

National Air Toxics Trends Study Grand Junction, Colorado

January through December 2009



**Colorado Department
of Public Health
and Environment**

**Prepared by the Air Pollution Control Division
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I. EXECUTIVE SUMMARY

The Grand Junction air toxics monitors were originally established as a part of the Pilot Study for the National Air Toxics Trends Sites (NATTS). The network was created by the Environmental Protection Agency (EPA) in an effort to gather data that were suitable for identifying trends in air toxics concentration levels. Grand Junction was one of the five “rural” sites selected. The EPA considers this area “rural” because it is not a major metropolitan area. This report discusses the data collected at the Grand Junction monitors for 2009.

Most of the compounds detected are found in urban air nationwide. There do not appear to be any compounds of local significance. The majority of compounds can be related to motor vehicle sources. These include formaldehyde, benzene, toluene, ethylbenzene, xylenes, and styrene. Chloroflourocarbons are also present, including chloromethane, dichlorodifluoromethane, trichlorofluoromethane, and trichlorotrifluoroethane. Polycyclic aromatic hydrocarbon compounds naphthalene, phenanthrene and acenaphthene are frequently detected.

This report has two companion documents. The report, “Documentation for Grand Junction Urban Air Toxics Trends Monitoring Locations – Site Maps and Photographs” provides information concerning the two air monitoring sites discussed in this report. The document, “Air Toxics Summary: Compounds Contributing to Cancer and Non-cancer Risks – Overview of Sources and Health Effects,” provides a brief summary of many of the compounds monitored. This report discusses the chemical formula, sources and uses of each compound. The companion report also profiles potential health effects, such as carcinogenicity, the compound’s potential to cause birth defects, and whether it damages target organs in the body.

II. INTRODUCTION

Background

The NATTS Network collects ambient air toxics monitoring data as a part of the Urban Air Toxic Strategy (UATS). Under Section 112 of the Clean Air Act (CAA), the EPA established a list of 188 toxic air pollutants, also known as hazardous air pollutants, or HAPs. These are pollutants that are known, or suspected, to cause cancer, or other major health issues. People who are exposed to these HAPs at sufficient concentration levels may have an increased chance of getting cancer, damaging their immune system, etc. Most air toxics originate from mobile sources, like cars, trucks, or buses, as well as stationary sources, such as factories, refineries, and power plants. Some air toxics also come from indoor sources as well, like cleaning solvents, and building materials.

Since it is not practical to monitor for each of the 188 compounds, the EPA developed a subset of HAPs that have the greatest impact on the public, as well as the environment, in urban areas. For the purposes of the NATTS Study, the list of 188 HAPs was pared down to a subset of 62 HAPs, 33 of which are on the “Urban HAP List.”¹ The remaining 29 compounds were chosen because they have risk factors that were developed by the EPA. From the list of 62 compounds, a “core” list of 19 toxic air pollutants that must be monitored at all times was created. These compounds are considered to be “priority compounds” because they are major health risk drivers, based on a relative ranking performed by the EPA.² They are referred to as the “Method Quality Objective (MQO) Core Analytes.”³ The compounds can be seen in Table 1.

1 Technical Assistance Document for the National Air Toxics Trends Stations Program.” US Environmental Protection Agency. April 1, 2009. http://www.epa.gov/ttnamti1/files/ambient/airtox/nattsTADRevision2_508Compliant.pdf

2 *Ibid.*

3 *Ibid.*

Table 1. NATTS HAPs with Mandatory Monitoring Requirements

VOCs	Carbonyls	PM ₁₀ Metals	TSP Metals	PAHs
Acrolein	Formaldehyde	Nickel	Hexavalent Chromium	Naphthalene
Tetrachloroethylene	Acetaldehyde	Arsenic		Benzo(a)pyrene
Benzene		Cadmium		
Carbon Tetrachloride		Manganese		
Chloroform		Beryllium		
Trichloroethylene		Lead		
1,3-Butadiene				
Vinyl Chloride				

The Grand Junction air toxics monitoring site was established in 2004. This site will measure air toxics for at least six years, to determine the success of the National Air Toxics Strategy in reducing the U.S. population exposure to cancer-causing substances in the air. The main test will be a comparison of mean concentrations of compounds for the first three years (2004-2006), versus the mean concentrations for successive three-year periods (2007-2009), starting from 2004 and continuing to the present. Data collected beyond the initial 6-year study scope will be used for trending analyses.

This report presents data from January 2009 through December 2009. It is separated into sections covering the various compounds of interest. Sections 3, 4, 5, 6, and 9 discuss the compounds monitored as a part of this study. Sections 7, 8 and 10 compare the PM₁₀, PM_{2.5}, and meteorological data collected as a part of the regular monitoring conducted in Grand Junction by the Colorado Department of Public Health and Environment (CDPHE) to the national ambient air quality standards (NAAQS). Each section begins with summary statistics for the compounds analyzed and then the percentage of samples in which each chemical was detected. Summary graphs of certain compounds are presented.

Site Information

The NATTS Study at Grand Junction collects samples at two separate locations. These two sites (Powell site and Pitkin site) are in close proximity to one another. The Powell site is located on top of the Powell Building (approximately three stories in height) at 650 South Avenue, and the Pitkin site is located approximately 50 meters to the NNW of the Powell building, on the roof of a small shelter, near ground level, at 654-1/4 Pitkin Avenue. The hexavalent chromium and particulate samplers are located on the Powell Building, and the carbon monoxide analyzer, air toxics samplers, and meteorological tower are located at the Pitkin site. Due to the different sampling heights, staff at Region VIII of the EPA suggested the sites be separately catalogued in the national air monitoring database. Documentation regarding these sites, including maps, photographs, and aerial views, is available in the companion report, "Documentation for Grand Junction Urban Air Toxics Trends Monitoring Locations – Site Maps and Photographs." The sites are located on the southern end of the city in an area of commercial/light industrial land use.

III. CARBONYLS

Summary Statistics

The carbonyls discussed in this section are the group of organic chemicals that contain a carbon atom double bonded to an oxygen atom. The generalized symbol for the carbonyl group is **R-C=O**, where the "R" is some other carbon compound. Twelve compounds were measured for this study. A listing of these compounds, as well as a summary of the collected data, is shown in Table 2 and Table 3.

Table 2. Carbonyl Average and Maximum Concentration Comparison 2009

Analyte	2009		
	Average ($\mu\text{g}/\text{m}^3$)	Maximum ($\mu\text{g}/\text{m}^3$)	Avg. MDL ($\mu\text{g}/\text{m}^3$)
2,5-Dimethylbenzaldehyde	0.002	0.002	0.003
Acetaldehyde	2.892	5.801	0.009
Acetone	5.573	11.355	0.010
Benzaldehyde	0.338	0.846	0.004
Butyraldehyde	0.348	1.000	0.006
Crotonaldehyde	0.222	0.677	0.006
Formaldehyde	4.010	6.502	0.010
Hexaldehyde	0.116	0.328	0.004
Isovaleraldehyde	0.013	0.088	0.004
Propionaldehyde	0.392	0.741	0.007
Tolualdehydes	0.182	0.536	0.017
Valeraldehyde	0.146	0.328	0.005

MDL = Minimum Detection Level

Table 3. Carbonyl Sample Summary - 2009

Compound	CAS Number	# of ND's	% ND
Acetaldehyde	75-07-0	0	0%
Acetone	67-64-1	0	0%
Benzaldehyde	100-52-7	0	0%
Butyraldehyde	123-72-8	0	0%
Crotonaldehyde	123-73-9	0	0%
Formaldehyde	50-00-0	0	0%
Hexaldehyde	66-25-1	0	0%
Propionaldehyde	123-38-6	1	2%
Tolualdehydes	NA	1	2%
Valeraldehyde	110-62-3	1	2%
Isovaleraldehyde	590-86-3	48	77%
2,5-Dimethylbenzaldehyde	5779-94-2	62	100%

ND = Not Detected

Carbonyl compounds were sampled on an every-sixth-day basis for the year, for a total of 62 samples attempted. All samples were collected, for a total of 62 samples taken on the year. The data recovery rate of 100% exceeds the EPA goal for over 85% sample recovery.

The annual maximum and mean concentrations for each carbonyl compound are listed in Table 2. The annual means were calculated by replacing all "non-detect" values with one-half of the sample minimum detection limit. This is an accepted conservative technique for calculating annual values when some of the samples were less than the laboratory's ability to detect. The most prevalent carbonyls in the ambient air in Grand Junction are formaldehyde, acetone, and acetaldehyde. The other nine compounds measured in this study occurred at concentration levels significantly below those of the top three compounds.

All of the carbonyls, except for isovaleraldehyde and 2,5-dimethylbenzaldehyde were present in over 98% of the samples. The isovaleraldehyde detection percentage of 23% is a decrease from the 39.3% detection

rate in 2008. Note that the true annual mean of 2,5-dimethylbenzaldehyde may be well below the number reported in the table. Due to the fact that this compound was never detected, one-half of the detection limit was used for the estimated concentration of the non-detects. Actual concentrations could have been at lower levels than these estimates. This compound has not been detected since 2006. During the pilot phase of this study in 2001-2002, 2,5-dimethylbenzaldehyde was detected 34 percent of the time. In 2005 the detection rate dropped to 4.8 percent, and it has not been found at detectable levels since that time.

Graphs

The summary data for carbonyl compounds measured during 2009 are graphed in Figure 1. These compounds in these graphs are ordered by ranking their maximum concentrations. The graphs show that acetaldehyde, acetone, and formaldehyde generally had the highest maxima. The maximums observed in 2009 were similar to those in 2008. The means for the compounds during the two years were fairly close, with no consistent trend across compounds.

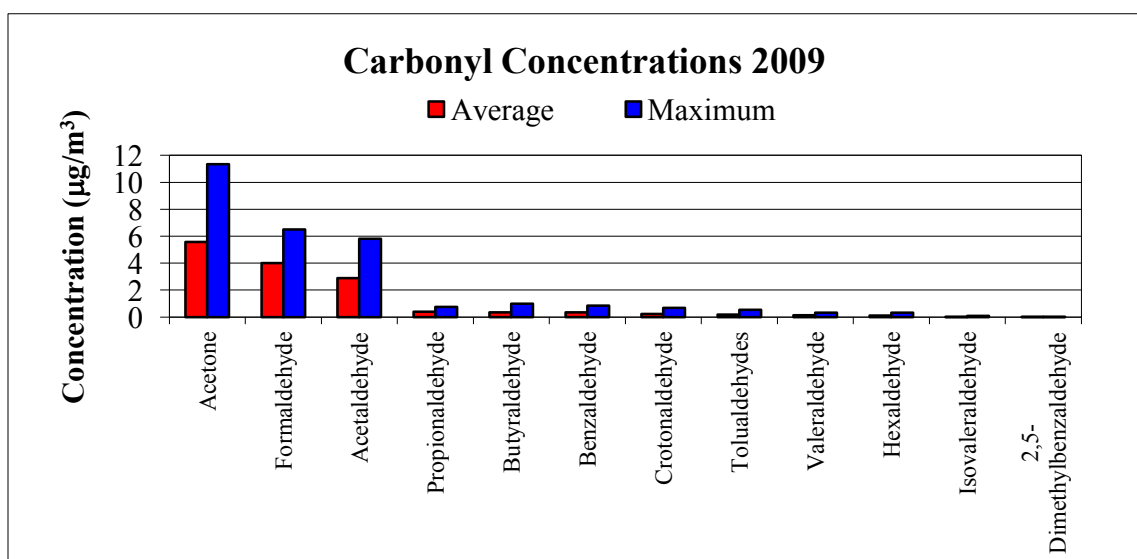


Figure 1. Annual Mean and Maximum Carbonyl Concentrations for 2009

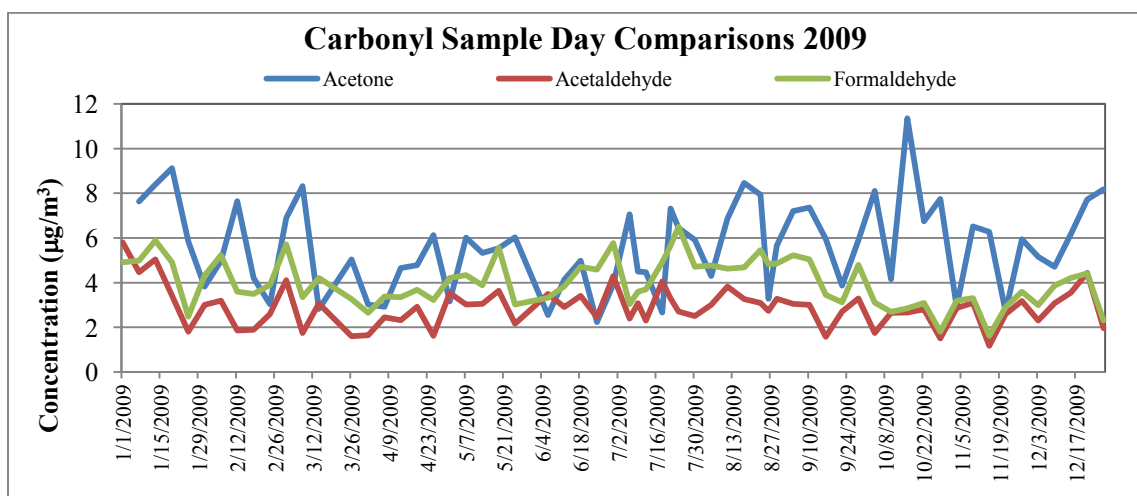


Figure 2. Carbonyl Sample Day Comparisons for 2009

Figure 2 shows the concentrations for select carbonyl compounds during the year. Unlike past years, the compounds did not show much seasonal variation. This was also the case in 2008 as well. This is interesting, because it is generally believed that more formaldehyde is formed photochemically during the summer period of higher solar radiation. Formaldehyde plays a role in the formation of ozone, a chemical that peaks during the summer. The “2008 – 2009 National Monitoring Programs Volume I: Main, Final Report,” put out by the EPA in December 2011, shows that the average concentrations nationwide (across all 27 NATTS sites) for acetaldehyde, acetone, and formaldehyde were 1.78, 2.85, and 3.72 micrograms per cubic meter, respectively.⁴ The annual average concentrations seen at the Grand Junction site were 2.89, 5.57, and 4.01 micrograms per cubic meter, respectively.

Figure 3 is a graph of the weekday versus weekend average carbonyl concentrations in 2009. As was expected, the average weekday concentrations were slightly higher than the average weekend concentrations, with the exceptions of 2,5-dimethylbenzaldehyde, isovaleraldehyde, butyraldehyde, and hexaldehyde. The first two compounds have weekday and weekend averages that are equal, as their concentrations are merely half the value of their respective MDLs for the entire year, since they were non-detectable in more than half of all samples. The last two compounds have slightly higher weekend averages than weekday averages. Sources for those two compounds are generally from rubber and plastic making, but they are also emitted by vegetation as well.

