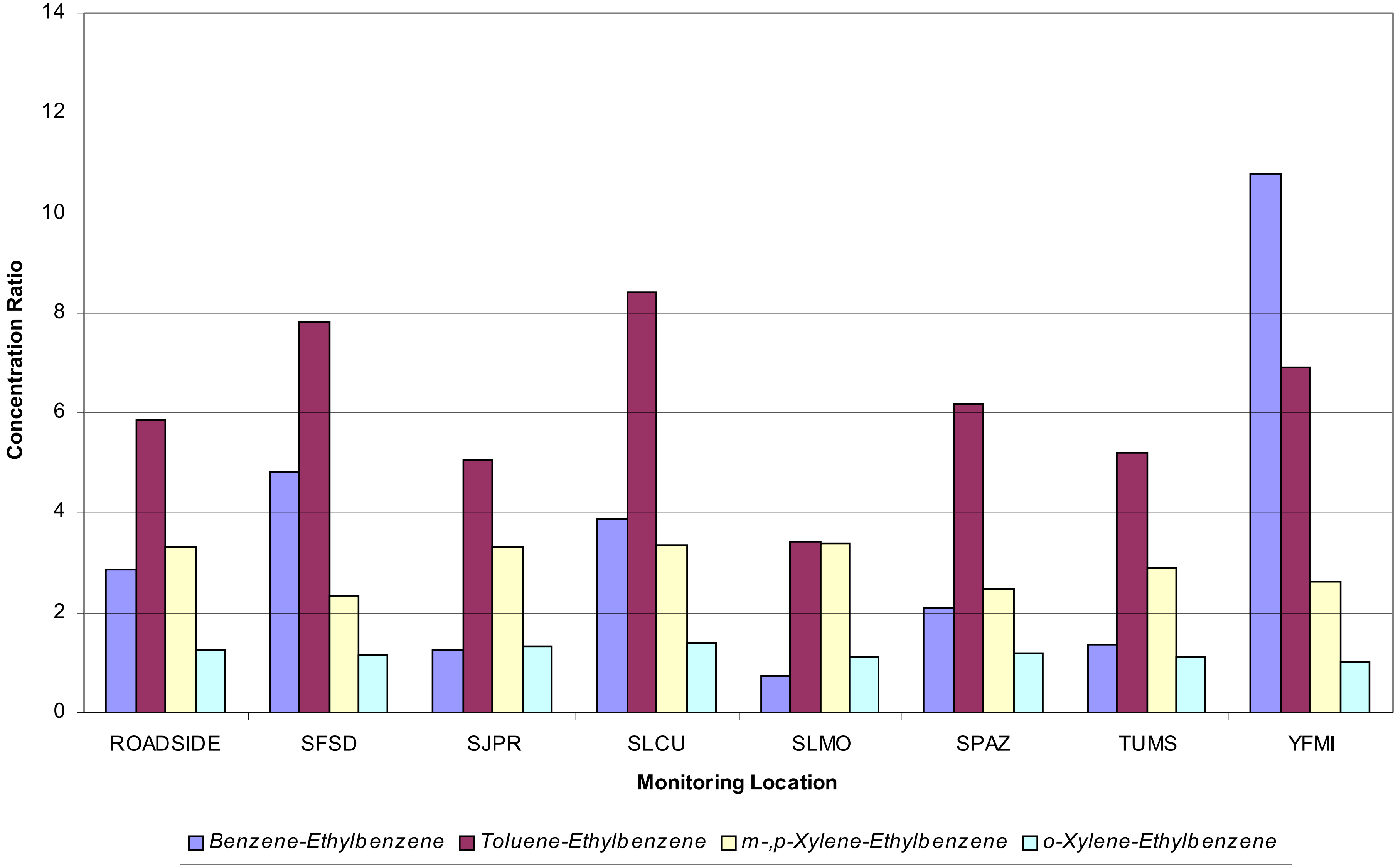


Figure 3-17: Coefficient of Variance Analysis of Acetaldehyde Across 36 Sites

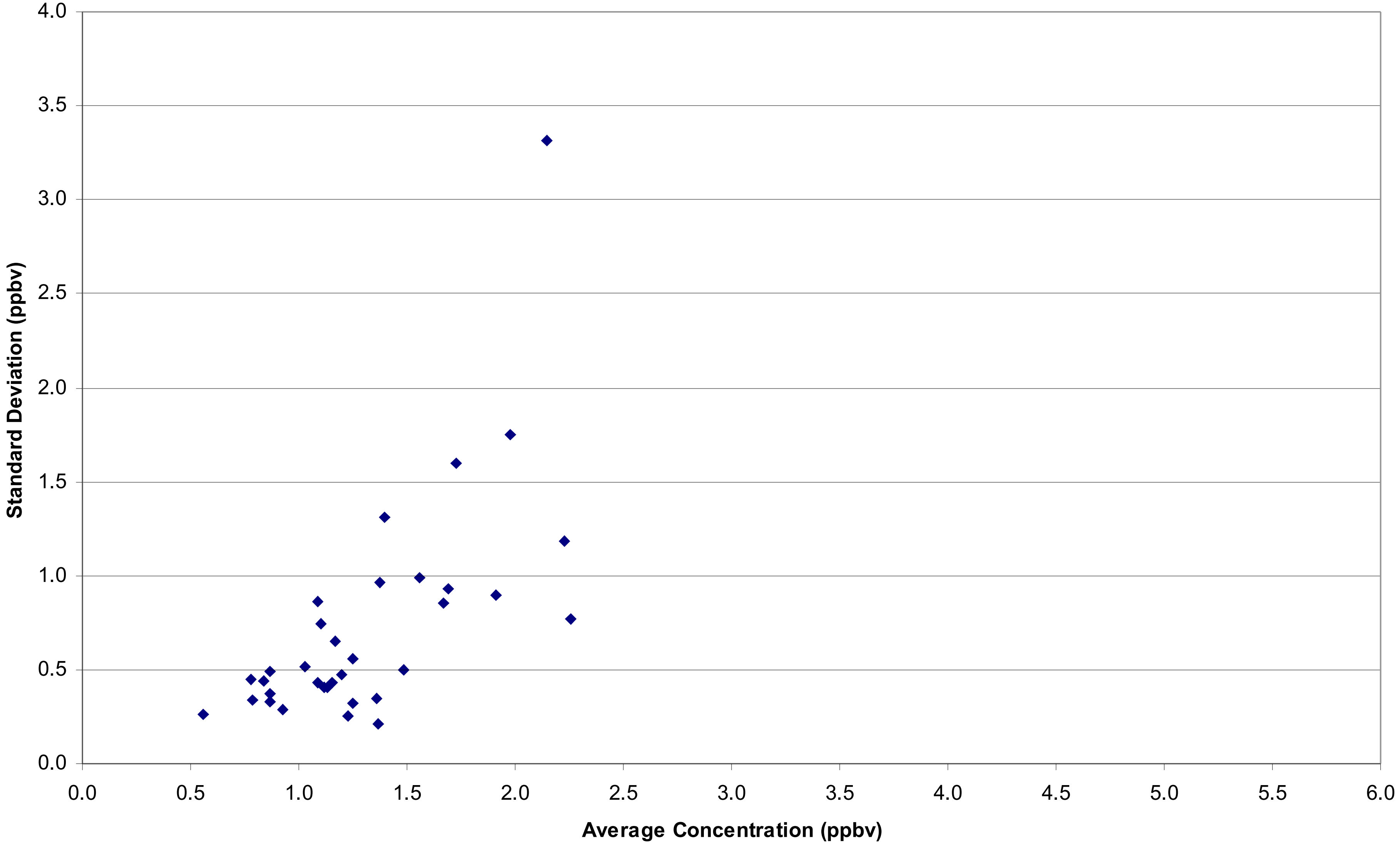


Figure 3-18: Coefficient of Variance Analysis of Acetone Across 36 Sites

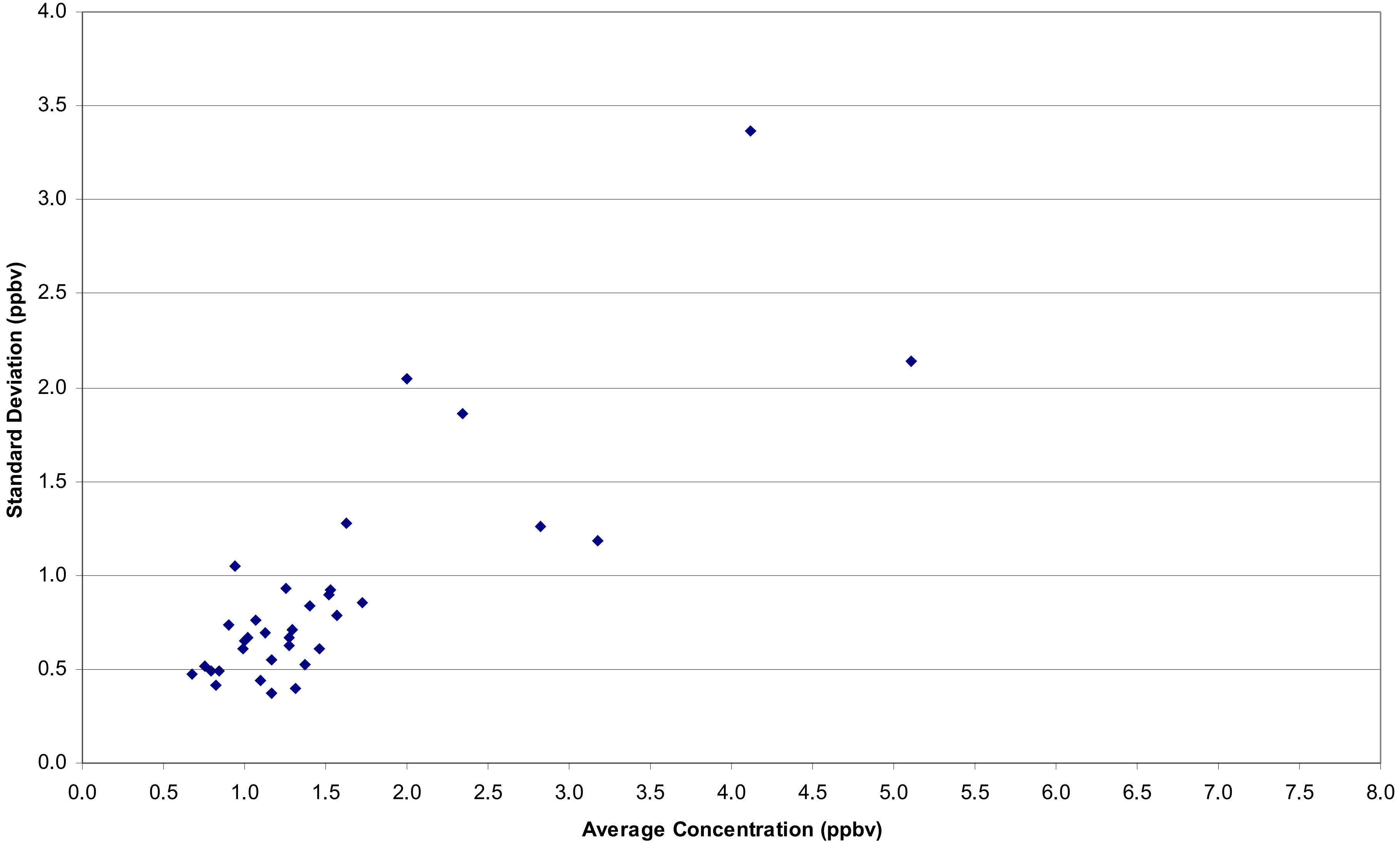


Figure 3-19: Coefficient of Variance Analysis of Acetylene Across 35 Sites

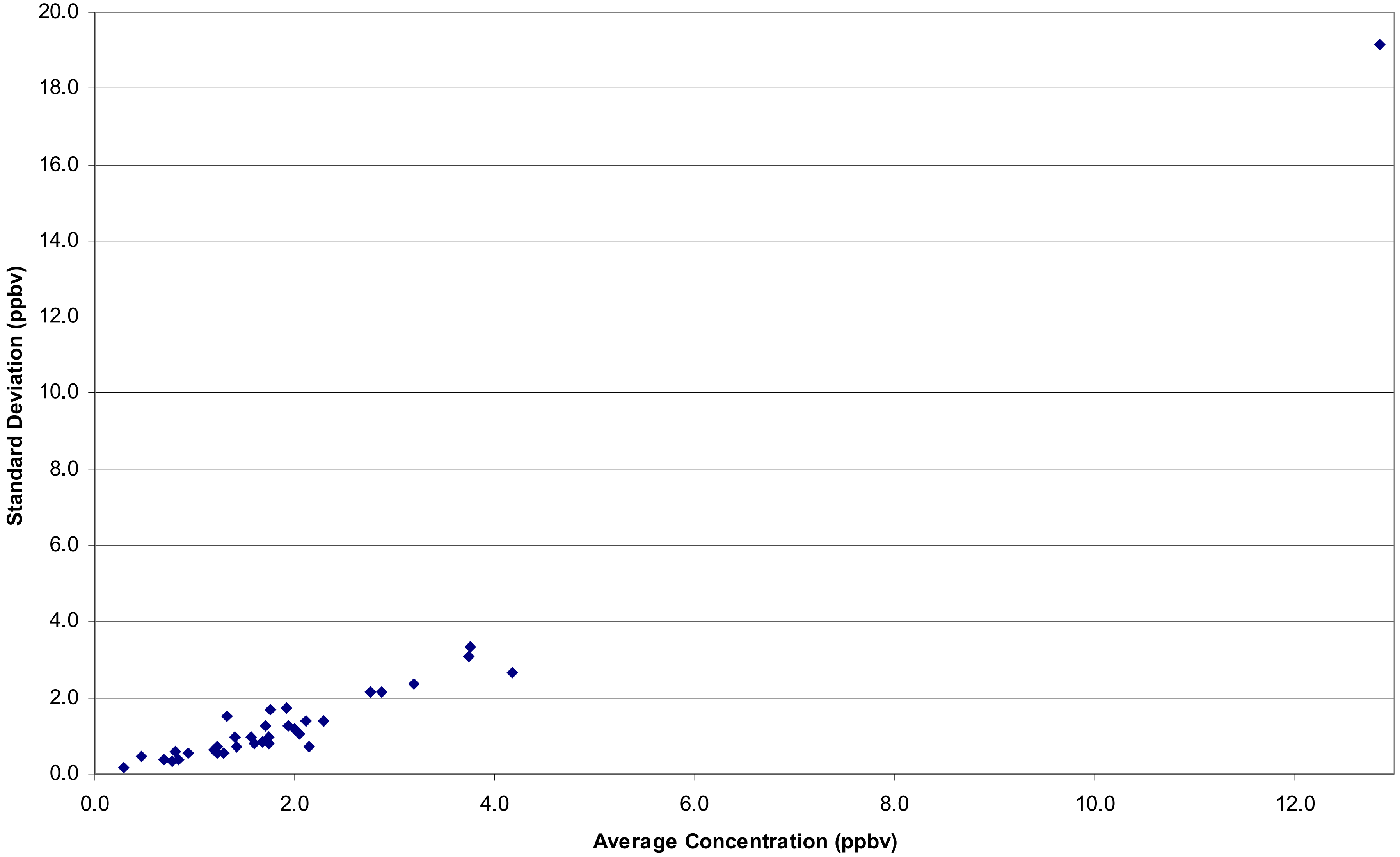


Figure 3-20: Coefficient of Variance Analysis of Benzene Across 35 Sites

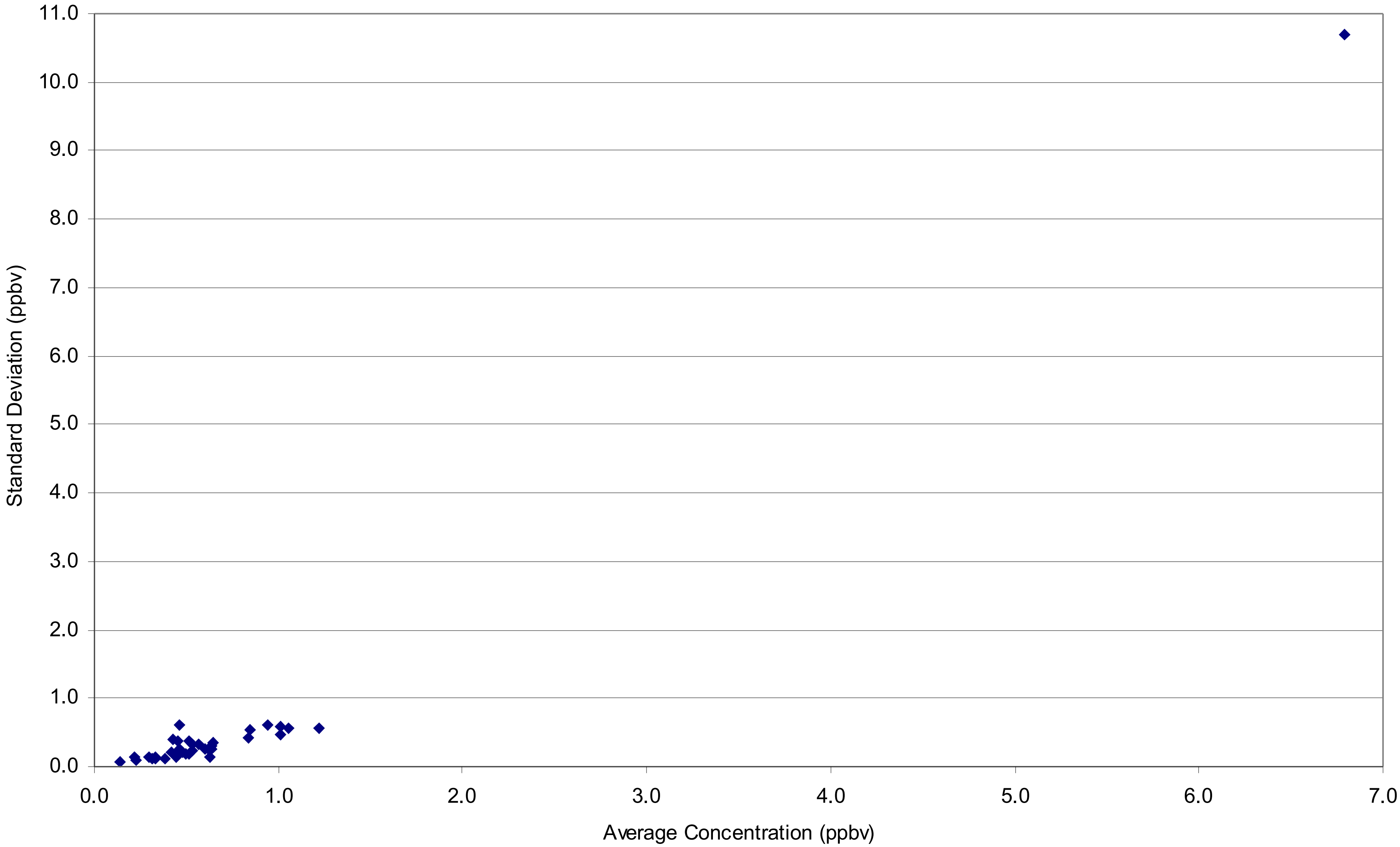


Figure 3-21: Coefficient of Variance Analysis of Chloromethane Across 35 Sites

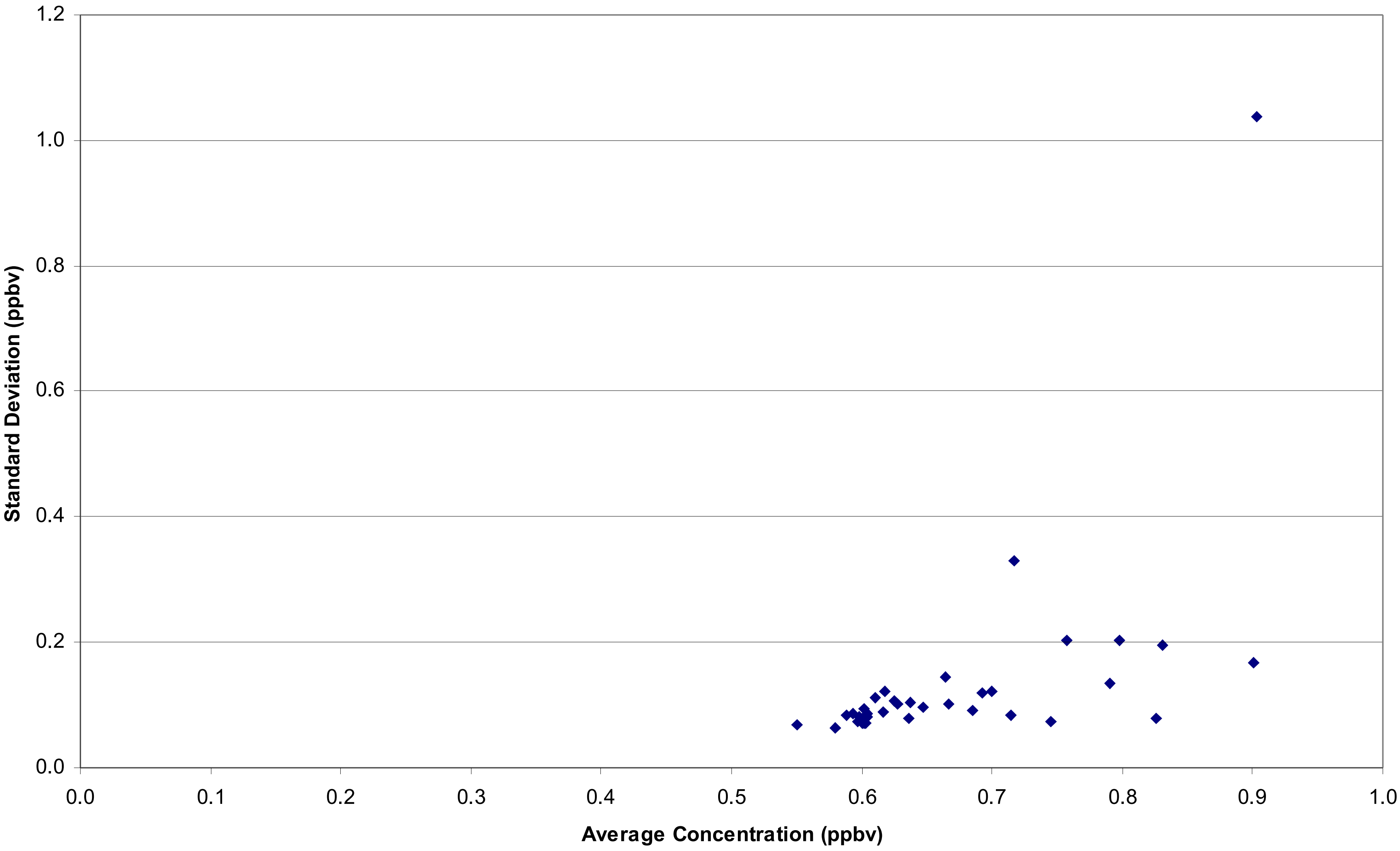


Figure 3-22: Coefficient of Variance Analysis of Dichlorodifluoromethane Across 35 Sites

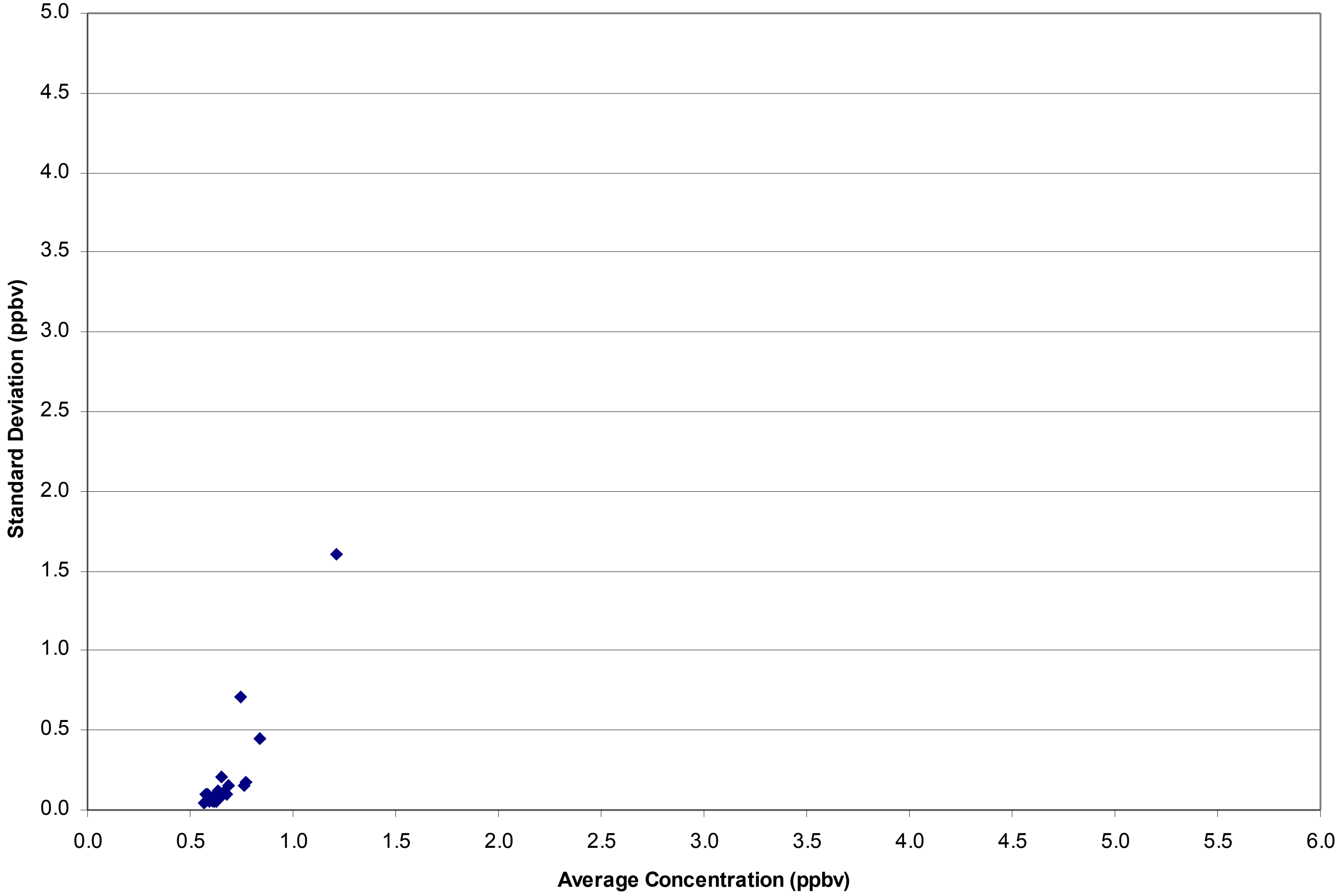


Figure 3-23: Coefficient of Variance Analysis of Ethylbenzene Across 35 Sites

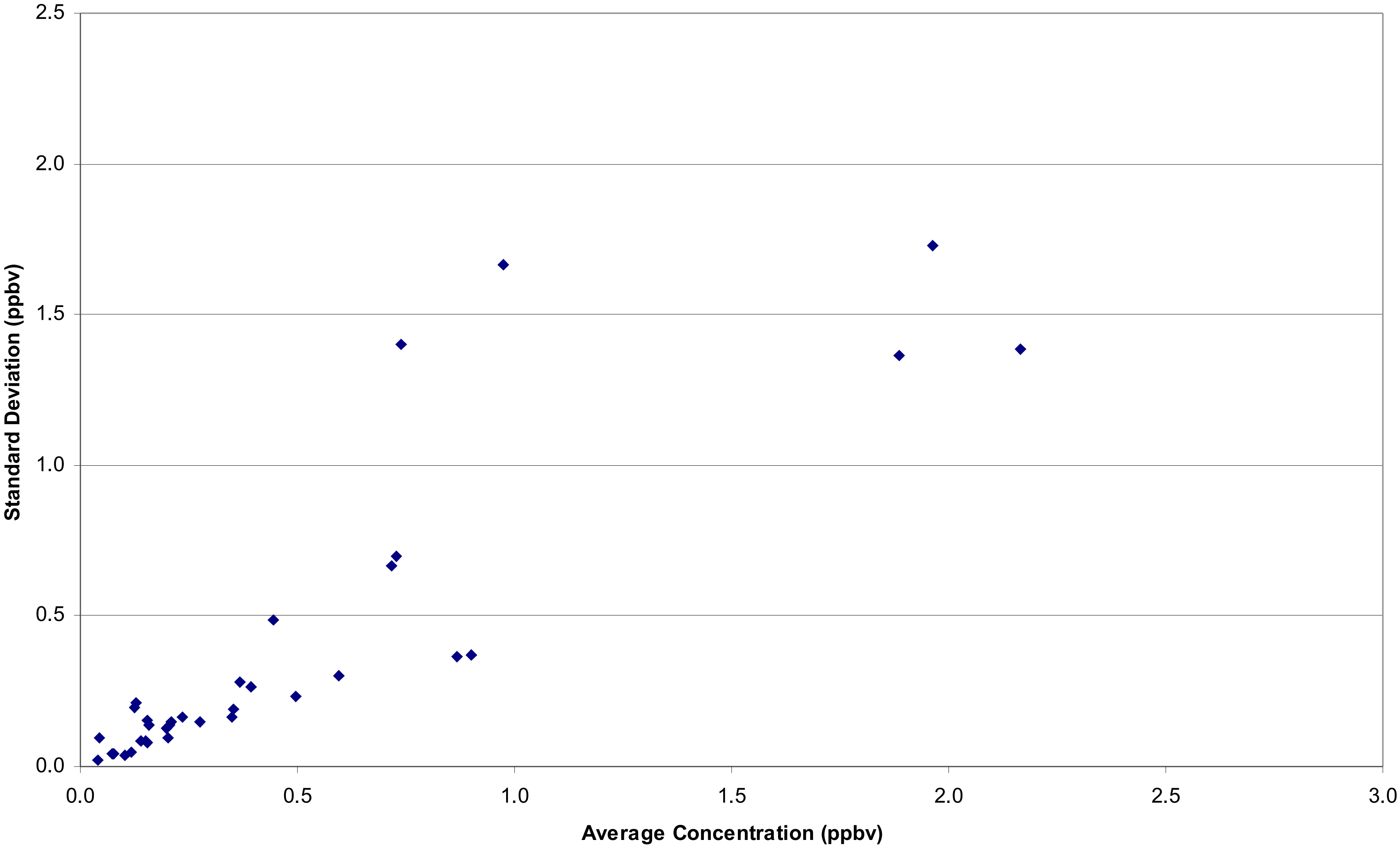


Figure 3-24: Coefficient of Variance Analysis of Formaldehyde Across 36 Sites

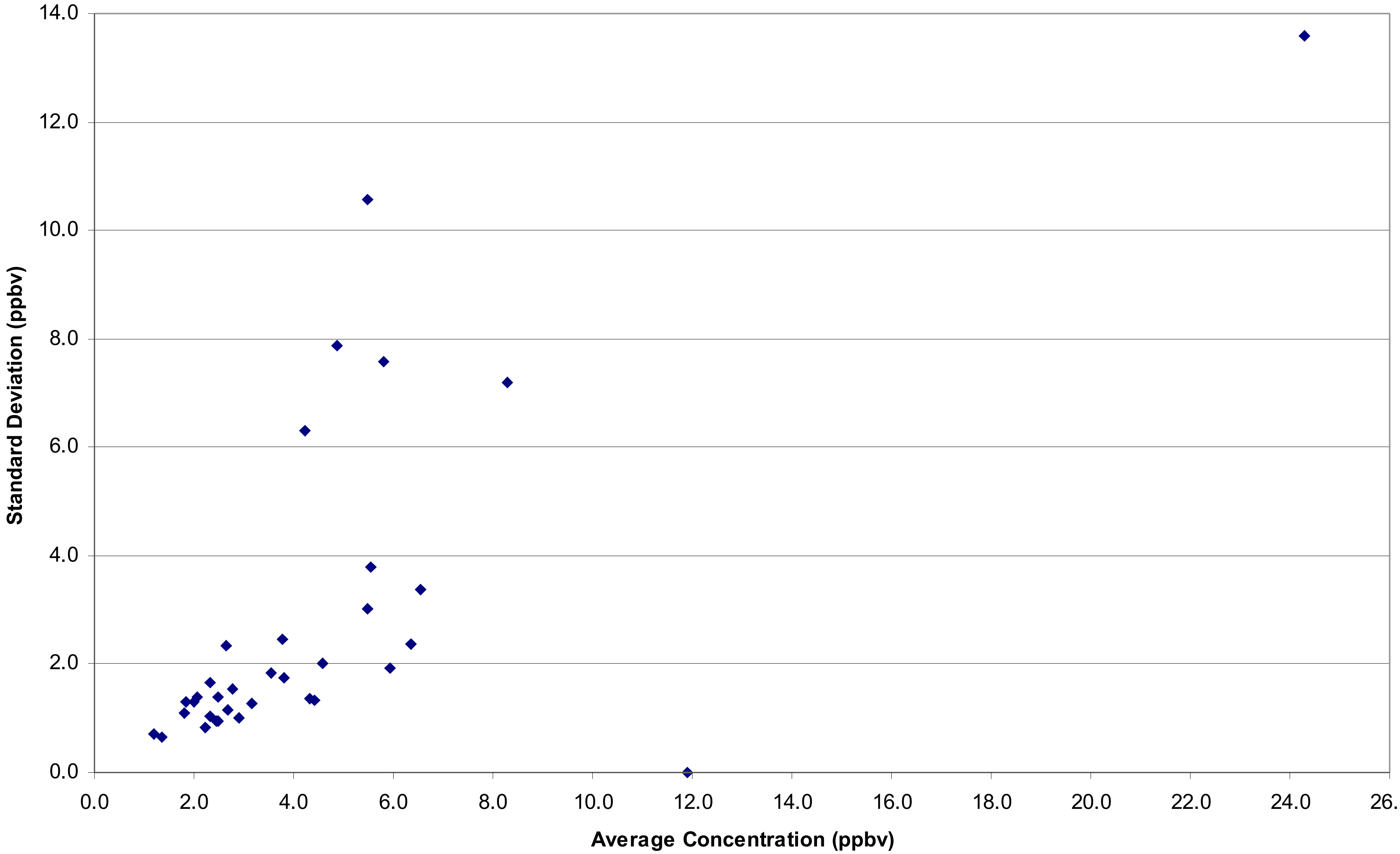


Figure 3-25: Coefficient of Variance Analysis of *m-,p*-Xylene Across 35 Sites

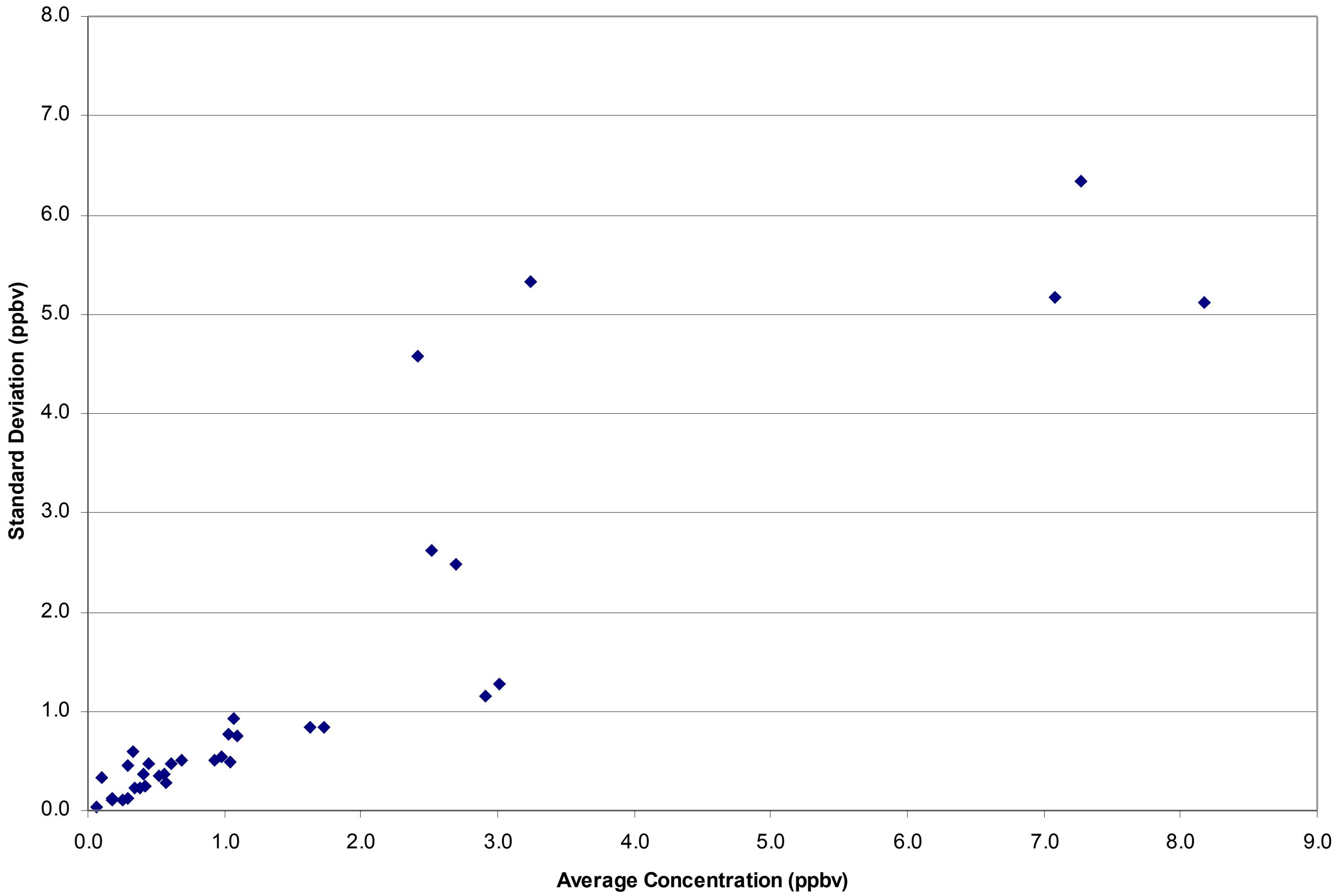


Figure 3-26: Coefficient of Variance Analysis of Methyl Ethyl Ketone Across 35 Sites

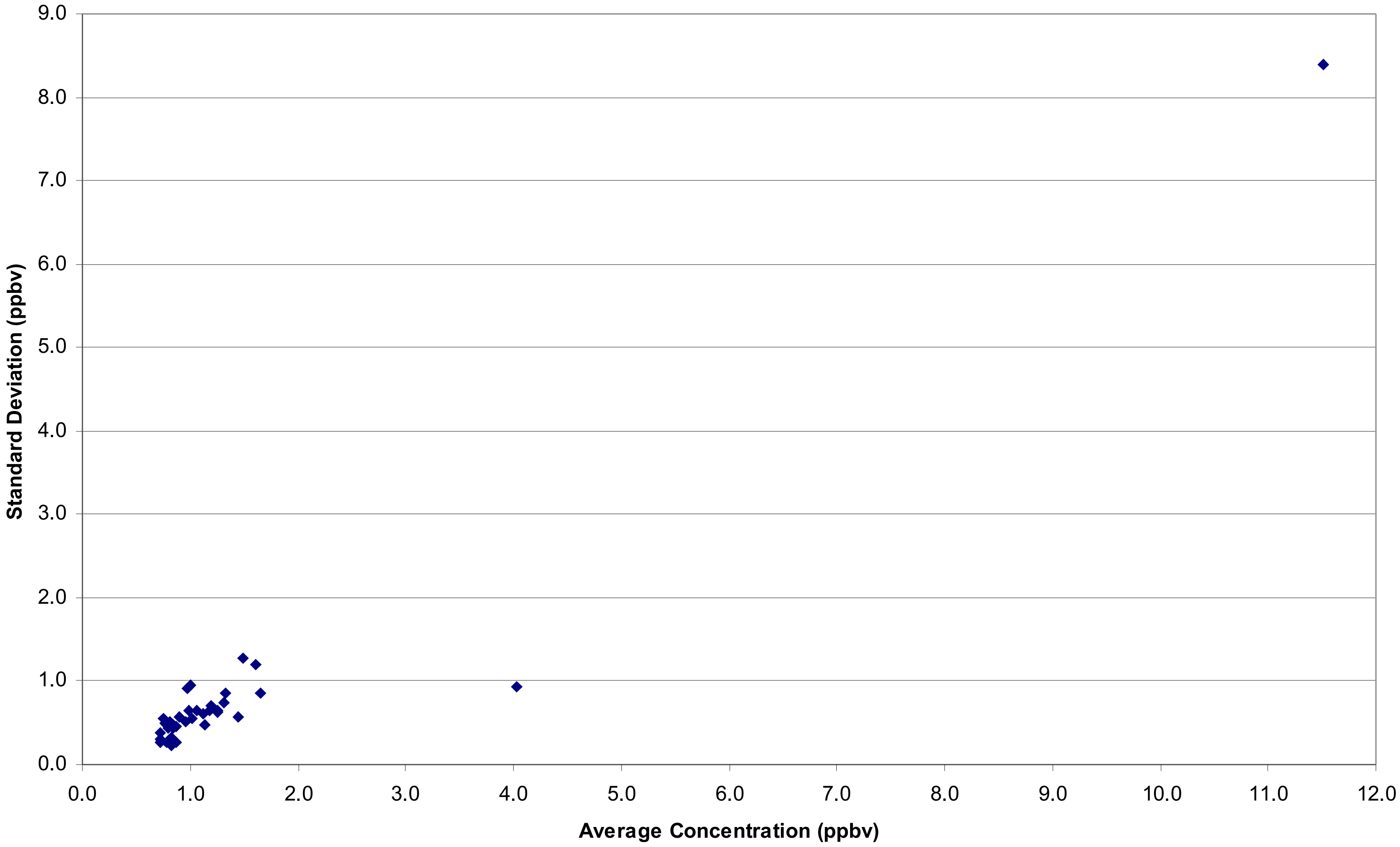


Figure 3-27: Coefficient of Variance Analysis of Methylene Chloride Across 35 Sites

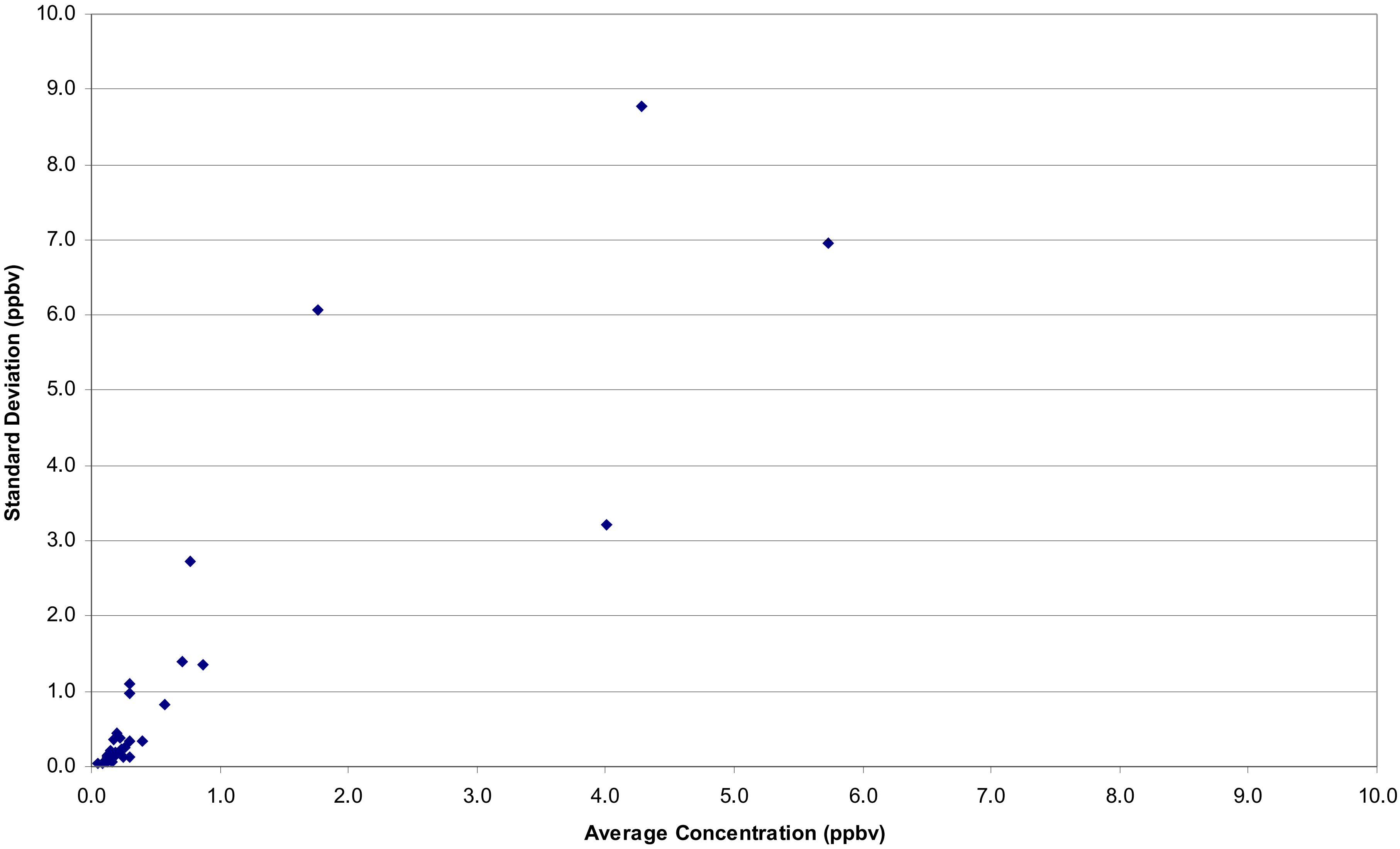


Figure 3-28: Coefficient of Variance Analysis of *o*-Xylene Across 35 Sites

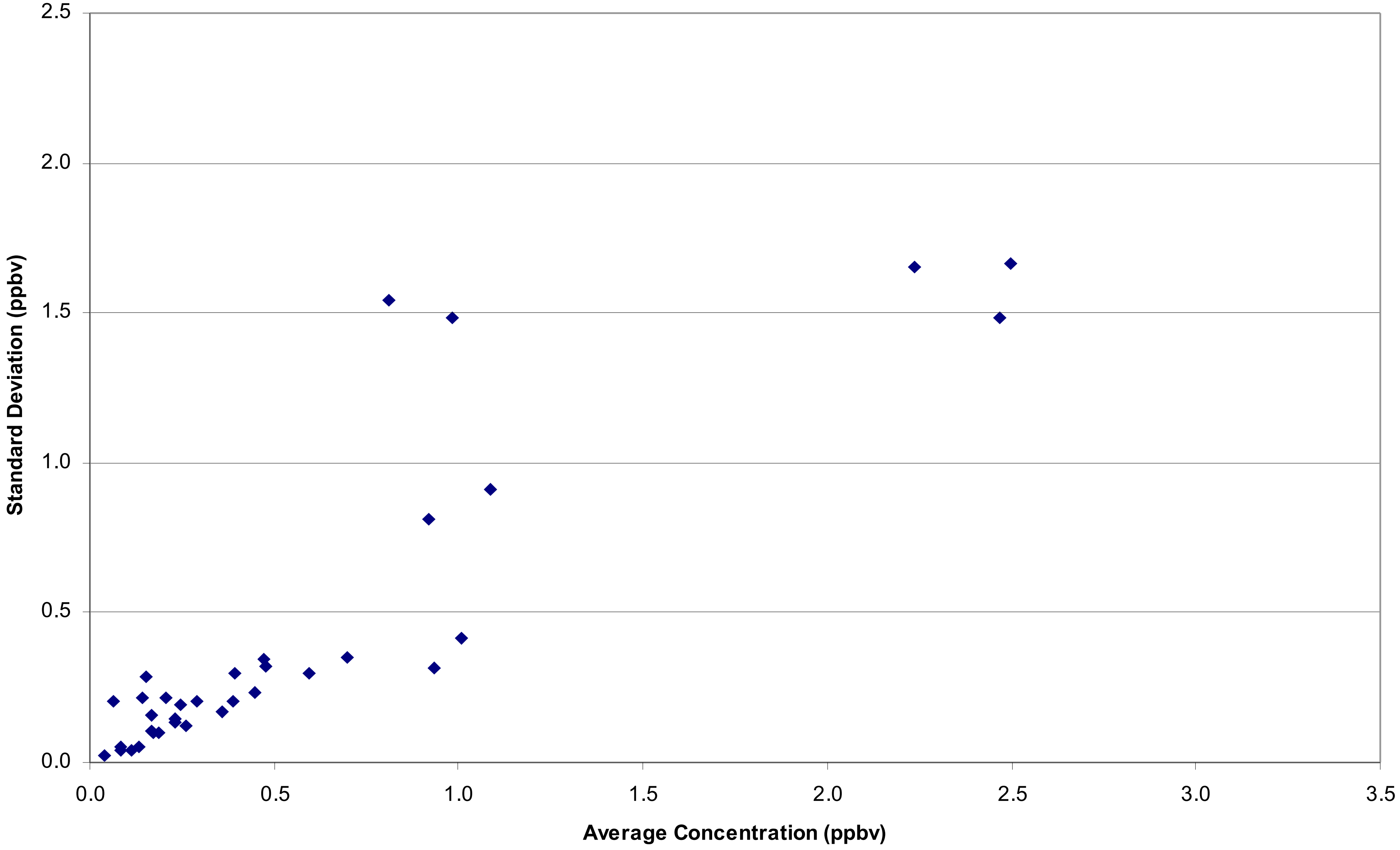


Figure 3-29: Coefficient of Variance Analysis of Propylene Across 35 Sites

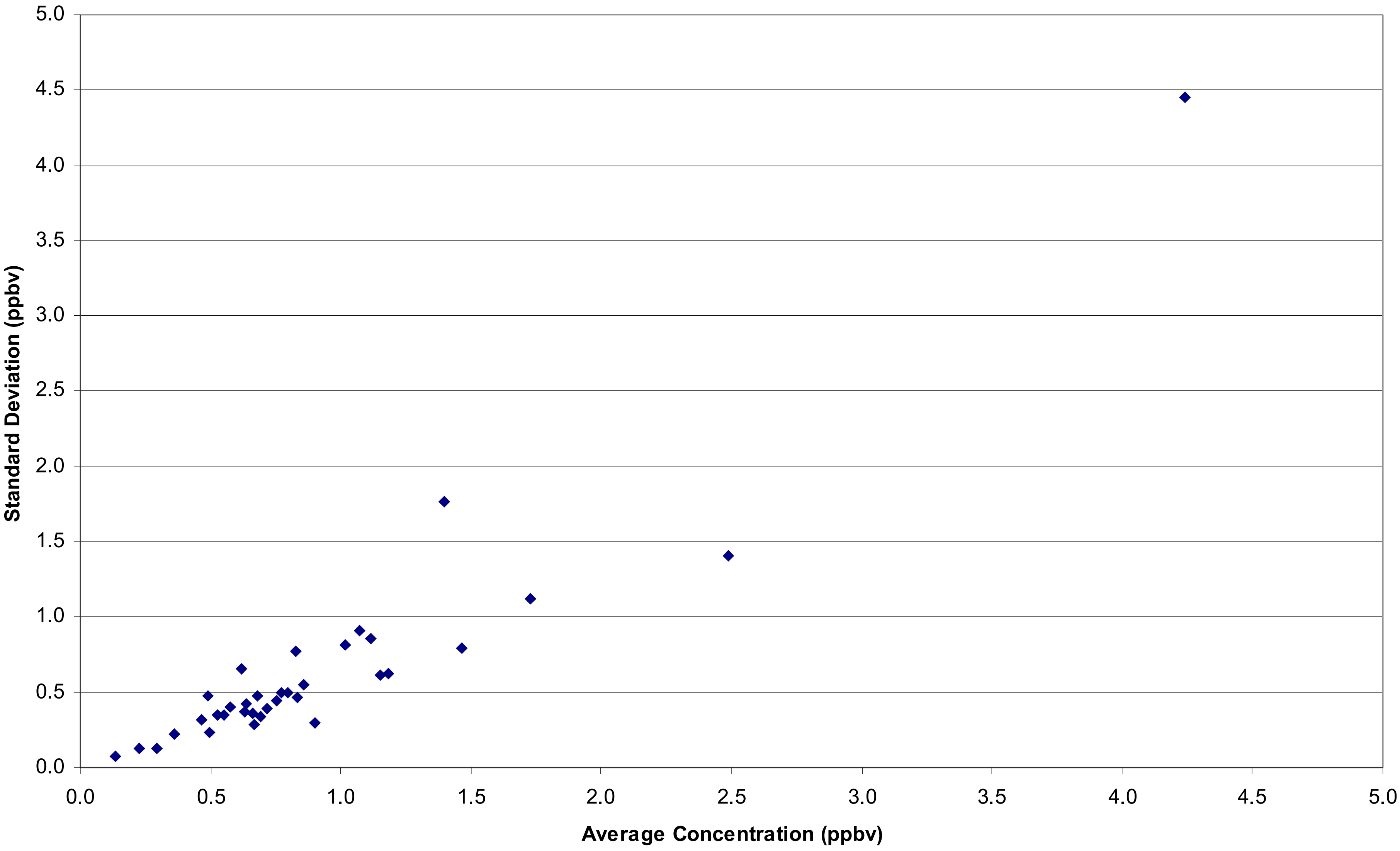


Figure 3-30: Coefficient of Variance Analysis of Toluene Across 35 Sites

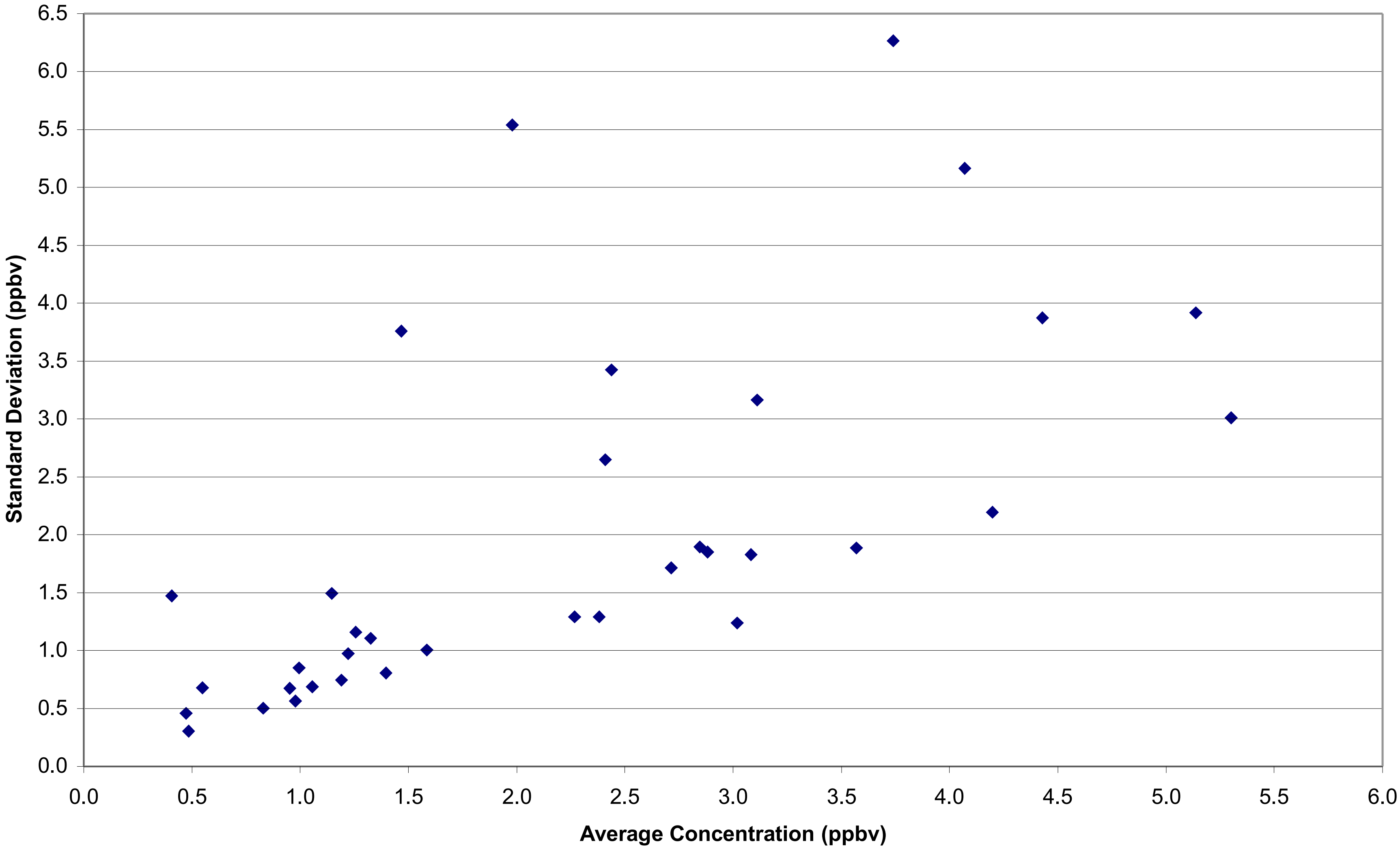


Figure 3-31a: Average Acetaldehyde Concentration by Season (A2TX-EPTX)

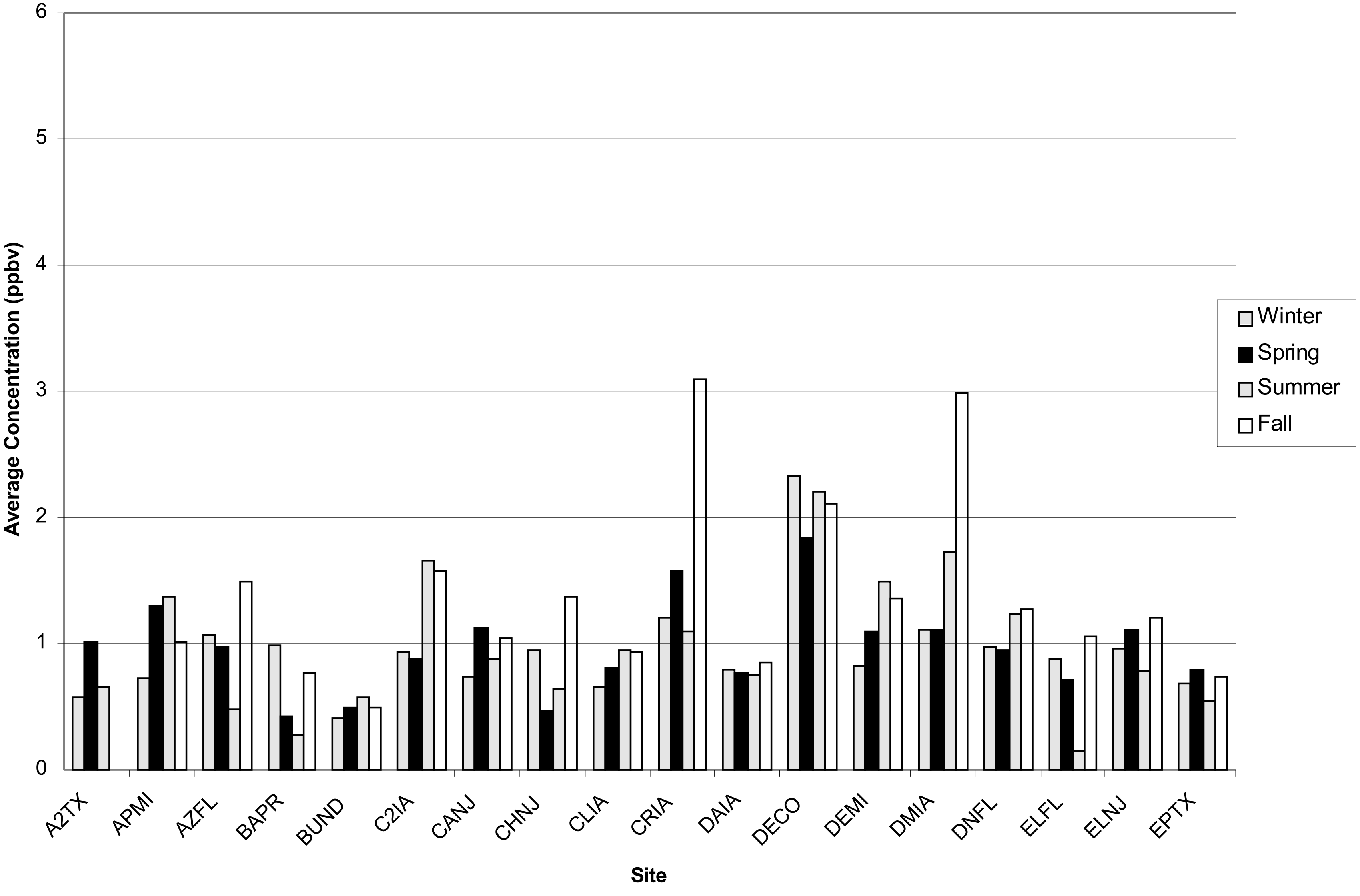


Figure 3-31b: Average Acetaldehyde Concentration by Season (G2CO-YFMI)

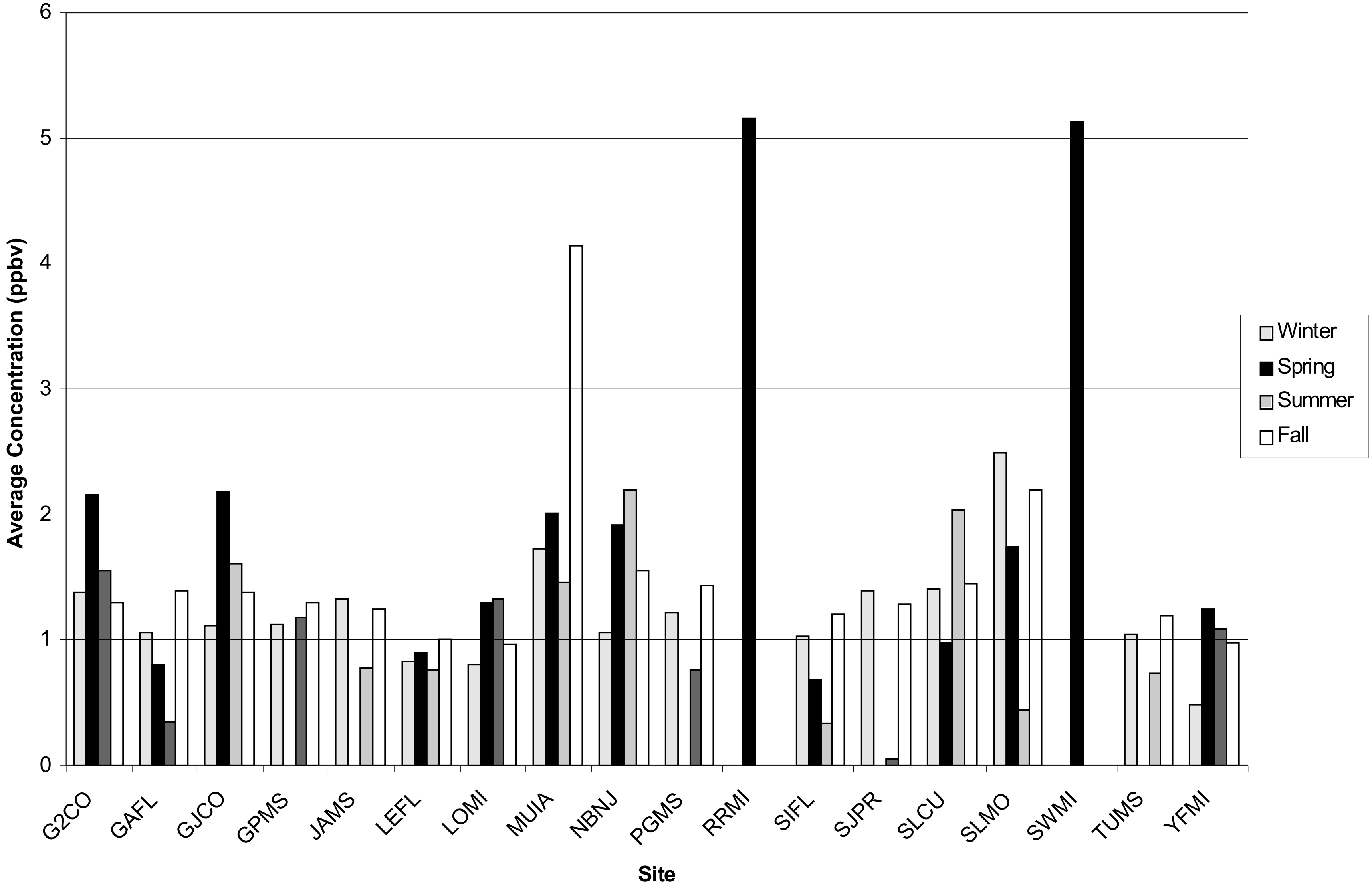


Figure 3-32a: Average Acetone Concentration by Season (A2TX-EPTX)

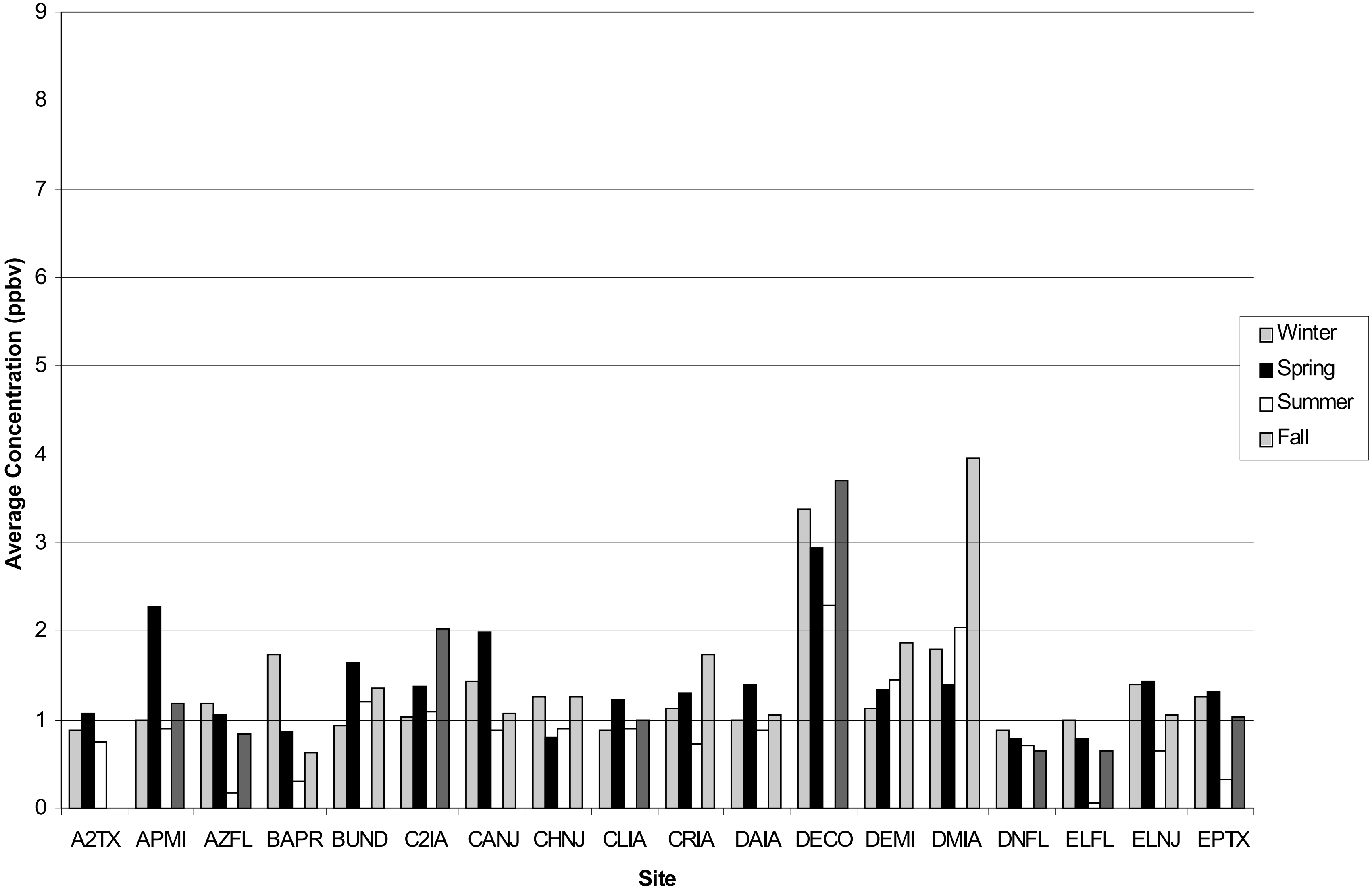


Figure 3-32b: Average Acetone Concentration by Season (G2CO-YFMI)

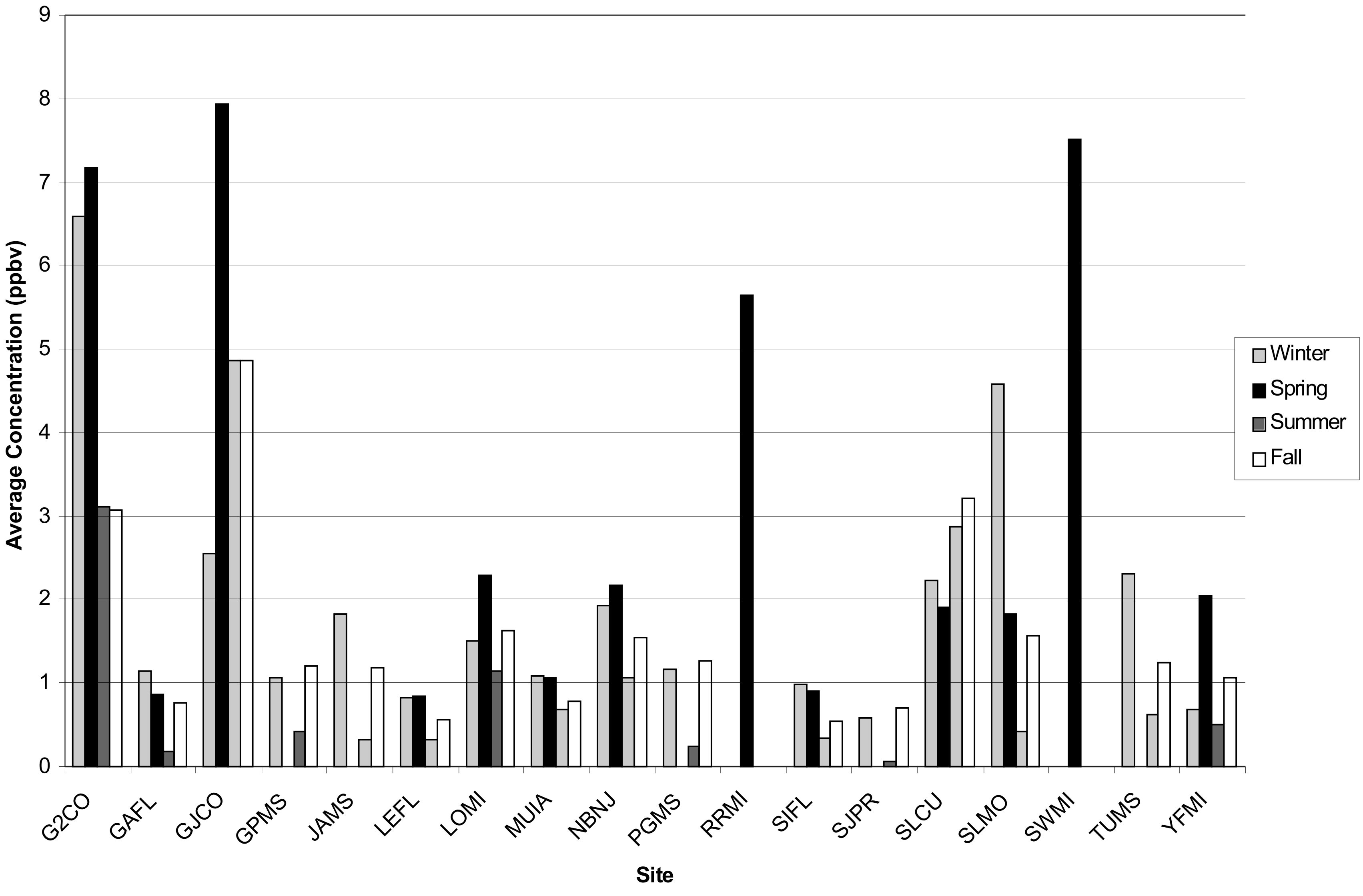


Figure 3-33a: Average Acetylene Concentration by Season (A2TX-GPMS)

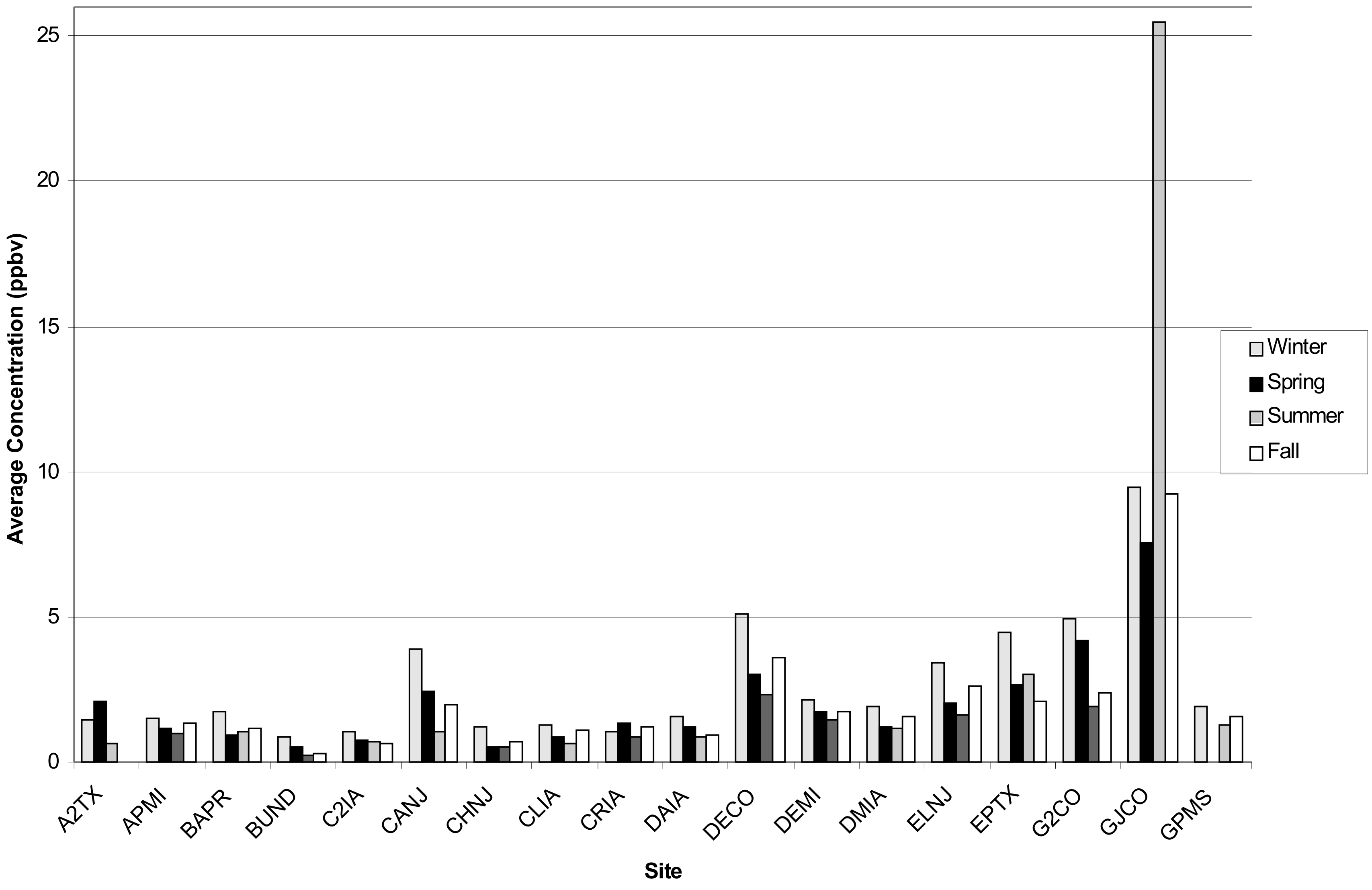


Figure 3-33b: Average Acetylene Concentration by Season (JAMS-YFMI)

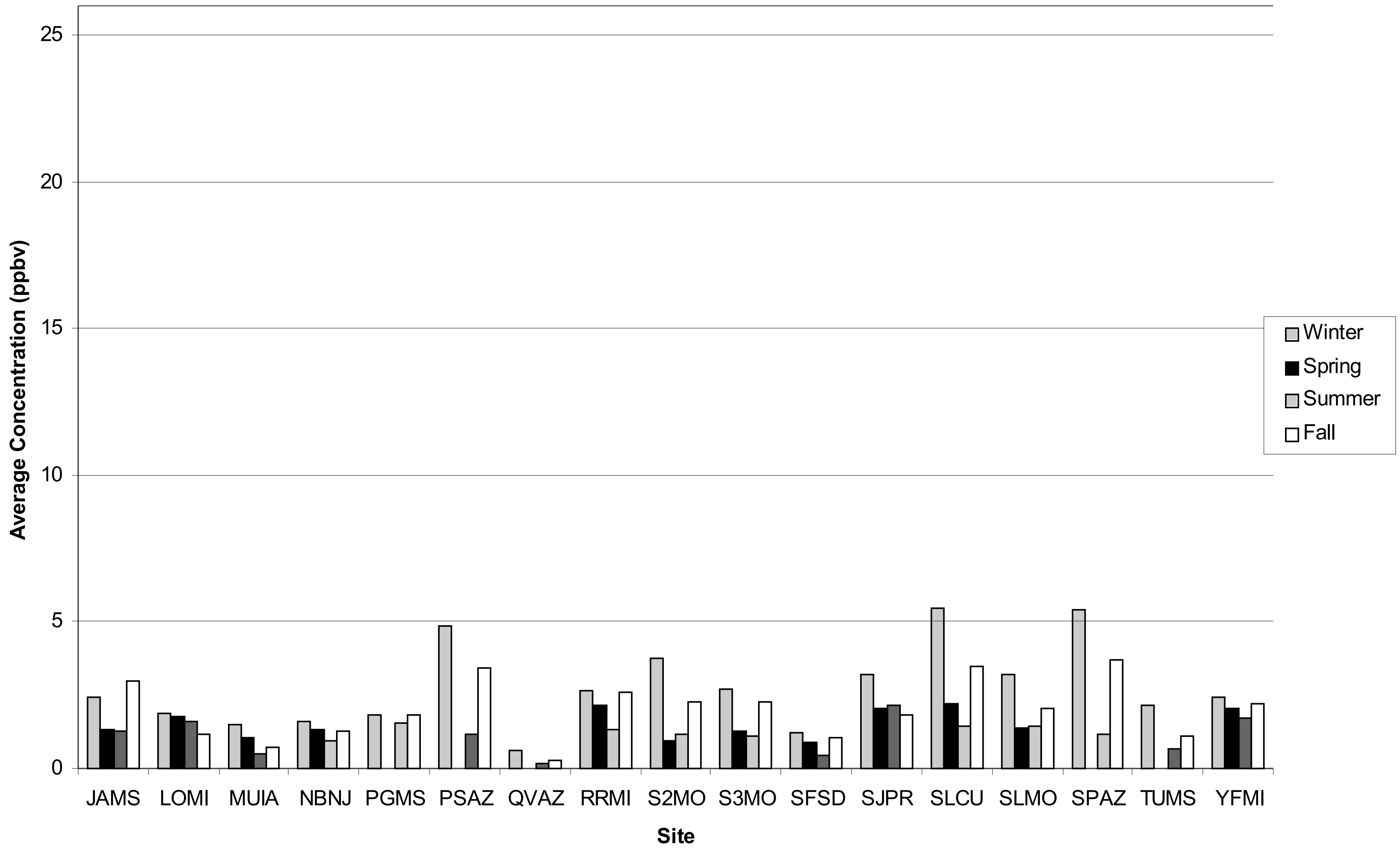


Figure 3-34a: Average Benzene Concentration by Season (A2TX-GPMS)

