Michigan 2009 Air Quality Report

Michigan DNRE

Department of NATURAL RESOURCES and ENVIRONMENT

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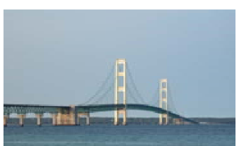
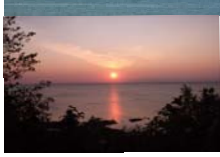
Cover Photos courtesy of Mary Mello.



Mackinac Bridge, Lower Peninsula (looking north) on the Lake Huron side of the Straits of Mackinac, September 2008



Sunset, Upper Peninsula on the Lake Michigan side of the Straits of Mackinac, September 2008

Grand Hotel on Mackinac Island, Lake Huron, September 2008

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2009 Air Quality Report

Introduction

The federal Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) for six criteria pollutants considered harmful to the public and the environment. These standards define the maximum permissible concentration of criteria pollutants in the air (see **Table 1.1**)

One or more NAAQS have been established for the six criteria pollutants that are monitored by the Department of Natural Resources and Environment (DNRE) Air Quality Division (AQD). These criteria pollutants are:

- Carbon monoxide (CO),
- Lead (Pb),
- Nitrogen dioxide (NO_2),
- Ozone (O_3),
- Particulate matter smaller than 10 and 2.5 microns in diameter (PM_{10} and $PM_{2.5}$ respectively)
- Sulfur dioxide (SO_2).

Chapters 2-7 provide information on each of the six criteria pollutants and include:

- Michigan's monitoring requirements for 2009,
- Attainment/nonattainment status,
- Monitoring site locations (tables show all the monitors active in 2009),
- Air quality trends from 2004-2009 broken down by location.[1]

The actual 2009 data for each criteria pollutant is available in **Appendix A.**

The AQD also monitors air toxics. "Air toxics" are other hazardous air pollutants that can affect human health and the environment.[2]

The purpose of this report is to provide a snapshot of Michigan's 2009 air quality data, air quality trends, overview of the monitoring network (available in much greater detail in the 2010 Network Review)[3], air toxics monitoring program, and other AQD programs, such as MIAir and Emissions Inventory.[4]

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[1] The air quality trends are based on actual statewide monitored readings, which are also listed in EPA's Air Quality Subsystem Quick Look Report Data.
[2] A fact sheet entitled What is an Air Contaminant/Pollutant? is available on the DNRE's website at http://www.deq.state.mi.us/documents/deq-ead-caap-airconfs.pdf.
[3] Available on online at http://www.michigan.gov/deq/0,1607,7-135-3310_4195-230649--,00.html
[4] Online information about criteria pollutants and air toxics, along with this and previous annual air quality reports, are available via the AQD's website at http://www.michigan.gov/deqair under "Spotlight."

Chapter 1: Background Information

This chapter provides a summary of the development of the NAAQS and how compliance with these standards is determined. Also included is an overview of Michigan's air sampling network, a description of the metropolitan statistical areas (MSAs) and their use, and the variety of monitoring techniques and requirements used to ensure quality data is obtained.

NAAQS

Under Section 109 of the CAA, the EPA establishes a primary and secondary NAAQS for each pollutant for which air quality criteria have been issued. The primary standard is designed to protect the public health with an adequate margin of safety, including the health of the most susceptible individuals in a population, such as children, the elderly, and those with chronic respiratory ailments. Factors in selecting the margin of safety for the primary standard include the nature and severity of the health effects involved and the size of the sensitive population at risk. Secondary standards are chosen to protect public welfare (personal comfort and well-being) and the environment by limiting economic damage, and visibility and climatic factors, as well as the harmful effects on soil, water, crops, vegetation, wildlife, and buildings.

In addition, the NAAQS have various averaging times to address health impacts. Short averaging times reflect the potential for acute (short-term, immediate) effects, whereas long-term averaging times are designed to protect against chronic (long-term) effects.

NAAQS have been established for CO, Pb, NO_2, O_3, PM, and SO_2. **Table 1.1** lists the primary and secondary NAAQS, averaging time, and concentration level for each criteria pollutant in effect in 2009. The concentrations are listed as parts per million (ppm), micrograms per cubic meter ($\mu g/m^3$), and/or milligrams per cubic meter (mg/m^3).