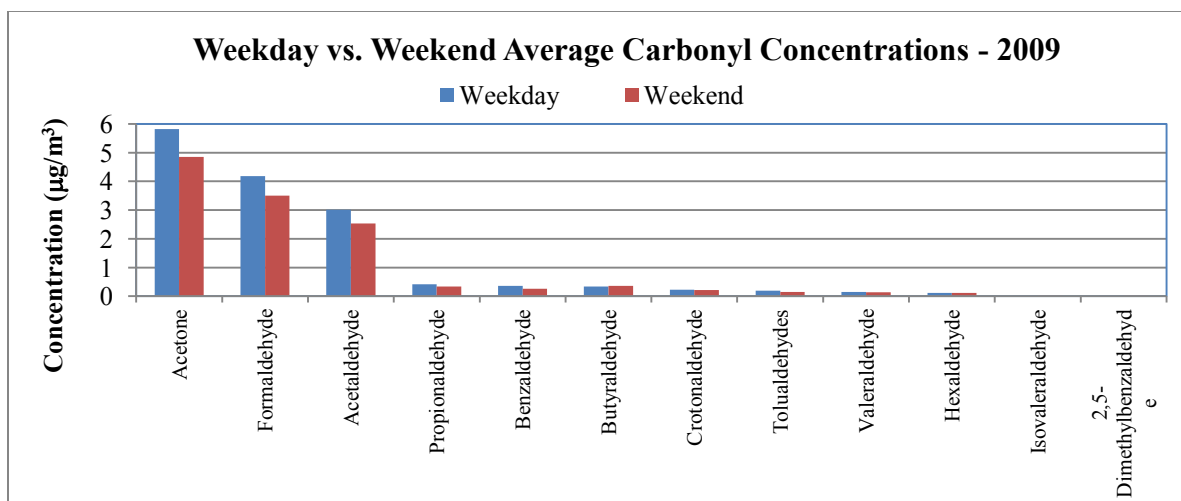


Figure 3. Weekday vs. Weekend Average Carbonyl Concentrations - 2009

Quality Assurance/Quality Control

Field Blanks

Field blanks were collected twelve times per year by attaching a blank sample cartridge to the sampler briefly, and then removing it. The purpose of these blanks was to assess contamination that might exist in the cartridge media, sample installation, or shipping. Most cartridges had very small amounts of formaldehyde, acetaldehyde, acetone, and propionaldehyde. Detailed information regarding field blank results is available upon request.

⁴ “2008 – 2009 National Monitoring Programs Volume I: Main, Final Report.” US Environmental Protection Agency. December 2011. <http://www.epa.gov/ttnamti1/files/ambient/airtox/20082009NMPFinalReportVol1Main.pdf>

Precision of Sample Results

This project collected precision data in order to assess both sampling and analytical procedures. Six times during the year, a second carbonyl cartridge was sampled simultaneously with the primary sample. These additional samples, or duplicates, were collected to assess the precision (repeatability) of the sampling method. In general, agreement between the two samples was excellent. Detailed information regarding precision results is available upon request.

IV. VOLATILE ORGANIC COMPOUNDS

Summary Statistics

Volatile organic compound (VOC) data collected at the Grand Junction – Powell station from January through December 2009 are presented in this section. There were 60 VOCs analyzed for this study. The list of these VOCs and the number of times each was detected in samples during the study is found in Table 4. These are the same VOCs collected by all of the sites participating in the national air toxics study. VOCs were sampled on an every-sixth-day basis, for a total of 66 possible days. Six samples were either not collected, or were voided for various reasons, giving 60 samples on the year (90.9% sample recovery).

Table 4. VOC List with 2009 Detection Rates

Compound	CAS Number*	# of ND's	% ND
1,1,1-Trichloroethane	71-55-6	0	0%
1,2,4-Trimethylbenzene	95-63-6	0	0%
1,3,5-Trimethylbenzene	108-67-8	0	0%
1,3-Butadiene	106-99-0	0	0%
Acetonitrile	75-05-8	0	0%
Acetylene	74-86-2	0	0%
Acrolein	107-02-8	0	0%
Benzene	71-43-2	0	0%
Bromomethane	74-83-9	0	0%
Carbon Disulfide	75-15-0	0	0%
Carbon Tetrachloride	56-23-5	0	0%
Chloromethane	74-87-3	0	0%
Dichlorodifluoromethane	75-71-8	0	0%
Dichloromethane	75-09-2	0	0%
Dichlorotetrafluoroethane	76-14-2	0	0%
Ethylbenzene	100-41-4	0	0%
m,p-Xylene	100-01-6	0	0%
Methyl Ethyl Ketone	78-93-3	0	0%
n-Octane	111-65-9	0	0%
o-Xylene	95-47-6	0	0%
Propylene	115-07-1	0	0%
Tetrachloroethylene	127-18-4	0	0%
Toluene	108-88-3	0	0%
Trichlorofluoromethane	75-69-4	0	0%
Trichlorotrifluoroethane	76-13-1	0	0%
Chloroform	67-66-3	1	2%

Compound	CAS Number*	# of ND's	% ND
Styrene	100-42-5	1	2%
Methyl Isobutyl Ketone	108-10-1	2	3%
Chloroethane	75-00-3	6	10%
p-Dichlorobenzene	106-46-7	20	33%
Trichloroethylene	79-01-6	29	48%
Acrylonitrile	107-13-1	33	55%
Vinyl chloride	75-01-4	49	82%
Methyl Methacrylate	80-62-6	50	83%
1,2-Dichloroethane	107-06-2	53	88%
Dibromochloromethane	124-48-1	56	93%
1,1,2-Trichloroethane	79-00-5	57	95%
1,1-Dichloroethene	75-35-4	57	95%
Bromoform	75-25-2	57	95%
Chloroprene	126-99-8	57	95%
1,2-Dibromoethane	106-93-4	58	97%
Bromodichloromethane	75-27-4	58	97%
trans-1,2-Dichloroethylene	156-60-5	58	97%
1,1-Dichloroethane	75-34-3	59	98%
1,2-Dichloropropane	78-87-5	59	98%
Chlorobenzene	108-90-7	59	98%
Chloromethylbenzene	100-44-7	59	98%
cis-1,2-Dichloroethylene	156-59-4	59	98%
cis-1,3-Dichloropropene	10061-01-5	59	98%
Ethyl Acrylate	140-88-5	59	98%
Ethyl tert-Butyl Ether	637-92-3	59	98%
m-Dichlorobenzene	541-73-1	59	98%
o-Dichlorobenzene	95-50-1	59	98%
1,1,2,2-Tetrachloroethane	79-34-5	60	100%
1,2,4-Trichlorobenzene	120-82-1	60	100%
Bromochloromethane	74-97-5	60	100%
Hexachloro-1,3-butadiene	87-68-3	60	100%
Methyl tert-Butyl Ether	1634-04-4	60	100%
tert-Amyl Methyl Ether	994-05-8	60	100%
trans-1,3-Dichloropropene	10061-02-6	60	100%

*CAS Number refers to the Chemical Abstract System Number. This is an alternate way of referencing organic chemicals, which can have multiple names.
 ND = Not Detected

In 2009 there were 29 compounds detected in at least 90% of the samples taken. In 2008 there were 28 compounds detected over 90% of the time. The addition to the 2009 compounds was methyl isobutyl ketone. It barely missed making the 90% list in 2008 with a detection rate of 88.5%. Table 5 is a listing of the 29 compounds most frequently detected in 2009.

Table 5. VOCs Detected in Greater Than 90% of 2009 Samples

Compounds Detected in greater than 90% of samples	
1,1,1-Trichloroethane	Dichloromethane
1,2,4-Trimethylbenzene	Dichlorotetrafluoroethane
1,3,5-Trimethylbenzene	Ethylbenzene
1,3-Butadiene	m,p-Xylene
Acetonitrile	Methyl Ethyl Ketone
Acetylene	Methyl Isobutyl Ketone
Acrolein	n-Octane
Benzene	o-Xylene
Bromomethane	Propylene
Carbon Disulfide	Styrene
Carbon Tetrachloride	Tetrachloroethylene
Chloroethane	Toluene
Chloroform	Trichlorofluoromethane
Chloromethane	Trichlorotrifluoroethane
Dichlorodifluoromethane	

There were seven compounds that were not detected at all during 2009, which is down from the 22 non-detects in 2008. There were 24 compounds that were detected in less than five percent of the samples in 2009. These compounds are listed in Table 6. This is an increase from 2008, where 22 compounds were detected in less than five percent of the samples. This list of 24 compounds includes many compounds that are chiefly emitted by stationary sources. It appears that these source types are not present in the immediate vicinity of the station.

Table 6. VOCs Detected in Less Than 5% of 2009 Samples

Compounds Detected in less than 5% of 2009 samples	
1,1,2,2-Tetrachloroethane	Chloroprene
1,1,2-Trichloroethane	cis-1,2-Dichloroethylene
1,1-Dichloroethane	cis-1,3-Dichloropropene
1,1-Dichloroethene	Ethyl Acrylate
1,2,4-Trichlorobenzene	Ethyl tert-Butyl Ether
1,2-Dibromoethane	Hexachloro-1,3-butadiene
1,2-Dichloropropane	m-Dichlorobenzene
Bromochloromethane	Methyl tert-Butyl Ether
Bromodichloromethane	o-Dichlorobenzene
Bromoform	tert-Amyl Methyl Ether
Chlorobenzene	trans-1,2-Dichloroethylene
Chloromethylbenzene	trans-1,3-Dichloropropene

Table 7 summarizes the annual maximum and mean concentrations for each of the 60 VOCs measured during the study. It should be noted that the annual means and maximums were calculated by replacing all “non-detect” values with one-half of the sample method detection limit. This is an accepted conservative technique for calculating annual values when some of the samples were less than the laboratory’s ability to measure. As a result of this technique, the average and maximum concentrations are the same if the compound was never detected. The compounds are listed in alphabetical order, with their respective MDLs for 2009, as well as their respective molecular weights.

Table 7. VOC Data Summary 2009

Analyte	Molecular Weight (g/mol)	Average ($\mu\text{g}/\text{m}^3$)	Maximum ($\mu\text{g}/\text{m}^3$)	Avg. MDL ($\mu\text{g}/\text{m}^3$)
1,1,1-Trichloroethane	133.41	0.084	0.131	0.005
1,1,2,2-Tetrachloroethane	167.85	0.010	0.010	0.021
1,1,2-Trichloroethane	133.41	0.009	0.027	0.016
1,1-Dichloroethane	98.96	0.004	0.020	0.008
1,1-Dichloroethene	96.94	0.007	0.020	0.012
1,2,4-Trichlorobenzene	181.45	0.026	0.026	0.052
1,2,4-Trimethylbenzene	120.20	0.427	2.148	0.025
1,2-Dibromoethane	187.87	0.005	0.061	0.008
1,2-Dichloroethane	98.96	0.013	0.101	0.008
1,2-Dichloropropane	112.99	0.007	0.032	0.014
1,3,5-Trimethylbenzene	120.20	0.140	0.511	0.020
1,3-Butadiene	54.09	0.151	0.706	0.007
Acetonitrile	41.05	1.136	15.58	0.097
Acetylene	26.04	1.867	7.690	0.013
Acrolein	56.07	0.928	6.352	0.034
Acrylonitrile	53.06	0.128	1.257	0.033
Benzene	78.12	1.753	7.956	0.019
Bromochloromethane	129.39	0.013	0.013	0.026
Bromodichloromethane	163.83	0.009	0.087	0.013
Bromoform	252.73	0.013	0.072	0.021
Bromomethane	94.94	0.051	0.132	0.008
Carbon Disulfide	76.13	12.37	43.59	0.006
Carbon Tetrachloride	153.82	0.603	1.472	0.013
Chlorobenzene	112.56	0.005	0.014	0.009
Chloroethane	64.52	0.037	0.164	0.005
Chloroform	119.38	0.112	0.225	0.010
Chloromethane	50.49	1.333	2.519	0.012
Chloromethylbenzene	126.58	0.005	0.021	0.010
Chloroprene	88.54	0.013	0.235	0.011
cis-1,2-Dichloroethylene	96.94	0.039	0.404	0.067
cis-1,3-Dichloropropene	110.97	0.007	0.023	0.014
Dibromochloromethane	208.29	0.007	0.068	0.009
Dichlorodifluoromethane	120.91	2.923	7.863	0.020
Dichloromethane	84.94	1.779	36.48	0.028
Dichlorotetrafluoroethane	170.92	0.123	0.210	0.007
Ethyl Acrylate	100.12	0.013	0.037	0.025
Ethyl tert-Butyl Ether	102.18	0.015	0.015	0.029
Ethylbenzene	106.17	0.484	2.393	0.017
Hexachloro-1,3-butadiene	260.76	0.064	0.064	0.128
m,p-Xylene	106.17	1.544	8.164	0.030
m-Dichlorobenzene	147.01	0.012	0.024	0.024

Analyte	Molecular Weight (g/mol)	Average ($\mu\text{g}/\text{m}^3$)	Maximum ($\mu\text{g}/\text{m}^3$)	Avg. MDL ($\mu\text{g}/\text{m}^3$)
Methyl Ethyl Ketone	72.11	0.937	3.421	0.115
Methyl Isobutyl Ketone	100.16	0.140	0.467	0.020
Methyl Methacrylate	100.12	0.082	1.433	0.115
Methyl tert-Butyl Ether	88.15	0.025	0.025	0.050
n-Octane	114.23	0.211	1.229	0.019
o-Dichlorobenzene	147.01	0.012	0.042	0.024
o-Xylene	106.17	0.548	3.009	0.013
p-Dichlorobenzene	147.01	0.034	0.084	0.024
Propylene	42.08	0.920	3.046	0.064
Styrene	104.16	0.569	3.745	0.013
tert-Amyl Methyl Ether	102.18	0.015	0.015	0.029
Tetrachloroethylene	165.83	0.389	1.553	0.020
Toluene	92.15	3.474	27.59	0.030
trans-1,2-Dichloroethylene	96.94	0.008	0.083	0.012
trans-1,3-Dichloropropene	110.97	0.007	0.007	0.014
Trichloroethylene	131.29	0.057	0.263	0.011
Trichlorofluoromethane	137.37	1.553	2.652	0.011
Trichlorotrifluoroethane	187.38	0.771	1.180	0.023
Vinyl chloride	62.50	0.005	0.026	0.005

MDL = Minimum Detection Level

In general, the concentrations from 2009 compared well with the 2008 data. Some compounds showed average concentrations that were increased from their 2008 values. However, there were not any significant increases in the average concentrations between 2008 and 2009. The MDL levels did change slightly for some of the compounds, but this is to be expected as the laboratory calculates new MDLs every year. There were no significant changes in MDL values.