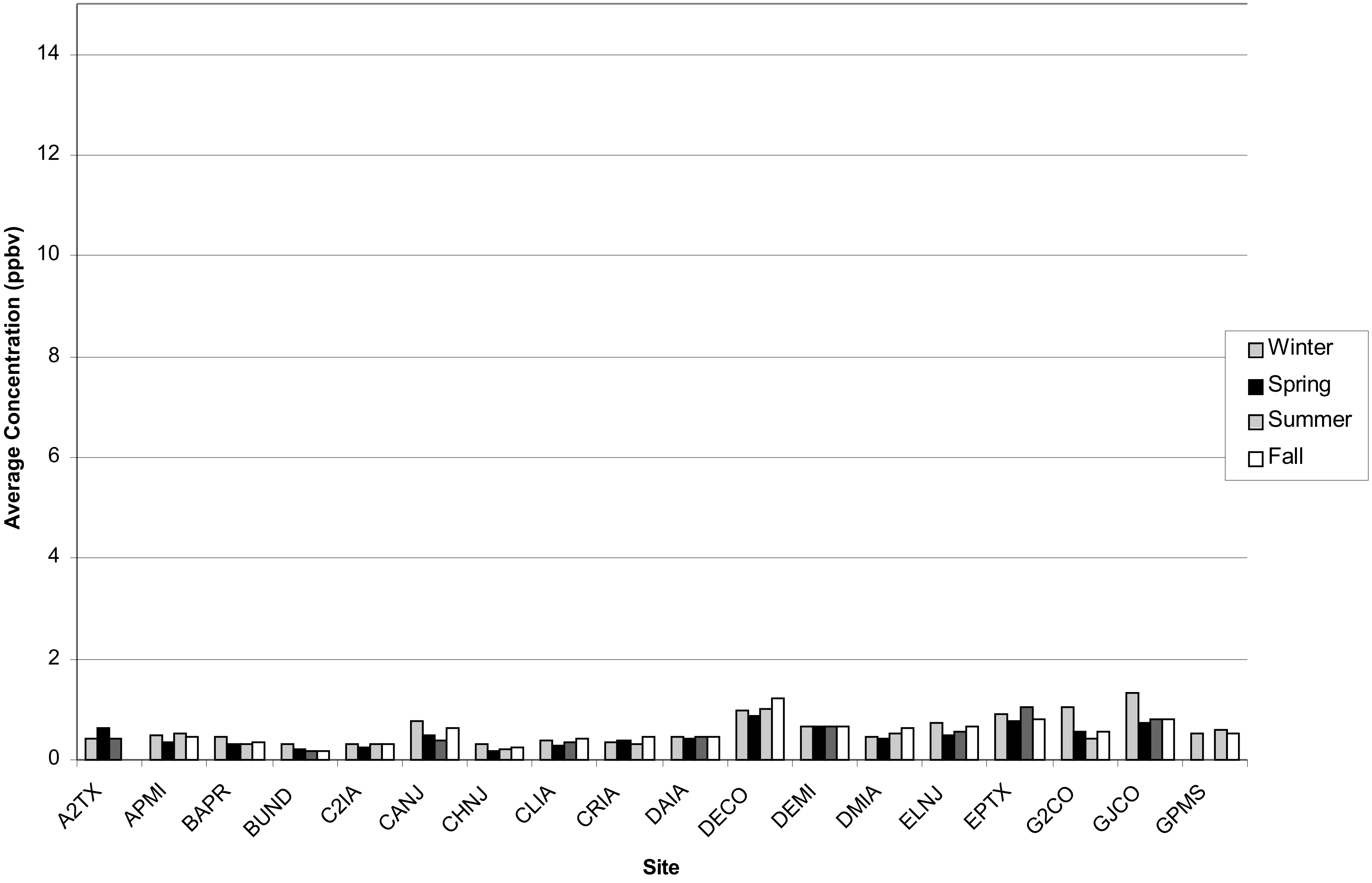
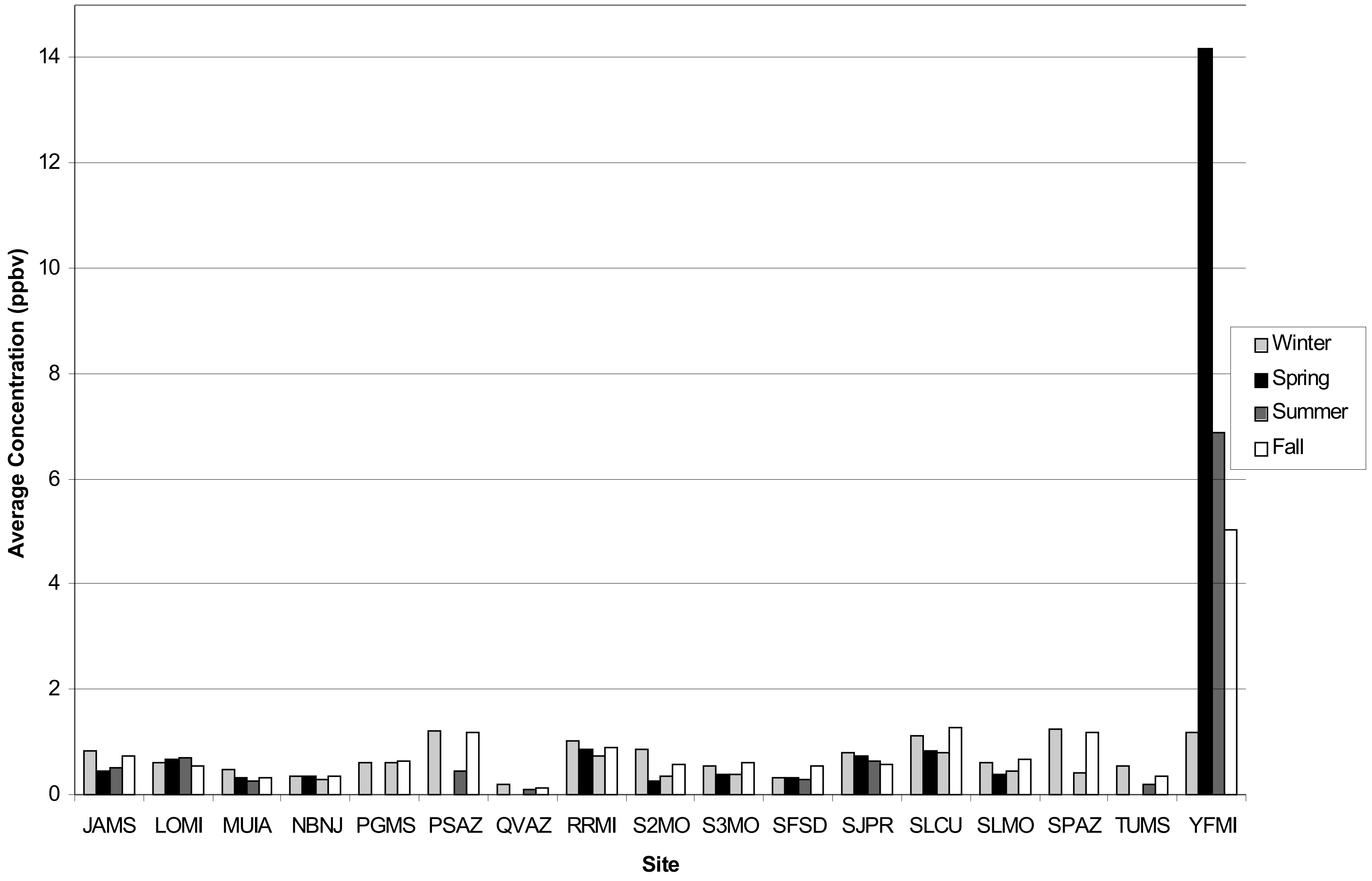


Figure 3-34b: Average Benzene Concentration by Season (JAMS-YFMI)



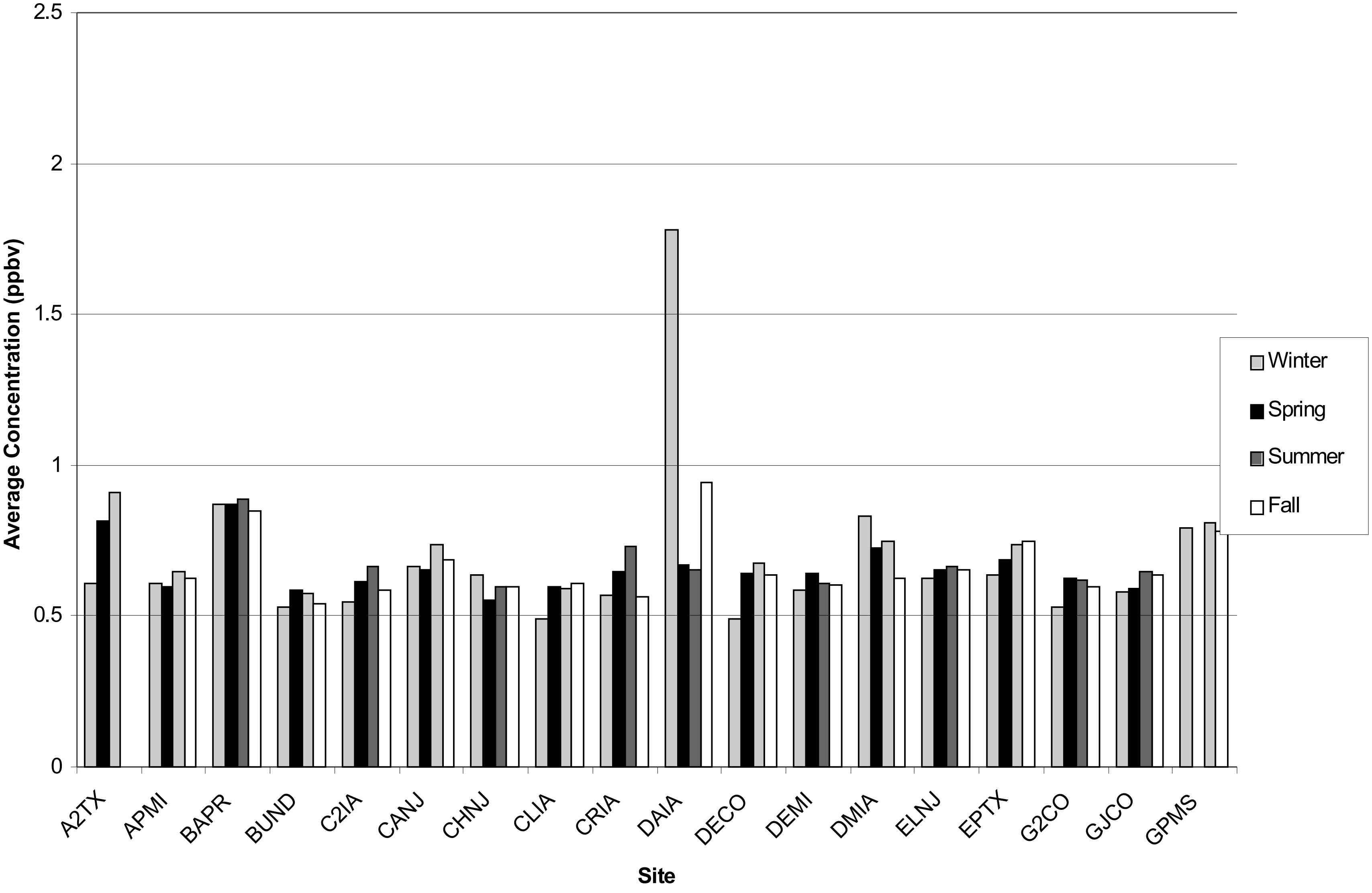


Figure 3-35a: Average Chloromethane Concentration by Season (A2TX-GPMS)

Figure 3-35b: Average Chloromethane Concentration by Season (JAMS-YFMI)

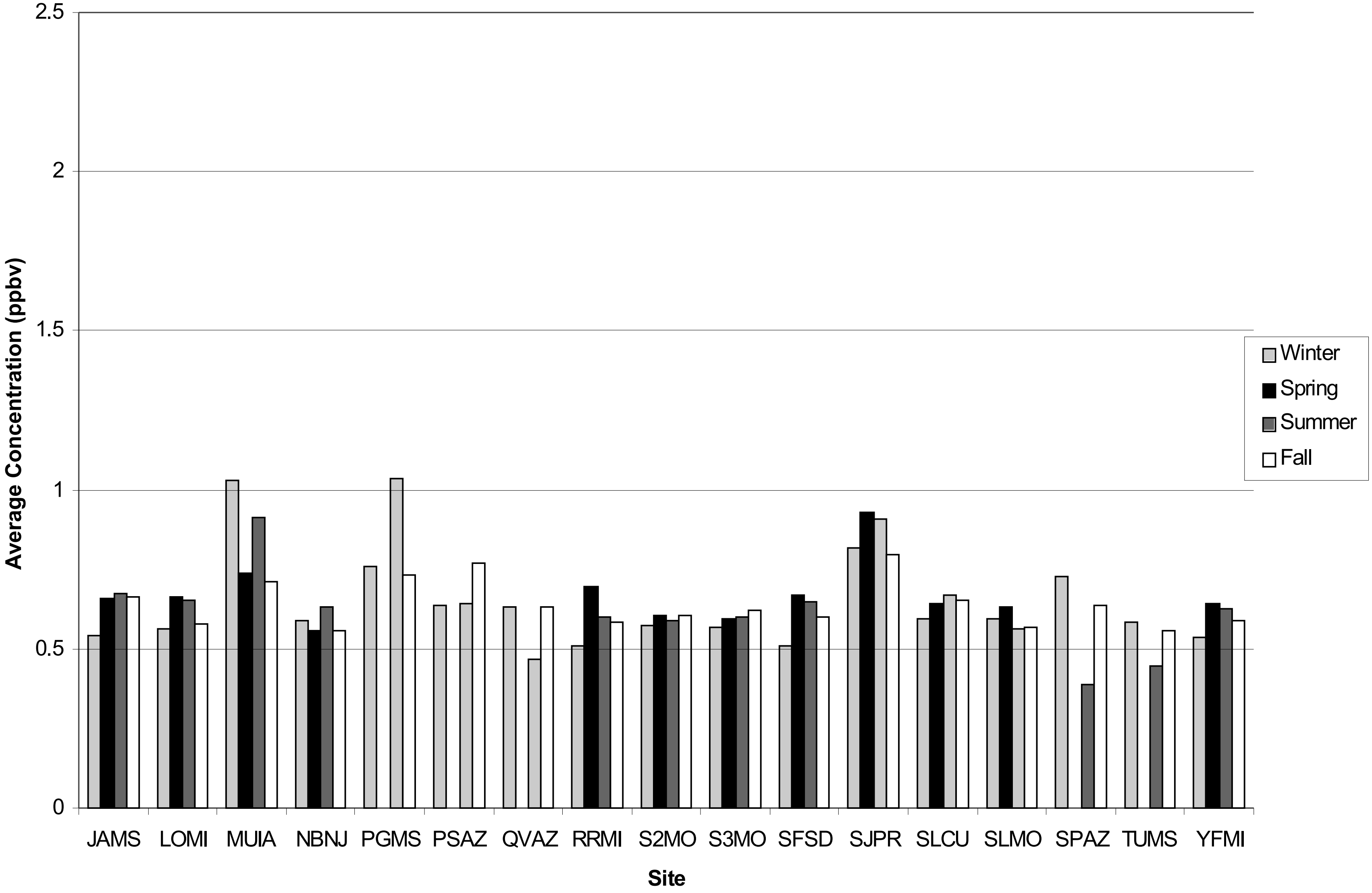


Figure 3-36a: Average Dichlorodifluoromethane Concentration by Season (A2TX-GPMS)

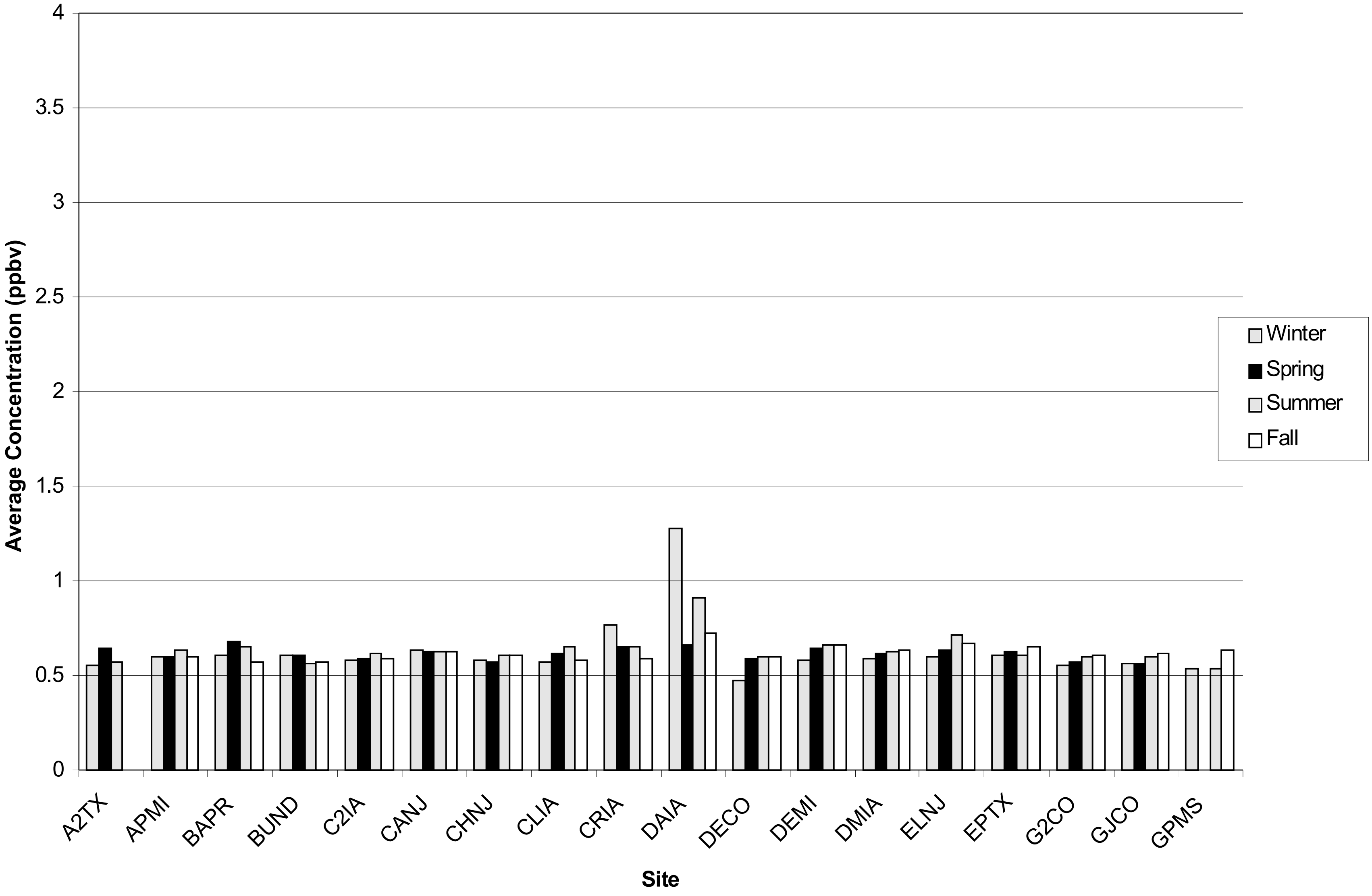


Figure 3-36b: Average Dichlorodifluoromethane Concentration by Season (JAMS-YFMI)

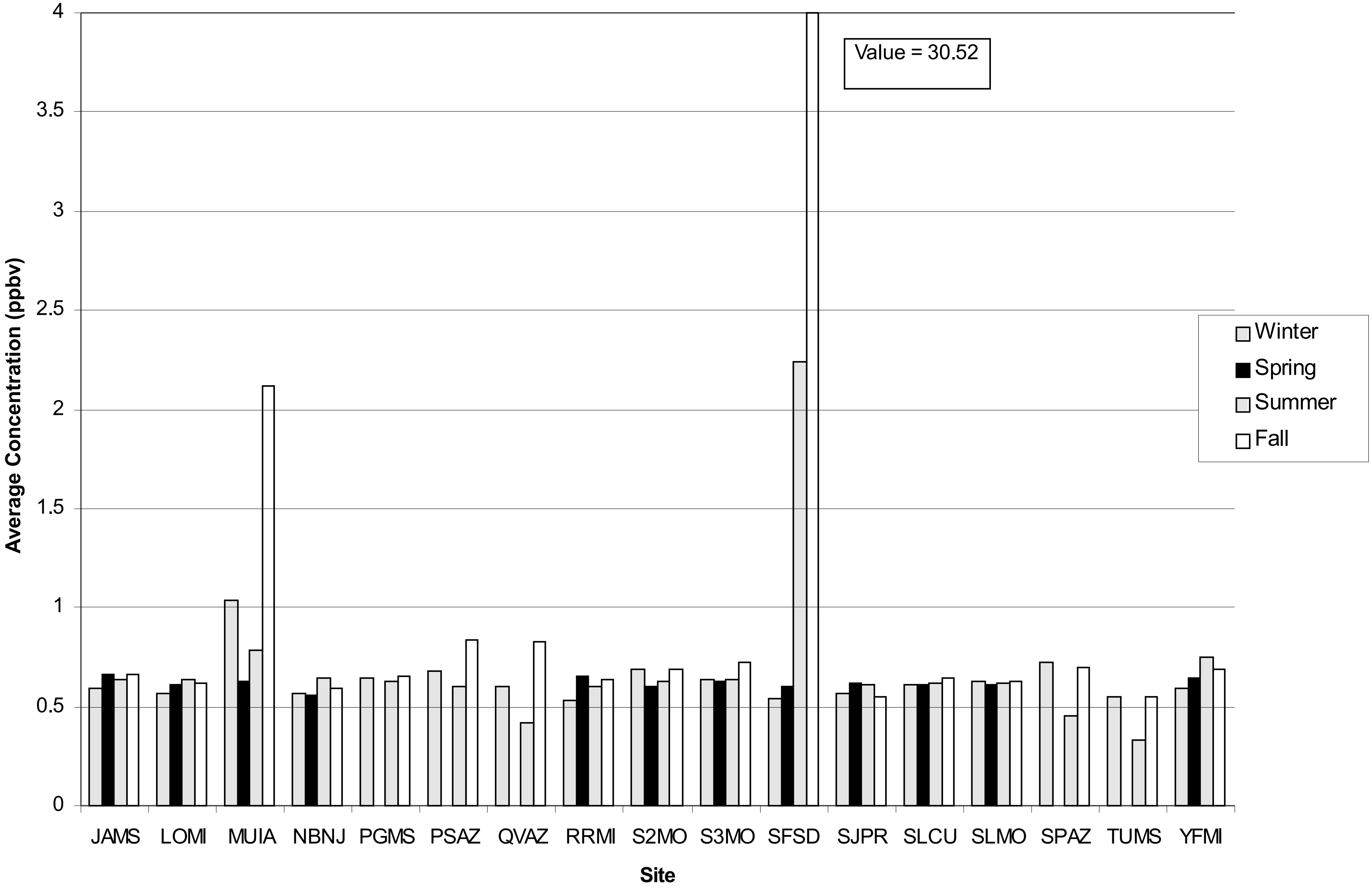


Figure 3-37a: Average Ethylbenzene Concentration by Season (A2TX-GPMS)

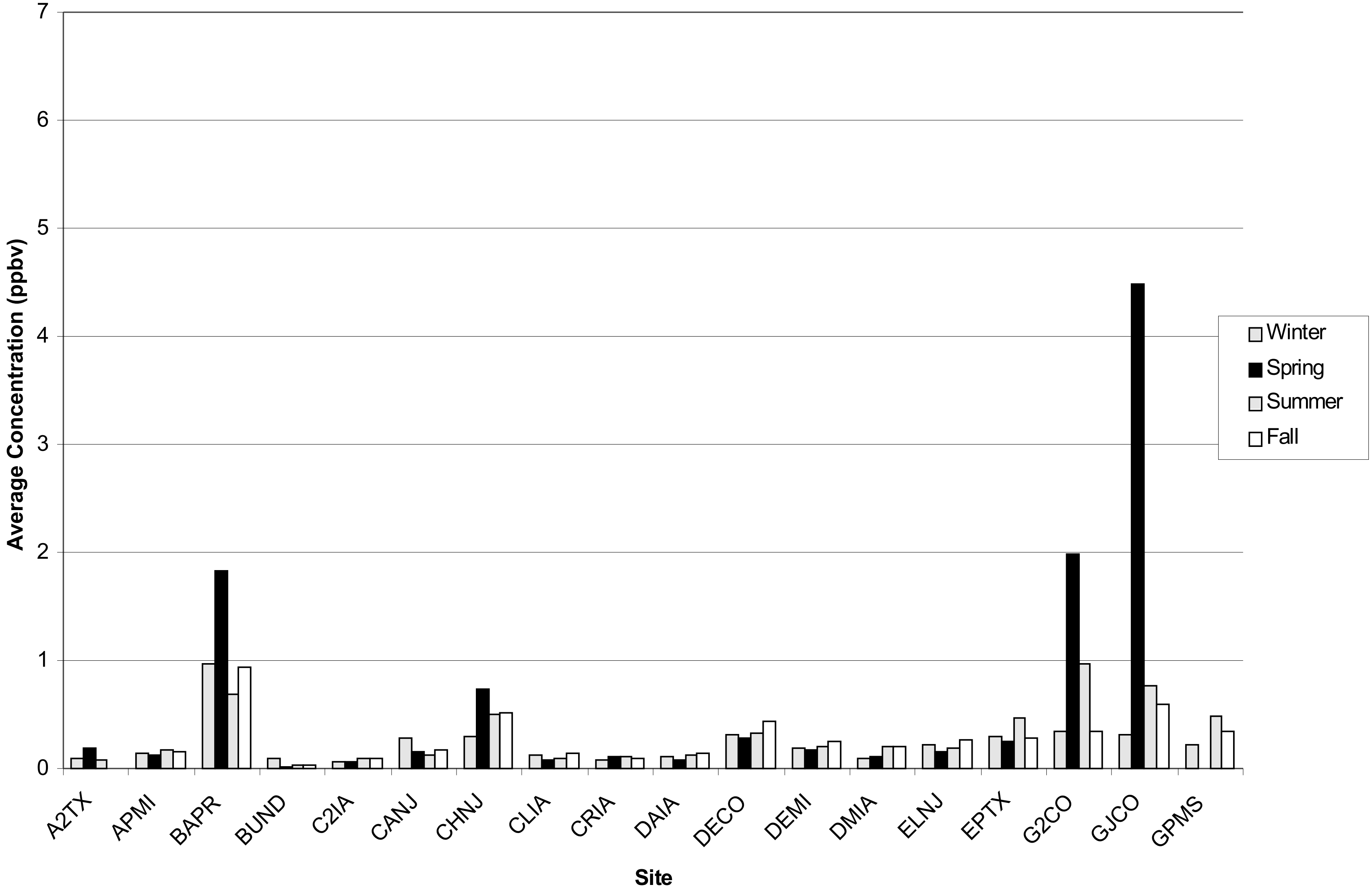


Figure 3-37b: Average Ethylbenzene Concentration by Season (JAMS-YFMI)

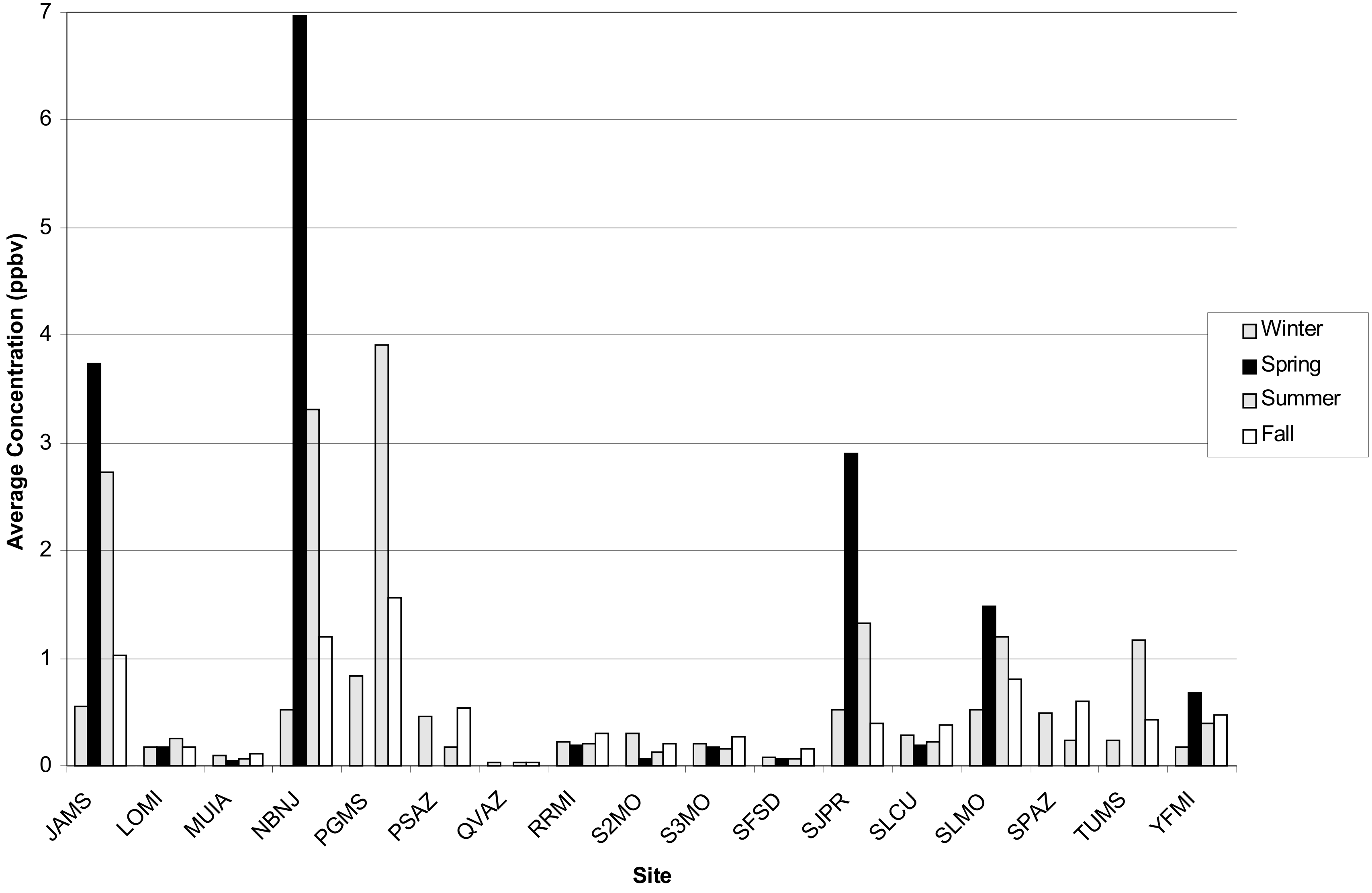


Figure 3-38a: Average Formaldehyde Concentration by Season (A2TX-GJCO)

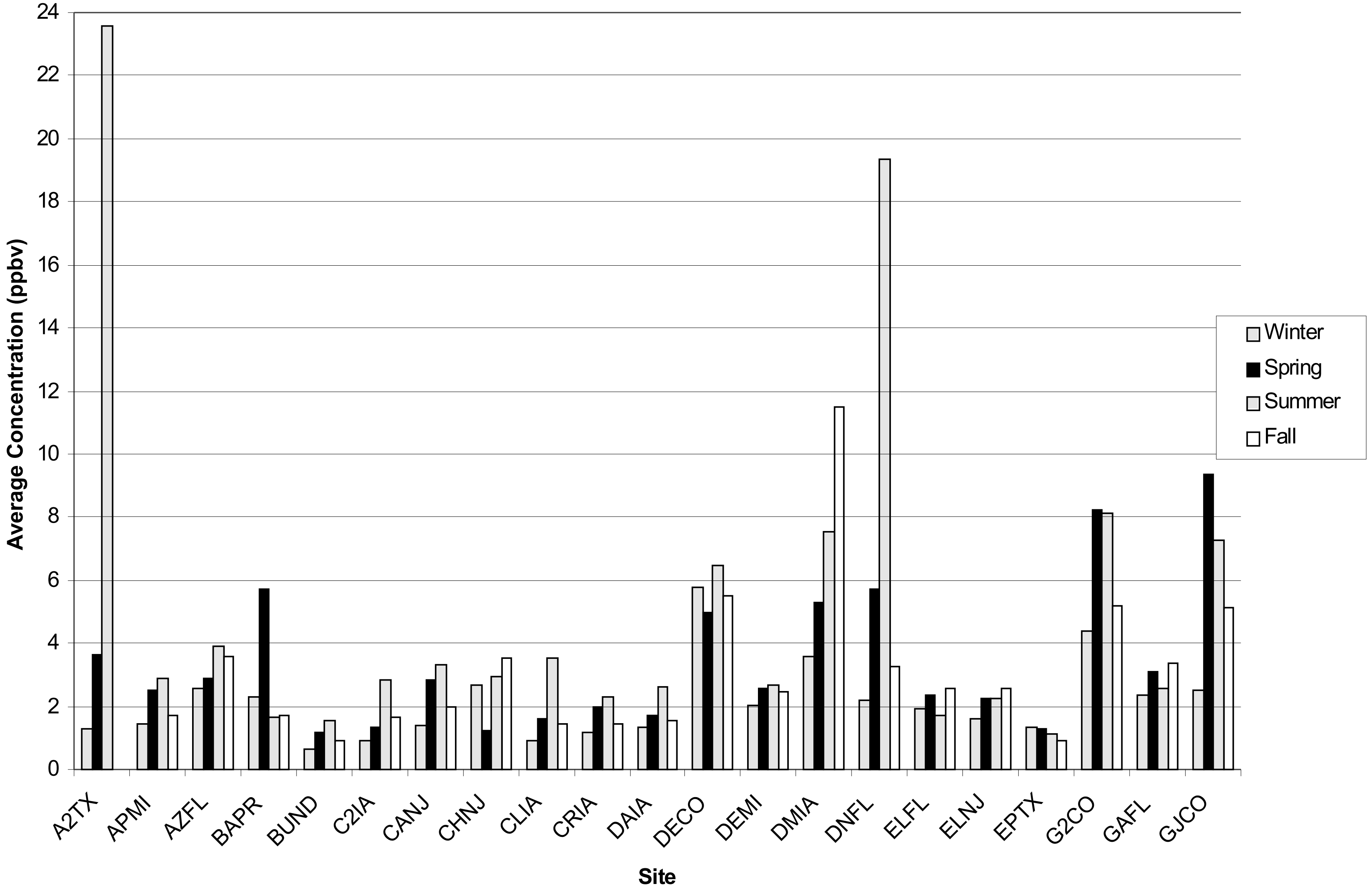


Figure 3-38b: Average Formaldehyde Concentration by Season (GPMS-YFMI)

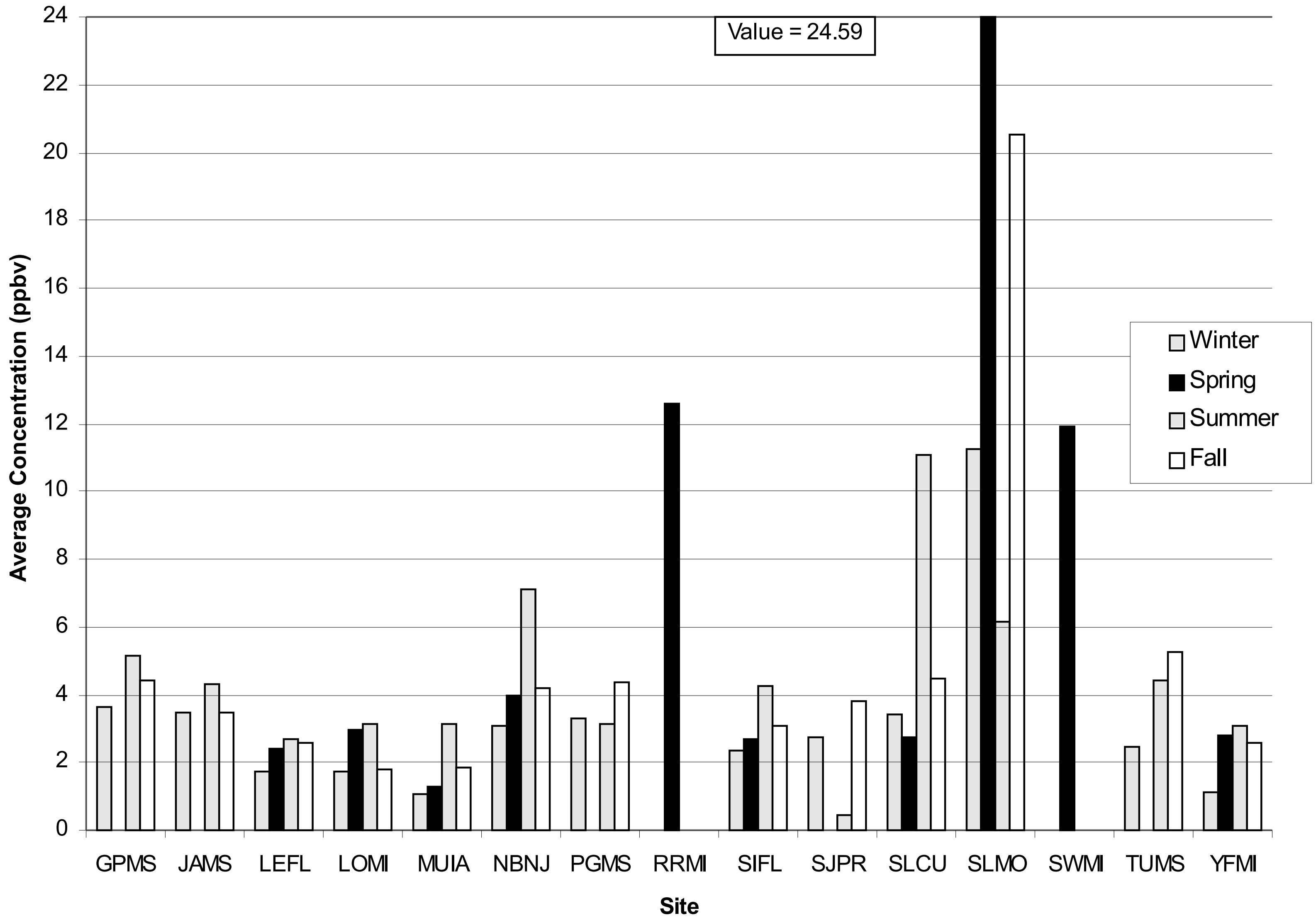


Figure 3-39a: Average m,p-Xylene Concentration by Season (A2TX-GPMS)

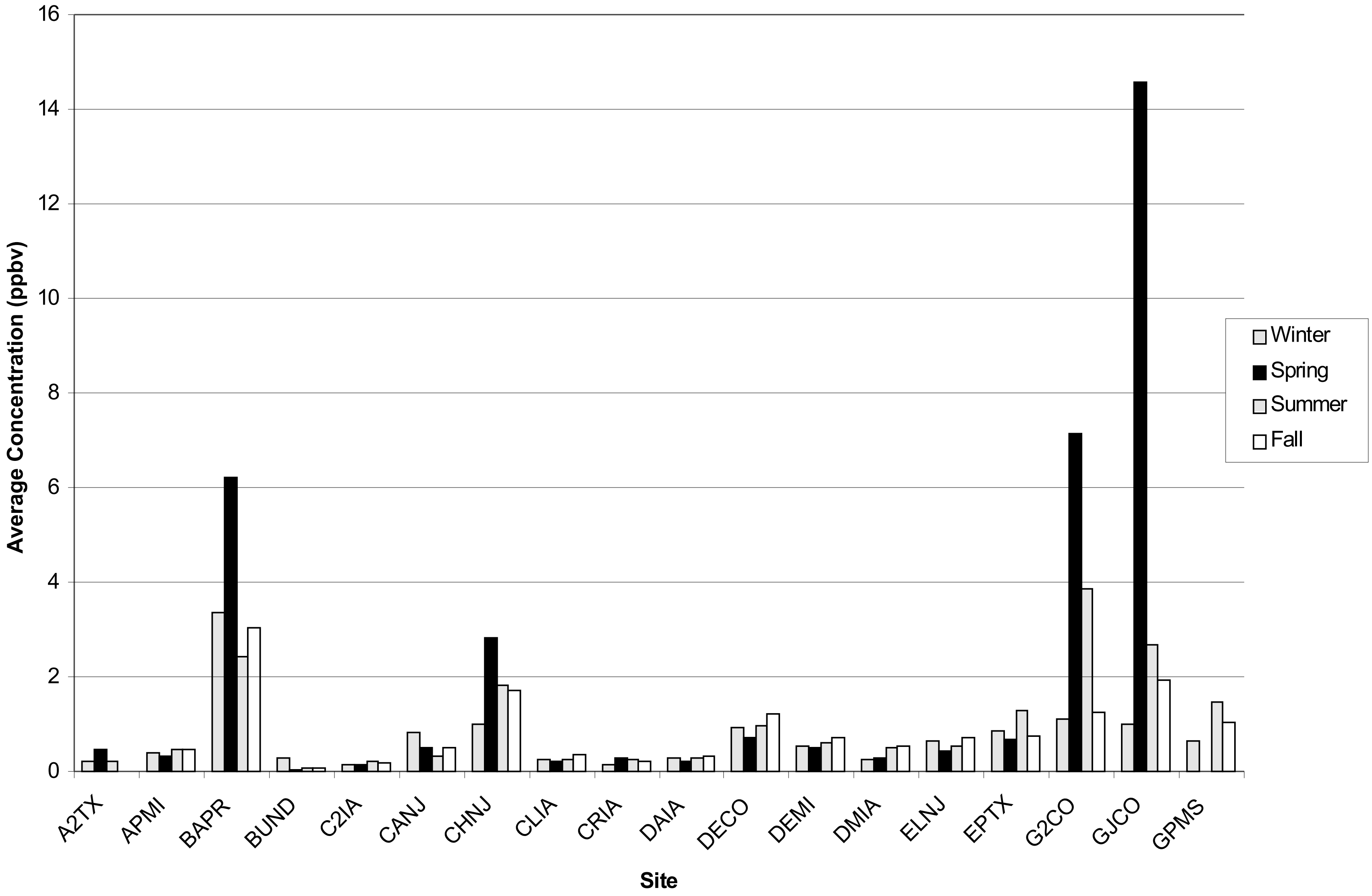


Figure 3-39b: Average m,p-Xylene Concentration by Season (JAMS-YFMI)

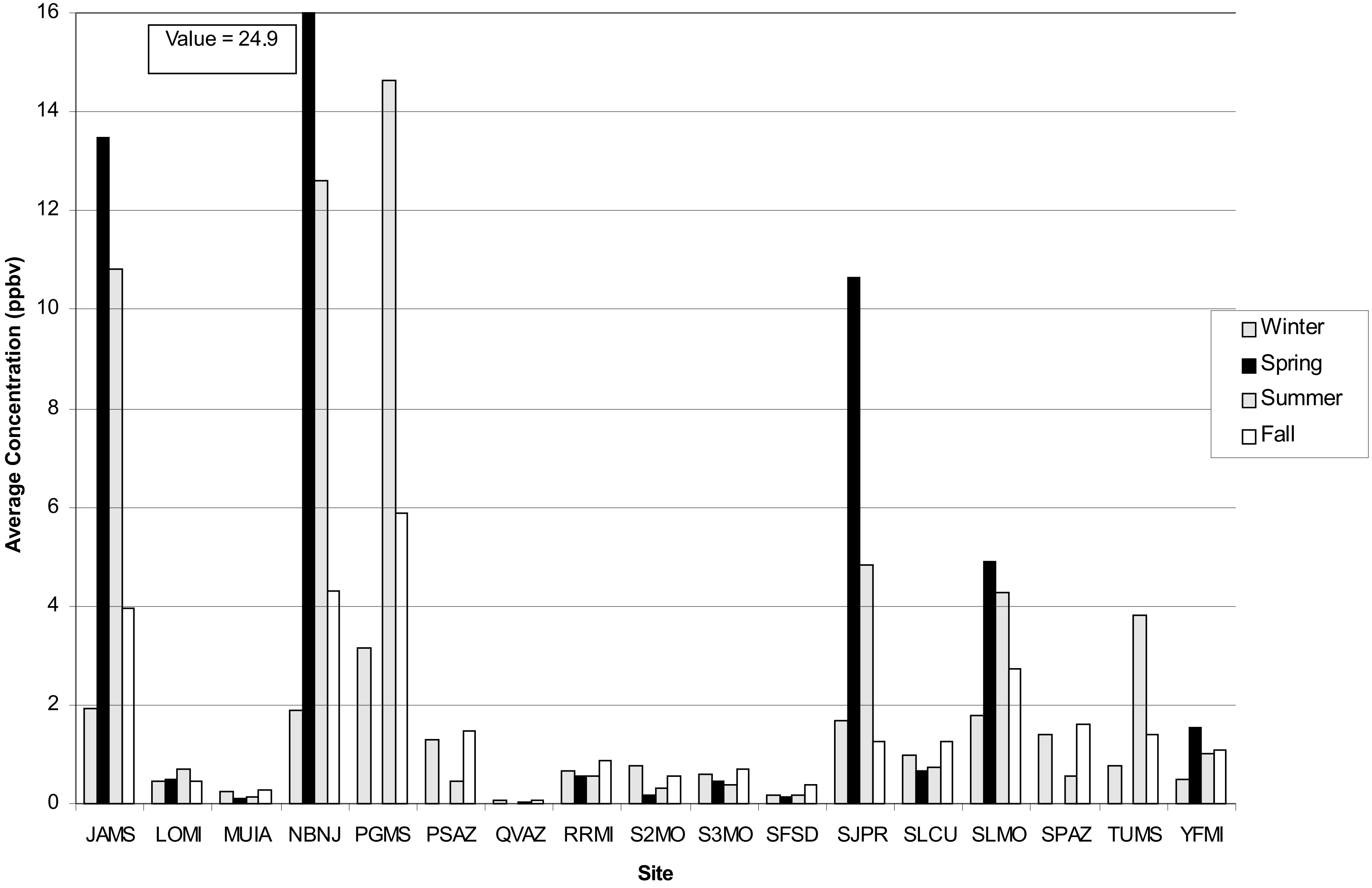


Figure 3-40a: Average Methyl Ethyl Ketone Concentration by Season (A2TX-GPMS)

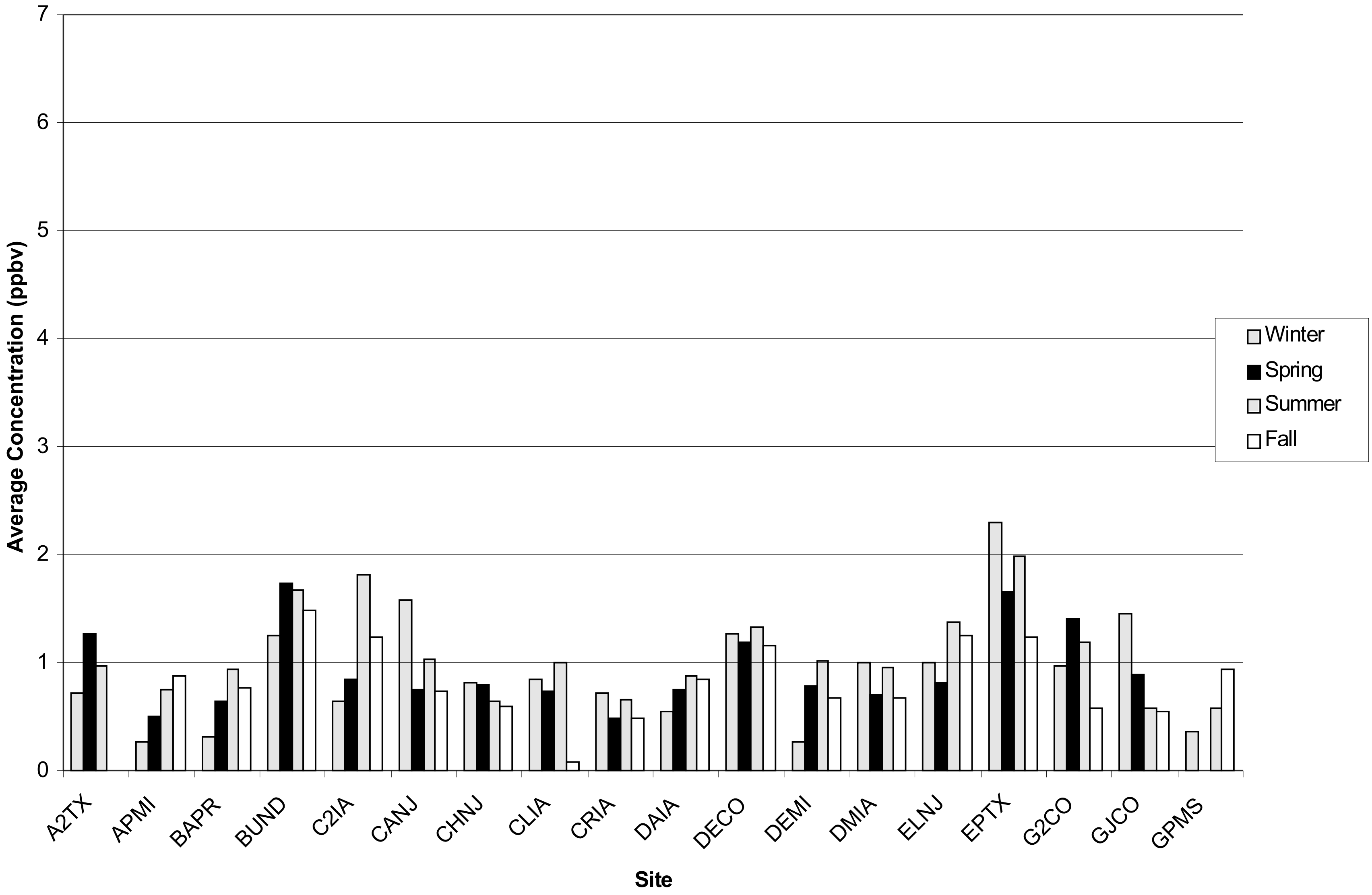


Figure 3-40b: Average Methyl Ethyl Ketone Concentration by Season (JAMS-YFMI)

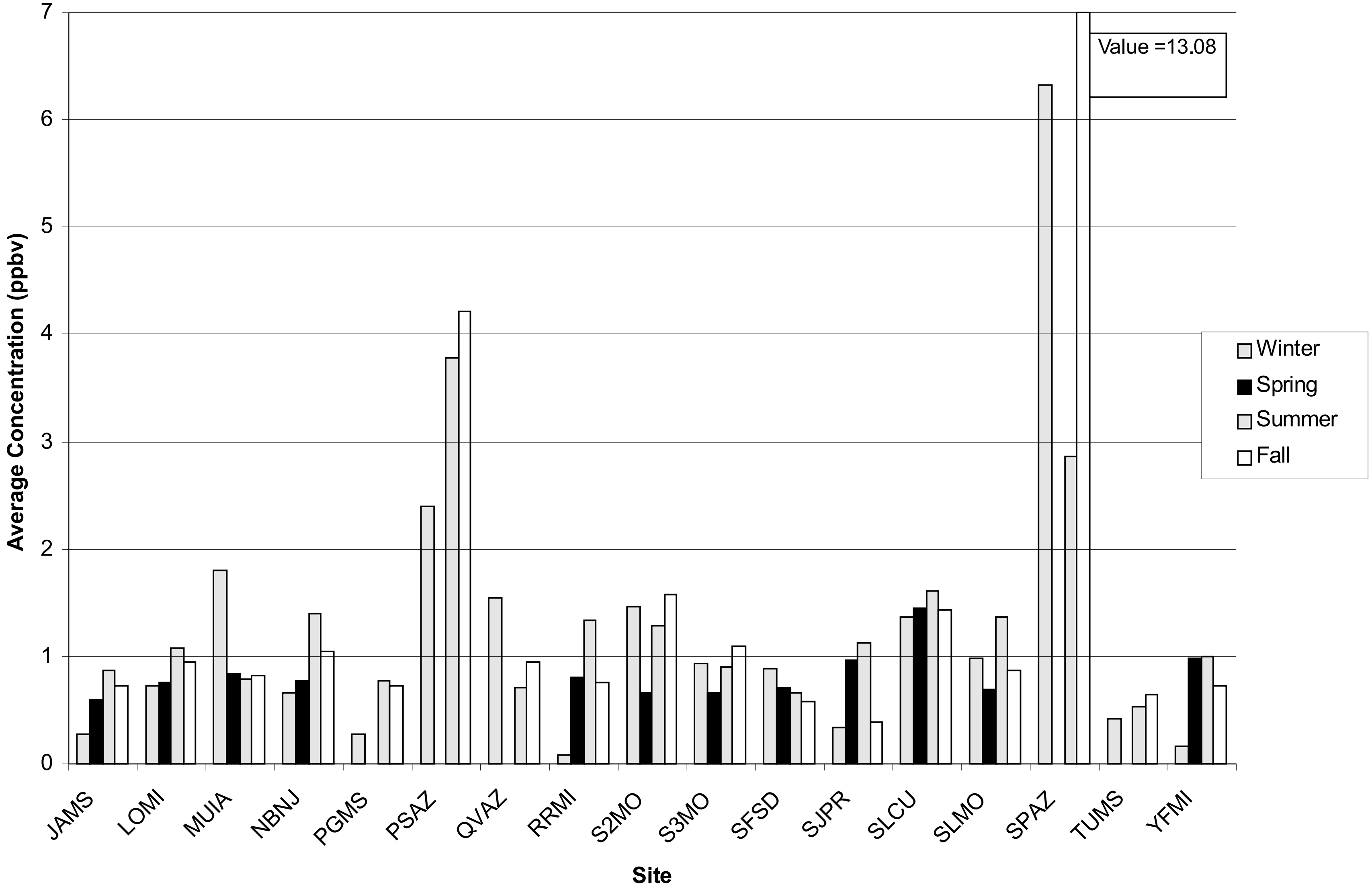
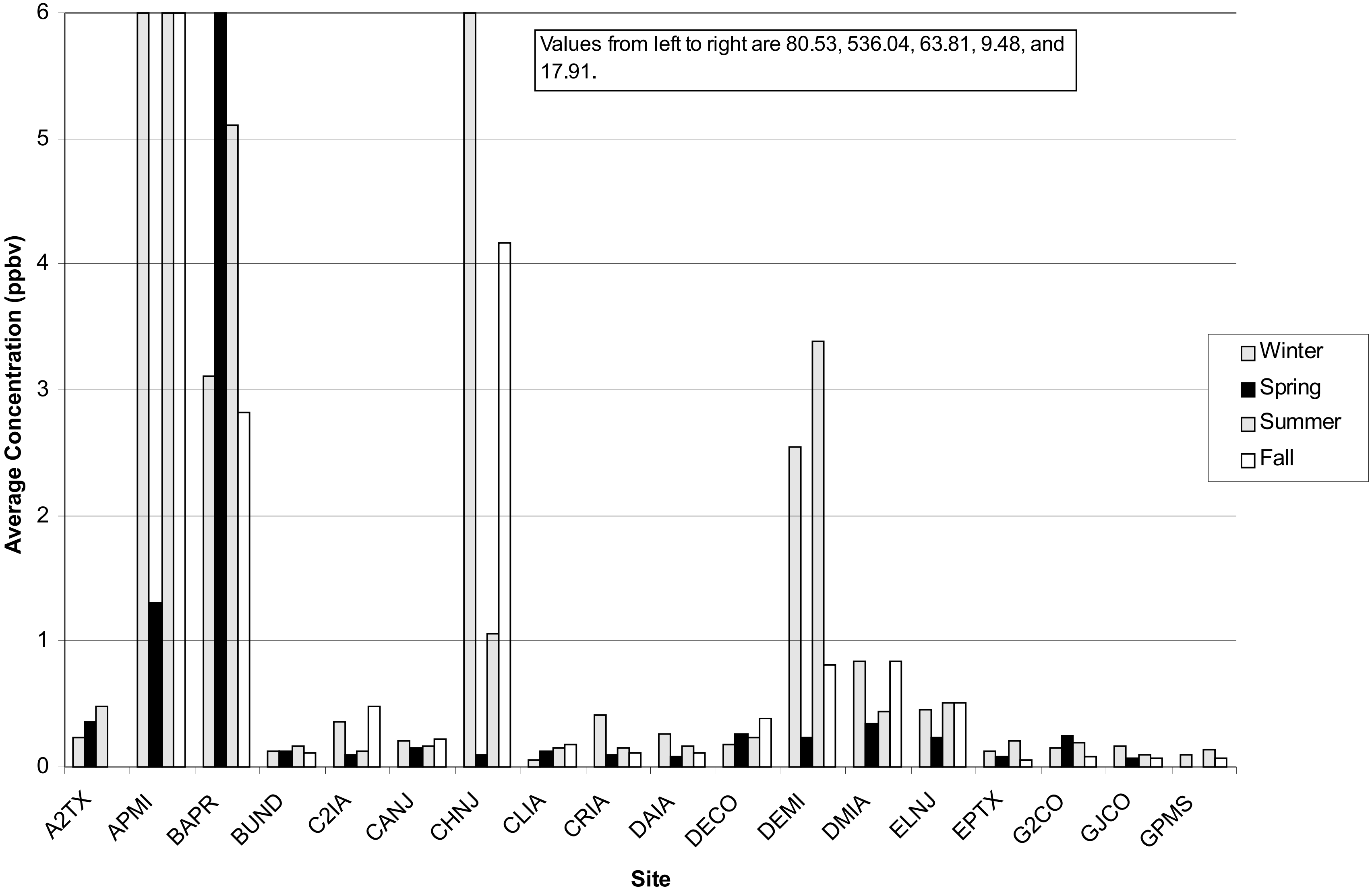
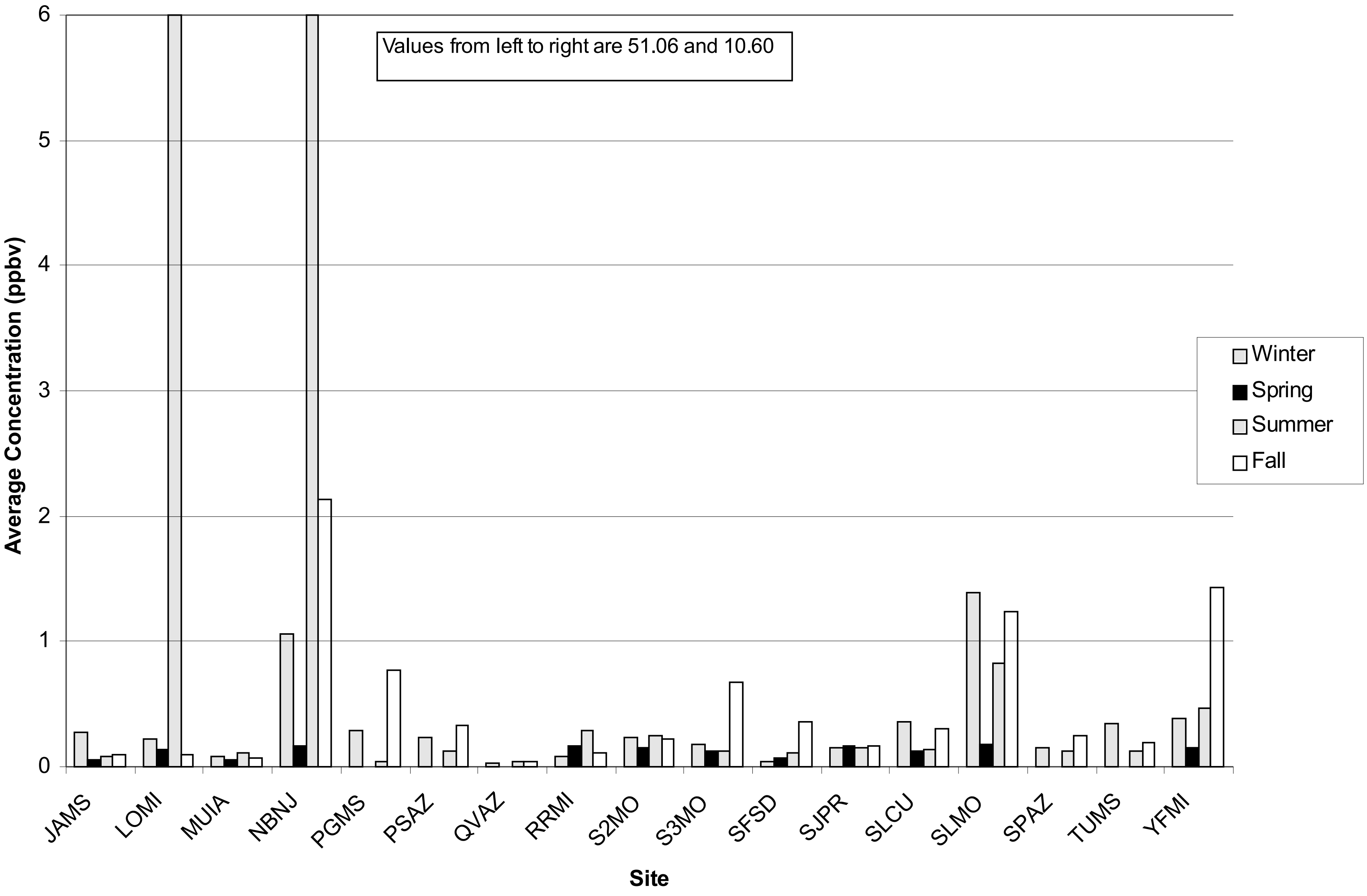


Figure 3-41a: Average Methylene Chloride Concentration by Season (A2TX-GPMS)



Values from left to right are 80.53, 536.04, 63.81, 9.48, and 17.91.

Figure 3-41b: Average Methylene Chloride Concentration by Season (JAMS-YFMI)



Values from left to right are 51.06 and 10.60

Figure 3-42a: Average *o*-Xylene Concentration by Season (A2TX-GPMS)

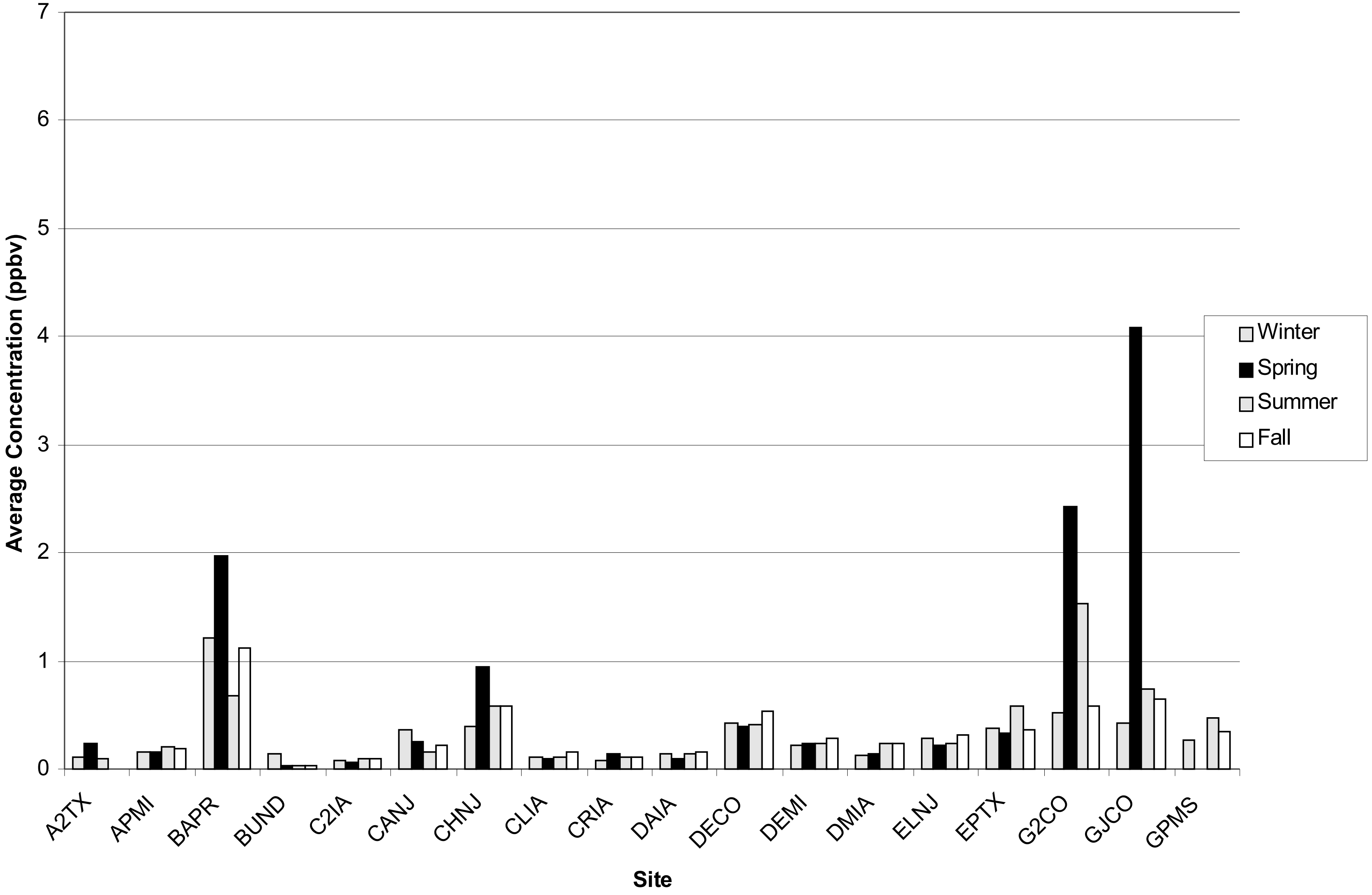
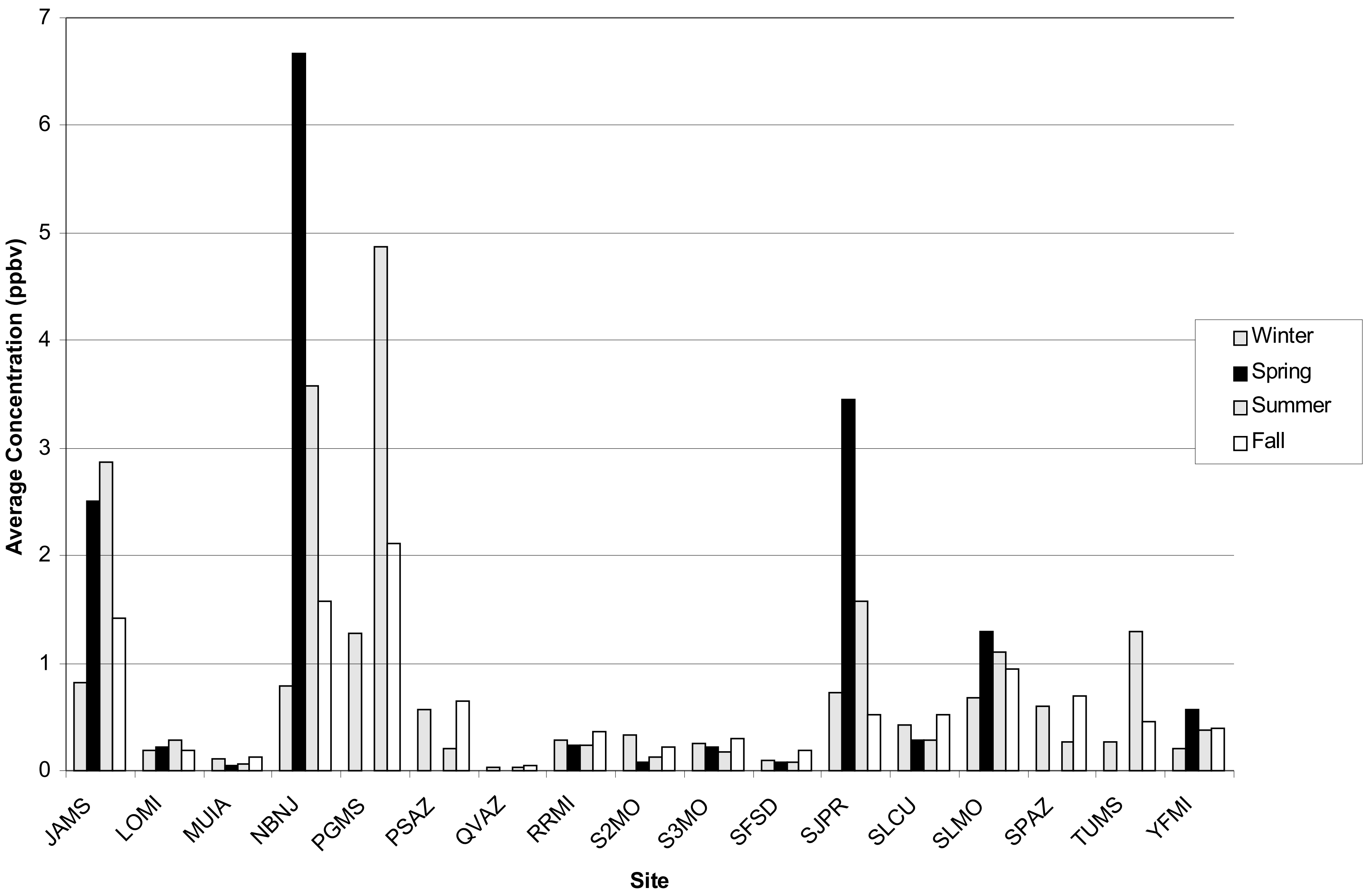


Figure 3-42b: Average *o*-Xylene Concentration by Season (JAMS-YFMI)



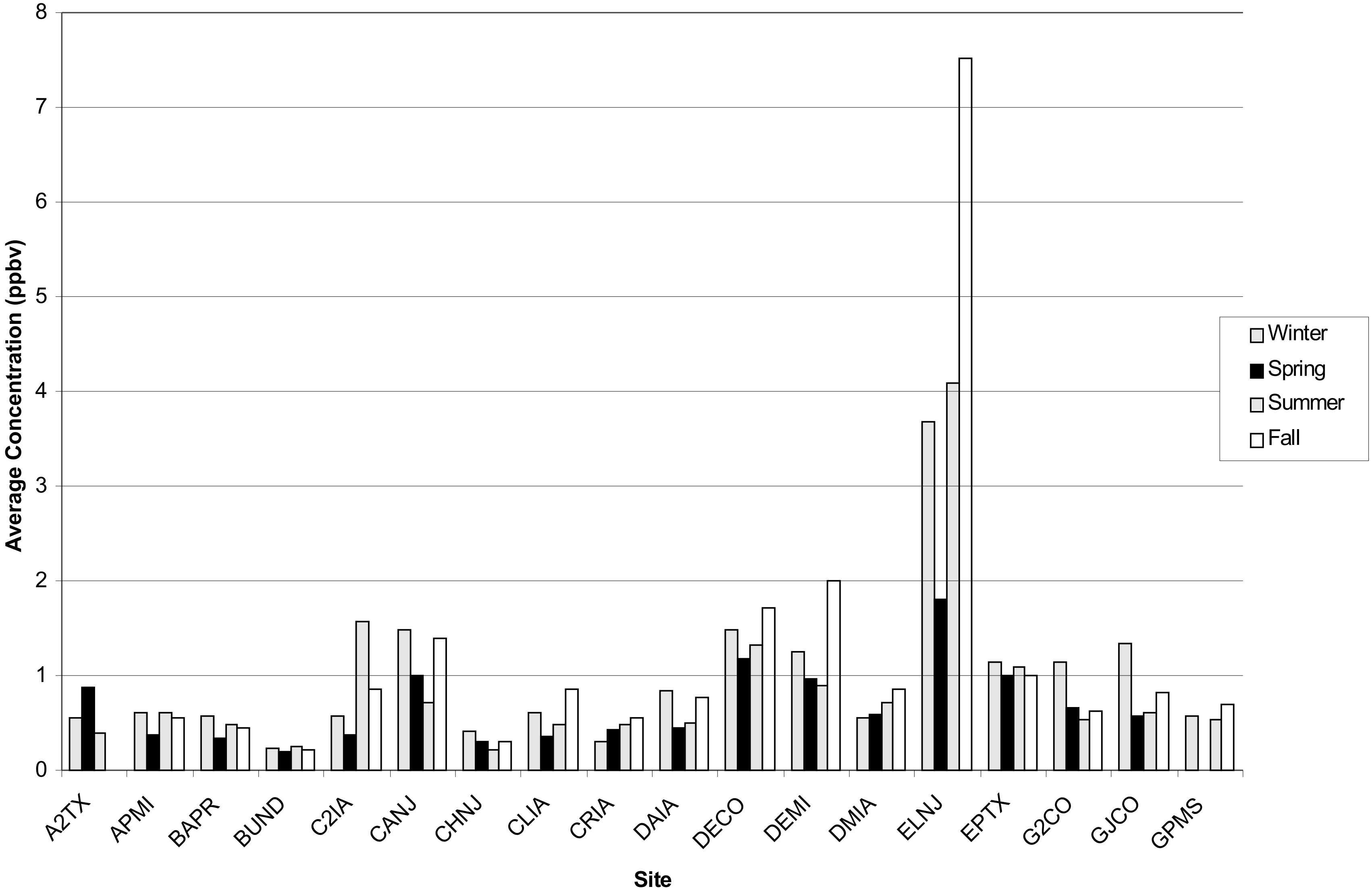


Figure 3-43a: Average Propylene Concentration by Season (A2TX-GPMS)

Figure 3-43b: Average Propylene Concentration by Season (JAMS-YFMI)

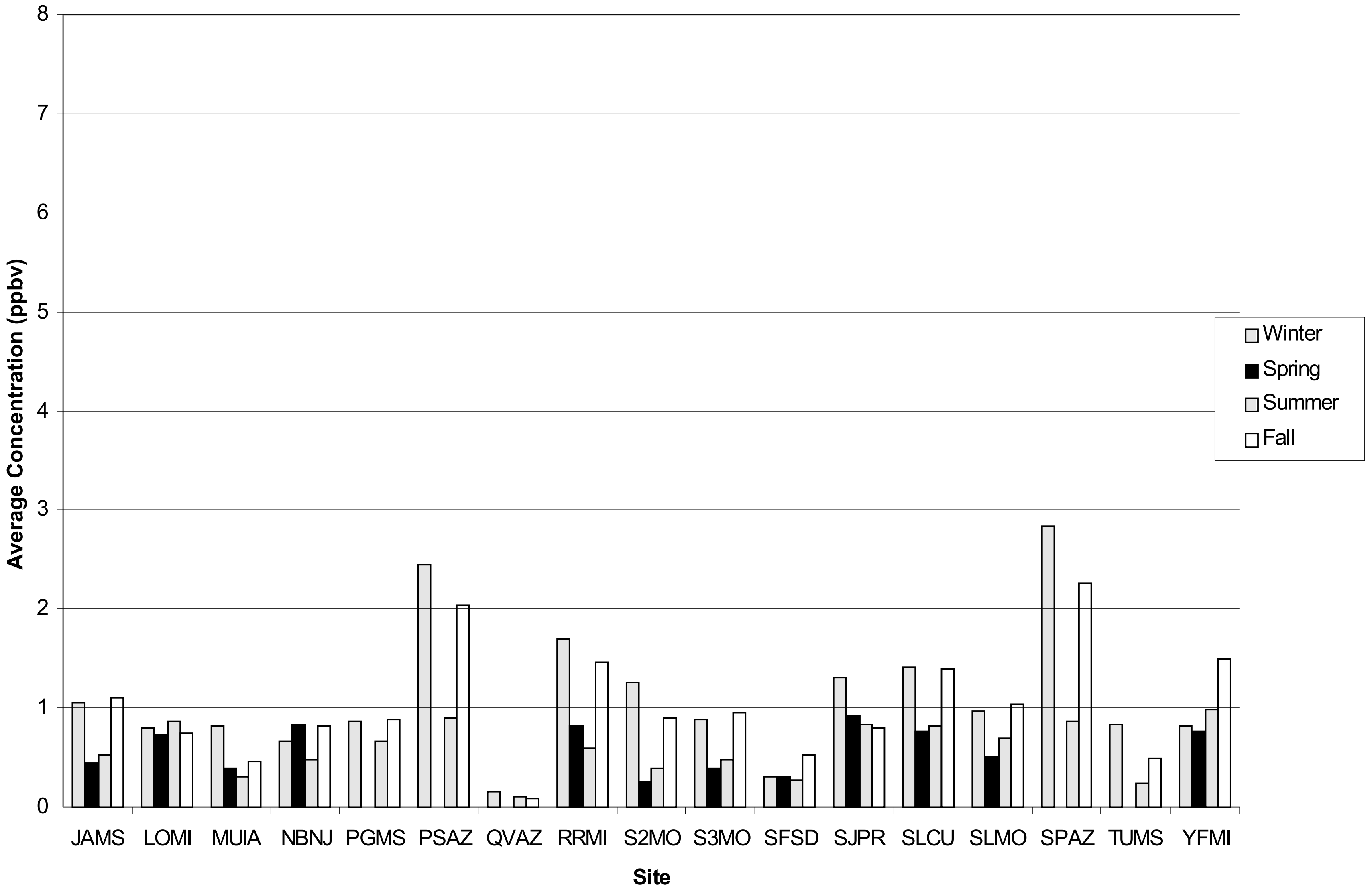


Figure 3-44a: Average Toluene Concentration by Season (A2TX-GPMS)

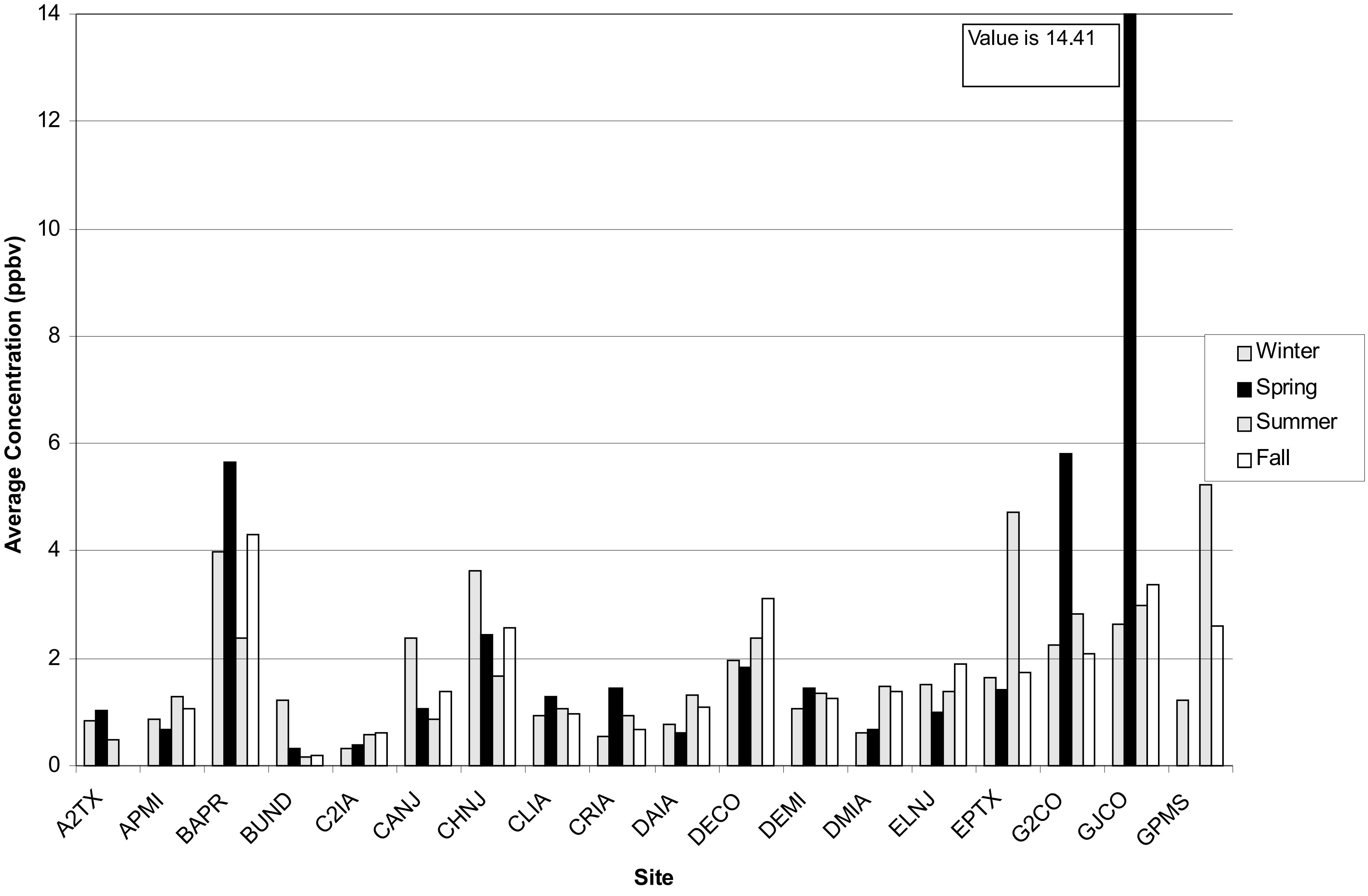


Figure 3-44b: Average Toluene Concentration by Season (JAMS-YFMI)