Table 1.1: NAAQS in Effect during 2009 for Criteria Pollutants

	Primary (health-related)		**Secondary (welfare-related)**	
Pollutant	**Level**	**Averaging Time**	**Level**	**Averaging Time**
Carbon Monoxide (CO)	9 ppm (10 mg/m^3)	2^{nd} highest 8-hour	None	
	35 ppm (40 mg/m^3)	2^{nd} highest 1-hour		
Lead (Pb)	0.15 $\mu g/m^3$	Maximum 3-month average	Same as Primary	
Nitrogen Dioxide (NO_2)	0.053 ppm (100 $\mu g/m^3$)	Annual arithmetic mean	Same as Primary	
Particulate Matter (PM_{10})	150 $\mu g/m^3$	24-hour	Same as Primary	
Particulate Matter ($PM_{2.5}$)	15.0 $\mu g/m^3$	Annual arithmetic mean	Same as Primary	
	35 $\mu g/m^3$	98^{th} percentile 24-hour averaged over 3 years	Same as Primary	
Ozone (O_3)	0.075 ppm	4^{th} highest 8-hour daily max. averaged over 3 years	Same as Primary	
Sulfur Dioxide (SO_2)	0.03 ppm (80 $\mu g/m^3$)	Annual arithmetic mean	0.5 ppm	3-hour
	0.14 ppm (365 $\mu g/m^3$)	24-hour		

To demonstrate compliance with the NAAQS, the EPA has defined specific criteria for each pollutant, which are summarized in **Table 1.2.**

Table 1.2: Criteria for the Determination of Compliance with the NAAQS

POLLUTANT	CRITERIA FOR COMPLIANCE
CO	Compliance with the CO standard is met when the 35 ppm 1-hour average standard and/or the 9 ppm 8-hour average standard is not exceeded more than once per year.
Pb	Compliance with the Pb standard is met when daily values collected for 3 consecutive months are averaged and do not exceed the 0.15 μg/m^3 standard.
NO_2	Compliance is met when the annual arithmetic mean concentration does not exceed the 0.053 ppm standard.
O_3	The 8-hour O_3 primary and secondary standards are met when the 3-year average of the 4th highest daily maximum 8-hr average concentration is less than or equal to 0.075 ppm.
PM	**PM_{10}:** The 24-hour PM_{10} primary and secondary standards are met when the expected number of days per calendar year above 150 μg/m^3 is equal or less than one.
	$PM_{2.5}$: The $PM_{2.5}$ annual and secondary standards are met when the annual arithmetic mean concentration is less than or equal to 15 μg/m^3. The 24-hour $PM_{2.5}$ primary and secondary standards are met when the 3-year average of the 98_{th} percentile 24-hour concentration is less than or equal to 35 μg/m^3.
SO_2	To determine compliance, the annual average concentration shall not exceed 0.03 ppm, the 24hour average concentration shall not exceed 0.14 ppm more than once per calendar year, and the 3-hour average concentration shall not exceed 0.5 ppm more than once per calendar year.

As part of the EPA's grant to the DNRE, the AQD provides an annual review of monitoring data collected from the previous year and recommends any network changes. These recommendations are based on each monitor's exceedance history, changes in population distribution, and modifications to federal monitoring under the CAA. Under the newly amended air monitoring regulations that began in 2007, states are required to solicit public comment on their future air monitoring network design prior to submitting the annual review to the EPA.

Michigan Air Sampling Network

The Michigan Air Sampling Network (MASN) is operated by the DNRE's AQD, along with other governmental agencies. For instance, the O_3 and $PM_{2.5}$ monitor in Manistee County is handled by the Little River Band of Ottawa Indians. **Figure 1.1** shows the 2009 MASN monitoring sites. **Figures 1.2** and **1.3** are pictures of two monitoring stations in Holland and W. Fort Street (Southwestern High School) in Detroit, respectively.