Graphs

Figures Figure 4 through Figure 6 are graphs showing the 24 hour maximum and annual mean concentrations for each of the 29 compounds that were detected in greater than 90% of the samples in 2009. These graphs are ordered from highest to lowest annual mean concentration. Note that the graphs' scales vary from a full-scale level at 50 micrograms per meter cubed to a full-scale value of 1.4 micrograms per meter cubed. The compounds with the five largest annual average concentrations are carbon disulfide, toluene, dichlorodifluoromethane, acetylene, and dichloromethane.

Carbon disulfide is commonly used in the manufacture of rayon, as well as for agricultural fumigants, and rubber production. Toluene concentrations are generally from automobile emissions. Dichlorodifluoromethane has been used as an aerosol propellant in the past, and is a member of the restricted class of ozone destroying CFCs. Acetylene is commonly used in welding and soldering applications, but is also found in boat fuel. Dichloromethane, or methylene chloride, is used as a solvent in paint strippers, and also as a propellant in aerosol paint and automobile products.

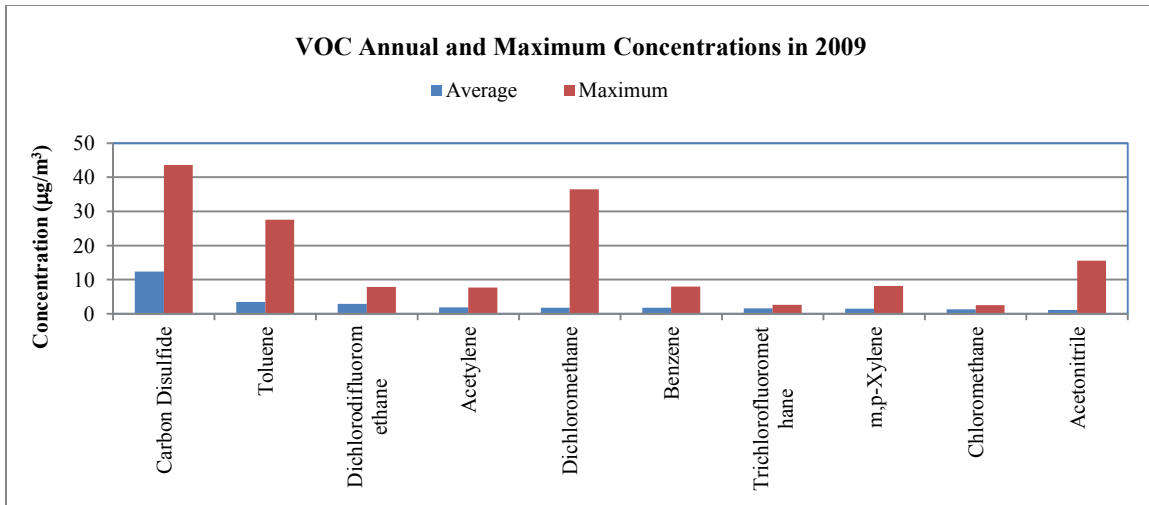


Figure 4. VOC Annual and Maximum Concentrations 2009

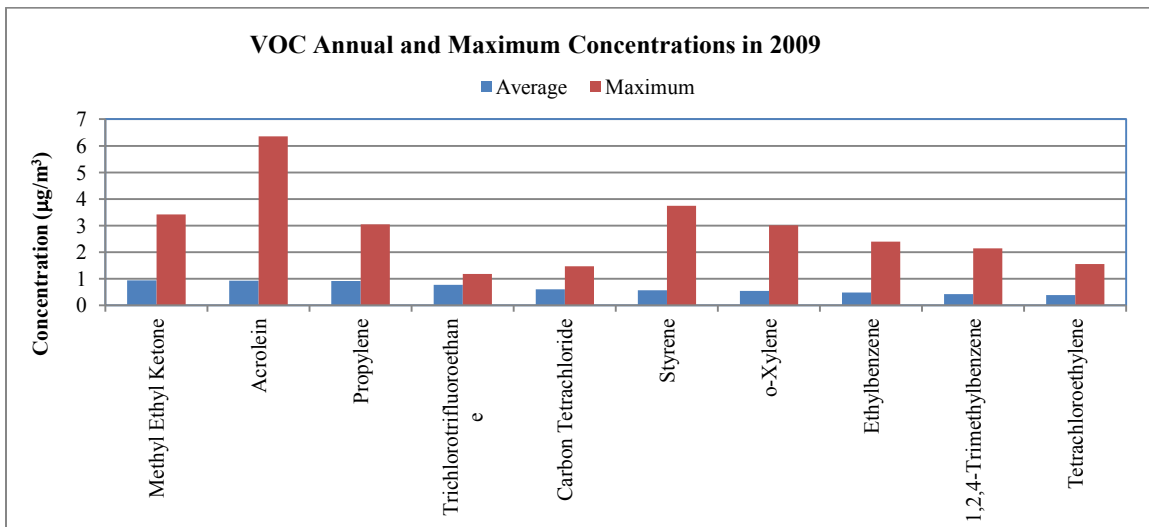


Figure 5. VOC Annual and Maximum Concentrations 2009, ctd.

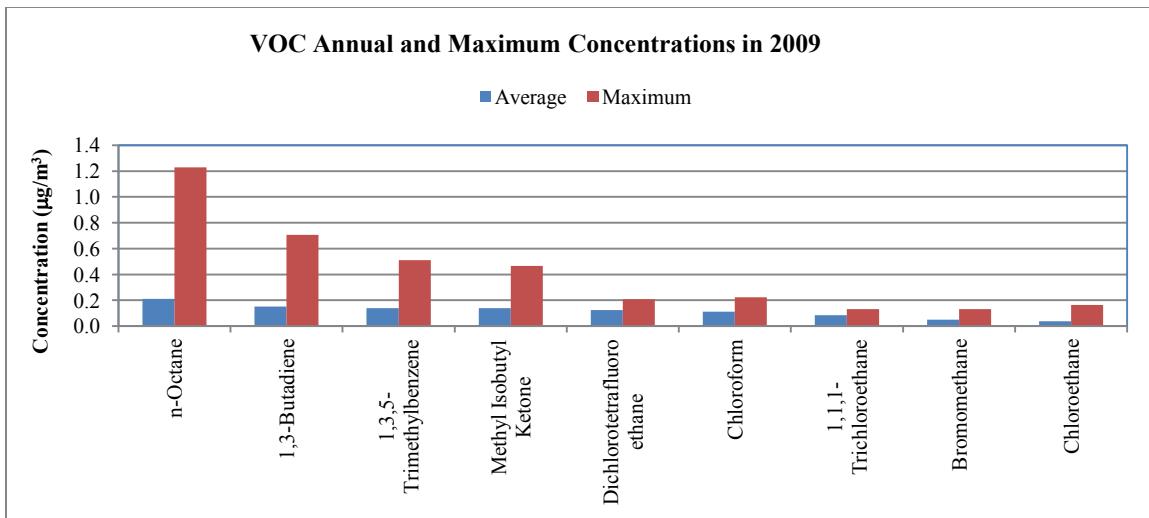


Figure 6. VOC Annual and Maximum Concentrations 2009, ctd.

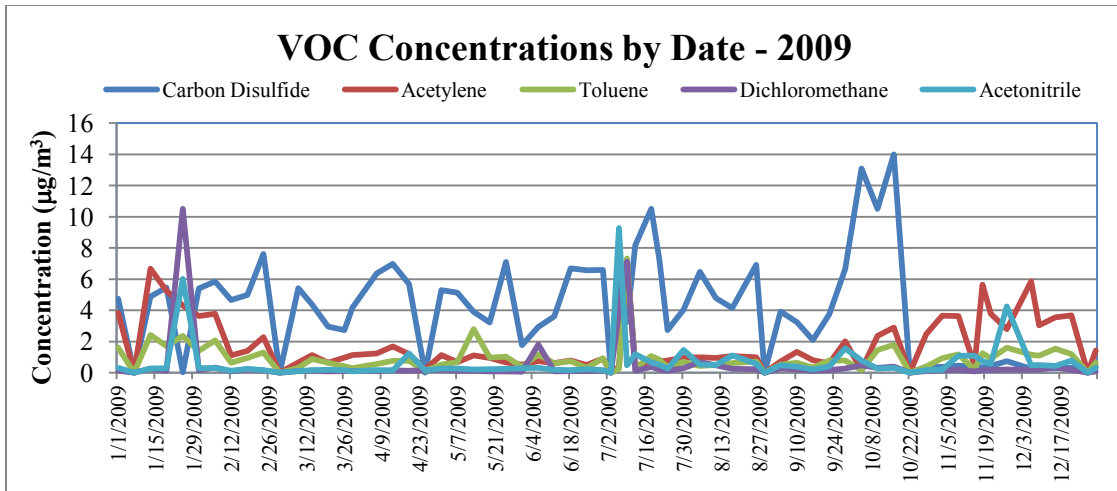


Figure 7. VOC Concentrations by Date 2009

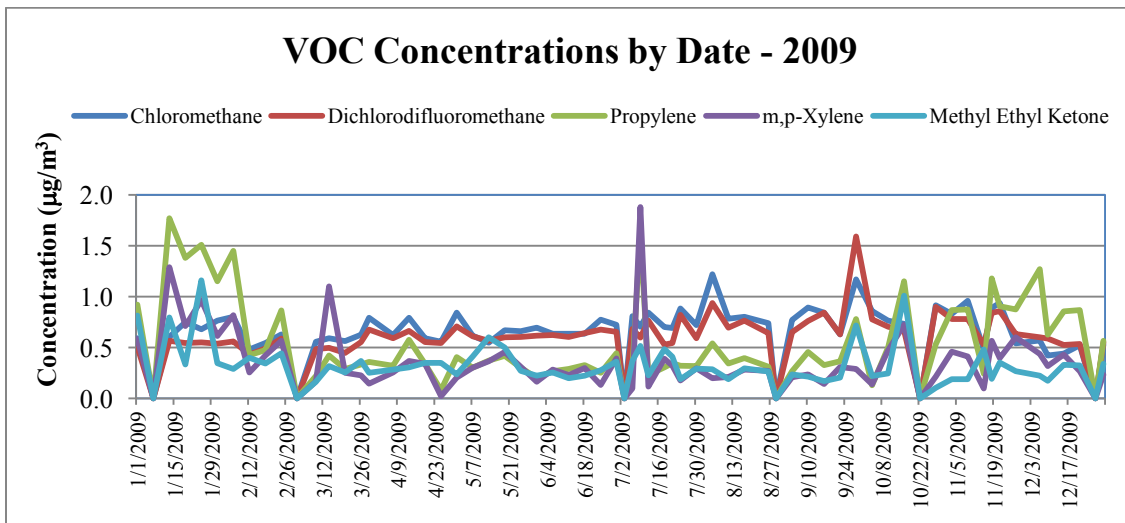


Figure 8. VOC Concentrations by Date 2009, ctd.

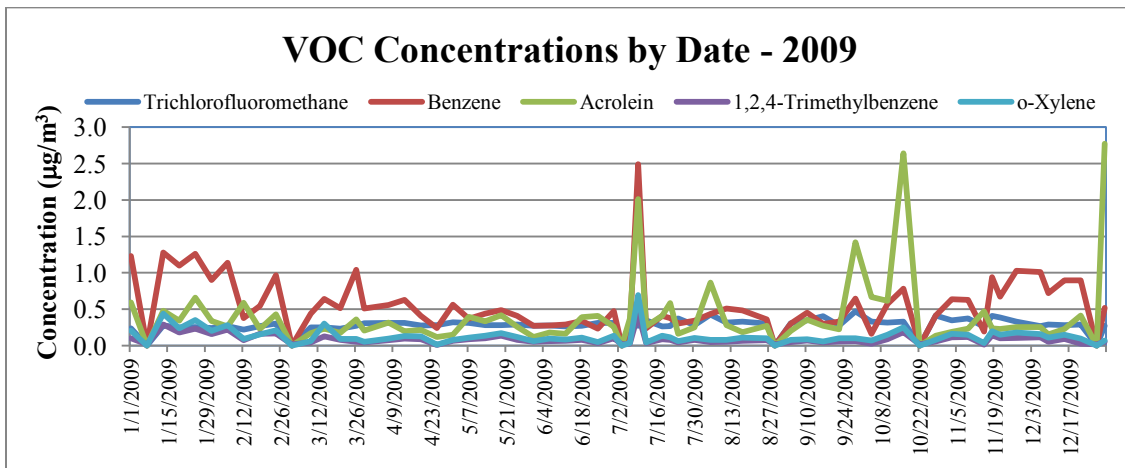


Figure 9. VOC Concentrations by Date 2009, ctd.

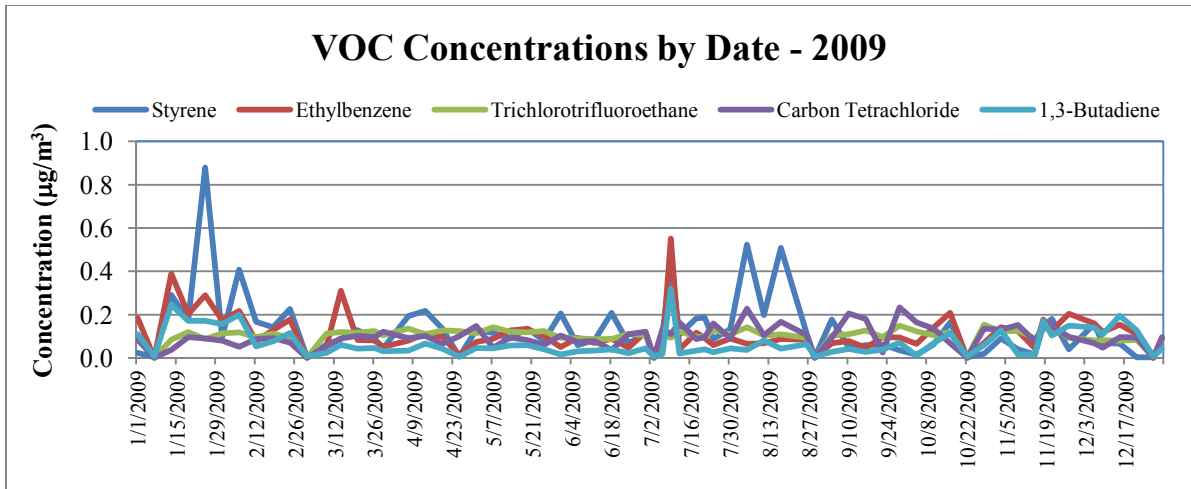


Figure 10. VOC Concentrations by Date 2009, ctd.