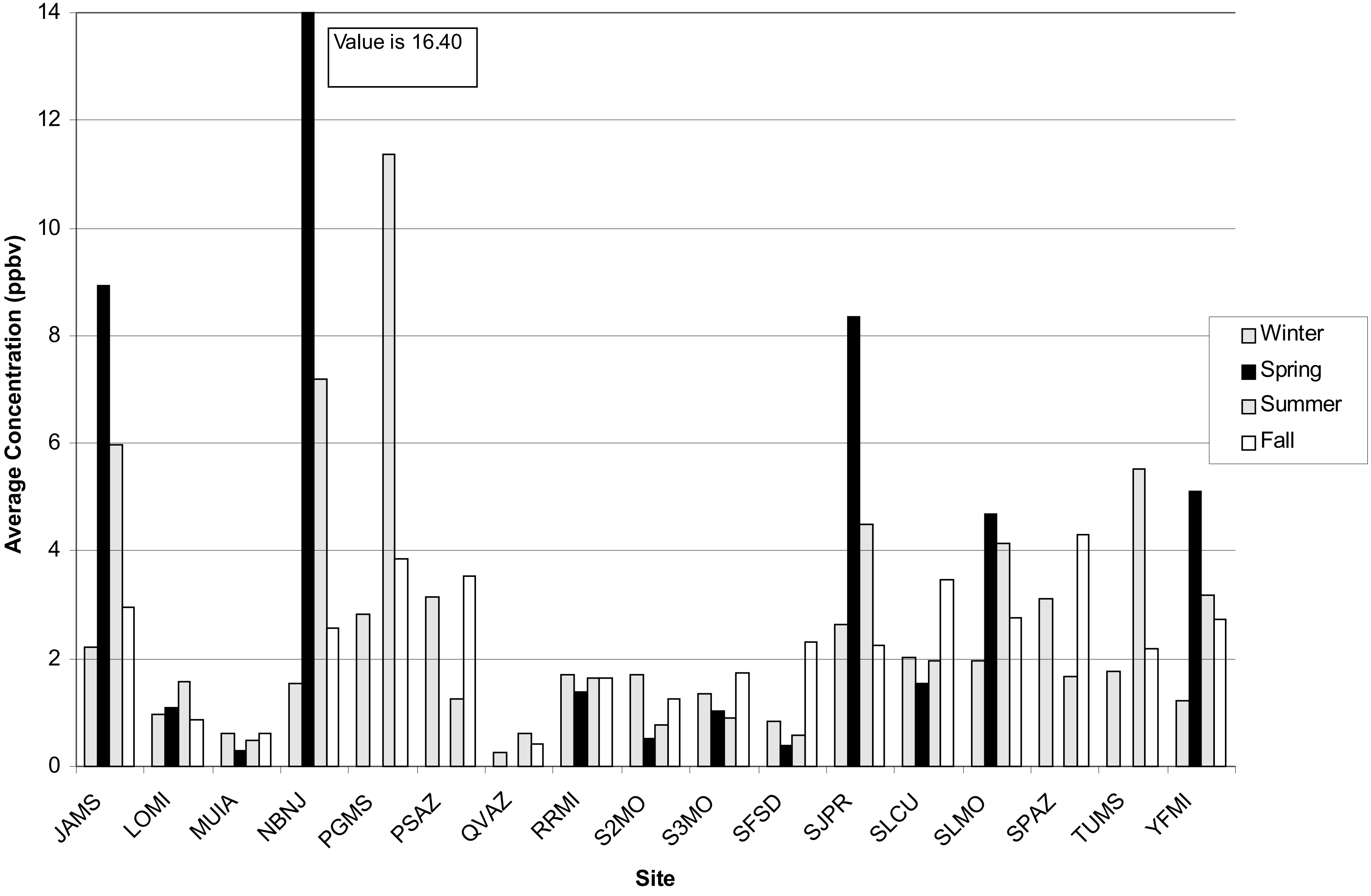


Table 3-1. Sampling Detect Summaries of the VOC Concentrations

Chemical[1]	**# of Detects**	**Min. Value (ppbv)**	**Max. Value (ppbv)**	**Average Value (ppbv)**	**Geometric Mean (ppbv)**	**Median (ppbv)**	**1st Quartile (ppbv)**	**3rd Quartile (ppbv)**	**Standard Deviation (ppbv)**	**Coefficient Of Variation**
Hydrocarbons										
Acetylene	1802	0.099	82.59	2.056	1.345	1.316	0.83	2.067	3.947	1.92
Benzene	1806	0.02	45.9	0.696	0.473	0.44	0.3	0.71	1.822	2.615
1,3-Butadiene	1103	0.01	6.25	0.125	0.085	0.08	0.05	0.141	0.251	2.011
Ethylbenzene	1775	0.01	10.68	0.368	0.191	0.18	0.09	0.38	0.663	1.798
n-Octane	1202	0.016	1.33	0.104	0.08	0.08	0.05	0.12	0.104	1.006
Propylene	1797	0.041	19.18	1.007	0.659	0.62	0.37	1.11	1.433	1.423
Styrene	1027	0.008	1.48	0.076	0.055	0.05	0.03	0.08	0.095	1.254
Toluene	1806	0.04	33.26	1.828	1.078	1.099	0.57	2.19	2.544	1.392
1,2,4-Trimethylbenzene	1768	0.01	2.02	0.226	0.152	0.16	0.08	0.288	0.224	0.993
1,3,5-Trimethylbenzene	1604	0.007	2.89	0.085	0.061	0.06	0.033	0.1	0.106	1.24
***m*-,*p*-Xylene**	30	0.017	0.26	0.069	0.054	0.06	0.032	0.09	0.051	0.744
***o*-Xylene**	1764	0.01	9.69	0.443	0.228	0.21	0.108	0.48	0.733	1.653
Halogenated Hydrocarbons										
Bromochloromethane	11	0.13	0.84	0.438	0.383	0.31	0.3	0.635	0.222	0.507
Bromodichloromethane	NA									
Bromoform	3	0.08	0.77	0.363	0.245	0.24	0.16	0.505	0.295	0.812
Bromomethane	63	0.018	0.37	0.082	0.066	0.06	0.044	0.1	0.063	0.764
Carbon Tetrachloride	1793	0.01	0.39	0.092	0.09	0.09	0.08	0.1	0.02	0.213
Chlorobenzene	35	0.021	0.52	0.131	0.092	0.11	0.05	0.175	0.116	0.885

Table 3-1. Sampling Detect Summaries of the VOC Concentrations (Continued)

Chemical[1]	# of Detects	Min. Value (ppbv)	Max. Value (ppbv)	Average Value (ppbv)	Geometric Mean (ppbv)	Median (ppbv)	1st Quartile (ppbv)	3rd Quartile (ppbv)	Standard Deviation (ppbv)	Coefficient Of Variation
Chloroethane	83	0.047	1.13	0.237	0.186	0.187	0.12	0.265	0.189	0.795
Chloroform	281	0.01	0.52	0.057	0.045	0.04	0.03	0.06	0.051	0.901
Chloromethane	1804	0.14	6.79	0.642	0.627	0.615	0.565	0.689	0.202	0.315
Chloromethylbenzene	1	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0	0
Chloroprene	2	0.07	0.6	0.335	0.205	0.335	0.203	0.468	0.265	0.791
Dibromochloromethane	1	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0	0
1,2-Dibromoethane	NA									
m-Dichlorobenzene	1792	0.01	33.98	1.185	0.516	0.488	0.23	1.14	2.368	1.999
o-Dichlorobenzene	8	0.02	0.07	0.038	0.034	0.035	0.02	0.045	0.018	0.476
p-Dichlorobenzene	533	0.008	1.69	0.084	0.049	0.047	0.022	0.09	0.128	1.527
1,1-Dichloroethane	8	0.1	1.65	0.683	0.482	0.575	0.335	0.94	0.495	0.725
1,2-Dichloroethane	NA									
1,1-Dichloroethene	6	0.03	0.346	0.226	0.174	0.277	0.148	0.309	0.115	0.511
cis-1,2-Dichloroethylene	2	0.04	0.335	0.188	0.116	0.188	0.114	0.261	0.148	0.787
trans-1,2-Dichloroethylene	4	0.09	0.11	0.1	0.1	0.1	0.098	0.103	0.007	0.071
1,2-Dichloropropane	NA									
cis-1,3-Dichloropropene	NA									
trans-1,3-Dichloropropene	NA									
Dichlorodifluoromethane	1806	0.19	460.464	1.644	0.639	0.61	0.571	0.66	20.947	12.742
Dichlorotetrafluoroethane	257	0.006	0.22	0.016	0.013	0.01	0.01	0.016	0.021	1.336
Hexachloro-1,3-Butadiene	2	0.025	0.056	0.041	0.038	0.041	0.033	0.048	0.015	0.378

Table 3-1. Sampling Detect Summaries of the VOC Concentrations (Continued)

Chemical[1]	# of Detects	Min. Value (ppbv)	Max. Value (ppbv)	Average Value (ppbv)	Geometric Mean (ppbv)	Median (ppbv)	1st Quartile (ppbv)	3rd Quartile (ppbv)	Standard Deviation (ppbv)	Coefficient Of Variation
Methylene Chloride	1668	0.016	3333.63	4.63	0.218	0.16	0.09	0.38	88.877	19.196
1,1,2,2-Tetrachloroethane	10	0.02	0.11	0.061	0.052	0.05	0.033	0.088	0.032	0.531
Tetrachloroethylene	709	0.01	1.54	0.085	0.063	0.06	0.04	0.1	0.097	1.142
1,2,4-Trichlorobenzene	3	0.07	0.21	0.133	0.121	0.12	0.095	0.165	0.058	0.434
1,1,1-Trichloroethane	1571	0.01	1.13	0.043	0.038	0.04	0.03	0.047	0.051	1.203
1,1,2-Trichloroethane	NA									
Trichloroethylene	186	0.019	15.172	0.246	0.062	0.05	0.034	0.09	1.507	6.121
Trichlorofluoromethane	1802	0.03	14.503	0.348	0.323	0.301	0.28	0.341	0.373	1.07
Trichlorotrifluoroethane	1803	0.02	10.08	0.115	0.105	0.1	0.09	0.12	0.239	2.084
Vinyl Chloride	NA									
Polar Compounds										
Acetonitrile	256	0.15	195.72	14.897	3.528	2.99	1.148	7.832	33.788	2.268
Acrylonitrile	108	0.03	60.11	2.054	0.657	0.625	0.3	1.432	6.128	2.983
tert-Amyl Methyl Ether	63	0.02	0.978	0.198	0.154	0.15	0.1	0.221	0.171	0.866
Ethyl Acrylate	3	0.03	0.12	0.067	0.056	0.05	0.04	0.085	0.039	0.579
Ethyl *tert*-Butyl Ether	1	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0	0
Methyl Ethyl Ketone	1614	0.08	38.488	1.255	0.958	0.9	0.624	1.37	1.709	1.361
Methyl Isobutyl Ketone	223	0.059	5.68	0.452	0.328	0.31	0.219	0.447	0.621	1.374
Methyl Methacrylate	26	0.1	2.798	0.545	0.329	0.27	0.15	0.443	0.686	1.259
Methyl *tert*-Butyl Ether	627	0.01	11.743	0.947	0.509	0.53	0.23	1.18	1.184	1.25

[1] = **BOLD** indicates the compound is prevalent for 2001 Program Year;
Italics indicates the chemical is an urban air toxics strategy HAP

Table 3-2. Sampling Detect Summaries of the Carbonyl Concentrations

Chemical[1]	# of Detects	Min. Value (ppbv)	Max. Value (ppbv)	Average Value (ppbv)	Geometric Mean (ppbv)	Median (ppbv)	1st Quartile (ppbv)	3rd Quartile (ppbv)	Standard Deviation (ppbv)	Coefficient Of Variation
Carbonyl Compounds										
Acetaldehyde	1979	0.001	19.620	1.320	1.025	1.106	0.731	1.600	1.022	0.774
Acetone	1964	0.000	18.650	1.649	1.138	1.233	0.733	2.035	1.587	0.962
Benzaldehyde	1966	0.000	1.320	0.068	0.046	0.045	0.028	0.073	0.090	1.333
Butyr/Isobutyraldehyde	1911	0.000	1.597	0.152	0.106	0.117	0.065	0.190	0.141	0.926
Crotonaldehyde	1408	0.000	0.526	0.040	0.020	0.018	0.009	0.049	0.058	1.429
2,5-Dimethylbenzaldehyde	622	0.000	1.100	0.025	0.013	0.014	0.007	0.030	0.058	2.315
Formaldehyde	2012	0.017	59.590	3.958	2.647	2.710	1.682	4.299	5.415	1.368
Hexaldehyde	1889	0.001	4.304	0.207	0.087	0.075	0.029	0.265	0.323	1.560
Isovaleraldehyde	469	0.000	2.960	0.087	0.030	0.032	0.010	0.085	0.206	2.360
Propionaldehyde	1869	0.000	1.144	0.122	0.088	0.097	0.055	0.156	0.102	0.839
Tolualdehydes	1864	0.000	3.529	0.070	0.042	0.043	0.025	0.070	0.172	2.467
Valeraldehyde	1704	0.001	1.089	0.057	0.033	0.031	0.018	0.059	0.086	1.518

[1] = **BOLD** indicates the compound is prevalent for 2001 Program Year;
Italics indicates the chemical is an urban air toxics strategy HAP

Table 3-3. Range of Detectable Values by Site

UATMP Site (SITE CODE)	Range of Detectable Values (ppbv)	Number of Sampling Days		Number of Detects	Number of Samples > 5ppbv
		Carbonyl	VOC		
A2TX	0.002 - 41	14	14	737	6
APMI	0.001 - 3333.63	22	24	708	19
AZFL	0.001 - 13.07	59	N/A	542	6
BAPR	0.001 - 124.57	17	19	627	25
BUND	0 - 13.23	61	61	2023	2
C2IA	0.01 - 14.15	109	114	3723	8
CANJ	0.001 - 13.86	44	45	1953	14
CHNJ	0.002 - 22.19	31	32	1119	27
CLIA	0 - 195.72	25	25	979	13
CRIA	0.001 - 17.34	57	58	2051	15
DAIA	0 - 7.02	31	31	1139	3
DECO	0.001 - 15.454	60	59	2415	69
DEMI	0 - 61.71	207	213	8996	87
DMIA	0.001 - 25.42	24	25	1005	25
DNFL	0 - 59.32	61	N/A	1304	18
ELFL	0.001 - 6.134	58	N/A	501	2
ELNJ	0.002 - 19.18	47	48	2096	32
EPTX	0.003 - 22.69	28	30	1335	10
G2CO	0.001 - 18.65	40	39	3182	125
GAFL	0 - 7.808	58	N/A	736	4
GJCO	0.005 - 84.04	38	39	1492	100
GPMS	0.002 - 134.06	13	13	410	8
JAMS	0.004 - 41.16	13	21	681	35
LEFL	0 - 4.626	61	N/A	797	0
LOMI	0 - 331.69	21	41	1065	7
MUIA	0.01 - 30.05	27	27	997	13
NBNJ	0.005 - 183.61	36	36	1321	76
PGMS	0.004 - 22.46	15	15	451	20
PSAZ	0.01 - 8.811	N/A	33	828	17
QVAZ	0.007 - 60.11	N/A	27	478	10
RRMI	0 - 12.58	1	21	444	3
S2MO	0.01 - 9.24	N/A	37	1018	3
S3MO	0.01 - 6.43	N/A	35	906	4
SFSD	0.006 - 460.46	N/A	60	1395	10
SIFL	0 - 42.94	61	N/A	714	11
SJPR	0.001 - 10.65	14	17	492	7
SLCU	0 - 59.59	53	54	2234	52
SLMO	0 - 50.627	27	28	1211	48
SPAZ	0.013 - 38.488	N/A	21	529	34
SWMI	0.062 - 11.911	1	N/A	11	3
TUMS	0.003 - 24.681	14	14	433	16
YFMI	0.001 - 45.9	37	38	1155	22

Table 3-4. Geometric Means by Site

UATMP Site	Geometric Mean (ppbv)			
	Carbonyls	Halogenated Hydrocarbons	Hydrocarbons	Polar
A2TX	4.15	3.33	4.41	2.31
APMI	4.89	19.28	4.06	3.84
AZFL	3.38	N/A	N/A	N/A
BAPR	1.43	6.38	10.87	9.19
BUND	2.43	2.91	1.31	2.01
C2IA	2.96	3.11	2.6	1.76
CANJ	2.88	3.28	5.18	2.42
CHNJ	2.88	6.38	5.97	1.95
CLIA	3.04	3.08	3.33	3.44
CRIA	3.68	3.1	2.81	1.24
DAIA	3.06	3.57	3.67	1.66
DECO	9.75	3.12	10.08	1.91
DEMI	3.62	4.02	5.81	1.98
DMIA	3.52	3.6	4.68	1.87
DNFL	5.03	N/A	N/A	N/A
ELFL	2.82	N/A	N/A	N/A
ELNJ	3.59	3.5	8.69	3.29
EPTX	2.31	3.3	7.53	2.72
G2CO	12.42	3.04	10.96	1.7
GAFL	3.19	N/A	N/A	N/A
GJCO	11.2	3.03	21.04	1.93
GPMS	6.96	3.24	7.25	6.16
JAMS	2.8	3.31	18.21	4.05
LEFL	3.56	N/A	N/A	N/A
LOMI	5.07	5.18	5.12	1.67
MUIA	3.93	3.53	2.42	2.02
NBNJ	5.67	5.71	16.11	3.23
PGMS	3.81	4.16	18.84	1.81
PSAZ	N/A	3.49	7.49	5.71
QVAZ	N/A	2.78	1.06	3.81
RRMI	27.44	3.14	6.03	1.5
S2MO	N/A	3.33	4.27	2.38
S3MO	N/A	3.3	4.94	2.31
SFSD	N/A	3.51	2.58	1.45
SIFL	3.18	N/A	N/A	N/A
SJPR	0.87	3.3	10.6	3.06
SLCU	5.57	3.22	8.57	2.16
SLMO	3.53	3.83	11.63	2.53
SPAZ	N/A	3.34	8.02	7.93
SWMI	26.35	N/A	N/A	N/A

Table 3-4. Geometric Means by Site (Continued)

UATMP Site	Geometric Mean (ppbv)			
	Carbonyls	Halogenated Hydrocarbons	Hydrocarbons	Polar
TUMS	3.21	2.7	4.26	3.69
YFMI	3.34	3.62	10.87	1.43

Table 3-5. Summary of Pearson Correlation Coefficients for Selected Meteorological Parameters and Prevalent Compounds

Prevalent Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.03	0.02	-0.06	-0.02	-0.10	-0.01	0.12
Acetone	-0.08	-0.04	-0.29	-0.15	-0.32	-0.02	0.03
Acetylene	0.07	0.06	-0.09	0.00	-0.20	-0.09	0.03
Benzene	0.01	0.04	0.01	0.03	-0.03	0.03	0.09
Chloromethane	0.07	0.06	0.09	0.07	0.02	-0.07	0.09
Dichlorodifluoromethane	-0.02	-0.03	-0.02	-0.03	-0.01	-0.01	0.02
EthylBenzene	0.16	0.09	0.07	0.09	-0.08	-0.10	-0.05
Formaldehyde	0.17	0.12	0.05	0.08	-0.13	-0.04	0.05
m-,p - Xylene	0.16	0.08	0.08	0.09	-0.07	-0.10	-0.05
Methyl Ethyl Ketone	0.17	0.19	0.03	0.12	-0.23	-0.03	0.00
Methylene Chloride	0.04	0.05	0.07	0.06	0.02	0.06	0.00
o - Xylene	0.17	0.10	0.07	0.09	-0.10	-0.12	-0.05
Propylene	0.05	0.07	0.05	0.07	-0.02	0.13	0.10
Toluene	0.18	0.14	0.06	0.11	-0.14	-0.11	-0.01

Table 3-6. Summary of Mobile Information by Site

UATMP Site	Estimated No of Motor Vehicles Owned	Estimated Traffic	County-Level On-Road Emissions	County-Level Non-Road Emissions	Hydrocarbon Geometric Mean (ppbv)
A2TX	534,416	17,472	8,707	1,662	4.41
APMI	764,968	60,000	10,742	1,884	4.06
AZFL	441,735	51,000	4,469	1,241	N/A
BAPR	N/A	10	174	88	10.81
BUND	4,591	1,350	78	57	1.31
C2IA	129,045	1,500	1,129	213	2.6
CANJ	1,564,196	62,000	2,680	445	5.18
CHNJ	176,913	12,623	2,680	962	5.97
CLIA	31,433	500	183	69	3.33
CRIA	129,746	15,600	1,129	213	2.81
DAIA	203,328	1,000	988	201	3.67
DECO	933,463	44,200	2,943	891	10.08
DEMI	918,346	12,791	11,162	4,537	5.81
DMIA	280,507	12,400	2,526	653	4.63
DNFL	335,027	16,281	4,469	1,241	N/A
E7MI	854,602	6,999	10,742	1,884	N/A
ELFL	366,638	14,000	4,469	1,241	N/A
ELNJ	1,549,285	170,000	2,097	513	8.69
EPTX	313,381	3,790	2,730	505	7.53
G2CO	75,650	2,200	785	178	10.96
GAFL	339,325	81,460	4,537	1,455	N/A
GJCO	82,425	10,000	785	178	21.04
GPMS	131,375	17,000	1,550	605	7.25
JAMS	196,492	12,500	1,881	229	18.21
LEFL	436,419	1,055	4,537	1,455	N/A
LOMI	825,470	100,000	11,162	4,537	5.12
MUIA	25,127	2,800	148	48	2.42
NBNJ	622,933	63,000	3,708	962	16.11
PGMS	43,835	8,600	1,030	366	18.34
PSAZ	971,853	250	11,725	5,925	7.49
QVAZ	64,642	200	740	267	1.06
RRMI	669,779	500	10,742	1,884	6.03
S2MO	597,918	1,000	2,609	288	4.27
S3MO	536,990	8,532	2,609	288	4.94
SFSD	109,862	4,320	859	178	2.58
SIFL	497,391	18,700	4,537	1,455	N/A
SJPR	N/A	51,000	3,084	1,671	10.6
SLCU	606,580	20,485	5,530	1,651	8.57
SLMO	597,918	15,014	2,609	288	11.63
SPAZ	597,424	50,000	11,725	5,925	8.02

Table 3-6. Summary of Mobile Information by Site (Continued)

UATMP Site	Estimated No of Motor Vehicles Owned	Estimated Traffic	County-Level On-Road Emissions	County-Level Non-Road Emissions	Hydrocarbon Geometric Mean (ppbv)
SWMI	885,315	18,437	10,742	1,884	N/A
TUMS	52,526	4,900	342	86	4.26
YFMI	885,315	500	10,742	1,884	10.87

4.0 Sites in Arizona

This section focuses on a few specific meteorological and concentration trends for the three UATMP sites in Arizona (PSAZ, QVAZ, and SPAZ). All three of these sites reside in the Phoenix metropolitan statistical area. Figures 4-1 through 4-3 are topographical maps showing the monitoring stations in their urban locations. Figures 4-4 and 4-5 are maps identifying facilities within ten miles of the sites and that reported to the 1999 NEI. The PSAZ and SPAZ sites are close to each other and are surrounded by numerous industries, while the QVAZ site has only two nearby industries. PSAZ and SPAZ are surrounded mostly by four types of industries: electronic/computer equipment manufacturers, fabricated metal product manufacturers, and utility companies. QVAZ is nearest to an unknown industry and one stone/glass/clay or concrete manufacturer.

Hourly meteorological data were retrieved for all of 2001 at two weather stations near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The two weather stations are Phoenix-Sky Harbor and Phoenix-Deer Valley (WBAN 23183 and 3184, respectively).

Table 4-1 highlights the average UATMP concentration at each of these sites, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), and wind information (average u- and v-components of the wind) for the entire year and on sampling days. Normally, the Phoenix area is extremely hot and dry, and the high average temperature and low average relative humidity values in Table 4-1 also confirm this observation. Wind speeds were also very light for each site, as the city resides in a valley, but the wind generally flow from the south and east. This information can be found at the following web site: http://www.ssec.org/idis/gates/States/physical/phoenix.htm.

4.1 Meteorological and Concentration Averages at the Arizona Sites

Carbonyl compounds were not measured at any of the three sites, as indicated in Tables 3-3 and 3-4. PSAZ and SPAZ each had hydrocarbon compounds geometric means more than double their halogenated hydrocarbon geometric means (7.49 ppbv vs. 3.49 ppbv and 8.02 ppbv vs. 3.34 ppbv, respectively). QVAZ measured the lowest geometric mean for hydrocarbons at 1.06 ppbv. The average total UATMP daily concentration at QVAZ was also lower compared to the other two sites and was computed to be 11.05 ppbv (±4.46) at QVAZ; at PSAZ, the value was nearly double (20.98 ppbv ±3.28) and at SPAZ, the value was nearly triple (30.99 ppbv ±7.98). Table 4-1 also lists the averages for selected meteorological parameters from January 2001 to December 2001, which is similar to the time period covered in this report.

Tables 4-2a-c are the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters by site. Identification of the prevalent compounds is discussed in Section 3 of this report. At PSAZ, all of the correlations are negative, with the exception of methyl ethyl ketone. Maximum and average temperatures had weak negative correlations, whereas the moisture parameters had relatively stronger negative correlations. Acetylene, benzene, ethylbenzene, *m-,p*-xylene, *o*-xylene, propylene, and toluene all had at least one correlation which was considered strong (less than -0.50 or greater than 0.50). The v-components of the wind speed were all negative for each of the fourteen compounds. The prevalent compounds generally increase when the moisture and wind speeds are decreasing.

At QVAZ, the correlations were not as strong (none were less than -0.50 or greater than 0.50). The strongest correlation was for methyl ethyl ketone with wet bulb temperature and *o*-xylene with average temperature (-0.33). The weak correlations across the temperature, moisture, and wind information make it difficult to ascertain when UATMP concentrations will increase.

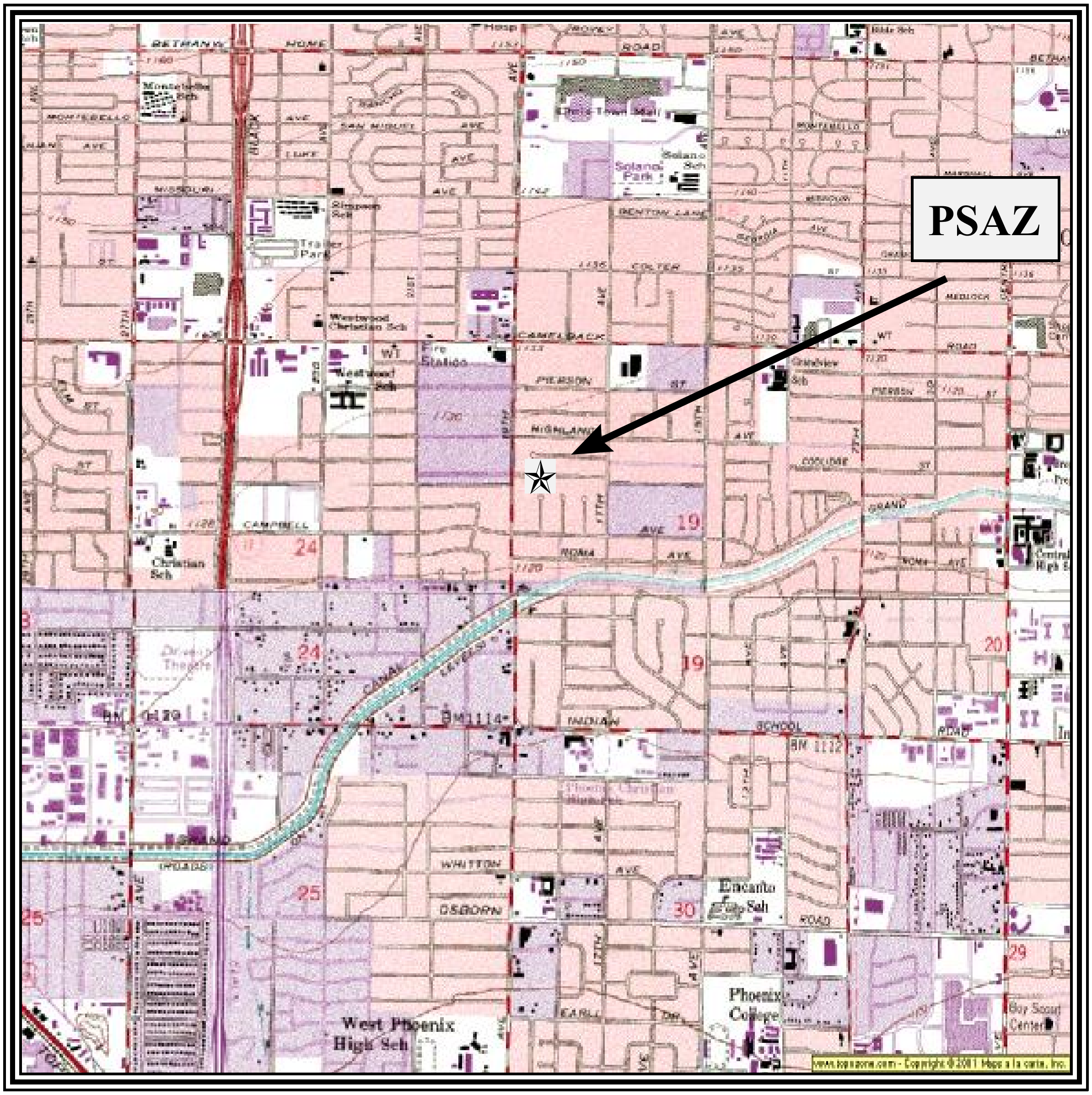
Similar to PSAZ, the SPAZ site had nearly all negative correlations. The strongest correlation was the v-component of the wind speed and toluene (-0.59). Acetylene, dichlorodifluoromethane, ethylbenzene, *m-,p*-xylene, *o*-xylene, and toluene all had at least one correlation which was considered strong (less than -0.50 or greater than 0.50). The prevalent compounds generally increase when the moisture and wind speeds are decreasing.

4.2 Spatial Analysis

Using the population within ten miles of each site, an estimate of the number of motor vehicles operating in proximity to the monitoring station can be established. The ratio used in the this report is 0.74 motor vehicles to every one person (refer to section 3.4.1 for more information on this ratio). Hence, the population near the PSAZ site is 1,313,315 people, all of whom are operating approximately 971,853 vehicles. A population of 807,330 people is driving 597,424 motor vehicles near the SPAZ site, while a considerably lower population of 87,354 people are driving 64,642 vehicles near the QVAZ site. This information is compared to the average daily concentration of the prevalent compounds at each Arizona site in Table 4-3. Also included in Table 4-3 is average daily traffic data, or more specifically, the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis.

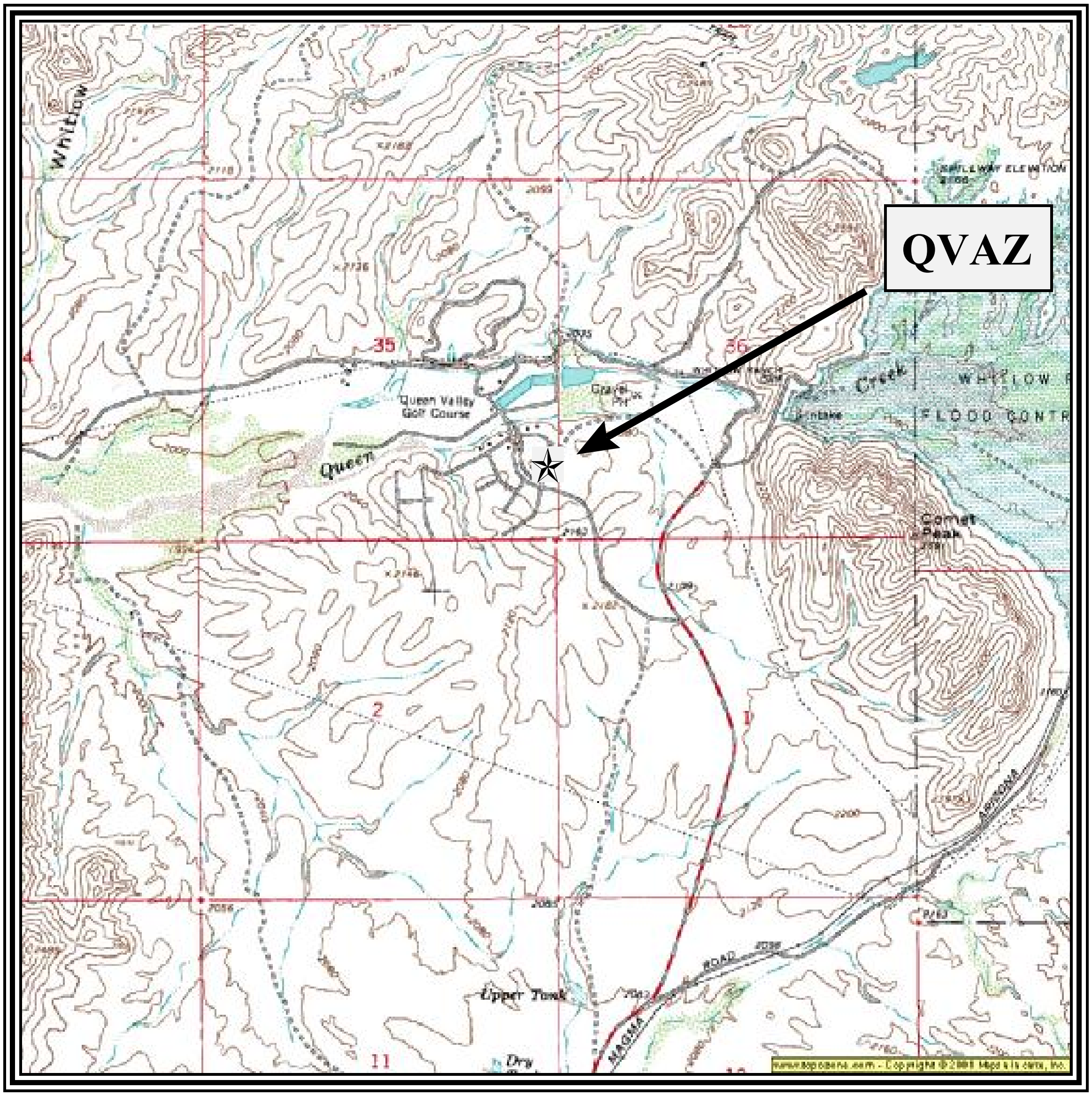
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area. (For more information on this study, refer to section 3.4.2.) Figure 3-16 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. The three Arizona sites all had higher toluene-ethylbenzene ratios than the roadside study, with QVAZ having the more than double the toluene-ethylbenzene ratio of the roadside study. QVAZ also had a higher benzene-ethylbenzene ratio than the roadside study, while SPAZ and PSAZ's were both lower than the roadside study. The *m-,p-*xylene-ethylbenzene concentration ratios for all three sites were lower than the roadside study's ratios, and the *o*-xylene-ethylbenzene ratios were all just slightly lower than the roadside study ratios. With the exception of QVAZ's toluene-ethylbenzene concentration ratio, the BTEX ratios of the Arizona sites resemble the ratios of the roadside study.

Figure 4-1. Phoenix, Arizona Site 1 (PSAZ) Monitoring Station



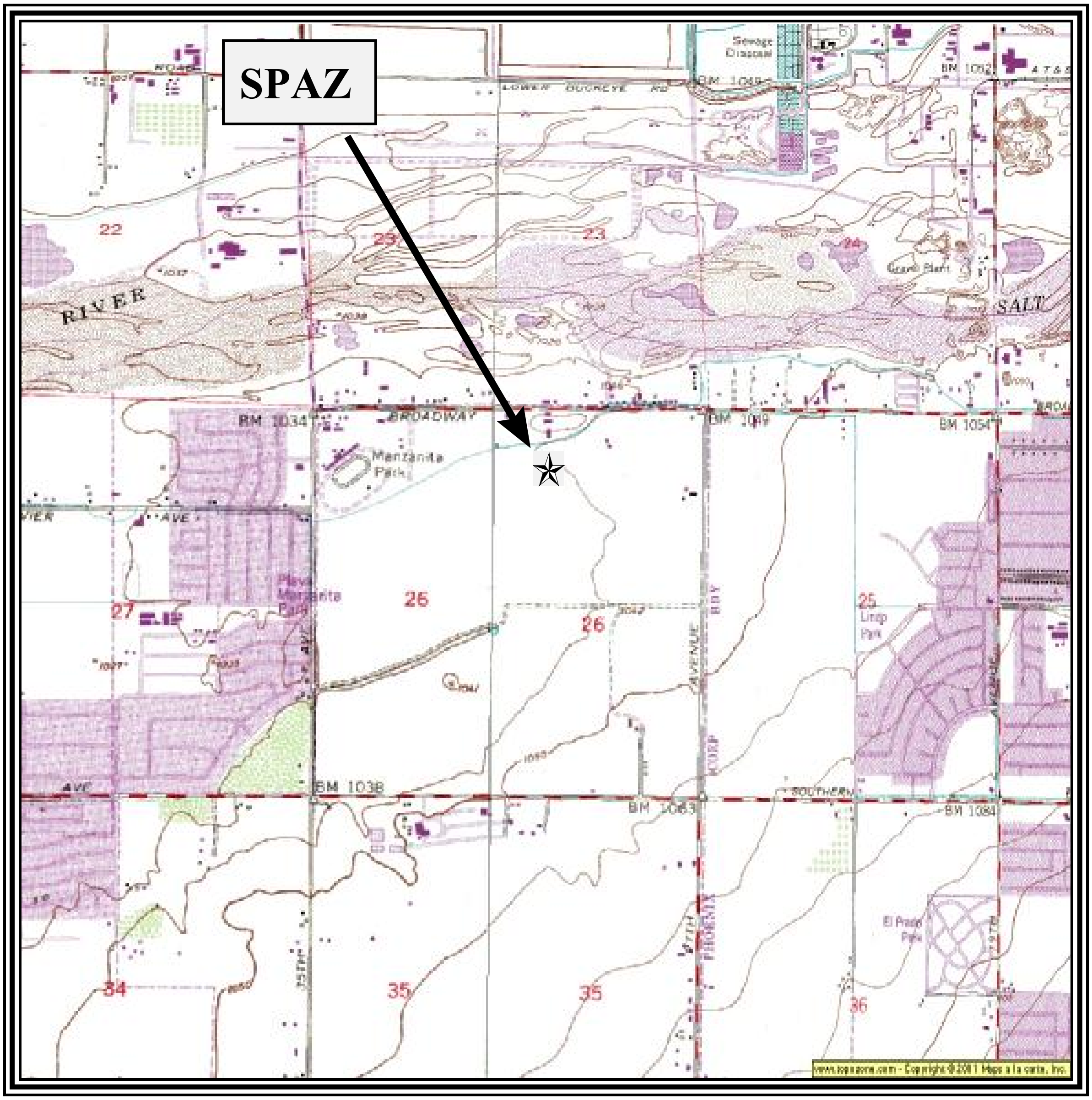
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 4-2. Phoenix, Arizona Site 2 (QVAZ) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 4-3. Phoenix, Arizona Site 3 (SPAZ) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 4-4. Facilities Located Within 10 Miles of PSAZ and SPAZ

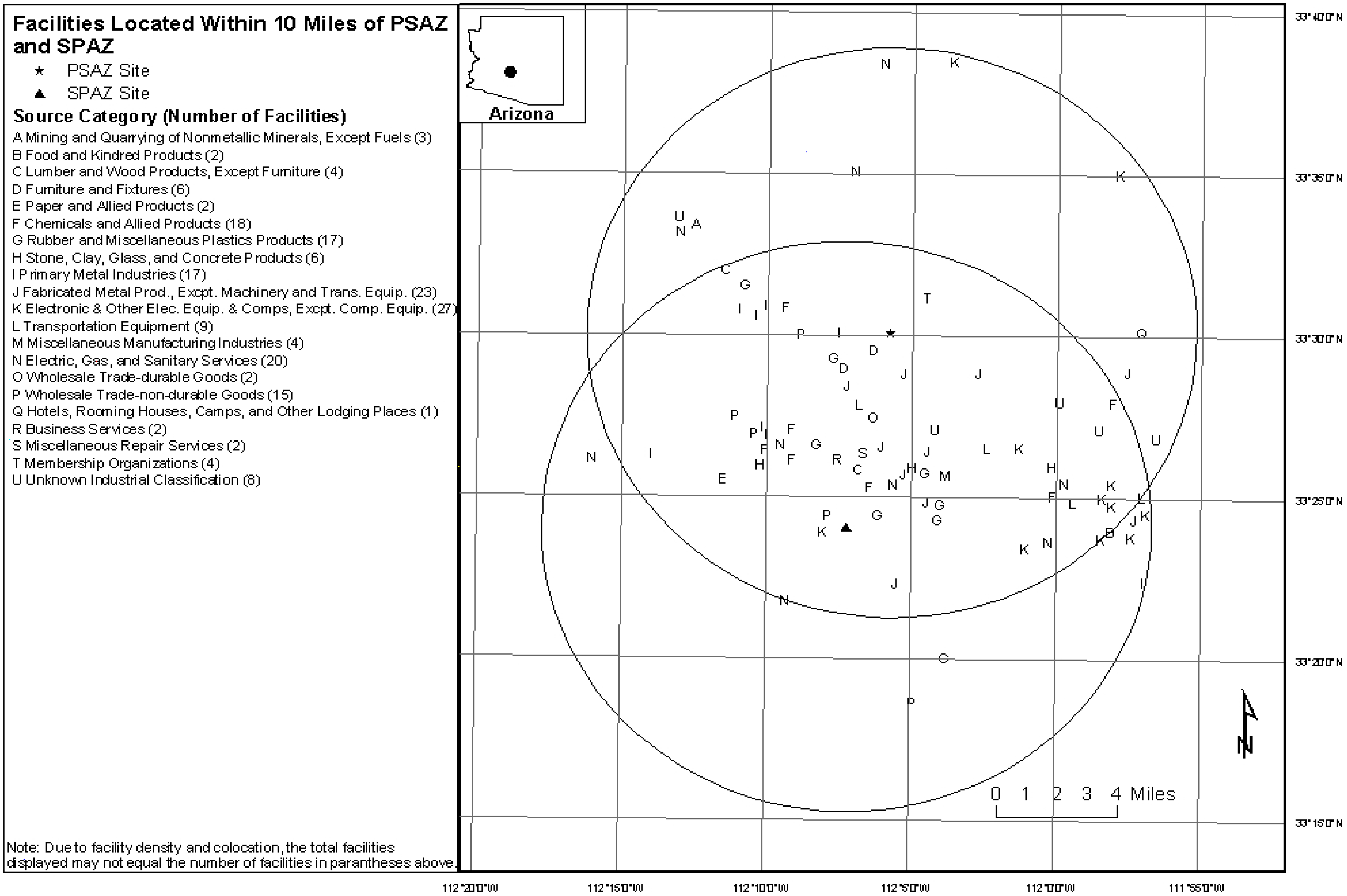


Figure 4-5. Facilities Located Within 10 Miles of QVAZ

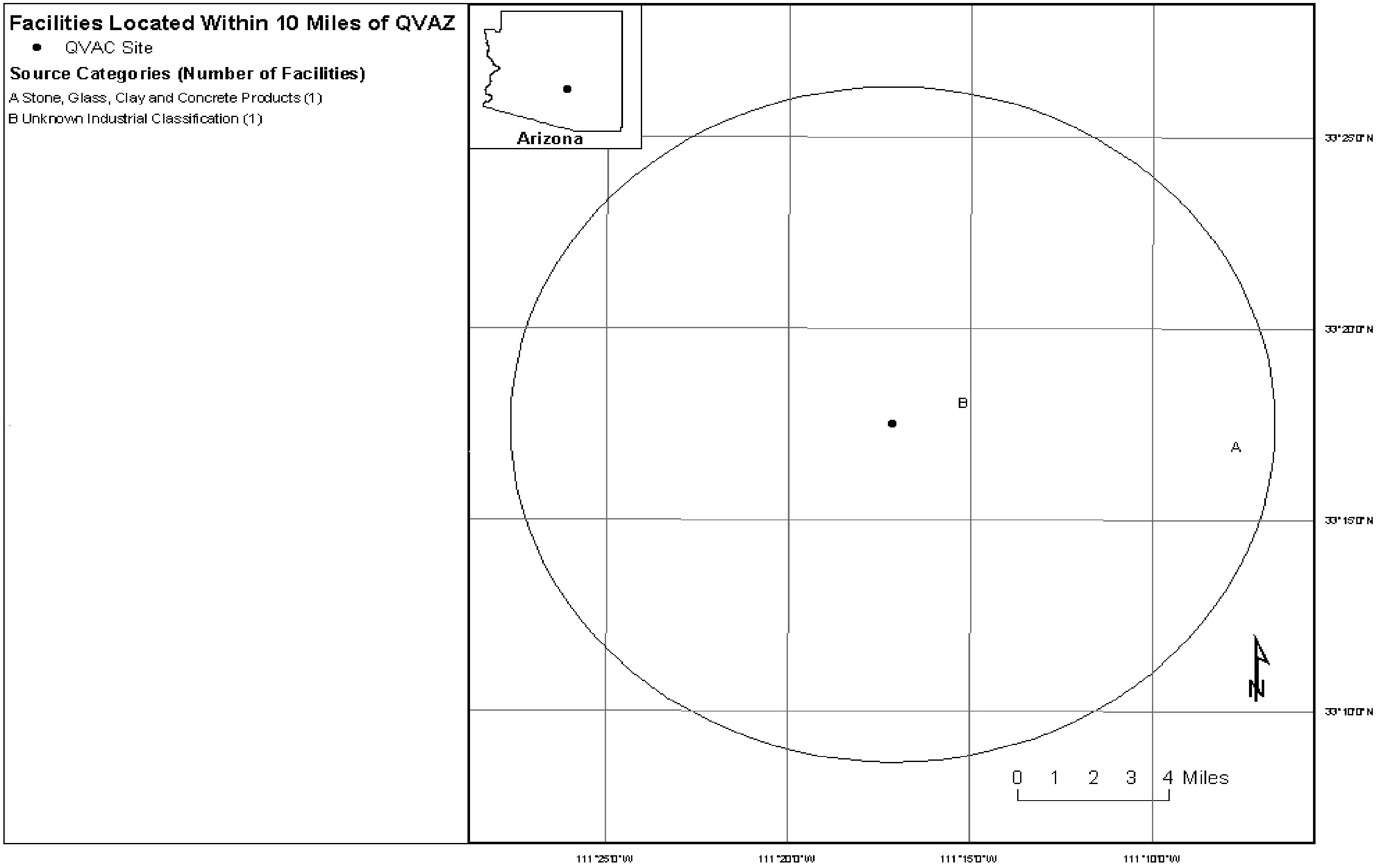


Table 4-1. Average Concentration and Meteorological Parameters for sites in Arizona

Site Name	Type	Average UATMP Concentration (ppbv)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
PSAZ	All 2001	▨	87.03 (±1.75)	74.10 (±1.71)	41.93 (±1.09)	56.18 (±1.04)	35.03 (±1.70)	-0.15 (±0.27)	0.84 (±0.22)
	sample day	20.98 (±3.28)	96.22 (±3.59)	82.50 (±3.67)	45.10 (±4.00)	61.07 (±2.57)	28.65 (±3.93)	0.25 (±1.01)	1.20 (±0.63)
QVAZ	All 2001	▨	89.68 (±1.76)	77.41 (±1.71)	43.49 (±1.09)	58.27 (±1.00)	34.61 (±1.67)	-0.34 (±0.33)	0.90 (±0.13)
	sample day	11.05 (±4.46)	99.96 (±2.68)	87.50 (±2.52)	50.15 (±3.79)	65.17 (±2.07)	30.66 (±4.17)	-0.20 (±1.11)	0.71 (±0.43)
SPAZ	All 2001	▨	87.03 (±1.75)	74.10 (±1.71)	41.93 (±1.09)	56.18 (±1.04)	35.03 (±1.70)	-0.15 (±0.27)	0.84 (±0.22)
	sample day	30.99 (±7.98)	94.18 (±4.68)	80.13 (±4.51)	42.40 (±4.87)	59.14 (±3.22)	27.74 (±3.78)	-0.47 (±1.31)	0.60 (±0.67)

Table 4-2a - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Supersite in Phoenix, Arizona (PSAZ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetylene	-0.20	-0.22	-0.57	-0.45	-0.36	-0.39	-0.53
Benzene	-0.19	-0.21	-0.47	-0.40	-0.28	-0.37	-0.52
Chloromethane	-0.17	-0.20	0.09	-0.03	0.26	-0.16	-0.20
Dichlorodifluoromethane	-0.12	-0.16	-0.20	-0.19	-0.04	-0.26	-0.40
Ethylbenzene	-0.19	-0.19	-0.50	-0.40	-0.33	-0.36	-0.55
m-,p - Xylene	-0.19	-0.19	-0.50	-0.40	-0.33	-0.37	-0.54
Methyl Ethyl Ketone	0.14	0.06	0.31	0.23	0.25	0.00	-0.01
Methylene Chloride	-0.08	-0.14	-0.39	-0.32	-0.26	-0.15	-0.37
o - Xylene	-0.18	-0.19	-0.50	-0.40	-0.34	-0.37	-0.54
Propylene	-0.19	-0.19	-0.45	-0.37	-0.27	-0.34	-0.52
Toluene	-0.22	-0.21	-0.46	-0.39	-0.27	-0.29	-0.57

Table 4-2b - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Queen Valley in Phoenix, Arizona (QVAZ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetylene	-0.12	-0.35	-0.01	-0.17	0.10	-0.23	-0.27
Benzene	0.06	-0.21	-0.08	-0.18	-0.03	0.07	0.00
Chloromethane	0.02	-0.11	-0.02	-0.09	-0.07	-0.01	-0.09
Dichlorodifluoromethane	0.19	0.20	0.08	0.12	-0.10	0.14	-0.20
Ethylbenzene	-0.06	-0.23	0.02	-0.10	0.10	0.13	0.04
m-,p - Xylene	-0.02	-0.24	0.01	-0.11	0.08	0.19	-0.05
Methyl Ethyl Ketone	0.05	-0.15	-0.32	-0.33	-0.28	-0.04	0.20
Methylene Chloride	-0.16	-0.13	0.19	0.09	0.26	0.14	0.01
o - Xylene	0.05	-0.33	-0.17	-0.28	0.00	0.02	-0.07
Propylene	0.25	0.10	0.10	0.10	-0.02	0.19	0.30
Toluene	0.29	0.18	0.28	0.27	0.10	0.29	0.17

Table 4-2c - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at South Phoenix, Arizona (SPAZ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetylene	-0.34	-0.32	-0.57	-0.50	-0.33	-0.17	-0.35
Benzene	-0.28	-0.23	-0.49	-0.41	-0.33	-0.18	-0.44
Chloromethane	-0.24	-0.17	-0.41	-0.33	-0.26	-0.28	-0.42
Dichlorodifluoromethane	-0.12	-0.19	-0.47	-0.38	-0.34	-0.21	-0.53
Ethylbenzene	-0.18	-0.15	-0.49	-0.37	-0.39	-0.16	-0.56
m-,p - Xylene	-0.22	-0.18	-0.49	-0.39	-0.36	-0.17	-0.53
Methyl Ethyl Ketone	-0.08	0.03	-0.21	-0.09	-0.16	-0.02	-0.19
Methylene Chloride	-0.19	0.05	-0.28	-0.13	-0.30	-0.19	-0.32
o - Xylene	-0.22	-0.20	-0.47	-0.38	-0.33	-0.14	-0.52
Propylene	-0.26	-0.24	-0.46	-0.40	-0.30	-0.12	-0.33
Toluene	-0.12	-0.05	-0.51	-0.32	-0.48	-0.25	-0.59

Table 4-3. Motor Vehicle Information vs Daily Concentration for Arizona Monitoring Sites

Monitoring Station	Population within Ten Miles	Estimated Number of Vehicles Owned	Traffic Data (Daily Average)	Average Daily UATMP Concentration
PSAZ	1,313,315	971,853	250	20.98 (±3.28) ppbv
QVAZ	87,354	64,642	200	11.05 (±4.46) ppbv
SPAZ	807,330	597,424	50,000	30.99 (±7.98) ppbv

5.0 Sites in Colorado

This section focuses on a few specific meteorological and concentration trends for the three UATMP sites in Colorado (DECO, G2CO, and GJCO). Two of the three sites reside in Grand Junction; the other is located in Denver. Figures 5-1 through 5-3 are topographical maps showing the monitoring stations in their urban locations. Figures 5-4 and 5-5 are maps identifying facilities within ten miles of the sites that reported to the 1999 NEI. The DECO site is surrounded by numerous industries, with the majority of the facilities to the south and east. A large number of facilities fall into three categories: automobile dealers and gas stations; automobile repair; and personal services. The G2CO site is to the south of GJCO and is surrounded by fewer industrial sites, most of which are automobile dealerships or gas stations.

Hourly meteorological data were retrieved for all of 2001 at two weather stations near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The two weather stations are Denver-Centennial and Grand Junction (WBAN 93067 and 23066, respectively).

Table 5-1 highlights the average UATMP concentration at each of the sites, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), and wind information (average u- and v-components of the wind) for the entire year and on sampling days. Climatologically, the Denver area is rather dry, as the relative humidity in Table 5-1 indicates, and the daily temperatures can fluctuate drastically between the seasons, with rather cold winters and warm summers. Wind speeds can vary for the site, but wind flows from the south-southwest on average. Grand Junction is slightly warmer than Denver, as the average maximum and average temperature indicate in Table 5-1. Grand Junction tends to be just as dry, but moderate winds blow from the southeast on average. This information can be found at the following web site: http://www.ssec.org/idis/gates/States/physical/denver.htm.

5.1 Meteorological and Concentration Averages at the Colorado Sites

Carbonyl and hydrocarbon compounds consistently had the highest geometric means for all three sites in Colorado. Polar compound geometric means ranged between 1.7 ppbv (G2CO) and 1.93 ppbv (GJCO), halogenated hydrocarbon geometric means ranged from 3.03 ppbv (GJCO) to 3.12 ppbv (DECO), and carbonyl geometric means ranged from 9.75 ppbv (DECO) to 12.42 ppbv (G2CO) among the sites. The hydrocarbon geometric means varied the greatest, between 10.08 ppbv (DECO) and 21.04 ppbv (GJCO). The average total UATMP daily concentration at the sites also varied greatly, between 35.16 ±7.65 (DECO) and 76.87 ±16.95 (G2CO). Table 5-1 also lists the averages for selected meteorological parameters from January 2001 to December 2001, which is similar to the time period covered in this report. The DECO site also opted to have total and speciated nonmethane organic compounds (SNMOC) sampled during its air toxic sampling. SNMOC/NMOC compounds are of particular interest because of their role in ozone formation. Readers are encouraged to review EPA's *2001 Nonmethane Organic Compounds (NMOC) and Speciated Nonmethane Organic Compounds (SNMOC) Monitoring Program, Final Report* (EPA, 2002) for more information on SNMOC/NMOC trends and concentrations. The average total NMOC value for DECO was 362 ppbC (±50.64), of which nearly 72% could be identified through speciation. Of the speciated compounds, ethane measured the highest concentration at the DECO site (24.67 ppbC). Typical sources of ethane include production of insulating materials and from cooking oils such as shortening. This information is given in Table 5-3. Unfortunately, ozone concentrations were not sampled at any of these sites.

Tables 5-2a-c present the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters by site. Identification of the prevalent compounds is discussed in Section 3 of this report. At DECO, the majority of the correlations are positive. While the majority of correlations are relatively weak, chloromethane had the strongest (strong meaning a correlation between 0.50 and 0.75 or -0.50 and 0.75) correlations with maximum and average temperatures (0.61 and 0.55, respectively), wet bulb temperature (0.54), and relative humidity (-0.52). Dichlorodifluoromethane had similar yet slightly weaker correlations.

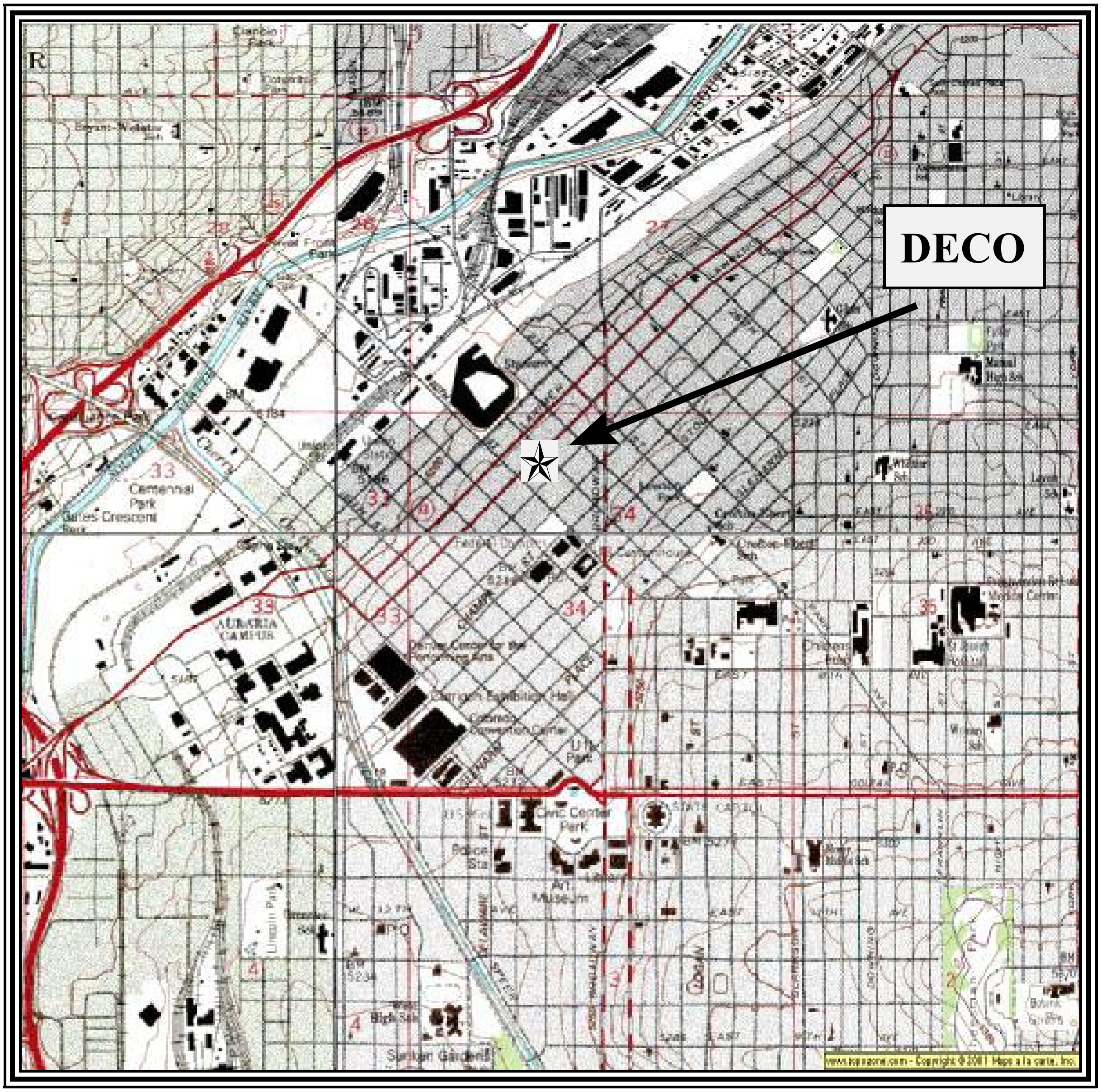
Prevalent compounds at the G2CO and GJCO sites also had mostly weak correlations that tended to be more positive than negative. Formaldehyde had the strongest correlation at both sites with average temperature (0.55 and 0.53 respectively), but also had strong positive correlations with maximum temperature and wet bulb temperature at G2CO. Acetone returned a high correlation with the u-component of the wind at the G2CO site (0.50), but failed to do so at GJCO. Both maximum and average temperatures returned a fair number (5) of moderately strong (between 0.25 and 0.50 or -0.25 and -0.50) correlations at the G2CO site, but varied between positive and negative.

5.2 Spatial Analysis

Using the population within ten miles of each site, an estimate of the number of cars operating in proximity to the monitoring station can be established. The ratio used in this report is 0.74 automobiles to every one person (refer to section 3.4.1 for more information on this ratio). Hence, the population near the DECO site is 1,261,437 people, all of whom are operating approximately 933,463 vehicles. A population of 111,385 people is driving 82,425 automobiles near the GJCO site, while a slightly lower population of 102,230 people is driving 75,650 vehicles near the G2CO site. This information is compared to the average daily concentration of the prevalent compounds at each Colorado site in Table 5-4. Also included in Table 5-4 are average daily traffic data, or more specifically, the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis.

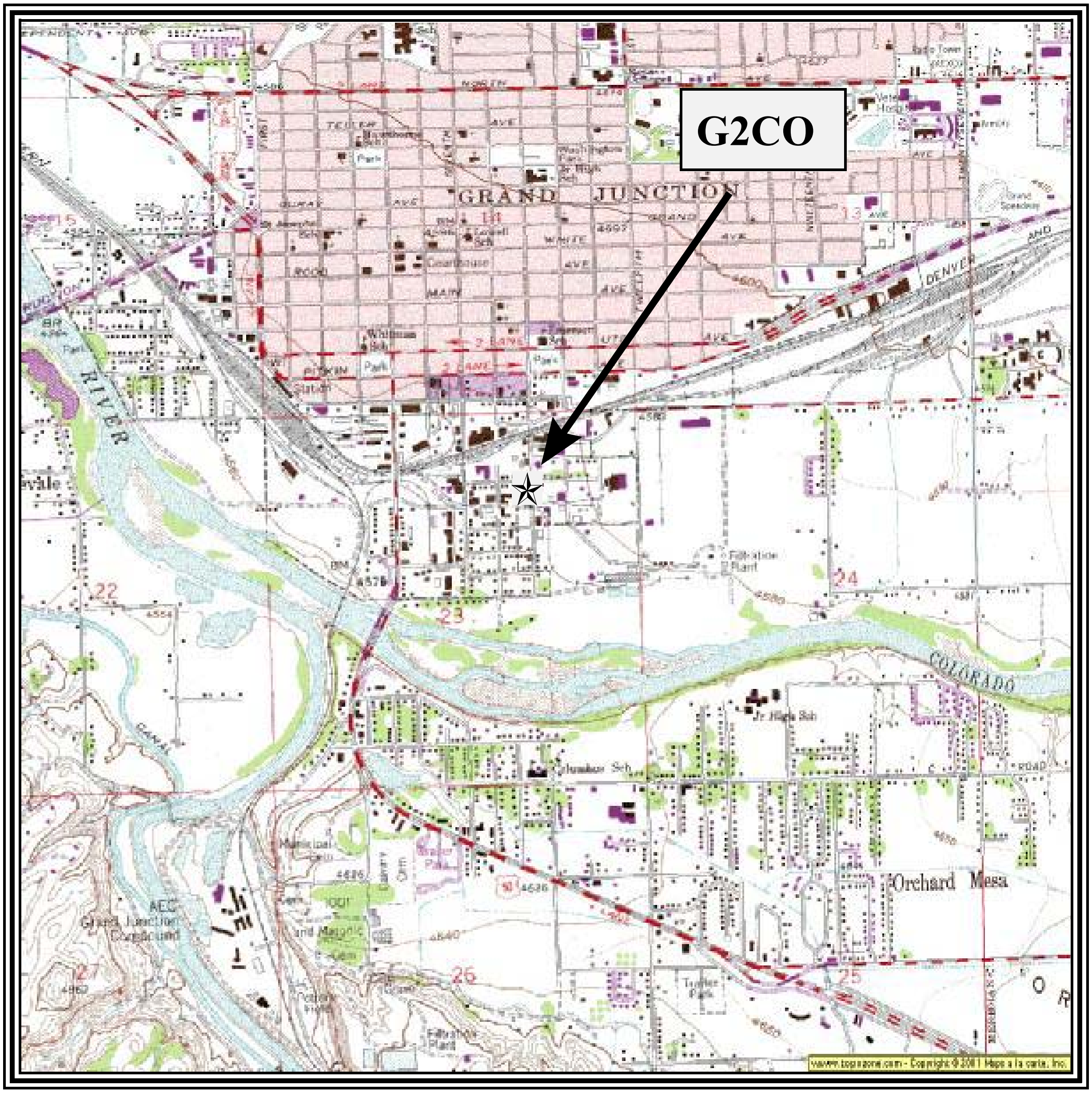
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area. (For more information on this study, refer to section 3.4.2.) Figure 3-16 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. The DECO site had higher toluene-ethylbenzene ratios than the roadside study, while the two Grand Junction sites' ratios were lower. Overall, both G2CO and GJCO's concentration ratios were very similar to the roadside study. DECO's benzene-ethylbenzene ratio is higher than its *m-,p*-xylene-ethylbenzene ratio, which is different from that of the roadside study.

Figure 5-1. Denver, Colorado (DECO) Monitoring Station



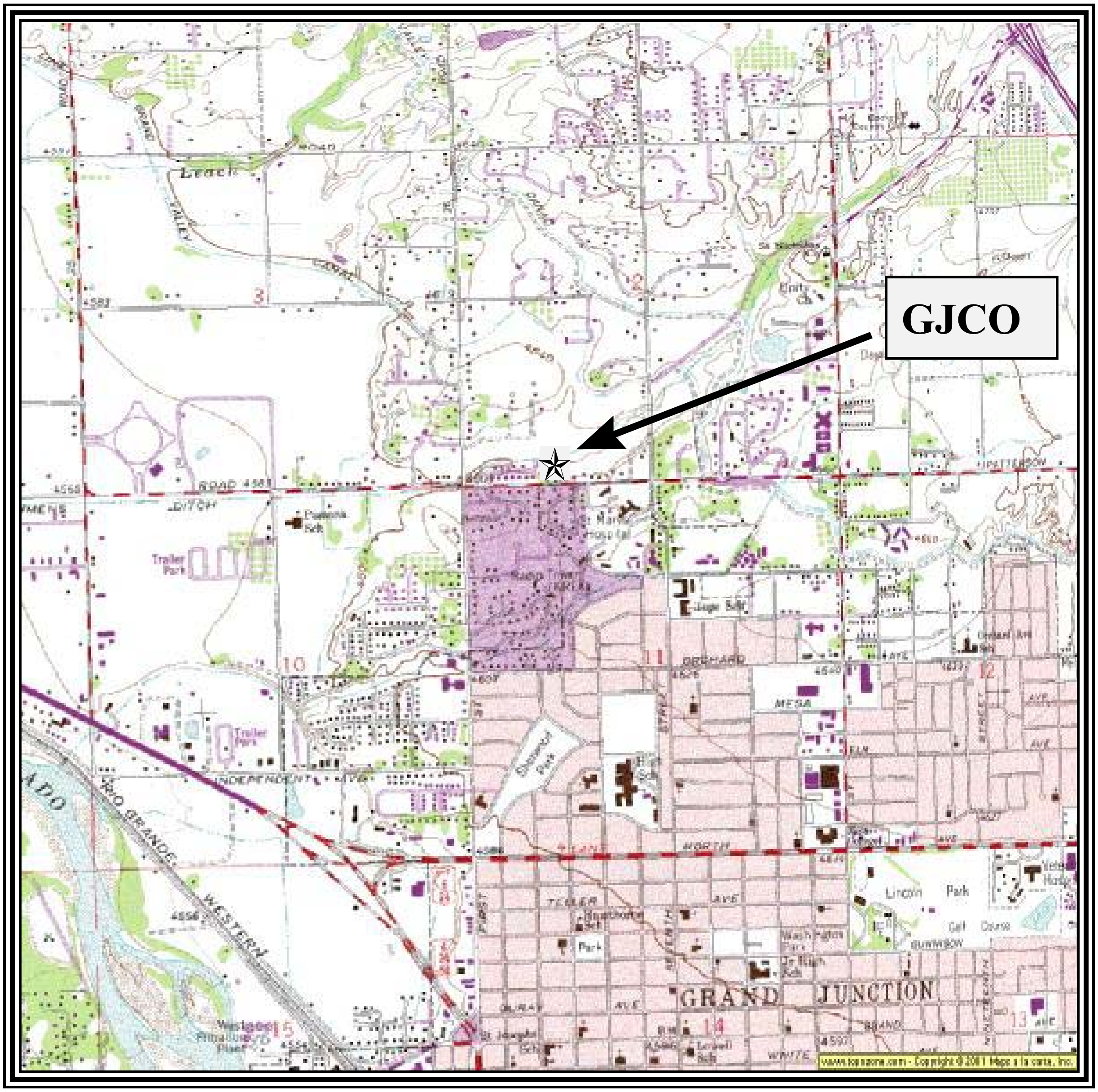
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 5-2. Grand Junction, Colorado Site 1 (G2CO) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 5-3. Grand Junction, Colorado Site 2 (GJCO) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 5-4. Facilities Located Within 10 Miles of DECO

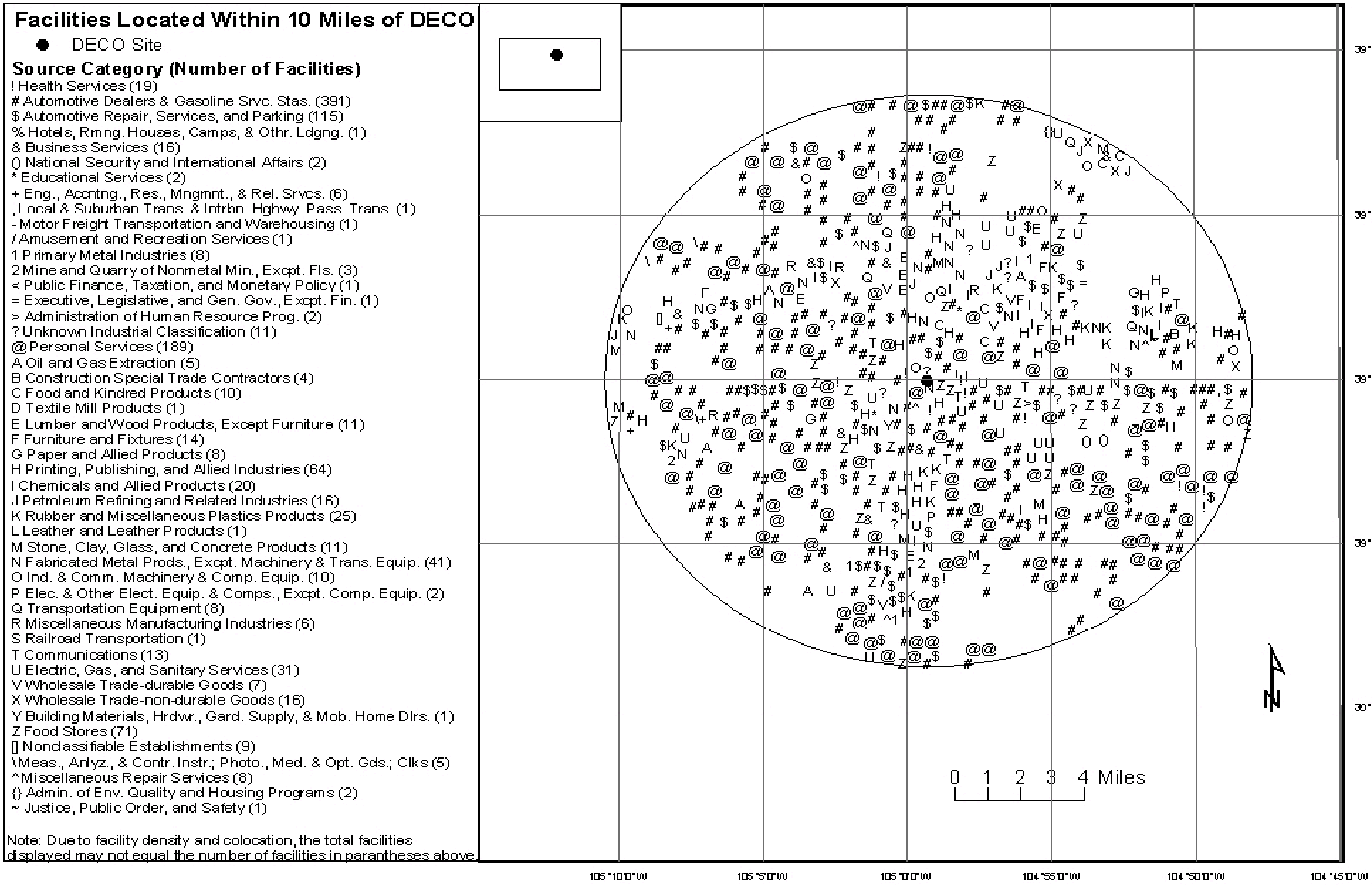


Figure 5-5. Facilities Located Within 10 Miles of G2CO and GJCO

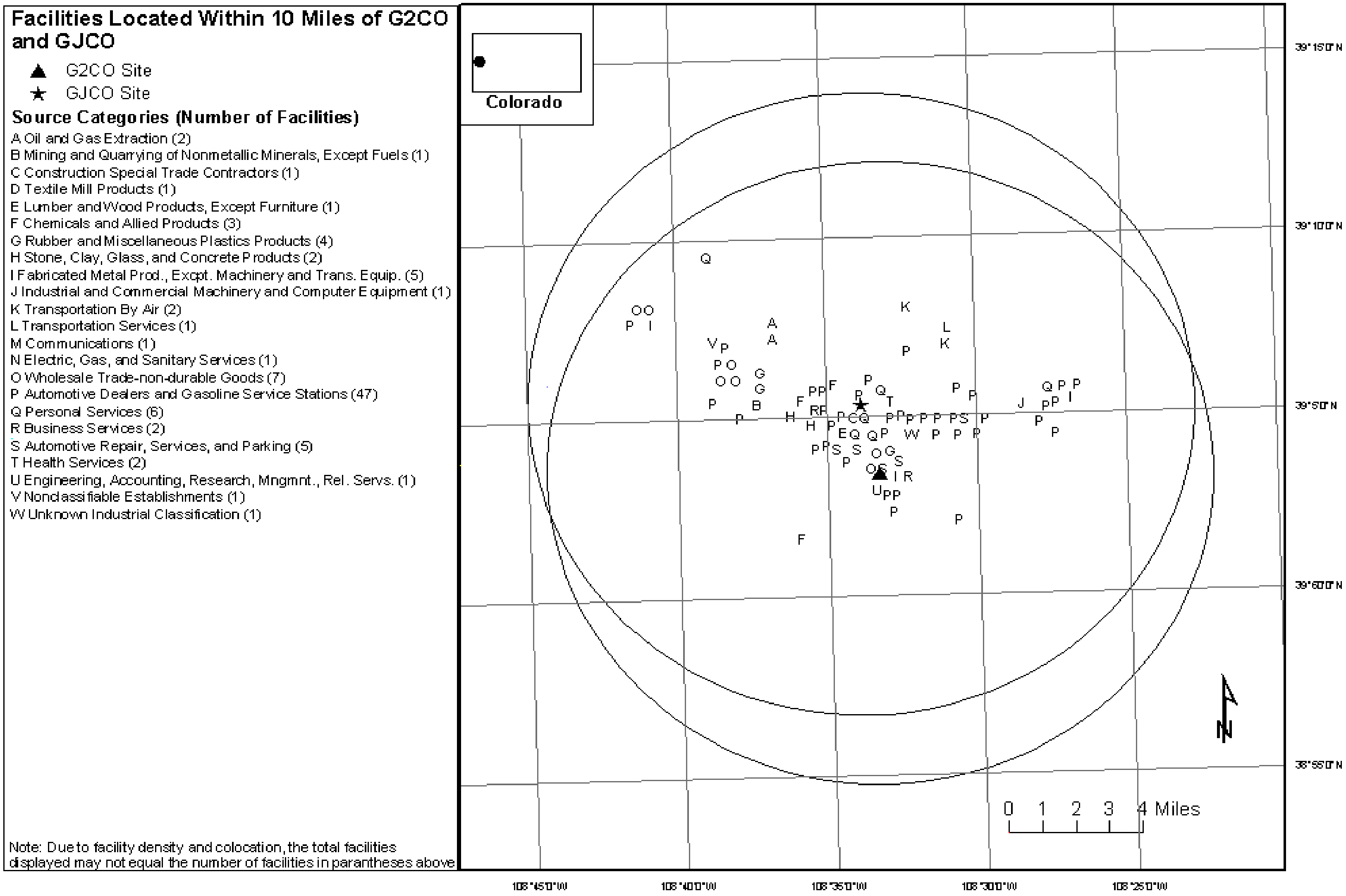


Table 5-1. Average Concentration and Meteorological Parameters for Sites in Colorado

Site Name	Type	Average UATMP Concentration (ppbv)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
DECO	All 2001	[redacted]	66.14 (±1.97)	48.17 (±1.74)	27.74 (±1.22)	38.18 (±1.26)	44.44 (±1.44)	0.28 (±0.26)	1.58 (±0.39)
	sample day	35.16 (±7.65)	67.85 (±4.56)	50.81 (±4.03)	28.24 (±2.80)	39.85 (±2.84)	43.75 (±3.70)	0.21 (±0.65)	1.90 (±0.87)
G2CO	All 2001	[redacted]	70.93 (±2.70)	54.64 (±1.95)	29.45 (±1.12)	42.08 (±1.28)	41.34 (±1.79)	-1.69 (±0.29)	0.66 (±0.26)
	sample day	76.87 (±16.95)	83.42 (±3.87)	65.68 (±3.70)	33.74 (±3.01)	49.01 (±2.34)	34.23 (±4.93)	-2.03 (±0.76)	1.23 (±0.60)
GJCO	All 2001	[redacted]	70.93 (±2.07)	54.64 (±1.95)	29.45 (±1.12)	42.08 (±1.28)	41.34 (±1.79)	-1.69 (±0.29)	0.66 (±0.26)
	sample day	65.75 (±20.49)	84.91 (±3.86)	66.13 (±3.70)	33.98 (±3.06)	49.29 (±7.65)	34.06 (±5.06)	-1.98 (±0.77)	1.19 (±0.61)

Table 5-2a - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Denver, Colorado (DECO)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.01	0.07	-0.02	0.05	0.05	-0.11	0.26
Acetone	-0.20	-0.13	-0.31	-0.19	0.02	-0.11	0.22
Acetylene	-0.20	-0.26	-0.38	-0.30	0.02	0.17	0.18
Benzene	0.14	0.09	-0.11	0.05	-0.20	0.14	0.23
Chloromethane	0.61	0.55	0.38	0.54	-0.52	0.10	0.07
Dichlorodifluoromethane	0.54	0.49	0.30	0.47	-0.43	0.05	-0.01
Ethylbenzene	0.17	0.14	-0.06	0.11	-0.21	0.15	0.22
Formaldehyde	0.14	0.20	0.17	0.19	0.02	-0.16	0.19
m-,p - Xylene	0.14	0.09	-0.15	0.03	-0.25	0.18	0.25
Methyl Ethyl Ketone	0.01	0.06	0.04	0.08	0.07	0.09	-0.05
Methylene Chloride	0.24	0.27	0.06	0.23	-0.30	0.09	0.23
o - Xylene	0.11	0.08	-0.13	0.04	-0.19	0.15	0.23
Propylene	0.07	0.03	-0.16	-0.01	-0.18	0.17	0.21
Toluene	0.24	0.18	-0.05	0.13	-0.27	0.11	0.17

Table 5-2b - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Grand Junction, Colorado Site 2 (G2CO)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.22	0.24	-0.15	0.10	-0.38	0.26	-0.20
Acetone	-0.37	-0.26	-0.20	-0.27	0.18	0.50	-0.41
Acetylene	-0.33	-0.30	0.09	-0.16	0.35	0.06	-0.20
Benzene	-0.39	-0.33	-0.16	-0.31	0.19	0.17	-0.24
Chloromethane	-0.02	0.15	0.26	0.24	-0.01	0.05	0.19
Dichlorodifluoromethane	-0.19	-0.12	0.11	-0.04	0.16	-0.01	0.07
Ethylbenzene	0.16	0.24	-0.01	0.17	-0.26	0.22	-0.02
Formaldehyde	0.54	0.55	0.35	0.53	-0.34	-0.02	0.20
m-,p - Xylene	0.21	0.28	0.01	0.21	-0.30	0.19	0.03
Methyl Ethyl Ketone	0.32	0.27	0.16	0.26	-0.21	0.01	0.01
Methylene Chloride	0.03	0.20	0.30	0.28	0.08	0.06	0.02
o - Xylene	0.27	0.35	0.15	0.31	-0.26	0.04	0.19
Propylene	-0.35	-0.32	-0.01	-0.23	0.27	0.12	-0.22
Toluene	0.02	0.15	0.05	0.15	-0.08	0.15	-0.13

Table 5-2c - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Grand Junction, Colorado Site 1 (GJCO)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.21	0.34	0.00	0.27	-0.26	0.15	-0.01
Acetone	0.08	0.28	-0.01	0.22	-0.22	0.12	-0.10
Acetylene	0.45	0.42	0.27	0.40	-0.18	-0.40	0.36
Benzene	-0.10	-0.03	0.03	-0.01	0.05	-0.07	0.03
Chloromethane	-0.07	-0.09	-0.01	-0.08	0.07	-0.03	-0.17
Dichlorodifluoromethane	-0.07	-0.01	0.11	0.05	0.01	-0.36	0.26
Ethylbenzene	-0.18	-0.10	-0.07	-0.08	0.06	0.27	-0.19
Formaldehyde	0.36	0.53	0.20	0.49	-0.30	0.03	0.12
m-,p - Xylene	-0.17	-0.09	-0.06	-0.06	0.05	0.27	-0.19
Methyl Ethyl Ketone	-0.02	-0.22	-0.05	-0.17	0.18	0.15	-0.31
Methylene Chloride	0.06	0.07	0.09	0.11	0.02	-0.15	0.09
o - Xylene	-0.19	-0.11	-0.08	-0.09	0.06	0.27	-0.20
Propylene	-0.42	-0.38	-0.17	-0.35	0.23	0.07	-0.16
Toluene	-0.23	-0.17	-0.11	-0.14	0.11	0.26	-0.20

Table 5-3. TNMOC Measured by the Denver, CO (DECO) Monitoring Station

Average TNMOC (speciated)	Average TNMOC (w/unknowns)	% TNMOC Identified	SNMOC Compound with the Highest Concentration	Typical Emissions Sources
261 ppbC (±32.44)	362 ppbC (±50.64)	72 %	Ethane (24.67 ppbC)	Production of insulating materials; shortening and cooking oils

Table 5-4. Motor Vehicle Information vs. Daily Concentration for Colorado Monitoring Sites

Monitoring Station	Population within Ten Miles	Estimated Number of MotorVehicles Owned	Traffic Data (Daily Average)	Average Daily UATMP Concentration
DECO	1,261,437	933,463	44,200	35.16 (±7.65) ppbv
G2CO	102,230	75,650	2,200	76.87 (±16.95) ppbv
GJCO	111,385	82,425	10,000	65.75 (±20.49) ppbv

6.0 Sites in Florida

This section focuses on a few specific meteorological and concentration trends for the six UATMP sites in Florida (AZFL, DNFL, ELFL, GAFL, LEFL, and SIFL). Three of these sites reside in St. Petersburg, while the other three reside to the east in Tampa. Figures 6-1 through 6-6 are topographical maps showing the monitoring stations in their urban locations. Figure 6-7 is a map identifying facilities within ten miles of the sites and that reported to the 1999 NEI. The St. Petersburg sites (ELFL, DNFL, and AZFL) are oriented somewhat north to south, as are the Tampa sites (LEFL, GAFL, and SIFL), just shifted further east. The majority of the industrial facilities are located between DNFL, AZFL, and GAFL, and between GAFL and LEFL. The fewest facilities surround SIFL and ELFL. These facilities cover a wide range of industries including, but not limited to power/utility companies, transportation equipment, and wholesale trade-non-durable goods manufacturing.