Figure 1.1: 2009 MASN Monitoring Sites

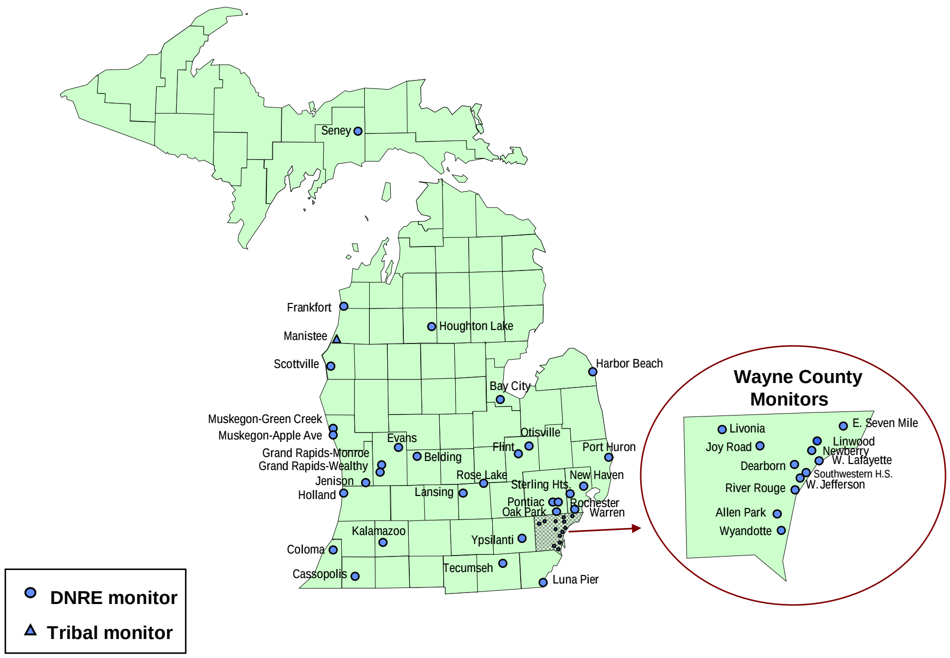


Figure 1.2 - Holland

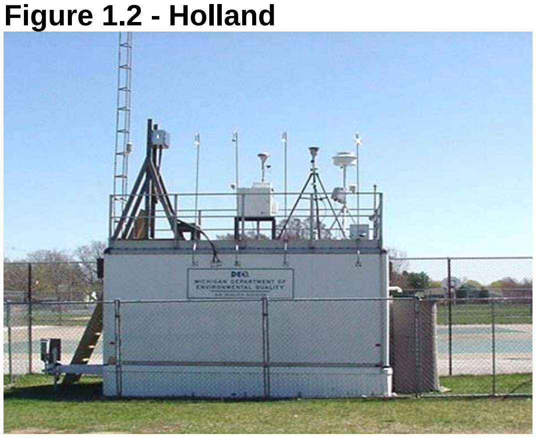
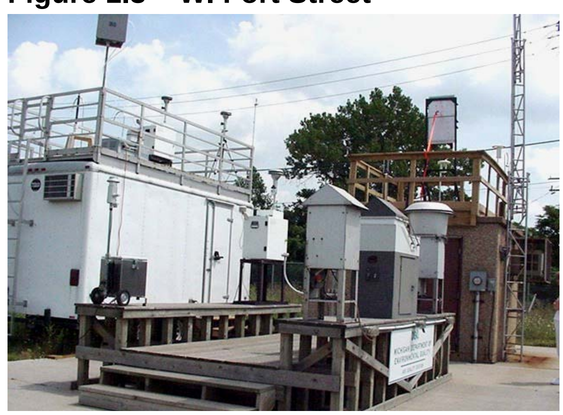


Figure 1.3 – W. Fort Street



The MASN consists of federal reference method (FRM) monitors that enable continuous monitoring for the gaseous pollutants (O_3, CO, NO_2, and SO_2), PM monitors that measure PM concentrations over a 24-hour period, and high volume samplers for Pb. In addition, continuous $PM_{2.5}$ and PM_{10} monitors are used to provide real-time hourly data, and $PM_{2.5}$ chemical speciation monitors determine the chemical composition of $PM_{2.5}$ and help characterize back-ground levels. The MASN data is also used to provide timely reporting to the DNRE's air quality reporting web page (discussed in **Chapter 9**). The types of monitoring conducted in 2009 and the MASN locations are shown in **Table 1.3.**