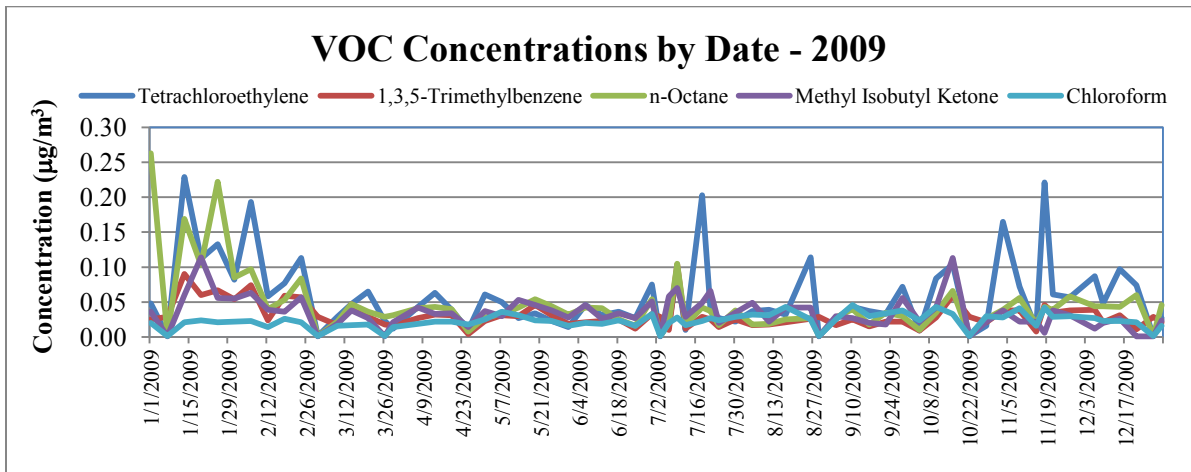


Figure 11. VOC Concentrations by Date 2009, ctd.

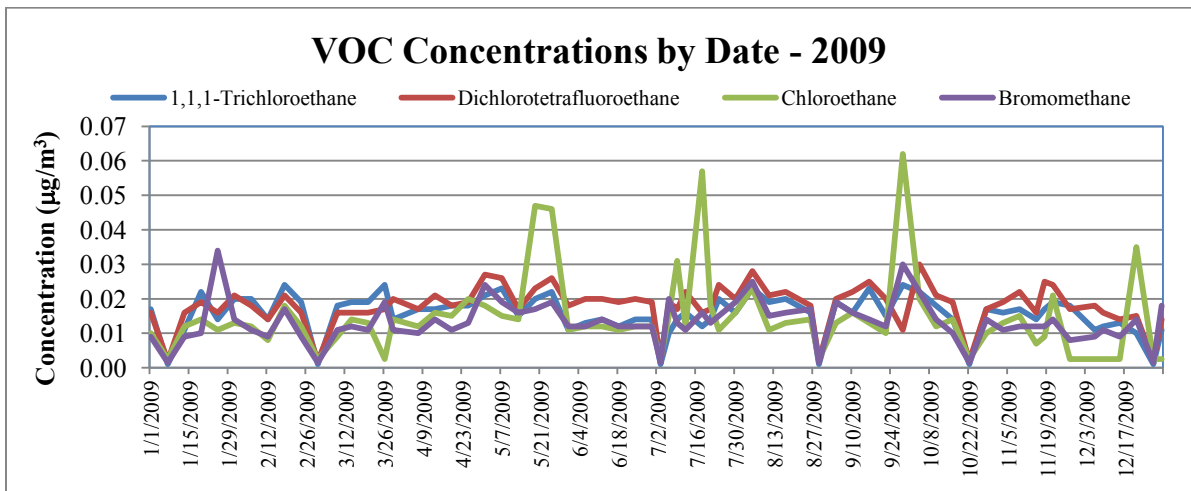


Figure 12. VOC Concentrations by Date 2009, ctd.

Figure 7 through Figure 12 show the concentrations of the 29 most detected VOCs by date. The concentrations tended to trend well with each other. An interesting note is the lack of any apparent seasonal trends in the data. VOC concentrations are typically higher in the summer due to the higher temperatures, and longer availability of ultraviolet rays for the photolytic process.

Figure 13 through Figure 18 graphically illustrate the weekday versus weekend VOC concentrations in 2009 for all 60 compounds. It should be noted here that compounds showing the same weekday and weekend averages are reflecting concentrations that are equal to one-half of the MDL; that is, they were never detected. In general, the weekday concentrations for most compounds were larger than those on the weekend. This is expected, as many of the compounds emitted are associated with automobile emissions, and traffic in the area is usually decreased on the weekends. There were, however, a few exceptions to this. Twenty-four of the compounds had higher weekend concentrations than weekday concentrations. Some of these compounds were carbon disulfide, dichloromethane, acetonitrile, methyl ethyl ketone, styrene, dichlorodifluoromethane, acrylonitrile, *cis*-1,2-dichloroethylene, and chloroprene. At this time, the reasoning behind this phenomenon is unclear.

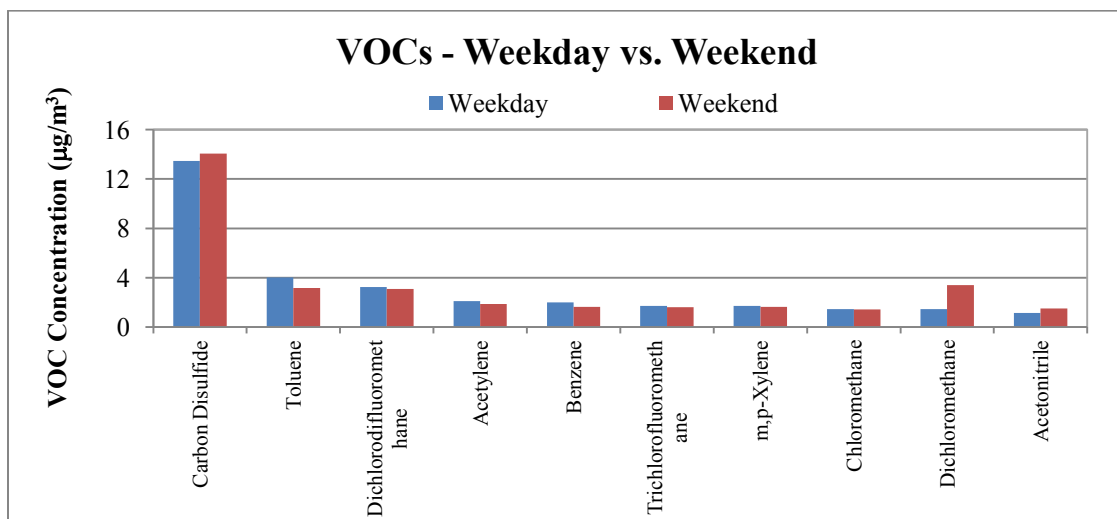


Figure 13. VOC Weekend vs. Weekday Concentrations 2009

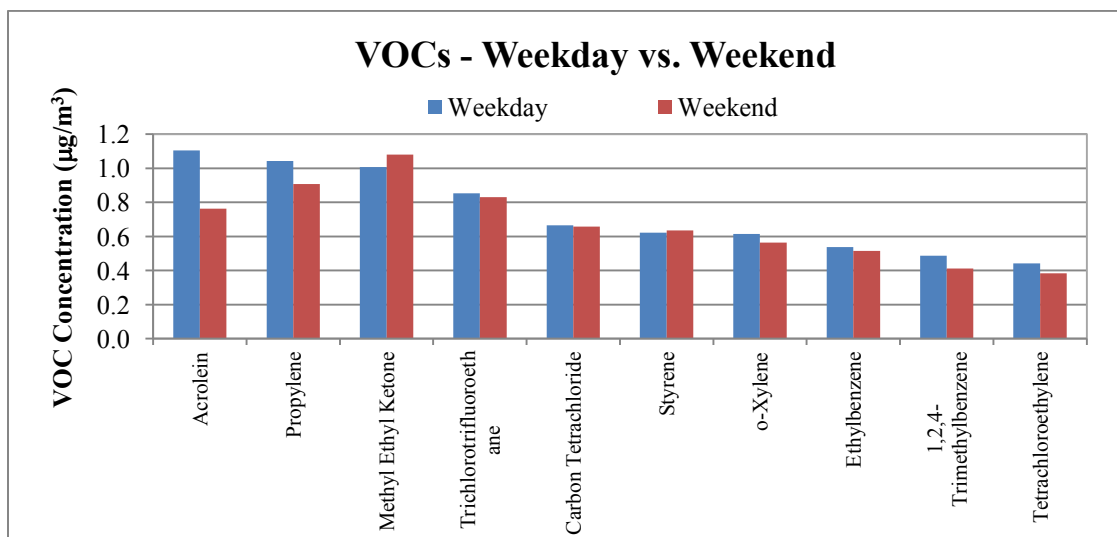


Figure 14. VOC Weekend vs. Weekday Concentrations 2009, ctd.

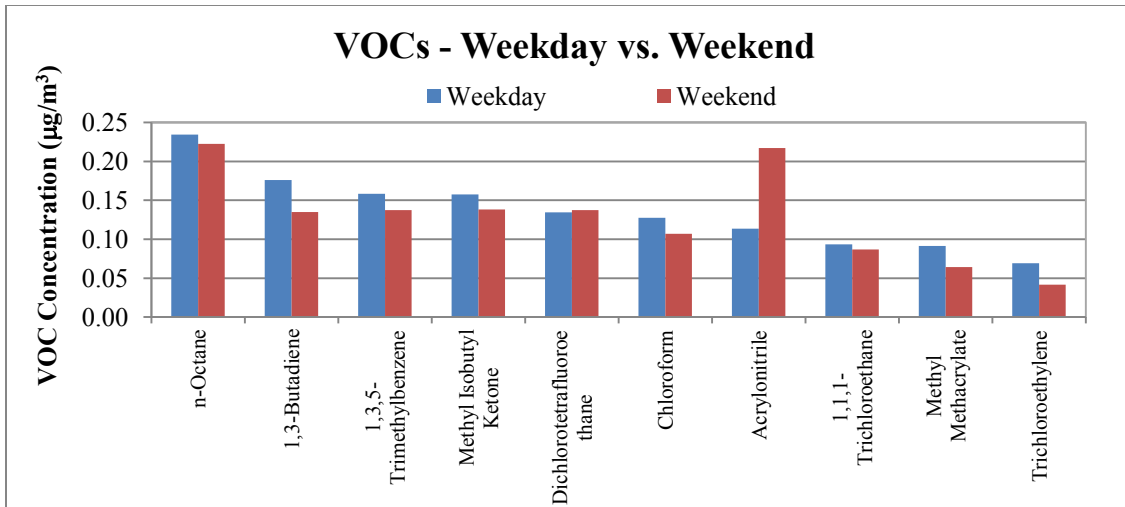


Figure 15. VOC Weekend vs. Weekday Concentrations 2009, ctd.

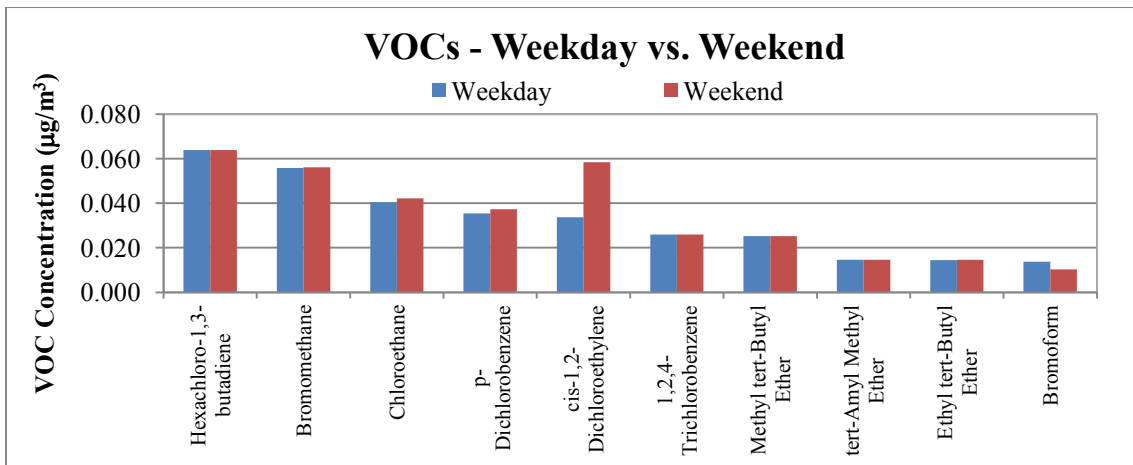


Figure 16. VOC Weekend vs. Weekday Concentrations 2009, ctd.

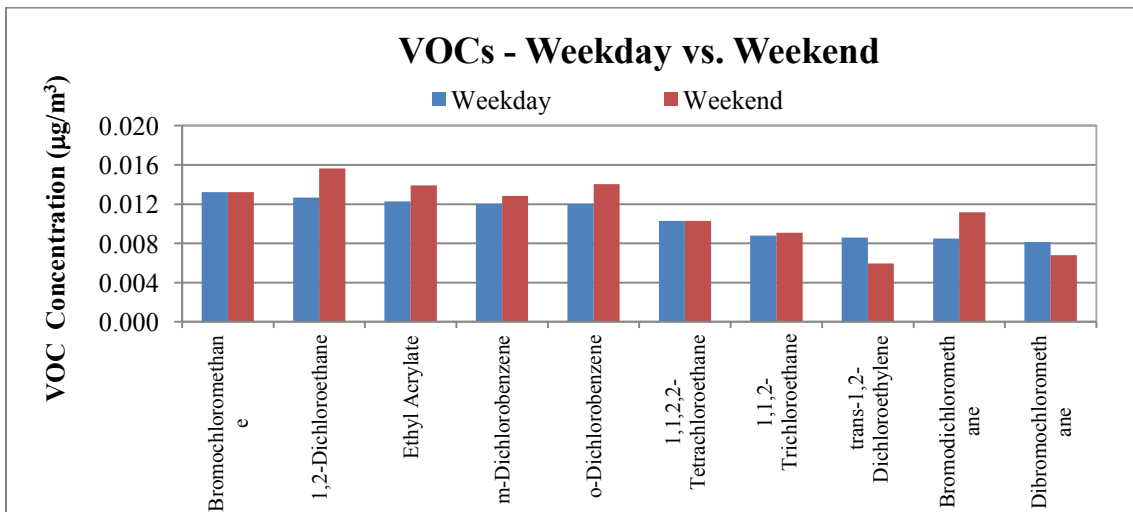


Figure 17. VOC Weekend vs. Weekday Concentrations 2009, ctd.