Hourly meteorological data were retrieved for all of 2001 at three weather stations near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The three weather stations are Tampa-International, St. Petersburg, and New Port Ritchie (WBAN 12842, 92806, and 92802, respectively).

Table 6-1 highlights the average UATMP concentration at each of the sites, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), and wind information (average u- and v-components of the wind) for the entire year and on sampling days. The Tampa/St. Petersburg area resides on Florida's Gulf Coast and its climate is considered subtropical. As Table 6-1 confirms, the area is warm and moist, with an annual average maximum temperature in the 80s and relative humidity in the 60 to 70 percent range. Light to moderate winds generally flow from the north and east. This information can be found at the following web sites: http://www.ssec.org/idis/gates/States/physical/orlando.htm and http://meetings.sixcontinentshotels.com/destinations/tampa/weather.html.

6.1 Meteorological and Concentration Averages at the Florida Sites

Only carbonyl compounds were measured at the six sites, as indicated in Tables 3-3 and 3-4. Geometric means of the carbonyl compounds ranged from 2.82 ppbv (ELFL) to 5.03 ppbv (DNFL), while the average daily UATMP concentration had a greater range of 3.84 ±0.42 ppbv (ELFL) to 18.34 ±7.32 ppbv (DNFL). Table 6-1 also lists the averages for selected meteorological parameters from January 2001 to December 2001, which is similar to the time period covered in this report.

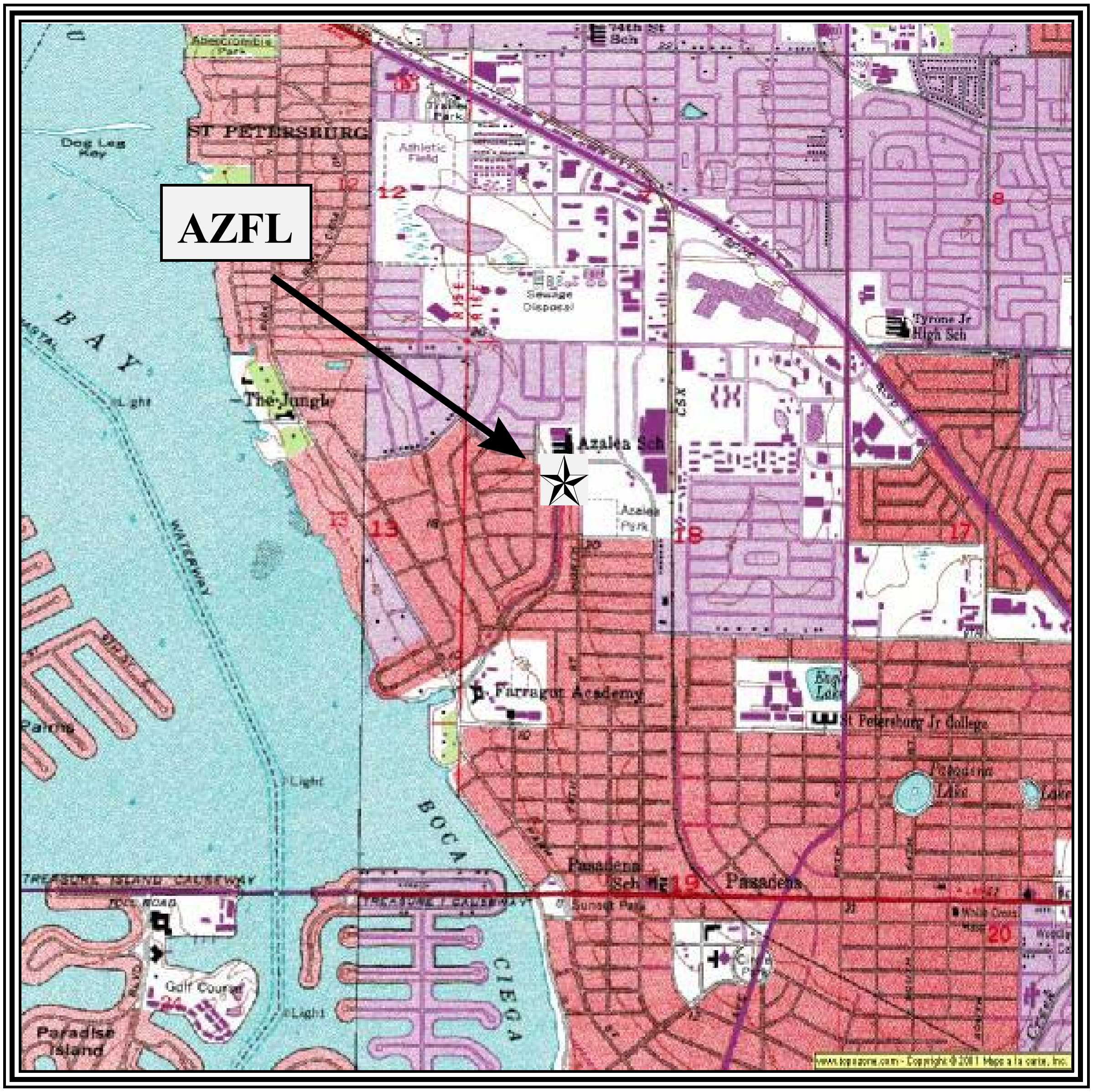
Tables 6-2a-f are the summary of calculated Pearson Correlation coefficients for each of the prevalent carbonyl compounds and selected meteorological parameters by site. Identification of the prevalent compounds is discussed in Section 3 of this report. Formaldehyde is consistently moderately strong (between 0.25 and 0.50 or -0.25 and -0.50) to strongly (between 0.50 and 0.75 or -0.50 and -0.75) and positively correlated with maximum temperature across all of the sites, with the exception of ELFL (0.19 correlation). Formaldehyde concentrations generally increased with increasing maximum temperature. Acetone had moderately strong to strong negative correlations with average maximum temperature at all sites, and with the v-component of the wind at all but one site (DNFL). The majority of all correlations with acetone were negative, regardless of the strength of the correlation. Concentrations of acetone generally decreased as temperature, moisture content, and winds increased. Acetaldehyde's greatest correlation across all sites except LEFL and DNFL was a moderately strong negative correlation with both wind components. Other correlations were generally weak (between 0 and 0.25 or 0 and -0.25) and varied between positive and negative at the St. Petersburg sites (AZFL, DNFL, and ELFL). However, the Tampa sites of LEFL and SIFL had moderately strong negative correlations with the moisture variables. Relative humidity at LEFL and SIFL (-0.28 at both sites), and both dew point and wet bulb temperatures at SIFL (-0.27 and -0.24) demonstrated this correlation with acetaldehyde. Acetaldehyde concentrations generally decreased as moisture content and wind speed increased.

6.2 Spatial Analysis

Using the population within ten miles of each site, an estimate of the number of motor vehicles operating in proximity to the monitoring station can be established. The ratio used in this report is 0.74 automobiles to every one person (refer to section 3.4.1 for more information on this ratio). The population is the highest near the SIFL site, with 672,150 people operating approximately 497,391 vehicles. The lowest population of the Florida sites is near DNFL, where 452,739 people are driving 335,027 automobiles. This information is compared to the average daily concentration of the prevalent compounds at each Florida site in Table 6-3. Also included in Table 6-3 is average daily traffic data, or more specifically, the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis.

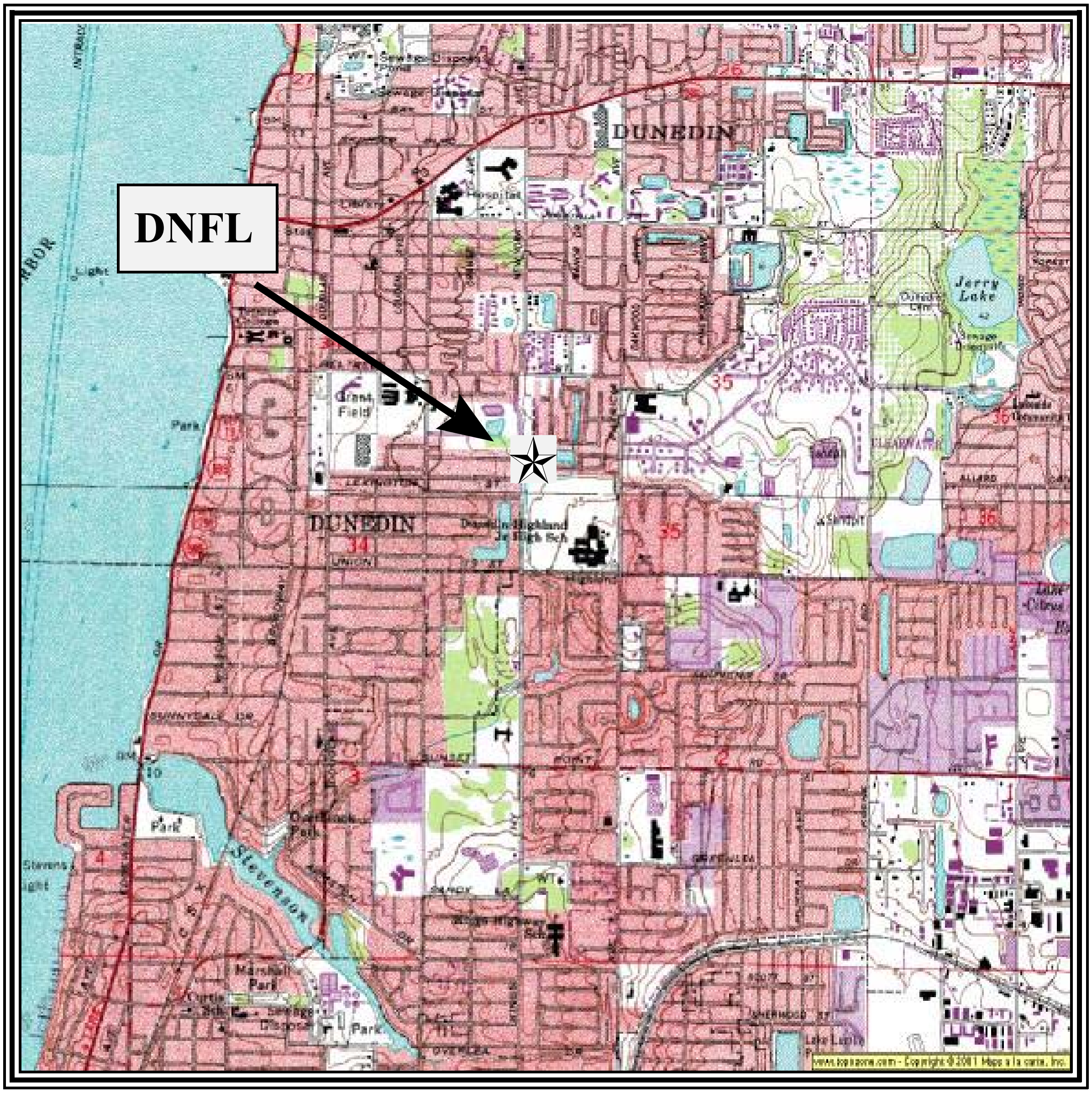
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area. (For more information on this study, refer to section 3.4.2.) Figure 3-16 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. As the Florida sites only measured carbonyl compounds, these six sites are not included in Figure 3-16.

Figure 6-1 St. Petersburg, Florida (AZFL) Monitoring Station



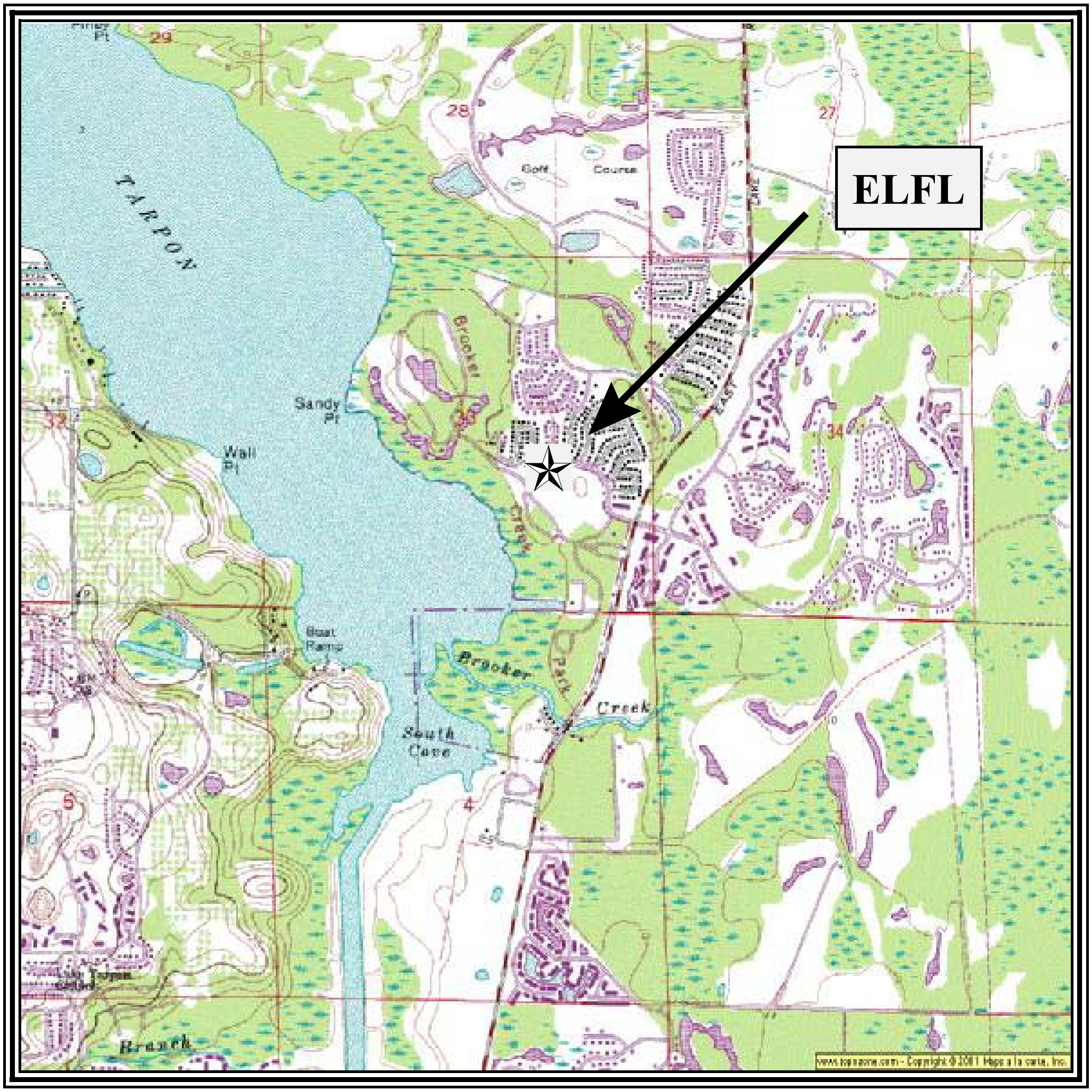
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 6-2 St. Petersburg, Florida Site 2 (DNFL) Monitoring Station



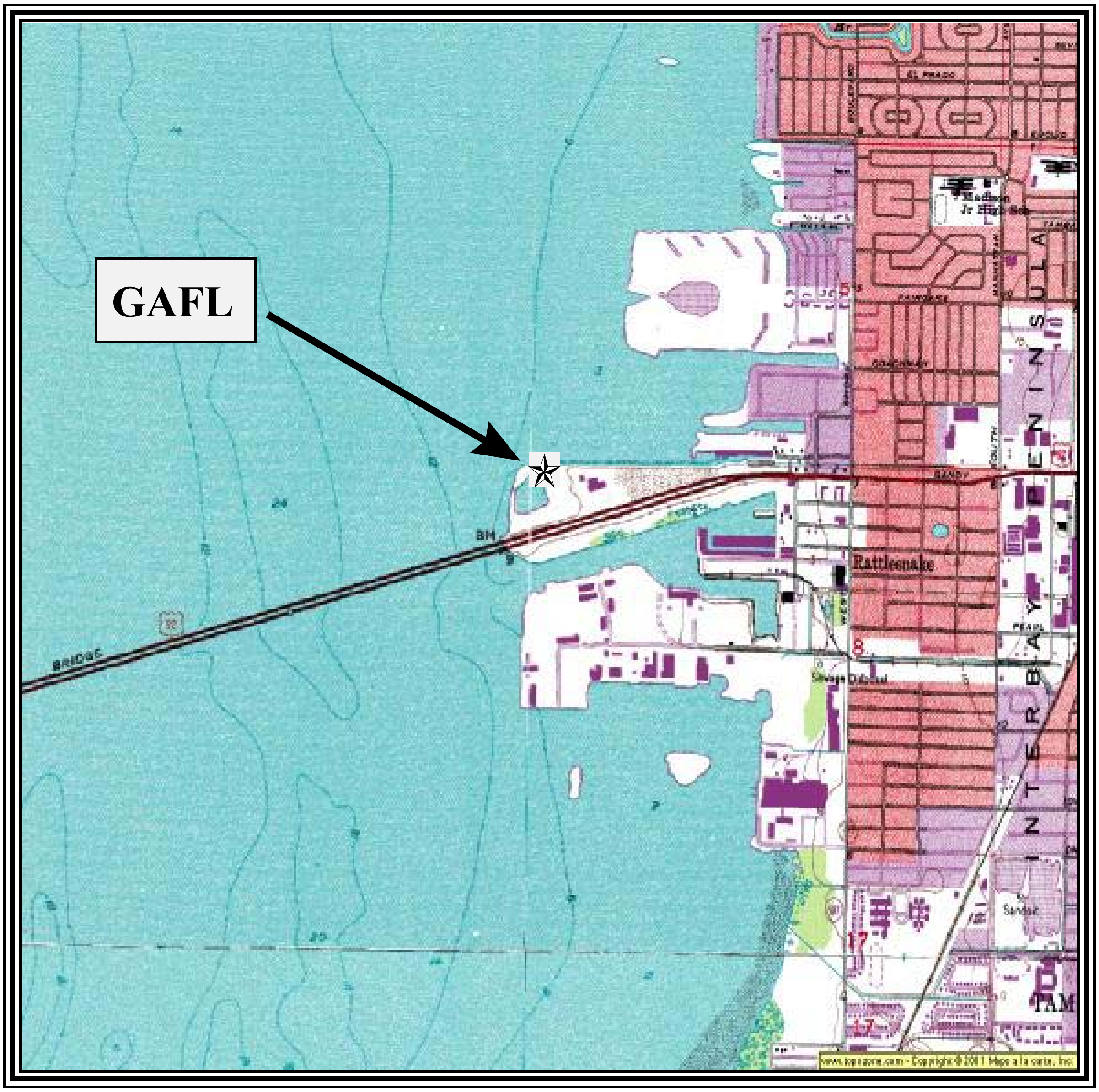
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 6-3 St. Petersburg, Florida Site 3 (ELFL) Monitoring Station



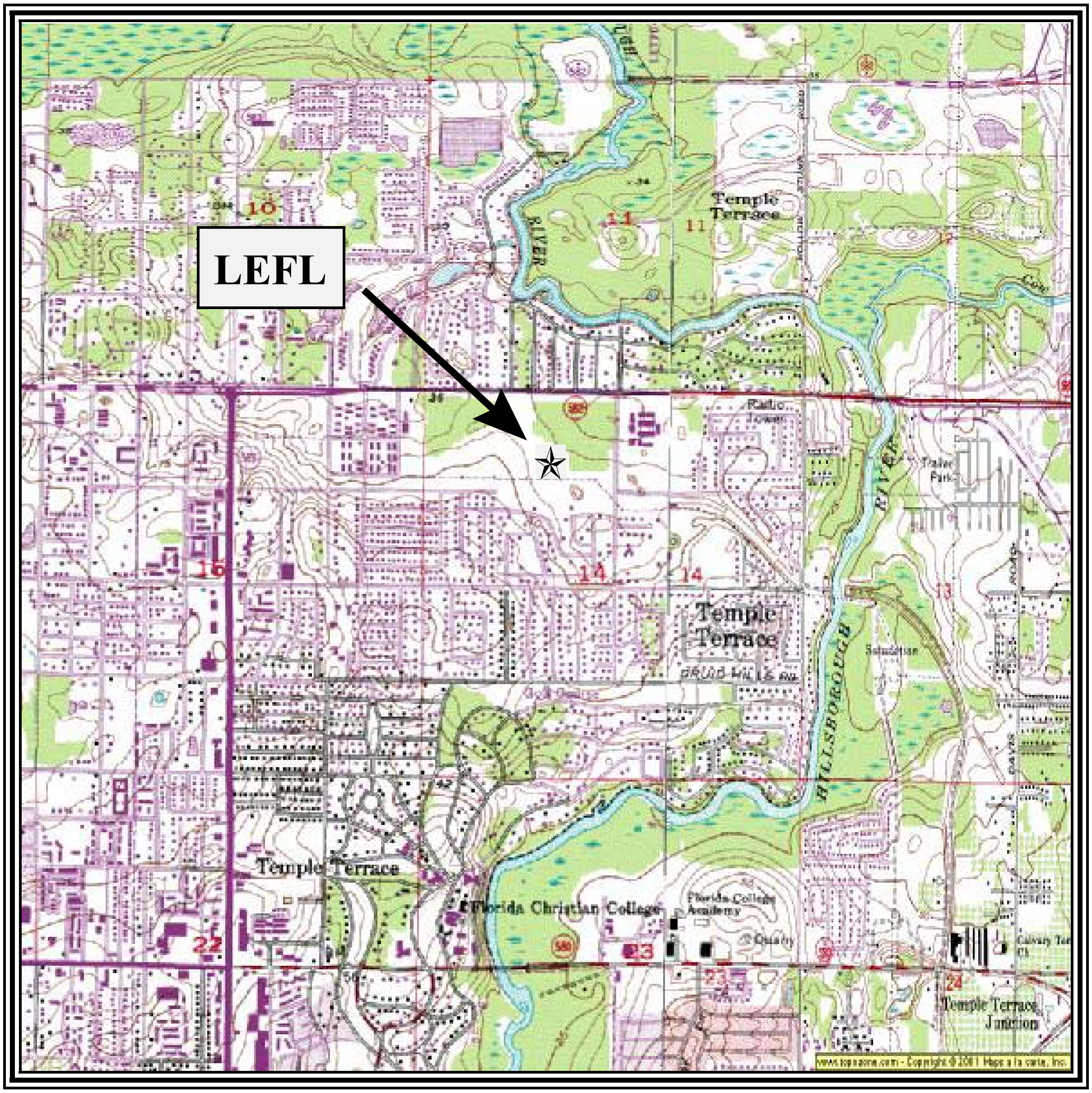
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 6-4 Tampa, Florida Site 1 (GAFL) Monitoring Station



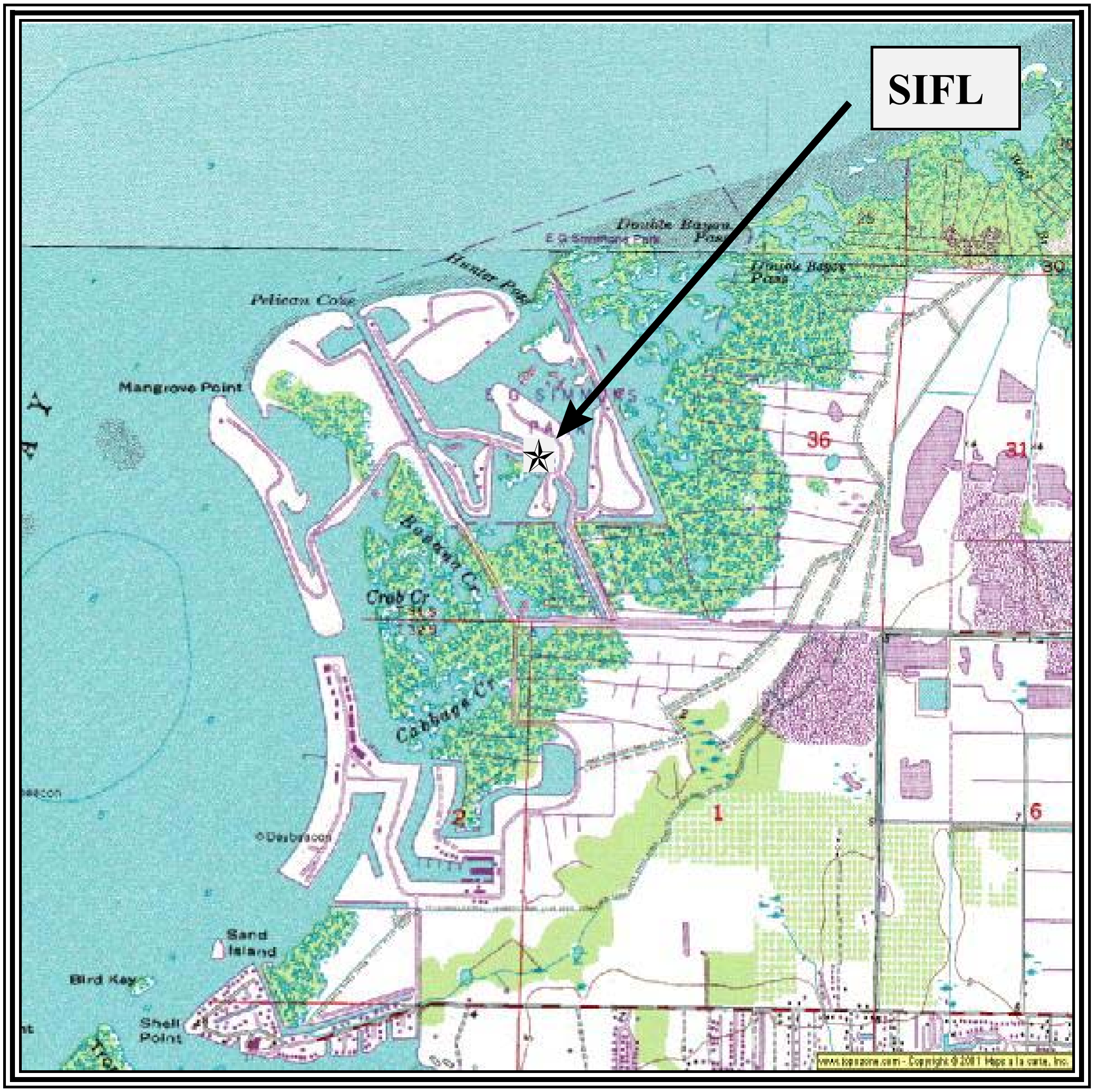
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 6-5 Tampa, Florida Site 2 (LEFL) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 6-6 Tampa, Florida Site 3 (SIFL) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 6-7. Facilities Located Within 10 Miles of AZFL, DNFL, ELFL, GAFL, LEFL, and SIFL

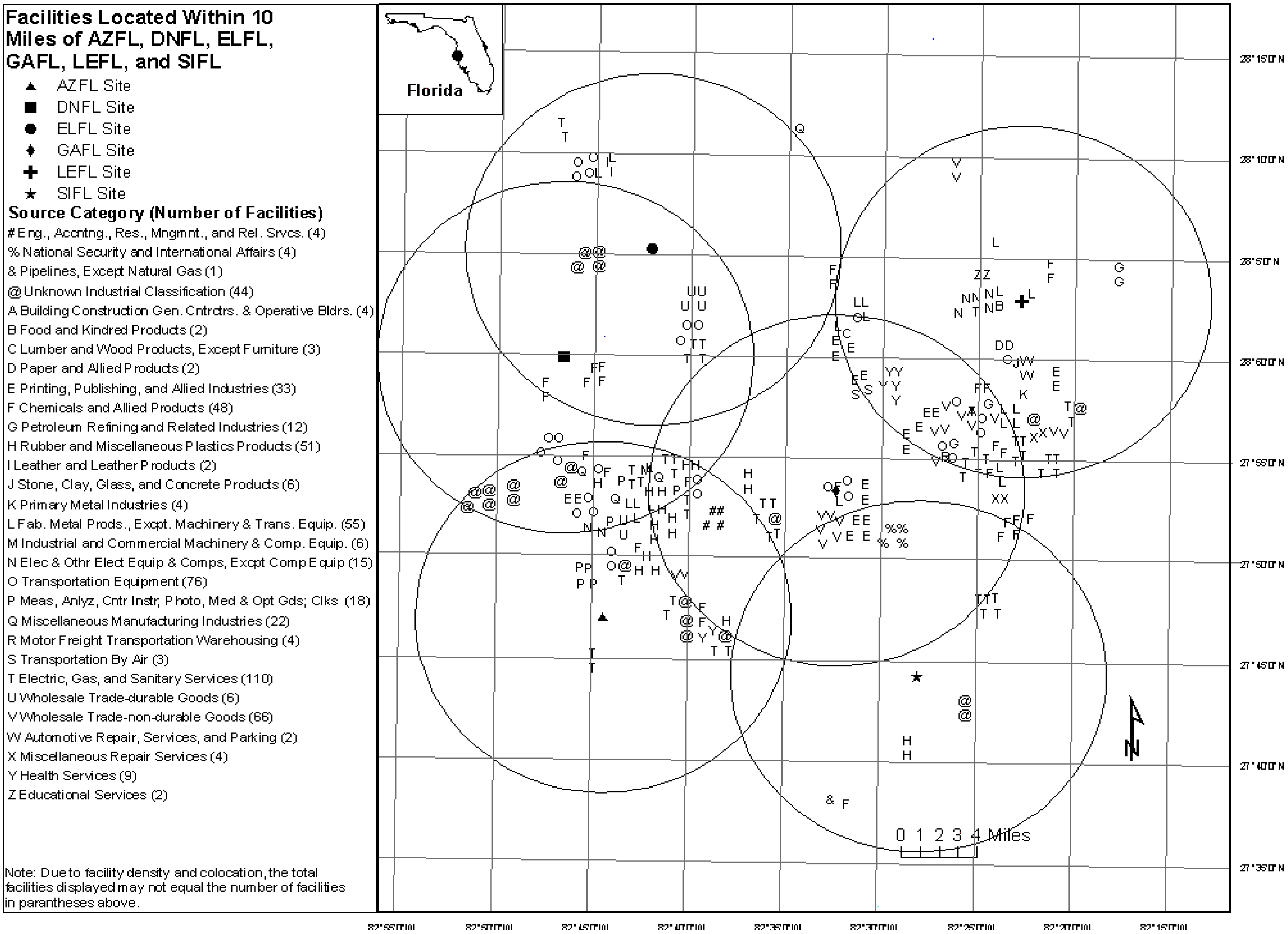


Table 6-1. Average Concentration and Meteorological Parameters for Sites in Florida

Site Name	Type	Average UATMP Concentration (ppbv)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
AZFL	All 2001	[redacted]	80.53 (±0.94)	64.72 (±1.37)	55.52 (±1.36)	58.78 (±1.37)	63.84 (±1.49)	-1.77 (±0.51)	-1.00 (±0.55)
	sample day	5.58 (±0.70)	79.48 (±2.34)	62.25 (±3.48)	52.71 (±3.68)	55.73 (±3.76)	61.52 (±3.88)	-1.70 (±1.14)	-0.98 (±1.40)
DNFL	All 2001	[redacted]	80.53 (±0.94)	64.72 (±1.37)	55.52 (±1.36)	58.78 (±1.37)	63.84 (±1.49)	-1.77 (±0.51)	-1.00 (±0.55)
	sample day	18.34 (±7.32)	79.65 (±2.37)	63.13 (±3.34)	53.22 (±3.69)	56.41 (±3.71)	61.77 (±3.92)	-1.71 (±1.16)	-0.70 (±1.30)
ELFL	All 2001	[redacted]	80.53 (±0.94)	64.72 (±1.37)	55.52 (±1.36)	58.78 (±1.37)	63.84 (±1.49)	-1.77 (±0.51)	-1.00 (±0.55)
	sample day	3.84 (±0.42)	79.65 (±2.37)	63.13 (±3.34)	53.22 (±3.69)	56.41 (±3.71)	61.77 (±3.92)	-1.71 (±1.16)	-0.70 (±1.30)
GAFL	All 2001	[redacted]	81.43 (±0.95)	68.29 (±1.12)	59.67 (±1.11)	62.93 (±1.02)	69.88 (±0.96)	-0.05 (±0.41)	-0.81 (±0.38)
	sample day	6.91 (±1.51)	80.88 (±2.21)	68.68 (±2.59)	60.07 (±2.66)	63.32 (±2.41)	71.04 (±2.02)	-0.04 (±0.95)	-0.65 (±0.94)
LEFL	All 2001	[redacted]	81.43 (±0.95)	68.29 (±1.12)	59.67 (±1.11)	62.93 (±1.02)	69.88 (±0.96)	-0.05 (±0.41)	-0.81 (±0.38)
	sample day	5.84 (±1.33)	81.29 (±2.20)	68.63 (±2.62)	60.13 (±2.67)	63.31 (±2.44)	70.88 (±1.90)	0.12 (±0.96)	-0.54 (±0.91)
SIFL	All 2001	[redacted]	81.43 (±0.95)	68.29 (±1.12)	59.67 (±1.11)	62.93 (±1.02)	69.88 (±0.96)	-0.05 (±0.41)	-0.81 (±0.38)
	sample day	8.17 (±4.07)	81.07 (±2.17)	68.65 (±2.54)	60.24 (±2.59)	63.39 (±2.36)	71.29 (±1.95)	0.06 (±0.93)	-0.61 (±0.89)

Table 6-2a - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Azalea Park in St. Petersburg, Florida (AZFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	-0.10	-0.05	-0.05	0.00	-0.10	-0.23	-0.37
Acetone	-0.62	-0.18	-0.21	-0.11	-0.01	-0.03	-0.57
Formaldehyde	0.25	-0.05	-0.06	-0.08	-0.24	-0.06	0.13

Table 6-2b - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Dunedin in St. Petersburg, Florida (DNFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.12	0.08	-0.04	-0.03	-0.12	-0.07	-0.02
Acetone	-0.27	-0.13	-0.12	-0.05	-0.03	-0.08	-0.21
Formaldehyde	0.33	0.17	0.01	-0.01	-0.18	0.17	0.32

Table 6-2c - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at East Lake in St. Petersburg, Florida (ELFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	-0.31	-0.08	0.01	0.05	0.17	-0.40	-0.43
Acetone	-0.75	-0.19	-0.22	-0.11	0.10	-0.08	-0.56
Formaldehyde	0.19	0.10	0.17	0.15	0.06	-0.29	-0.07

Table 6-2d - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Gandy in Tampa, Florida (GAFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	-0.08	-0.14	-0.17	-0.16	-0.12	-0.35	-0.27
Acetone	-0.58	-0.54	-0.65	-0.61	-0.24	-0.15	-0.32
Formaldehyde	0.32	0.13	0.10	0.12	-0.16	-0.22	0.05

Table 6-2e - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Lewis in Tampa, Florida (LEFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.17	0.11	0.01	0.06	-0.28	0.01	0.02
Acetone	-0.55	-0.40	-0.60	-0.51	-0.41	0.16	-0.45
Formaldehyde	0.59	0.50	0.44	0.47	-0.14	0.14	0.14

Table 6-2f - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Simmons in Tampa, Florida (SIFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	-0.13	-0.19	-0.27	-0.24	-0.28	-0.30	-0.40
Acetone	-0.26	-0.15	-0.27	-0.21	-0.17	0.08	-0.28
Formaldehyde	0.25	0.24	0.20	0.22	-0.07	0.05	-0.10

Table 6-3. Motor Vehicle Information vs. Daily Concentration for Florida Monitoring Sites

Monitoring Station	Population within Ten Miles	Estimated Number of Motor Vehicles Owned	Traffic Data (Daily Average)	Average Daily UATMP Concentration
AZFL	596,939	441,735	51,000	5.58 (±0.70) ppbv
DNFL	452,739	335,027	16,281	18.34 (±7.32) ppbv
ELFL	495,457	366,638	14,000	3.84 (±0.42) ppbv
GAFL	458,547	339,325	81,460	6.91 (±1.51) ppbv
LEFL	589,756	436,419	1,055	5.84 (±1.33) ppbv
SIFL	672,150	497,391	18,700	8.17 (±4.07) ppbv

7.0 Sites in Iowa

This section focuses on a few specific meteorological and concentration trends for the six UATMP sites in Iowa (C2IA, CLIA, CRIA, DAIA, DMIA, and MUIA). Five of these sites reside in eastern Iowa (C2IA, CLIA, CRIA, DAIA, and MUIA), while one is located in central Iowa (DMIA). Several Iowa cities are involved in the 2001 UATMP report including Cedar Rapids (C2IA and CRIA), Clinton (CLIA), Davenport (DAIA), Des Moines (DMIA), and Muscatine (MUIA). Figures 7-1 through 7-6 are topographical maps showing the monitoring stations in their urban locations. Figures 7-7 through 7-11 are maps identifying facilities within ten miles of the sites and that reported to the 1999 NEI. The C2IA and CRIA sites are within a few miles of each other, oriented north to south. The bulk of the industrial facilities are located between the two sites and are mostly food product industries. CLIA has a few facilities mainly to the southwest and west of its locations; DAIA has the largest number of industrial facilities nearby, generally located to the east and southeast; DMIA has a number of facilities to its northeast and east, and just three to its west and west-southwest; and MUIA's nearby facilities, of which most are chemical producing sites, are oriented mainly to the north and south of the monitoring site.

Hourly meteorological data were retrieved for all of 2001 at four weather stations near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The four weather stations are Cedar Rapids Municipal Airport, Clinton Municipal Airport, Des Moines International, and Muscatine (WBAN 14990, 94982, 14933, and 14937, respectively).

Table 7-1 highlights the average UATMP concentration at each of these sites, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), and wind information (average u- and v-components of the wind) for the entire year and on sampling days. Typically, Iowa experiences cold, rather dry winters and warm, moist summers, thanks to its continental climate. The seasons show marked contrast, producing variable weather. Table 7-1 shows that the majority of the weather parameters vary little among the stations, with the exception of the wind components.

However, even the average annual wind components show only a directional variation between southwest and west among Iowa's participating monitoring stations. This information can be found at the following web site: http://www.ssec.org/idis/gates/States/physical/desmoin.htm.

7.1 Meteorological and Concentration Averages at the Iowa Sites

Carbonyl compounds and VOC (volatile organic compounds) were measured at all of the sites, as indicated in Tables 3-3 and 3-4. Halogenated hydrocarbon compounds' geometric means varied the least among the sites, with CLIA reporting 3.08 ppbv and DMIA reporting 3.60 ppbv. Carbonyl compounds geometric means came in a close second, with C2IA measuring 2.96 ppbv and MUIA measuring 3.93 ppbv. Hydrocarbons and polar compounds geometric means had more variation. The highest geometric mean for hydrocarbons was 4.68 ppbv at DMIA and the lowest was 2.42 at MUIA. The polar compounds' highest geometric mean was 3.44 ppbv at CLIA and the lowest was 1.24 at CRIA. CLIA reported the highest daily average UATMP concentration of the six sites (59.20 ±62.27 ppbv), which was at least twice the averages of the other sites. The other five sites ranged from the mid-teen to the upper 20s, as indicated in Table 7-1. Table 7-1 also lists the averages for selected meteorological parameters from January 2001 to December 2001, which is similar to the time period covered in this report. These sites also opted to have total and speciated nonmethane organic compounds (SNMOC) sampled during air toxic sampling. SNMOC/NMOC compounds are of particular interest because of their role in ozone formation. Readers are encouraged to review EPA's *2001 Nonmethane Organic Compounds (NMOC) and Speciated Nonmethane Organic Compounds (SNMOC) Monitoring Program, Final Report* (EPA, 2002) for more information on SNMOC/NMOC trends and concentrations.

The average total NMOC value for C2IA was 137 (±7.76) ppbC, of which nearly 51% could be identified through speciation; the average total NMOC for CLIA was 142 (±25.03) ppbC, of which nearly 59% could be identified; the average total NMOC for CRIA was 168 (±36.68) ppbC, of which nearly 71% could be identified; the average total NMOC for DAIA was 176 (±18.08) ppbC, of which nearly 54% could be identified; the average total NMOC for DMIA was 196 (±23.23) ppbC, of which nearly 53% could be identified; and the average total

NMOC for MUIA was 197 (±61.38) ppbC, of which nearly 72% could be identified. Of the speciated compounds, ethane, isopentane, and propane measured the highest concentrations at the Iowa sites. These values, as well as typical sources of these compounds, are included in Table 7-3. Ozone concentrations were also sampled at CLIA on 123 sample days, and were retrieved from the U.S. EPA's AIRS database. The average ozone concentration for each sample day was 57.36 ppbv. Unfortunately, ozone concentrations were not sampled at the other sites. This information is also available in Table 7-3.

Tables 7-2a-f are the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters by site. Identification of the prevalent compounds is discussed in Section 3 of this report. Several strong correlations were calculated at most of the sites; only DMIA failed to have any correlations fall into the "strong" category (0.50 to 0.75 or -0.50 to -0.75). C2IA indicated strong positive correlations between several weather parameters (maximum and average temperature, and dew point and wet bulb temperature) and four compounds (chloromethane, formaldehyde, methyl ethyl ketone, and propylene). A similar moderately strong (between 0.25 and 0.50 or -0.25 and -0.50) to strong positive correlation was found with C2IA's sister site, CRIA, among these same variables, but only with formaldehyde, similar to the DAIA site. CLIA indicated the same moderately strong to strong positive correlation with these weather parameters and two compounds, formaldehyde and chloromethane.

MUIA was the only site that indicated a moderately strong to strong negative correlation of the four previously mentioned weather parameters to any of the compounds. These compounds include acetone, acetylene, benzene, and propylene. However, DAIA showed a moderately strong negative correlation between acetylene, chloromethane, and dichlorodifluoromethane and the four temperature parameters, and DMIA demonstrated this correlation with acetylene and the temperature parameters. Maximum and average temperature and dew point and wet bulb temperature seem to have a strong correlation to several of the compounds, some positive, some negative.

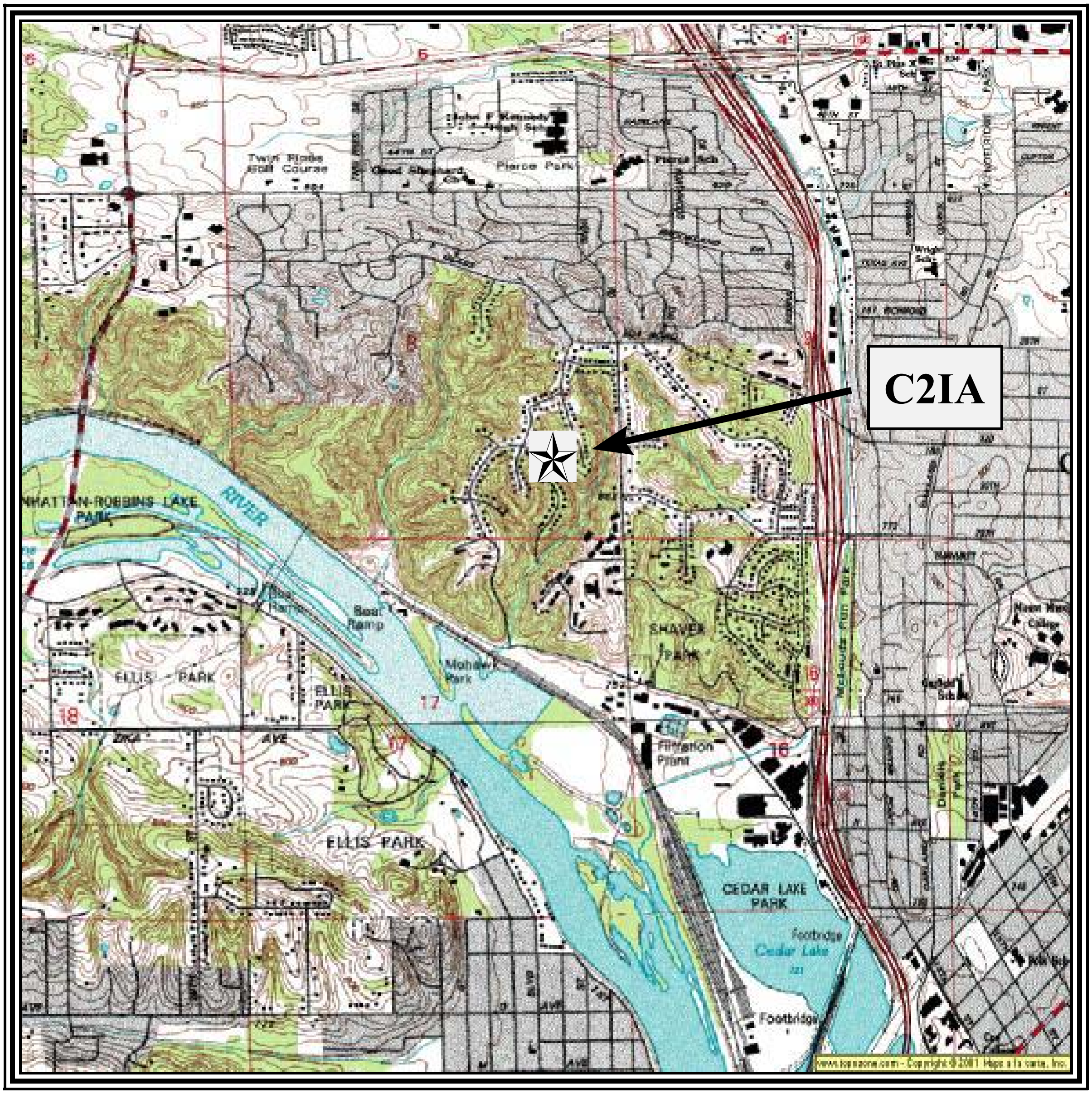
With regard to the wind components, some interesting correlations were noted at several of the sites. Two sites, DMIA and MUIA, had a majority of the compounds return moderately strong negative correlations to the v-component of the wind. At the DAIA site, half of the fourteen compounds returned moderately strong to strong negative correlations to the u-component of the wind, while the other half had only weak (in this case, between 0.15 and -0.04) correlations. Lastly, the C2IA site reported all but one compound (methylene chloride) had a weak (between 0 and 0.25 or 0 and -0.25) negative correlation with the u-component of the wind, while all but one compound (again, methylene chloride) had a weak positive correlation with the v-component of the wind.

7.2 Spatial Analysis

Using the population within ten miles of each site, an estimate of the number of motor vehicles operating in proximity to the monitoring station can be established. The ratio used in this report is 0.74 automobiles to every one person (refer to section 3.4.1 for more information on this ratio). The population near the DMIA site is the highest with 379,063 people operating approximately 280,507 vehicles. The lowest population of the Iowa sites is near CLIA, with 42,478 people driving 31,433 automobiles. This information is compared to the average daily concentration of the prevalent compounds at each Iowa site in Table 7-4. Also included in Table 4-6 is average daily traffic data, or more specifically, the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis.

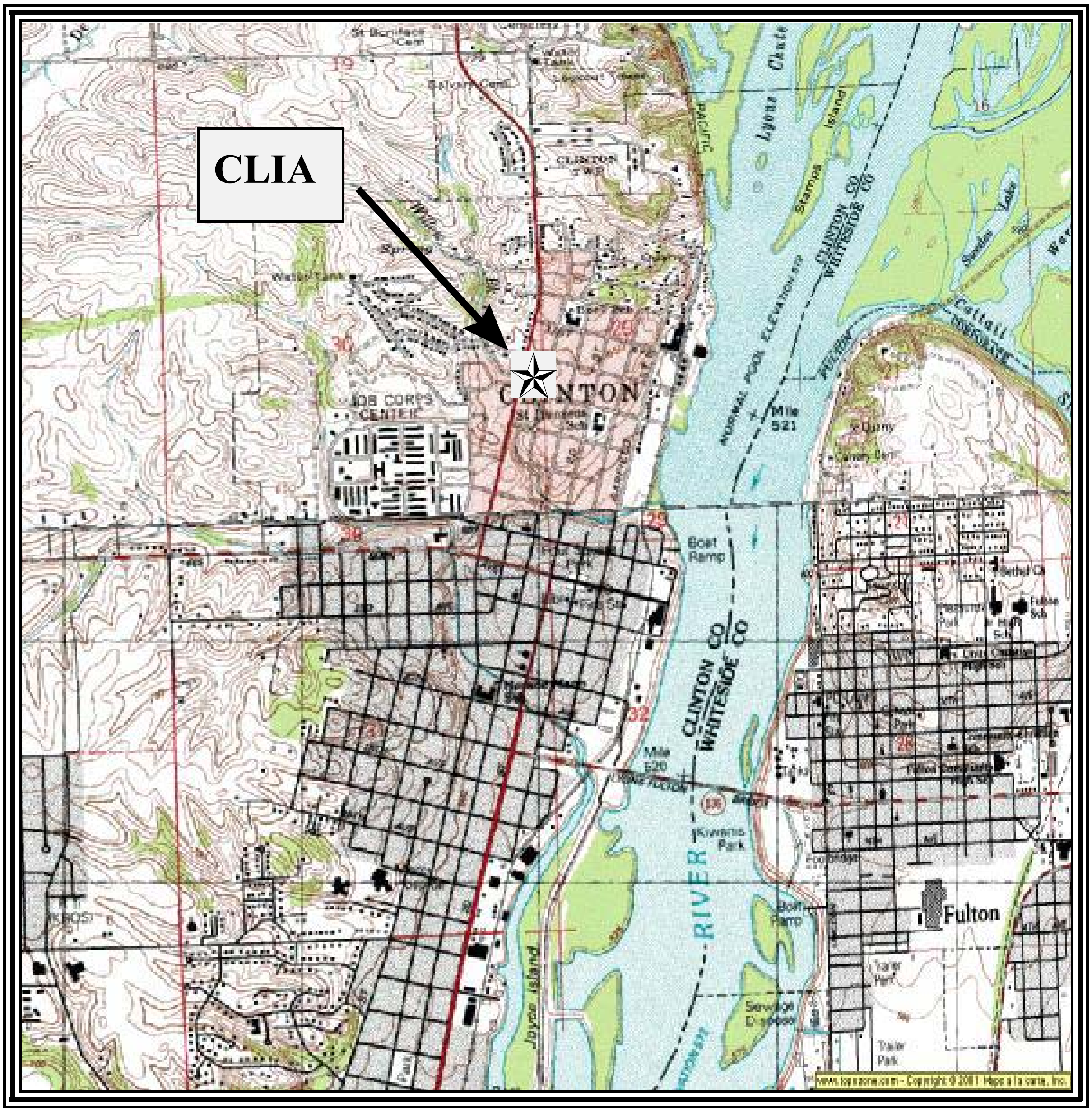
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area. (For more information on this study, refer to section 3.4.2.) Figure 3-16 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. The six Iowa sites all concentration ratios that resembled those of the roadside study, although the actual values varied. CLIA had a toluene-ethylbenzene ratio that nearly doubled that of the roadside study. In fact, all of the toluene-ethylbenzene ratios at the Iowa monitoring sites were larger than that of the roadside study. This trend also held with the concentration ratios of benzene-ethylbenzene. Conversely, both *m-,p*-xylene-ethylbenzene and *o*-xylene-ethylbenzene concentration ratios were slightly less at the monitoring locations than the roadside study ratios.

Figure 7-1. Cedar Rapids, Iowa Site 1 (C2IA) Monitoring Station



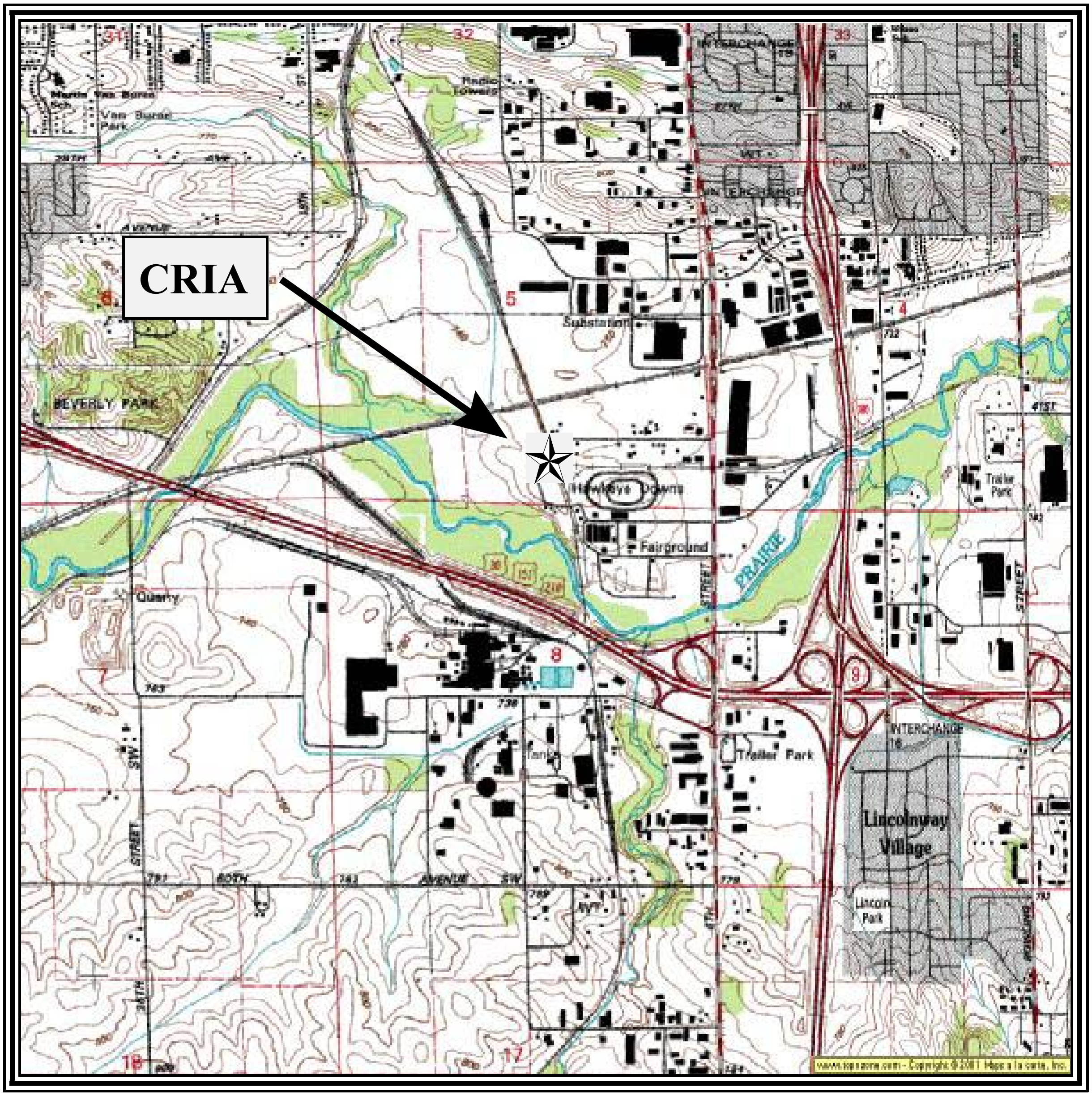
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 7-2. Clinton, Iowa (CLIA) Monitoring Station



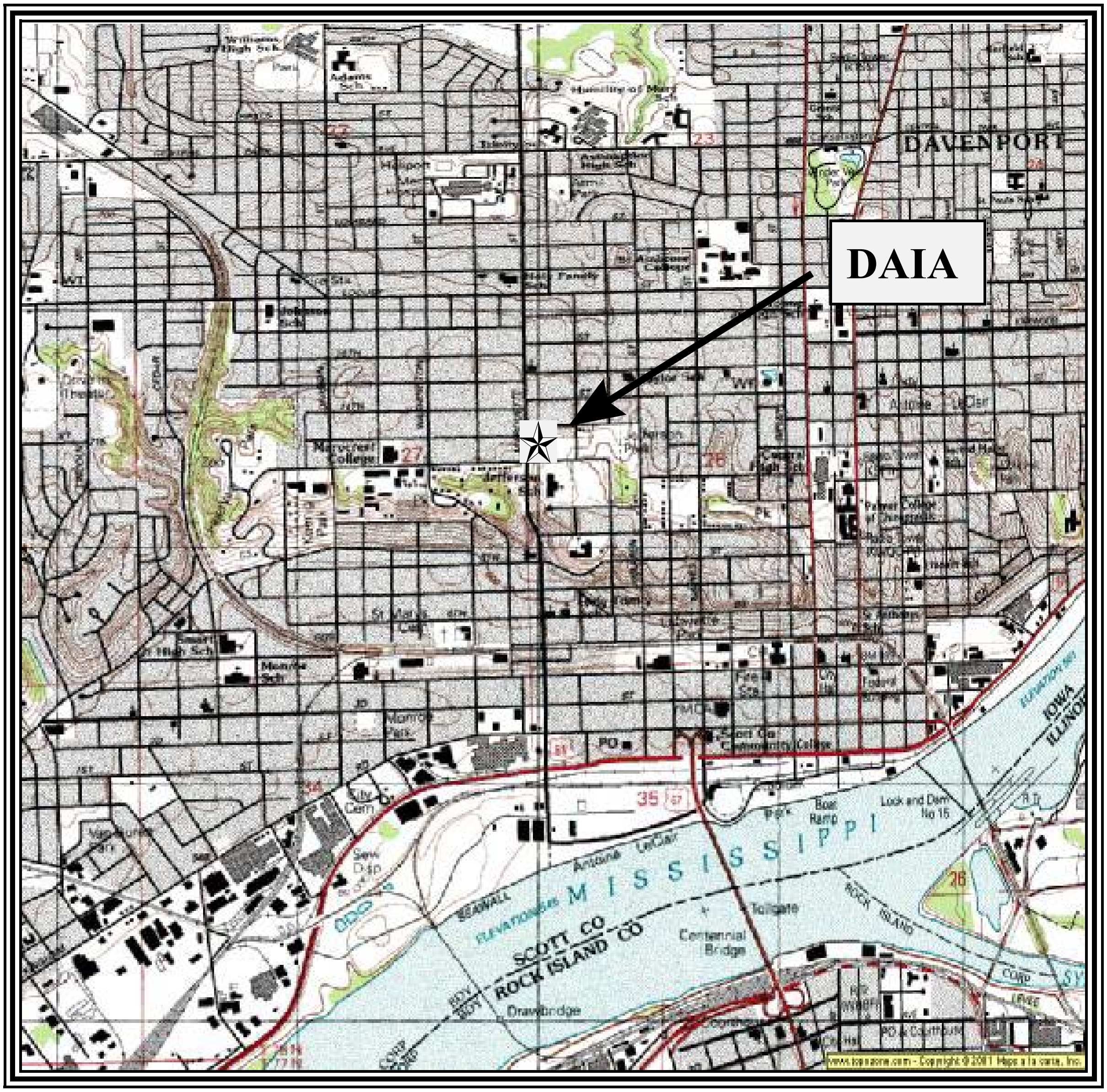
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 7-3. Cedar Rapids, Iowa Site 2 (CRIA) Monitoring Station



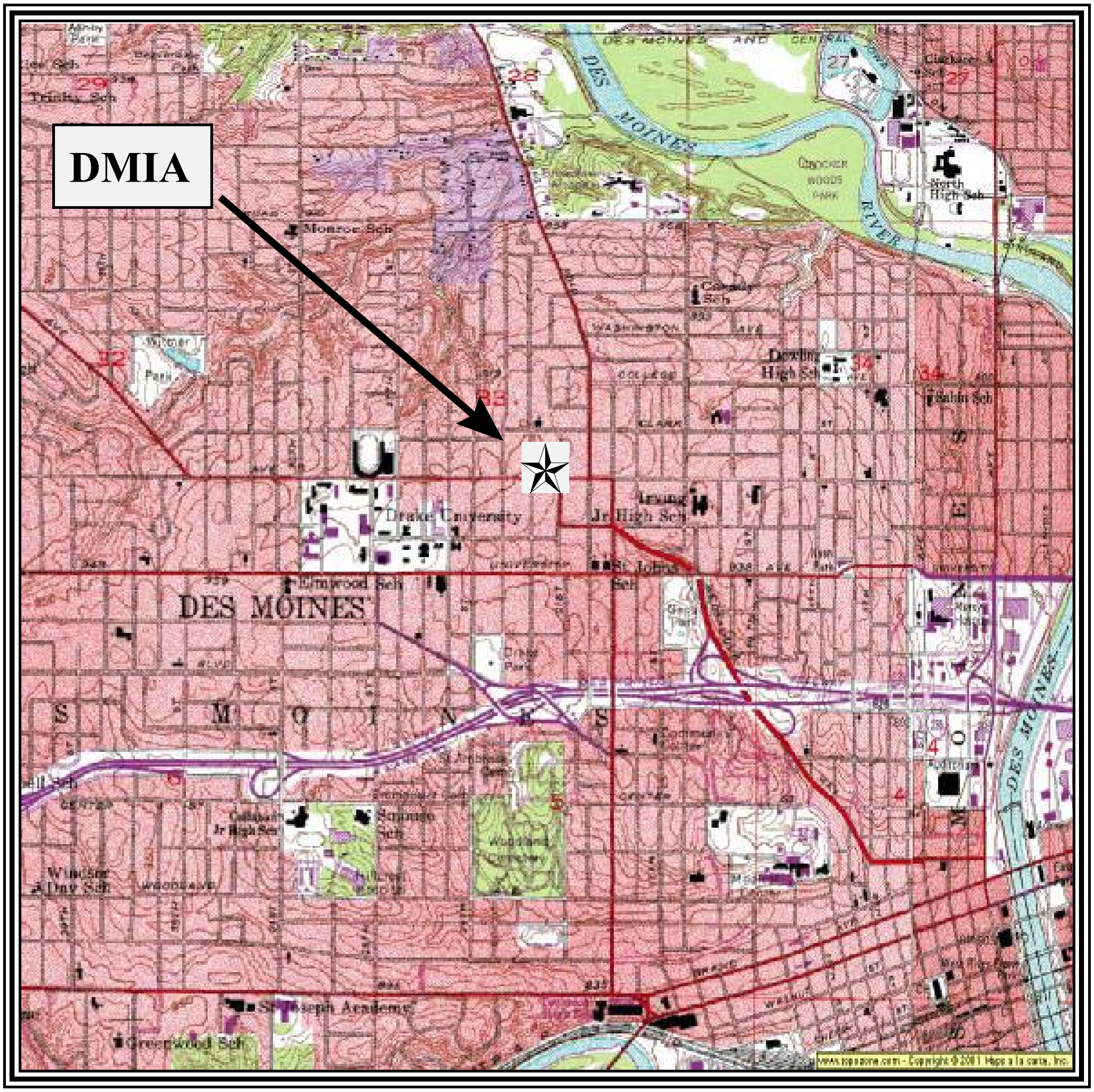
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 7-4. Davenport, Iowa (DAIA) Monitoring Station



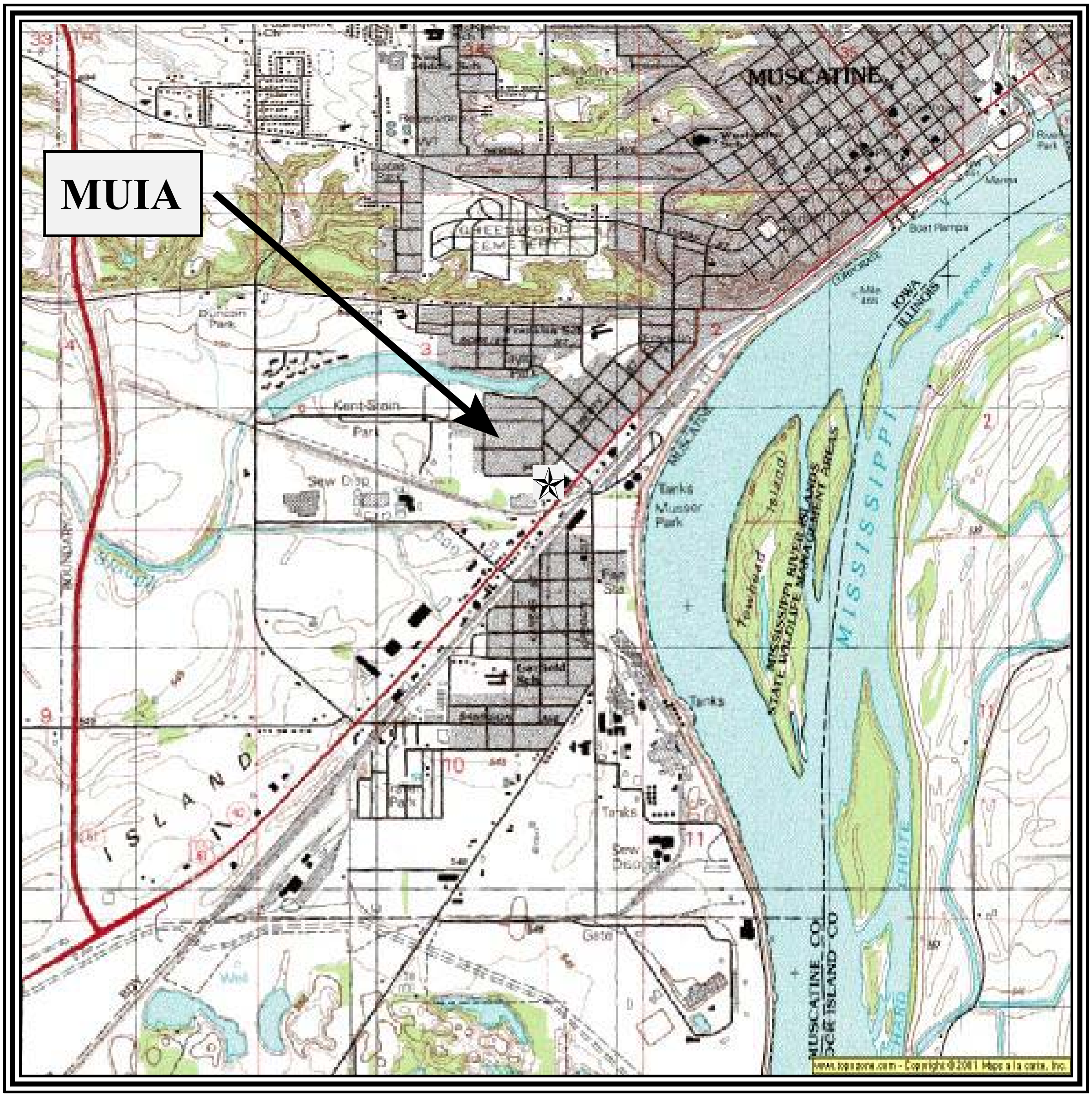
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 7-5. Des Moines, Iowa (DMIA) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 7-6. Muscatine, Iowa (MUIA) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 7-7. Facilities Located Within 10 Miles of C2IA and CRIA

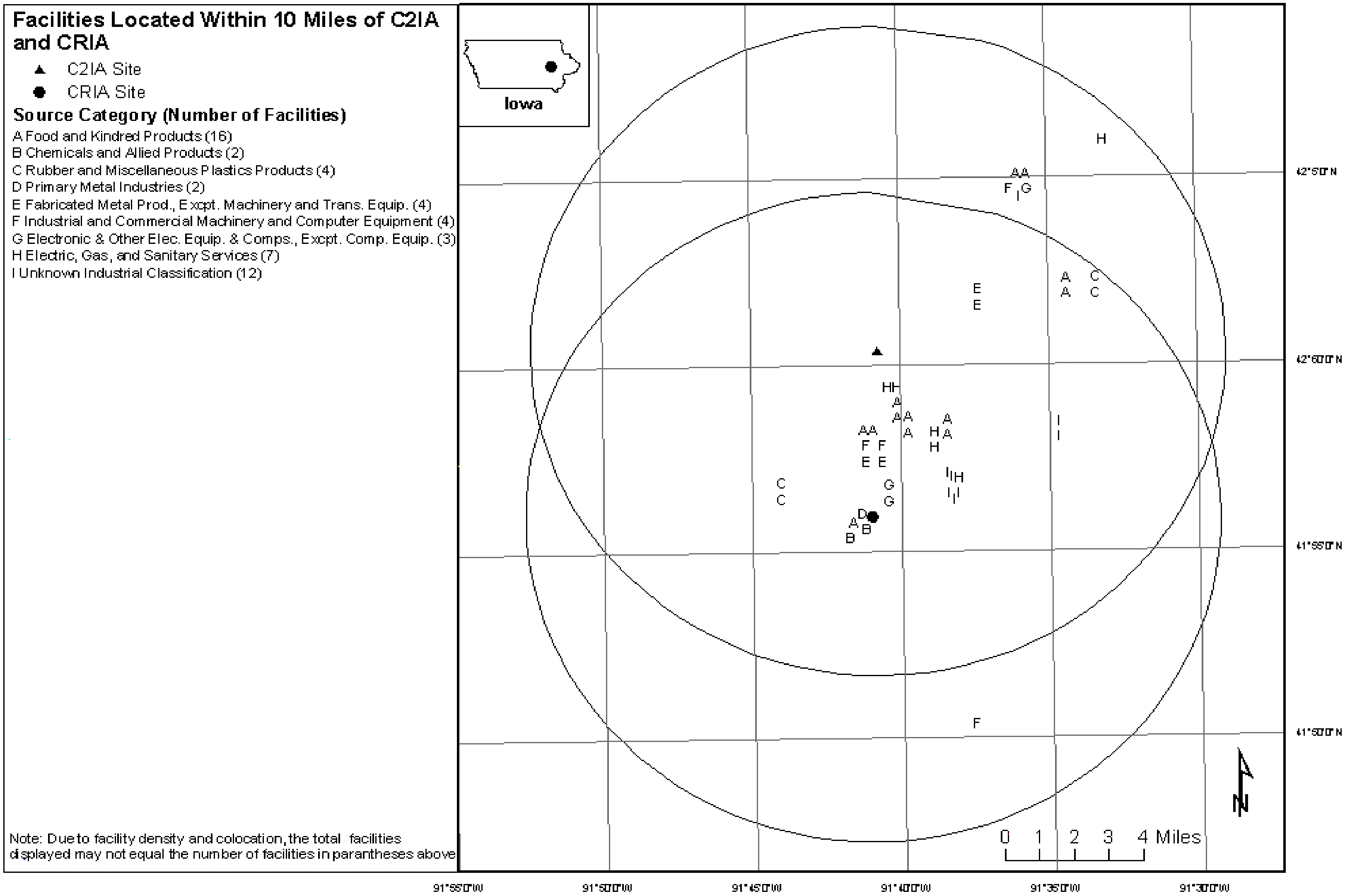


Figure 7-8. Facilities Located Within 10 Miles of CLIA

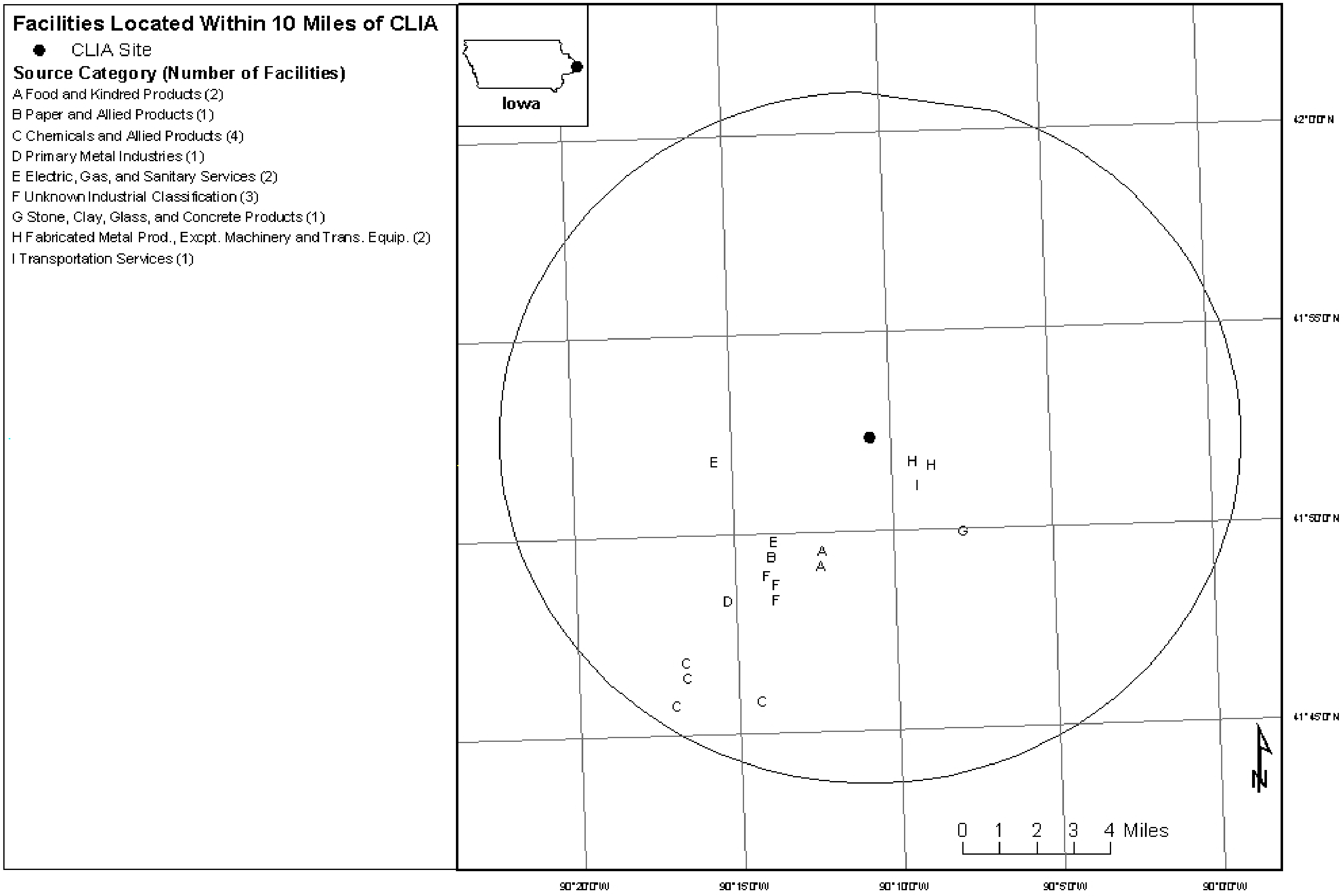


Figure 7-9. Facilities Located Within 10 Miles of DAIA

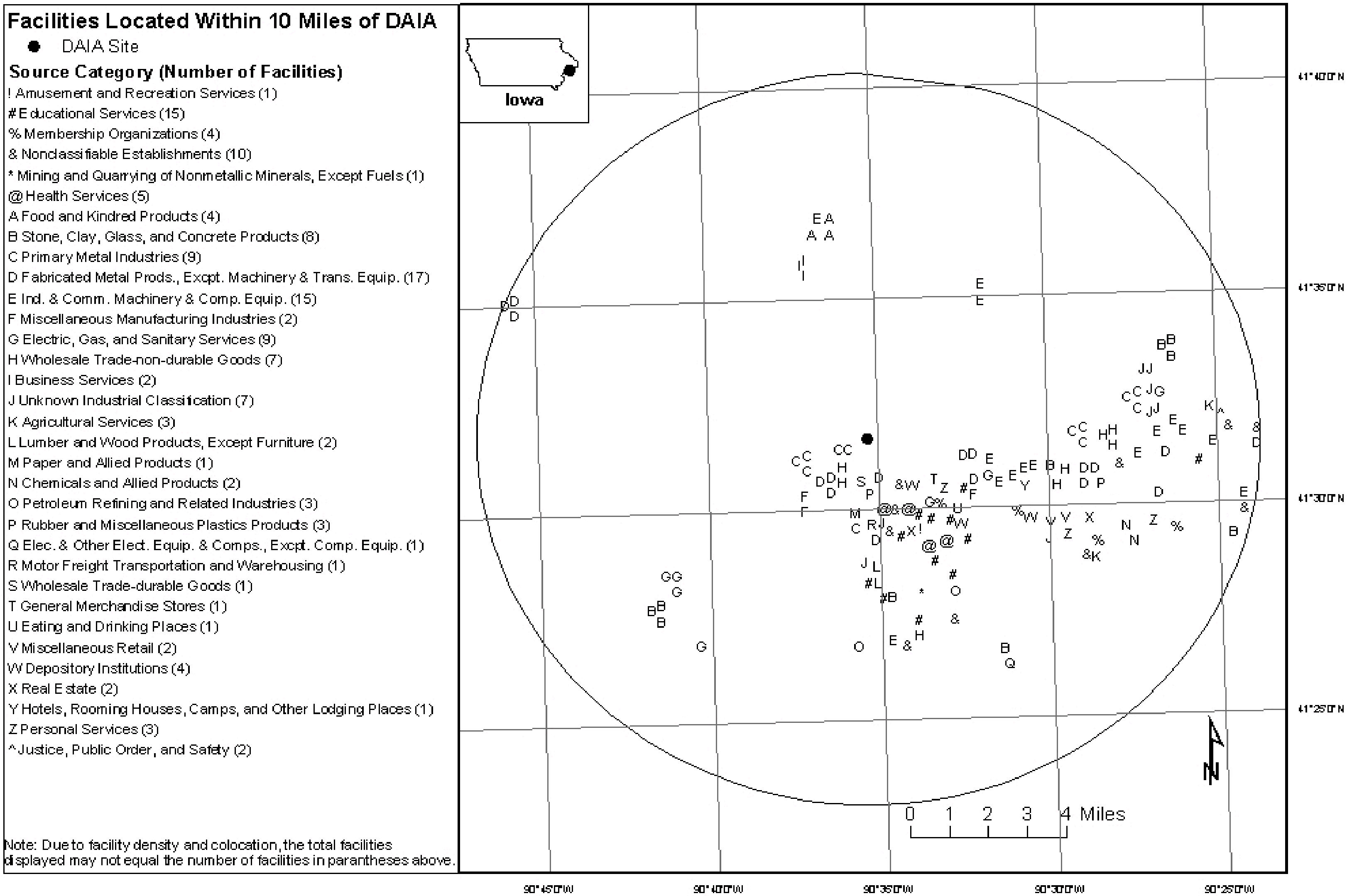


Figure 7-10. Facilities Located Within 10 Miles of DMIA

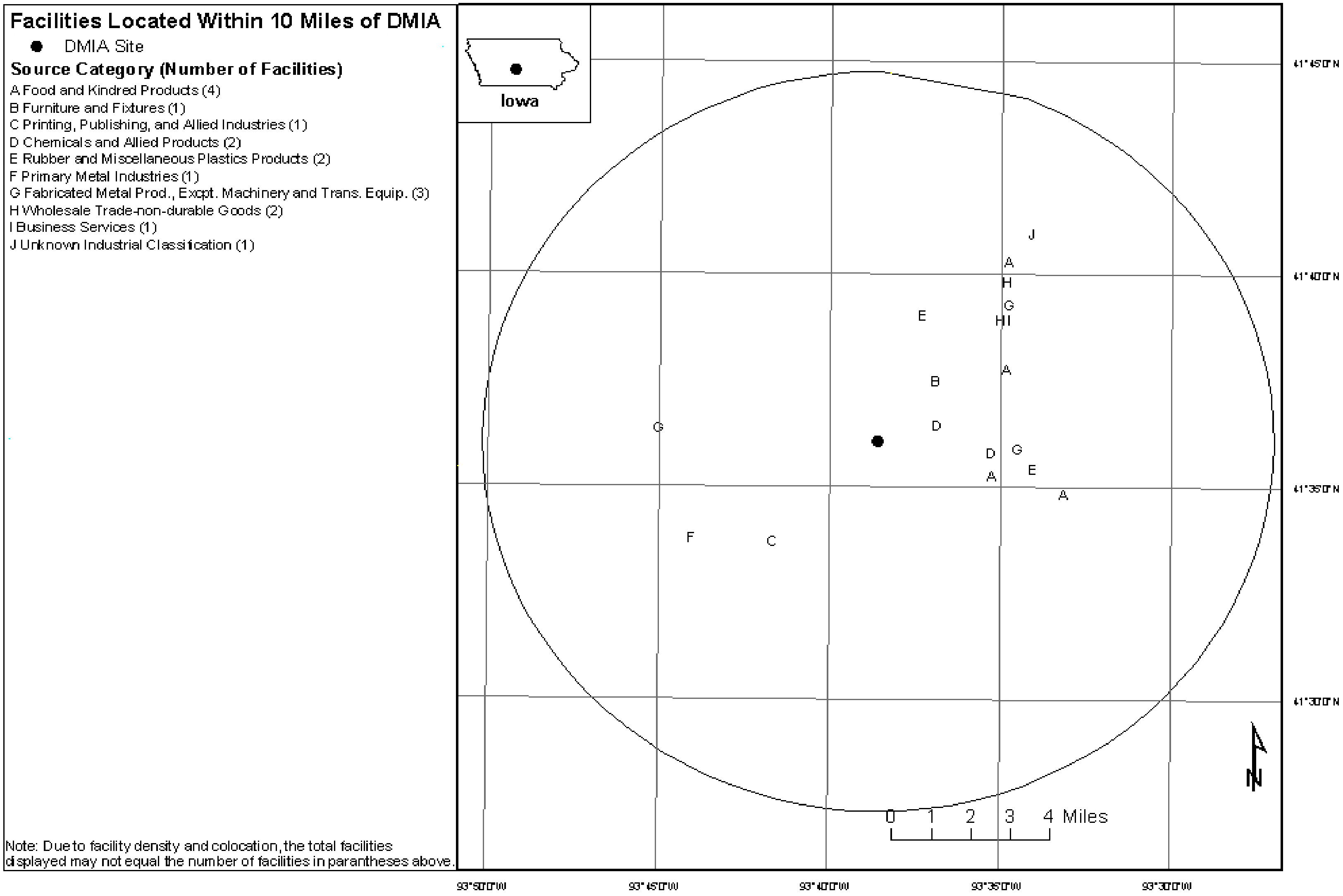


Figure 7-11. Facilities Located Within 10 Miles of MUIA

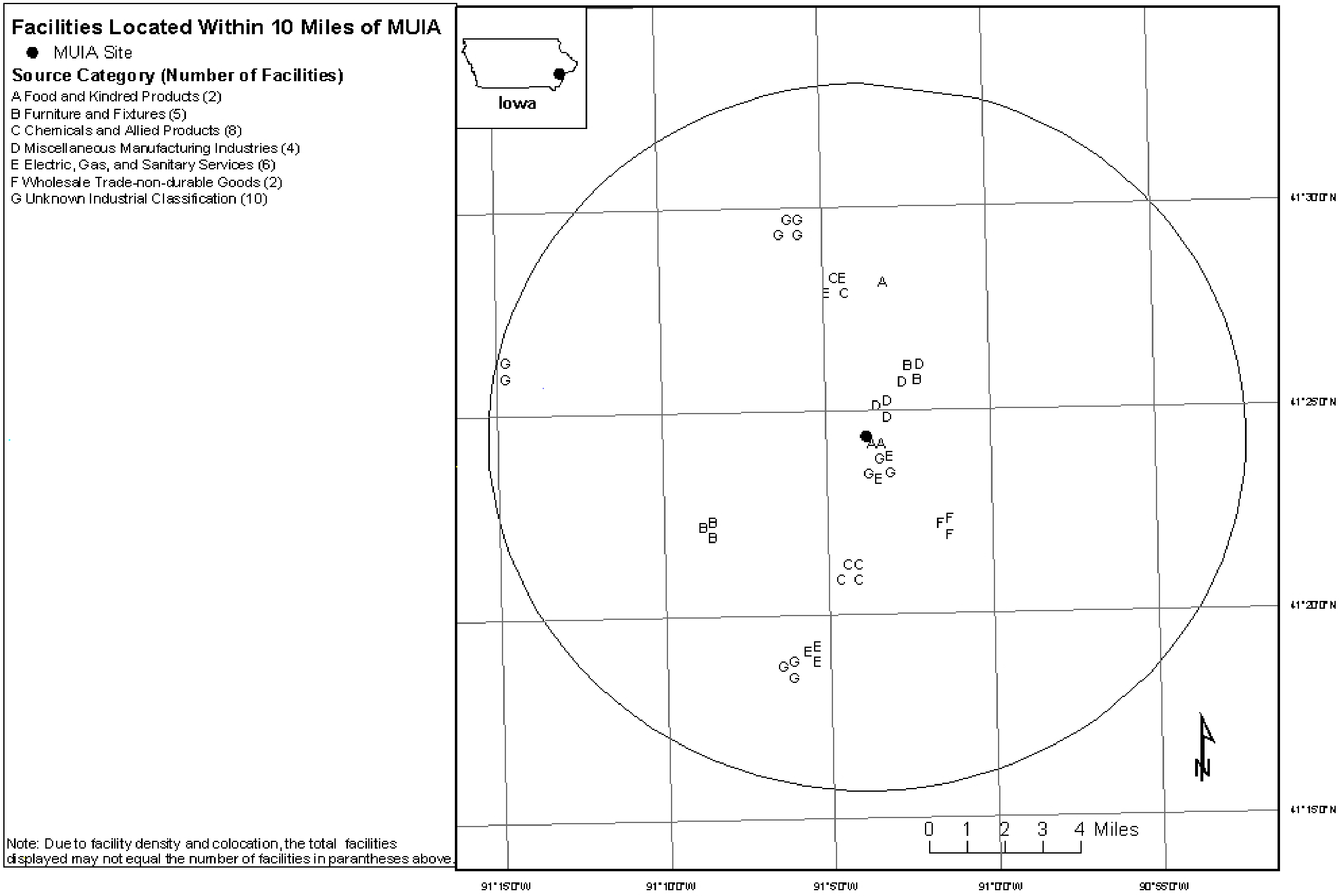


Table 7-1. Average Concentration and Meteorological Parameters for Sites in Iowa

Site Name	Type	Average UATMP Concentration (ppbv)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
C2IA	All 2001		60.43 (±2.22)	43.98 (±2.04)	36.51 (±1.83)	40.05 (±1.83)	64.48 (±1.24)	1.07 (±0.58)	0.51 (±0.55)
	sample day	15.16 (±2.18)	60.35 (±3.83)	44.24 (±3.51)	36.57 (±3.14)	40.08 (±3.10)	64.63 (±2.08)	0.68 (±1.00)	1.05 (±0.99)
CLIA	All 2001		61.52 (±2.16)	44.19 (±2.08)	36.26 (±1.83)	40.16 (±1.86)	61.75 (±1.30)	1.60 (±0.61)	1.10 (±0.56)
	sample day	59.20 (±62.27)	59.85 (±8.47)	45.24 (±8.33)	36.98 (±7.09)	40.90 (±7.31)	63.68 (±4.46)	1.90 (±2.10)	2.53 (±2.18)
CRIA	All 2001		60.43 (±2.22)	43.98 (±2.04)	36.51 (±1.83)	40.05 (±1.83)	64.48 (±1.24)	1.07 (±0.58)	0.51 (±0.55)
	sample day	17.94 (±6.97)	60.78 (±5.17)	45.29 (±5.01)	37.22 (±4.45)	40.61 (±4.36)	64.53 (±2.96)	0.68 (±1.30)	1.65 (±1.41)
DAIA	All 2001		61.52 (±2.16)	44.19 (±2.08)	36.26 (±1.83)	40.16 (±1.86)	61.75 (±1.30)	1.60 (±0.61)	1.10 (±0.56)
	sample day	16.59 (±4.08)	60.23 (±7.37)	44.63 (±7.28)	36.12 (±6.21)	40.27 (±6.37)	62.59 (±4.10)	2.42 (±1.65)	3.15 (±2.01)
DMIA	All 2001		62.51 (±2.24)	47.01 (±2.20)	38.18 (±1.93)	42.41 (±1.94)	62.30 (±1.15)	0.73 (±0.52)	1.04 (±0.60)
	sample day	28.09 (±8.61)	63.50 (±7.33)	47.75 (±7.36)	38.69 (±6.39)	42.97 (±6.47)	61.29 (±4.10)	0.84 (±1.86)	3.35 (±2.25)
MUIA	All 2001		62.21 (±2.21)	43.23 (±1.98)	35.78 (±1.75)	39.42 (±1.77)	61.58 (±1.29)	1.01 (±0.41)	-0.08 (±0.48)
	sample day	23.52 (±15.00)	64.79 (±8.48)	47.00 (±7.75)	39.11 (±6.92)	42.76 (±6.92)	63.25 (±4.38)	1.28 (±1.30)	2.08 (±1.71)