Table 1.3 Types of Monitoring Conducted in 2009 and MASN Location

Area	AIRS ID	Site Name	Trace CO	NO_2	Trace NO_y	O_3	PM_{10}	$PM_{2.5}$	$PM_{2.5}$ TEOM	$PM_{2.5}$ Speciation	SO_2	Trace SO_2	VOC	Carbonyls	Trace Metals	Wind Speed & Direction, Temp.	Relative Humidity	Solar Radiation	Barometric Pressure
Detroit-Ann Arbor	260910007	Tecumseh				√		√		√						√			√
	260990009	New Haven				√		√								√	√	√	
	260991003	Warren				√													
	261250001	Oak Park				√		√								√			
	261470005	Port Huron				√		√	√	√						√			
	261610008	Ypsilanti				√		√	√							√			√
	261630001	Allen Park	√		√	√	√	√	√	√		√			√@	√	√		√
	261630005	River Rouge												√	√@	√			
	261630015	Detroit- W Fort S					√	√		√	√		√	√	√@	√	√		√
	261630016	Detroit- Linwood						√											
	261630019	Detroit- E Seven Mile		√		√		√								√	√		√
	261630025	Livonia						√								√	√		√
	261630027	Detroit-W Jefferson													√@				
	261630033	Dearborn					√	√	√	√			√	√	√ + Pb	√	√		√
	261630036	Wyandotte						√											
	261630038	Detroit- Newberry						√	√							√			
	261630039	Detroit W. Lafayette						√	√							√			
Flint	260490021	Flint				√		√	√						√#	√			√
	260492001	Otisville				√										√			
Grand Rapids	261390005	Jenison				√		√								√			
	260810007	Grand Rapids - Wealthy					√	√											
	260810020	Grand Rapids - Monroe	√		√	√	√	√	√	√		√			√@	√			√
	260810022	Evans				√										√			
Lansing/East Lansing	260650012	Lansing				√		√	√							√			√
	260370001	Rose Lake				√													
Monroe Co	261150005	Luna Pier						√		√									
Huron Co	260630007	Harbor Beach				√										√			
Bay Co	260170014	Bay City						√	√							√			
MissaukeeCo	261130001	Houghton Lake				√	√	√	√	√						√			√
Allegan Co	260050003	Holland				√		√								√	√	√	√
Benzie Co	260190003	Frankfort				√													
Berrien Co	260210014	Coloma				√		√								√			
Cass Co	260270003	Cassopolis				√										√			
Kalamazoo Co	260770008	Kalamazoo				√		√	√										
Manistee Co	261010922	Manistee +				√		√								√		√	√
Mason Co	261050007	Scottville				√										√			
Muskegon Co	261210038	Muskegon - Green				√										√			
	261210040	Muskegon - Apple Ave						√											
Schoolcraft Co	261530001	Seney Nat'l Wildlife				√			√							√	√	√	√
√ = Data Collected																			
# = Mn only																			
@ = Mn, As, Cd, Ni																			
+= Operated by the Little River Band of Ottawa Indians																			

The MASN is designed to meet the EPA's national ambient air quality monitoring requirements, is used to measure and determine which areas are meeting the NAAQS for the six criteria pollutants, and provides real-time air quality measurements for AIRNOW and MIAir (see **Chapter 9**). In 2006, the EPA amended its air monitoring requirements to include more collocated monitors. The amended air monitoring requirements will also add National Core (NCore) sites that will be multi-pollutant in nature, which will enhance the understanding of how the various forms of air pollution are related and how it is transported. Information on the effects of the 2006 amended monitoring requirements is discussed by criteria pollutant in **Chapters 2 through 7**.

Quality Assurance

The Air Monitoring Unit (AMU) ensures that all of the data collected and reported is of high quality and meeting the federal requirements. The AMU has a quality system in place that includes a Quality Assurance Project Plan (QAPP), standard operating procedures, standardized forms and documentation policies, and a robust audit and assessment program.

The monitoring network adheres to the requirements in Title 40 Code of Federal Regulations Parts 50, 53, and 58. This ensures that the monitors are correctly sited, operated in accordance to the federal reference methods, and adhere to the quality assurance requirements.

Quality assurance checks are conducted by the site operators at the frequencies required in the regulations and unit procedures. Independent audits are conducted by the AMU's Quality Assurance (QA) Team, which has a separate reporting line of supervision. The quality assurance checks and audits are reported to the EPA each quarter.

External audits are conducted annually by the EPA. The EPA conducts Performance Evaluation Program (PEP) audits for $PM_{2.5}$ samplers and the National Performance Audit Program (NPAP) for the gaseous monitors. The EPA also conducts program-wide Technical Systems Audits every three to five years to evaluate overall program operations, and assess adequacy of documentation and records retention. External audits are also conducted on the laboratory operations for certain analytical techniques using performance evaluation samples.