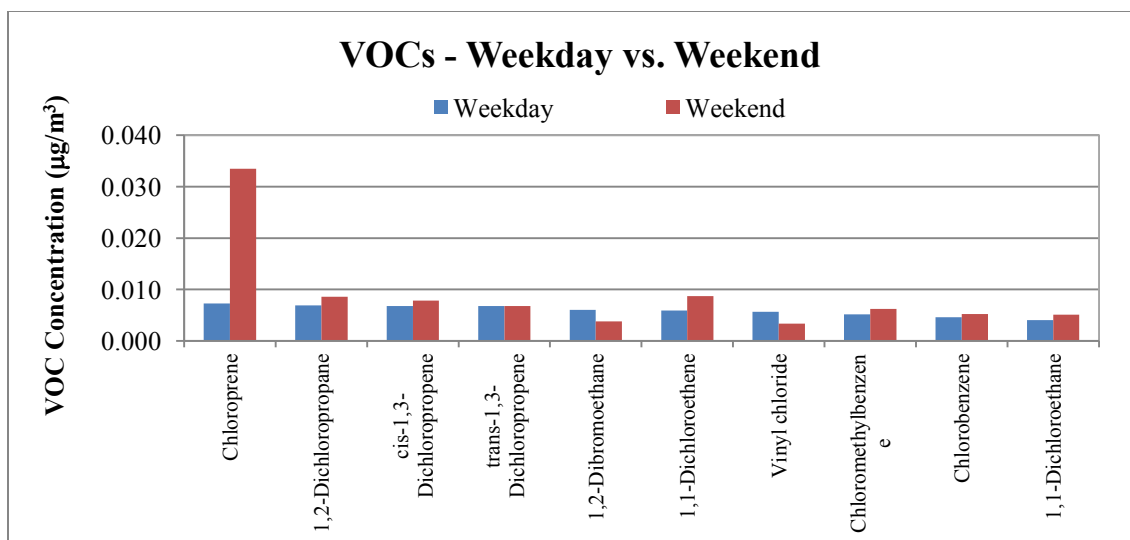


Figure 18. VOC Weekend vs. Weekday Concentrations 2009, ctd.

Quality Assurance/Quality Control

Field Blanks

The volatile organic compound sampling method involves sampling in stainless steel canisters with specially treated interior surfaces. The canisters are re-used. After a full canister is analyzed, it is pumped out repeatedly to a high vacuum. This procedure cleans it for the next use. Periodically, one canister from each cleaning batch is tested to make sure the method is performing adequately. The test canister is filled with ultra-pure air, and then analyzed. If it shows no contamination, the batch is released for use. If contamination is found, the entire batch is sent through the cleaning process for a second time. The canisters arrive in the field closed, and under 20 to 30 inches of vacuum. Therefore, field blanks are not used in this method. The canisters are “blanked” at the laboratory prior to shipping to the field.

Precision of Sample Results

On six sampling dates, a second canister was sampled simultaneously with the primary sample. These additional samples, known as duplicates, were collected in order to assess the precision (repeatability) of the canister sampling method. In general, repeatability for the two collocated samples was excellent. Information regarding precision and accuracy results is available upon request to the Air Pollution Control Division.

V. PM₁₀ METALS

Summary Statistics

During the study, metals were sampled on the every sixth day schedule, for a total of 61 samples attempted. Of those 61 samples, 6 were voided for various reasons, leaving a total of 55 samples collected (90.2% sample recovery). Table 8 shows the percentage of the samples in which each metal was detected. Chromium (total) and manganese were detected in about 85% or more of the samples. Lead and nickel were present in one-half to two-thirds of the samples. Arsenic was never detected.

Table 8. Metals List with 2009 Detection Rates

Compound	CAS Number	# of ND's	% ND
Chromium (total)	7440-47-3	4	7%
Manganese	7439-96-5	7	13%
Nickel	7440-02-0	20	36%
Lead	7439-92-1	31	56%
Antimony	7440-36-0	32	58%
Beryllium	7440-41-7	49	89%
Cadmium	7440-43-9	50	91%
Arsenic	7440-38-2	55	100%

Table 9 summarizes the annual maximum and mean concentrations for each of the metals measured during the study. Annual means were calculated by using one-half of the detection limit in place of the non-detect samples. This is an accepted conservative technique for calculating annual values when some of the samples were less than the laboratory's ability to measure. Results show that manganese and total chromium were the compounds with the highest annual averages. The other metals were present at lower concentrations. The 2009 annual mean levels are generally less than 2008, except for cadmium and total chromium, which were higher in 2009. Although arsenic was never detected, the average and maximum concentration values are not equal as with other compounds. This is due to shifting MDL levels at the lab throughout the year.

Table 9. Metals Data Summary 2009

Analyte	Molecular Weight (g/mol)	Average ($\mu\text{g}/\text{m}^3$)	Maximum ($\mu\text{g}/\text{m}^3$)	Avg. PQL ($\mu\text{g}/\text{m}^3$)
Chromium (total)	52.00	0.00883	0.01764	0.00091
Manganese	54.94	0.00870	0.02882	0.00043
Lead	207.20	0.00209	0.00861	0.00152
Nickel	58.70	0.00088	0.00253	0.00049
Arsenic	74.92	0.00087	0.00234	0.00175
Antimony	121.75	0.00054	0.00309	0.00045
Cadmium	112.41	0.00023	0.00652	0.00020
Beryllium	9.01	0.00013	0.00026	0.00023

Graphs

The metal compounds measured during the study are graphed in Figure 19. This figure shows that manganese and total chromium were the metals with the largest concentrations. Total chromium and cadmium were higher in 2009 as opposed to 2008. Figures Figure 20 and Figure 21 indicate that most of the metals were at low concentration levels throughout the year. There does not appear to be any seasonal trending in the metals values based on the 2009 data. Manganese has the largest amount of variability in the concentration values recorded, with values ranging from just slightly over zero to near 0.030 micrograms per meter cubed.

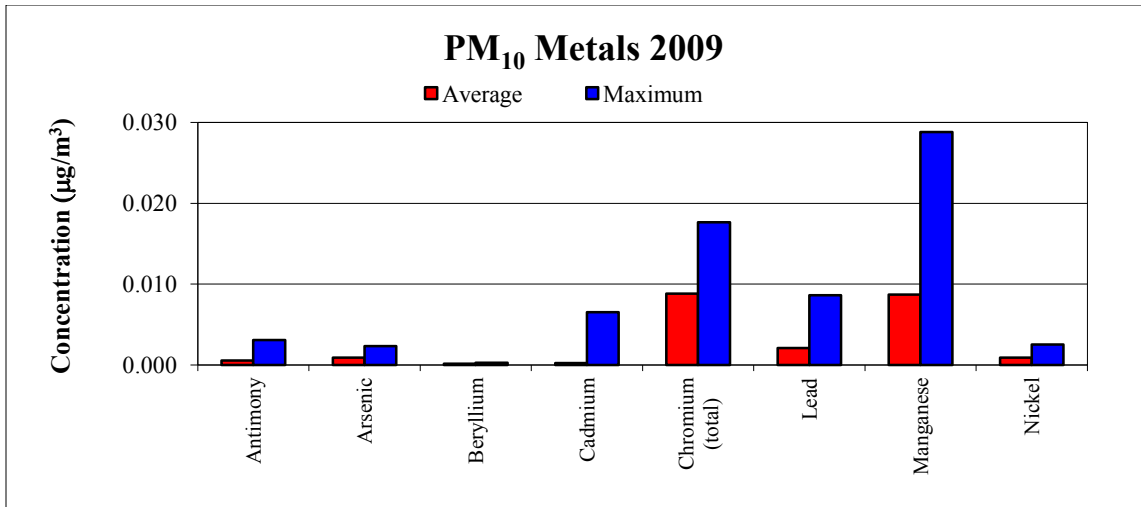


Figure 19. PM₁₀ Metals Average and Maximum Concentrations 2009

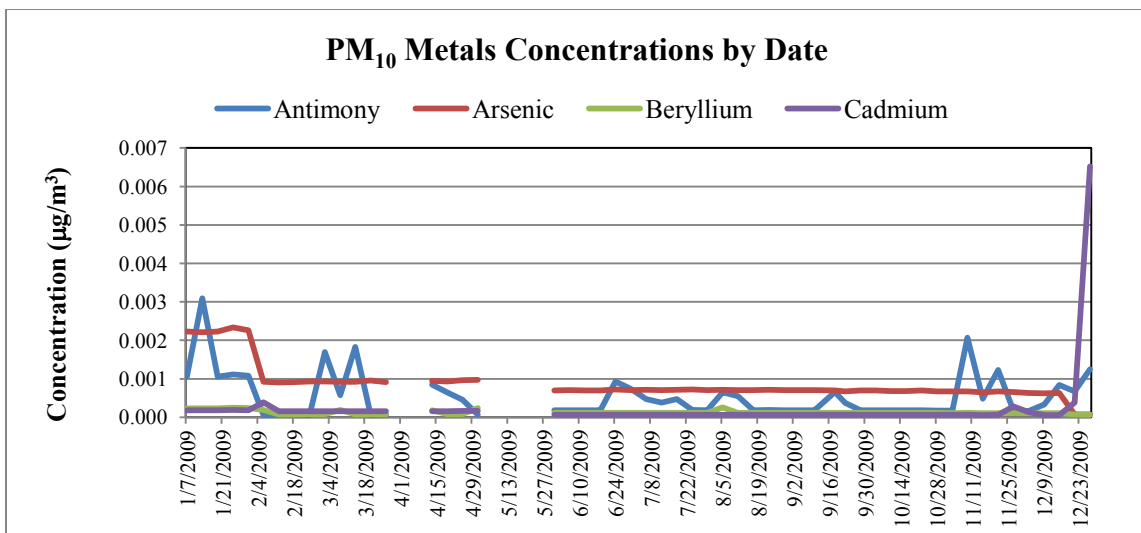


Figure 20. PM₁₀ Metals Concentrations by Date 2009

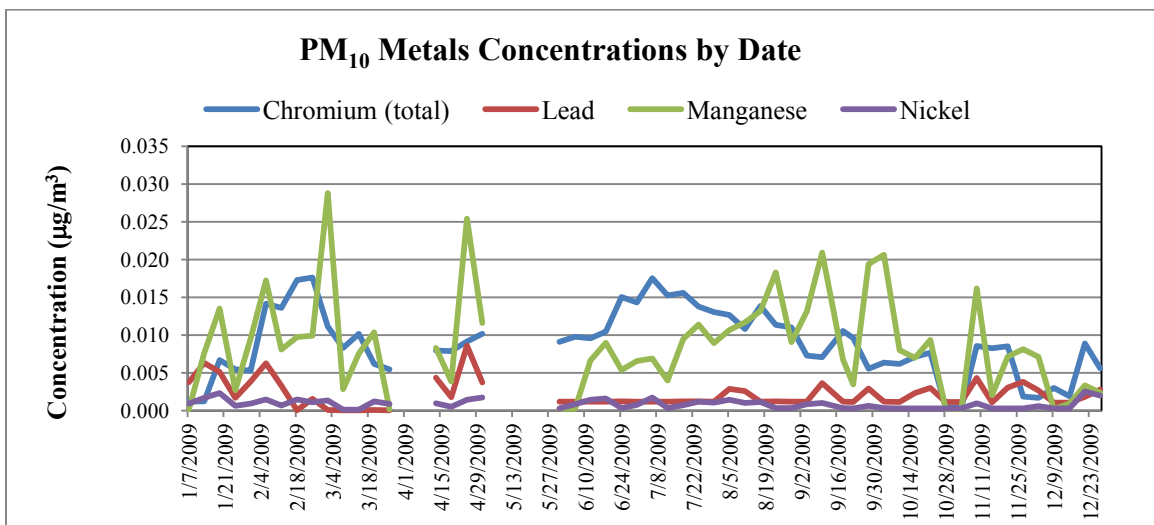


Figure 21. PM₁₀ Metals Concentrations by Date 2009, ctd.

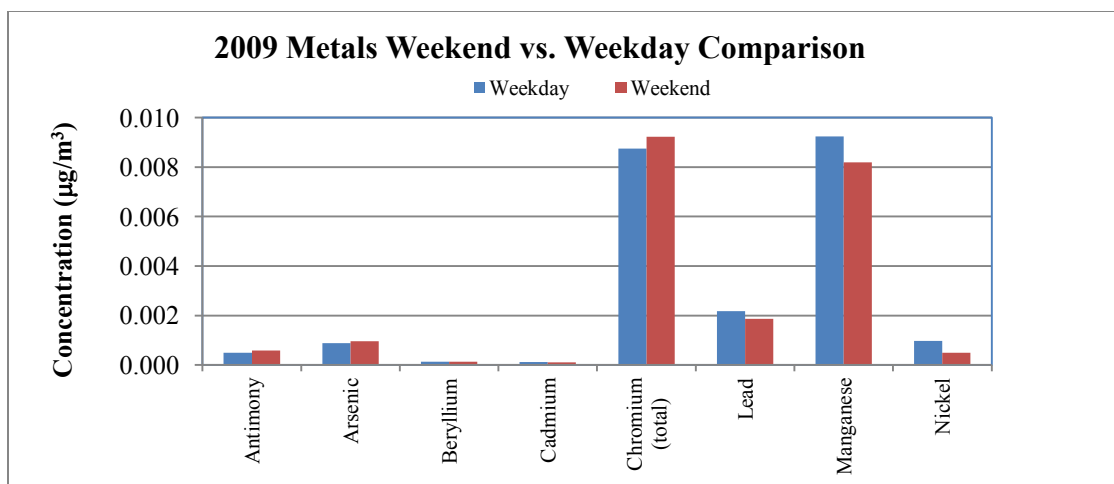


Figure 22. PM₁₀ Metals Weekend versus Weekday Comparison 2009

Figure 22 is a chart of the weekend versus weekday concentrations for the PM₁₀ metals. Three of the compounds, antimony, arsenic and total chromium, all had average weekend concentration values that were larger than their weekday averages. Lead, manganese, and nickel all had average weekend concentration values that were smaller than their weekday averages. Beryllium and cadmium had average values for the weekday and weekend concentrations that were nearly equal. The beryllium and cadmium were detected in less than 10 percent of the samples collected, while arsenic was not detected at all. Lead and antimony were detected less than 50 percent of the time.