Table 7-2a - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Cedar Rapids, Iowa Site 2 (C2IA)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.23	0.33	0.31	0.32	0.16	-0.07	0.26
Acetone	0.11	0.21	0.18	0.21	0.22	-0.08	0.07
Acetylene	-0.36	-0.33	-0.34	-0.32	0.17	-0.16	0.14
Benzene	0.02	0.00	0.01	0.01	0.05	-0.11	0.07
Chloromethane	0.59	0.50	0.53	0.52	-0.07	-0.15	0.15
Dichlorodifluoromethane	0.17	0.13	0.13	0.14	-0.06	-0.04	0.05
Ethylbenzene	0.30	0.27	0.30	0.29	0.15	-0.15	0.14
Formaldehyde	0.52	0.61	0.62	0.62	0.18	-0.21	0.27
m-,p - Xylene	0.36	0.32	0.36	0.35	0.13	-0.22	0.18
Methyl Ethyl Ketone	0.50	0.53	0.56	0.56	0.17	-0.12	0.18
Methylene Chloride	0.08	0.00	0.01	0.00	-0.11	0.07	-0.07
o - Xylene	0.32	0.30	0.32	0.32	0.13	-0.19	0.21
Propylene	0.68	0.68	0.74	0.72	0.21	-0.16	0.15
Toluene	0.28	0.25	0.25	0.26	0.00	-0.12	0.05

Table 7-2b - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Clinton, Iowa (CLIA)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.29	0.31	0.29	0.29	-0.14	0.16	0.38
Acetone	-0.10	-0.06	-0.08	-0.08	0.01	0.14	0.08
Acetylene	-0.48	-0.38	-0.37	-0.37	0.40	0.07	0.07
Benzene	0.02	-0.04	0.05	0.00	0.30	-0.02	0.02
Chloromethane	0.61	0.49	0.45	0.48	-0.14	0.26	0.29
Dichlorodifluoromethane	0.19	0.24	0.26	0.26	0.36	0.08	-0.11
Ethylbenzene	0.03	-0.03	0.04	-0.01	-0.06	-0.22	-0.02
Formaldehyde	0.64	0.58	0.57	0.57	-0.24	0.10	0.32
m-,p - Xylene	0.27	0.21	0.27	0.24	0.10	-0.17	0.11
Methyl Ethyl Ketone	0.13	0.06	0.10	0.07	-0.13	-0.04	0.06
Methylene Chloride	0.21	0.23	0.25	0.23	0.05	-0.06	-0.04
o - Xylene	0.16	0.09	0.16	0.12	0.04	-0.18	0.10
Propylene	0.12	0.10	0.11	0.11	0.24	0.12	0.11
Toluene	0.05	-0.04	0.03	-0.01	-0.10	-0.24	-0.20

Table 7-2c - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Cedar Rapids, Iowa Site 1 (CRIA)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.10	0.11	0.07	0.13	0.11	0.18	0.24
Acetone	-0.06	-0.01	-0.03	0.02	0.18	-0.06	0.08
Acetylene	0.06	0.06	0.00	0.06	-0.08	-0.06	-0.09
Benzene	0.17	0.16	0.10	0.16	-0.06	-0.13	-0.05
Chloromethane	0.36	0.34	0.34	0.34	0.00	-0.17	0.17
Dichlorodifluoromethane	-0.23	-0.22	-0.21	-0.22	-0.06	0.31	-0.30
Ethylbenzene	0.20	0.20	0.15	0.18	-0.13	-0.22	-0.11
Formaldehyde	0.43	0.51	0.42	0.46	-0.11	-0.16	0.30
m-,p - Xylene	0.21	0.22	0.18	0.21	-0.13	-0.23	-0.09
Methyl Ethyl Ketone	-0.01	0.03	0.02	0.02	0.08	-0.09	0.20
Methylene Chloride	-0.01	-0.08	-0.04	-0.06	-0.07	-0.12	0.01
o - Xylene	0.20	0.21	0.16	0.19	-0.12	-0.20	-0.10
Propylene	0.31	0.30	0.28	0.33	0.03	-0.20	-0.08
Toluene	0.19	0.21	0.14	0.19	-0.14	-0.13	-0.10

Table 7-2d - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Davenport, Iowa (DAIA)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.17	0.19	0.18	0.18	-0.18	0.04	0.20
Acetone	-0.03	0.08	0.06	0.07	0.14	0.08	0.07
Acetylene	-0.44	-0.49	-0.45	-0.48	0.05	-0.39	-0.21
Benzene	-0.06	-0.23	-0.13	-0.19	-0.04	-0.54	-0.20
Chloromethane	-0.33	-0.27	-0.27	-0.27	0.07	-0.25	0.23
Dichlorodifluoromethane	-0.39	-0.37	-0.35	-0.37	-0.12	0.15	-0.26
Ethylbenzene	0.18	-0.03	0.07	0.01	-0.11	-0.39	-0.19
Formaldehyde	0.54	0.59	0.56	0.57	-0.13	0.04	0.25
m-,p - Xylene	0.24	0.05	0.13	0.08	-0.07	-0.41	-0.15
Methyl Ethyl Ketone	0.03	0.02	-0.04	-0.01	-0.19	0.06	0.02
Methylene Chloride	0.33	0.31	0.32	0.31	0.02	-0.04	0.03
o - Xylene	0.15	-0.06	0.04	-0.02	-0.11	-0.47	-0.21
Propylene	-0.23	-0.25	-0.22	-0.24	0.07	-0.34	0.15
Toluene	0.33	0.27	0.27	0.27	-0.10	0.02	0.17

Table 7-2e- Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Des Moines, Iowa (DMIA)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.14	0.15	0.19	0.17	0.12	-0.14	-0.28
Acetone	0.10	0.14	0.15	0.15	0.12	-0.08	-0.24
Acetylene	-0.37	-0.39	-0.38	-0.38	0.27	-0.23	-0.17
Benzene	-0.07	-0.22	-0.11	-0.17	0.13	-0.23	-0.35
Chloromethane	0.02	0.13	0.13	0.11	0.11	0.16	-0.17
Dichlorodifluoromethane	0.23	0.31	0.23	0.29	0.26	-0.11	0.29
Ethylbenzene	0.18	0.03	0.16	0.09	0.13	-0.31	-0.29
Formaldehyde	0.14	0.11	0.17	0.14	0.10	-0.09	-0.32
m-,p - Xylene	0.15	0.01	0.14	0.06	0.15	-0.27	-0.35
Methyl Ethyl Ketone	0.08	0.17	0.04	0.12	-0.08	0.17	0.13
Methylene Chloride	-0.25	-0.18	-0.17	-0.17	0.22	0.19	-0.47
o - Xylene	0.12	-0.02	0.11	0.03	0.12	-0.28	-0.39
Propylene	0.03	-0.02	0.06	0.02	0.26	0.02	-0.38
Toluene	0.29	0.17	0.27	0.22	0.13	-0.16	-0.14

Table 7-2f - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Muscatine, Iowa Site 1 (MUIA)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.01	0.06	-0.08	0.01	-0.24	0.06	0.46
Acetone	-0.54	-0.47	-0.52	-0.49	0.12	0.12	-0.36
Acetylene	-0.68	-0.63	-0.60	-0.62	0.25	0.11	-0.36
Benzene	-0.65	-0.63	-0.61	-0.63	0.17	0.15	-0.35
Chloromethane	-0.01	-0.02	0.04	0.00	0.00	-0.02	0.08
Dichlorodifluoromethane	-0.03	0.03	-0.09	-0.01	-0.14	-0.01	0.36
Ethylbenzene	-0.20	-0.33	-0.26	-0.31	-0.06	0.03	-0.35
Formaldehyde	0.41	0.19	0.23	0.20	-0.43	-0.14	-0.03
m-,p - Xylene	-0.17	-0.27	-0.21	-0.25	-0.02	0.04	-0.30
Methyl Ethyl Ketone	-0.40	-0.40	-0.41	-0.41	-0.07	0.00	-0.03
Methylene Chloride	0.24	0.13	0.20	0.16	-0.09	-0.30	0.07
o - Xylene	-0.26	-0.35	-0.29	-0.34	0.01	0.03	-0.32
Propylene	-0.66	-0.61	-0.61	-0.61	0.15	0.10	-0.23
Toluene	-0.13	-0.31	-0.24	-0.29	-0.16	0.00	-0.28

Table 7-3. TNMOC and Ozone Measured by the Iowa Monitoring Stations

Monitoring Location	Average Ozone Concentrations from May-Aug	Total Number of Ozone Sampling Days	Average TNMOC (speciated)	Average TNMOC (w/ unknowns)	% TNMOC Identified	SNMOC Compound with the Highest Concentration	Typical Emission Sources
C2IA	N/A	N/A	70 (±4.45) ppbC	137 (±7.76) ppbC	51 %	Ethane (6.87 ppbC)	Production of insulating materials; cooking oils such as shortening
CLIA	57.36 ppbv	123	83 (±8.09) ppbC	142 (±25.03) ppbC	59 %	Isopentane (7.18 ppbC)	Non-wood upholstered office side and arm chairs
CRIA	N/A	N/A	120 (±31.79) ppbC	168 (±36.68) ppbC	71 %	Isopentane (14.40 ppbC)	See above entry for Isopentane
DAIA	N/A	N/A	95 (±11.42) ppbC	176 (±18.08) ppbC	54 %	Ethane (8.25 ppbC)	See above entry for Ethane
DMIA	N/A	N/A	103 (±18.78) ppbC	196 (±23.23) ppbC	53 %	Isopentane (17.73 ppbC)	See above entry for Isopentane
MUIA	N/A	N/A	83 (±12.82) ppbC	197 (±61.38) ppbC	42 %	Propane (8.96 ppbC)	Vehicle fuel; residential and industrial fuel, refrigerant

Table 7-4. Motor Vehicle Information vs. Daily Concentration for Iowa Monitoring Sites

Monitoring Station	Population within Ten Miles	Estimated Number of MotorVehicles Owned	Traffic Data (Daily Average)	Average Daily UATMP Concentration
C2IA	174,385	129,045	1,500	15.16 (±2.18) ppbv
CLIA	42,478	31,433	500	59.20 (±62.27) ppbv
CRIA	175,333	129,746	15,600	17.94 (±6.97) ppbv
DAIA	274,768	203,328	1,000	16.59 (±4.08) ppbv
DMIA	379,063	280,507	12,400	28.09 (±8.61) ppbv
MUIA	33,956	25,127	2,800	23.52 (±15.00) ppbv

8.0 Sites in Michigan

This section focuses on a few specific meteorological and concentration trends for the seven UATMP sites in Michigan (AMPI, DEMI, E7MI, LOMI, RRMI, SWMI, and YFMI). All seven of these sites reside in the Detroit metropolitan statistical area. Figures 8-1 through 8-7 are topographical maps showing the monitoring stations in their urban locations. Figures 8-8 and 8-9 are maps identifying facilities within ten miles of the sites that reported to the 1999 NEI. The E7MI and LOMI sites are further to the north of the city than the other five monitoring locations, and the majority of the industrial sites are fabricated metal producers, transportation equipment manufacturers, and chemical companies. The bulk of the industrial facilities is to the south of E7MI and LOMI. The DEMI, RRMI, SWMI, and YFMI sites are close to each other, and are surrounded by numerous industries, most of which are fabricated metal producers, transportation equipment manufacturers, utility companies, and chemical producers. APMI is just to the southwest of the cluster of other sites.

Hourly meteorological data were retrieved for all of 2001 at three weather stations near the sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The three weather stations are Pontiac, Detroit-Metropolitan, and Detroit City Airport (WBAN 94817, 94847, and 14822, respectively).

Table 8-1 highlights the average UATMP concentration at each of the sites, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), and wind information (average u- and v-components of the wind) for the entire year and on sampling days. The Detroit area is located in the Great Lakes region, a place for active weather, as several storm tracks run right across the region. Hence, winters can be cold and wet, while summers are generally mild. The urbanization of the area along with Lake St. Clair to the east are two major influences on the city's weather. The lake tends to keep Detroit warmer in the winter and cooler in the summer than more inland areas. The urban heat island tends to keep the city warmer than outlying areas. Winds are often breezy and generally flow from the southwest and west on average, as can be confirmed by Table 8-1. This information can be found at the following web sites:

http://www.ssec.org/idis/gates/States/physical/detroit.htm and http://meetings.sixcontinentshotels.com/destinations/detroit/weather.html.

8.1 Meteorological and Concentration Averages at the Michigan Sites

Carbonyl compounds and VOC (volatile organic compounds) were measured at all of the sites with the exception of SWMI, which only measured carbonyls, and E7MI, which only measured SVOC. Tables 3-3 and 3-4 provide information on sites that measured carbonyls and VOC only. RRMI and SWMI had the two highest carbonyl geometric means, 27.44 ppbv and 26.35 ppbv, respectively, while the remaining four sites had geometric means less than one-fifth of these two. A similar situation occurred with halogenated hydrocarbons, with APMI far surpassing the other sites with a geometric mean of 19.28 ppbv. The other sites measured between 3.14 ppbv (RRMI) and 5.18 ppbv (LOMI). The hydrocarbon geometric means were closer together, with the lowest geometric mean reported by APMI (4.06 ppbv) and the highest reported by YFMI (10.87 ppbv). The polar compounds had the smallest variation, ranging from 1.43 ppbv (YFMI) and 3.84 ppbv (APMI). The average total UATMP daily concentration at APMI was by far the highest reported by any of the stations, 145.23 (±161.92) ppbv, while the remaining sites ranged between 12.84 ±2.41ppbv (RRMI) and 32.14 ±9.21 ppbv (LOMI). Table 8-1 also lists the averages for selected meteorological parameters from January 2001 to December 2001, which is similar to the time period covered in this report.

SVOC concentrations were sampled at all seven of the sites. Average SVOC concentrations ranged from 5.64 (±0.15) μg at APMI to 28.35 (±8.68) μg at YFMI. Ozone concentrations were also sampled at APMI and E7MI on 123 sample days, and were retrieved from the U.S. EPA's AIRS database. The average ozone concentration for each sample day was 54.63 ppbv and 60.74 ppbv, respectively. Unfortunately, ozone concentrations were not sampled at the other sites. Information on SVOC and ozone concentrations is given in Table 8-3.

Tables 8-2a-f are the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters by site. Identification of the prevalent compounds is discussed in Section 3 of this report. At APMI, strong (between 0.50

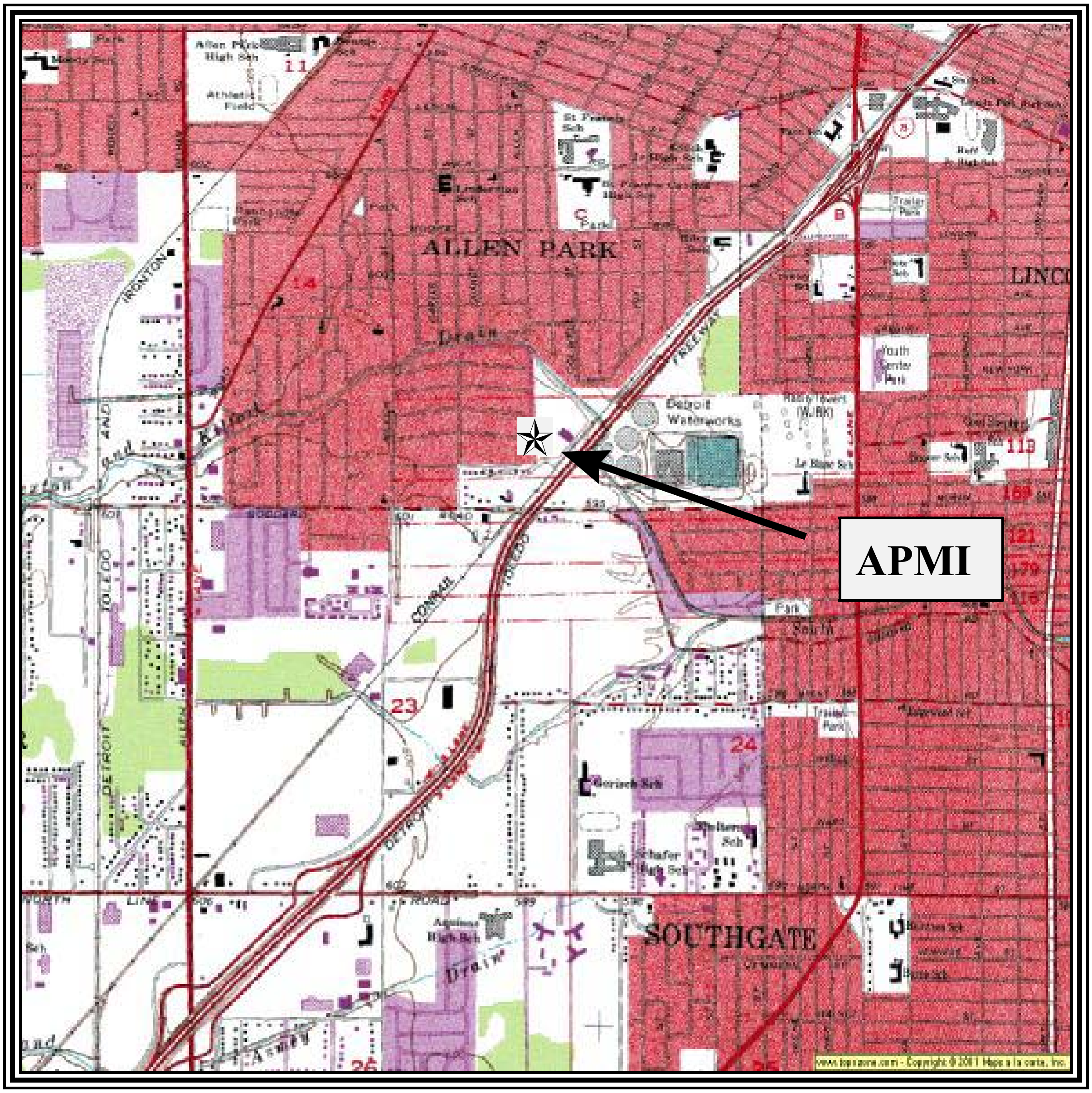
and 0.75 or -0.50 and -0.75) to moderately strong (between 0.25 and 0.50 or -0.25 and -0.50) positive correlations were noted between acetaldehyde, formaldehyde (where all correlations were strong), and methylene chloride and maximum temperature, average temperature, dew point, and wet bulb temperature. A similar correlation was seen at LOMI with the same weather parameters and formaldehyde. A strong positive correlation between methylene chloride and relative humidity was noted at the APMI site as well. At the YFMI site, the BETX compounds (benzene, ethylbenzene, *m-,p*-xylene, *o*-xylene, and toluene) had a strong positive correlation with the v-component of the wind. Strong to moderately strong positive correlations between chloromethane, dichlorodifluoromethane, and methyl ethyl ketone with several of the temperature and moisture variables were seen at RRMI. At the majority of the sites in Michigan, most of the correlations, regardless of the strength of the correlation, were positive, with the exception of the u-component of the wind, which was generally weakly negative.

8.2 Spatial Analysis

Using the population within ten miles of each site, an estimate of the number of motor vehicles operating in proximity to the monitoring station can be established. The ratio used in this report is 0.74 motor vehicles to every one person (refer to section 3.4.1 for more information on this ratio). The Michigan site with the highest population is the DEMI site, where 1,241,008 people are operating approximately 918,346 vehicles. The RRMI has the lowest population of the seven Michigan sites, with 905,107 people driving 669,779 automobiles. This information is compared to the average daily concentration of the prevalent compounds at each Michigan site in Table 8-4. Also included in Table 8-4 are average daily traffic data, or more specifically, the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis.

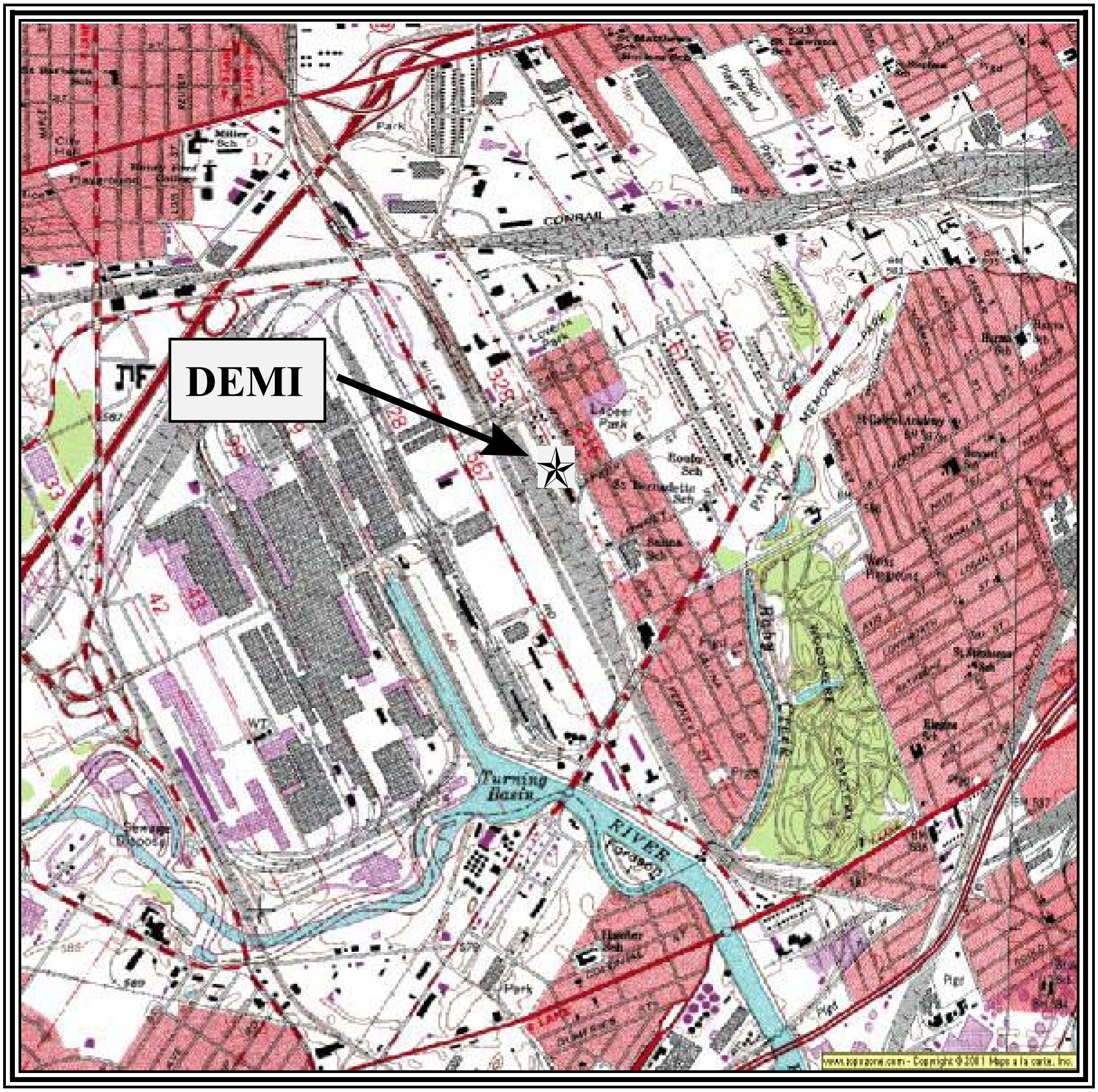
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area. (For more information on this study, refer to section 3.4.2.) Figure 3-16 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. Two of the Michigan sites are not located on this table, SWMI and E7MI. (Refer to section 8.1 for an explanation). Four of the sites' concentration ratios, APMI, DEMI, LOMI, and RRMI, look very similar to those of the roadside study, with the exception that the *m-,p*-xylene-ethylbenzene ratio is lower than the benzene-ethylbenzene ratio. In the roadside study, the *m-,p*-xylene-ethylbenzene concentration ratio is higher. The YFMI site's concentration ratios appears different from the roadside study's ratios. More specifically, the benzene-ethylbenzene ratio is by far the highest of the four ratios, and is more than triple the roadside study's benzene-ethylbenzene ratio. The *m-,p*-xylene-ethylbenzene ratio is significantly lower than the benzene-ethylbenzene ratio at the YFMI site, as the benzene-ethylbenzene ratio is so high at this site.

Figure 8-1. Detroit, Michigan Site 1 (APMI) Monitoring Station



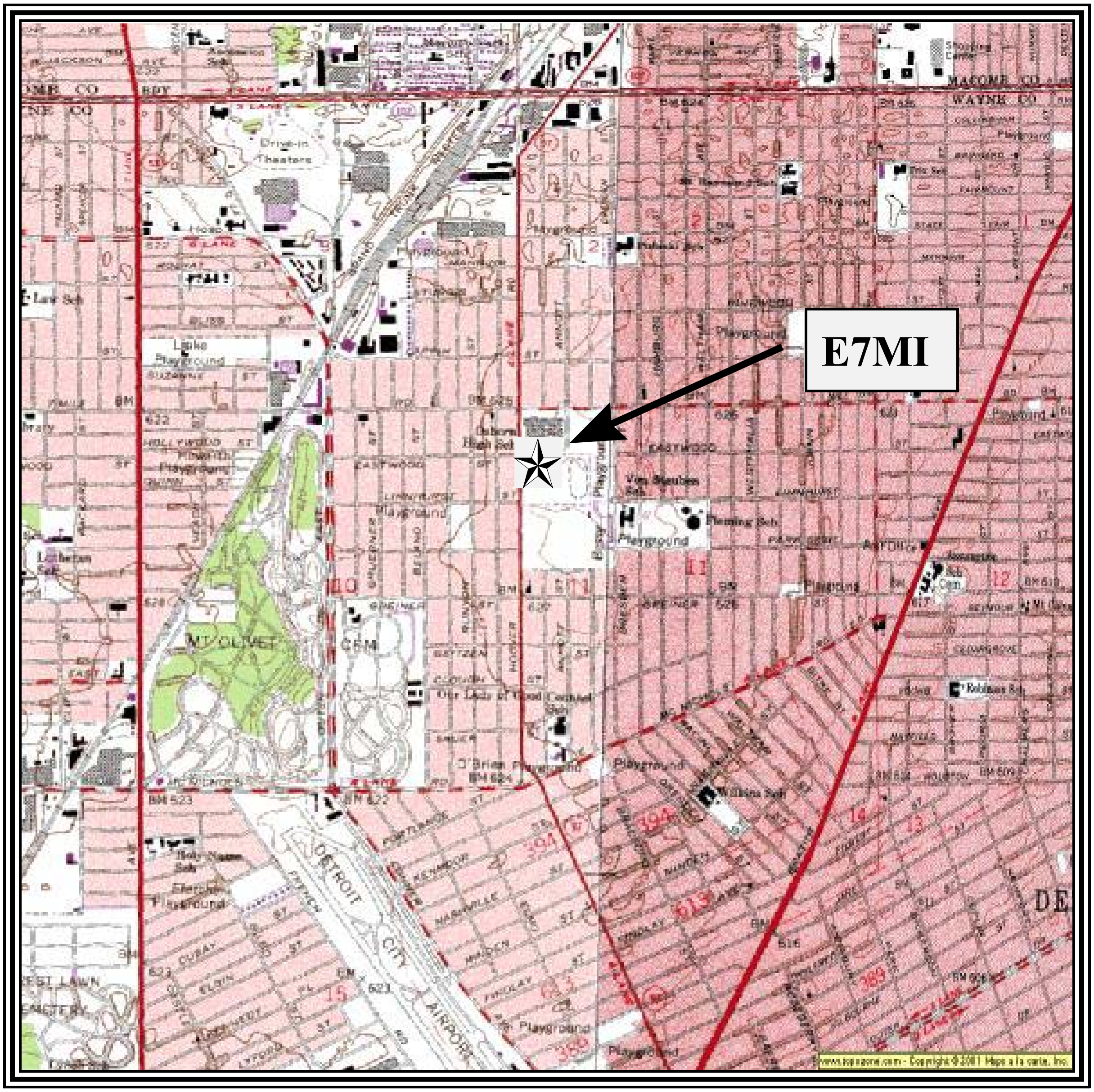
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 8-2. Detroit, Michigan Site 2 (DEMI) Monitoring Station



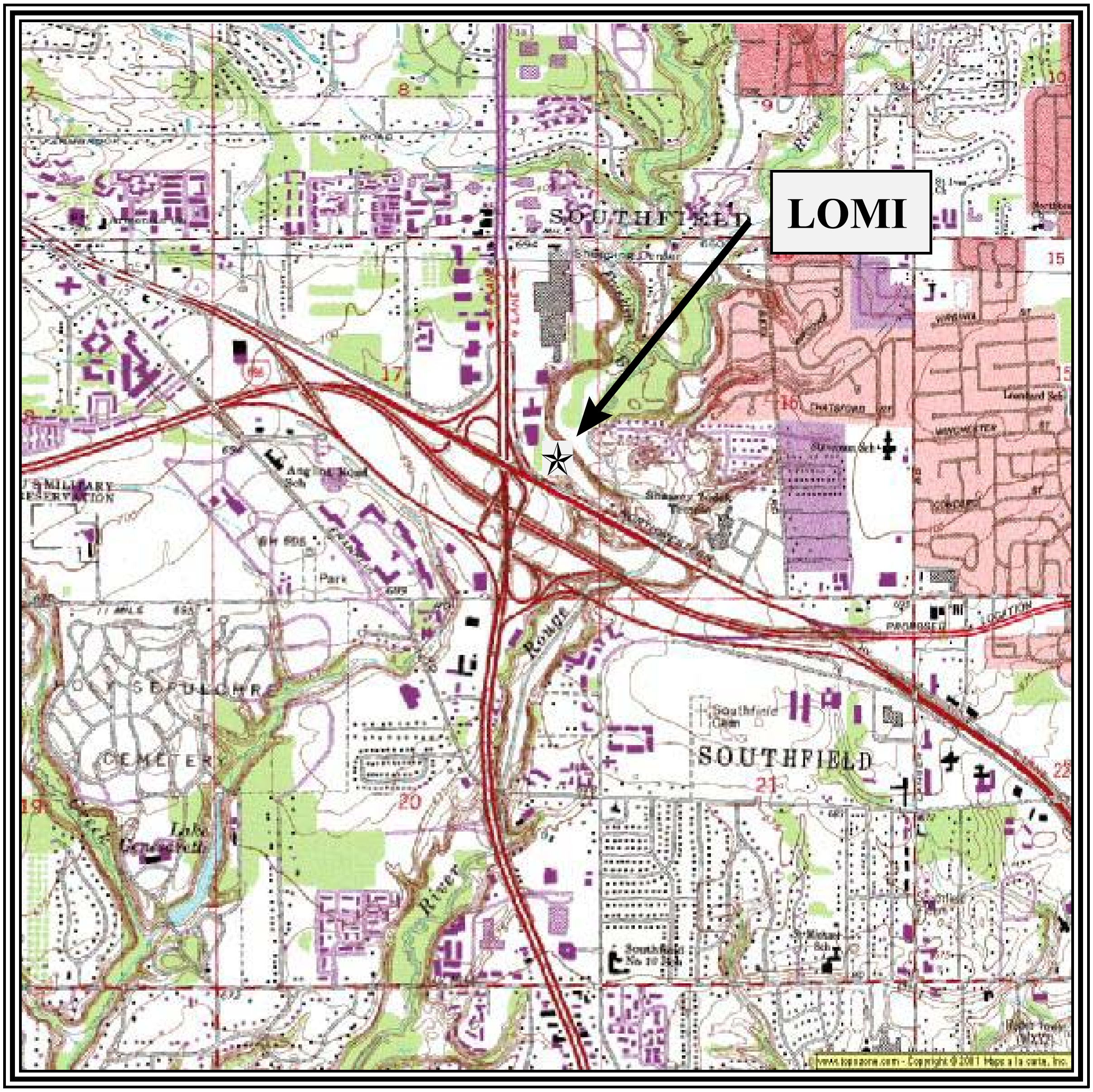
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 8-3. Detroit, Michigan Site 3 (E7MI) Monitoring Station



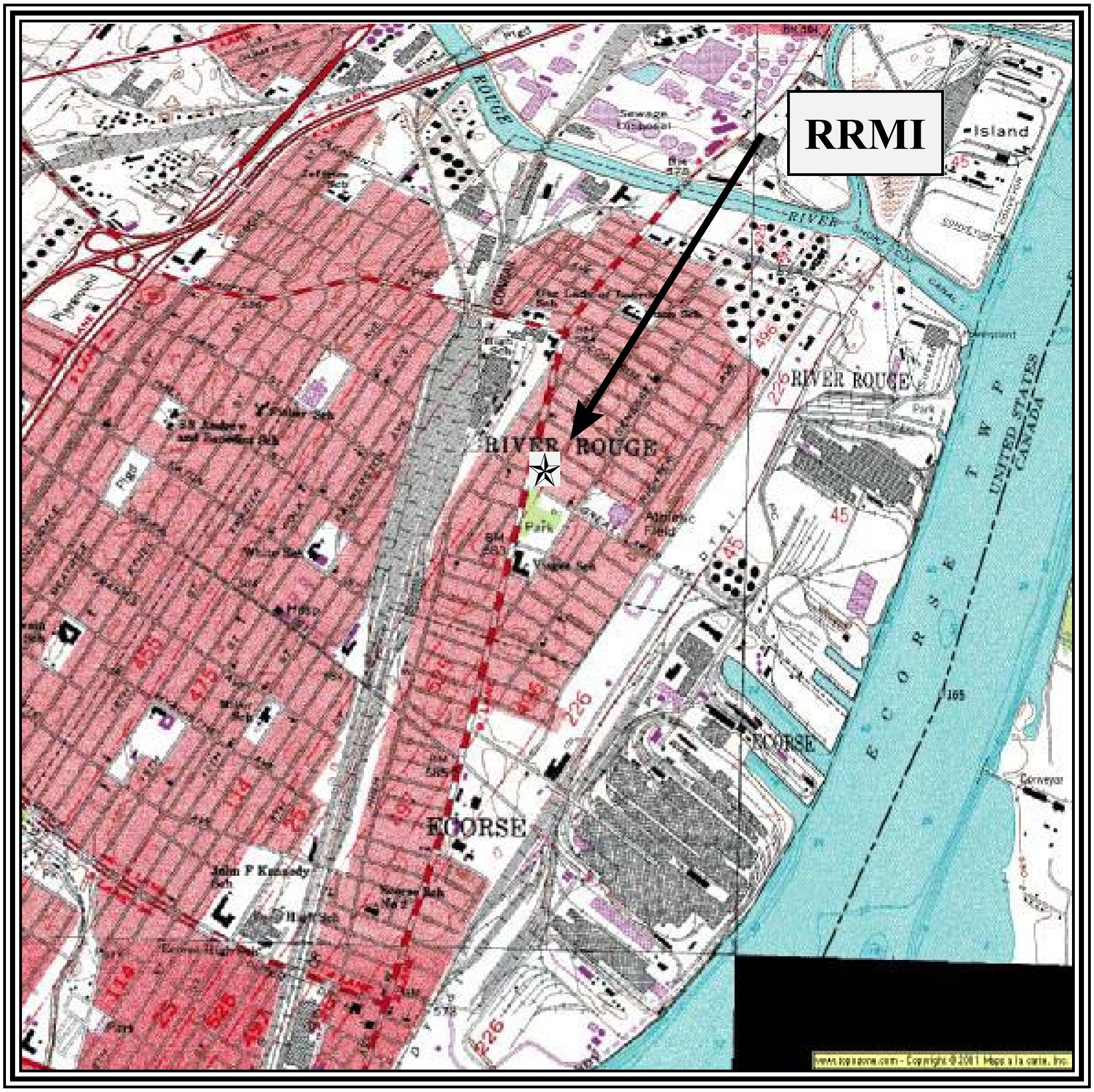
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 8-4. Detroit, Michigan Site 4 (LOMI) Monitoring Station



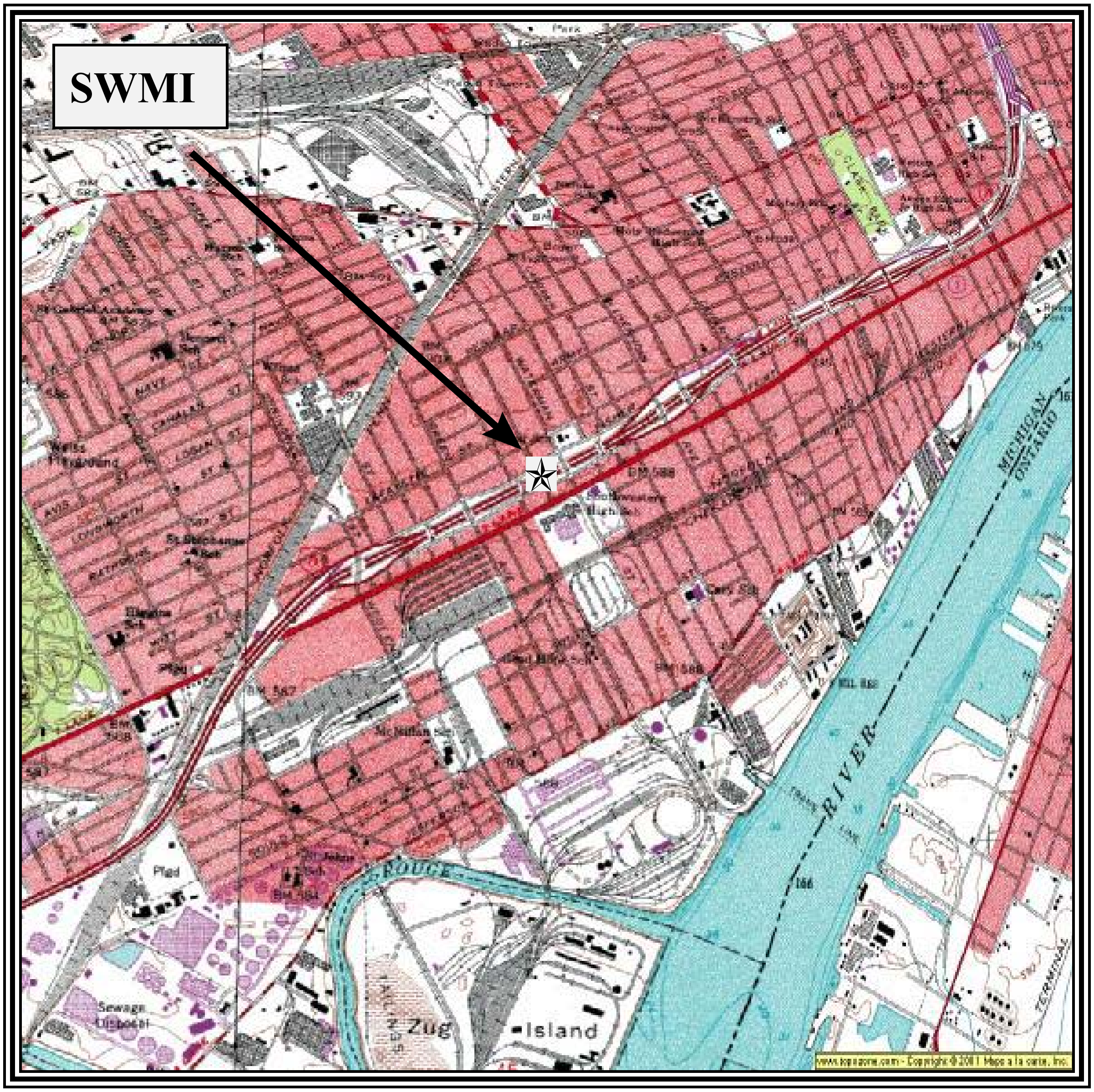
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 8-5. Detroit, Michigan Site 5 (RRMI) Monitoring Station



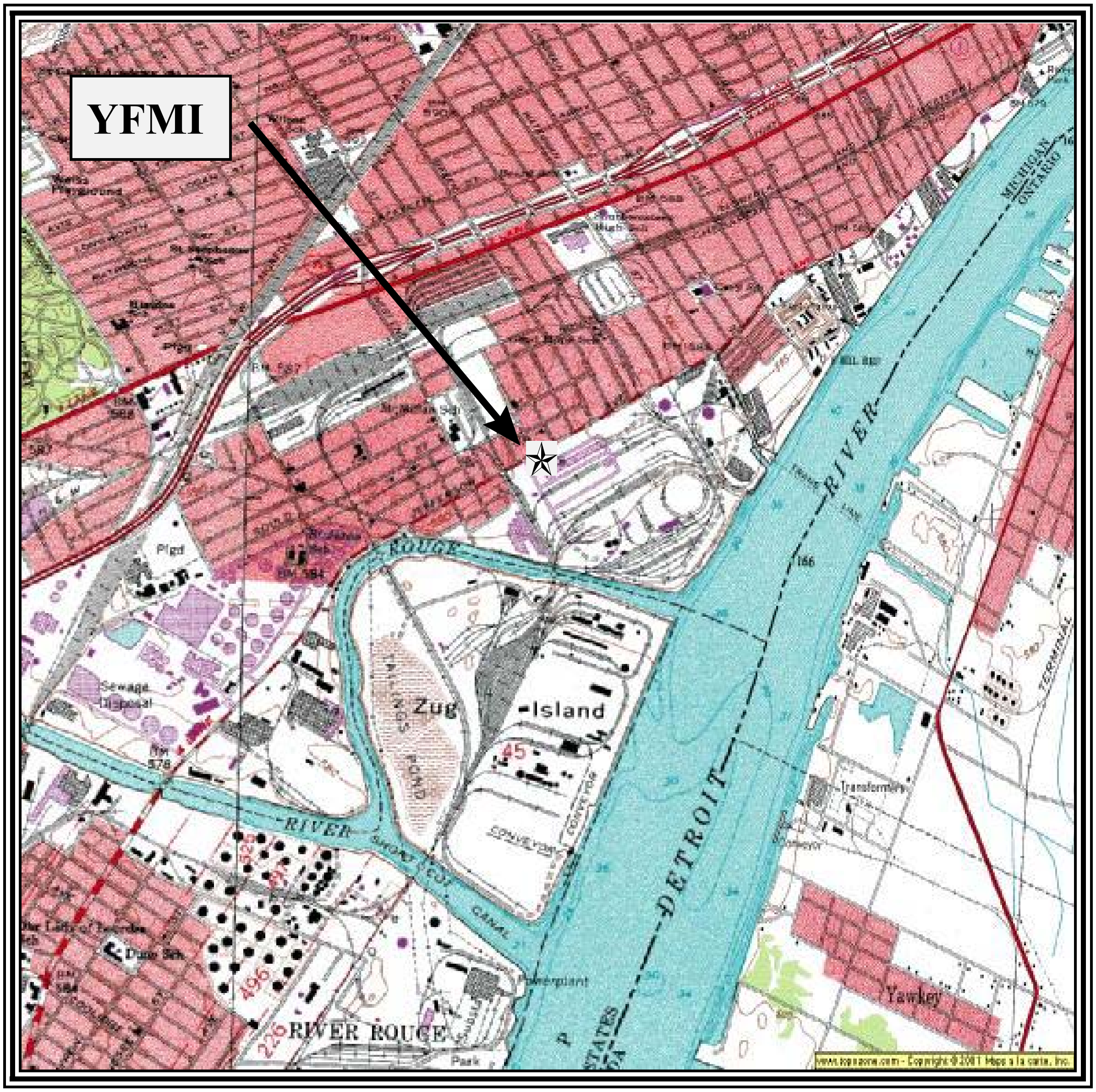
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 8-6. Detroit, Michigan Site 6 (SWMI) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 8-7. Detroit, Michigan Site 7 (YFMI) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 8-8. Facilities Located Within 10 Miles of APMI, DEMI, RRMI, SWMI, and YFMI

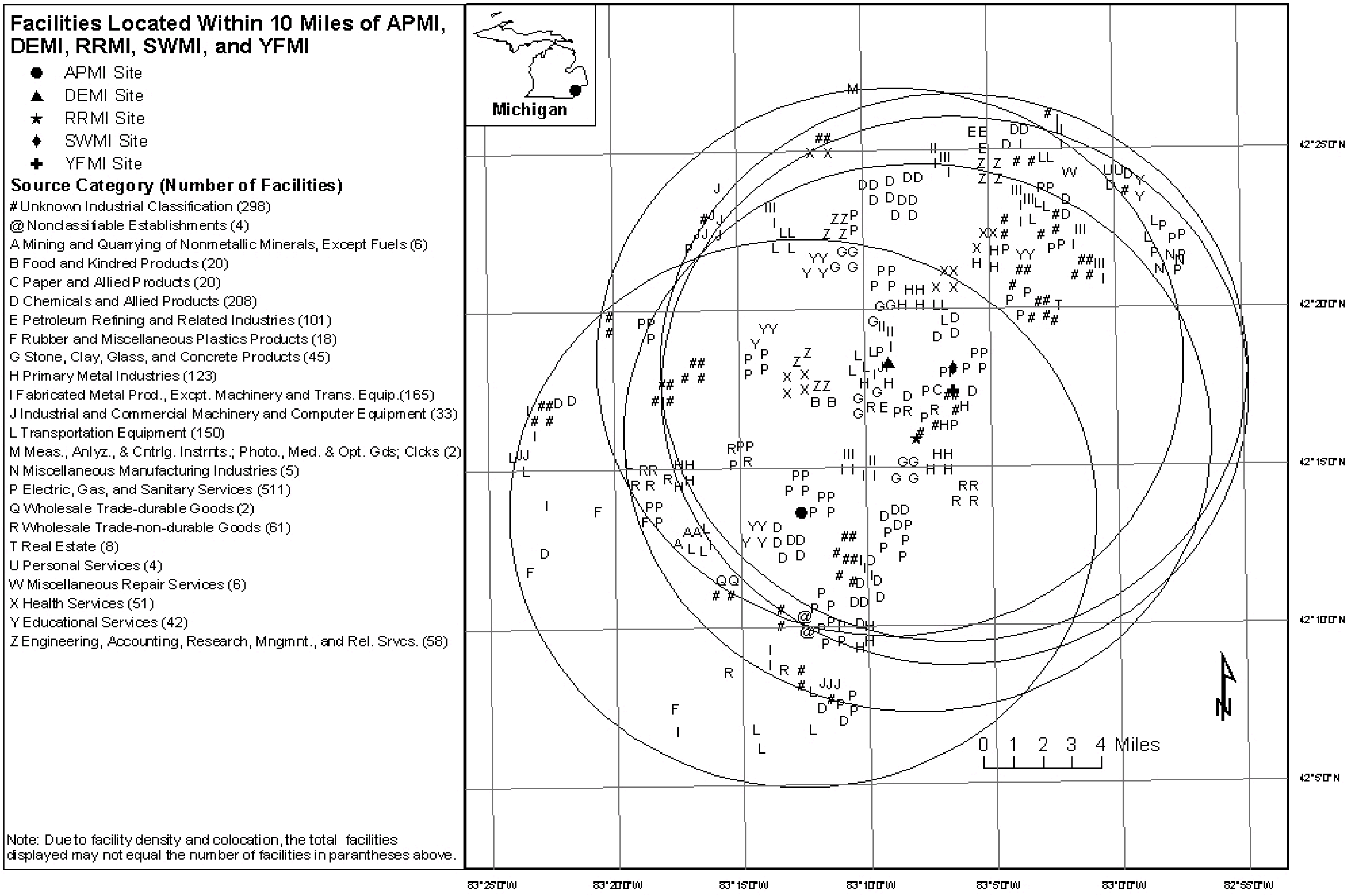


Figure 8-9. Facilities Within 10 Miles of E7MI and LOMI

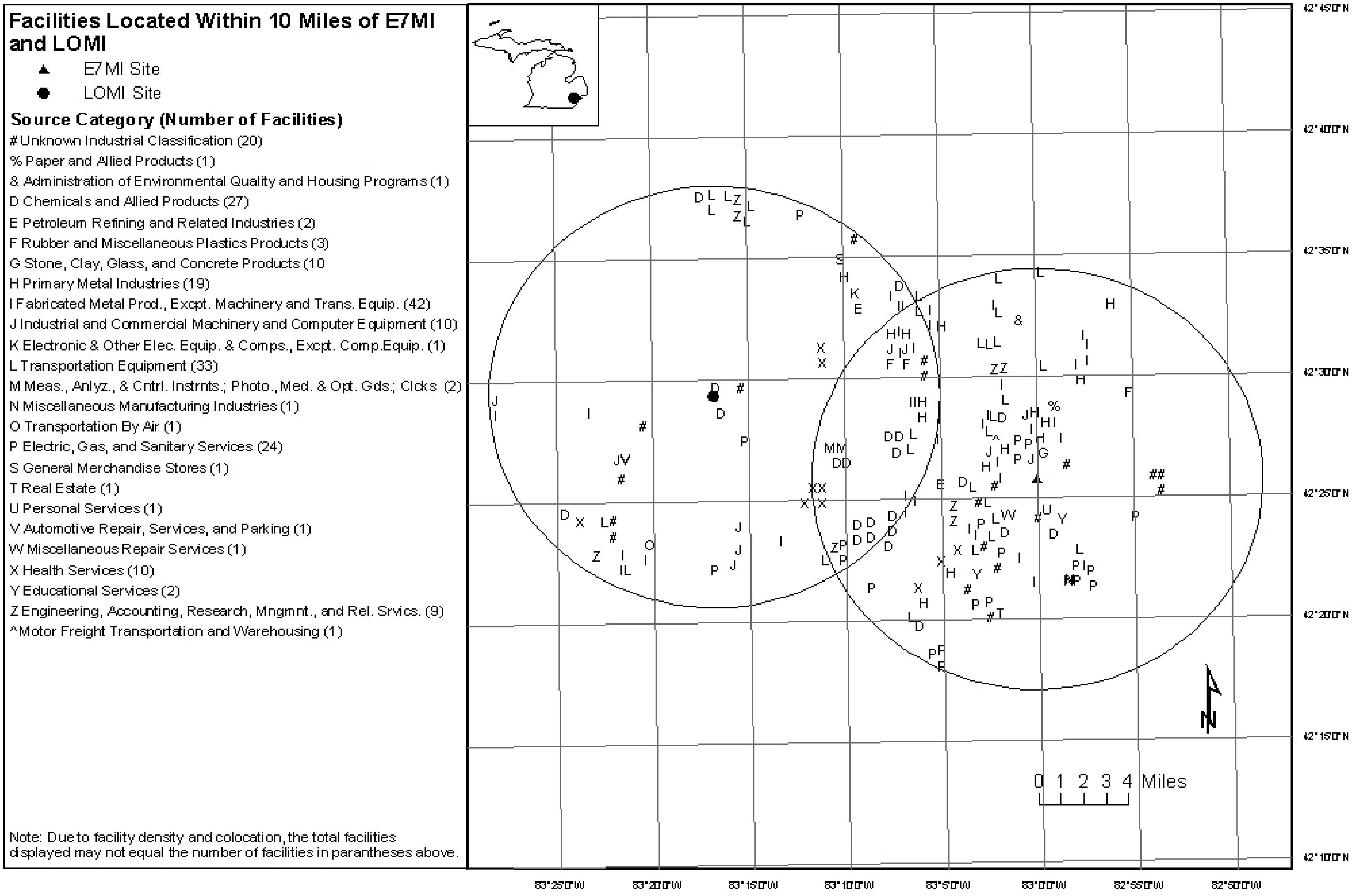


Table 8-1. Average Concentration and Meteorological Parameters for Sites in Michigan

Site Name	Type	Average UATMP Concentration (ppbv)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
APMI	All 2001	[redacted]	61.32 (±2.01)	47.14 (±1.88)	37.36 (±1.63)	42.23 (±1.63)	60.69 (±0.90)	2.63 (±0.50)	1.03 (±0.51)
	sample day	145.23 (±161.92)	69.88 (±3.97)	55.31 (±4.23)	44.87 (±3.54)	49.59 (±3.57)	61.37 (±2.46)	1.66 (±1.12)	1.00 (±1.30)
DEMI	All 2001	[redacted]	61.00 (±2.00)	46.05 (±1.98)	36.00 (±1.63)	40.97 (±1.69)	57.55 (±1.16)	2.08 (±0.49)	0.41 (±0.42)
	sample day	25.66 (±2.88)	71.36 (±1.64)	54.91 (±2.11)	43.40 (±1.68)	48.60 (±1.76)	55.94 (±1.30)	1.79 (±0.55)	0.82 (±0.53)
LOMI	All 2001	[redacted]	59.98 (±2.06)	44.97 (±1.95)	35.54 (±1.63)	40.26 (±1.68)	60.04 (±0.94)	2.55 (±0.51)	0.45 (±0.45)
	sample day	32.14 (±19.21)	70.41 (±3.80)	54.65 (±4.23)	44.04 (±3.35)	48.81 (±3.48)	60.86 (±2.51)	2.17 (±1.18)	0.71 (±1.23)
RRMI	All 2001	[redacted]	61.00 (±2.00)	46.05 (±1.98)	36.00 (±21.63)	40.97 (±1.69)	57.55 (±1.16)	2.08 (±0.49)	0.41 (±0.42)
	sample day	12.84 (±2.41)	69.38 (±4.82)	55.12 (±5.88)	43.15 (±4.82)	48.71 (±4.99)	56.92 (±3.53)	-0.07 (±1.42)	0.81 (±1.64)
SWMI	All 2001	[redacted]	61.00 (±2.00)	46.05 (±1.98)	36.00 (±1.63)	40.97 (±1.69)	57.55 (±1.16)	2.08 (±0.49)	0.41 (±0.42)
	sample day	26.35	63.00	53.00	36.25	45.00	55.33	-0.41	1.69
YFMI	All 2001	[redacted]	61.00 (±2.00)	46.05 (±1.98)	36.00 (±1.63)	40.97 (±1.69)	57.55 (±1.16)	2.08 (±0.49)	0.41 (±0.42)
	sample day	23.02 (±5.04)	69.46 (±3.83)	55.08 (±4.54)	43.50 (±3.69)	48.76 (±3.81)	57.55 (±2.87)	1.48 (±1.21)	0.91 (±1.06)

Table 8-2a - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Allen Park in Detroit, Michigan (APMI)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.51	0.42	0.42	0.42	0.05	-0.24	0.13
Acetone	-0.19	-0.13	-0.34	-0.22	-0.36	-0.26	0.15
Acetylene	-0.15	-0.01	-0.01	-0.01	0.36	-0.17	0.23
Benzene	0.21	0.32	0.30	0.31	0.19	-0.12	0.16
Chloromethane	0.22	0.27	0.23	0.25	-0.11	0.17	-0.17
Dichlorodifluoromethane	0.24	0.35	0.33	0.34	0.18	-0.07	-0.04
Ethylbenzene	0.29	0.40	0.40	0.40	0.26	-0.15	0.17
Formaldehyde	0.68	0.61	0.60	0.61	0.04	-0.14	0.19
m-,p - Xylene	0.28	0.39	0.40	0.40	0.28	-0.13	0.15
Methyl Ethyl Ketone	0.14	0.14	0.33	0.22	0.53	0.15	0.04
Methylene Chloride	0.48	0.47	0.52	0.50	0.10	0.32	-0.04
o - Xylene	0.33	0.43	0.43	0.43	0.22	-0.13	0.18
Propylene	0.17	0.28	0.26	0.27	0.21	-0.18	0.12
Toluene	0.32	0.36	0.37	0.36	0.11	-0.05	0.23

Table 8-2b - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Dearborn in Detroit, Michigan (DEMI)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.28	0.12	0.16	0.13	-0.03	-0.19	0.06
Acetone	0.07	0.07	0.04	0.06	0.00	-0.09	-0.01
Acetylene	-0.08	0.02	-0.01	0.02	0.15	-0.24	0.04
Benzene	0.10	0.12	0.15	0.14	0.20	-0.38	0.13
Chloromethane	0.06	0.00	0.04	0.01	0.01	-0.07	0.14
Dichlorodifluoromethane	0.18	0.23	0.24	0.24	0.15	-0.15	0.03
Ethylbenzene	0.03	0.08	0.08	0.09	0.11	-0.15	-0.05
Formaldehyde	0.21	0.07	0.10	0.08	-0.05	-0.09	0.06
m-,p - Xylene	0.03	0.09	0.09	0.09	0.11	-0.15	-0.06
Methyl Ethyl Ketone	0.38	0.35	0.39	0.37	0.14	-0.25	0.15
Methylene Chloride	0.06	0.11	0.08	0.10	-0.01	-0.09	-0.09
o - Xylene	0.03	0.10	0.10	0.11	0.16	-0.22	-0.05
Propylene	-0.07	-0.04	-0.04	-0.03	0.06	0.15	0.44
Toluene	0.09	0.16	0.16	0.17	0.17	-0.29	-0.03

Table 8-2c - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Lodge in Detroit, Michigan (LOMI)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.45	0.23	0.26	0.24	-0.17	0.06	0.33
Acetone	-0.44	-0.06	-0.36	-0.17	-0.03	0.11	0.16
Acetylene	0.10	-0.08	-0.04	-0.06	-0.10	-0.23	0.23
Benzene	0.13	-0.09	0.02	-0.05	-0.04	-0.16	0.20
Chloromethane	0.37	0.46	0.45	0.47	0.08	-0.29	-0.11
Dichlorodifluoromethane	0.25	0.30	0.35	0.33	0.23	-0.09	-0.18
Ethylbenzene	0.20	-0.06	0.07	-0.01	-0.06	-0.09	0.10
Formaldehyde	0.60	0.49	0.45	0.48	-0.15	0.00	0.25
m-,p - Xylene	0.21	-0.06	0.08	0.00	-0.07	-0.09	0.12
Methyl Ethyl Ketone	0.07	-0.13	-0.04	-0.11	-0.19	0.07	0.19
Methylene Chloride	0.31	0.08	0.19	0.12	-0.10	-0.10	-0.08
o - Xylene	0.23	0.01	0.14	0.06	-0.04	-0.11	0.16
Propylene	0.07	-0.10	-0.02	-0.07	0.00	-0.24	0.10
Toluene	0.31	0.14	0.24	0.19	-0.01	-0.13	0.15

Table 8-2d - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at River Rouge in Detroit, Michigan (RRMI)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetylene	-0.18	-0.11	-0.16	-0.13	0.03	0.15	-0.07
Benzene	0.10	0.04	0.03	0.04	0.07	-0.13	-0.22
Chloromethane	0.29	0.52	0.44	0.51	0.46	-0.18	0.24
Dichlorodifluoromethane	0.13	0.53	0.43	0.51	0.65	-0.13	0.18
Ethylbenzene	0.04	-0.03	0.00	-0.02	0.12	-0.14	-0.29
m-,p - Xylene	0.01	-0.04	-0.02	-0.03	0.13	-0.12	-0.29
Methyl Ethyl Ketone	0.53	0.09	0.27	0.16	-0.04	-0.22	0.18
Methylene Chloride	0.45	0.20	0.31	0.24	0.02	-0.48	0.01
o - Xylene	0.02	-0.01	0.01	0.01	0.16	-0.12	-0.30
Propylene	-0.30	-0.09	-0.12	-0.09	0.29	-0.06	-0.23
Toluene	0.19	0.01	0.08	0.04	0.08	-0.25	-0.29

Table 8-2e - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Yellow Freight, Michigan (YFMI)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.35	0.32	0.27	0.30	-0.05	-0.08	0.22
Acetone	-0.41	-0.28	-0.38	-0.31	0.00	-0.23	0.23
Acetylene	-0.02	-0.02	-0.07	-0.04	-0.05	0.03	-0.12
Benzene	0.10	0.24	0.16	0.22	0.05	0.14	0.71
Chloromethane	0.24	0.27	0.23	0.26	0.04	-0.18	-0.14
Dichlorodifluoromethane	0.24	0.16	0.25	0.20	0.13	-0.22	-0.05
Ethylbenzene	0.06	0.23	0.18	0.22	0.15	0.13	0.64
Formaldehyde	0.45	0.31	0.30	0.30	-0.17	-0.05	0.12
m-,p - Xylene	0.10	0.27	0.20	0.25	0.13	0.09	0.63
Methyl Ethyl Ketone	0.26	0.15	0.18	0.16	0.00	-0.32	0.32
Methylene Chloride	-0.29	-0.16	-0.22	-0.18	0.00	0.22	0.02
o - Xylene	0.12	0.29	0.22	0.27	0.14	0.04	0.59
Propylene	0.03	0.00	-0.07	-0.04	-0.19	0.30	-0.19
Toluene	0.11	0.27	0.20	0.25	0.12	0.08	0.70

Table 8-3. SVOC and Ozone Measured by the Michigan Monitoring Stations

Monitoring Station	Average SVOC Concentration	Average Ozone Concentrations from May-Aug	Total Number of Ozone Sampling Days
APMI	5.64 (±0.15) μg	54.63 ppbv	123
DEMI	6.76 (±0.70) μg	N/A	N/A
E7MI	7.15 (±0.98) μg	60.74 ppbv	123
LOMI	5.69 (±0.26) μg	N/A	N/A
RRMI	6.43 (±0.75) μg	N/A	N/A
SWMI	7.43 (±1.94) μg	N/A	N/A
YFMI	28.35 (±8.68) μg	N/A	N/A

Table 8-4. Motor Vehicle Information vs. Daily Concentration for Michigan Monitoring Sites

Monitoring Station	Population within Ten Miles	Estimated Number of Motor Vehicles Owned	Traffic Data (Daily Average)	Average Daily UATMP Concentration
APMI	1,033,740	764,968	60,000	145.23 (±161.92) ppbv
DEMI	1,241,008	918,346	12,791	25.66 (±2.88) ppbv
E7MI	1,154,868	854,602	6,999	N/A
LOMI	1,115,500	825,470	100,000	32.14 (±19.21) ppbv
RRMI	905,107	669,779	500	12.84 (±2.41) ppbv
SWMI	1,196,371	885,315	18,437	26.35 ppbv
YFMI	1,196,371	885,315	500	23.02 (±5.04) ppbv

9.0 Sites in Mississippi

This section focuses on a few specific meteorological and concentration trends for the four UATMP sites in Mississippi (GPMS, JAMS, PGMS, and TUMS). All four of these sites reside in different cities in Mississippi: Gulf Port; Jackson; Pascagoula; and Tupelo. Figures 9-1 through 9-4 are topographical maps showing the monitoring stations in their urban locations. Figures 9-5 through 9-8 are maps identifying facilities within ten miles of the sites and that reported to the 1999 NEI. The GPMS and PGMS sites are the furthest south, with both locations along the Gulf Coast. Further east is PGMS, where the majority of the industrial sites are located within a four mile radius of the monitoring station and are mostly chemical facilities. GPMS is further west along the Mississippi shoreline, and the few nearby industrial facilities, which are mainly comprised of utility companies, are mainly to the north. JAMS, somewhat centrally located, also has few sites nearby and these are located to the southwest of the site. The industrial facilities within a ten mile radius of TUMS, which is located in northeast Mississippi, are mainly to the east of the site. A large number of the facilities near the TUMS site are involved in rubber and plastic producing.

Hourly meteorological data were retrieved for all of 2001 at four weather stations near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The weather observations were reported from each of the four cities' reporting stations (WBAN 93874, 3940, 53858, and 93862, respectively).

Table 9-1 highlights the average UATMP concentration at each site, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), and wind information (average u- and v-components of the wind) for the entire year and on sampling days. Climatologically, all four of the Mississippi cities can be considered warm and humid. High temperatures and humidities, with relatively light winds can make the region very oppressive. Annual average wind direction for all of the sites tends to be from the east and east-southeast. This information can be found at the following web sites: http://www.ssec.org/idis/gates/States/physical/jackson.htm and http://www.ssec.org/idis/gates/States/physical/mobile.htm.

9.1 Meteorological and Concentration Averages at the Mississippi Sites

Carbonyl compounds and VOC (volatile organic compounds) were measured at all of the sites, as indicated in Tables 3-3 and 3-4. JAMS and PGMS each sampled hydrocarbon compounds' geometric means was more than double that of the other sites (18.21 ppbv and 18.84 ppbv, respectively). Each of these two site hydrocarbon geometric mean was also more than triple their other compound type geometric means. GPMS had the highest geometric means for carbonyl and polar compounds. However, the ranges on these two compound types had the smallest variation among all of the sites. The average total UATMP daily concentration at TUMS was the lowest in comparison to the other three sites and was computed to be 24.17 (±8.19) ppbv. JAMS had the highest value of 40.99 (±13.66) ppbv, while the other sites' average daily concentration fell into the thirties. Table 9-1 also lists the averages for selected meteorological parameters from January 2001 to December 2001, which is similar to the time period covered in this report.

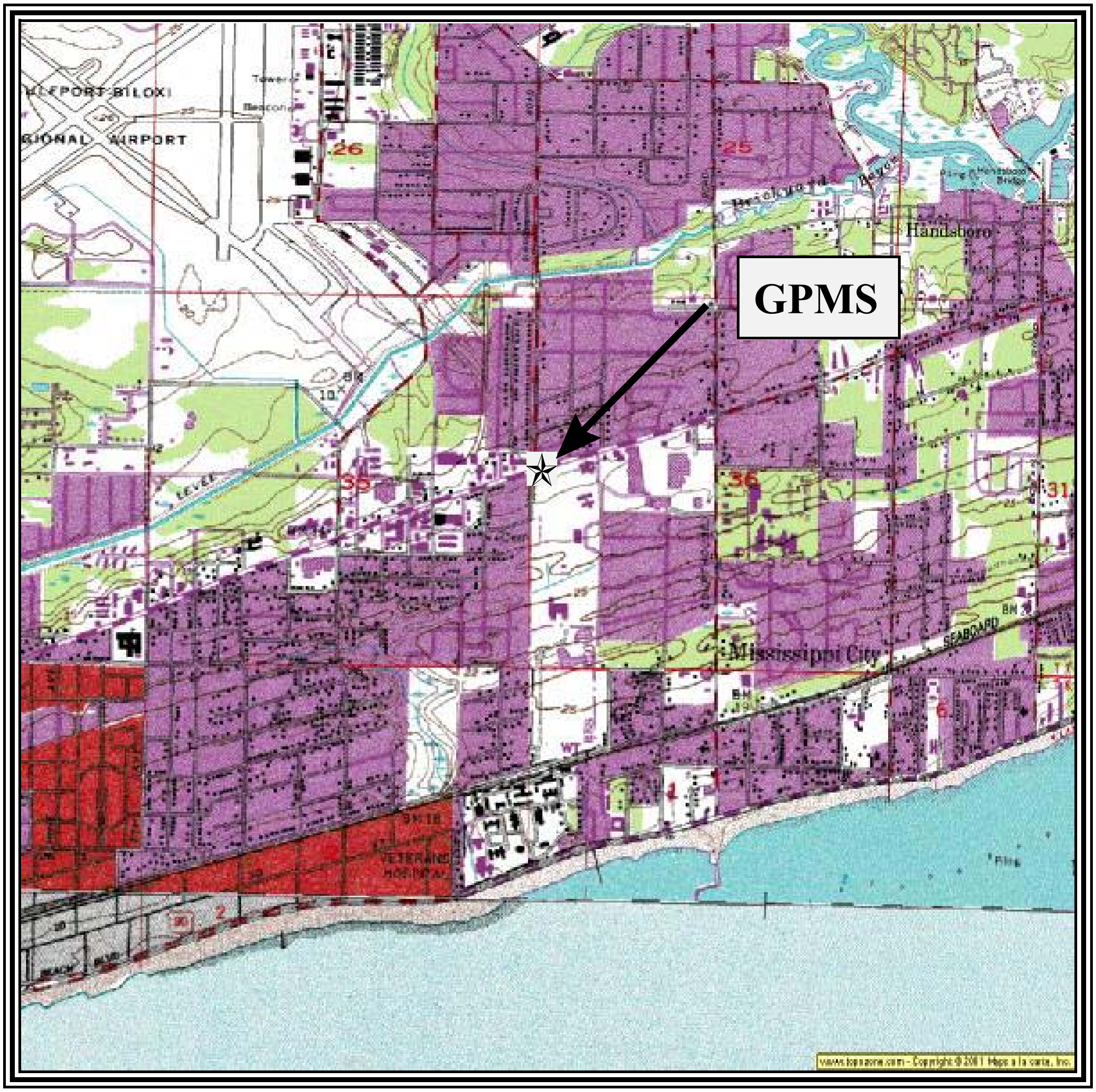
Tables 9-2a-d are the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters by site. Identification of the prevalent compounds is discussed in Section 3 of this report. Acetone generally had strong (between 0.50 and 0.75 or -0.50 and -0.75) to moderately strong (between 0.25 and 0.50 or -0.25 and -0.50) negative correlations with the majority of the weather parameters, especially the temperature and moisture variables, at each site. One of the strongest correlations indicated across all of the sites in the entire UATMP was acetone's very strong (between 0.75 and 1 or -0.75 and -1) negative correlation with maximum temperature at the PGMS site (-0.81). Acetone concentrations generally increase with decreasing maximum temperature. Several different compounds had strong to moderately strong positive correlations with average maximum temperature at three sites, with the exception of the TUMS site, whose compounds tended to have an opposite correlation with maximum temperature. Also at the TUMS site, all of the compounds had a positive correlation with relative humidity. At GPMS, JAMS, and PGMS, a few compounds at each site had strong correlations with the temperature and moisture variables. Nearly half of the compounds at the GPMS site had at least a moderately strong positive correlation with at least one component of the wind, if not two.

9.2 Spatial Analysis

Using the population within ten miles of each site, an estimate of the number of motor vehicles operating in proximity to the monitoring station can be established. The ratio used in this report is 0.74 motor vehicles to every one person (refer to section 3.4.1 for more information on this ratio). The population near the JAMS site is 265,530 people, all of whom are operating approximately 196,492 vehicles. This site had the largest population (and most motor vehicles) of the four Mississippi sites. The site with the lowest population was PGMS, with a population of 59,236 people driving 43,835 motor vehicles. This information is compared to the average daily concentration of the prevalent compounds at each Mississippi site in Table 9-3. Also included in Table 9-3 are average daily traffic data, or more specifically, the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis.

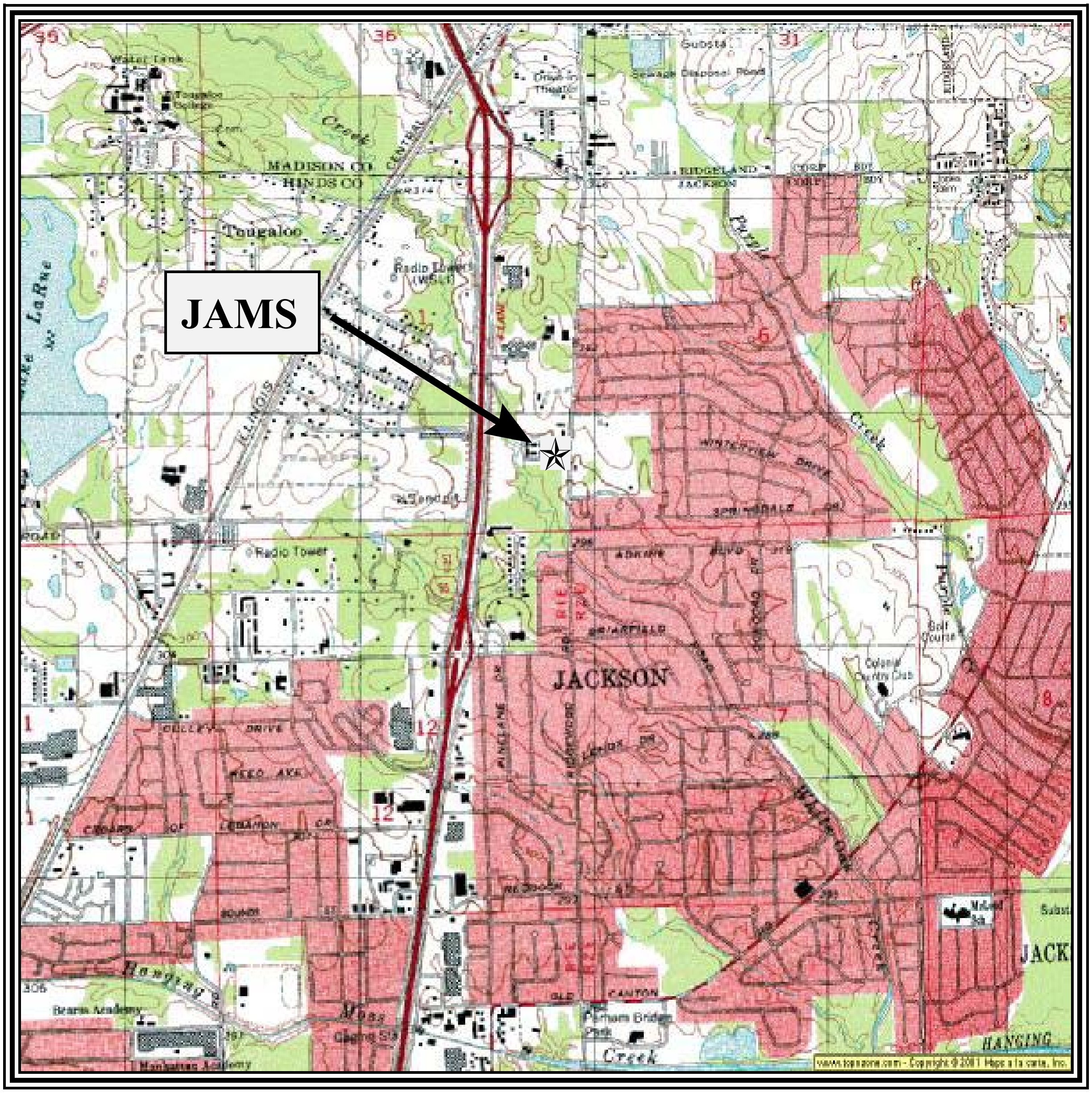
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area. (For more information on this study, refer to section 3.4.2.) Figure 3-16 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. The TUMS and GPMS sites's concentration ratios resembled that of the roadside study, although GPMS's toluene-ethylbenzene ratio was considerably higher. At the JAMS site, the concentration ratio that was the highest was *m-,p*-xylene-ethylbenzene, as opposed to the toluene-ethylbenzene ratio of the roadside study. The benzene-ethylbenzene concentration ratio was higher than the *m-,p*-xylene-ethylbenzene ratio at the LOMI site, which also differed from that of the roadside study.