Chapter 2: Carbon Monoxide (CO)

Carbon monoxide is a colorless, odorless and poisonous gas formed during incomplete burning of fuel. Levels peak during colder months primarily due to cold temperatures that affect combustion efficiencies of engines. It has a standard of 9 ppm for the 2nd highest 8-hour average and 35 ppm for the 2nd highest 1-hour average. Its sources and effects are as follows:

- **Sources:** Outdoor exposure sources are automobile exhaust, industrial processes (metal processing and chemical production), non-vehicle fuel combustion, and natural sources, such as forest fires. Indoor exposure sources are wood stoves, gas ranges with continuous pilot flame ignition, unvented gas or kerosene heaters, and cigarette smoke.
- **Effects:** CO enters the bloodstream through the lungs, where it displaces oxygen delivered to the organs and tissues. Elevated levels can cause visual impairment, interfere with mental acuity by reducing learning ability and manual dexterity, and can decrease work performance in the completion of complex tasks. CO alters atmospheric photochemistry that contributes to the formation of ground-level O_3, which can trigger serious respiratory problems.
- **Population most at risk:** Those who suffer from cardiovascular (heart and respiratory) disease are most at risk for exposure to elevated levels of CO. People with angina and peripheral vascular disease are especially at risk as their circulatory systems are already compromised and less efficient at carrying oxygen. However, elevated CO levels can also affect healthy people.

Figure 2.1 shows the location of each CO monitor. Traditional CO monitoring is no longer required. However, for the NCore Network, that must be operational by 2011, trace CO monitoring is required. Therefore, trace CO is monitored at Grand Rapids and Allen Park.

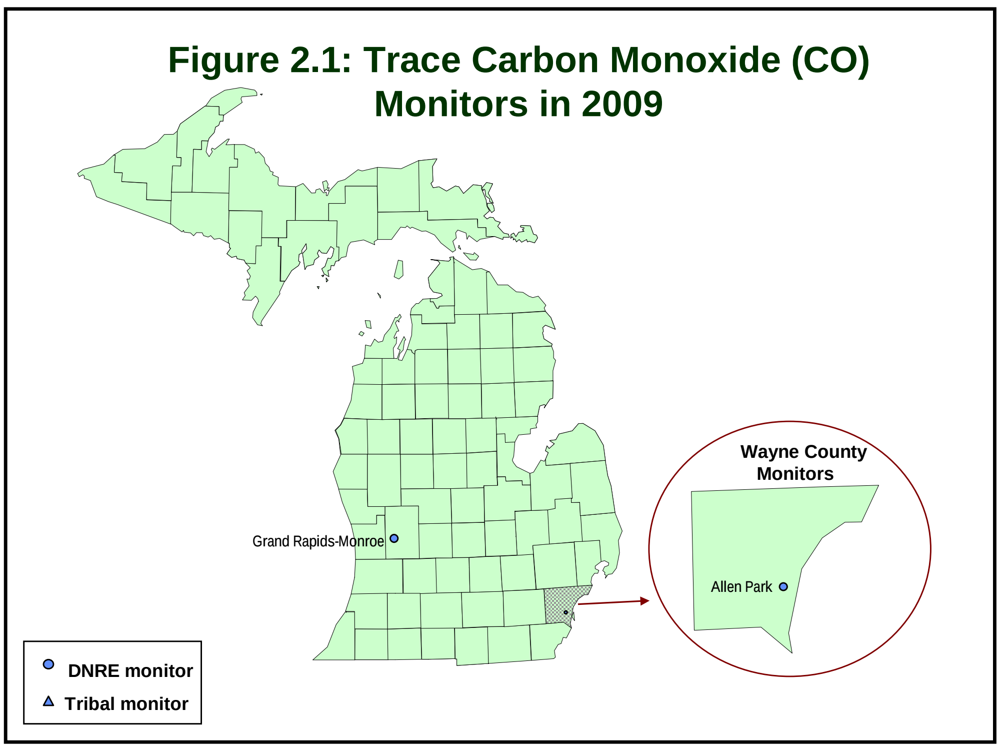


Figure 2.1: Trace Carbon Monoxide (CO) Monitors in 2009

Figures 2.2 – 2.3 show CO emission sources and CO emissions by county (courtesy of EPA's State and County Emission Summaries).