Quality Assurance/Quality Control

Field and Filter Blanks

Periodically, the laboratory analyzes a “blank,” or unused, filter for metals. The purpose of this extra analysis is to determine if there was any contamination of the filter during manufacturing or during laboratory processing. In 2009, the laboratory analyzed 23 “filter blanks,” filters which never left the laboratory. Chromium, lead, manganese, and nickel showed up consistently in the blanks. In 2004, total chromium contamination was a problem for the national air toxics network. These chromium contamination findings were believed to be related to the use of metal knives in cutting individual filters from the giant sheets prepared at the factory. At the extremely low levels of metals in ambient air that the national air toxics network is assessing, such filter contamination is a concern. Figure 23 visually illustrates the effect that the blank concentrations have on the total concentration for the individual metals. It shows the percentage contribution of the blank concentrations to the total concentration. The concentrations are generally not significant, except in the case of chromium. The national project team evaluated new filter materials and sampling methods, and recommended changing to Teflon filters, and low volume PM₁₀ samplers in early 2005. Unfortunately, large amounts of chromium continue to show up in the blanks of the 2009 filters. Blank amounts are subtracted from the ambient values, but the chromium variability is still a problem.

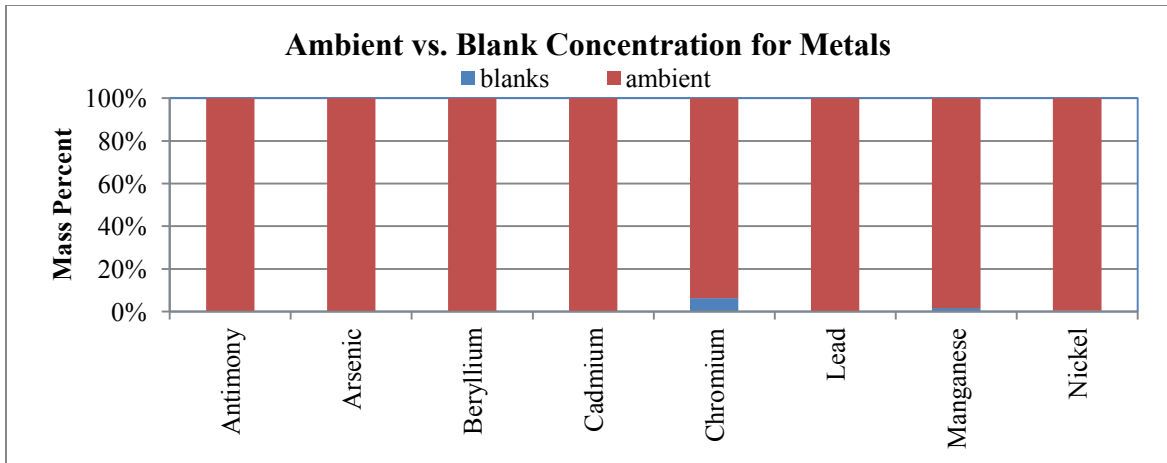


Figure 23. Ambient versus Blank Concentrations for Metals

Precision of Sample Results

Approximately 41 duplicate precision samples were run in 2009. The agreement between samples was very good, with a ten percent or less difference between the concentration values.

VI. HEXAVALENT CHROMIUM

Summary Statistics

Hexavalent chromium data collected at the Grand Junction – Powell station in 2009 are presented in this section. In 2005, a new hexavalent chromium sampler was added to the Grand Junction site. The technical steering committee made this decision for the nationwide air toxics monitoring network. The previous method only measured total chromium and could not distinguish between the trivalent (Cr^{3+}) and the hexavalent (Cr^{6+}) forms. These two forms are quite different in their health effects. The Cr^{6+} form is a carcinogen, while the Cr^{3+} form is not. This new method is described in the document, “Hexavalent Chromium Method Development: Final Report, Work Assignment 5-03,” by Eastern Research Group in Morrisville, North Carolina on September 30, 2005. Note that, due to its sensitivity, this method gives results in nanograms per cubic meter of air (ng/m^3), a unit one thousand times lower than the micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) used elsewhere in this report.

During the year long period, hexavalent chromium was sampled on an every sixth day basis, with several extra samples taken throughout the year. A total of 65 samples were attempted, with 62 being analyzed (95.4% sample recovery). Table 10 shows that hexavalent chromium was detected in less than 40 percent of the samples taken in 2009. Table 11 shows the average and maximum hexavalent chromium concentrations recorded in 2009. The annual mean was calculated by using one-half of the minimum detection limit in place of the non-detect samples. This is an accepted conservative technique for calculating annual values when some of the samples were less than the laboratory’s ability to measure. The average and maximum values seen in 2009 are lower than those seen in 2008 (0.0208 and 0.6850 ng/m^3 , respectively), and 2007 (0.0155 and 0.0928 ng/m^3 , respectively).

Table 10. Hexavalent Chromium Sample Summary 2009

Compound	CAS Number	# of ND's	% ND
Hexavalent Chromium	1854-02-99	38	61%

Table 11. Hexavalent Chromium Average and Maximum Concentrations 2009

Analyte	Molecular Weight (g/mol)	Average (ng/m ³)	Maximum (ng/m ³)	Avg. MDL (ng/m ³)
Hexavalent Chromium	52.00	0.0082	0.0322	0.0045

Graphs

Figure 24 shows the annual average and maximum hexavalent chromium concentrations for 2009. Figure 25 shows hexavalent chromium concentrations during the calendar year. All concentrations were less than 0.035 ng/m³ for the year. The maximum concentration occurred on September 28, 2009.

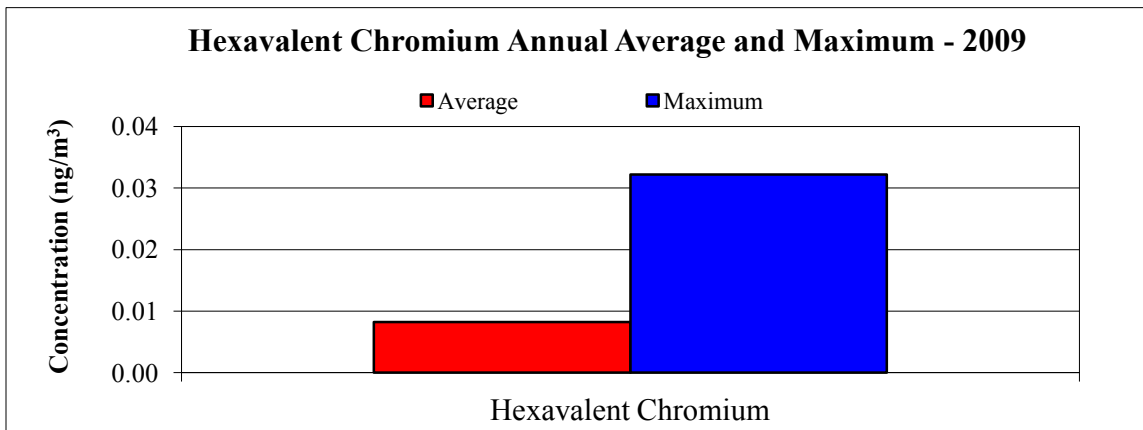


Figure 24. Hexavalent Chromium Annual Average and Maximum 2009

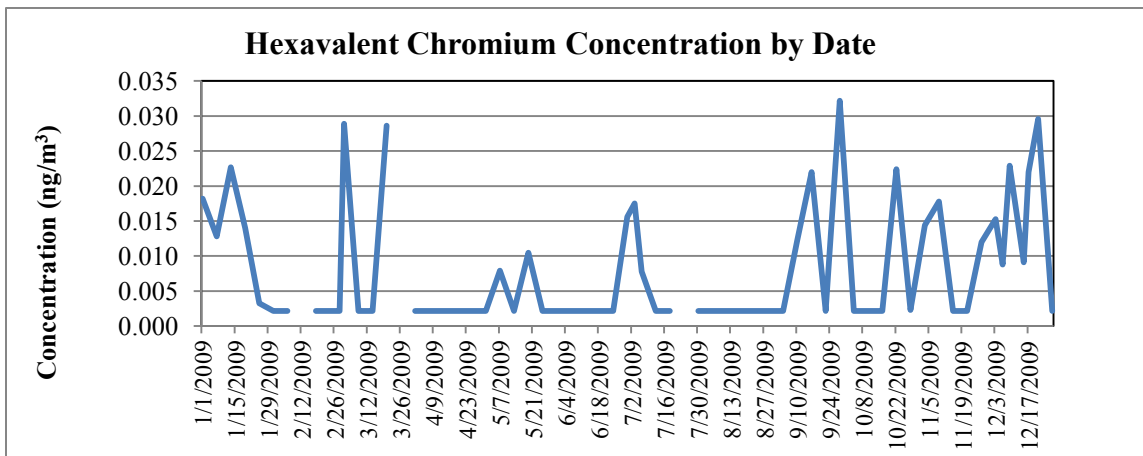


Figure 25. Hexavalent Chromium Concentrations by Date 2009

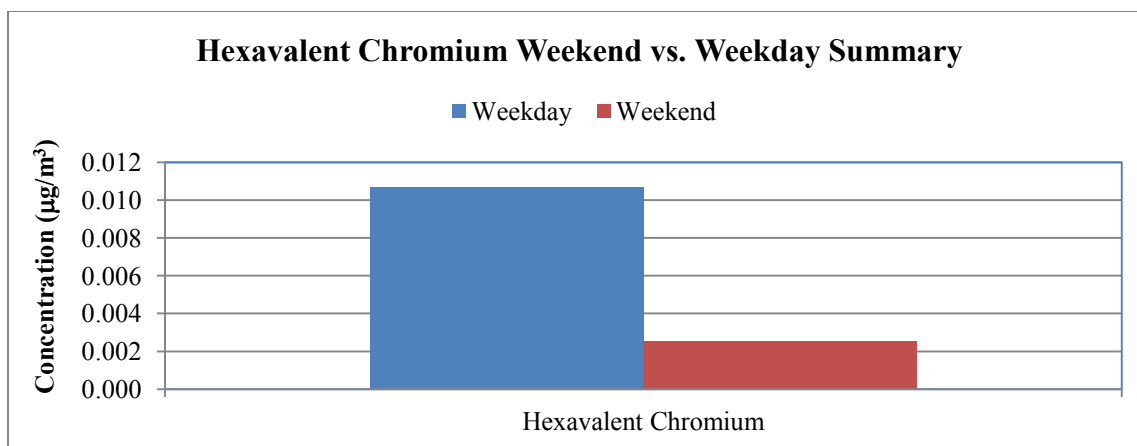


Figure 26. Hexavalent Chromium Weekend vs. Weekday Summary

Figure 26 is a summary of the weekday versus weekend hexavalent chromium concentrations. The average weekday concentration is approximately five times larger than the weekend concentration. This is expected, as hexavalent chromium is primarily used in industrial processes and would be primarily used during the week.

Quality Assurance/Quality Control

Field Blanks

Once a month a filter was transported to the field, placed on the sampler, and immediately removed, without having any air passed through it. These “field blanks” were taken to assess whether contamination in the field or the sampling materials is significant. Out of 12 blanks taken, none showed detectable levels of hexavalent chromium. Unlike total chromium samples discussed in the previous section, hexavalent chromium samples are not potentially compromised by high blank levels. This is good, because the concentrations of hexavalent chromium are more relevant to risk assessment than the amount of total chromium is.

Precision of Sample Results

Six times during the year a laboratory split sample was analyzed. An incoming sample is split into two separate samples, and then analyzed by the lab. A comparison of the results obtained gives an idea of the precision of the analytical method. In general, the duplicate samples showed good agreement.

VII. PM₁₀

Sample Statistics Summary

The Colorado Department of Public Health and Environment operates samplers for particulate matter 10 microns or less in diameter (PM₁₀) and particulate matter 2.5 microns or less in diameter (PM_{2.5}) at the Grand Junction – Powell, and Grand Junction – Pitkin stations. These samplers serve to indicate the status of Grand Junction regarding the National Ambient Air Quality Standards (NAAQS) for PM₁₀ and PM_{2.5}. Results of the statewide particulate matter monitoring network are discussed in “Colorado: 2009 Air Quality Data Report” by the Air Pollution Control Division. The National Air Toxics Trends Study chose to monitor air toxics in Grand Junction because of the availability of PM_{2.5} speciation data, which gives insight into air toxics in particulate matter. In 2009, the percentage of PM₁₀ data recovery was 91.4 percent, with 128 samples attempted, and 117 collected.

Table 12. PM₁₀ Average and Maximum Concentrations 2009

Analyte	Average ($\mu\text{g}/\text{m}^3$)	Maximum ($\mu\text{g}/\text{m}^3$)
PM ₁₀ (every 3rd day sample)	24.5	64.6
PM ₁₀ (every 6th day sample)	25.4	64.6

Table 12 lists the average and maximum concentrations observed at the Grand Junction site in 2009. The table lists concentrations for the entire every third day sampling period, as well as concentrations obtained on the same days that the air toxics analyzers were in operation (every sixth day). The averages are very similar for the third and sixth day sampling, and are approximately half of the former annual standard level of 50 micrograms per meter cubed. The maxima for the third and sixth day sampling are the same, and are less than half of the 24-hour maximum standard of 150 micrograms per meter cubed. The percent difference between the collocated samplers ranged from -11% to +7%, well within the acceptable range for collocated samplers.

Graphs

Figure 27 and Figure 28 are graphs of the PM₁₀ concentration data recorded every third, and every sixth sampling day. As is evidenced in the annual averages, both graphs indicate that the concentrations were very similar on both the third and sixth day sample schedules.