Figure 9-1. Gulf Port, Mississippi (GPMS) Monitoring Station



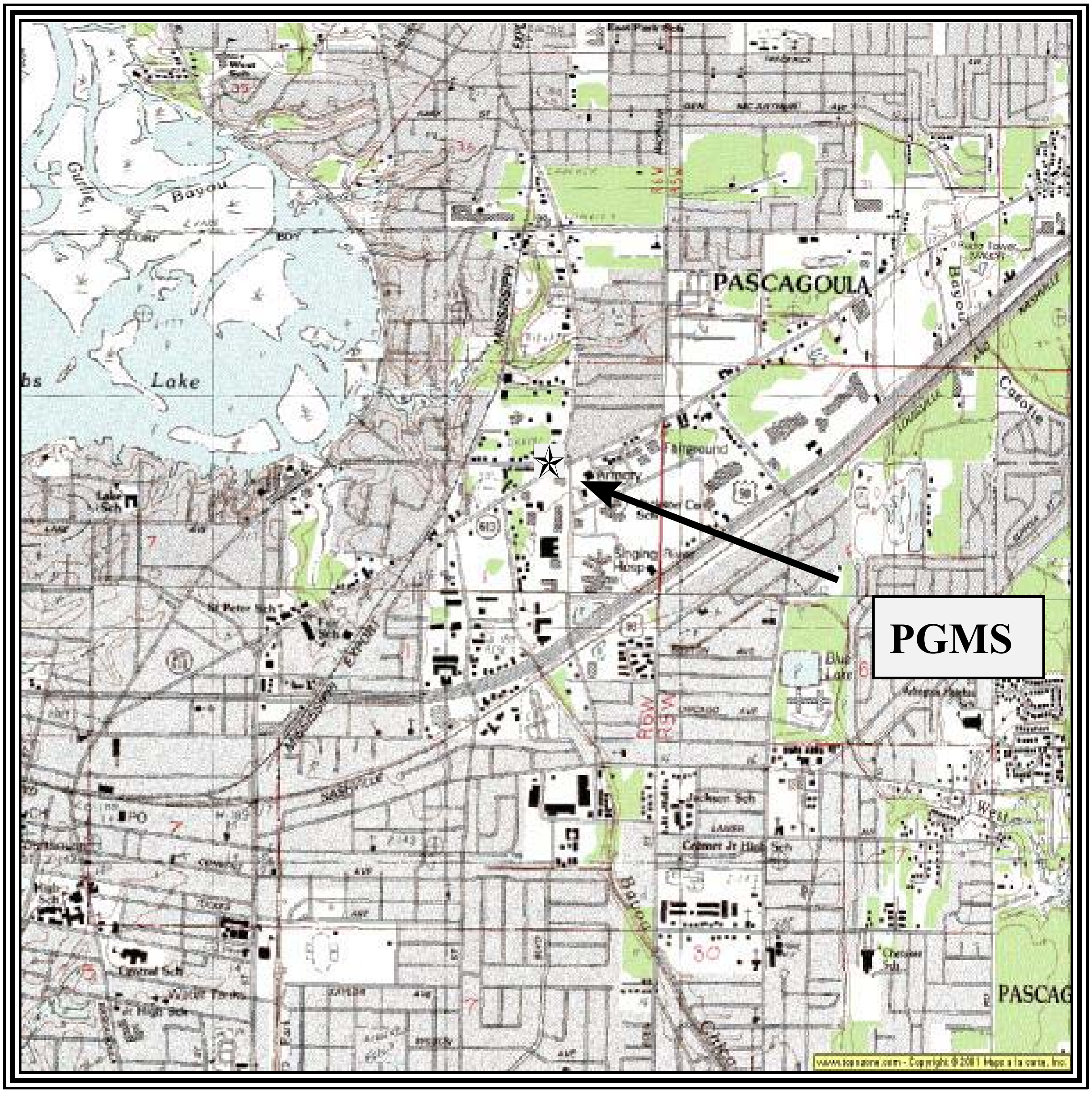
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 9-2. Jackson, Mississippi (JAMS) Monitoring Station



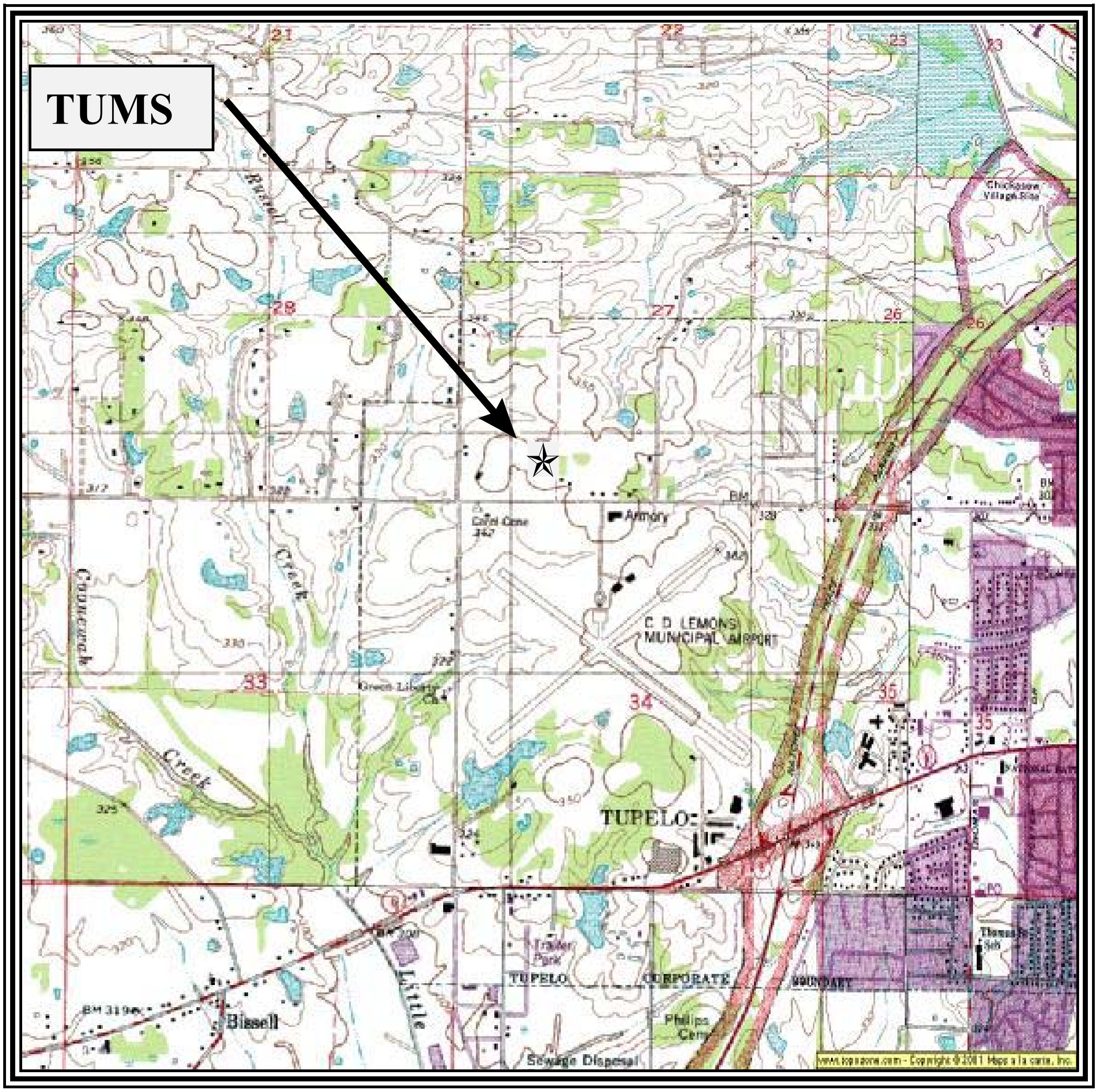
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 9-3. Pascagoula, Mississippi (PGMS) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 9-4. Tupelo, Mississippi (TUMS) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 9-5. Facilities Located Within 10 Miles of GPMS

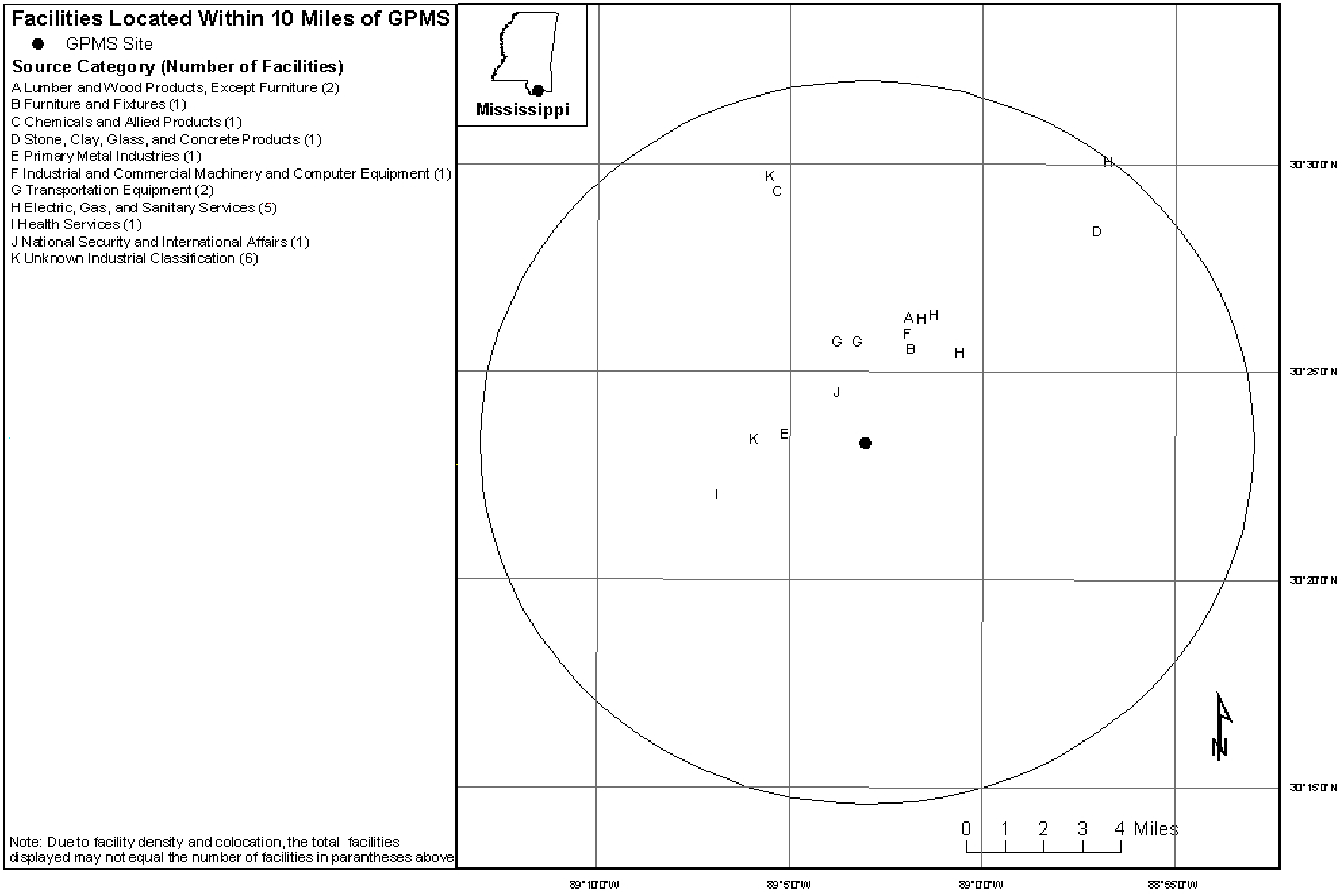


Figure 9-6. Facilities Located Within 10 Miles of JAMS

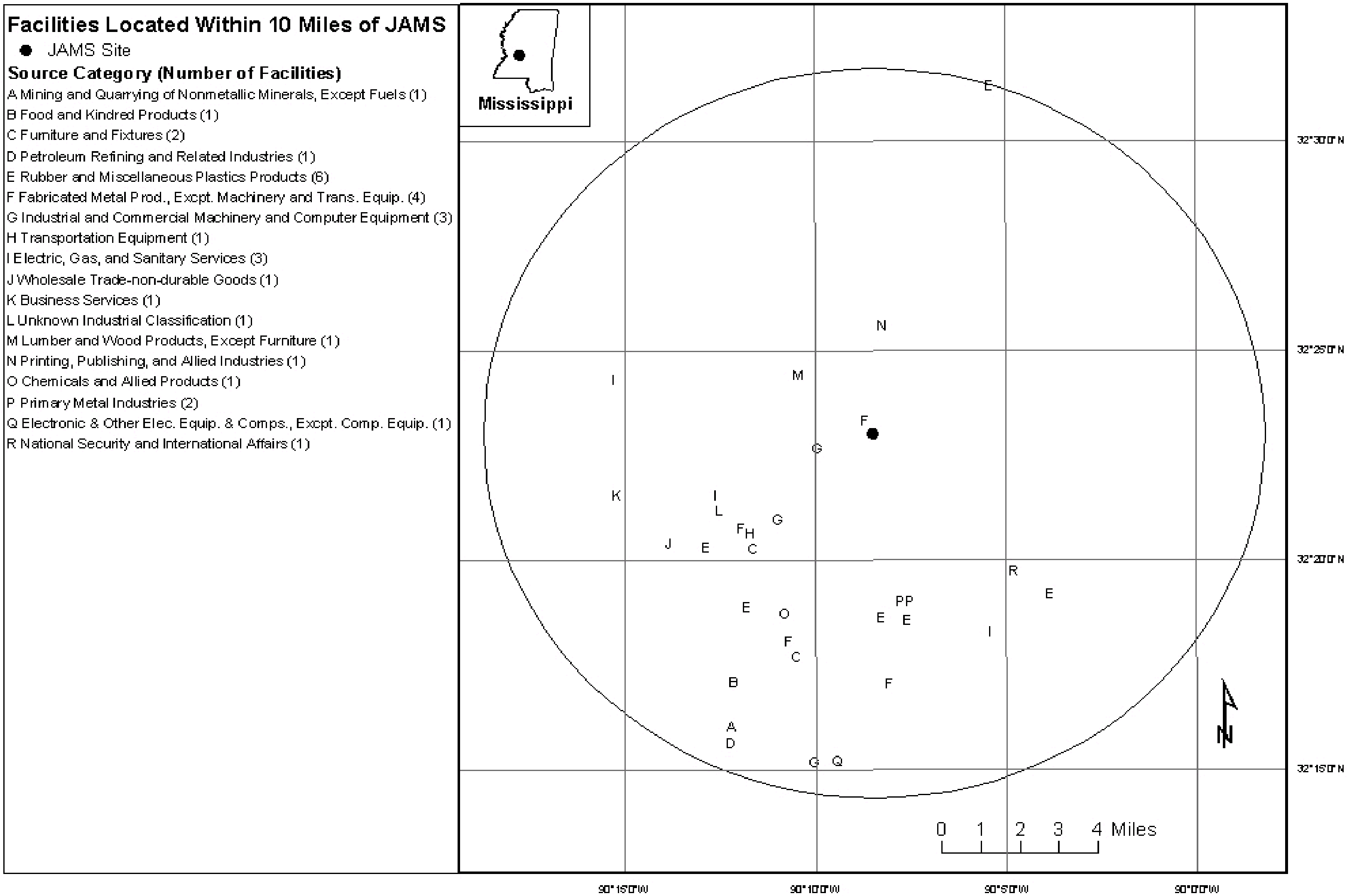


Figure 9-7. Facilities Located Within 10 Miles of PGMS

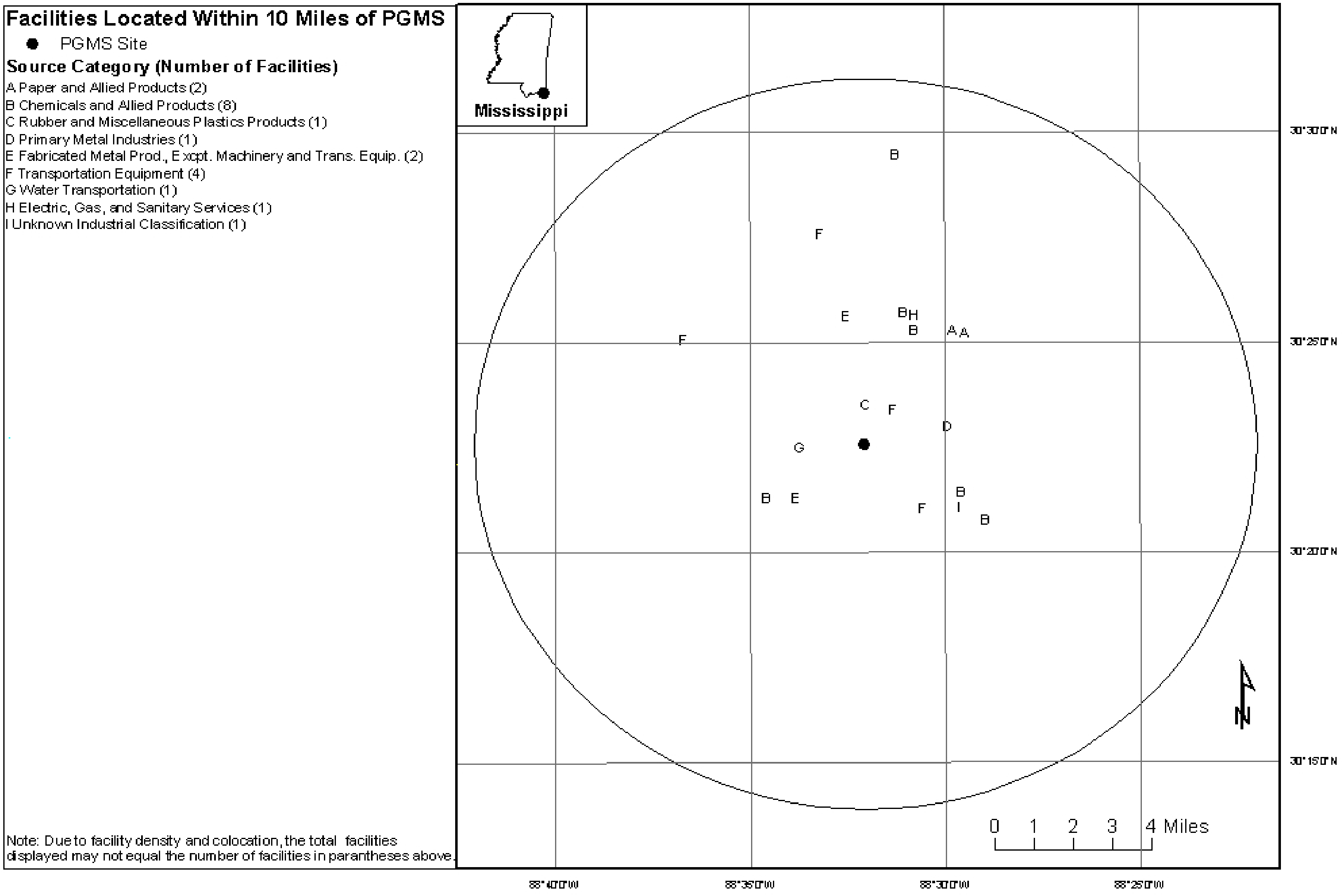


Figure 9-8. Facilities Located Within 10 Miles of TUMS

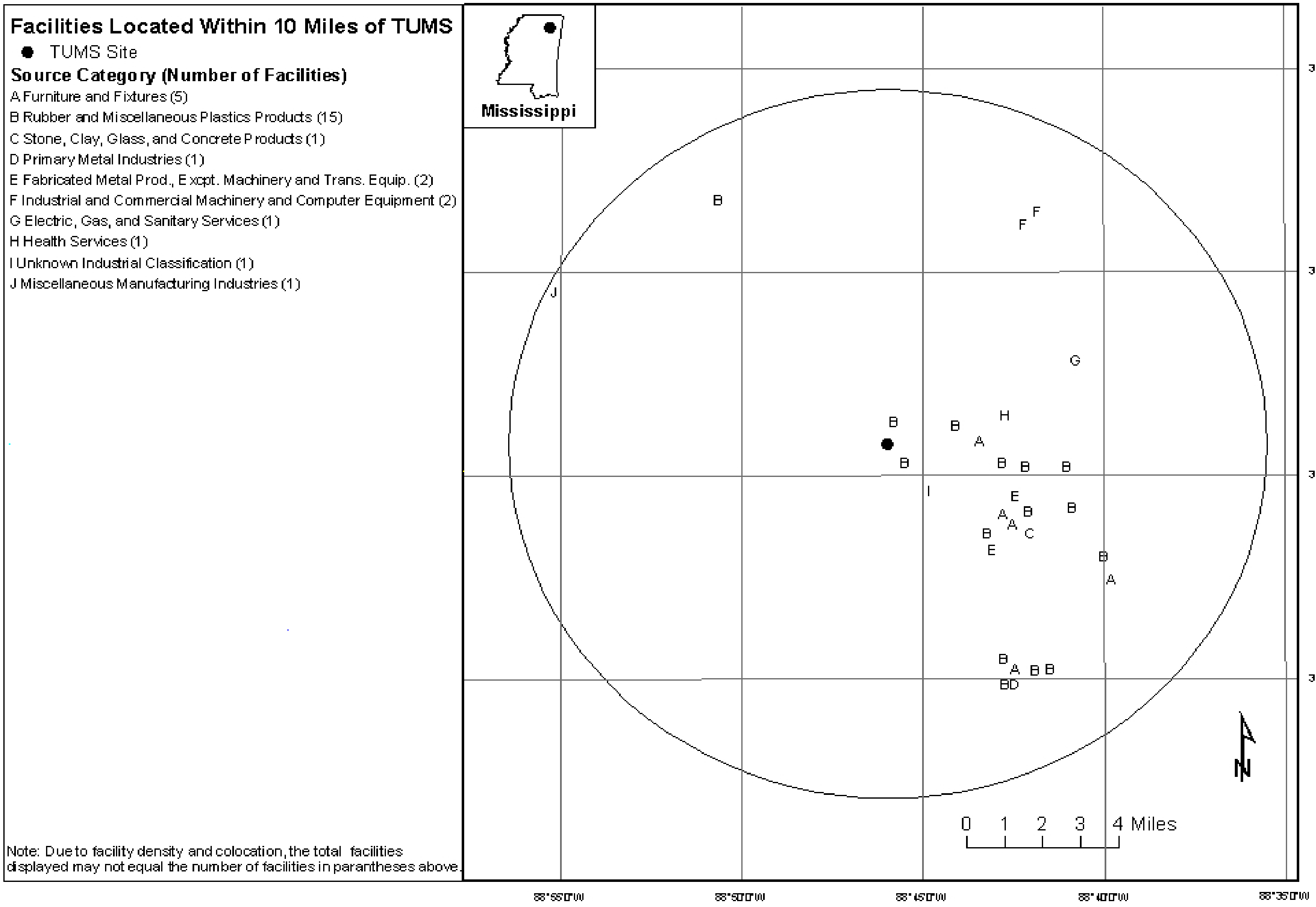


Table 9-1. Average Concentration and Meteorological Parameters for Sites in Mississippi

Site Name	Type	Average UATMP Concentration (ppbv)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
GPMS	All 2001	[redacted]	76.72 (±1.17)	57.20 (±1.47)	49.66 (±1.38)	52.58 (±1.34)	64.32 (±1.21)	-1.05 (±0.31)	0.18 (±0.43)
	sample day	34.98 (±20.21)	80.64 (±5.99)	63.98 (±6.59)	55.43 (±7.30)	58.59 (±6.76)	70.27 (±4.58)	-0.67 (±0.80)	-2.10 (±1.60)
JAMS	All 2001	[redacted]	76.27 (±1.42)	54.33 (±1.63)	46.31 (±1.49)	49.76 (±1.47)	62.62 (±1.29)	-0.61 (±0.22)	0.12 (±0.38)
	sample day	40.99 (±13.66)	82.60 (±4.13)	60.76 (±5.96)	51.89 (±5.42)	55.44 (±5.35)	62.38 (±7.65)	-0.82 (±0.66)	-0.37 (±1.49)
PGMS	All 2001	[redacted]	78.93 (±1.17)	49.45 (±1.50)	43.41 (±1.37)	45.56 (±1.40)	58.18 (±1.52)	-0.93 (±0.25)	-0.19 (±0.32)
	sample day	31.33 (±8.26)	83.53 (±4.63)	55.28 (±7.23)	48.64 (±6.83)	50.65 (±6.99)	62.38 (±7.65)	-0.59 (±0.99)	-1.15 (±0.97)
TUMS	All 2001	[redacted]	73.25 (±1.64)	53.01 (±1.68)	43.95 (±1.53)	48.05 (±1.50)	60.95 (±1.27)	-0.25 (±0.24)	0.13 (±0.47)
	sample day	24.17 (±8.19)	79.87 (±5.70)	59.14 (±6.05)	50.31 (±5.69)	53.93 (±5.47)	65.11 (±5.11)	-0.51 (±0.90)	-1.03 (±2.00)

Table 9-2a - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Gulf Port, Mississippi (GPMS)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.01	0.03	-0.09	-0.02	-0.22	-0.05	0.13
Acetone	-0.47	-0.53	-0.64	-0.58	-0.34	-0.14	0.00
Acetylene	-0.25	-0.45	-0.45	-0.43	-0.25	0.05	0.29
Benzene	-0.14	-0.37	-0.32	-0.32	-0.22	0.13	0.38
Chloromethane	0.10	-0.10	0.06	-0.03	0.04	0.28	0.03
Dichlorodifluoromethane	-0.22	-0.26	-0.29	-0.28	-0.38	0.03	-0.38
Ethylbenzene	0.62	0.16	0.29	0.25	0.16	0.61	0.44
Formaldehyde	0.62	0.57	0.58	0.58	0.18	0.22	0.01
m-,p - Xylene	0.61	0.10	0.25	0.20	0.10	0.66	0.38
Methyl Ethyl Ketone	-0.13	-0.28	-0.22	-0.23	-0.07	0.00	0.15
Methylene Chloride	0.25	-0.12	-0.04	-0.06	0.01	0.33	0.47
o - Xylene	0.36	-0.18	-0.03	-0.09	-0.12	0.66	0.32
Propylene	-0.24	-0.47	-0.42	-0.42	-0.25	0.07	0.24
Toluene	0.61	0.39	0.44	0.43	0.18	0.42	0.42

Table 9-2b - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Jackson, Mississippi (JAMS)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	-0.07	0.02	-0.12	-0.05	-0.08	-0.03	0.12
Acetone	-0.48	-0.44	-0.59	-0.51	-0.20	-0.02	0.09
Acetylene	-0.28	-0.16	-0.22	-0.19	0.32	0.11	-0.04
Benzene	-0.15	0.05	-0.02	0.03	0.51	0.15	0.04
Chloromethane	0.29	0.03	0.14	0.08	0.01	-0.55	0.11
Dichlorodifluoromethane	0.08	0.18	0.15	0.16	0.15	-0.40	-0.05
Ethylbenzene	0.43	0.03	0.09	0.04	-0.47	-0.18	0.25
Formaldehyde	0.32	0.53	0.43	0.48	0.16	-0.01	0.13
m-,p - Xylene	0.46	0.05	0.12	0.06	-0.46	-0.18	0.24
Methyl Ethyl Ketone	0.36	0.54	0.63	0.59	0.54	-0.07	-0.08
Methylene Chloride	-0.05	0.15	0.18	0.18	0.44	0.15	-0.22
o - Xylene	0.44	-0.11	0.02	-0.07	-0.41	-0.46	0.19
Propylene	-0.16	0.03	-0.06	0.00	0.49	0.09	-0.02
Toluene	0.31	-0.04	0.03	-0.02	-0.42	-0.15	0.27

Table 9-2c - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Pascagoula, Mississippi (PGMS)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	-0.30	-0.28	-0.31	-0.31	-0.11	0.23	-0.17
Acetone	-0.81	-0.35	-0.50	-0.36	0.10	0.18	-0.34
Acetylene	-0.07	-0.14	-0.23	-0.18	0.01	0.16	0.21
Benzene	0.05	-0.03	-0.09	-0.07	0.08	0.11	0.33
Chloromethane	0.40	0.49	0.58	0.51	0.31	0.13	0.15
Dichlorodifluoromethane	0.08	0.63	0.55	0.58	0.47	-0.03	-0.34
Ethylbenzene	0.40	0.38	0.50	0.39	0.13	0.11	0.28
Formaldehyde	-0.04	-0.13	-0.10	-0.17	-0.15	0.23	-0.16
m-,p - Xylene	0.37	0.38	0.49	0.39	0.14	0.11	0.26
Methyl Ethyl Ketone	0.62	0.01	0.13	0.04	-0.19	-0.05	0.22
Methylene Chloride	0.24	0.12	0.09	0.13	0.15	0.11	0.06
o - Xylene	0.35	0.40	0.51	0.42	0.18	0.10	0.26
Propylene	-0.01	-0.02	-0.09	-0.03	0.17	0.12	0.23
Toluene	0.42	0.30	0.41	0.30	0.08	0.13	0.37

Table 9-2d - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Tupelo, Mississippi (TUMS)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	-0.28	0.03	0.05	0.05	0.30	0.16	0.13
Acetone	-0.44	-0.36	-0.32	-0.34	0.18	0.02	0.17
Acetylene	-0.23	-0.22	-0.13	-0.18	0.24	0.13	0.50
Benzene	-0.26	-0.24	-0.16	-0.20	0.20	0.14	0.45
Chloromethane	-0.22	0.21	0.21	0.23	0.32	0.19	-0.07
Dichlorodifluoromethane	-0.39	0.11	0.08	0.11	0.41	0.21	-0.16
Ethylbenzene	0.00	0.35	0.29	0.33	0.22	-0.13	-0.15
Formaldehyde	0.00	0.42	0.37	0.42	0.17	0.37	-0.03
m-,p - Xylene	0.00	0.35	0.29	0.34	0.22	-0.12	-0.15
Methyl Ethyl Ketone	-0.26	-0.02	0.00	0.00	0.26	0.01	-0.04
Methylene Chloride	-0.06	0.20	0.23	0.23	0.45	0.23	0.28
o - Xylene	0.01	0.36	0.30	0.34	0.21	-0.12	-0.14
Propylene	-0.31	-0.33	-0.24	-0.29	0.21	0.06	0.40
Toluene	-0.01	0.35	0.29	0.33	0.24	-0.11	-0.12

Table 9-3. Motor Vehicle Information vs. Daily Concentration for Mississippi Monitoring Sites

Monitoring Station	Population within Ten Miles	Estimated Number of Motor Vehicles Owned	Traffic Data (Daily Average)	Average Daily UATMP Concentration
GPMS	177,534	131,375	17,000	34.98 (±20.21) ppbv
JAMS	265,530	196,492	12,500	40.99 (±13.66) ppbv
PGMS	59,236	43,835	8,600	31.33 (±8.26) ppbv
TUMS	70,981	52,526	4,900	24.17 (±8.19) ppbv

10.0 Sites in Missouri

This section focuses on a few specific meteorological and concentration trends for the three UATMP sites in Missouri (S2MO, S3MO, and SLMO). All three of these sites reside in the St. Louis metropolitan statistical area. Figures 10-1 through 10-3 are topographical maps showing the monitoring stations in their urban locations. Figure 10-4 is a map identifying facilities within ten miles of the sites that reported to the 1999 NEI. Many of these facilities are classified as unknown industries. A large number of chemical producing industries are also located near the sites.

Hourly meteorological data were retrieved for all of 2001 at a weather station near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The weather station is Cahokia-St. Louis (WBAN 3960).

Table 10-1 highlights the average UATMP concentration at each of these sites, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), and wind information (average u- and v- components of the wind) for the entire year and on sampling days. St. Louis has a climate that is continental in nature, with cold, rather dry winters, warm, somewhat wetter summers, and a significant seasonal variability. Wind speeds are generally light and wind flows from the southwest on average. This information can be found at the following web site: http://www.ssec.org/idis/gates/States/physical/stlouis.htm.

10.1 Meteorological and Concentration Averages at the Missouri Sites

Carbonyl compounds were not measured at two of the sites, but were measured at SLMO, as indicated in Tables 3-3 and 3-4. All three sites' geometric means for halogenated hydrocarbons and polar compounds were relatively close to each other, reporting values of 3.33 ppbv and 2.38 ppbv (S2MO), 3.30 ppbv and 2.31 ppbv (S2MO), and 3.83 ppbv and 2.53 ppbv (SLMO). Hydrocarbon compounds had more variability, due to SLMO's geometric mean of 11.63 ppbv, more than twice the other two sites' geometric means. The average total UATMP daily concentration at SLMO was over triple the concentration of the other two sites (47.14

±19.41 ppbv vs. 13.43 ±2.87 and 13.41 ±3.00 ppbv). Table 10-1 also lists the averages for selected meteorological parameters from January 2001 to December 2001, which is similar to the time period covered in this report.

SLMO also opted to have total and SNMOC and SVOC sampled during its air toxic sampling. SNMOC/NMOC compounds are of particular interest because of their role in ozone formation. Readers are encouraged to review EPA's *2001 Nonmethane Organic Compounds (NMOC) and Speciated Nonmethane Organic Compounds (SNMOC) Monitoring Program, Final Report* (EPA, 2002) for more information on SNMOC/NMOC trends and concentrations. The average total NMOC value for SLMO was 313 (±37.91) ppbC, of which nearly 56% could be identified through speciation. Of the speciated compounds, *m-,p*-xylene measured the highest concentration at the SLMO site (18.33 ppbC). Typical sources of *m-,p*-xylene include evaporative losses, spills, and leaks from petroleum refining, coal tar production, solvents, and losses of during gasoling transport and storage. SVOC concentrations at the SLMO site averaged 5.90 (±0.25) ppbv. This information is given in Table 10-3.

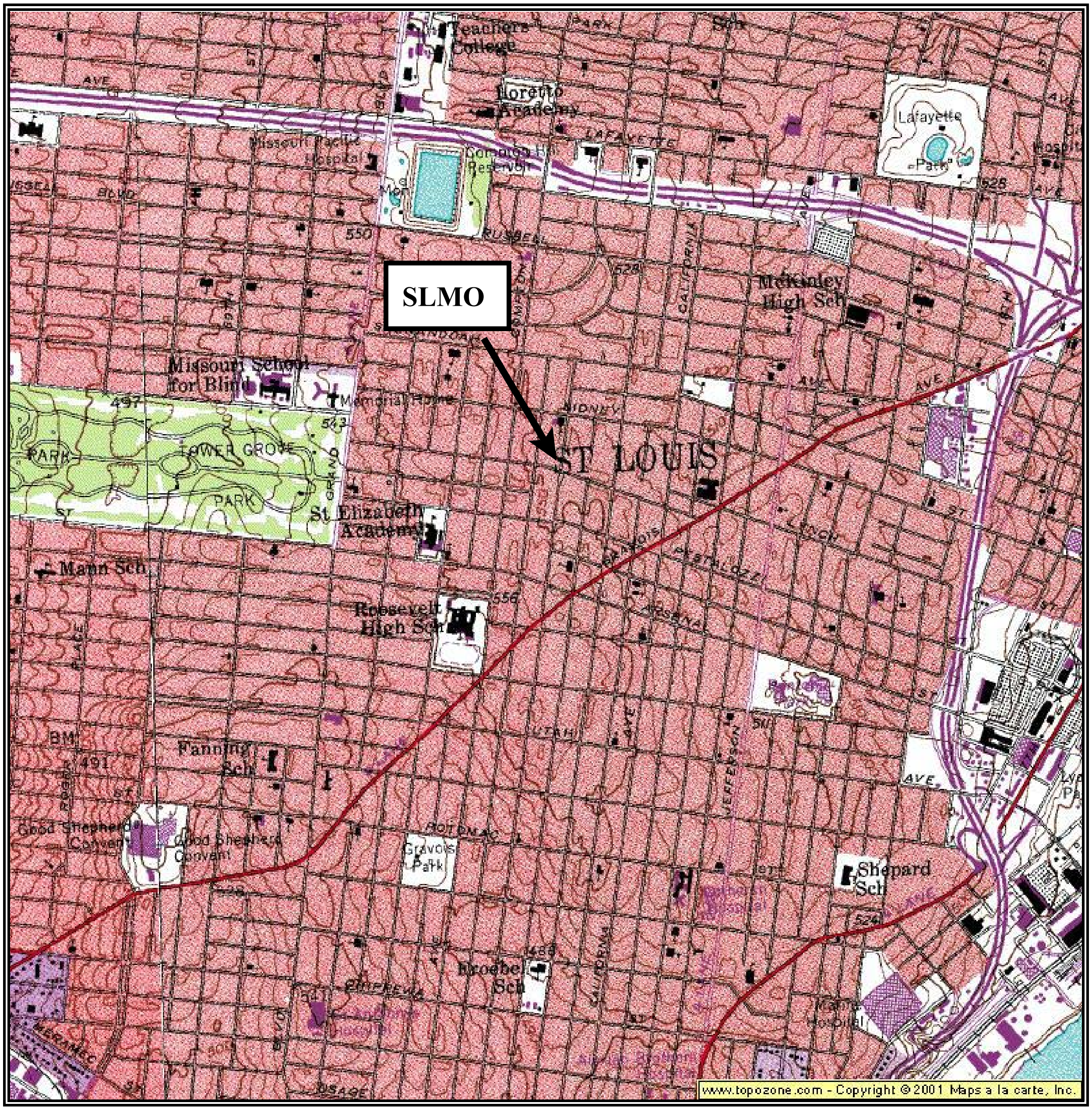
Tables 10-2a-c are the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters by site. Identification of the prevalent compounds is discussed in Section 3 of this report. At SLMO, where carbonyls were measured as well as the hydrocarbons, both acetaldehyde and acetone showed strong (between 0.50 and 0.75 or -0.50 and -0.75) negative correlations with average maximum temperature, and moderately strong (between 0.25 and 0.50 or -0.25 and -0.50) negative correlations with average temperature, dew point and wet bulb temperature. As temperature and moisture content increase, carbonyl concentrations at SLMO decrease. A large number of the VOC showed a negative correlation with the four previously mentioned weather parameters, with strengths ranging from weak (between 0 and 0.25 or 0 and -0.25) to strong at the S2MO and S3MO sites, but this trend wasn't consistent at the SLMO site. In fact, very few correlations reached the moderately strong category (greater than 0.25 or less than -0.25) at the SLMO site.

10.2 Spatial Analysis

Using the population within ten miles of each site, an estimate of the number of motor vehicles operating in proximity to the monitoring station can be established. The ratio used in this report is 0.74 motor vehicles to every one person (refer to section 3.4.1 for more information on this ratio). The population near the S2MO and SLMO sites is 807,997 people, all of whom are operating approximately 597,918 motor vehicles. The S3MO site is populated with 725,662 people driving 536,990 motor vehicles. This information is compared to the average daily concentration of the prevalent compounds at each Missouri site in Table 10-3. Also included in Table 10-3 are average daily traffic data, or more specifically, the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis.

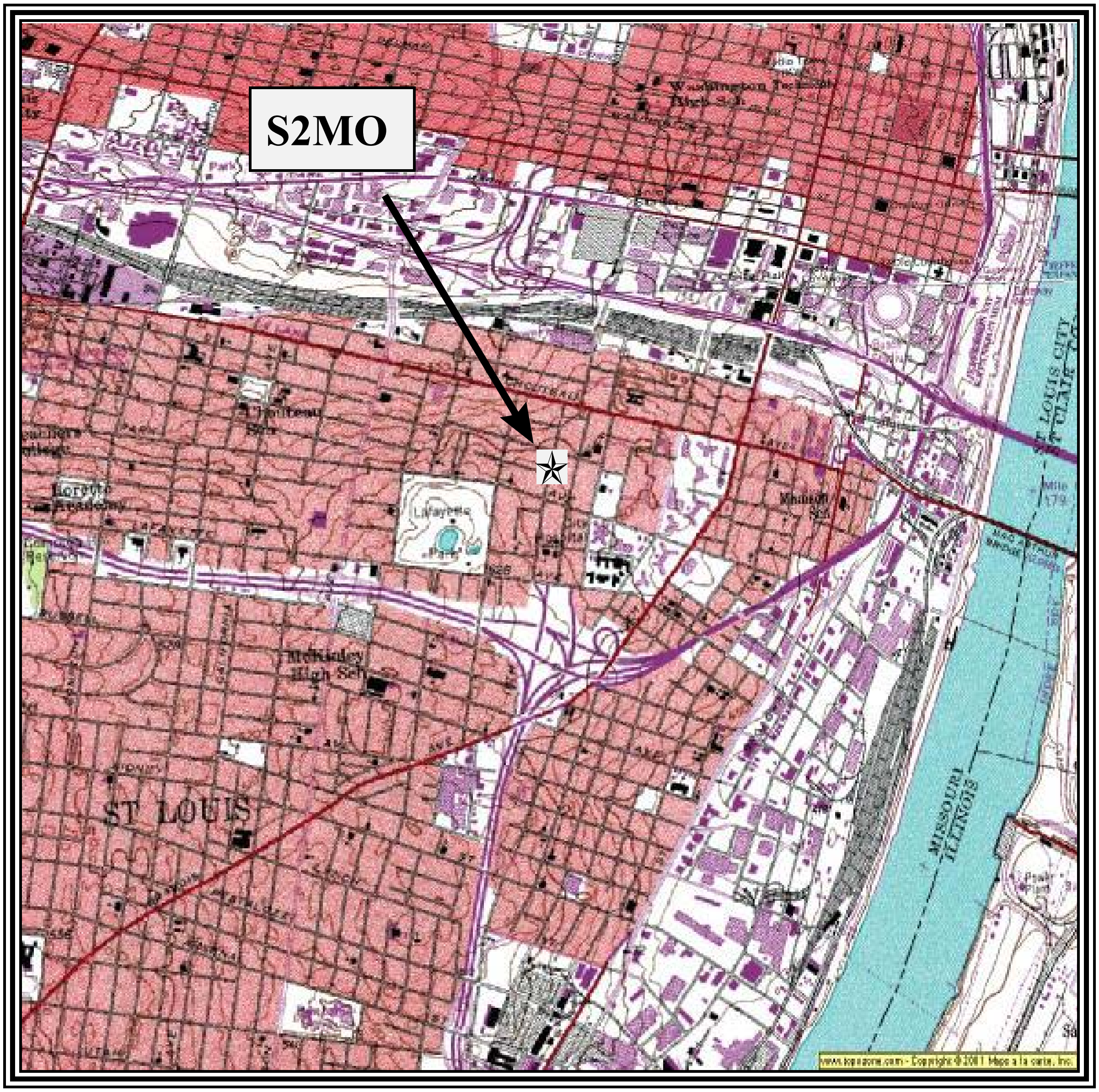
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area. (For more information on this study, refer to section 3.4.2.) Figure 3-16 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. S2MO and S3MO's concentration ratios looked relatively similar to the roadside study, with the exception of the *m-,p*-xylene-ethylbenzene ratio being lower than the benzene-ethylbenzene ratio at the two sites. The toluene-ethylbenzene ratio and the *m-,p*-xylene-ethylbenzene ratio are almost the same value at the SLMO site, which is different than the roadside study as well.

Figure 10-1. St. Louis, Missouri (SLMO) Monitoring Station



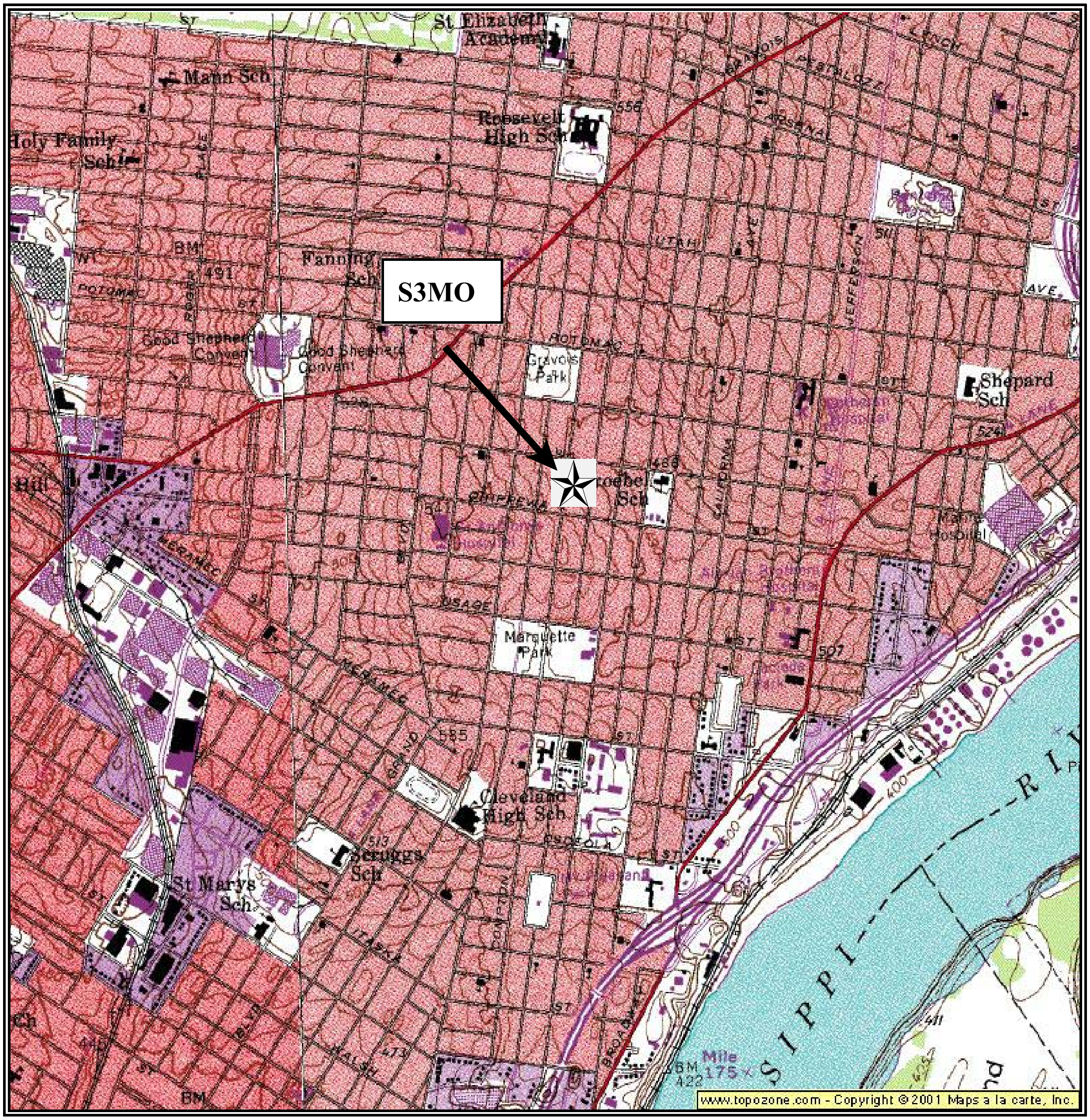
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 10-2. St. Louis, Missouri (S2MO) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 10-3. St. Louis, Missouri (S3MO) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 10-4. Facilities Located Within 10 Miles of S2MO, S3MO, and SLMO

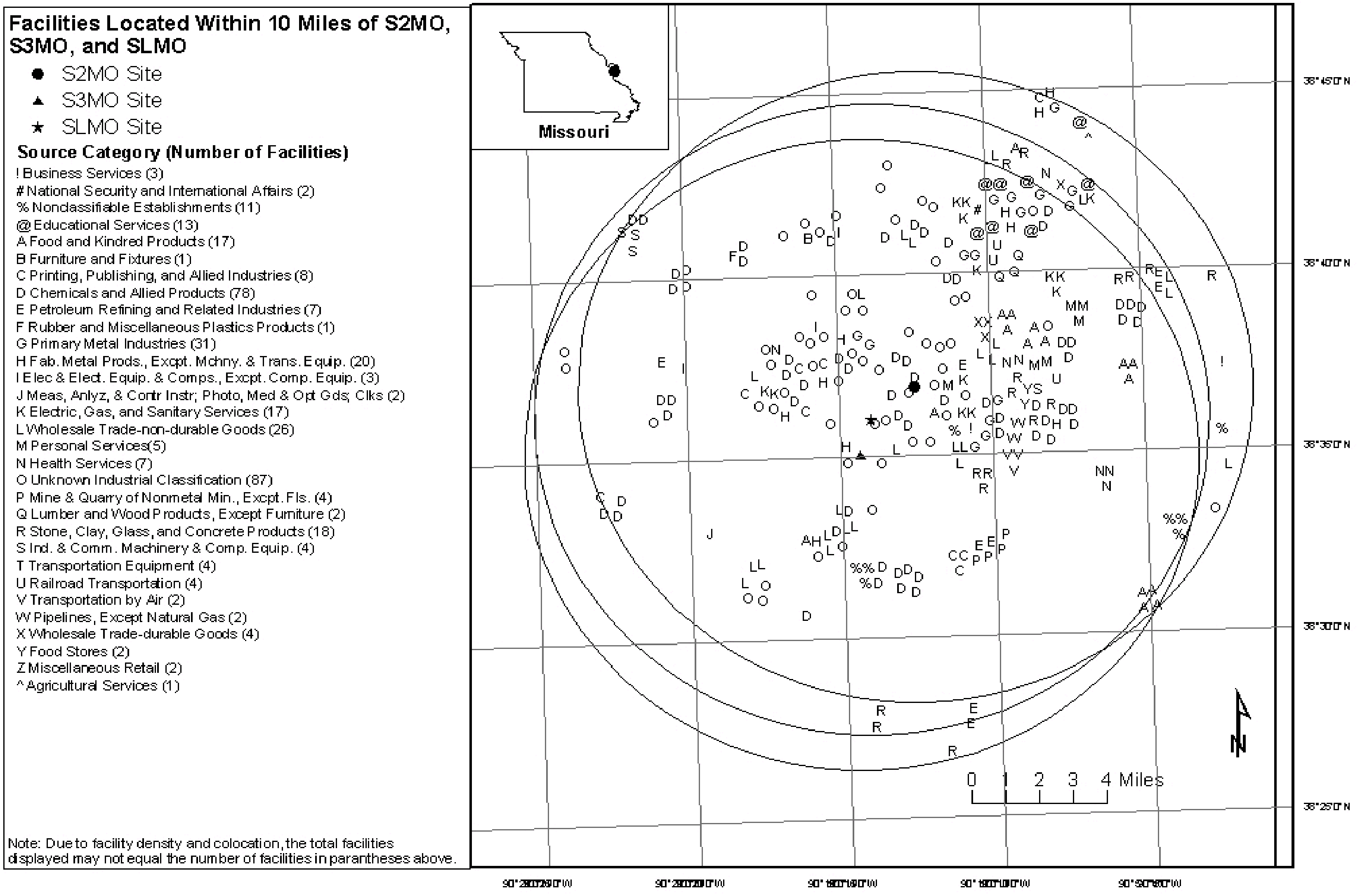


Table 10-1. Average Concentration and Meteorological Parameters for Sites in Missouri

Site Name	Type	Average UATMP Concentration (ppbv)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
S2MO	All 2001	[redacted]	69.47 (±1.98)	49.42 (±1.84)	41.26 (±1.65)	45.03 (±1.64)	62.02 (±1.23)	0.39 (±0.37)	0.58 (±0.42)
	sample day	13.43 (±2.87)	78.00 (±3.65)	55.75 (±5.10)	48.24 (±4.28)	51.26 (±4.44)	63.37 (±3.20)	-0.43 (±0.83)	1.07 (±0.99)
S3MO	All 2001	[redacted]	69.47 (±1.98)	49.42 (±1.84)	41.26 (±1.65)	45.03 (±1.64)	62.02 (±1.23)	0.39 (±0.37)	0.58 (±0.42)
	sample day	13.41 (±3.00)	79.35 (±3.88)	55.86 (±5.65)	48.58 (±4.65)	51.40 (±4.90)	61.42 (±3.80)	-0.57 (±0.88)	1.29 (±0.90)
SLMO	All 2001	[redacted]	69.47 (±1.98)	49.42 (±1.84)	41.26 (±1.65)	45.03 (±1.64)	62.02 (±1.23)	0.39 (±0.37)	0.58 (±0.42)
	sample day	47.14 (±19.41)	78.09 (±3.69)	54.58 (±5.04)	47.18 (±4.17)	50.16 (±4.36)	61.97 (±3.53)	-0.47 (±0.84)	1.15 (±0.99)

Table 10-2a - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at St. Louis, Missouri Site 2 (S2MO)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetylene	-0.41	-0.46	-0.49	-0.48	-0.27	0.43	-0.22
Benzene	-0.17	-0.13	-0.15	-0.14	0.19	-0.08	-0.12
Chloromethane	0.32	0.24	0.27	0.26	0.11	-0.03	-0.13
Dichlorodifluoromethane	0.18	0.04	0.05	0.04	0.00	-0.05	-0.17
Ethylbenzene	-0.12	-0.27	-0.28	-0.28	-0.07	0.09	-0.14
m-,p - Xylene	-0.17	-0.29	-0.31	-0.30	-0.07	0.11	-0.13
Methyl Ethyl Ketone	-0.19	-0.27	-0.26	-0.27	-0.10	0.44	-0.17
Methylene Chloride	0.16	0.19	0.17	0.18	0.02	-0.28	0.08
o - Xylene	-0.17	-0.23	-0.25	-0.25	0.00	0.09	-0.12
Propylene	-0.21	-0.25	-0.29	-0.27	0.02	0.09	-0.06
Toluene	0.05	-0.10	-0.09	-0.10	0.00	-0.04	-0.21

Table 10-2b - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at St. Louis, Missouri Site 3 (S3MO)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetylene	-0.40	-0.44	-0.47	-0.46	-0.16	0.14	-0.13
Benzene	-0.23	-0.35	-0.35	-0.35	-0.13	0.06	-0.30
Chloromethane	0.44	0.04	0.09	0.05	-0.24	-0.04	0.03
Dichlorodifluoromethane	0.03	-0.05	-0.04	-0.05	0.04	0.12	-0.24
Ethylbenzene	-0.21	-0.39	-0.40	-0.40	-0.24	0.17	-0.24
m-,p - Xylene	-0.25	-0.42	-0.43	-0.43	-0.25	0.19	-0.21
Methyl Ethyl Ketone	0.23	-0.01	-0.01	-0.02	-0.21	-0.05	-0.04
Methylene Chloride	0.00	-0.24	-0.26	-0.26	-0.30	0.08	-0.02
o - Xylene	-0.26	-0.41	-0.42	-0.42	-0.23	0.18	-0.21
Propylene	-0.24	-0.36	-0.38	-0.38	-0.17	0.13	-0.27
Toluene	-0.15	-0.40	-0.41	-0.42	-0.34	0.11	-0.14

Table 10-2c - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at St. Louis, Missouri Site 1 (SLMO)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	-0.65	-0.29	-0.38	-0.32	0.18	0.25	0.05
Acetone	-0.74	-0.27	-0.35	-0.30	0.23	0.24	0.08
Acetylene	-0.24	-0.16	-0.20	-0.18	0.09	-0.04	0.11
Benzene	-0.15	-0.16	-0.18	-0.17	0.10	-0.15	0.04
Chloromethane	0.23	0.22	0.18	0.20	-0.15	0.13	0.02
Dichlorodifluoromethane	0.11	-0.08	-0.06	-0.08	-0.13	-0.01	-0.14
Ethylbenzene	0.13	0.06	0.07	0.06	-0.33	-0.13	0.08
Formaldehyde	-0.38	-0.17	-0.21	-0.19	0.08	0.19	-0.06
m-,p - Xylene	0.17	0.11	0.13	0.11	-0.30	-0.15	0.07
Methyl Ethyl Ketone	0.24	0.29	0.33	0.31	0.12	-0.19	-0.05
Methylene Chloride	-0.24	-0.16	-0.14	-0.15	-0.13	0.29	0.18
o - Xylene	0.06	0.01	0.00	-0.01	-0.28	-0.17	0.13
Propylene	-0.10	-0.16	-0.20	-0.18	0.00	-0.09	0.09
Toluene	0.16	0.06	0.09	0.06	-0.33	-0.11	0.14

Table 10-3. SVOC and SNMOC Measured by the St. Louis, MO (SLMO) Monitoring Station

Average SVOC Concentration	**TNMOC (speciated)**	**TNMOC (with unknowns)**	**% of TNMOC Identified**	**SNMOC Compound with the Highest Concentration**	**Typical Emission Sources**
5.90 (±0.25) μg	174 (±26.78) ppbC	313 (±37.91) ppbC	56%	*m-,p*-xylene (18.33 ppbC)	Evaporative losses, spills and leaks from petroleum refining, coal tar production, solvents, losses during gasoline transport and storage

Table 10-4. Motor Vehicle Information vs. Daily Concentration for Missouri Monitoring Sites

Monitoring Station	Population within Ten Miles	Estimated Number of Motor Vehicles Owned	Traffic Data (Daily Average)	Average Daily UATMP Concentration
S2MO	807,997	597,918	1,000	13.43 (±2.87) ppbv
S3MO	725,662	536,990	8,532	13.41 (±3.00) ppbv
SLMO	807,997	597,918	15,016	47.14 (±19.41) ppbv

11.0 Sites in New Jersey

This section focuses on a few specific meteorological and concentration trends for the four UATMP sites in New Jersey (CANJ, CHNJ, ELNJ, and NBNJ). Each of the four sites is located in different cities (Camden, Chester, Elizabeth, and New Brunswick, respectively). Figures 11-1 through 11-4 are topographical maps showing the monitoring stations in their urban locations. Figures 11-5 through 11-7 are maps identifying facilities within ten miles of the sites that reported to the 1999 NEI. CANJ is located on the southeast side of the state, near the PA/NJ border and has a number of facilities located mainly to its north and west. CHNJ is located in the north-central part of New Jersey and has only ten industrial sites nearby, most of which lie just within the ten mile radius from the site. ELNJ and NBNJ are somewhat closer to each other, with the outer portions of their ten mile radius intersecting. These two sites are near the New Jersey/New York border, just west of Staten Island, and have a number of industrial facilities in the vicinity, most of which are chemical producers.

Hourly meteorological data were retrieved for all of 2001 at three weather stations near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The weather stations are Philadelphia, Newark International Airport, and Somerville, NJ (WBAN 94732, 14734, and 54785, respectively).

Table 11-1 highlights the average UATMP concentration at each of these sites, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), and wind information (average u- and v- components of the wind) for the entire year and on sampling days. New Jersey is located in a region where most storm systems track across, allowing its weather to be somewhat variable. However, its proximity to the Atlantic Ocean has a moderating effect. Hence, summers along the coast tend to be cooler than areas farther inland, while winters tend to be warmer. Its location also tends to allow for ample annual precipitation and often high humidity. To demonstrate this point, Elizabeth, the Jersey city closest to the ocean, claims the highest average temperature, highest average dew point and wet bulb temperature, and highest average relative humidity out of the four New Jersey sites. This information is presented in Table 11-1. Annual average wind direction is from the northwest for all of the sites located in New Jersey. However, wind speeds tend to vary. This information can be found at the following web sites: http://www.ssec.org/idis/gates/States/physical/newyork.htm and http://www.ssec.org/idis/gates/States/physical/philly.htm.

11.1 Meteorological and Concentration Averages at the New Jersey Sites

Carbonyl compound and VOC (volatile organic compounds) were measured at all four of the sites, as indicated in Tables 3-3 and 3-4. NBNJ had the highest reported geometric means for both carbonyls (5.67 ppbv) and hydrocarbons (16.11 ppbv), and this hydrocarbon value was the highest of all of the geometric means at all sites for all compound types. Hydrocarbons had the highest geometric mean reported for CANJ, ELNJ, and NBNJ, while halogenated hydrocarbons had the highest geometric mean at CHNJ. CANJ consistently had the lowest reported geometric means, with the exception of the polar compounds, where it came in second lowest to CHNJ (2.42 ppbv at CANJ vs. 1.95 ppbv at CHNJ). The average total UATMP daily concentration at NBNJ was also the highest at 48.16 (±12.86) ppbv, while CANJ was again the lowest average value at 22.11 (±5.24) ppbv. NBNJ's value is more than double that of CANJ, and surpasses the other two sites by nearly 40 percent. Table 11-1 also lists the averages for selected meteorological parameters from January 2001 to December 2001, which is similar to the time period covered in this report.

SVOC concentrations were sampled at all four of the sites. Average SVOC concentrations ranged from 5.48 (±0.09) μg at NBNJ to 181.42 (±21.87) μg at CANJ. Ozone concentrations were also sampled at CANJ and CHNJ on 61 sample days, and were retrieved from the U.S. EPA's AIRS database. The average ozone concentration for each sample day was 65.95 ppbv and 64.16 ppbv, respectively. Unfortunately, ozone concentrations were not sampled at the other sites. Information on SVOC and ozone concentrations is given in Table 11-3.

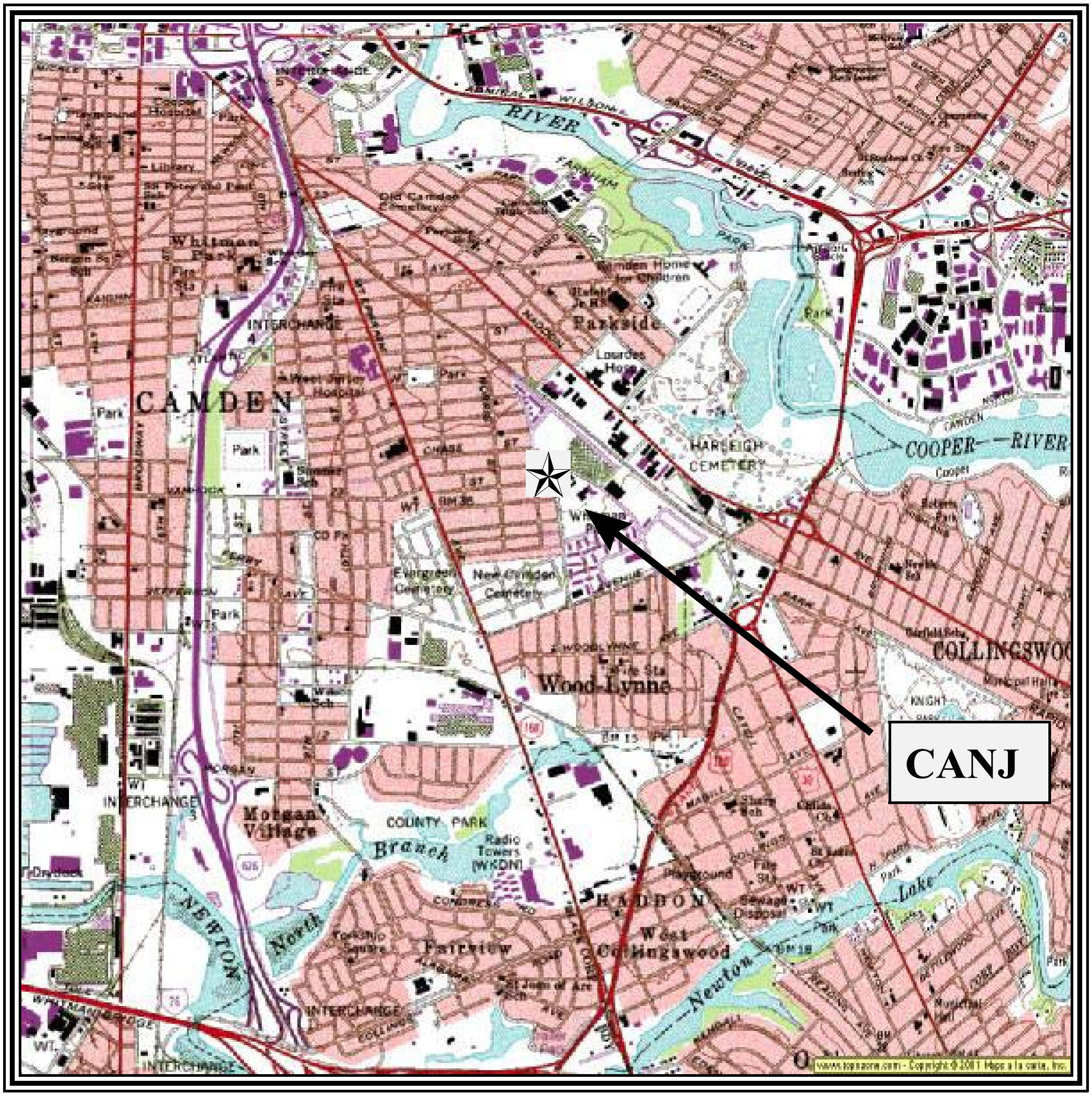
Tables 11-2a-d are the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters by site. Identification of the prevalent compounds is discussed in Section 3 of this report. At ELNJ, the majority of the correlations between each compound and temperature and moisture parameters were weak (between 0 and 0.25 or 0 and -0.25) to moderately strong (between 0.25 and 0.50 or -0.25 and -0.50) and positive. (The few that didn't tended to be acetone, acetylene, and benzene, of which almost all correlations were negative.) Also, the correlation between the compounds and the wind components tended to be moderately strong and positive (acetone, acetylene, and benzene included). Concentrations at ELNJ tended to increase as the majority of the weather variables increase. CANJ didn't have any correlations that fall into the strong category (between 0.50 and 0.75 or -0.50 and -0.75). However, acetone, acetylene, and benzene seem to follow the same tendency that they did at ELNJ for the various weather parameters. As a matter of fact, these three compounds had similar correlations at all four sites. The moisture variables and the average temperature had nearly all negative correlations of various strengths at the CHNJ sites, while the v-component of the wind had mostly weak to moderately strong positive correlations to the majority of the compounds. At the NBNJ site, over half of the compounds demonstrated moderately strong to strong positive correlations with the maximum temperature.

11.2 Spatial Analysis

Using the population within ten miles of each site, an estimate of the number of motor vehicles operating in proximity to the monitoring station can be established. The ratio used in this report is 0.74 motor vehicles to every one person (refer to section 3.4.1 for more information on this ratio). The population near the CANJ site is 2,113,778 people, all of whom are operating approximately 1,564,196 motor vehicles. This site had the largest population (and vehicles) of the four New Jersey sites. The site with the lowest population was CHNJ, with a population of 239,072 people driving 176,913 motor vehicles. This information is compared to the average daily concentration of the prevalent compounds at each New Jersey site in Table 11-4. Also included in Table 11-4 are average daily traffic data, or more specifically, the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis.

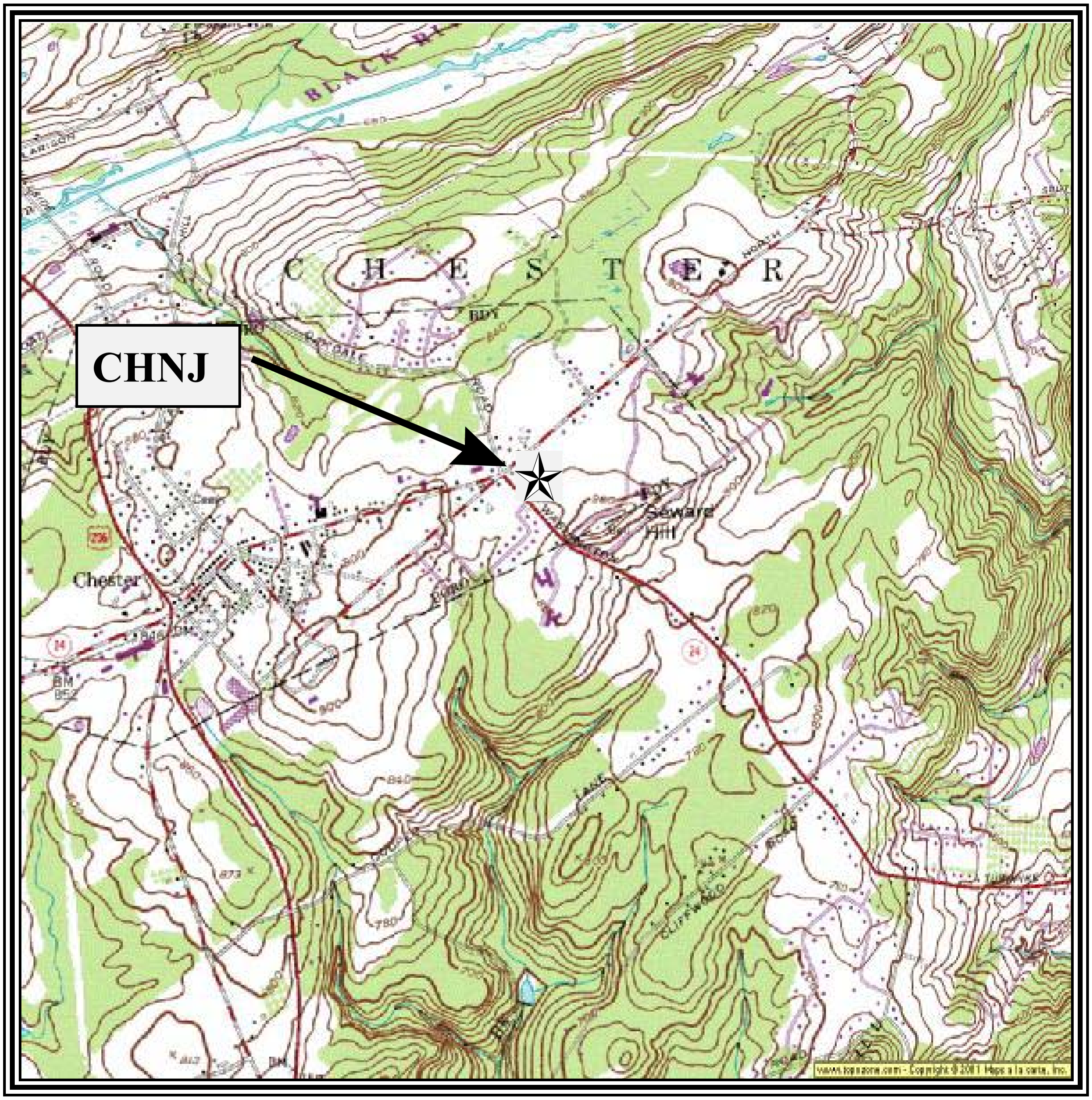
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area. (For more information on this study, refer to section 3.4.2.) Figure 3-16 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. The CANJ site has a benzene-ethylbenzene concentration ratio that is higher than its *m-,p*-xylene-ethylbenzene ratio, which is different than those of the roadside study. The ELNJ site also has a higher benzene-ethylbenzene concentration ratio than its *m-,p*-xylene-ethylbenzene ratio. The CHNJ site has a very low concentration ratio for benzene-ethylbenzene, as does NBNJ. The NBNJ site's ratios look very different from the roadside study's ratios. The highest ratio is *m-,p*-xylene-ethylbenzene, as opposed to toluene-ethylbenzene at not only the roadside study, but also the other three New Jersey sites. Also at NBNJ, the *o*-xylene-ethylbenzene ratio is higher than the benzene-ethylbenzene ratio, which also occurs at CHNJ. Generally, the New Jersey sites didn't remain consistent with the roadside study.