Figure 2.2

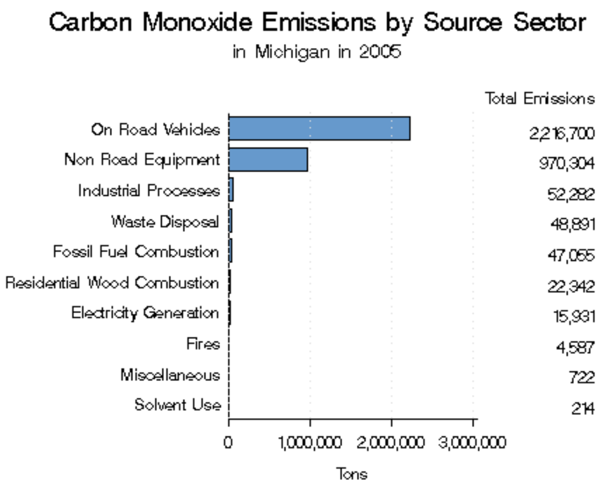


Figure 2.3

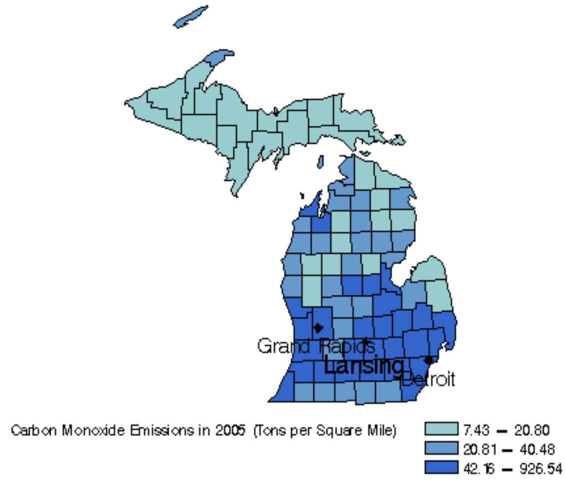
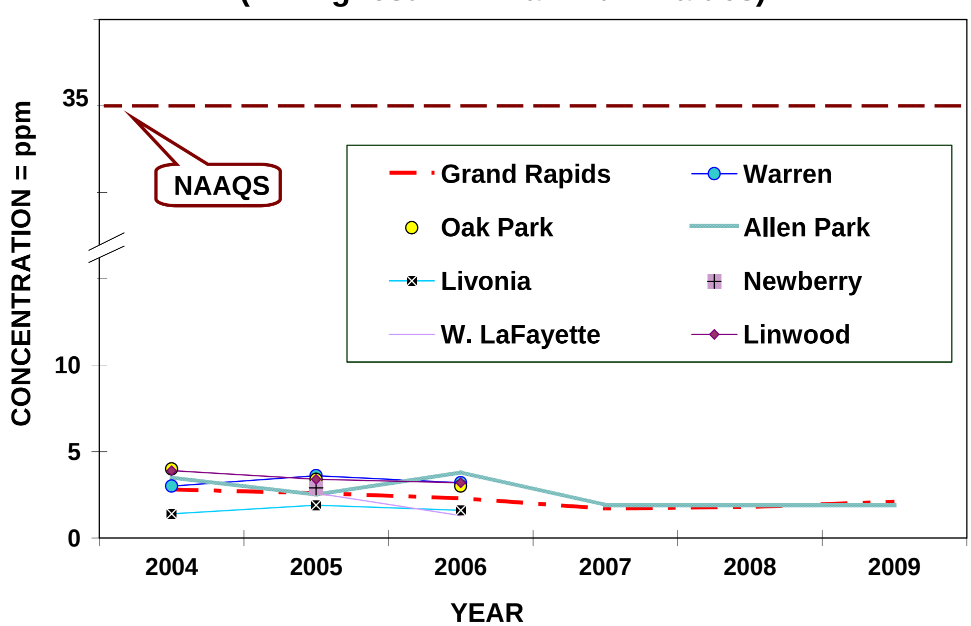


Figure 2.4 provides the maximum second highest 1-hour CO level trends for Michigan from 2004-2009, which demonstrates that there have not been any exceedances of the 1-hour CO NAAQS.