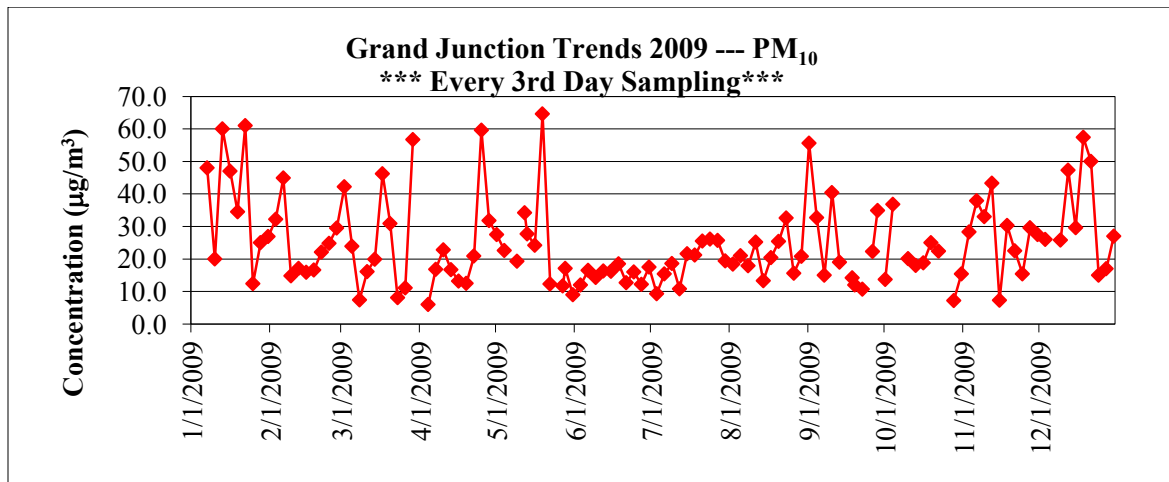


Figure 27. PM₁₀ Concentrations by Date (every 3rd Day)

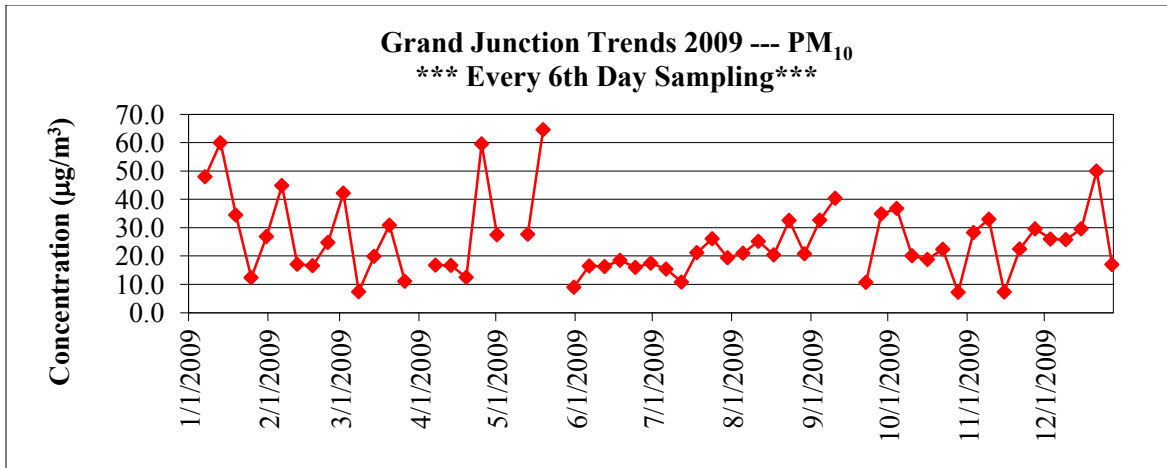


Figure 28. PM₁₀ Concentrations by Date (every 6th Day)

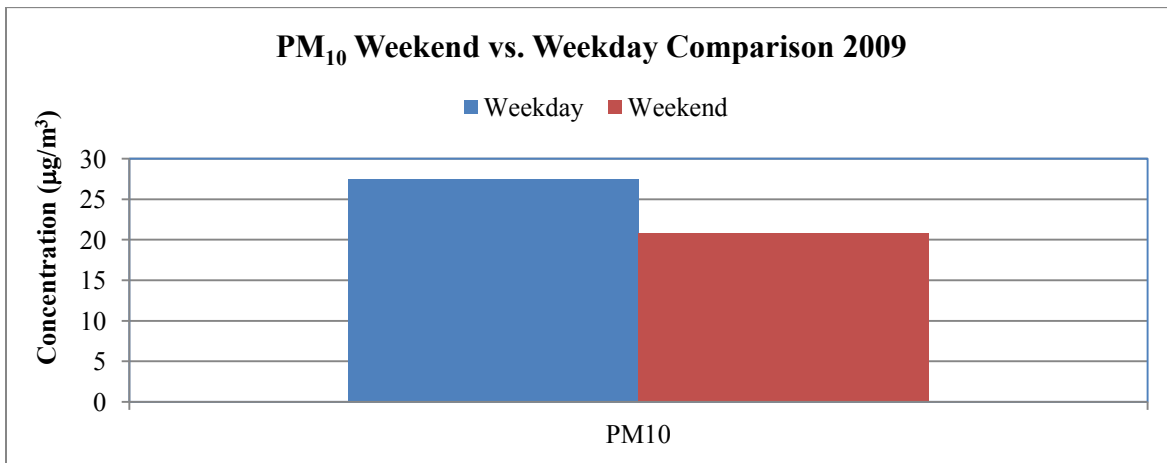


Figure 29. PM₁₀ Weekend vs. Weekday Comparison 2009

Figure 29 is a graph of the weekend versus weekday concentrations for PM₁₀. The weekday average is larger than the weekend average. PM₁₀ is dominated by surface disturbance of earth materials (street sand, windblown dust). The PM₁₀ levels are subject to change due to daily weather conditions.

Quality Assurance/Quality Control

Field Blanks

There were no field blanks taken for PM₁₀.

Precision of Sample Results

Collocated samples were run approximately half as frequently as the primary samples were run. This is done in an effort to validate the collected data. There is good agreement between the primary and collocated sampler concentrations.

VIII. PM_{2.5}

Sample Statistics Summary

The Colorado Department of Public Health and Environment operates a sampler for particulate matter 2.5 microns or less in diameter (PM_{2.5}) at the Grand Junction – Powell station. This sampler serves to indicate the status of Grand Junction regarding the National Ambient Air Quality Standards (NAAQS) for and PM_{2.5}. Results of the statewide particulate matter monitoring network are discussed in “Colorado: 2009 Air Quality Data Report” by the Air Pollution Control Division. The National Air Toxics Trends Study chose to monitor air toxics in Grand Junction because of the availability of PM_{2.5} speciation data, which gives insight into air toxics in particulate matter. It should be noted here, however, that the speciation sampler previously located in Grand Junction was removed, and relocated to the state’s NCore site in Denver. At this time no replacement instrumentation is available. The PM_{2.5} data discussed here is derived from gravimetric analyses only, and does not include any speciated results. In 2009, the percentage of PM_{2.5} data recovery was 98.4 percent, with 128 samples attempted, and 126 collected.

Table 13. PM_{2.5} Average and Maximum Concentrations 2009

Analyte	Average (µg/m ³)	Maximum (µg/m ³)
PM _{2.5} (every 3rd day sample)	9.8	59.1
PM _{2.5} (every 6th day sample)	10.5	59.1

Table 13 lists the annual average and maximum PM_{2.5} concentrations at the Grand Junction sites. The maximum value occurred on an air toxics sampling day, January 1, 2009. The elevated value is likely due to agricultural sources, or wood burning smoke at that time of the year. PM_{2.5} emissions are also generated by combustion of automobile tailpipe emissions, coal burning, etc. The table lists particulate concentrations for the entire every third day sampling period, as well as concentrations for an every sixth day sampling period, for the days that the air toxics analyzers were in operation with the PM_{2.5} monitor. The averages are very similar for the third and sixth day sampling, and are approximately two-thirds of the annual standard level of 15 micrograms per meter cubed. The maxima for the third and sixth day sampling are the same, and above the 24-hour maximum standard of 35 micrograms per meter cubed.

Graphs

Graphs of the daily concentration values for every third and every sixth day sampling are shown in Figure 30 and Figure 31. They show that the PM_{2.5} concentrations are generally pretty consistent throughout the year, but tend to vary more during the winter months, when there is more smoke in the air from agriculture, and household wood burning.

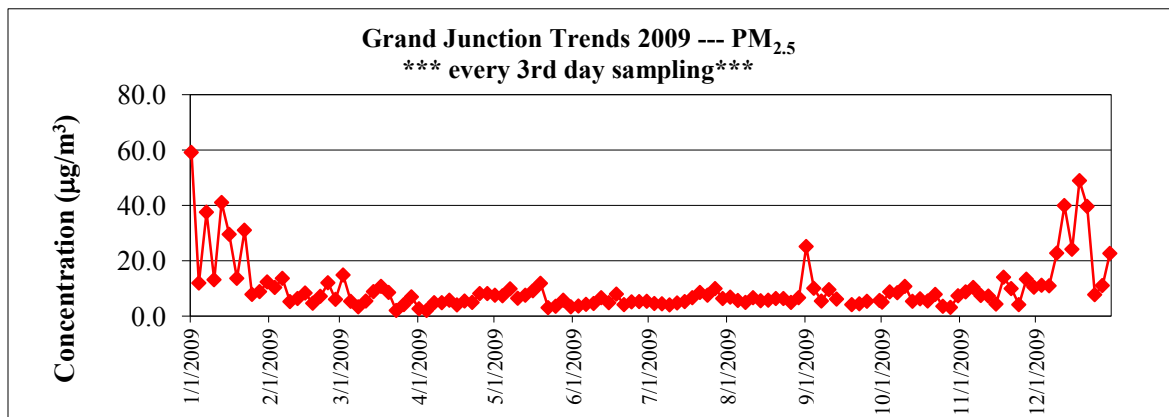


Figure 30. PM_{2.5} Concentration by Date, Every 3rd Day Sampling 2009

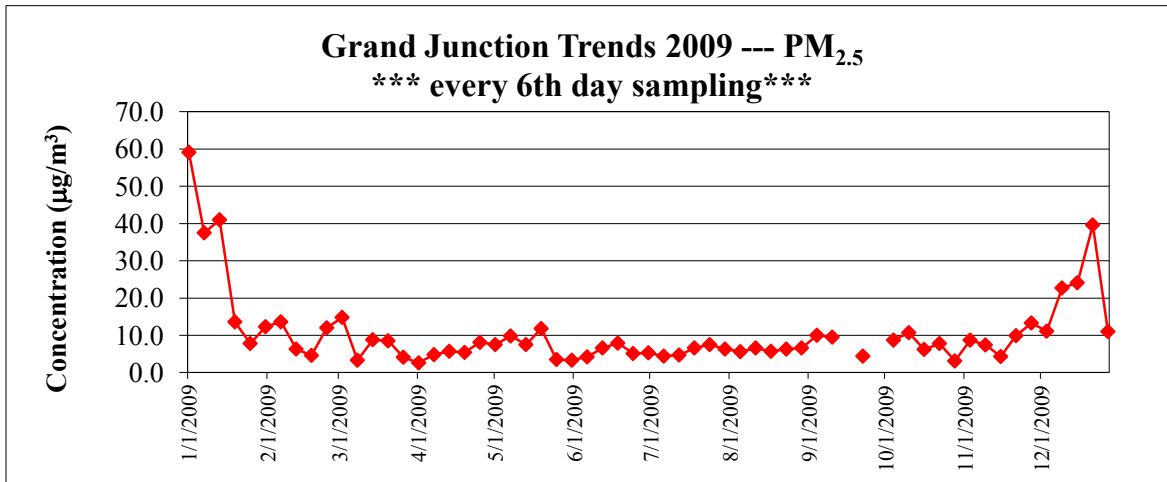


Figure 31. PM_{2.5} Concentration by Date, Every 6th Day Sampling 2009

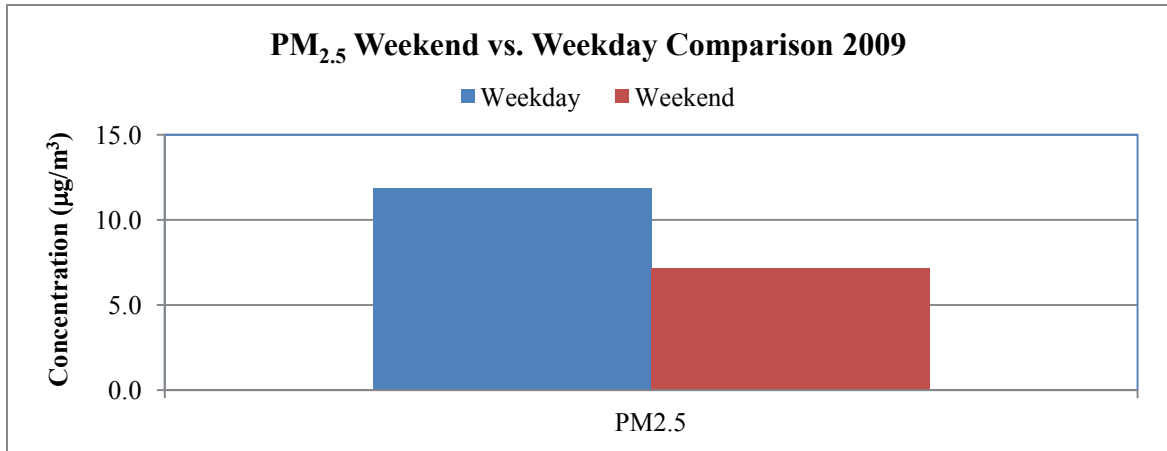


Figure 32. PM_{2.5} Weekend vs. Weekday Comparison 2009

Quality Assurance/Quality Control

Field Blanks

There were no field blanks taken for PM_{2.5}.

Precision of Sample Results

No collocated samples were run for PM_{2.5}.

IX. POLYCYCLIC AROMATIC HYDROCARBONS

Summary Statistics

In April 2008, the Grand Junction National Air Toxics Trends Site added a sampler for polycyclic aromatic hydrocarbon (PAH) compounds. A good definition of these chemicals is:

Polycyclic aromatic hydrocarbons (also known as polynuclear aromatic hydrocarbons) are composed of two or more aromatic (benzene) rings which are fused together when a pair of carbon atoms is shared between them. The resulting structure is a molecule where all carbon and hydrogen atoms lie in one plane. Naphthalene (C₁₀H₈, MW = 128.16 g), formed from two benzene rings fused together, has the lowest molecular weight of all PAHs. The environmentally significant PAHs are those molecules which contain two (e.g., naphthalene) to seven benzene rings (e.g., coronene with a chemical formula C₂₄H₁₂; MW = 300.36 g). In this range, there are a large number of PAHs which differ in number of aromatic rings, position at which aromatic rings are fused to one another, and number, chemistry, and position of substituents on the basic ring system. (Source: Ambient Water Quality Criteria for Polycyclic Aromatic Hydrocarbons (PHAs) Ministry of Environment, Lands and Parks, Province of British Columbia. By N. K. Nagpal, Ph.D., Water Quality Branch, Water Management Division, British Columbia, Canada, Ministry of Environment, February, 1993).

In all, 64 PAH samples were attempted, and 61 were collected for analysis (95.3% sample recovery rate). Twenty-two compounds were measured for this study. The list of these compounds and the summary of the collected data are shown in Table 14 and Table 15. Twelve of the 22 compounds analyzed for were detected in greater than 90% of the samples, and 19 were detected in greater than 50% of the samples. Seven compounds were detected in each of the samples taken. They are: 9-fluorenone, acenaphthene, fluoranthene, fluorine, naphthalene, phenanthrene, and pyrene.