Figure 11-1. Camden, New Jersey (CANJ) Monitoring Station



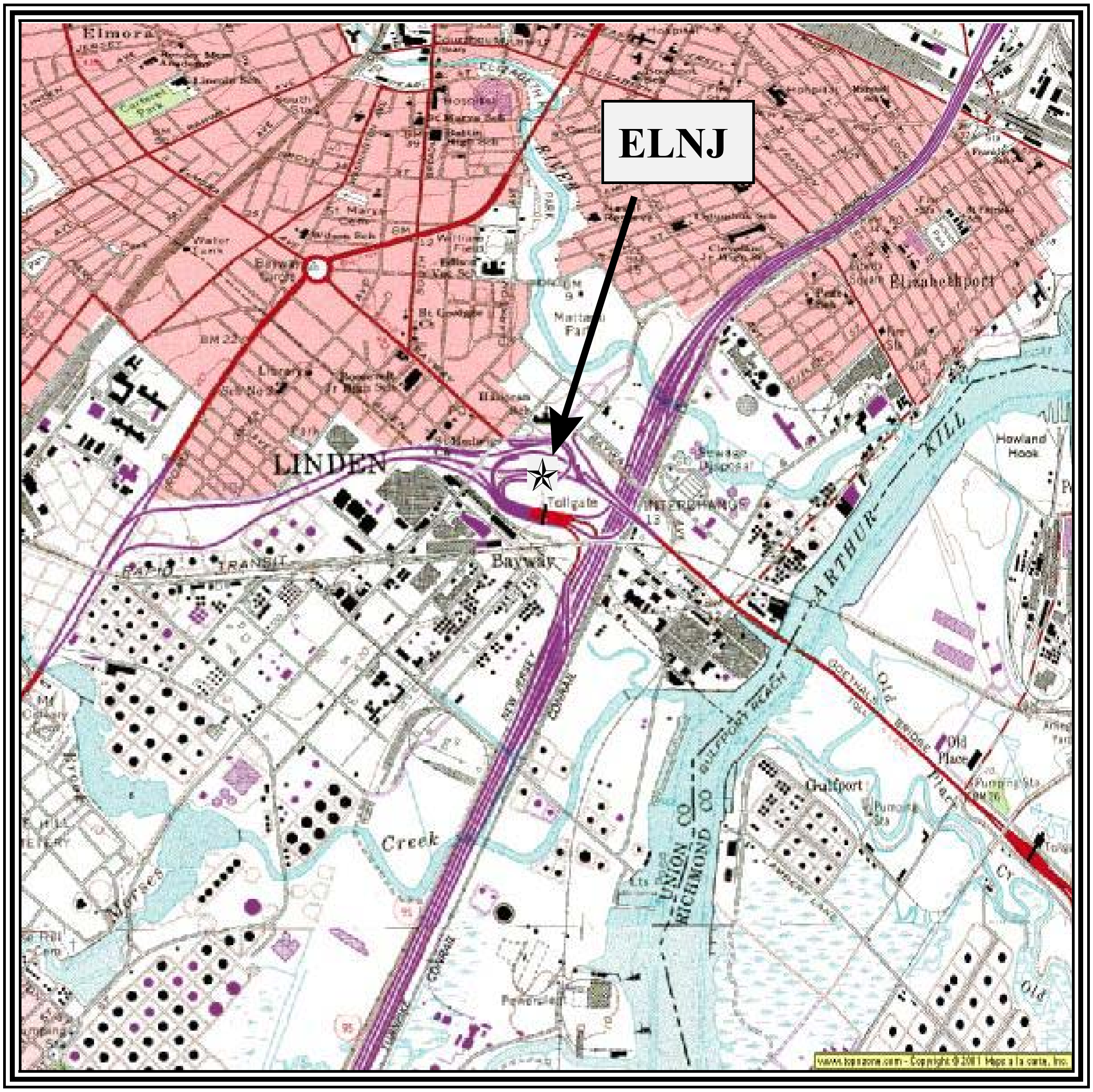
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 11-2. Chester, New Jersey (CHNJ) Monitoring Station



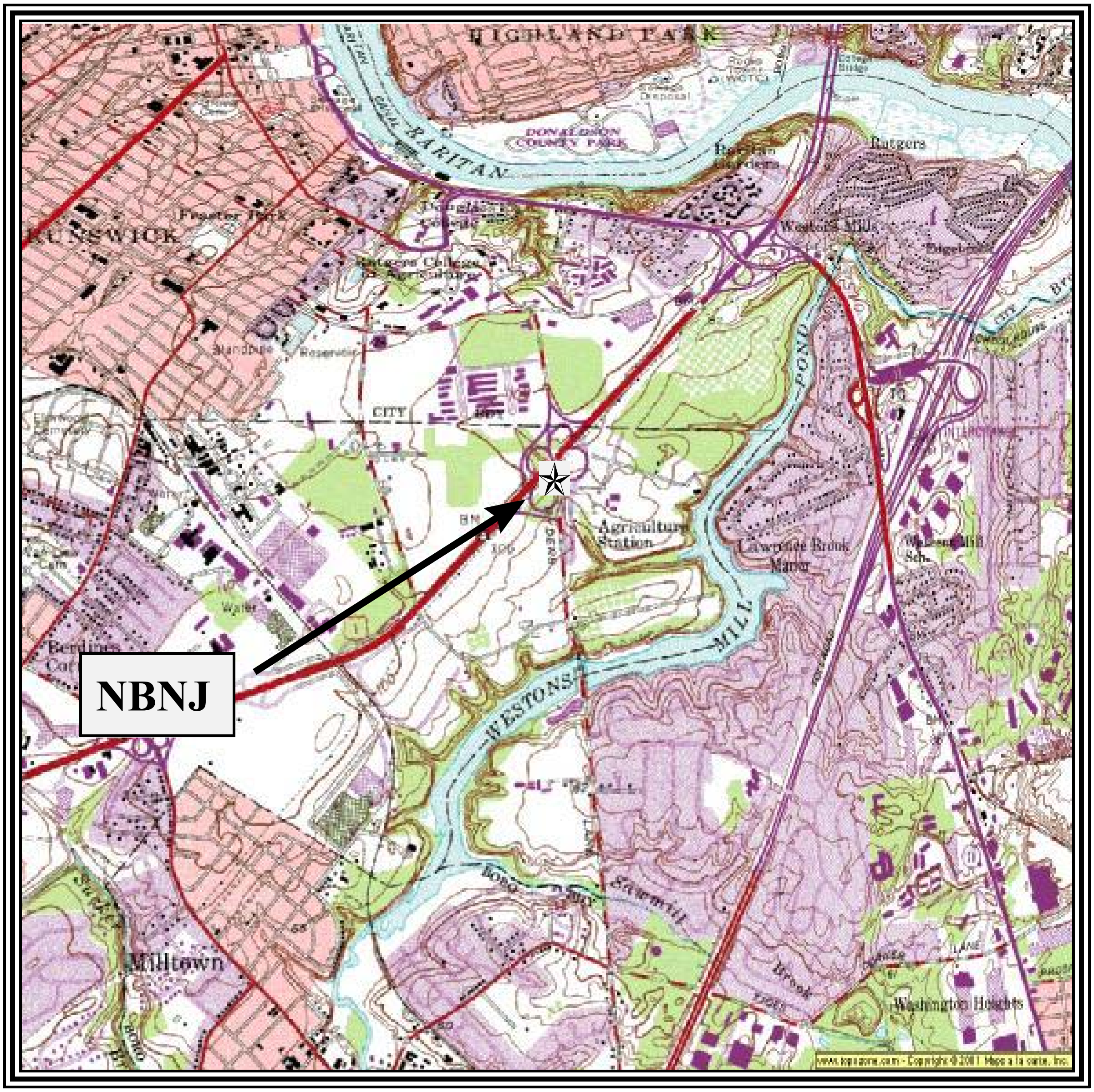
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 11-3. Elizabeth, New Jersey (ELNJ) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 11-4. New Brunswick, New Jersey (NBNJ) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

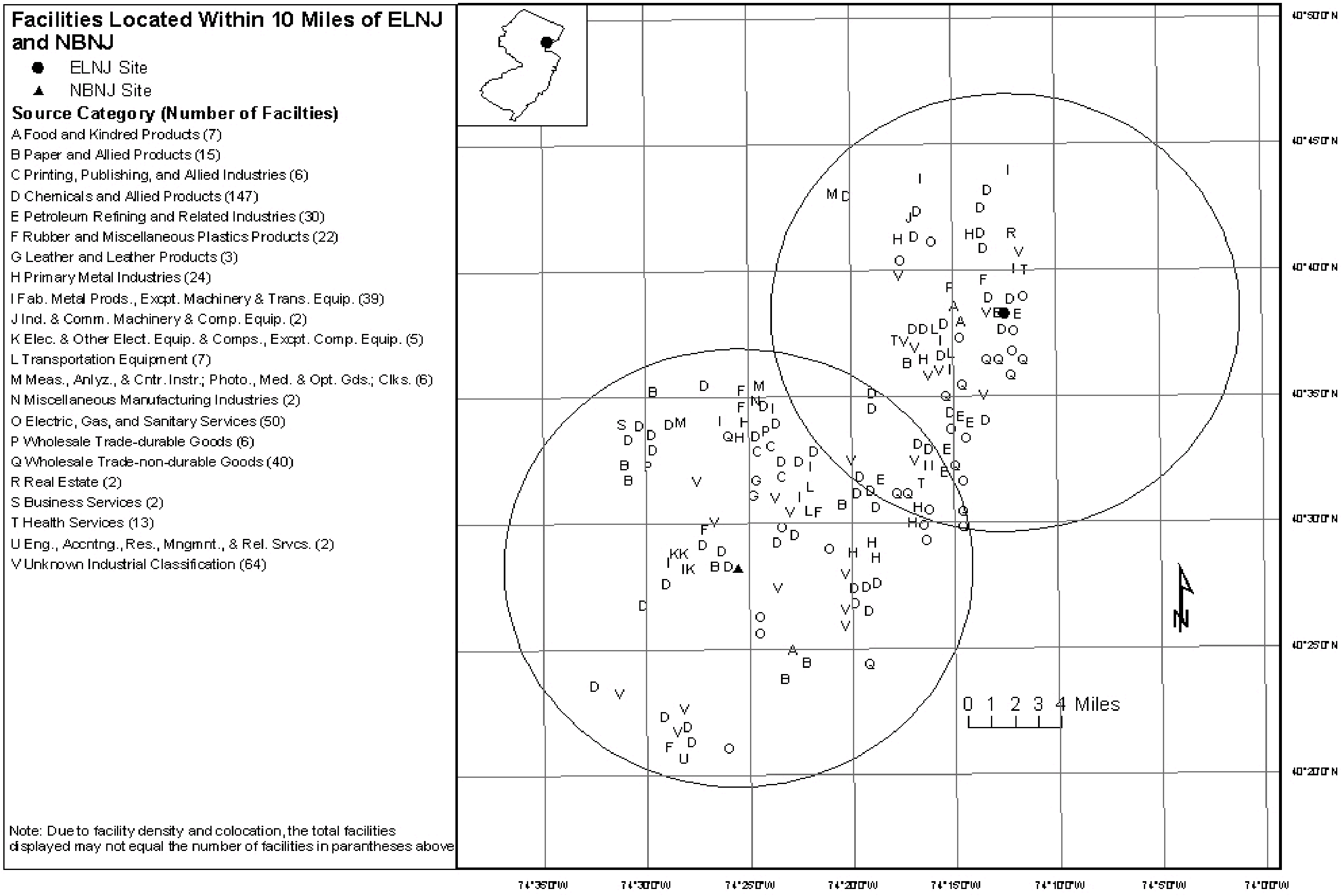


Figure 11-5. Facilities Located Within 10 Miles of ELNJ and NBNJ

Figure 11-6. Facilities Located Within 10 Miles of CHNJ

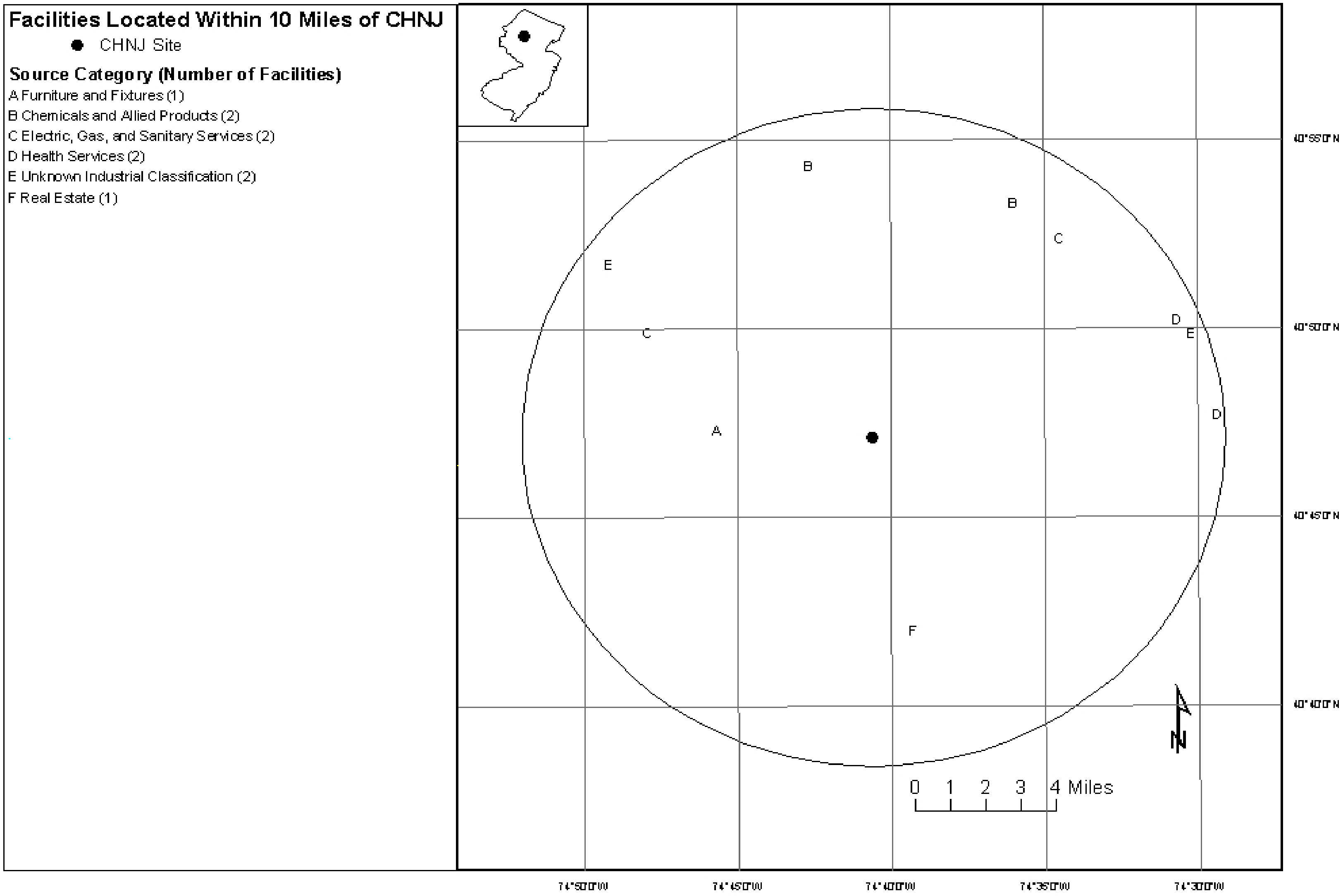


Figure 11-7. Facilities Located Within 10 Miles of CANJ

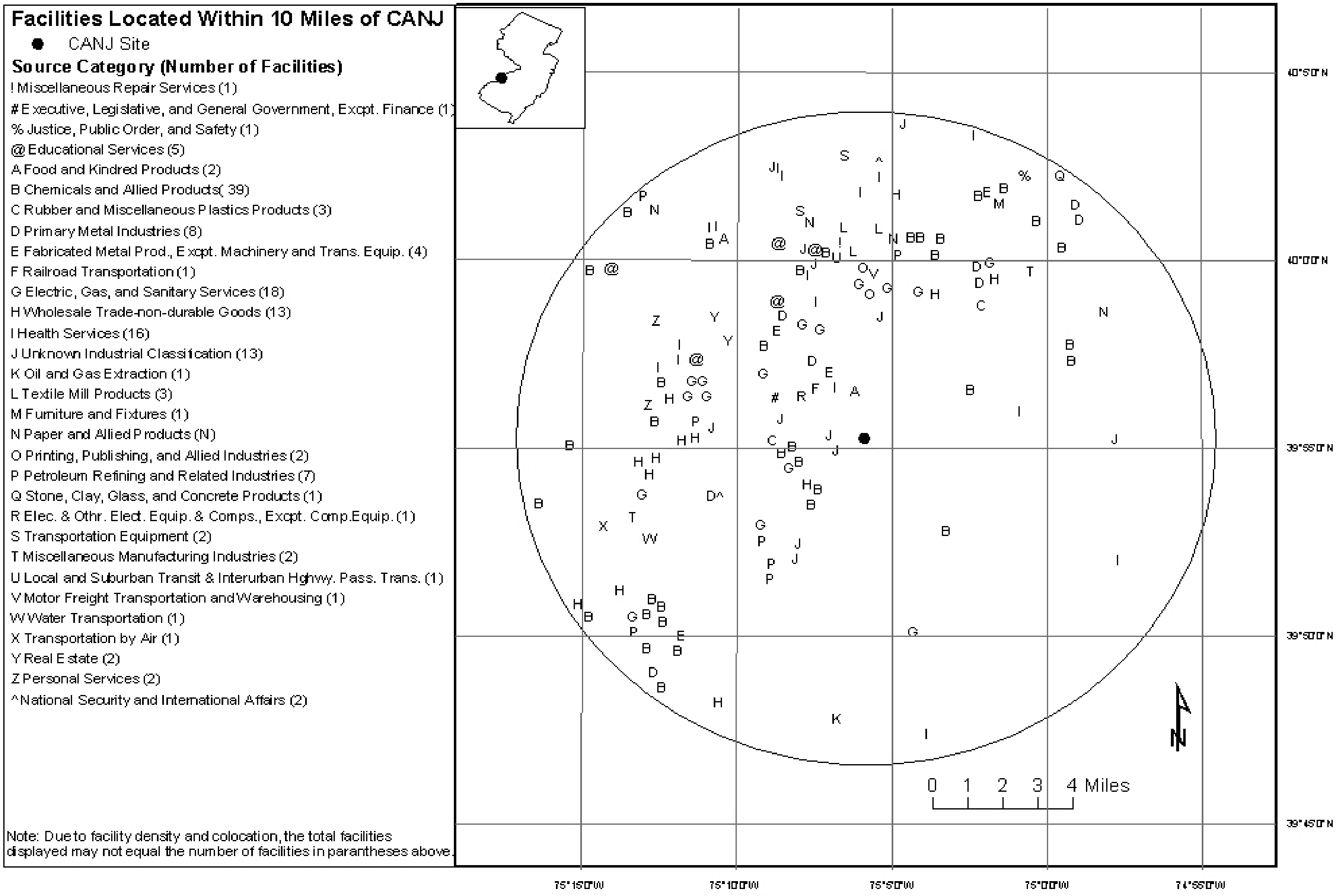


Table 11-1. Average Concentration and Meteorological Parameters for Sites in New Jersey

Site Name	Type	Average UATMP Concentration (ppbv)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
CANJ	All 2001	[redacted]	66.63 (±1.91)	50.75 (±1.80)	38.97 (±1.58)	44.70 (±1.54)	57.48 (±1.27)	1.91 (±0.46)	-1.11 (±0.39)
	sample day	22.11 (±5.24)	70.71 (±4.48)	53.41 (±4.45)	41.48 (±4.06)	47.02 (±3.90)	56.72 (±3.78)	1.29 (±1.22)	-1.11 (±0.87)
CHNJ	All 2001	[redacted]	64.64 (±1.97)	43.49 (±1.63)	34.43 (±1.44)	39.11 (±1.43)	57.50 (±1.52)	0.23 (±0.20)	-1.12 (±0.30)
	sample day	27.52 (±8.71)	74.13 (±3.64)	48.40 (±3.74)	40.71 (±3.10)	44.17 (±3.25)	59.25 (±4.58)	0.12 (±0.45)	-0.76 (±0.74)
ELNJ	All 2001	[redacted]	65.74 (±1.88)	52.97 (±1.76)	40.41 (±1.64)	46.75 (±1.52)	58.55 (±1.23)	2.44 (±0.52)	-1.28 (±0.53)
	sample day	30.37 (±6.72)	68.09 (±4.78)	55.40 (±4.58)	43.59 (±4.33)	49.33 (±4.04)	60.17 (±2.70)	2.07 (±1.28)	-1.08 (±1.23)
NBNJ	All 2001	[redacted]	64.64 (±1.97)	43.49 (±1.63)	34.43 (±1.44)	39.11 (±1.43)	57.50 (±1.52)	0.23 (±0.20)	-1.12 (±0.30)
	sample day	48.16 (±12.86)	73.86 (±3.63)	47.82 (±3.48)	40.18 (±2.97)	43.67 (±3.03)	58.64 (±4.25)	0.07 (±0.42)	-0.87 (±0.73)

Table 11-2a - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Camden, New Jersey (CANJ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.09	-0.03	0.01	-0.03	0.05	-0.01	-0.01
Acetone	-0.35	-0.25	-0.25	-0.25	0.19	0.00	-0.06
Acetylene	-0.37	-0.38	-0.27	-0.34	0.23	0.14	0.03
Benzene	-0.01	-0.10	-0.01	-0.08	0.19	0.22	0.05
Chloromethane	0.41	0.08	0.25	0.15	-0.08	-0.12	0.20
Dichlorodifluoromethane	0.22	0.01	0.09	0.04	0.00	-0.01	0.18
Ethylbenzene	-0.01	-0.08	0.01	-0.05	0.17	0.24	-0.03
Formaldehyde	0.15	-0.01	0.04	0.00	-0.05	-0.18	-0.12
m-,p - Ylene	-0.03	-0.08	0.00	-0.05	0.15	0.26	-0.03
Methyl Ethyl Ketone	0.14	0.16	0.10	0.12	-0.12	-0.02	0.27
Methylene Chloride	0.03	0.00	0.01	0.00	0.06	0.28	-0.20
o - Xylene	-0.06	-0.10	-0.04	-0.08	0.13	0.25	-0.06
Propylene	0.02	-0.11	-0.01	-0.08	0.18	0.24	0.15
Toluene	-0.07	-0.10	-0.05	-0.09	0.12	0.31	-0.10

Table 11-2b - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Chester, New Jersey (CHNJ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	-0.27	-0.19	-0.17	-0.17	0.24	0.08	0.13
Acetone	-0.47	-0.04	-0.04	-0.03	0.44	-0.01	-0.11
Acetylene	-0.43	-0.43	-0.41	-0.41	0.22	-0.05	0.16
Benzene	-0.31	-0.19	-0.22	-0.19	0.20	0.05	0.14
Chloromethane	0.07	-0.39	-0.26	-0.34	-0.03	0.01	0.57
Dichlorodifluoromethane	0.29	0.11	0.20	0.14	0.11	0.05	0.40
Ethylbenzene	0.19	-0.31	-0.17	-0.27	-0.37	-0.25	0.36
Formaldehyde	0.19	-0.14	-0.04	-0.11	-0.10	0.10	0.19
m-,p - Xylene	0.16	-0.29	-0.14	-0.24	-0.35	-0.31	0.35
Methyl Ethyl Ketone	-0.03	-0.24	-0.25	-0.24	-0.19	-0.16	-0.18
Methylene Chloride	-0.59	-0.20	-0.25	-0.20	0.41	0.11	0.17
o - Xylene	0.06	-0.31	-0.15	-0.25	-0.25	-0.31	0.38
Propylene	-0.29	-0.53	-0.45	-0.49	0.00	-0.16	0.22
Toluene	0.15	-0.22	-0.11	-0.18	-0.12	-0.13	0.35

Table 11-2c - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Elizabeth, New Jersey (ELNJ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	-0.01	0.05	0.00	0.02	0.07	-0.03	0.09
Acetone	-0.39	-0.32	-0.45	-0.38	-0.22	0.10	-0.12
Acetylene	-0.31	-0.44	-0.31	-0.39	0.22	0.09	0.23
Benzene	-0.05	-0.15	-0.01	-0.09	0.39	0.28	0.45
Chloromethane	0.22	0.05	0.19	0.10	0.10	-0.09	0.19
Dichlorodifluoromethane	0.38	0.36	0.46	0.42	0.36	-0.14	0.17
Ethylbenzene	0.15	0.00	0.16	0.06	0.38	0.24	0.42
Formaldehyde	0.28	0.23	0.22	0.22	-0.01	-0.04	0.08
m-,p - Xylene	0.10	-0.04	0.11	0.02	0.37	0.25	0.42
Methyl Ethyl Ketone	0.30	0.33	0.36	0.35	0.25	0.35	0.42
Methylene Chloride	0.26	0.23	0.34	0.28	0.45	0.30	0.42
o - Xylene	0.05	-0.10	0.06	-0.04	0.35	0.22	0.37
Propylene	0.27	0.22	0.28	0.26	0.30	0.42	0.51
Toluene	0.17	0.04	0.19	0.10	0.35	0.28	0.41

Table 11-2d - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at New Brunswick, New Jersey (NBNJ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.40	0.17	0.31	0.20	-0.09	0.10	0.39
Acetone	-0.42	0.07	-0.04	0.03	0.47	0.25	-0.06
Acetylene	-0.41	-0.15	-0.19	-0.17	0.42	0.00	0.11
Benzene	-0.29	-0.14	-0.14	-0.14	0.33	-0.10	0.08
Chloromethane	0.42	0.03	0.19	0.07	-0.09	-0.08	0.55
Dichlorodifluoromethane	0.46	0.23	0.36	0.26	0.00	-0.05	0.52
Ethylbenzene	0.28	0.13	0.16	0.13	-0.31	-0.31	-0.06
Formaldehyde	0.46	0.20	0.36	0.25	-0.08	0.23	0.50
m-,p - Xylene	0.30	0.15	0.18	0.14	-0.32	-0.31	-0.06
Methyl Ethyl Ketone	0.57	-0.11	0.11	-0.04	-0.37	0.04	0.38
Methylene Chloride	0.31	0.27	0.30	0.28	-0.10	0.23	0.00
o - Xylene	0.32	0.13	0.18	0.13	-0.33	-0.32	-0.02
Propylene	-0.32	-0.20	-0.18	-0.19	0.39	-0.14	0.26
Toluene	0.21	0.14	0.16	0.13	-0.24	-0.33	-0.05

Table 11-3. SVOC and Ozone Measured by the New Jersey Monitoring Stations

Monitoring Station	Average SVOC Concentration	Average Ozone Concentrations from May-Aug	Total Number of Ozone Sampling Days
CANJ	181.42 (±21.87) μg	65.95 ppbv	61
CHNJ	46.71 (±9.75) μg	64.16 ppbv	61
ELNJ	6.01 (±0.20) μg	N/A	N/A
NBNJ	5.48 (±0.09) μg	N/A	N/A

Table 11-4. Motor Vehicle Information vs. Daily Concentration for New Jersey Monitoring Sites

Monitoring Station	Population within Ten Miles	Estimated Number of Motor Vehicles Owned	Traffic Data (Daily Average)	Average Daily UATMP Concentration
CANJ	2,113,778	1,564,196	62,000	22.11 (±5.24) ppbv
CHNJ	239,072	176,913	12,623	27.52 (±8.71) ppbv
ELNJ	2,093628	1,549,285	170,000	30.37 (±6.72) ppbv
NBNJ	841,801	622,933	63,000	48.16 (±12.86) ppbv

12.0 Site in North Dakota

This section focuses on a few specific meteorological and concentration trends for the UATMP site in North Dakota (BUND). This site is located in Beulah, and Figure 12-1 is a topographical map showing the monitoring station in its urban location. Figure 12-2 is a map identifying facilities within ten miles of the site and that reported to the 1999 NEI. The BUND site has very few industrial facilities nearby, mainly in the utility industries. Hourly meteorological data were retrieved for all of 2001 at the Bismarck Municipal Airport (WBAN 24011) with the purpose of calculating correlations of meteorological data with ambient air concentration measurements.

Table 12-1 highlights the average UATMP concentration at the site, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), and wind information (average u- and v-components of the wind) for the entire year and on sampling days. Beulah is located to the northwest of Bismarck, and Beulah's climate is continental in nature. This means that cold, dry winters and generally mild summers are normally expected. Moderate northerly winds are expected, climatologically. This information can be found at the following web site: http://www.ssec.org/idis/gates/States/physical/fargo.htm.

12.1 Meteorological and Concentration Averages at the North Dakota Site

Carbonyl compounds and VOC (volatile organic compounds) were measured at the site, as indicated in Tables 3-3 and 3-4. BUND's lowest geometric mean was 1.31 ppbv for the hydrocarbons, and the highest geometric mean was 2.91 ppbv for the halogenated hydrocarbons. Polar and carbonyl compound values fell between these values. The average total UATMP daily concentration at BUND was 13.10 (±2.70) ppbv. Table 12-1 also lists the averages for selected meteorological parameters from January 2001 to December 2001, which is similar to the time period covered in this report.

This site also opted to have total and speciated nonmethane organic compounds (SNMOC) measured during its air toxic sampling. SNMOC/NMOC compounds are of particular interest because of their role in ozone formation. Readers are encouraged to review EPA's *2001 Nonmethane Organic Compounds (NMOC) and Speciated Nonmethane Organic Compounds (SNMOC) Monitoring Program, Final Report* (EPA, 2002) for more information on SNMOC/NMOC trends and concentrations. The average total NMOC value for BUND was 81 (±17.90) ppbC, of which nearly 76% could be identified through speciation. Of the speciated compounds, ethane measured the highest concentration at the BUND site (6.69 ppbC). Typical sources of ethane include production of insulating materials and cooking oils such as shortening. Ozone concentrations were also sampled at BUND on 123 sample days, and were retrieved from the U.S. EPA's AIRS database. The average ozone concentration for each sample day was 46.00 ppbv. This information is available in Table 12-3.

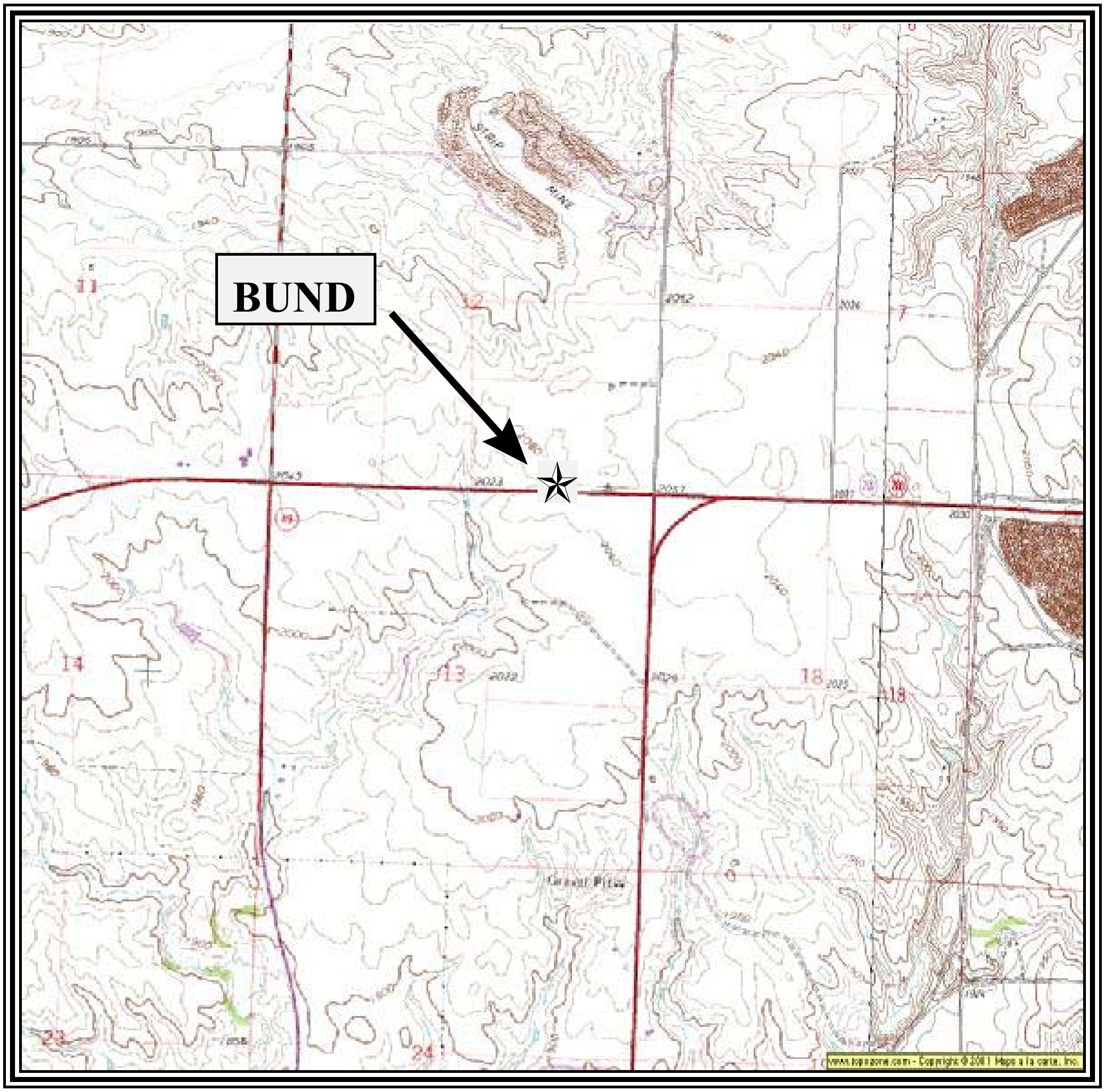
Tables 12-2 is the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters. Identification of the prevalent compounds is discussed in Section 3 of this report. The strongest (strong meaning a correlation between 0.50 and 0.75 or -0.50 and -0.75) negative correlation at BUND was between acetylene and maximum temperature, but acetylene also had moderately strong (between 0.25 and 0.50 or -0.25 and -0.50) negative correlations between average, dew point, and wet bulb temperatures as well. Benzene, ethylbenzene, *m-,p*-xylene, *o*-xylene, and toluene demonstrated similar moderately strong negative correlations with the four previously mentioned weather parameters. The strongest positive correlation exists between formaldehyde and the same four weather parameters. A similar positive, but not as strong, correlation exists with acetaldehyde, acetone, chloromethane, and methylene chloride and the same temperature and moisture variables. The compounds measured at BUND also tended to have a weak to moderately strong correlations with the v-component of the wind, as all but one compound's correlation was positive (methyl ethyl ketone).

12.2 Spatial Analysis

Using the population within ten miles of each site, an estimate of the number of motor vehicles operating in proximity to the monitoring station can be established. The ratio used in this report is 0.74 motor vehicles to every one person (refer to section 3.4.1 for more information on this ratio). The population near the BUND site is 6,204 people, all of whom are operating approximately 4,591 motor vehicles. This information is compared to the average daily concentration of the prevalent compounds at the North Dakota site in Table 12-4. Also included in Table 12-4 are average daily traffic data, or more specifically, the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis.

A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area. (For more information on this study, refer to section 3.4.2.) Figure 3-16 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at the monitoring site. The BUND site's concentration ratios look somewhat different than those of the roadside study. The benzene-ethylbenzene and toluene-ethylbenzene ratios are significantly higher than the roadside study's ratios for the same compounds, especially the benzene-ethylbenzene ratio. The benzene-ethylbenzene ratio is also significantly higher than the *m-,p*-xylene-ethylbenzene ratio, which is different than the roadside study's ratios.

Figure 12-1. Beulah, North Dakota (BUND) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 12-2. Facilities Located Within 10 Miles of BUND

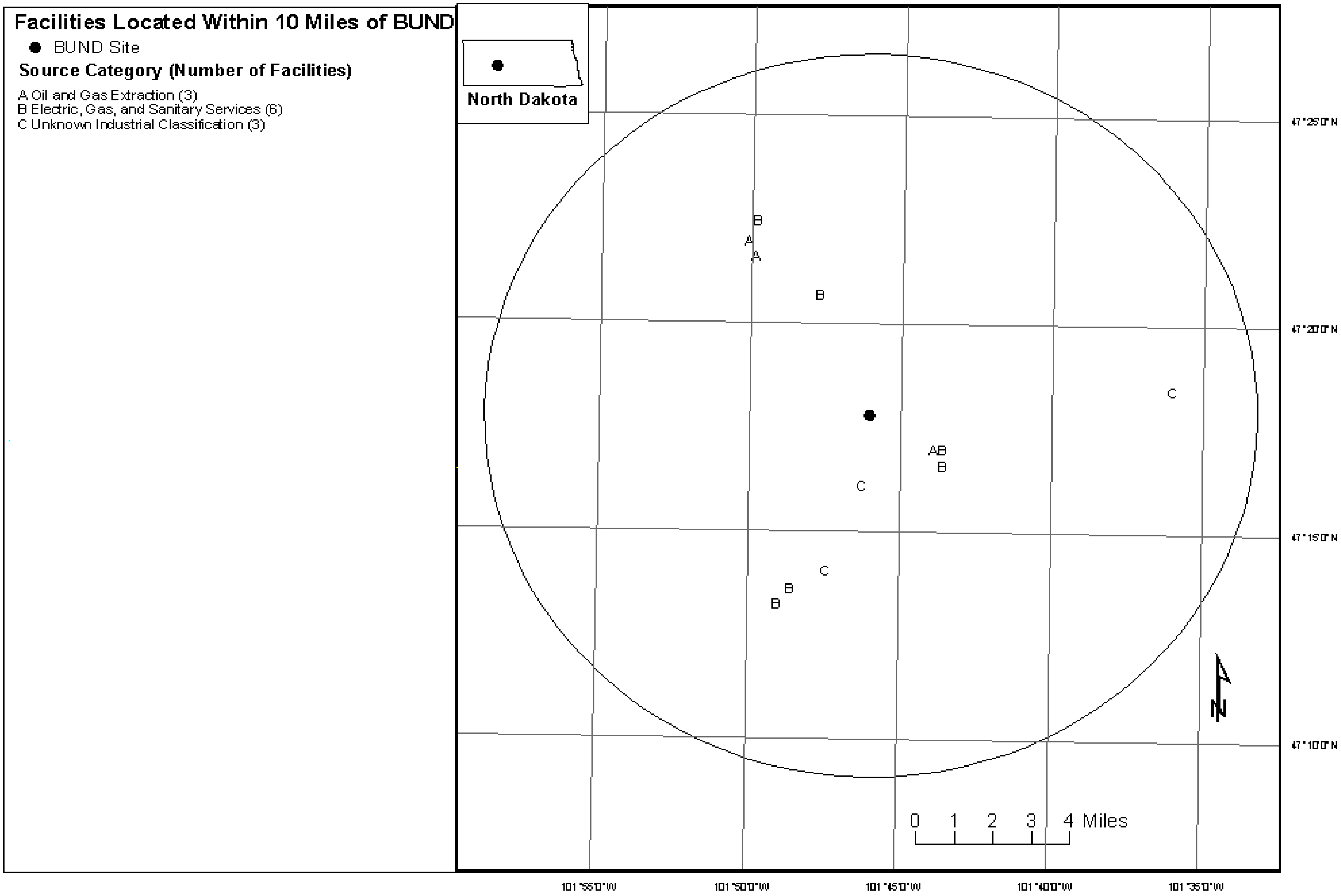


Table 12-1. Average Concentration and Meteorological Parameters for Site in North Dakota

Site Name	Type	Average UATMP Concentration (ppbv)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
BUND	All 2001	[redacted]	59.31 (±2.49)	43.03 (±2.25)	33.77 (±1.94)	38.36 (±1.98)	64.28 (±1.25)	-0.03 (±0.50)	-1.00 (±0.54)
	sample day	13.10 (±2.70)	60.57 (±5.79)	43.27 (±5.36)	33.73 (±4.63)	38.48 (±4.74)	63.08 (±2.77)	-0.39 (±1.11)	-1.35 (±1.23)

Table 12-2. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Beulah, North Dakota (BUND)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.32	0.35	0.33	0.33	0.08	-0.27	0.34
Acetone	0.27	0.27	0.21	0.24	-0.02	-0.12	0.23
Acetylene	-0.52	-0.49	-0.49	-0.50	0.05	-0.01	0.06
Benzene	-0.48	-0.43	-0.44	-0.45	0.12	0.13	0.04
Chloromethane	0.26	0.30	0.28	0.30	0.09	-0.12	0.17
Dichlorodifluoromethane	-0.24	-0.22	-0.24	-0.23	-0.02	-0.01	0.09
Ethylbenzene	-0.31	-0.31	-0.31	-0.32	-0.06	0.01	0.07
Formaldehyde	0.55	0.56	0.55	0.55	-0.02	-0.28	0.41
m-,p - Xylene	-0.30	-0.29	-0.29	-0.29	-0.05	0.00	0.09
Methyl Ethyl Ketone	-0.03	0.05	0.04	0.05	0.17	0.14	-0.12
Methylene Chloride	0.25	0.32	0.32	0.31	-0.06	-0.19	0.05
o - Xylene	-0.29	-0.28	-0.28	-0.29	-0.05	0.00	0.09
Propylene	-0.02	0.03	0.01	0.01	-0.02	-0.08	0.13
Toluene	-0.31	-0.29	-0.29	-0.30	-0.04	0.00	0.08

Table 12-3. TNMOC and Ozone Measured by the Beulah, ND (BUND) Monitoring Station

Average Ozone Concentrations from May-Aug	Total Number of Ozone Sampling Days	Average TNMOC (speciated)	Average TNMOC (w/ unknowns)	% TNMOC Identified	SNMOC Compound with the Highest Concentration	Typical Emission Sources
46.00 ppbv	123	61 (±17.63) ppbC	81 (±17.90) ppbC	76 %	Ethane (6.69 ppbC)	Production of insulating materials; cooking oils such as shortening

Table 12-4. Motor Vehicle Information vs. Daily Concentration for the North Dakota Monitoring Site

Monitoring Station	Population within Ten Miles	Estimated Number of Motor Vehicles Owned	Traffic Data (Daily Average)	Average Daily UATMP Concentration
BUND	6,204	4,591	1,350	13.10 (±2.70) ppbv

13.0 Sites in Puerto Rico

This section focuses on a few specific meteorological and concentration trends for the two UATMP sites in Puerto Rico (BAPR and SJPR). These sites reside along Puerto Rico's northern coastline, with SJPR in San Juan and BAPR further west in Barceloneta. No topographical maps are available for these sites, but Figures 13-1 through 13-2 are maps identifying facilities within ten miles of the sites that reported to the 1999 NEI. There are a number of chemical industrial facilities just to the east of BAPR. SJPR has nearly as many facilities nearby but they are more scattered around the monitoring site. Hourly meteorological data were retrieved for all of 2001 at the San Juan weather station (WBAN 11641) with the purpose of calculating correlations of meteorological data with ambient air concentration measurements.

Table 13-1 highlights the average UATMP concentration at each of these sites, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), and wind information (average u- and v- components of the wind) for the entire year and on sampling days. Puerto Rico is located in the northern Caribbean and experiences a tropical climate, where the air is warm and humid year-round (as Table 13-1 confirms). Breezy winds flow from the northeast to the east on average with the aid of the sub-tropical high pressure that resides over the tropical Atlantic.

13.1 Meteorological and Concentration Averages at the Puerto Rico Sites

Carbonyl compounds and VOC (volatile organic compounds) were measured at the two Puerto Rican sites, as indicated in Tables 3-3 and 3-4. There was a considerable difference in the geometric means of the two sites for all compound types, with the exception of hydrocarbons, where the values were closer together, as Table 3-4 demonstrates. The largest difference was between the polar compounds, where BAPR's geometric mean was 9.19 ppbv vs. SJPR's mean of 3.06 ppbv. The average total UATMP daily concentration at the two sites also demonstrated this large difference in the sampled compounds. BAPR's average concentration was 50.30 (±18.17) ppbv while SJPR's was less than half of that (18.59 ±4.82 ppbv). Table 13-1 also lists the averages for selected meteorological parameters from January 2001 to December 2001, which is similar to the time period covered in this report.

These sites also opted to have total and SNMOC sampled during its air toxic sampling. SNMOC/NMOC compounds are of particular interest because of their role in ozone formation. Readers are encouraged to review EPA's *2001 Nonmethane Organic Compounds (NMOC) and Speciated Nonmethane Organic Compounds (SNMOC) Monitoring Program, Final Report* (EPA, 2002) for more information on SNMOC/NMOC trends and concentrations. The average total NMOC value for BAPR was 436 (±81.85) ppbC, of which nearly 38% could be identified through speciation, and the average total NMOC value for SJPR was 371 (±77.84) ppbC, of which nearly 60% could be identified through speciation. Of the speciated compounds, toluene and isopentane measured the highest concentrations at the BAPR and SJPR sites (20.52 ppbC and 24.78 ppbC, respectively). Typical sources of toluene include motor vehicle exhaust, volatilization of toluene-based solvents and thinners, production of benzene and urethane. Sources of isopentane include non-wood upolstered office side and arm chairs. This information is given in Table 13-3. Unfortunately, ozone concentrations were not sampled at these sites.

Tables 13-2a-b are the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters by site. Identification of the prevalent compounds is discussed in Section 3 of this report. A number of the compounds had moderately strong (between 0.25 and 0.50 or -0.25 and -0.50) to strong (between 0.50 and 0.75 or -0.50 and -0.75) positive correlations with a majority of the weather parameters at the BAPR site. However, the strongest positive correlations were between acetylene, benzene, and propylene with the v-component of the wind. This wind component trend was also evident at the SJPR site. However, a moderately strong to strong correlation was computed between almost all of the compounds and both wind components. But the carbonyls demonstrated a positive correlation while the VOC demonstrated a negative correlation. The computed correlations for the remaining weather parameters and the compounds at SJPR were generally weak. Wind speed and direction obviously have some effect on the concentration of the prevalent compounds at the Puerto Rican monitoring locations.

13.2 Spatial Analysis

Data used to estimate of the number of motor vehicles operating in proximity to the monitoring stations were not available for the Puerto Rico sites. However, the average daily traffic data, or more specifically, the average number of motor vehicles passing the monitoring sites on the nearest roadway to each site on a daily basis was available. This information is compared to the average daily concentration of the prevalent compounds at the Puerto Rico sites in Table 13-4. As evident in Table 13-4, the San Juan site has significantly more nearby traffic than the Barceloneta site.

A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area. (For more information on this study, refer to section 3.4.2.) Figure 3-16 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at the monitoring site. Overall, the two Puerto Rico sites' concentration ratios resemble those of the roadside study. However, the benzene-ethylbenzene concentration ratio is significantly lower at both BAPR and SJPR than at the roadside study. Also, the toluene-ethylbenzene ratio is lower at these two sites than the roadside study, but less so than the benzene-ethylbenzene concentration ratio.

Figure 13-1. Facilities Located Within 10 Miles of BAPR

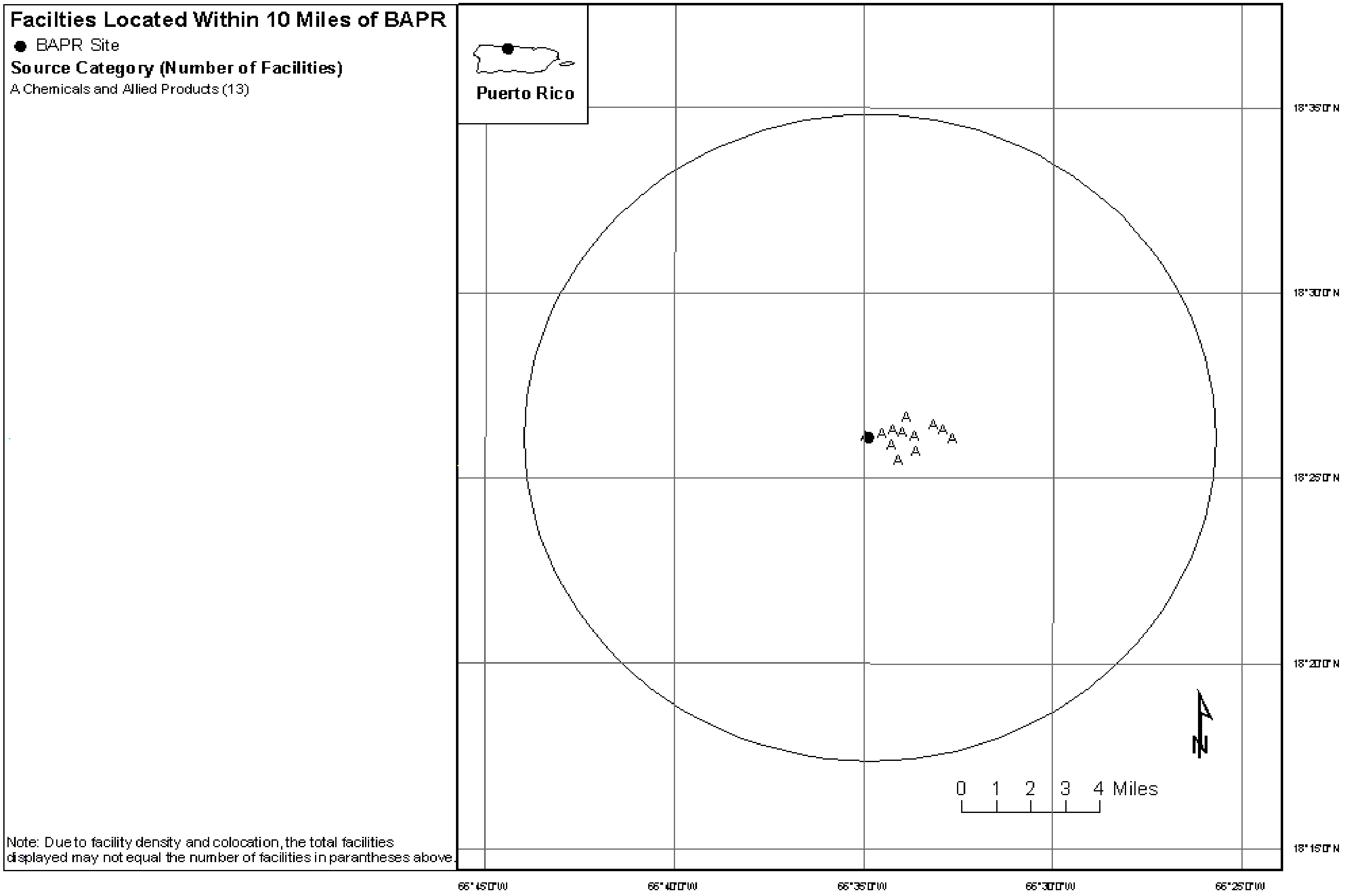


Figure 13-2. Facilities Located Within 10 Miles of SJPR

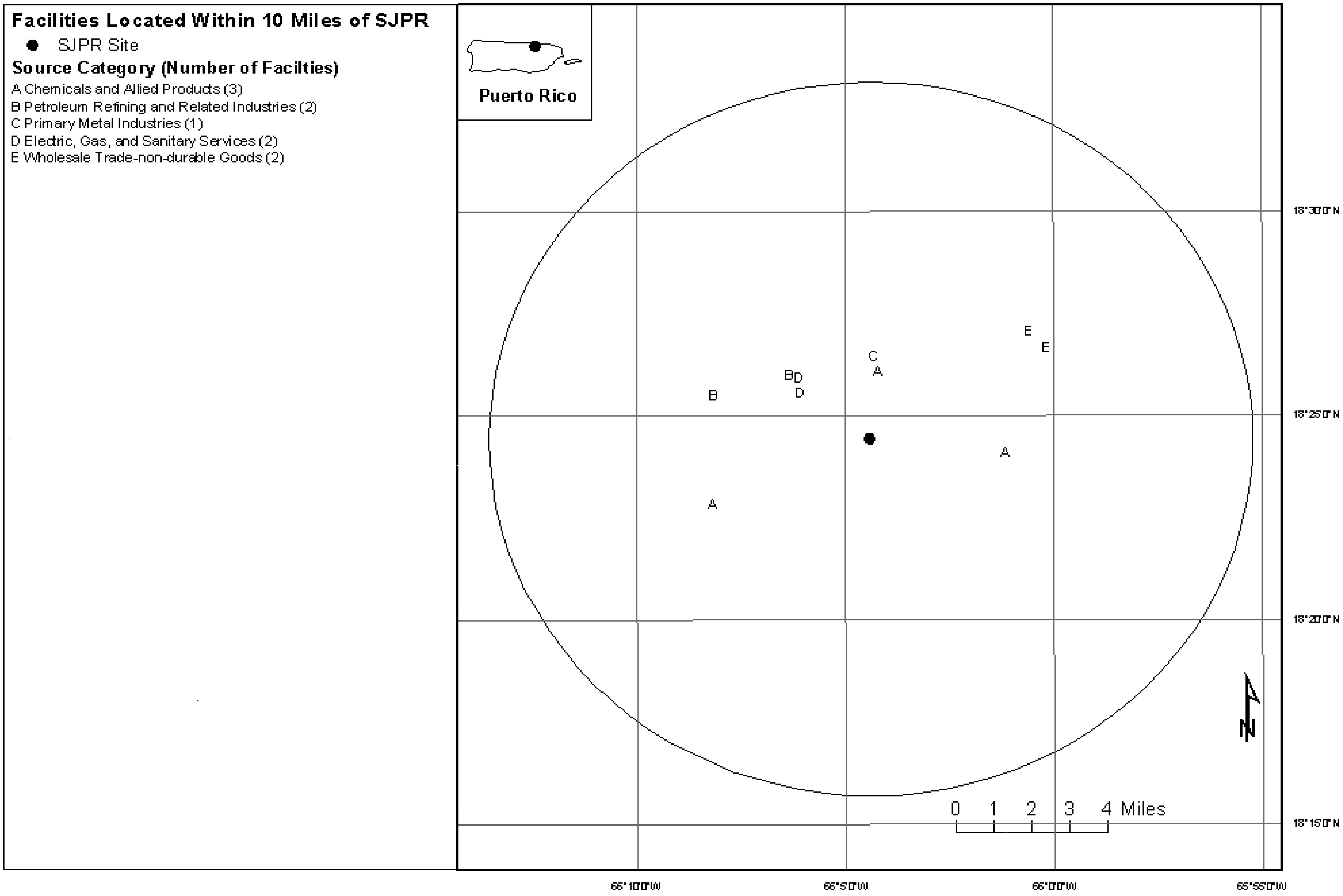


Table 13-1. Average Concentration and Meteorological Parameters for Sites in Puerto Rico

Site Name	**Type**	**Average UATMP Concentration (ppbv)**	**Average Maximum Temperature (°F)**	**Average Temperature (°F)**	**Average Dewpoint Temperature (°F)**	**Average Wet Bulb Temperature (°F)**	**Average Relative Humidity (%)**	**Average u-component of the Wind (kts)**	**Average v-component of the Wind (kts)**
BAPR	All 2001	[redacted]	86.60 (±0.33)	70.72 (±1.16)	63.60 (±1.00)	65.84 (±1.05)	68.06 (±1.02)	-5.56 (±0.29)	-0.80 (±0.25)
	sample day	50.30 (±18.17)	88.05 (±0.92)	68.00 (±4.11)	61.61 (±3.45)	63.57 (±3.63)	65.51 (±3.53)	-4.55 (±1.34)	-0.47 (±0.65)
SJPR	All 2001	[redacted]	86.60 (±0.33)	70.72 (±1.16)	63.60 (±1.00)	65.84 (±1.05)	68.06 (±1.02)	-5.56 (±0.29)	-0.80 (±0.25)
	sample day	18.59 (±4.82)	88.05 (±0.92)	68.00 (±4.11)	61.61 (±3.45)	63.57 (±3.63)	65.51 (±3.53)	-4.55 (±1.34)	-0.47 (±0.65)

Table 13-2a - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Barceloneta, Puerto Rico (BAPR)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.32	0.13	0.07	0.09	-0.02	0.40	0.48
Acetone	0.31	0.13	0.08	0.10	0.02	0.27	0.25
Acetylene	0.10	0.34	0.38	0.37	0.48	0.47	0.74
Benzene	-0.09	0.15	0.17	0.16	0.24	0.41	0.52
Chloromethane	-0.40	-0.25	-0.19	-0.22	-0.03	0.19	0.07
Dichlorodifluoromethane	-0.18	-0.07	-0.05	-0.06	-0.04	-0.50	-0.24
Ethylbenzene	0.28	0.47	0.45	0.46	0.34	-0.05	0.21
Formaldehyde	0.28	0.26	0.20	0.23	0.07	-0.13	0.12
m-,p - Xylene	0.23	0.45	0.43	0.44	0.33	-0.13	0.15
Methyl Ethyl Ketone	-0.17	-0.17	-0.14	-0.16	-0.08	-0.24	-0.16
Methylene Chloride	-0.14	-0.01	0.05	0.03	0.11	-0.16	0.03
o - Xylene	0.26	0.42	0.40	0.41	0.31	0.07	0.26
Propylene	0.03	0.36	0.41	0.39	0.48	0.28	0.59
Toluene	0.46	0.48	0.41	0.44	0.24	0.22	0.46

Table 13-2b - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at San Juan, Puerto Rico (SJPR)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.15	0.16	0.15	0.16	0.18	0.55	0.55
Acetone	0.29	0.22	0.18	0.20	0.16	0.43	0.45
Acetylene	0.29	0.11	0.07	0.08	-0.05	-0.23	-0.01
Benzene	-0.13	-0.06	-0.01	-0.04	0.02	-0.30	-0.22
Chloromethane	-0.15	-0.02	-0.04	-0.03	-0.08	-0.60	-0.44
Dichlorodifluoromethane	-0.51	-0.01	0.07	0.03	0.22	-0.51	-0.30
Ethylbenzene	0.02	0.25	0.24	0.24	0.15	-0.66	-0.31
Formaldehyde	-0.01	-0.05	-0.04	-0.04	0.04	0.47	0.28
m-,p - Xylene	0.00	0.23	0.22	0.22	0.13	-0.67	-0.33
Methyl Ethyl Ketone	-0.08	0.00	-0.03	-0.02	-0.10	-0.74	-0.49
Methylene Chloride	0.20	0.43	0.39	0.41	0.25	-0.11	0.30
o - Xylene	0.01	0.24	0.24	0.24	0.15	-0.65	-0.31
Propylene	-0.08	-0.11	-0.05	-0.08	0.01	-0.03	-0.02
Toluene	0.01	0.21	0.20	0.20	0.12	-0.60	-0.25

Table 13-3. TNMOC Measured by the Puerto Rico Monitoring Stations

Monitoring Station	Average TNMOC (speciated)	Average TNMOC (w/ unknowns)	% TNMOC Identified	SNMOC Compound with the Highest Concentration	Typical Emission Sources
BAPR	167 (±29.90) ppbC	436 (±81.85) ppbC	38%	Toluene (20.52 ppbC)	Motor vehicle exhaust; volatilization of toluene-based solvents and thinners; used to make benzene and urethane
SJPR	222 (±30.94) ppbC	371 (±77.84) ppbC	60%	Isopentane (24.78 ppbC)	Non-wood upholstered office side and arm chairs

Table 13-4. Motor Vehicle Information vs. Daily Concentration for Puerto Rico Monitoring Sites

Monitoring Station	County Population[a]	Estimated Number of Motor Vehicles Owned	Traffic Data (Daily Average)	Average Daily UATMP Concentration
BAPR	26,644	N/A	10	50.30 (±18.17) ppbv
SJPR	436,334	N/A	51,000	18.59 (±4.82) ppbv

[a] County population data available for 1997 at the Census Bureau web site http://blue.census.gov/

14.0 Site in South Dakota

This section focuses on a few specific meteorological and concentration trends for the UATMP site in South Dakota (SFSD). This site resides in Sioux Falls, situated in southeastern South Dakota. Figure 14-1 is a topographical map showing the monitoring station is its urban location. Figure 14-2 is a map identifying facilities within ten miles of the site that reported to the 1999 NEI. The map shows that there are very few industrial facilities near the monitoring site, mostly to the northwest. Hourly meteorological data were retrieved for all of 2001 at the Sioux Falls weather station (WBAN 14944) near the site with the purpose of calculating correlations of meteorological data with ambient air concentration measurements.

Table 14-1 highlights the UATMP average concentration at each site, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), and wind information (average u- and v-components of the wind) for the entire year and on sampling days. The Sioux Falls area has a continental climate, with cold winters, warm summers, with often drastic day to day variations. Precipitation varies throughout the year, but is typically sufficient for the springtime growing season. On average, winds come from the south-southeast and are relatively light. This information can be found at the following web site: http://www.ssec.org/idis/gates/States/physical/sioux.htm.

14.1 Meteorological and Concentration Averages at the South Dakota Site

Carbonyl compounds were not measured at this site, as indicated in Tables 3-3 and 3-4. The highest computed geometric mean belonged to the halogenated hydrocarbons (3.51 ppbv). The polar compounds had the lowest geometric mean, with a value of 1.45 ppbv, and the hydrocarbons' geometric mean fell in between with a value of 2.58 ppbv. The average total UATMP daily concentration at SFSD was 41.61 (±62.70) ppbv. Table 14-1 also lists the averages for selected meteorological parameters from January 2001 to December 2001, which is similar to the time period covered in this report. This site also opted to have total and speciated nonmethane organic compounds (SNMOC) sampled during its air toxic sampling. SNMOC/NMOC compounds are of particular interest because of their role in ozone formation.

Readers are encouraged to review EPA's *2001 Nonmethane Organic Compounds (NMOC) and Speciated Nonmethane Organic Compounds (SNMOC) Monitoring Program, Final Report* (EPA, 2002) for more information on SNMOC/NMOC trends and concentrations. The average total NMOC value for SFSD was 153 (±28.37) ppbC, of which nearly 61% could be identified through speciation. Of the speciated compounds, isopentane measured the highest concentration at the SFSD site (9.01 ppbC). Typical sources of isopentane are non-wood upholstered office side and arm chairs. This information is given in Table 14-3. Ozone concentrations were also sampled at this site on 31 sample days, and were retrieved from the U.S. EPA's AIRS database. The average ozone concentration for each sample day was 50.84 ppbv.

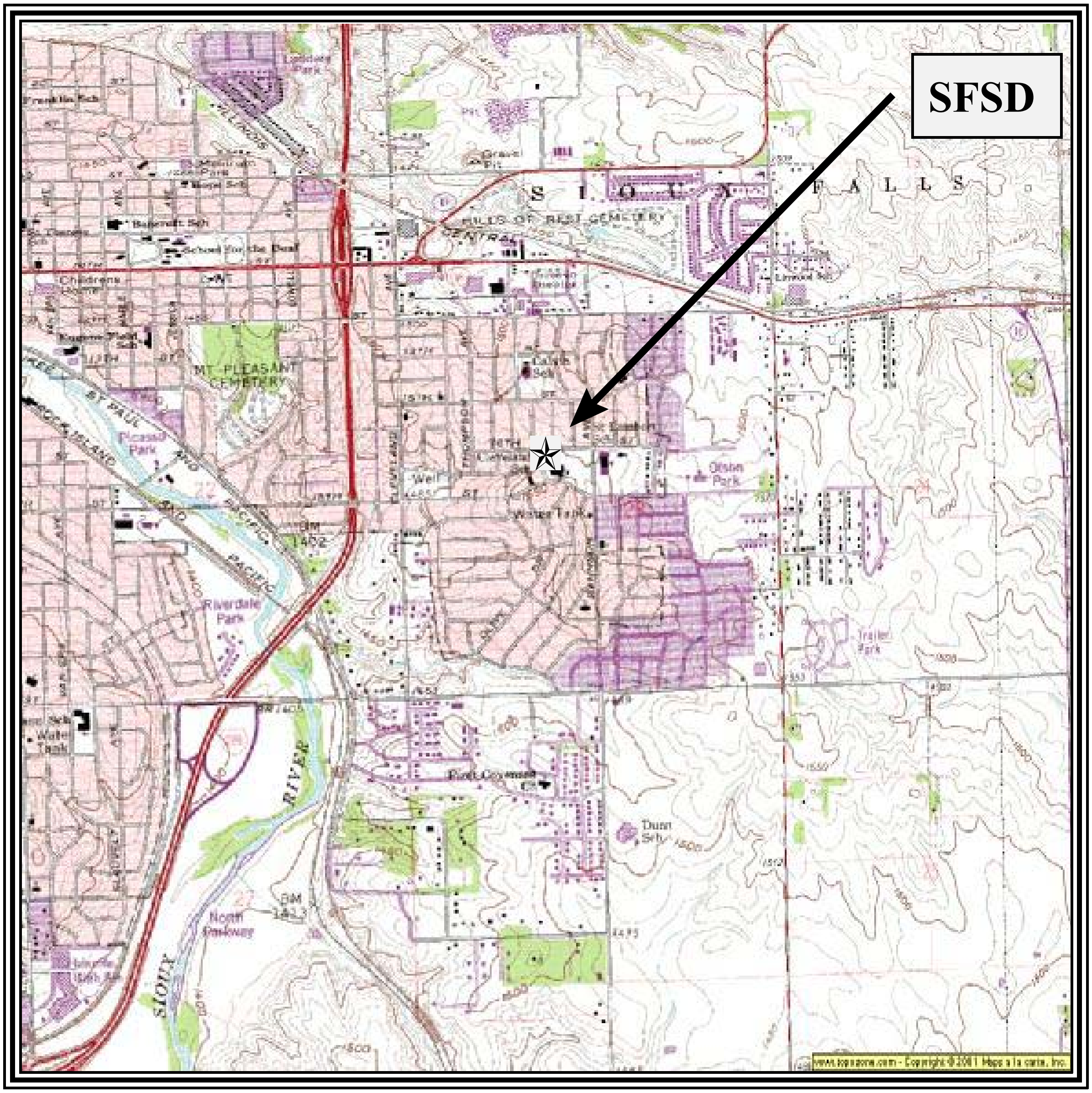
Table 14-2 is the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters. Identification of the prevalent compounds is discussed in Section 3 of this report. The strongest (strong meaning a correlation between 0.50 and 0.75 or -0.50 and -0.75) correlations at the SFSD site were between acetylene and maximum and average temperature and dew point and wet bulb temperature, and they were all negative. As these parameters increased, concentrations tended to decrease. On the other hand, moderately strong positive correlations were computed between chloromethane and the same four weather parameters. Thus, for chloromethane, as temperature and moisture increased, concentrations tended to increase as well. The remainder of the correlations were weak (between 0 and 0.25 or 0 and -0.25) and fluctuated between negative and positive.

14.2 Spatial Analysis

Using the population within ten miles of each site, an estimate of the number of cars operating in proximity to the monitoring station can be established. The ratio used in this report is 0.74 automobiles to every one person (refer to section 3.4.1 for more information on this ratio). The population near the SFSD site is 148,462 people, all of whom are operating approximately 109,862 vehicles. This information is compared to the average daily concentration of the prevalent compounds at the South Dakota site in Table 14-3. Also included in Table 14-3 are average daily traffic data, or more specifically, the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis.

A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area. (For more information on this study, refer to section 3.4.2.) Figure 3-16 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. Both the benzene-ethylbenzene and toluene-ethylbenzene concentration ratios were higher than those of the roadside study, while both *m-,p*-xylene-ethylbenzene and *o*-xylene-ethylbenzene were slightly lower at the site vs the roadside study. Another difference between the site and the study is that the site's benzene-ethylbenzene ratio is higher than the *m-,p*-xylene-ethylbenzene ratio, whereas the roadside study's *m-,p*-xylene-ethylbenzene ratio is higher.

Figure 14-1. Sioux Falls, South Dakota (SFSD) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 14-2. Facilities Located Within 10 Miles of SFSD

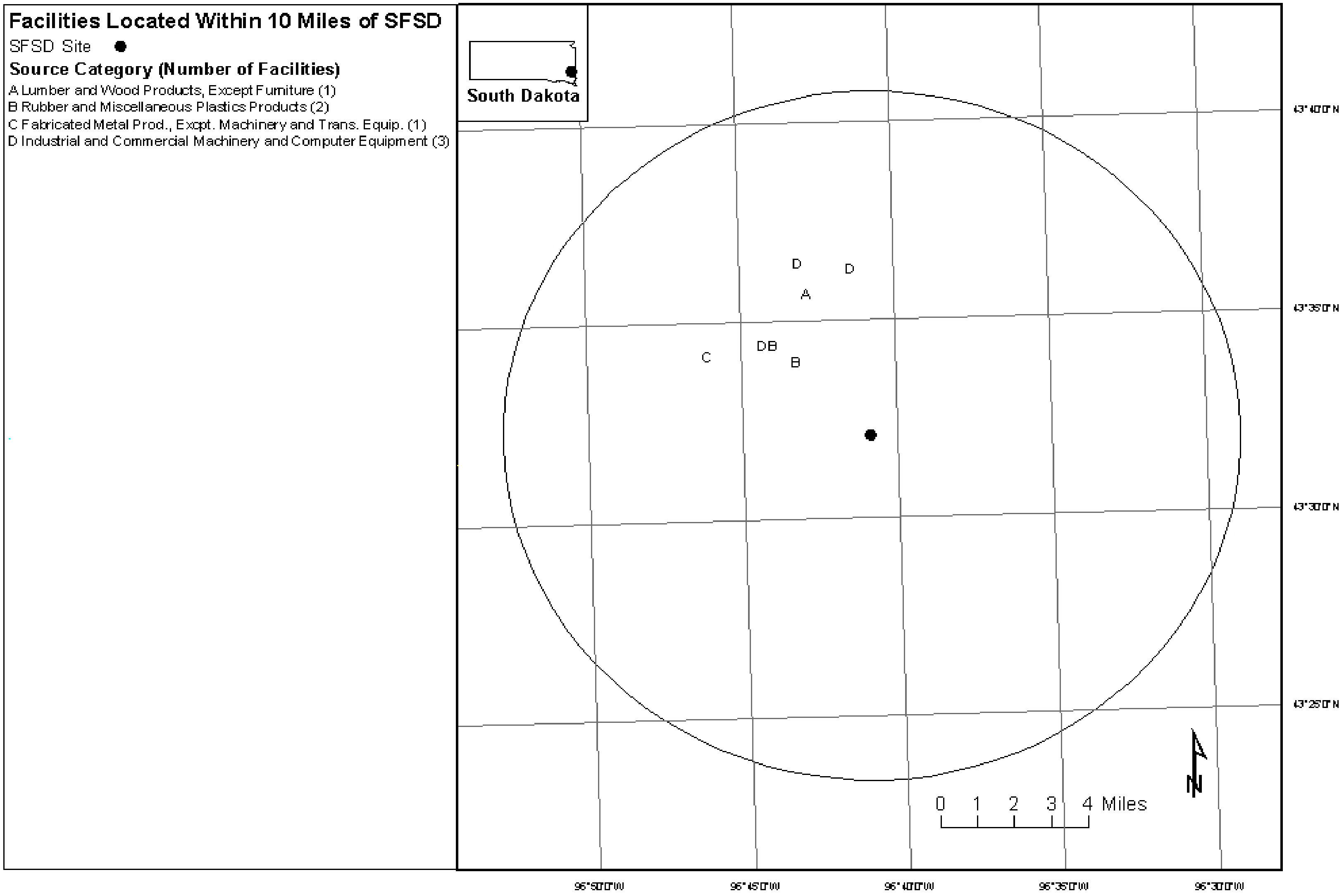


Table 14-1. Average Concentration and Meteorological Parameters for the Site in South Dakota

Site Name	Type	Average UATMP Concentration (ppbv)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
SFSD	All 2001	[redacted]	59.34 (±2.45)	43.44 (±2.33)	35.04 (±2.00)	39.11 (±2.06)	63.50 (±1.26)	-0.08 (±0.55)	0.19 (±0.68)
	sample day	41.61 (±62.70)	60.95 (±6.11)	44.12 (±5.68)	35.55 (±4.92)	39.67 (±5.04)	63.66 (±2.63)	-0.28 (±1.23)	1.60 (±1.43)

Table 14-2 - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Sioux Falls, South Dakota (SFSD)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetylene	-0.48	-0.57	-0.56	-0.57	0.05	0.18	-0.27
Benzene	-0.03	-0.13	-0.09	-0.11	-0.14	0.00	-0.01
Chloromethane	0.40	0.35	0.37	0.37	-0.01	-0.21	0.15
Dichlorodifluoromethane	0.01	-0.08	-0.04	-0.06	-0.18	-0.03	0.04
Ethylbenzene	-0.03	-0.13	-0.10	-0.12	-0.20	0.04	-0.03
m-,p - Xylene	0.00	-0.11	-0.08	-0.10	-0.19	0.04	-0.04
Methyl Ethyl Ketone	-0.03	-0.04	-0.02	-0.04	0.00	-0.06	-0.08
Methylene Chloride	0.16	0.09	0.04	0.07	-0.30	0.11	0.02
o - Xylene	0.01	-0.10	-0.07	-0.09	-0.21	0.03	-0.03
Propylene	0.07	-0.11	-0.13	-0.12	-0.31	0.07	-0.10
Toluene	-0.02	-0.11	-0.07	-0.09	-0.17	-0.01	0.04

Table 14-3. TNMOC and Ozone Measured by the Sioux Falls, SD (SFSD) Monitoring Station

Average Ozone Concentrations from May-Aug	Total Number of Ozone Sampling Days	Average TNMOC (speciated)	Average TNMOC (w/ unknowns)	% TNMOC Identified	SNMOC Compound with the Highest Concentration	Typical Emission Sources
50.84 ppbv	31	93 (±20.38) ppbC	153 (±28.37) ppbC	61 %	Isopentane (9.01 ppbC)	Non-wood upholstered office side and arms chairs

Table 14-4. Motor Vehicle Information vs. Daily Concentration for the South Dakota Monitoring Site

Monitoring Station	Population within Ten Miles	Estimated Number of Vehicles Owned	Traffic Data (Daily Average)	Average Daily UATMP Concentration
SFSD	148,462	109,862	4,320	41.61 (±62.70) ppbv

15.0 Sites in Texas

This section focuses on a few specific meteorological and concentration trends for the two UATMP sites in Texas (A2TX and EPTX). A2TX is located in Arlington, just outside of Dallas, and EPTX is located in El Paso, at the westernmost point of the Texas panhandle. Figures 15-1 through 15-2 are topographical maps showing the monitoring stations in their urban locations. Figures 15-3 and 15-4 are maps identifying facilities within ten miles of the sites that reported to the 1999 NEI. Numerous industrial facilities of a variety of types surround the A2TX station, with the majority to the north of the station. The industry with the largest number of facilities near the A2TX site is transportation equipment. EPTX has considerably fewer industrial sites, but again the majority of them are to the north of the monitoring site. However, this scenerio may be explained because to the south of the site is Mexico, which the NEI does not cover. Petroleum refining has the largest number of facilities in the area. Hourly meteorological data were retrieved for all of 2001 at two weather stations near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The two weather stations are Dallas-Ft. Worth and El Paso International Airport (WBAN 3927 and 23044, respectively).

Table 15-1 highlights the average UATMP concentration at each site, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), and wind information (average u- and v-components of the wind) for the entire year and on sampling days. The Dallas climate is classified as humid subtropical and temperatures can be extremely hot in the summer and mild in the winter. The area is humid, but usually less than its neighbors closer to the Gulf of Mexico. Winds can be breezy and tend to flow from the southeast on average. El Paso, on the other hand, is warm and very dry, as its location is on the edge of the Franklin Mountains in the Chihuahuan Desert and tends to dry out any moist air masses as they move from west to east. Winds in El Paso flow out of the southwest on average, only adding to the dry tendency. This information can be found at the following web sites: http://www.ssec.org/idis/gates/States/physical/dallas.htm, http://www.desertusa.com/Cities/tx/tx_elpaso.html and http://www.ci.el-paso.tx.us.

15.1 Meteorological and Concentration Averages at the Texas Sites

Carbonyl compounds and VOC (volatile organic compounds) were measured at the two sites, as indicated in Tables 3-3 and 3-4. A2TX reported higher geometric means for carbonyl and halogenated hydrocarbons than EPTX (4.15 ppbv and 3.33 ppbv vs. 2.31 ppbv and 3.30 ppbv, respectively), but EPTX had higher hydrocarbon and polar compound geometric means than A2TX (7.53 ppbv and 2.72 ppbv vs. 4.41 ppbv and 2.31 ppbv, respectively). The average total UATMP daily concentrations at the two sites were very similar (29.43 ±13.35 ppbv at A2TX and 29.25 ±11.52 ppbv at EPTX). Table 15-1 also lists the averages for selected meteorological parameters from January 2001 to December 2001, which is similar to the time period covered in this report.

Tables 15-2a-b are the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters by site. Identification of the prevalent compounds is discussed in Section 3 of this report. A2TX had the highest correlations computed across all of the UATMP sites. Chloromethane had very strong (between 0.75 and 1 or -0.75 and -1) positive correlations with maximum and average temperature and dew point and wet bulb temperature (0.84, 0.81, 0.89, and 0.85). Formaldehyde had strong (between 0.50 and 0.75 or -0.50 and -0.75) positive correlations with the same four weather parameters (0.61, 0.64, 0.63, and 0.62). Other compounds had similar positive correlations, but were not nearly as strong. These compounds are acetylene, dichlorodifluoromethane, methyl ethyl ketone, and methylene chloride. All but two compounds (acetone and acetylene) had weak to strong negative correlations with the u-component of the wind.

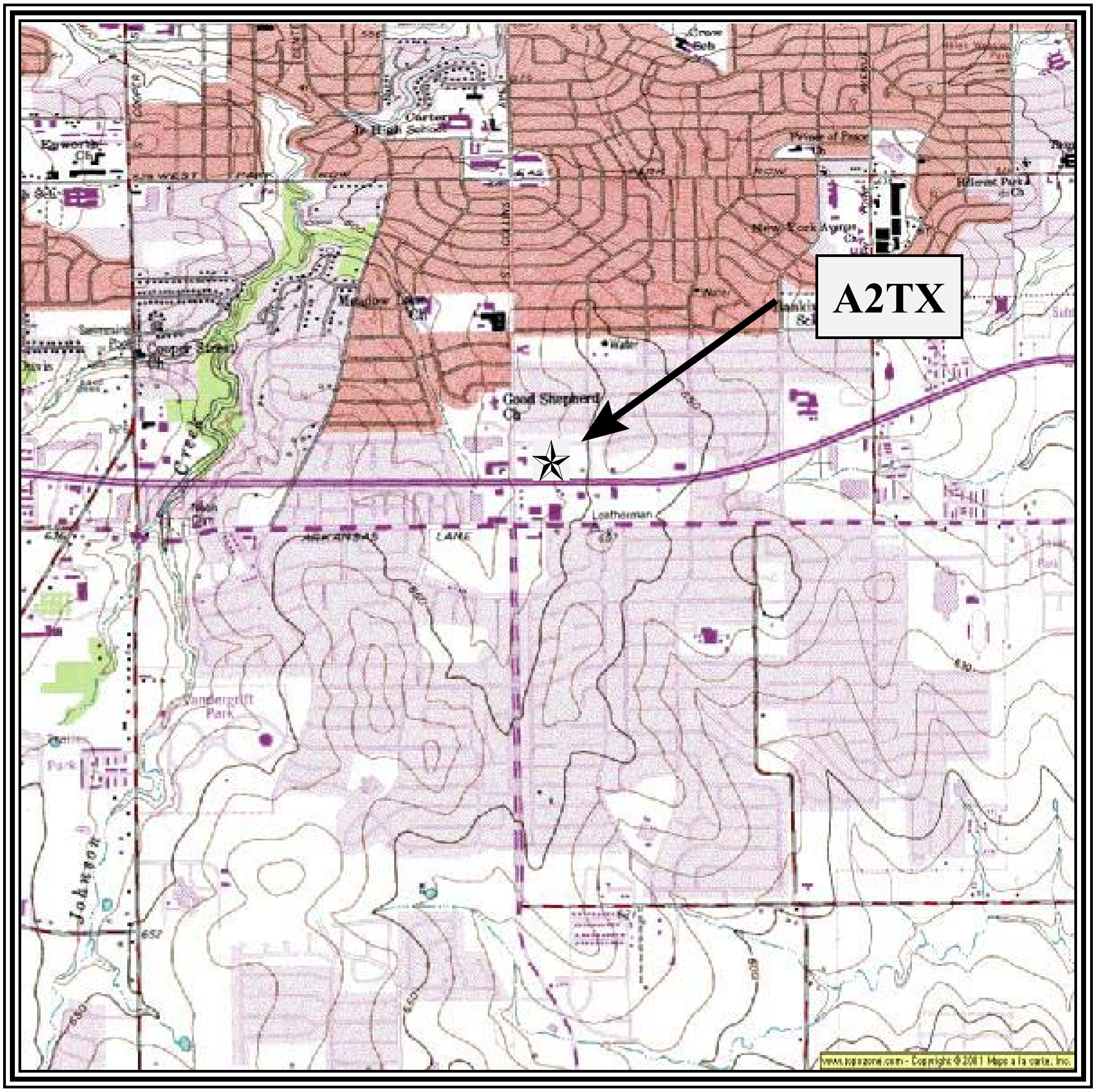
At EPTX, acetone demonstrated a moderately strong (between 0.25 and 0.50 or -0.25 and -0.50) to strong negative correlation with maximum and average temperature and dew point and wet bulb temperature, and acetylene showed a similar correlation to the same four parameters. On the other hand, chloromethane demonstrated a moderately strong to strong positive correlation with the previously mentioned parameters. All compounds showed a weak to moderately strong negative correlation with the u-component of the wind, while all but one (methyl ethyl ketone) showed a weak (between 0 and 0.25 or 0 and -0.25) to moderately strong positive correlation with the v-component of the wind. The temperature, moisture, and wind parameters tend to factor into the average concentrations of the compounds, but in varying ways and degrees.

15.2 Spatial Analysis

Using the population within ten miles of each site, an estimate of the number of motor vehicles operating in proximity to the monitoring station can be established. The ratio used in this report is 0.74 motor vehicles to every one person (refer to section 3.4.1 for more information on this ratio). The population near the A2TX site is 721,819 people, all of whom are operating approximately 534,416 motor vehicles. EPTX has a population of 423,488 people driving 313,381 automobiles. This information is compared to the average daily concentration of the prevalent compounds at each Texas site in Table 15-3. Also included in Table 15-3 are average daily traffic data, or more specifically, the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis.

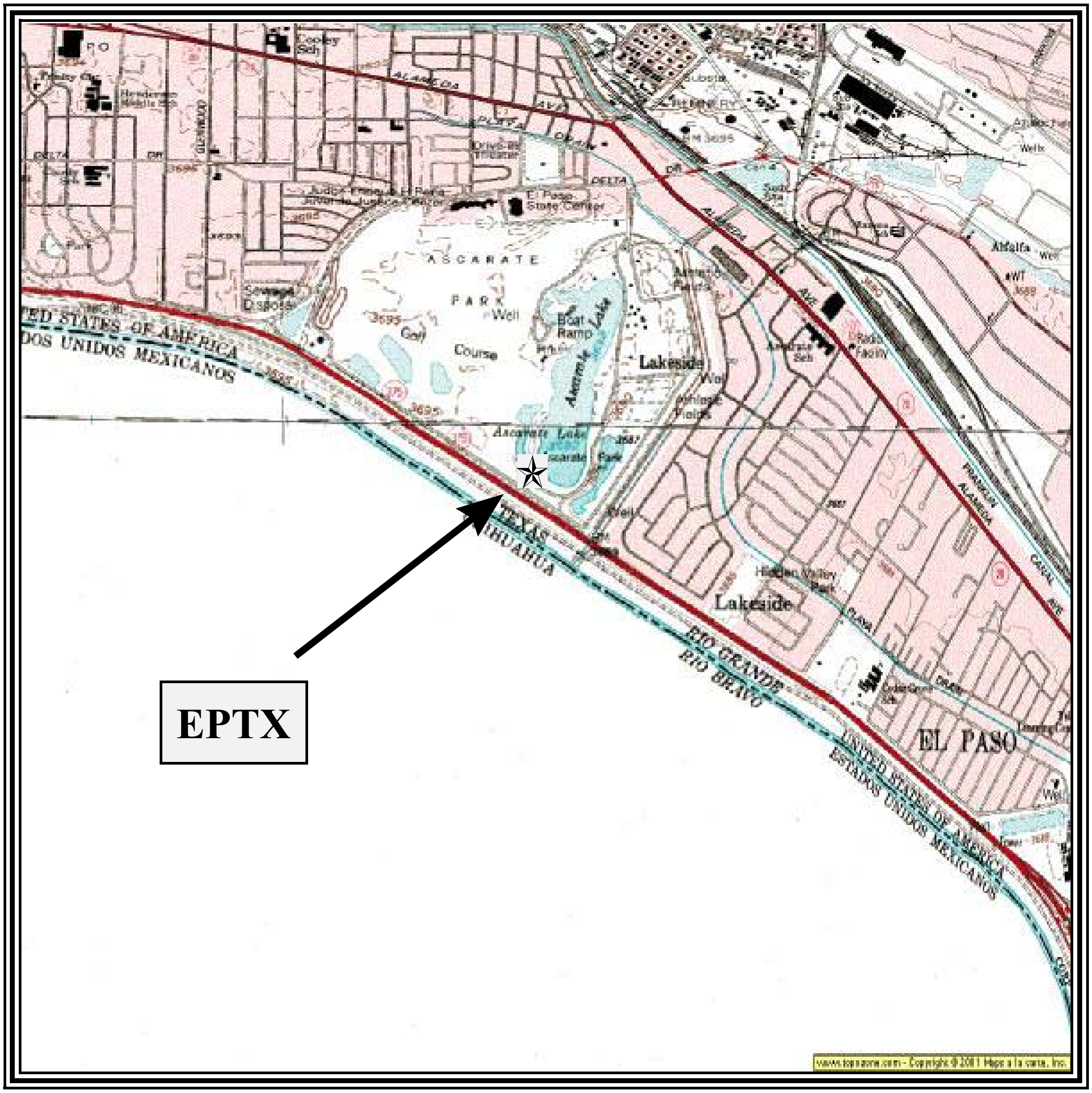
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area. (For more information on this study, refer to section 3.4.2.) Figure 3-16 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. The EPTX site's concentration ratios look very similar to the roadside study's, with one exception: the benzene-ethylbenzene ratio is slightly higher than the *m-,p*-xylene-ethylbenzene ratio, whereas the roadside study had a higher ratio for the *m-,p*-xylene-ethylbenzene. The A2TX site also had a higher benzene-ethylbenzene ratio than *m-,p*-xylene-ethylbenzene. The ratios were also higher at the A2TX site for benzene-ethylbenzene and toluene-ethylbenzene than for the same compounds for the roadside study.