Figure 2.4: CO Levels in MI from 2004-2009 (2nd Highest 1-Hr Maximum Values)



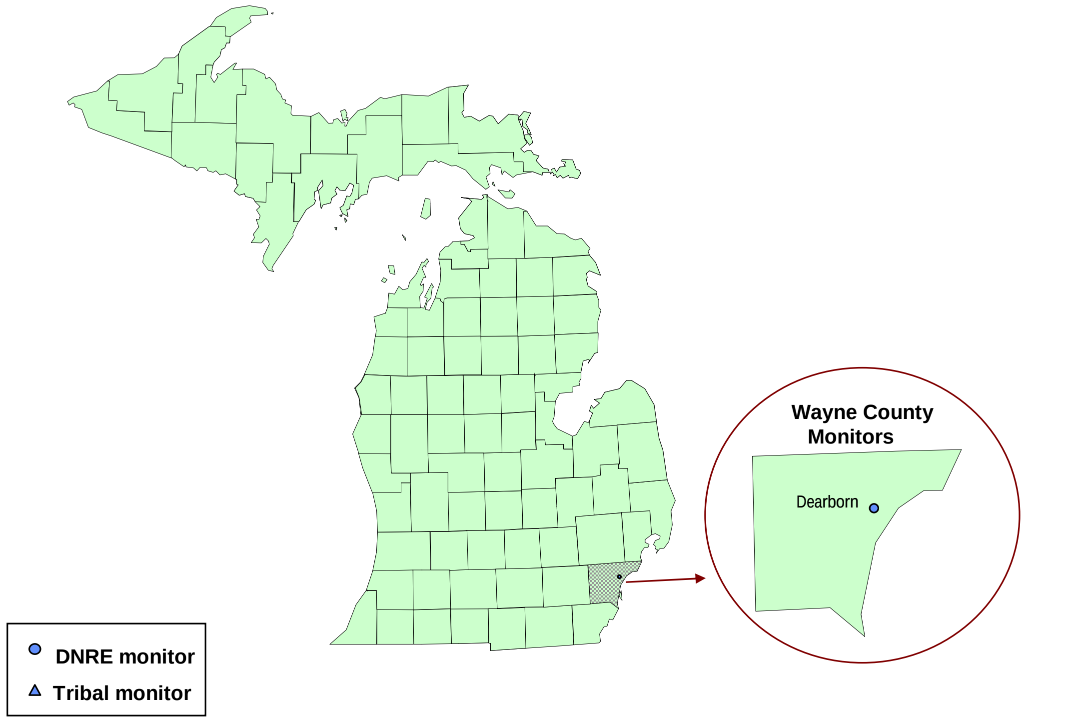
Chapter 3: Lead (Pb)

Lead is a highly toxic metal found in coal, oil, and waste oil. It is also found in municipal solid waste and sewage sludge incineration and may be released to the atmosphere during their combustion*.* Its sources and effects are as follows:

- **Sources:** With the phase-out of leaded gas in the 1970s, the major sources of Pb emissions are industrial and combustion sources. The highest air concentrations of Pb are found near smelters and battery manufacturers (Pb acid batteries, Pb oxide/ pigments). Other industrial sources include Pb glass, Portland cement, and solder production.
- **Effects:** Exposure occurs through the inhalation or ingestion of Pb in food, water, soil, or dust particles. Pb primarily accumulates in the body's blood, bones, and soft tissues, and adversely affects the kidneys, liver, nervous system, and other organs.
- **Population most at risk:** Fetuses and children are most at risk as low levels of Pb may cause central nervous system damage. Excessive Pb exposure during the early years of life is associated with lower IQ scores and neurological impairment (seizures, mental retardation, and behavioral disorders). Even at low doses, Pb exposure is associated with changes in fundamental enzymatic, metabolic, and homeostatic mechanisms in the body, and Pb may be a factor in high blood pressure and subsequent heart disease.

Figure 3.1 shows the location of the one Pb monitor in the state.

Figure 3.1: Lead (Pb) Monitors in 2009



Figures 3.2 – 3.3 show Pb emission sources and Pb emissions by county (courtesy of EPA's State and County Emission Summaries).