Table 14. PAH Sample Summary Data 2009

Compound	CAS Number	# of ND's	% ND
9-Fluorenone	486-25-9	0	0%
Acenaphthene	83-32-9	0	0%
Fluoranthene	206-44-0	0	0%
Fluorene	86-73-7	0	0%
Naphthalene	91-20-3	0	0%
Phenanthrene	85-01-8	0	0%
Pyrene	129-00-0	0	0%
Chrysene	218-01-9	1	2%
Retene	483-65-8	1	2%
Anthracene	120-12-7	3	5%
Benzo (b) fluoranthene	205-99-2	3	5%
Benzo (g,h,i) perylene	191-24-2	5	8%
Benzo (e) pyrene	192-97-2	7	11%
Coronene	191-07-1	7	11%
Benzo (a) anthracene	56-55-3	11	18%
Benzo (k) fluoranthene	207-08-9	16	26%
Indeno(1,2,3-cd)pyrene	193-39-5	17	28%
Acenaphthylene	208-96-8	18	30%
Benzo (a) pyrene	50-32-8	21	34%
Cyclopenta[cd]pyrene	27208-37-3	34	56%
Perylene	198-55-0	34	56%
Dibenz (a,h) anthracene	53-70-3	48	79%

ND = Not Detected

Table 15 summarizes the annual maximum, and mean concentrations for each PAH measured during the study. The annual means were calculated by replacing all “non-detect” values with one-half of the sample minimum detection limit. This is an accepted conservative technique for calculating annual values when

some of the samples were less than the laboratory's ability to detect. Naphthalene had the largest annual average of the PAH compounds with a value of 189.13 nanograms per meter cubed. This is over ten times greater than the next closest average concentration, which is phenanthrene, with 17.91 nanograms per meter cubed. Naphthalene is found in tobacco smoke, mothballs, coal tar production, and from the combustion of coal and oil. The 2009 annual averages are larger than the 2008 annual averages. This is likely due to the fact that PAH sampling began in April of 2008, and a full year of data was not obtained then.

Table 15. PAH Annual Average and Maximum Values 2009

Analyte	Molecular Weight (g/mol)	Average (ng/m ³)	Maximum (ng/m ³)	Avg. MDL (ng/m ³)
Naphthalene	128.17	189.13	523.00	0.41
Phenanthrene	178.23	17.91	43.30	0.10
Acenaphthene	154.21	11.34	31.50	0.07
Fluorene	166.22	9.20	17.40	0.06
Fluoranthene	202.26	3.79	9.02	0.07
Acenaphthylene	152.19	3.68	25.70	0.08
Pyrene	202.25	2.87	9.03	0.10
9-Fluorenone	180.19	2.67	6.16	0.08
Anthracene	178.23	1.65	24.00	0.08
Retene	234.34	1.37	6.20	0.09
Benzo (b) fluoranthene	252.31	0.72	3.15	0.10
Chrysene	228.28	0.68	2.91	0.07
Benzo (g,h,i) perylene	276.33	0.43	1.94	0.06
Benzo (a) anthracene	228.29	0.39	2.03	0.10
Benzo (e) pyrene	252.31	0.39	3.72	0.08
Indeno(1,2,3-cd)pyrene	276.31	0.37	1.61	0.07
Benzo (a) pyrene	252.31	0.33	1.72	0.10
Coronene	300.36	0.23	1.10	0.07
Benzo (k) fluoranthene	252.31	0.21	0.93	0.10
Cyclopenta[cd]pyrene	226.27	0.19	1.35	0.11
Perylene	252.31	0.08	0.29	0.05
Dibenz (a,h) anthracene	278.35	0.06	0.19	0.08

Graphs

The PAHs with the three largest annual average concentrations are shown in Figure 33 and Figure 34. Naphthalene is the most variable, with concentrations ranging from 0.2 to 523 nanograms per meter cubed. The concentrations of the other compounds appear to be more constant than that of naphthalene. Acenaphthylene exhibits a seasonal variation, with larger concentrations in the winter months, and lower concentrations in the summer months. Acenaphthylene is a component of crude oil, and a product of combustion.

Figure 35 is a graph of the weekend versus weekday concentrations for all the PAH compounds. The weekday averages were larger than the weekend values for all compounds except acenaphthene. The values for naphthalene are off the chart with a weekday average of 194 nanograms per meter cubed, and a weekend average of 174 nanograms per meter cubed.

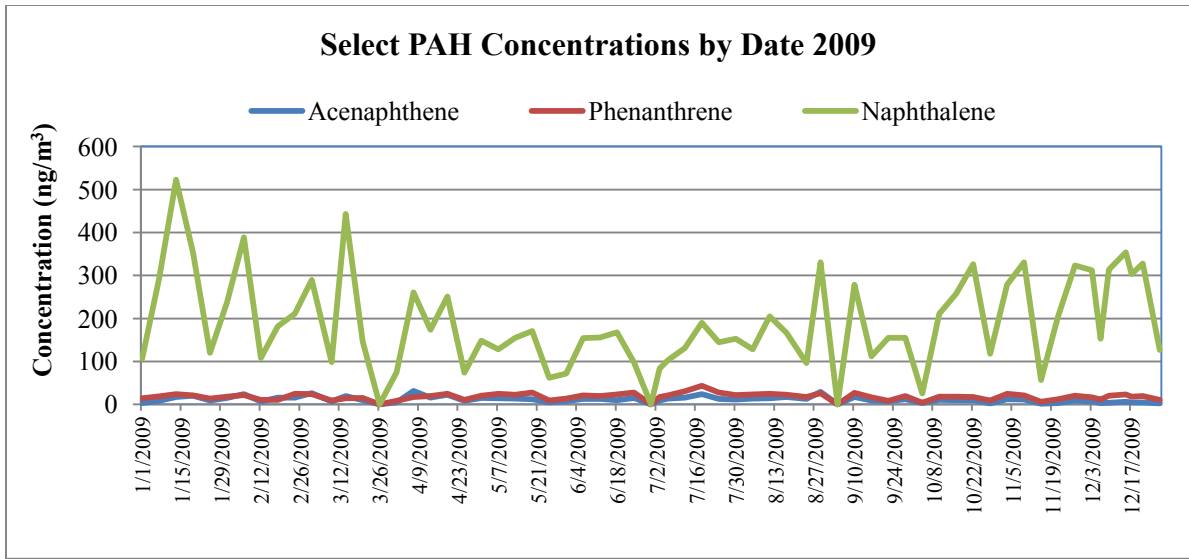


Figure 33. Select PAH Concentrations by Date 2009

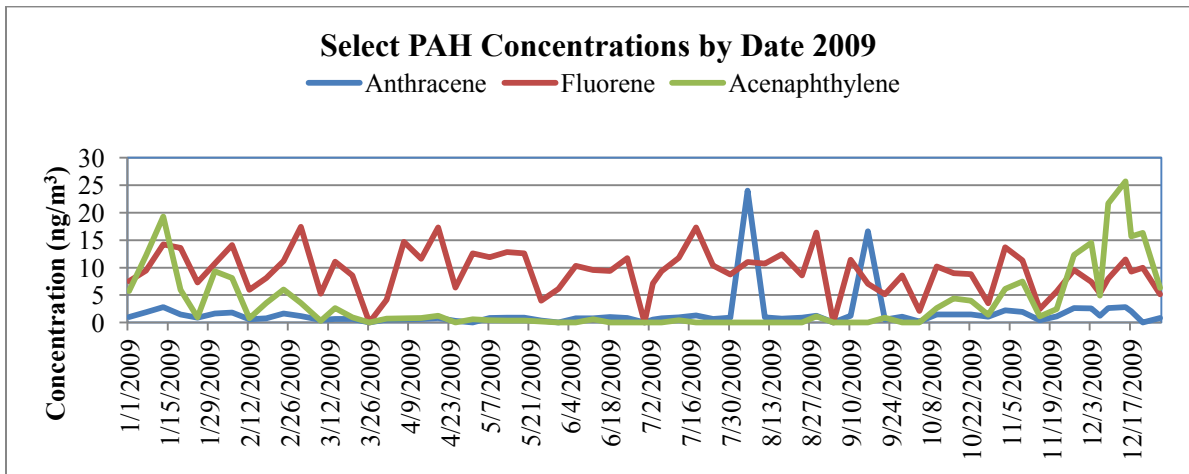


Figure 34. Select PAH Concentrations by Date 2009, etc.

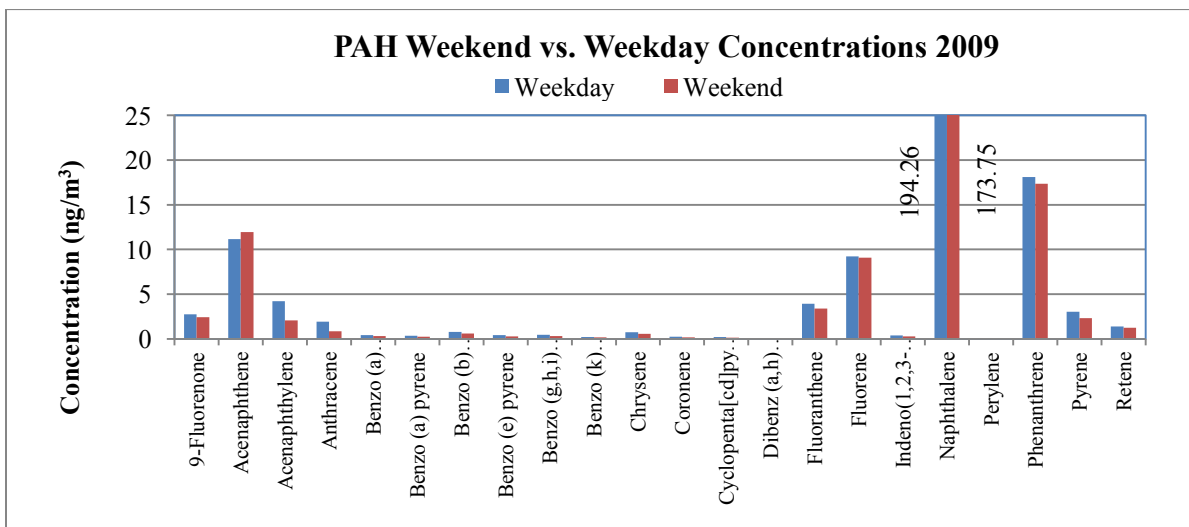


Figure 35. PAH Weekend vs. Weekday Concentrations

Quality Assurance/Quality Control

Field Blanks

Periodically, the laboratory analyzes a “blank,” or unused, filter for PAH compounds. The purpose of this extra analysis is to determine if there was any contamination of the filter during manufacturing, or during laboratory processing. In 2009, the laboratory analyzed 12 “filter blanks,” filters which never left the lab. Naphthalene and phenanthrene were detected at low levels in every filter blank. Fluoranthene and pyrene were detected in half of the blank samples. Acenaphthene, anthracene, and chrysene each showed up in a single blank.

Precision of Sample Results

Precision air samples were not run in 2009. Assessing precision requires a collocated sampler at the site, and the NATTS group chose to take precision samples at other locations in the nationwide network.

X. METEOROLOGY

A meteorological tower at the Powell shelter site measures wind speed, wind direction, relative humidity, and temperature. The year 2009 wind rose is shown below. The “arms” of this diagram show the percentage of the time that the wind blew from each direction. The shading on each arm indicates the wind speeds associated with each direction. Each of the concentric rings, moving outward, signifies an additional three percent of the time. For example, just below 12% of the winds are from the west-northwest. Wind speeds in the ranges of 1 – 4 mph or 4 – 7 mph are the most frequent. It should be noted here that the legend listing the wind speeds in units of knots is incorrect, and should read as miles per hour. There is no option for using mph units on the software that was used to generate the wind rose. All speeds listed are in miles per hour.

The wind rose shows that winds follow a daily pattern typical of river valleys. At night, the winds come from the southeast quarter, flowing down river. During the day, heating of the air causes flow reversals, and flow comes from the northwest.

A look at the highest concentrations days for each pollutant indicated that some days showed maxima for more than one air pollutant. Many of these dates are in the fall or winter period, which indicates possible local temperature inversions and limited air mixing, thus allowing pollutants of all types to build up in the area.

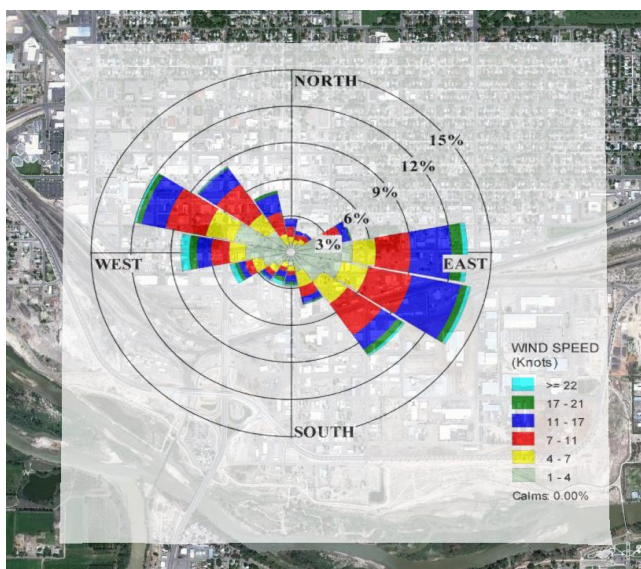


Figure 36. Wind Rose for Grand Junction 2009

XI. SUMMARY AND CONCLUSIONS

The National Air Toxics Trends Study in Grand Junction for 2009 showed similar results to prior years. The highest carbonyls in air were formaldehyde, acetaldehyde, and acetone. Twenty-nine volatile organic compounds are ubiquitous, having been detected in 90% of the air samples for 2009. A listing of these compounds can be seen in Table 5. For the metals, total chromium, lead and manganese showed the highest average concentrations. Hexavalent chromium is an extremely small fraction of the chromium in air. The highest polycyclic aromatic hydrocarbons in air were naphthalene, acenaphthene, and phenanthrene.

The study will continue in 2010. One of the major goals of this study is to run the site for at least six years, and then compare the mean concentrations for each pollutant during the first three years to the means for the next three years. The Environmental Protection Agency is conducting this study at a number of locations around the country. The purpose is to assess whether air pollution control strategies aimed at reducing air toxics have succeeded. These interim results, when compared to levels measured during the 2001 Pilot study, suggest that levels are decreasing.