Figure 15-1. Arlington, Texas (A2TX) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 15-2. El Paso, Texas (EPTX) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 15-3. Facilities Located Within 10 Miles of A2TX

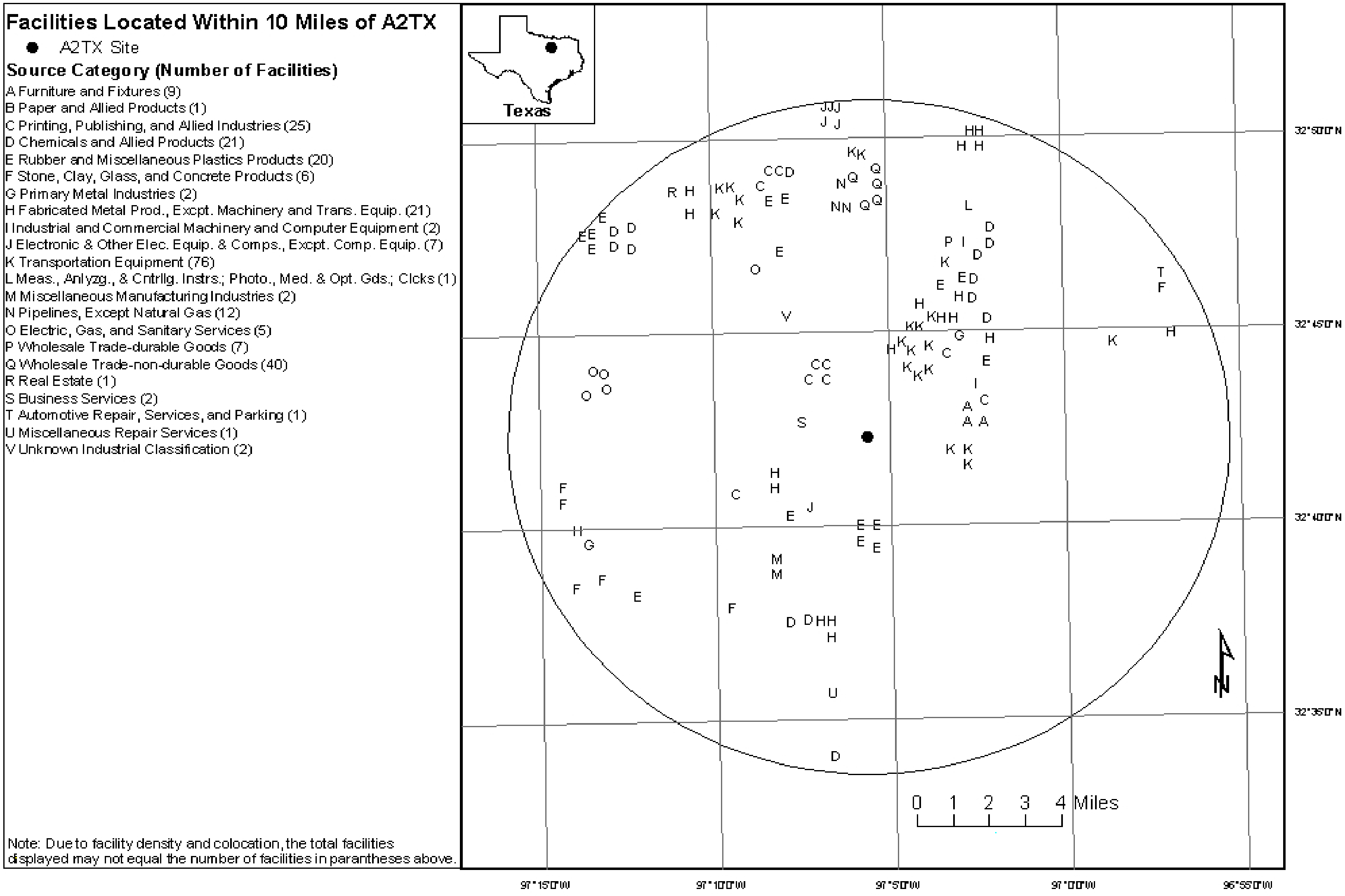


Figure 15-4. Facilities Located Within 10 Mile of EPTX

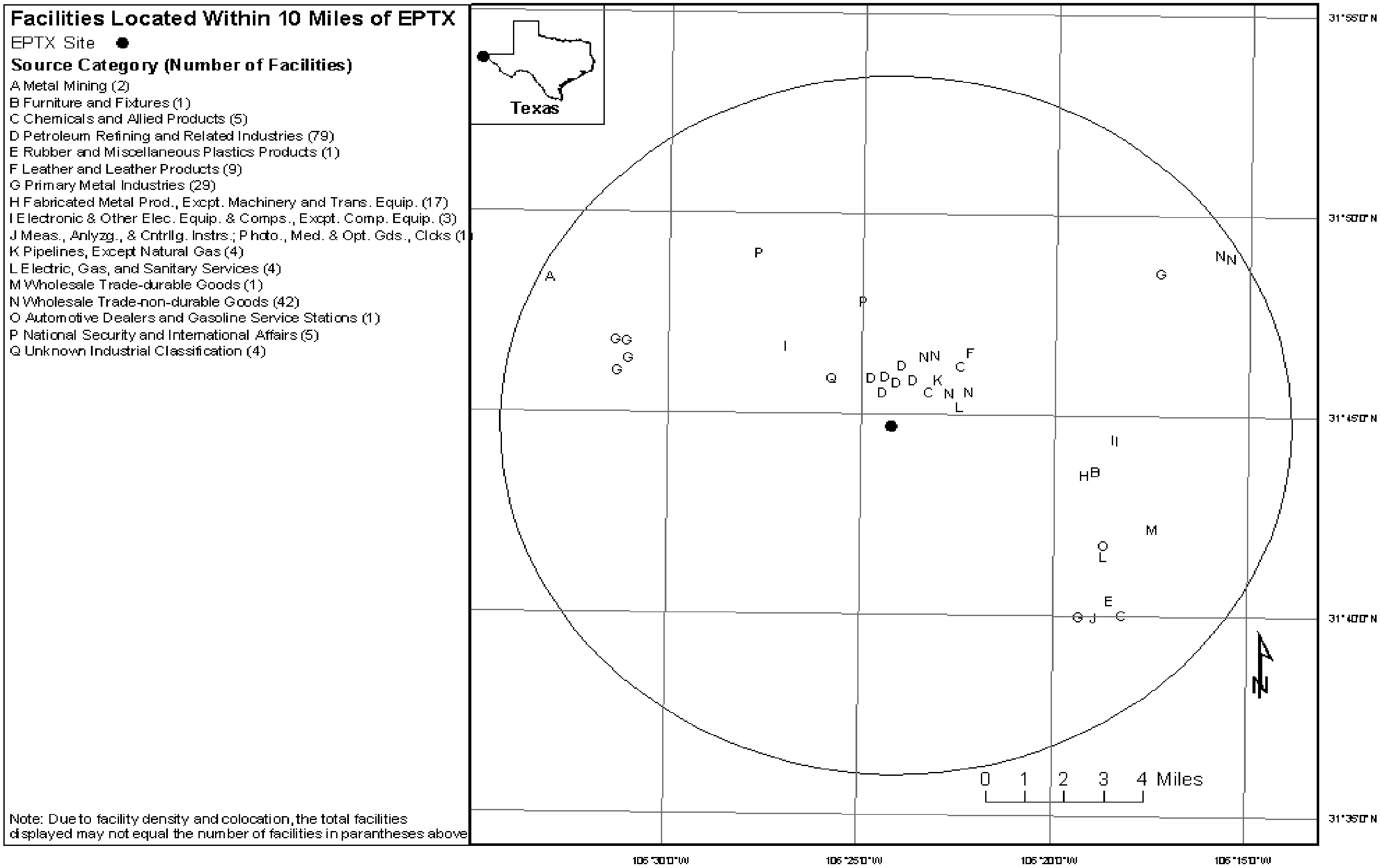


Table 15-1. Average Concentration and Meteorological Parameters for Sites in Texas

Site Name	Type	Average UATMP Concentration (ppbv)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
A2TX	All 2001	[redacted]	76.84 (±1.64)	61.31 (±1.84)	51.00 (±1.53)	55.10 (±1.55)	63.36 (±1.10)	-1.15 (±0.32)	3.01 (±0.71)
	sample day	29.43 (±13.35)	68.33 (±8.22)	54.99 (±9.07)	45.85 (±8.12)	49.92 (±8.11)	66.66 (±6.07)	0.21 (±2.18)	0.61 (±3.68)
EPTX	All 2001	[redacted]	80.01 (±1.54)	65.97 (±1.53)	36.19 (±1.42)	50.39 (±1.12)	36.48 (±1.49)	0.89 (±0.57)	0.49 (±0.34)
	sample day	29.25 (±11.52)	79.72 (±5.76)	65.33 (±5.31)	35.90 (±5.06)	50.01 (±3.95)	36.13 (±4.78)	0.93 (±1.70)	0.76 (±1.11)

Table 15-2a - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Arlington, Texas (A2TX)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.08	0.09	0.02	0.08	0.15	-0.06	-0.22
Acetone	-0.16	-0.12	-0.30	-0.19	-0.23	0.37	-0.37
Acetylene	-0.42	-0.33	-0.38	-0.35	0.12	0.15	-0.42
Benzene	-0.08	-0.10	-0.06	-0.08	0.25	-0.29	0.00
Chloromethane	0.84	0.81	0.89	0.85	0.25	-0.60	0.54
Dichlorodifluoromethane	0.36	0.34	0.23	0.30	-0.09	-0.10	0.06
Ethylbenzene	0.03	0.02	-0.07	-0.02	-0.05	-0.05	-0.12
Formaldehyde	0.61	0.64	0.62	0.62	0.02	-0.10	0.28
m-,p - Xylene	0.03	0.05	-0.06	0.00	-0.05	-0.01	-0.17
Methyl Ethyl Ketone	0.21	0.34	0.28	0.33	0.28	-0.08	-0.12
Methylene Chloride	0.54	0.51	0.46	0.48	-0.05	-0.32	0.31
o - Xylene	0.02	0.03	-0.07	-0.01	-0.06	-0.01	-0.16
Propylene	-0.14	-0.18	-0.19	-0.19	0.01	-0.15	0.03
Toluene	0.08	-0.07	-0.23	-0.15	-0.55	0.41	0.14

Table 15-2b - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at El Paso, Texas (EPTX)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.04	0.03	0.06	0.07	0.07	-0.13	0.04
Acetone	-0.23	-0.26	-0.59	-0.42	-0.39	-0.21	0.01
Acetylene	-0.38	-0.34	-0.39	-0.40	-0.03	-0.18	0.18
Benzene	-0.02	0.05	-0.14	-0.03	-0.21	-0.25	0.27
Chloromethane	0.45	0.49	0.41	0.51	-0.16	-0.14	0.13
Dichlorodifluoromethane	0.00	0.04	-0.09	-0.01	-0.19	-0.14	0.10
Ethylbenzene	0.10	0.17	0.04	0.12	-0.14	-0.22	0.27
Formaldehyde	0.02	0.01	-0.08	-0.03	-0.16	-0.35	0.23
m-,p - Xylene	0.09	0.16	0.02	0.11	-0.17	-0.22	0.29
Methyl Ethyl Ketone	-0.17	-0.12	-0.10	-0.12	0.05	-0.06	-0.14
Methylene Chloride	0.04	0.13	0.16	0.16	0.09	-0.12	0.12
o - Xylene	0.10	0.17	0.02	0.12	-0.17	-0.22	0.30
Propylene	-0.11	-0.06	-0.25	-0.15	-0.21	-0.23	0.20
Toluene	0.17	0.24	0.15	0.21	-0.09	-0.14	0.22

Table 15-3. Motor Vehicle Information vs. Daily Concentration for Texas Monitoring Sites

Monitoring Station	Population within Ten Miles	Estimated Number of Motor Vehicles Owned	Traffic Data (Daily Average)	Average Daily UATMP Concentration
A2TX	721,819	534,416	17,472	29.43 (±13.35) ppbv
EPTX	423,488	313,381	3,790	29.25 (±11.52) ppbv

16.0 Site in Utah

This section focuses on a few specific meteorological and concentration trends for the UATMP site in Utah (SLCU), which resides in Salt Lake City, in north central Utah. Figure 16-1 is a topographical map showing the monitoring station in its urban location. Figure 16-2 is a map identifying facilities within ten miles of the site that reported to the 1999 NEI. The map shows that there are numerous industrial facilities, of a variety of types, near the monitoring site, and most of them are to the northeast and east. Hourly meteorological data were retrieved for all of 2001 at Salt Lake City International Airport's weather station (WBAN 24124) near the site with the purpose of calculating correlations of meteorological data with ambient air concentration measurements.

Table 16-1 highlights the average UATMP concentration at each site, along with the temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), and wind information (average u- and v-components of the wind) for the entire year and on sampling days. The Salt Lake City area has a semi-arid continental climate, with large seasonal variations. The area is dry, located on the west side of the Wasatch Mountains, and the Great Salt Lake tends to have a moderating influence on the city's temperature. Moderate winds flow out of the southeast on average. This information can be found at the following web site:
http://www.ssec.org/idis/gates/States/physical/saltlak.htm.

16.1 Meteorological and Concentration Averages at the Utah Site

Carbonyl compounds and VOC (volatile organic compounds) were measured at this site, as indicated in Tables 3-3 and 3-4. The highest computed geometric mean belonged to the hydrocarbons (8.57 ppbv). The polar compounds had the lowest geometric mean, with a value of 2.16 ppbv, and the carbonyls and halogenated hydrocarbons' geometric means fell in between with values of 5.57 ppbv and 3.22 ppbv, respectively. The average total UATMP daily concentration at SLCU was 32.27 (±7.16) ppbv. Table 16-1 also lists the averages for selected meteorological parameters from January 2001 to December 2001, which is similar to the time period covered in this report. This site also opted to have total and speciated nonmethane organic compounds (SNMOC) sampled during its air toxic sampling. SNMOC/NMOC compounds are of particular interest because of their role in ozone formation. Readers are encouraged to review EPA's *2001 Nonmethane Organic Compounds (NMOC) and Speciated Nonmethane Organic Compounds (SNMOC) Monitoring Program, Final Report* (EPA, 2002) for more information on SNMOC/NMOC trends and concentrations. The average total NMOC value for SLCU was 306 (±104.05) ppbC, of which nearly 62% could be identified through speciation. Of the speciated compounds, isopentane measured the highest concentration at the SLCU (16.20 ppbC). Typical sources of isopentane are non-wood upholstered office side and arm chairs. This information is given in Table 16-3. Ozone concentrations were also sampled at this site on 123 sample days, and were retrieved from the U.S. EPA's AIRS database. The average ozone concentration for each sample day was 68 ppbv.

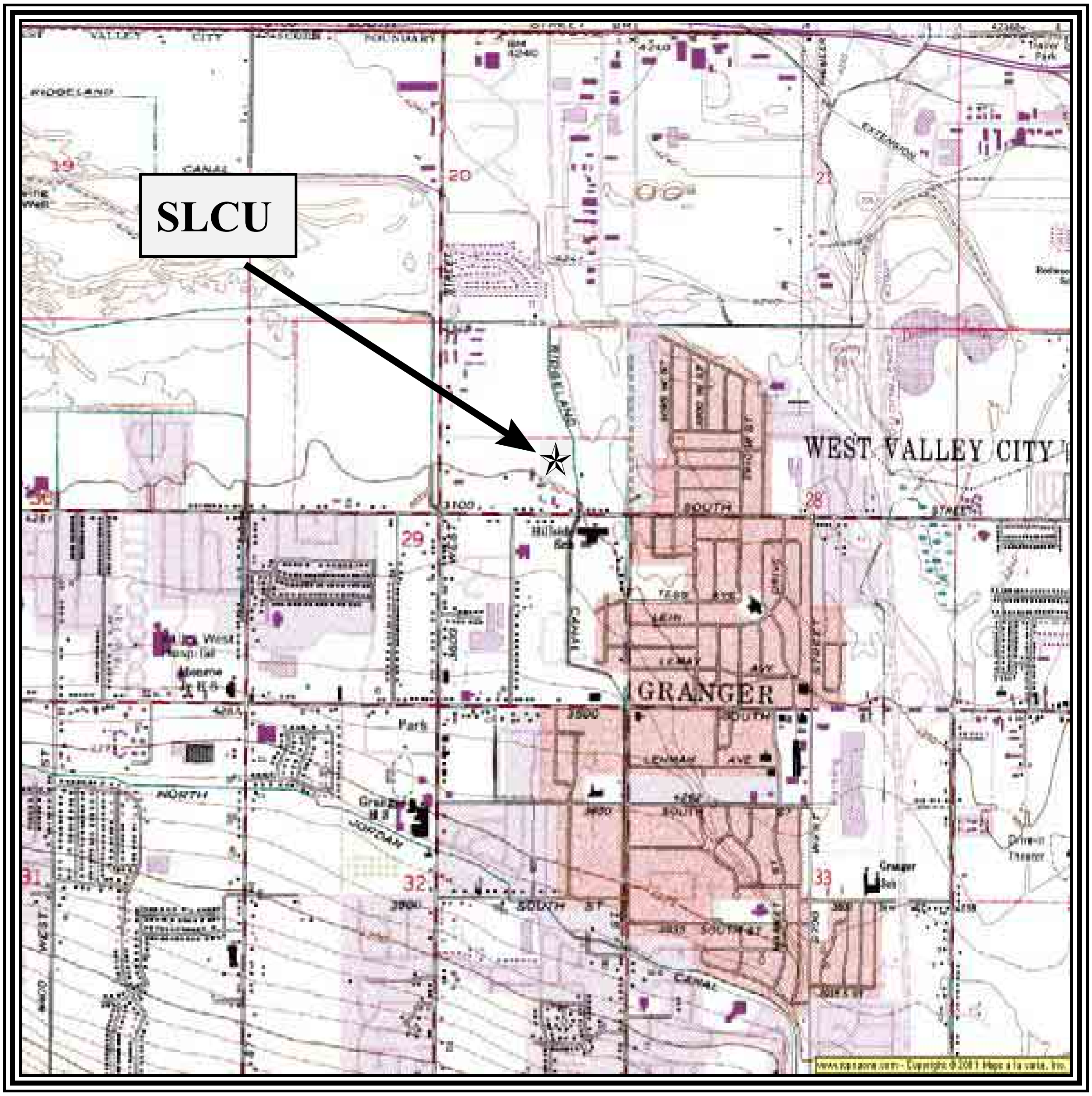
Table 16-2 is the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters. Identification of the prevalent compounds is discussed in Section 3 of this report. Acetylene had strong (between 0.50 and 0.75 or -0.50 and -0.75) negative correlations with maximum and average temperature and dew point and wet bulb temperature, and a strong positive correlation with relative humidity. Propylene had similar correlations, but somewhat weaker. Chloromethane, on the other hand, had the exact opposite correlations, having strong positive correlations with the maximum and average temperature and dew point and wet bulb temperature, and a moderately strong (between 0.25 and 0.50 or -0.25 and -0.50) negative correlation with relative humidity. The carbonyl compounds had moderately strong negative correlations with the v-component of the wind. The remainder of the computed correlations were generally weak (between 0 and 0.25 or 0 and -0.25) .

16.2 Spatial Analysis

Using the population within ten miles of each site, an estimate of the number of motor vehicles operating in proximity to the monitoring station can be established. The ratio used in this report is 0.74 motor vehicles to every one person (refer to section 3.4.1 for more information on this ratio). The population near the SLCU site is 819,703 people, all of whom are operating approximately 606,580 motor vehicles. This information is compared to the average daily concentration of the prevalent compounds at the Utah site in Table 16-4. Also included in Table 16-4 are average daily traffic data, or more specifically, the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis.

A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area. (For more information on this study, refer to section 3.4.2.) Figure 3-16 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. The SLCU site's concentration ratio for benzene-ethylbenzene ratio is higher than the *m-,p*-xylene-ethylbenzene ratio, whereas the roadside study had a higher ratio for the *m-,p*-xylene-ethylbenzene. The toluene-ethylbenzene concentration ratio is somewhat higher than that of the roadside study. The other two ratios, *m-,p*-xylene-ethylbenzene and *o*-xylene-ethylbenzene, look very similar to the roadside study's ratios for the same compounds.

Figure 16-1. Salt Lake City, Utah (SLCU) Monitoring Station



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 16-2. Facilities Located Within 10 Miles of SLCU

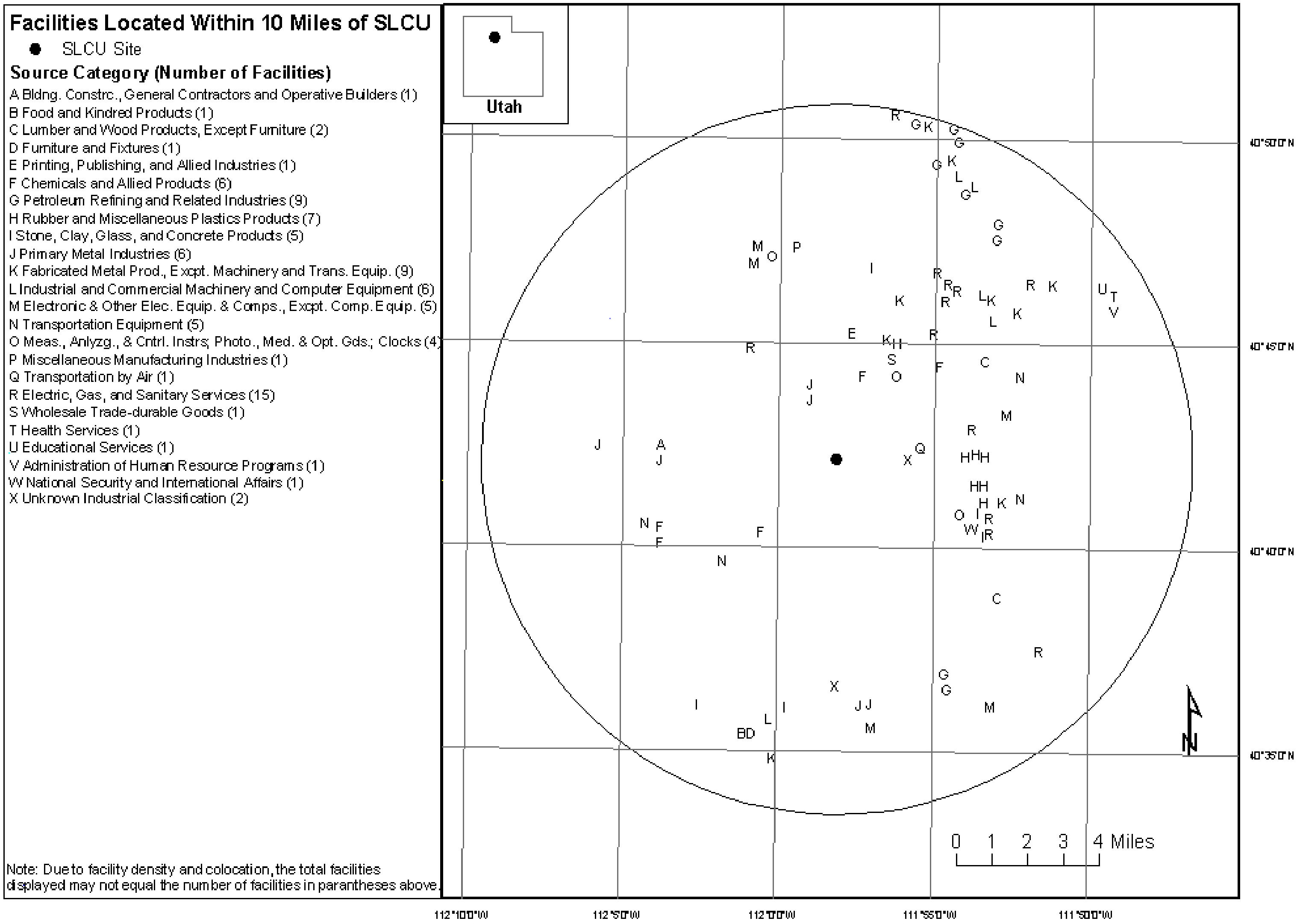


Table 16-1. Average Concentration and Meteorological Parameters for the Site in Utah

Site Name	Type	Average UATMP Concentration (ppbv)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
SLCU	All 2001		68.26 (±2.22)	54.03 (±2.14)	32.14 (±1.09)	42.64 (±1.44)	44.24 (±1.67)	-0.24 (±0.23)	1.39 (±0.49)
	sample day	32.27 (±7.16)	69.46 (±5.56)	54.15 (±5.50)	31.69 (±2.65)	42.46 (±3.67)	42.15 (±3.68)	-0.11 (±0.54)	1.06 (±1.11)

Table 16-2 - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Salt Lake City, Utah (SLCU)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.13	0.08	0.02	0.05	-0.19	0.25	-0.50
Acetone	0.22	0.17	0.07	0.15	-0.14	0.12	-0.33
Acetylene	-0.55	-0.62	-0.53	-0.62	0.51	0.02	0.05
Benzene	-0.15	-0.20	-0.12	-0.18	0.32	-0.21	0.07
Chloromethane	0.58	0.55	0.59	0.58	-0.35	-0.11	-0.06
Dichlorodifluoromethane	0.19	0.20	0.29	0.23	0.07	-0.12	-0.05
Ethylbenzene	-0.04	-0.07	-0.01	-0.05	0.24	-0.24	0.07
Formaldehyde	0.11	0.01	0.00	0.00	-0.16	0.34	-0.49
m-,p - Xylene	-0.06	-0.09	-0.03	-0.07	0.25	-0.24	0.06
Methyl Ethyl Ketone	0.05	0.07	0.12	0.08	0.06	-0.07	0.13
Methylene Chloride	0.08	0.05	-0.03	0.04	-0.04	-0.26	0.10
o - Xylene	-0.12	-0.15	-0.09	-0.13	0.28	-0.22	0.07
Propylene	-0.24	-0.30	-0.22	-0.29	0.34	-0.20	0.14
Toluene	0.06	0.02	0.06	0.04	0.16	-0.26	0.08

Table 16-3. TNMOC and Ozone Measured by the Salt Lake City, UT (SLCU) Monitoring Station

Average Ozone Concentrations from May-Aug	Total Number of Ozone Sampling Days	Average TNMOC (speciated)	Average TNMOC (w/ unknowns)	% TNMOC Identified	SNMOC Compound with the Highest Concentration	Typical Emission Sources
68.00 ppbv	123	189 (±22.51) ppbC	306 (±104.05) ppbC	62%	Isopentane (16.20 ppbC)	Non-wood upholstered office side and arms chairs

Table 16-4. Motor Vehicle Information vs. Daily Concentration for the Utah Monitoring Site

Monitoring Station	Population within Ten Miles	Estimated Number of Motor Vehicles Owned	Traffic Data (Daily Average)	Average Daily UATMP Concentration
SLCU	819,703	606,580	20,485	32.27 (±7.16) ppbv

17.0 Data Quality

This section the precision and accuracy of ambient air concentration measurements during the 2001 UATMP. As indicators of the reliability of experimental measurements, both precision and accuracy must be considered when interpreting ambient air monitoring results. In general, this section shows that the 2001 UATMP monitoring data are of a known and high quality, particularly for the most program-wide prevalent compounds in urban air. Collocated duplicate samples were collected in the State of Michigan. The precision and accuracy of these collocated samples are discussed further in Sections 17.1.1 and 17.2. All calculations were based on sample concentrations detected above the method detection limits for each compound.

Calculation of method precision for the UATMP is determined by repeated analysis of duplicate samples. Ten percent of all sample collections were duplicate samples. A duplicate sample is a sample collected simultaneously with a primary sample (i.e., in two separate canisters through the same sampling system at the same time). This simultaneous collection is typically achieved by teeing the line from the sampler to each of the two canisters and doubling the flow rate applied to achieve integration over the 24-hour collection period.

The only exception to this approach was for the State of Michigan, Detroit's Pilot Project. For this Pilot Project, collocated samples were collected and analyzed in replicate. The difference between duplicate and collocated samples is that the duplicate samples are collected from two canisters using one collection system, whereas collocated samples are collected at the same time but using two completely separate collection systems.

Both approaches provide valuable, but different, assessment of method precision as follows:

- Replicate analysis of duplicate samples provides information on the potential for variability (or precision) expected from a single collection system, but does not provide information on the variability expected between different collection systems.

- Replicate analysis of collocated samples provide information on the potential for variability (or precision) expected between different collection systems, but does not provide information on the variability expected from single collection systems.

17.1 Precision

Precision refers to the agreement between independent measurements performed according to identical protocols and procedures. To quantify "sampling and analytical precision" (i.e., how precisely the sampling and analytical methods measure ambient air concentrations), concentrations measured during analysis of duplicate samples are compared.

> *Applied to ambient air monitoring data, precision is a measurement of random errors inherent to the process of sampling and analyzing ambient air.*

17.1.1 Analytical Precision

Analytical precision is a measurement of random errors associated with laboratory analysis of environmental samples. These errors may result from various factors, but typically originate from random "noise" inherent to analytical instruments. Laboratories can easily evaluate analytical precision by comparing concentrations measured during replicate analysis of the same ambient air samples. This report uses two parameters to quantify random errors indicated by replicate analyses of 2001 UATMP samples:

- ***Average concentration difference*** simply quantifies how replicate analytical results differ, on average, for each compound. When interpreting central tendency estimates for specific compounds sampled during the 2001 UATMP, participating agencies are encouraged to compare central tendencies to the average concentration differences. If a compound's average concentration difference exceeds or nearly equals its central tendency, the analytical method may not be capable of precisely characterizing annual concentrations. Therefore, data interpretation for these compounds should be made with caution.

- ***Relative percent difference (RPD)*** expresses average concentration differences relative to the average concentrations detected during replicate analyses. The RPD is calculated as follows:

$$RPD = \frac{/X_1 - X_2/}{\bar{X}} \times 100 \qquad \textbf{(1)}$$

Where:

X_1 is the ambient air concentration of a given compound measured in one sample;
X_2 is the concentration of the same compound measured during replicate analysis; and
$\bar{X}$ is the arithmetic mean of X_1 and X_2.

As Equation 1 shows, replicate analyses with low variability have lower RPDs (and better precision), and replicate analyses with high variability have higher RPDs (and poorer precision).

The following approach was employed to estimate how precisely the central laboratory analyzed 2001 UATMP samples:

- RPDs and concentration differences were calculated for every replicate analysis performed during the program. In cases where compounds were not detected during replicate analyses, these parameters were not calculated.
- Second, to make an overall estimate of method precision, program-average RPDs and concentration absolute differences were calculated for each compound by averaging the values from the individual replicate analyses.

Tables 17-1 and 17-2 use both absolute average concentration differences and RPDs to characterize the analytical precision representing all sites for VOC, representing replicate analysis of duplicate samples and replicate analysis of collocated samples, respectively.

In Table 17-1, the replicate analytical data for duplicate samples show that laboratory VOC analysis precision was within the control limits of 85 to 100 percent, with the exception of acrylonitrile and methyl methacrylate at 32.4 and 33.5 percent, respectively. The method was most precise when measuring air concentrations for the program-wide prevalent compounds (i.e., compounds consistently found at levels exceeding their detection limits). For the duplicate VOC, samples exhibit RPDs ranging from 0.2 percent to 33.5 percent. The relatively high variability for the methyl methacrylate resulted from poor agreement from replicate analysis of one set of samples collected on September 29, 2001 in El Paso, Texas (EPTX). The poor precision for acrylonitrile was due to poor agreement from replicate samples from Muscatine, IA (MUIA) on February 18, 2001 and from Grand Junction, CO (G2CO) on September 22, 2001. Both of these compounds were detected in less than 4% of all replicate samples analyzed (16 samples for acrylonitrile and 7 for methyl methacrylate out of 372 possible samples). In terms of average concentration difference, the precision of the VOC analytical method was fairly uniform across compounds, ranging from 0.01 ppbv for dichlorotetrafluoroethane, trichlorotrifluoroethane, bromochloromethane, and chloroform to 1.78 ppbv for acetonitrile.

Table 17-2 shows the RPD for the results from replicate analysis of collocated VOC samples taken at the Dearborn site in Detroit, Michigan. The replicate results from collocated samples vary little for the majority of the compounds, ranging from 0.2 percent to 23.2 percent. The highest RPD (23.2%) was calculated for methyl ethyl ketone, with an average concentration difference of 0.26 ppbv, showing a low precision and variability between compounds.

Table 17-3 presents replicate analytical data for duplicate SNMOC samples. The RPD was less than 30 percent for every SNMOC compound with the exception of 3-methyl-1-butene which had an RPD of 32.5 percent. The average concentration differences observed for replicate analyses of SNMOC compounds ranged from 0.05 to 1.5 ppbC. The total speciated and total hydrocarbons (speciated and unspeciated) showed the greater concentration differences ranging from 7.26 to 22.5 ppbC, respectively.

Table 17-4 shows precision for replicate laboratory analysis of duplicate carbonyl samples during the 2001 UATMP. The RPD ranged from 4.3 percent for formaldehyde to 27.0 percent for 2,5-dimethylbenzaldehyde. The average concentration differences observed for replicate analyses of carbonyl compounds was less than or equal to 0.22 ppbv. Table 17-5 shows the RPD for the replicate analysis of collocated samples for the Dearborn site. The replicate analyses for collocated samplers vary for the majority of the compounds ranging from formaldehyde at 7.8 percent to tolualdehyde at 34.1 percent.

Replicate analytical data for semivolatile analysis are presented in Table 17-6. The RPD was calculated for the only site that sampled semivolatiles in 2001, which was a site with collocated samplers at Allen Park in Michigan. All replicate analyses were less than 18.0 percent for all detected compounds, with the exception of phenanthrene, which had a RPD at 56.38 percent. The poor precision for phenanthrene was due to poor agreement from replicate samples obtained on June 18, 2001. The average concentration differences observed for all observed the replicate analyses were less than 0.05 μg/m^3.

Replicate analytical data for hexavalent chromium (Cr^{6+})analysis are presented in Table 17-7. The RPD was calculated for only one of the four sites that sampled for Cr^{6+}, in 2001. This site was at River Rouge in Michigan, with collocated samplers. All replicate analyses were less than 14.4 percent for hexavalent chromium. The average concentration differences observed on the replicate analyses were less than 0.008 μg/m^3.

Overall, replicate analyses both duplicate and collocated of VOC, SNMOC, carbonyl compounds, semivolatile, and hexavalent chromium samples suggest that the corresponding analytical methods consistently measured each compound in air samples at a precision with an average concentration difference less than 20 percent. This precision level is well within the UATMP data quality objectives (USEPA, 2002) and guidelines in the Compendium Methods (USEPA, 1999).

17.1.2 Sampling and Analytical Precision

As the name implies, *sampling and analytical precision* quantifies random errors associated not only with analyzing ambient air samples in the laboratory but also with collecting the samples in the field. This form of precision is most easily evaluated by comparing concentrations measured in duplicate samples collected off the same manifold. During the 2001 UATMP, duplicate samples were collected on approximately 10 percent of the scheduled sampling days, and most of these samples were analyzed in replicate. Collocated samples were collected on a schedule designed by the State of Michigan, the only State collecting collocated samples.

To calculate sampling and analytical precision, data analysts first averaged the results from each replicate analysis performed, then compared these average concentrations between the two samples in each duplicate. Tables 17-8 through 17-9, 17-11 through 17-13, 17-15 through 17-16 present average concentration differences and RPDs as estimates of duplicate and collocated sampling and analytical precision for VOC, SNMOC, carbonyls, semivolatiles, and hexavalent chromium measurements, respectively. It should be noted that the number of observations from Tables 17-1 through 17-7, in comparison to the respective tables listed for duplicate analyses in Tables 17-8 through 17-16, is approximately twice as high.

Table 17-8, presenting the sampling and analytical data for VOC, shows that the duplicates samples collected during the 2001 UATMP were in excellent agreement (i.e., below 30 percent average RPD). The average concentration difference ranged from 0.01 for trichloroethylene to 2.92 ppbv for acetonitrile. The collocated VOC sampling and analytical data are presented in Table 17-9, and the comparison between duplicate and collocated data is shown in Table 17-10. The greatest differences in average RPD for collocated samples were measured for acetonitrile and methylene chloride, at 42.1 and 118.7 percent, respectively. The collocated samples consistently show a greater average RPD with comparison to the duplicate samples for the higher molecular weight compounds (i.e., methyl isobutyl ketone and higher), as Table 17-10 presents. The samples that are represented as Not Applicable (“NA”), and have a RPD for the corresponding duplicate or collocated sample, are also flagged with an “NA”.

The SNMOC precision for duplicate samples is presented in Table 17-11. Relative percent differences for replicate analyses for duplicate samples ranged from 3.1 for ethane to 121.4 percent for dodecane. This high variability is due to the low detections - less than 5 times the detection limit. The VOC and SNMOC sampling and analytical precision data presented in Tables 17-8 and 17-11 do not differ significantly from the analytical precision data in Tables 17-1 and 17-3, respectively. This similarity suggests that limitations associated with laboratory analysis of the VOC and SNMOC samples during the 2001 UATMP probably outweighed random errors associated with sampling procedures.

The duplicate sampling results presented in Table 17-12 show that the results for carbonyl compounds were relatively precise. The high variability, RPD above 30 percent, is due to detection at levels less than five times the detection limits. Variability is higher at these low concentrations. The high variability is also shown for the collocated samples presented in Table 17-13, but the variability is not caused by low concentrations in the samples. After removing all of the compound results below five times the detection limit, the RPD values range from 26.1 to 78.2 percent, in comparison to 26.9 to 215 percent (as shown in Table 17-12) including low detections. For most compounds, the duplicate sampling and analytical RPDs (see Table 17-12) were notably higher than the analytical precision RPDs (see Table 17-4)—a trend that differs from the trend observed for VOC or SNMOC. This observation suggests that random errors associated with collecting air samples and random errors associated with analyzing these samples both contributed significantly to overall imprecision in the carbonyl compound sampling and analytical method. As the estimates of sampling and analytical precision show, however, such sources of contamination did not have significant impacts on the carbonyl compound monitoring results. The comparisons between duplicate and collocated samples, presented in Table 17-14, also show the variability between samplers as previously encountered with the VOC samples.

The sampling and analytical precision for collocated semivolatile samples are presented in Table 17-15, and was less than 10 percent for all compounds detected. The sampling and analytical precision data presented in Table 17-6 do not differ significantly from the analytical precision data in Table 17-15. This similarity suggests that limitations associated with laboratory analysis of the semivolatile samples during the 2001 UATMP probably outweighed random errors associated with sampling procedures.

Analytical data for hexavalent chromium (Cr^{6+}) samples are presented in Table 17-16. The RPD was calculated for only one of the four sites that sampled for Cr^{6+}, in 2001. The RPD is 40 percent for this collocated site but less than 20 percent for values higher than five times the detection limit. All replicate analyses were less than 40.7 percent for all detected compounds. The average concentration differences observed on the replicate analyses was less than 0.024 $\mu g/m^3$.

To summarize, duplicate sampling results indicate that the 2001 UATMP air quality measurements generally have sampling and analytical precision better than 25 percent—well within the UATMP data quality objectives of 100 percent (USEPA, 1988). This excellent measurement precision suggests that the 2001 UATMP monitoring data offer a precise account of air quality at the selected monitoring locations, especially for the most program-wide prevalent compounds. Although random errors had very small impacts on measurement of the less program-wide prevalent compounds, participating agencies should note that the central tendencies for these compounds have nearly the same magnitude as the average concentration difference. Therefore, central tendency concentrations for these less program-wide prevalent compounds should be interpreted with caution.

Measurements from collocated samplers have higher variations than the standard duplicate sampling as performed by the National UATMP. Because collocated sampling varies the sampling media as well as the sampler (including sampling probes), higher RPD values should be expected. The variation, however, should not cause the validity of the data to be questioned, but should allow the State Agencies extra information to qualify the data.

17.2 Accuracy

Highly accurate air sampling and analytical methods can measure air concentrations in very close agreement to actual ambient levels. Laboratories typically evaluate their accuracy by analyzing external audit samples and comparing measured concentrations to the known concentrations of the audit samples.

> *Accuracy* indicates the extent to which experimental measurements represent their corresponding “true” or “actual” values.

Air Toxics Pilot Laboratory Intercomparison studies were performed in November 2001. A Quality Assurance Report for all laboratories that participated in this study is available on EPA’s web site: http://www.epa.gov/ttn/amtic/files/ambient/airtox/atpilot.pdf. ERG also prepares audits standards for different State laboratories. Table 17-17 presents the analytical comparisons for carbonyls between ERG and other State laboratories.

The accuracy of the 2001 UATMP monitoring data can also be assessed qualitatively by reviewing the accuracy of the monitoring methods and how they were implemented:

- The sampling and analytical methods used in the 2001 UATMP (i.e., Compendium Methods TO-11A and TO-15) have been approved by EPA for accurately measuring ambient levels of VOC and carbonyl compounds, respectively—an approval that is based on many years of research into the development of ambient air monitoring methodologies.
- When collecting and analyzing ambient air samples, all field sampling staff and laboratory analysts strictly followed quality control and quality assurance guidelines detailed in the respective monitoring methods. This strict adherence to the well-documented sampling and analytical methods suggests, though certainly does not prove, that the 2001 UATMP monitoring data accurately represent ambient air quality.

Table 17-1. VOC Sampling and Analytical Precision: Total 372 Replicates on Duplicate Samples

Compound	Number of Observations	Average RPD in Replicate Analysis (%)	Average Concentration Difference in Replicate Analysis (ppbv)
Acetylene	371	9.55	0.15
Propylene	372	10.88	0.06
Dichlorodifluoromethane	372	6.30	0.09
Chloromethane	372	7.96	0.06
Dichlorotetrafluoroethane	1	NA	0.01
Vinyl Chloride	0	NA	NA
1,3-Butadiene	137	15.16	0.03
Bromomethane	9	12.77	0.04
Chloroethane	13	23.45	0.07
Acetonitrile	31	8.68	1.78
Trichlorofluoromethane	371	7.69	0.03
Acrylonitrile	16	32.43	0.43
1,1-Dichloroethene	4	9.93	0.03
Methylene Chloride	286	13.71	0.06
Trichlorotrifluoroethane	366	10.75	0.01
trans - 1,2 - Dichloroethylene	0	NA	NA
1,1 - Dichloroethane	0	NA	NA
Methyl tert-Butyl Ether	121	8.60	0.07
Methyl Ethyl Ketone	339	29.57	0.24
Chloroprene	0	NA	NA
cis-1,2-Dichloroethylene	0	NA	NA
Bromochloromethane	4	3.16	0.01
Chloroform	26	16.76	0.01
Ethyl tert-Butyl Ether	0	NA	NA
1,2 - Dichloroethane	0	NA	NA
1,1,1 - Trichloroethane	17	20.03	0.05
Benzene	372	6.95	0.04
Carbon Tetrachloride	244	9.11	0.03
tert-Amyl Methyl Ether	4	0.15	0.18
1,2 - Dichloropropane	0	NA	NA
Ethyl Acrylate	0	NA	NA
Bromodichloromethane	0	NA	NA
Trichloroethylene	16	20.57	0.04
Methyl Methacrylate	7	33.52	0.60
cis -1,3 - Dichloropropene	0	NA	NA
Methyl Isobutyl Ketone	37	13.56	0.20
trans - 1,3 - Dichloropropene	0	NA	NA
1,1,2 - Trichloroethane	0	NA	NA

Table 17-1. VOC Sampling and Analytical Precision: Total 372 Replicates on Duplicate Samples (Continued)

Compound	Number of Observations	Average RPD in Replicate Analysis (%)	Average Concentration Difference in Replicate Analysis (ppbv)
Toluene	372	6.14	0.13
Dibromochloromethane	0	NA	NA
1,2-Dibromoethane	0	NA	NA
n-Octane	181	19.77	0.03
Tetrachloroethylene	37	7.52	0.02
Chlorobenzene	5	5.16	0.02
Ethylbenzene	346	8.26	0.03
m,p - Xylene	362	7.63	0.07
Bromoform	0	NA	NA
Styrene	74	14.29	0.04
1,1,2,2 - Tetrachloroethane	0	NA	NA
o - Xylene	332	8.96	0.04
1,3,5-Trimethylbenzene	134	8.18	0.03
1,2,4-Trimethylbenzene	271	10.14	0.03
m - Dichlorobenzene	0	NA	NA
Chloromethylbenzene	0	NA	NA
p - Dichlorobenzene	14	9.96	0.03
o - Dichlorobenzene	0	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA

Table 17-2. VOC Sampling and Analytical Precision: Total 104 Replicates of Collocated Samples

Compound	Number of Observations	Average RPD in Replicate Analysis (%)	Average Concentration Difference in Replicate Analysis (ppbv)
Acetylene	104	7.09	0.10
Propylene	104	5.71	0.10
Dichlorodifluoromethane	104	5.16	0.03
Chloromethane	104	6.45	0.04
Dichlorotetrafluoroethane	0	NA	NA
Vinyl Chloride	0	NA	NA
1,3-Butadiene	41	19.29	0.03
Bromomethane	0	NA	NA
Chloroethane	2	NA	0.07
Acetonitrile	38	16.78	0.58
Trichlorofluoromethane	104	6.19	0.02
Acrylonitrile	0	NA	NA
1,1-Dichloroethene	0	NA	NA
Methylene Chloride	100	7.33	0.07
Trichlorotrifluoroethane	104	8.53	0.01
trans - 1,2 - Dichloroethylene	0	NA	NA
1,1 - Dichloroethane	0	NA	NA
Methyl tert-Butyl Ether	7	7.37	0.06
Methyl Ethyl Ketone	86	23.17	0.26
Chloroprene	0	NA	NA
cis-1,2-Dichloroethylene	1	NA	0.34
Bromochloromethane	0	NA	NA
Chloroform	3	17.68	0.03
Ethyl tert-Butyl Ether	0	NA	NA
1,2 - Dichloroethane	0	NA	NA
1,1,1 - Trichloroethane	2	15.95	0.01
Benzene	104	3.95	0.03
Carbon Tetrachloride	99	7.70	0.01
tert-Amyl Methyl Ether	0	NA	NA
1,2 - Dichloropropane	0	NA	NA
Ethyl Acrylate	0	NA	NA
Bromodichloromethane	0	NA	NA
Trichloroethylene	2	7.48	1.14
Methyl Methacrylate	0	NA	NA
cis -1,3 - Dichloropropene	0	NA	NA
Methyl Isobutyl Ketone	12	7.07	0.13
trans - 1,3 - Dichloropropene	0	NA	NA
1,1,2 - Trichloroethane	0	NA	NA

Table 17-2. VOC Sampling and Analytical Precision: Total 104 Replicates of Collocated Samples (Continued)

Compound	Number of Observations	Average RPD in Replicate Analysis (%)	Average Concentration Difference in Replicate Analysis (ppbv)
Toluene	104	5.56	0.07
Dibromochloromethane	0	NA	NA
1,2-Dibromoethane	0	NA	NA
n-Octane	52	21.12	0.04
Tetrachloroethylene	47	14.11	0.02
Chlorobenzene	0	NA	NA
Ethylbenzene	100	7.61	0.02
m,p - Xylene	104	7.36	0.03
Bromoform	1	NA	0.77
Styrene	7	14.24	0.04
1,1,2,2 - Tetrachloroethane	0	NA	NA
o - Xylene	102	8.34	0.02
1,3,5-Trimethylbenzene	44	9.77	0.04
1,2,4-Trimethylbenzene	99	8.41	0.02
m - Dichlorobenzene	0	NA	NA
Chloromethylbenzene	0	NA	NA
p - Dichlorobenzene	4	0.23	0.08
o - Dichlorobenzene	0	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA

Table 17-3. SNMOC Sampling and Analytical Precision: Total 192 Replicates on Duplicate Samples

Compound	Number of Observations	Average RPD in Replicate Analysis (%)	Average Concentration Difference in Replicate Analysis (ppbv)
Ethylene	192	2.97	0.11
Acetylene	192	3.65	0.12
Ethane	192	1.97	0.16
Propylene	192	3.26	0.06
Propane	192	2.45	0.24
Propyne	0	NA	NA
Isobutane	192	3.30	0.10
Isobutene/1-Butene	191	5.31	0.16
1,3-Butadiene	64	6.51	0.06
n-Butane	192	3.37	0.25
trans-2-Butene	106	5.42	0.06
cis-2-Butene	179	8.98	0.05
3-Methyl-1-butene	25	32.45	0.70
Isopentane	178	12.56	1.45
1-Pentene	168	12.11	0.16
2-Methyl-1-butene	106	14.18	0.14
n-Pentane	192	3.33	0.16
Isoprene	158	5.04	0.05
trans-2-Pentene	147	4.51	0.06
cis-2-Pentene	151	6.39	0.08
2-Methyl-2-butene	115	6.40	0.09
2,2-Dimethylbutane	190	11.49	0.07
Cyclopentene	60	14.30	0.17
4-Methyl-1-pentene	2	NA	0.27
Cyclopentane	178	9.50	0.06
2,3-Dimethylbutane	192	20.23	0.14
2-Methylpentane	192	16.37	0.44
3-Methylpentane	191	4.25	0.08
2-Methyl-1-pentene	24	10.03	0.27
1-Hexene	192	9.20	0.05
2-Ethyl-1-butene	1	NA	0.92
n-Hexane	191	6.40	0.15
trans-2-Hexene	1	NA	0.31
cis-2-Hexene	7	7.14	0.12
Methylcyclopentane	189	4.74	0.06
2,4-Dimethylpentane	189	7.29	0.06
Benzene	192	5.85	0.18

Table 17-3. SNMOC Sampling and Analytical Precision: Total 192 Replicates on Duplicate Samples (Continued)

Compound	Number of Observations	Average RPD in Replicate Analysis (%)	Average Concentration Difference in Replicate Analysis (ppbv)
Cyclohexane	191	5.92	0.10
2-Methylhexane	179	7.91	0.11
2,3-Dimethylpentane	192	9.03	0.08
3-Methylhexane	167	18.04	0.22
1-Heptene	58	9.16	0.14
2,2,4-Trimethylpentane	186	7.18	0.17
n-Heptane	182	7.66	0.07
Methylcyclohexane	178	9.96	0.12
2,2,3-Trimethylpentane	77	9.16	0.20
2,3,4-Trimethylpentane	157	6.93	0.08
Toluene	192	8.21	0.92
2-Methylheptane	90	16.84	0.18
3-Methylheptane	116	14.42	0.15
1-Octene	54	7.46	0.07
n-Octane	155	20.19	0.18
Ethylbenzene	168	17.31	0.21
m-Xylene/p-Xylene	186	19.65	0.53
Styrene	181	13.79	0.33
o-Xylene	176	10.39	0.15
1-Nonene	49	12.90	0.18
n-Nonane	133	14.28	0.16
Isopropylbenzene	54	6.78	0.15
a-Pinene	74	12.70	0.29
n-Propylbenzene	105	8.64	0.06
m-Ethyltoluene	158	9.53	0.13
p-Ethyltoluene	143	11.58	0.11
1,3,5-Trimethylbenzene	115	11.43	0.09
o-Ethyltoluene	106	13.31	0.15
b-Pinene	94	11.65	0.22
1,2,4-Trimethylbenzene	183	8.14	0.11
1-Decene	0	NA	NA
n-Decane	161	19.91	0.25
1,2,3-Trimethylbenzene	107	9.07	0.09
m-Diethylbenzene	104	26.41	0.26
p-Diethylbenzene	109	13.96	0.14
1-Undecene	30	6.25	0.06
n-Undecane	183	15.86	0.24

Table 17-3. SNMOC Sampling and Analytical Precision: Total 192 Replicates on Duplicate Samples (Continued)

Compound	Number of Observations	Average RPD in Replicate Analysis (%)	Average Concentration Difference in Replicate Analysis (ppbv)
1-Dodecene	25	16.31	0.43
n-Dodecane	139	12.37	0.22
1-Tridecene	0	NA	NA
n-Tridecane	29	20.99	0.36
TNMOC (speciated)	192	11.67	7.26
TNMOC (w/ unknowns)	192	10.01	22.54

Table 17-4. Carbonyl Sampling and Analytical Precision: Total 588 Replicates on Duplicate Samples

Compound	Number of Observations	Average RPD in Replicate Analysis (%)	Average Concentration Difference in Replicate Analysis (ppbv)
Formaldehyde	589	4.24	0.22
Acetaldehyde	576	5.20	0.05
Acetone	567	4.55	0.07
Propionaldehyde	529	12.23	0.01
Crotonaldehyde	308	14.57	0.01
Butyr/Isobutyraldehyde	548	16.21	0.01
Benzaldehyde	576	15.37	0.01
Isovaleraldehyde	99	25.78	0.03
Valeraldehyde	441	24.13	0.01
Tolualdehydes	542	23.18	0.02
Hexaldehyde	512	10.37	0.03
2,5-Dimethylbenzaldehyde	213	27.04	0.01

Table 17-5. Carbonyl Sampling and Analytical Precision: Total 116 Replicates of Collocated Samples

Compound	Number of Observations	Average RPD in Replicate Analysis (%)	Average Concentration Difference in Replicate Analysis (ppbv)
Formaldehyde	112	7.8	0.26
Acetaldehyde	115	24.4	0.13
Acetone	116	21.0	0.17
Propionaldehyde	106	20.2	0.04
Crotonaldehyde	73	27.0	0.02
Butyr/Isobutyraldehyde	110	17.1	0.04
Benzaldehyde	106	22.8	0.02
Isovaleraldehyde	35	22.0	0.03
Valeraldehyde	106	15.5	0.01
Tolualdehydes	112	27.6	0.02
Hexaldehyde	111	15.6	0.03
2,5-Dimethylbenzaldehyde	31	28.0	0.02

Table 17-6. Semivolatile Sampling and Analytical Precision: Total 82 Replicates on Collocated Samples

Compound	Number of Observations	Average RPD in Replicate Analysis (%)	Average Concentration Difference in Replicate Analysis ($\mu g/m^3$)
Phenol	1	ND	0.117
1,4-Dichlorobenzene	44	17.92	0.008
Naphthalene	82	11.99	0.021
2-Methylnaphthalene	80	11.41	0.015
Acenaphthene	2	ND	0.031
Phenanthrene	7	56.38	0.038
Fluoranthene	15	13.53	0.127

Table 17-7. Hexavalent Chromium Sampling and Analytical Precision: Total 76 Replicates on Collocated Samples

Compound	Number of Observations	Average RPD in Replicate Analysis (%)	Average Concentration Difference in Replicate Analysis ($\mu g/m^3$)
Hexavalent Chromium	68	14.4	0.008

Table 17-8. VOC Sampling and Analytical Precision: Total 198 Duplicate Samples

Compound	Number of Observations	Average RPD in Replicate Analyses of Duplicates (%)	Average Concentration Difference in Replicate Analyses of Duplicates (ppbv)
Acetylene	197	5.64	0.11
Propylene	198	11.40	0.08
Dichlorodifluoromethane	198	6.01	0.26
Chloromethane	198	8.69	0.06
Dichlorotetrafluoroethane	0	NA	NA
Vinyl Chloride	0	NA	NA
1,3-Butadiene	63	15.50	0.04
Bromomethane	5	9.57	0.05
Chloroethane	7	17.67	0.15
Acetonitrile	17	13.49	2.92
Trichlorofluoromethane	197	8.57	0.03
Acrylonitrile	8	14.78	0.70
1,1-Dichloroethene	2	17.86	0.05
Methylene Chloride	137	28.41	0.15
Trichlorotrifluoroethane	193	12.05	0.02
trans - 1,2 - Dichloroethylene	0	NA	NA
1,1 - Dichloroethane	0	NA	NA
Methyl tert-Butyl Ether	66	9.52	0.08
Methyl Ethyl Ketone	182	29.68	0.40
Chloroprene	0	NA	NA
cis-1,2-Dichloroethylene	0	NA	NA
Bromochloromethane	4	14.76	0.09
Chloroform	11	27.58	0.05
Ethyl tert-Butyl Ether	0	NA	NA
1,2 - Dichloroethane	0	NA	NA
1,1,1 - Trichloroethane	7	11.81	0.10
Benzene	198	6.75	0.03
Carbon Tetrachloride	127	11.03	0.03
tert-Amyl Methyl Ether	2	NA	0.16
1,2 - Dichloropropane	0	NA	NA
Ethyl Acrylate	0	NA	NA
Bromodichloromethane	0	NA	NA
Trichloroethylene	8	13.52	0.01
Methyl Methacrylate	1	NA	1.64
cis -1,3 - Dichloropropene	0	NA	NA
Methyl Isobutyl Ketone	18	23.90	0.33
trans - 1,3 - Dichloropropene	0	NA	NA
1,1,2 - Trichloroethane	0	NA	NA

Table 17-8. VOC Sampling and Analytical Precision: Total 198 Duplicate Samples (Continued)

Compound	Number of Observations	Average RPD in Replicate Analyses of Duplicates (%)	Average Concentration Difference in Replicate Analyses of Duplicates (ppbv)
Toluene	197	10.47	0.22
Dibromochloromethane	0	NA	NA
1,2-Dibromoethane	0	NA	NA
n-Octane	91	23.15	0.07
Tetrachloroethylene	19	11.00	0.03
Chlorobenzene	3	17.45	0.04
Ethylbenzene	182	9.81	0.03
m,p - Xylene	193	8.44	0.08
Bromoform	0	NA	NA
Styrene	40	18.49	0.03
1,1,2,2 - Tetrachloroethane	0	NA	NA
o - Xylene	177	9.38	0.04
1,3,5-Trimethylbenzene	70	7.65	0.03
1,2,4-Trimethylbenzene	140	7.41	0.02
m - Dichlorobenzene	0	NA	NA
Chloromethylbenzene	0	NA	NA
p - Dichlorobenzene	14	7.84	0.02
o - Dichlorobenzene	0	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA

Table 17-9. VOC Sampling and Analytical Precision: Total 38 Collocated Samples

Compound	Number of Observations	Average RPD in Replicate Analyses at Collocated Sites (%)	Average Concentration Difference in Replicate Analyses at Co-Located Sites (ppbv)
Acetylene	38	7.39	0.12
Propylene	38	13.44	0.19
Dichlorodifluoromethane	38	3.08	0.02
Chloromethane	38	5.16	0.03
Dichlorotetrafluoroethane	0	NA	NA
Vinyl Chloride	0	NA	NA
1,3-Butadiene	12	21.77	0.05
Bromomethane	0	NA	NA
Chloroethane	0	NA	NA
Acetonitrile	14	42.08	4.91
Trichlorofluoromethane	38	7.25	0.02
Acrylonitrile	0	NA	NA
1,1-Dichloroethene	0	NA	NA
Methylene Chloride	37	118.70	1.26
Trichlorotrifluoroethane	38	10.30	0.01
trans - 1,2 - Dichloroethylene	0	NA	NA
1,1 - Dichloroethane	0	NA	NA
Methyl tert-Butyl Ether	2	17.29	0.10
Methyl Ethyl Ketone	32	29.96	0.19
Chloroprene	0	NA	NA
cis-1,2-Dichloroethylene	0	NA	NA
Bromochloromethane	0	NA	NA
Chloroform	1	NA	0.06
Ethyl tert-Butyl Ether	0	NA	NA
1,2 - Dichloroethane	0	NA	NA
1,1,1 - Trichloroethane	0	NA	NA
Benzene	38	6.93	0.05
Carbon Tetrachloride	38	11.05	0.01
tert-Amyl Methyl Ether	0	NA	NA
1,2 - Dichloropropane	0	NA	NA
Ethyl Acrylate	0	NA	NA
Bromodichloromethane	0	NA	NA
Trichloroethylene	0	NA	NA
Methyl Methacrylate	0	NA	NA
cis -1,3 - Dichloropropene	0	NA	NA
Methyl Isobutyl Ketone	6	21.41	0.07
trans - 1,3 - Dichloropropene	0	NA	NA
1,1,2 - Trichloroethane	0	NA	NA

Table 17-9. VOC Sampling and Analytical Precision: Total 38 Collocated Samples (Continued)

Compound	Number of Observations	Average RPD in Replicate Analyses at Collocated Sites (%)	Average Concentration Difference in Replicate Analyses at Co-Located Sites (ppbv)
Toluene	38	14.53	0.15
Dibromochloromethane	0	NA	NA
1,2-Dibromoethane	0	NA	NA
n-Octane	21	31.50	0.07
Tetrachloroethylene	15	13.44	0.03
Chlorobenzene	0	NA	NA
Ethylbenzene	37	17.77	0.04
m,p - Xylene	38	26.00	0.15
Bromoform	0	NA	NA
Styrene	4	NA	0.07
1,1,2,2 - Tetrachloroethane	0	NA	NA
o - Xylene	37	29.08	0.07
1,3,5-Trimethylbenzene	19	15.44	0.05
1,2,4-Trimethylbenzene	37	26.80	0.06
m - Dichlorobenzene	0	NA	NA
Chloromethylbenzene	0	NA	NA
p - Dichlorobenzene	1	NA	0.13
o - Dichlorobenzene	0	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA

Table 17-10. VOC Sampling and Analytical Precision: Comparison of Duplicate and Collocated Samples - VOCs

Compound	Average RPD in Replicate Analyses of Duplicates (%)	Average RPD in Replicate Analyses of Collocated Duplicates (%)	Average Concentration Difference (%)
Acetylene	5.64	7.39	30.9
Propylene	11.40	13.44	18.0
Dichlorodifluoromethane	6.01	3.08	48.7
Chloromethane	8.69	5.16	40.6
Dichlorotetrafluoroethane	NA	NA	NA
Vinyl Chloride	NA	NA	NA
1,3-Butadiene	15.50	21.77	40.5
Bromomethane	9.57	NA	NA
Chloroethane	17.67	NA	NA
Acetonitrile	13.49	42.08	211.9
Trichlorofluoromethane	8.57	7.25	15.4
Acrylonitrile	14.78	NA	NA
1,1-Dichloroethene	17.86	NA	NA
Methylene Chloride	36.02	118.70	229.5
Trichlorotrifluoroethane	12.05	10.30	14.6
trans - 1,2 - Dichloroethylene	NA	NA	NA
1,1 - Dichloroethane	NA	NA	NA
Methyl tert-Butyl Ether	9.52	17.29	81.6
Methyl Ethyl Ketone	29.68	29.96	1.0
Chloroprene	NA	NA	NA
cis-1,2-Dichloroethylene	NA	NA	NA
Bromochloromethane	14.76	NA	NA
Chloroform	27.58	NA	100.0
Ethyl tert-Butyl Ether	NA	NA	NA
1,2 - Dichloroethane	NA	NA	NA
1,1,1 - Trichloroethane	11.81	NA	NA
Benzene	6.75	6.93	2.6
Carbon Tetrachloride	11.03	11.05	0.2
tert-Amyl Methyl Ether	NA	NA	NA
1,2 - Dichloropropane	NA	NA	NA
Ethyl Acrylate	NA	NA	NA
Bromodichloromethane	NA	NA	NA
Trichloroethylene	13.52	NA	NA
Methyl Methacrylate	NA	NA	NA
cis -1,3 - Dichloropropene	NA	NA	NA
Methyl Isobutyl Ketone	23.90	21.41	10.4
trans - 1,3 - Dichloropropene	NA	NA	NA

Table 17-10. VOC Sampling and Analytical Precision: Comparison of Duplicate and Collocated Samples - VOCs (Continued)

Compound	Average RPD in Replicate Analyses of Duplicates (%)	Average RPD in Replicate Analyses of Collocated Duplicates (%)	Average Concentration Difference (%)
1,1,2 - Trichloroethane	NA	NA	NA
Toluene	10.47	14.53	38.8
Dibromochloromethane	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA
n-Octane	23.15	31.50	36.0
Tetrachloroethylene	11.00	13.44	22.2
Chlorobenzene	17.45	NA	NA
Ethylbenzene	9.81	17.77	81.2
m,p - Xylene	8.44	26.00	208.1
Bromoform	NA	NA	NA
Styrene	18.49	NA	100.0
1,1,2,2 - Tetrachloroethane	NA	NA	NA
o - Xylene	9.38	29.08	210.0
1,3,5-Trimethylbenzene	7.65	15.44	101.9
1,2,4-Trimethylbenzene	7.41	26.80	261.5
m - Dichlorobenzene	NA	NA	NA
Chloromethylbenzene	NA	NA	NA
p - Dichlorobenzene	7.84	NA	100.0
o - Dichlorobenzene	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA
Hexachloro-1,3-Butadiene	NA	NA	NA

Table 17-11. SNMOC Sampling and Analytical Precision: Total 104 Duplicate Samples

Compound	Number of Observations	Average RPD in Replicate Analyses of Duplicates (%)	Average Concentration Difference in Replicate Analyses of Duplicates (ppbv)
Ethylene	104	7.06	0.25
Acetylene	104	4.68	0.14
Ethane	104	3.12	0.17
Propylene	104	10.22	0.16
Propane	104	6.12	0.50
Propyne	0	NA	NA
Isobutane	104	7.81	0.15
Isobutene/1-Butene	103	10.43	0.18
1,3-Butadiene	32	9.26	0.05
n-Butane	104	4.11	0.22
trans-2-Butene	57	7.16	0.07
cis-2-Butene	95	7.59	0.06
3-Methyl-1-butene	14	35.44	0.12
Isopentane	99	21.23	1.30
1-Pentene	90	44.82	0.25
2-Methyl-1-butene	62	14.50	0.13
n-Pentane	104	11.95	0.41
Isoprene	84	5.66	0.05
trans-2-Pentene	79	6.35	0.07
cis-2-Pentene	78	5.09	0.05
2-Methyl-2-butene	60	5.84	0.12
2,2-Dimethylbutane	103	11.59	0.07
Cyclopentene	29	29.29	0.36
4-Methyl-1-pentene	2	6.08	0.02
Cyclopentane	95	11.69	0.08
2,3-Dimethylbutane	104	8.58	0.08
2-Methylpentane	104	49.57	0.56
3-Methylpentane	103	6.78	0.13
2-Methyl-1-pentene	12	9.21	0.17
1-Hexene	104	14.93	0.09
2-Ethyl-1-butene	1	NA	0.92
n-Hexane	103	10.16	0.45
trans-2-Hexene	0	NA	NA
cis-2-Hexene	5	5.53	0.12
Methylcyclopentane	103	10.21	0.15
2,4-Dimethylpentane	102	5.27	0.04
Benzene	104	8.79	0.34

Table 17-11. SNMOC Sampling and Analytical Precision: Total 104 Duplicate Samples (Continued)

Compound	Number of Observations	Average RPD in Replicate Analyses of Duplicates (%)	Average Concentration Difference in Replicate Analyses of Duplicates (ppbv)
Cyclohexane	103	13.57	0.22
2-Methylhexane	97	21.27	0.23
2,3-Dimethylpentane	104	4.54	0.04
3-Methylhexane	93	18.26	0.25
1-Heptene	27	14.97	0.24
2,2,4-Trimethylpentane	101	9.19	0.16
n-Heptane	98	7.27	0.06
Methylcyclohexane	96	13.33	0.10
2,2,3-Trimethylpentane	40	4.86	0.13
2,3,4-Trimethylpentane	85	9.66	0.08
Toluene	104	9.93	0.81
2-Methylheptane	46	17.44	0.24
3-Methylheptane	61	11.10	0.09
1-Octene	26	10.96	0.24
n-Octane	82	7.24	0.06
Ethylbenzene	90	12.29	0.13
m-Xylene/p-Xylene	101	11.17	0.23
Styrene	97	76.67	0.94
o-Xylene	94	11.19	0.10
1-Nonene	23	9.36	0.18
n-Nonane	68	8.35	0.11
Isopropylbenzene	27	7.09	0.05
a-Pinene	39	15.59	0.23
n-Propylbenzene	57	11.57	0.11
m-Ethyltoluene	87	12.08	0.13
p-Ethyltoluene	79	10.26	0.11
1,3,5-Trimethylbenzene	58	13.78	0.12
o-Ethyltoluene	55	13.36	0.16
b-Pinene	48	51.21	0.55
1,2,4-Trimethylbenzene	97	11.61	0.13
1-Decene	0	NA	NA
n-Decane	87	75.01	0.44
1,2,3-Trimethylbenzene	56	12.77	0.16
m-Diethylbenzene	54	28.16	0.40
p-Diethylbenzene	58	16.71	0.18
1-Undecene	15	18.58	0.15

Table 17-11. SNMOC Sampling and Analytical Precision: Total 104 Duplicate Samples (Continued)

Compound	Number of Observations	Average RPD in Replicate Analyses of Duplicates (%)	Average Concentration Difference in Replicate Analyses of Duplicates (ppbv)
n-Undecane	100	50.82	1.13
1-Dodecene	12	47.40	1.08
n-Dodecane	74	121.36	0.93
1-Tridecene	0	NA	NA
n-Tridecane	18	18.64	0.48
TNMOC (speciated)	104	7.87	6.72
TNMOC (w/ unknowns)	104	17.33	37.83

Table 17-12. Carbonyl Sampling and Analytical Precision: Total 290 Duplicate Samples

Compound	Number of Observations	Average RPD in Replicate Analyses of Duplicates (%)	Average Concentration Difference in Replicate Analyses of Duplicates (ppbv)
Formaldehyde	290	12.90	1.17
Acetaldehyde	285	22.92	0.21
Acetone	280	25.14	0.27
Propionaldehyde	261	20.79	0.03
Crotonaldehyde	158	15.23	0.01
Butyr/Isobutyraldehyde	272	29.87	0.04
Benzaldehyde	285	32.42	0.04
Isovaleraldehyde	51	38.53	0.04
Valeraldehyde	222	26.00	0.02
Tolualdehydes	272	48.11	0.07
Hexaldehyde	252	26.52	0.09
2,5-Dimethylbenzaldehyde	104	52.30	0.02

Table 17-13. Carbonyl Sampling and Analytical Precision: Total 54 Collocated Samples

Compound	Number of Observations	Average RPD in Replicate Analysis (%)	Average Concentration Difference in Replicate Analysis (ppbv)
Formaldehyde	48	37.86	1.23
Acetaldehyde	49	151.11	0.94
Acetone	50	215.15	1.54
Propionaldehyde	47	60.45	0.12
Crotonaldehyde	32	26.90	0.04
Butyr/Isobutyraldehyde	48	50.97	0.15
Benzaldehyde	48	37.37	0.03
Isovaleraldehyde	16	117.02	0.10
Valeraldehyde	48	66.54	0.06
Tolualdehydes	46	38.53	0.02
Hexaldehyde	48	73.16	0.14
2,5-Dimethylbenzaldehyde	15	131.71	0.03

Table 17-14. Carbonyl Sampling and Analytical Precision: Comparison of Duplicate and Collocated Samples - Carbonyls

Compound	Average RPD in Replicate Analyses of Duplicates (%)	Average RPD in Replicate Analyses of Collocated Duplicates (%)	Average Concentration Difference (%)
Formaldehyde	12.90	37.86	193.4
Acetaldehyde	22.92	151.11	559.2
Acetone	25.14	215.15	755.7
Propionaldehyde	20.79	60.45	190.7
Crotonaldehyde	15.23	26.90	76.6
Butyr/Isobutyraldehyde	29.87	50.97	70.6
Benzaldehyde	32.42	37.37	15.3
Isovaleraldehyde	38.53	117.02	203.7
Valeraldehyde	26.00	66.54	155.9
Tolualdehydes	48.11	38.53	19.9
Hexaldehyde	26.52	73.16	175.9
2,5-Dimethylbenzaldehyde	52.30	131.71	151.8

Table 17-15. Semivolatile Sampling and Analytical Precision: Total 40 Collocated Samples

Compound	Number of Observations	Average RPD in Replicate Analyses Collocated Samples (%)	Average Concentration Difference in Replicate Analyses of Collocated Samples (μµg/m^3)
Phenol	1	ND	0.117
1,4-Dichlorobenzene	22	6.98	0.008
Naphthalene	40	6.66	0.021
2-Methylnaphthalene	39	7.56	0.015
Acenaphthene	1	ND	0.031
Phenanthrene	4	1.97	0.038
Di-n-butyl phthalate	8	ND	0.127

Table 17-16. Hexavalent Chromium Sampling and Analytical Precision: Total 44 Collocated Samples

Compound	Number of Observations	Average RPD in Replicate Analysis (%)	Average Concentration Difference in Replicate Analysis (μg/m^3)
Hexavalent Chromium	38	40.7	0.024

Table 17-17. Round Robin Analytical Comparisons for Carbonyl Samples

Audit Date	Compound	Sample ID	Concentration (μ g cartridge)		
			Reported	Theoretical	% Difference
2/27/01	Formaldehyde	E VT Audit-3	0.255	0.270	94
	Acetaldehyde	E VT Audit-3	0.367	0.270	136
	Acetone	E VT Audit-3	0.399	0.270	148
	Propionaldehyde	E VT Audit-3	0.280	0.270	104
	Crotonaldehyde	E VT Audit-3	0.276	0.270	102
	Butyraldehyde	E VT Audit-3	0.309	0.270	114
	Benzaldehyde	E VT Audit-3	0.320	0.270	119
	Isovaleraldehyde	E VT Audit-3	0.270	0.270	100
	Valeraldehyde	E VT Audit-3	0.315	0.270	117
	Tolualdehydes	E VT Audit-3	0.979	0.270	121
	Hexaldehyde	E VT Audit-3	0.279	0.270	103
	2,5 - Dimethylbenzaldehyde	E VT Audit-3	0.322	0.270	119
3/12/01	Formaldehyde	19403	0.177	0.270	66
		17839	0.18	0.270	67
	Acetaldehyde	19403	0.346	0.270	128
		17839	0.333	0.270	123
	Acetone	19403	0.484	0.270	179
		17839	0.574	0.270	213
	Propionaldehyde	19403	0.244	0.270	90
		17839	0.254	0.270	94
	Crotonaldehyde	19403	0	0.270	0
		17839	0	0.270	0
	Butyraldehyde	19403	0.273	0.270	101
		17839	0.274	0.270	101
	Benzaldehyde	19403	0.174	0.270	64
		17839	0.193	0.270	71
	Isovaleraldehyde	19403	0.217	0.270	80
		17839	0.2	0.270	74
	Valeraldehyde	19403	0.228	0.270	84
		17839	0.259	0.270	96
	Tolualdehydes	19403	0.866	0.270	107
		17839	0.959	0.270	118
	Hexaldehyde	19403	0.183	0.270	68
		17839	0.188	0.270	70

Table 17-17. Round Robin Analytical Comparisons for Carbonyl Samples (Continued)

Audit Date	Compound	Sample ID	Concentration (μ g cartridge)		
			Reported	Theoretical	% Difference
	2,5 - Dimethylbenzaldehyde	19403	0.239	0.270	89
		17839	0.247	0.270	91
3/19/01	Formaldehyde	19401	0.227	0.270	84
		19402	0.258	0.270	96
	Acetaldehyde	19401	0.296	0.270	110
		19402	0.303	0.270	112
	Acetone	19401	0.353	0.270	131
		19402	0.365	0.270	135
	Propionaldehyde	19401	0.241	0.270	89
		19402	0.254	0.270	94
	Crotonaldehyde	19401	0.043	0.270	16
		19402	0	0.270	0
	Butyraldehyde	19401	0.213	0.270	79
		19402	0.187	0.270	69
	Benzaldehyde	19401	0.237	0.270	88
		19402	0.249	0.270	92
	Isovaleraldehyde	19401	0.203	0.270	75
		19402	0.227	0.270	84
	Valeraldehyde	19401	0.167	0.270	62
		19402	0.183	0.270	68
	Tolualdehydes	19401	0.719	0.270	89
		19402	0.757	0.270	93
	Hexaldehyde	19401	0.185	0.270	69
		19402	0.150	0.270	56
	2,5 -Dimethylbenzaldehyde	19401	0.230	0.270	85
		19402	0.241	0.270	89

18.0 Conclusions and Recommendations

As indicated throughout this report, UATMP monitoring data offer a wealth of information for evaluating trends and patterns in air quality and should ultimately help a wide range of audiences understand the complex nature of urban air pollution. The following discussion summarizes the main conclusions of this report and presents recommendations for ongoing urban air monitoring efforts.

18.1 Conclusions

Analyses of the 2001 UATMP monitoring data identified the following notable trends and patterns in urban air pollution:

- *Stationary emission sources of toxics.* The Denver, CO site had the greatest number o f stationary sources within a 10-mile radius reporting to the National Emissions Inventory (514 facilities). However, this site ranked tenth in average hydrocarbon concentration, twenty-fifth in polar compound concentration, twenty-seventh in halogenated hydrocarbon and carbonyl concentrations seem to correspond to the number of facilities emitting toxic compounds, while the halogenated hydrocarbon and polar compounds did not. The Queen Valley, AZ site had the fewest number of stationary sources (2 facilities) and this site ranked thirty-fifth (or last) in average hydrocarbon concentration, seventh in polar compound concentration, thirty-fourth in halogenated hydrocarbon concentration, and did not measure carbonyl compounds. The Queen Valley hydrocarbon and halogenated hydrocarbon concentrations seem to correspond to the number of facilities emitting toxic compounds, while the polar compounds did not.

- *Mobile emission sources of toxics.* It was estimated that the Camden, NJ site had the highest number of cars within a 10-mile radius (1,564,196 cars), while the Beulah, ND site had the fewer (4,591 cars). However, the Camden site ranked fairly low for its compound concentrations, with the polar compounds ranking the highest at fifteenth. The Beulah site's concentration rankings corresponded well with its lack of automobiles, with the polar compounds again ranking highest (twenty-first) and hydrocarbon ranking the lowest (thirty-fourth). It is also estimated that the Elizabeth, New Jersey site had the most number of automobiles pass near the site (170,000), while the Barceloneta, Puerto Rico has the lowest number of vehicles (10) passing by the site. The Elizabeth site's different compounds all ranked in the middle of the pack, while the Barceloneta site's carbonyls ranked last and polar compounds ranked first. A comparison of the BTEX compounds (Benzene, Toluene, Ethylbenzene, and Xylenes) with a Roadside speciation profile suggests the high influence of motor vehicles as an emission source. The three Arizona site BETX profiles bor the closest resemblance to the Roadside speciation profile.

- *Ambient air concentrations of hydrocarbons.* Levels of airborne hydrocarbons were highest at the Grand Junction, CO monitoring location and were lowest at the Queen Valley, AZ monitoring location (1.06 ppbv). Correlations among the hydrocarbons and the weather parameters at the GJCO an QVAZ sites tended to be weak. While a large number of reporting sites had significant negative correlations with average maximum and average temperature, and dew point and wet bulb temperature, this trend did not hold true at all sites measuring hydrocarbon compounds. However, each prevalent hydrocarbon compound, with the exception of toluene, had at least one site report a negative correlation across the four previously mentioned weather parameters. At the SPAZ site in Phoenix, Arizona, all of the hydrocarbon compounds had negative Pearson correlations with the same temperature and moisture variables listed above.

- *Ambient air concentrations of halogenated hydrocarbons.* Levels of airborne halogenated hydrocarbons were highest at the Allen Park, Detroit, MI monitoring location (19.28ppbv) and were lowest at the Tupelo, MS monitoring location (2.7 ppbv). These two sites had the same distinction in the 2000 UATMP report. The APMI site's concentration was more than three times the next highest site's concentration (BAPR with 6.38 ppbv). Little variation and demonstrated for halogenated hydrocarbon concentrations across the majority of the sites participating in the 2001 UATMP. Strong to moderately strong positive correlations were noted between methylene chloride and the weather parameters, with the exception of the wind components at the APMI site. All of the sites where significant correlations with the halogenated hydrocarbon compounds were calculated, with the exception of the DATA site, reported a positive correlation with average maximum and average temperature, and dew point and wet bulb temperature. Chloromethane had the highest (positive) correlation with the four previously mentioned temperature and moisture variables at the Arlington, Texas site among all of the halogenated hydrocarbon compounds, and among all of the compound in the UATMP. Negative correlations with the wind components and halogenated hydrocarbon compounds were also reported at several of the participating sites.

- *Ambient air concentrations of polar compounds.* Only one polar compound was determined to be "prevalent: in this year's UATMP, and that compound is methyl ethyl ketone. Levels of airborne polar compounds were highest at the Barceloneta , PR monitoring location (9.19 ppbv) and were lowest at the Cedar Rapids, IA monitoring location (1.24 ppbv). These two sites also had the same distinction in the 2000 UATMP report. Although the BARP site had the least traffic flowing on nearby roads, it had the highest polar compound concentration, and also had high concentrations for hydrocarbons and halogenated hydrocarbons. Three sites reported significant positive correlations with methyl ethyl ketone and the average maximum and average temperature, and dew point and wet bulb temperature. The San Juan, PR site had a calculated significant negative correlations between the wind components and methyl ethyl ketone.

- *Ambient air concentrations of carbonyl compounds.* Levels of airborne carbonyl compounds were highest at the River Rouge, Detroit, MI monitoring location (27.44 ppbv) and were lowest at the San Juan, PR monitoring location (0.87 ppbv). The RRMI site had the highest concentration of carbonyl compounds in the 2000 UATMP report, while the Barceloneta, PR station ranked lowest last year. However, BAPR was only slightly higher than the SJPR site in 2001. For the carbonyl compound concentrations, little variation was demonstrated, similar to the halogenated hydrocarbon compounds. While a large number of sites reported significant negative correlations between acetone and average maximum and average temperature, and dew point and wet bulb temperature, a large number of sites reported a positive correlation with formaldehyde and the four temperature and moisture variables. Significant correlations were also established with acetaldehyde and the previously mentioned weather parameters, but that compound had an equal number of positive and negative correlations.

- *Specific meteorological trends for participating states.* UATMP concentrations were correlated with the selected meteorological parameters. For those sites sampling SNMOC and SVOC, similar analysis was performed. Also, on days in which the average ozone concentrations were considered high (a day in which the concentration was higher than the average concentration), a weather map analysis was performed. The following specific meteorological trends resulted from analysis of the 2001 UATMP monitoring data:

    1. Arizona: All three sites exhibited an average annual relative humidity less than forty percent. All prevalent compound concentrations had a negative tendency with the selected meteorological parameters. High concentrations days for ozone corresponded with high temperatures and with an upper level ridge in place over the West.

    2. Florida: The Florida sites all exhibit a high annual average maximum (near 80°) and average (mid 60°s) temperature, as well as a high relative humidity (65-70%). The carbonyl compounds had the strongest correlations with the weather parameters. High ozone concentration days were related to the presence high pressure near the Panhandle, and light northwesterly winds.

    3. Michigan: The Michigan sites had cool annual average temperature ranging from the low 40s to the upper 40s. Winds also tended to be breezy at the sites on annual average. However, generally light winds and ridging aloft were related to high ozone concentration days. The majority of the significant correlations at the Michigan sites tended to be positive.

    4. New Jersey: Annual average temperature and moisture amount varies across the New Jersey sites, depending on geographic location. The majority of the significant correlations at the New Jersey sites tended to be positive, with the exception of the Chester, NJ site. Ridging in the east and light winds seems related to high ozone concentration days.

    5. Texas: The two Texas sites tended to both have high average maximum and average temperatures, however, the Arlington site was significantly more humid

than the El Paso site, due to their locations. The Arlington's sites correlations tended to be positive between the compounds and the temperature and moisture variables. But the El Paso site's compounds didn't follow this trend as well. High ozone days are generally associated with ridging aloft over the Southwest and South central U.S. and light south to southeasterly winds.

6. Utah: While the Salt Lake City site had a fairly mild average annual temperature (mid 50°s), its relative humidity is rather low. The calculated Pearson correlations make it difficult to determine the concentration of the prevalent compounds as no significant trend was identified with the exception of a negative correlation with the carbonyls and the v-component of the wind. High ozone days tend to accompany warm temperatures and a ridge aloft over the West.

18.2 Recommendations

In light of the lessons learned from the 2001 UATMP, a number of recommendations for future ambient air monitoring are warranted:

- *Continue to identify and implement improvements to the sampling and analytical methods.* The improvements made to the analytical methods prior to the 1999-2000 UATMP allowed for measurement of ambient air concentrations of 11 compounds that were not measured during previous programs. This improvement provides sponsoring agencies and a variety of interested parties with important information about air quality within their urban areas. Further research is encouraged to identify other method improvements that would allow the UATMP to characterize an even wider range of components in urban air pollution.

- *Continue to strive to develop standard conventions for interpreting air monitoring data.* The lack of consistent approaches to present and summarize ambient air monitoring data complicates or invalidates comparisons between different studies. Additional research should be conducted on the feasibility of establishing standard approaches for analyzing and reporting air monitoring data.

- *Prepare a report* characterizing all years of the UATMP and then update it yearly to better assess Trends and better understand the nature of U.S. urban air pollution.

- *Consider more rigorous study of the impact of automobile emissions on ambient air quality using the complete UATMP data set.* Because the UATMP has monitoring sites where years of continuous data are collected, a real opportunity exists to evaluate the importance and impact of automobile emissions on ambient air quality. Suggested areas of study include:

    1. *Signature Compound Assessment.* Sample data from each site should be evaluated to look for signature compounds from mobile sources—that is, species

typically associated with only diesel and/or gasoline combustion. If the appropriate compounds are included in the UATMP speciation, sites lacking these compounds can be excluded from subsequent analyses. Desert Research Institute can provide a listing of potential signature compounds for mobile sources.

2. *Micro-Climate Assessment.* An assessment is needed of the immediate micro-climate for a representative "urban" and "rural" site, to determine a reasonable geographic radius of influence. It is absolutely critical to determine a rough estimate of the maximum radius of concern (R_{max}) in order to know what sources need to be included in the characterization. A value for R_{max} may be determined with relatively little effort using simple dispersion models, such as CALINZ4 for urban settings. In these models R_{max} would be defined for non-reactive species such as CO or PM. Since most/all of the toxic compounds of concern have some level of reactivity, R_{max} would actually be somewhat less. Therefore this method would provide a conservative estimate for R_{max}.

3. *Identify Roadways of Concern.* All roadways within a distance of R_{max} should be identified for each site. Local area maps are best suited for this purpose.

4. *Parking Lot Characterizations.* Several monitoring locations are situated in or near parking lots. Evaporative emissions from parked gasoline vehicles could have a very significant impact on the monitors for these sites (depending upon the species of concern). Therefore we recommend determining the size of the lots in question in terms of number of spaces, as well as an average occupancy rate with total vehicles per day (to determine the number of start episodes). The occupancy rate should be a 24 hour annual average, and can be established either through observation or local "experts" (e.g., the lot operator). Also, it should be determined if the parking is covered or open—covered lots can significantly decrease crankcase temperatures and therefore lower evaporative emissions rates.

5. *Site-Specific Information.* Additional information could be collected as needed to improve the quality of discussions of air quality at specific sites. For example, for the El Paso site the UATMP could obtain a vehicle count split for US versus Mexican vehicles. Mexican vehicles have dramatically higher pollution rates and should be considered separately. This estimate could be obtained from the EPA or Texas Natural Resource Conservation Commission Border Liaisons.

- *Encourage continued participation in the UATMP.* Ongoing ambient air monitoring at fixed locations can provide insight into long-term trends in urban air quality and the potential for urban air pollution to cause adverse health effects among the general population. Therefore, state and local agencies should be strongly encouraged either to develop and implement their own ambient air monitoring programs or to participate in future UATMP monitoring efforts.

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