Figure 3.2

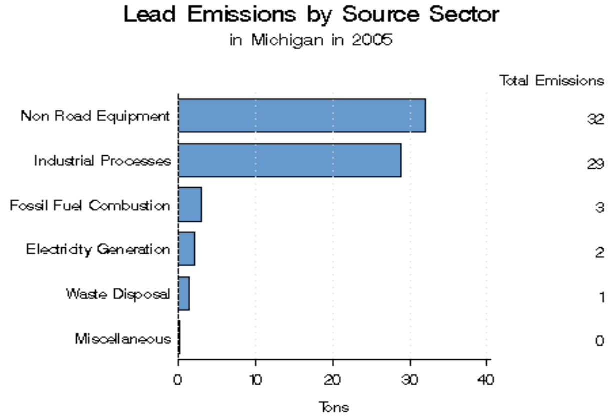
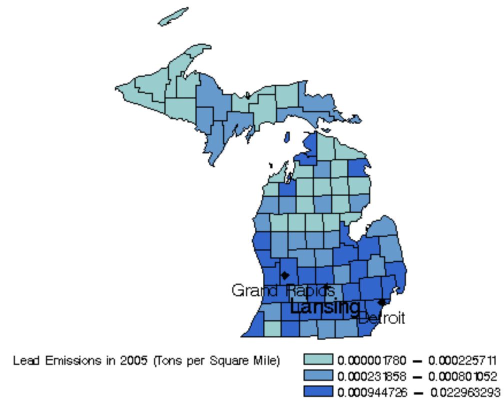


Figure 3.3

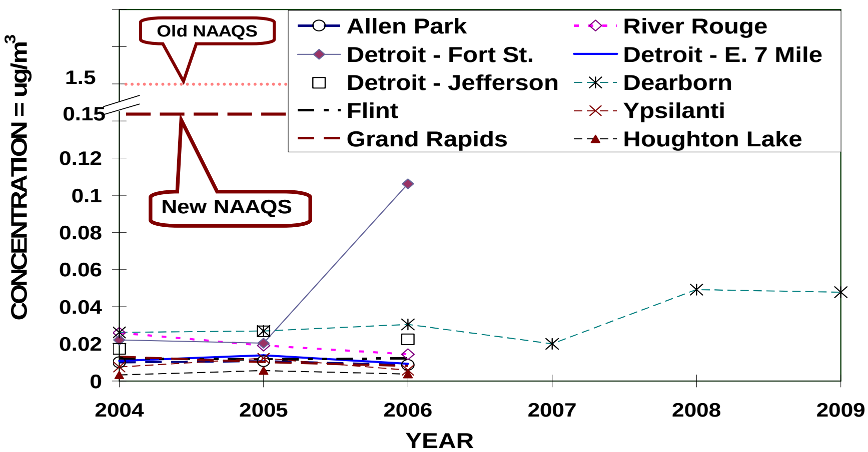


On November 12, 2008, the EPA modified the Pb NAAQS by reducing the level of the standard from a maximum quarterly average of 1.5 µg/m^3 to a 3-month rolling average of 0.15 µg/m^3. The monitoring network design has been modified to consist of both source-oriented monitors as well as population-oriented monitors. For details of the new Pb network that has begun in 2010, see Michigan's 2010 Annual Ambient Air Monitoring Network Review.

Ambient Pb levels in Michigan have been well below the old NAAQS of 1.5 µg/m^3 as well as the new NAAQS of 0.15 µg/m^3. The Dearborn site is part of the National Air Toxics Trend Sites (NATTS) program and monitors Pb and other trace metals, both as total suspended particulate (TSP), PM_{10} and $PM_{2.5}$. Pb measurements as $PM_{2.5}$ are made throughout the $PM_{2.5}$ speciation network.

Figure 3.4 provides the maximum Quarterly Pb level values.

Figure 3.4: Pb Levels in Michigan from 2004-2009 (Maximum Quarterly Values)



Chapter 4: Sulfur Dioxide (SO_2)

Sulfur dioxide is a colorless gas formed by the burning of sulfur-containing material. Odorless at typical ambient concentrations, SO_2 can react with other atmospheric chemicals to form sulfuric acid. When sulfur-bearing fuel is burned, the sulfur is oxidized to form SO_2, which then reacts with other pollutants to form aerosols. In liquid form, it is found in clouds, fog, rain, aerosol particles, and in surface films on these particles. It is a major precursor to $PM_{2.5}$. The primary standard for SO_2 is an annual mean of 0.03 ppm and 0.14 ppm for the 2^{nd} highest 24-hour average. The secondary standard is a 3 hour average of 0.5 ppm. Its sources and effects are as follows:

- **Sources:** Coal-burning power plants are the largest source of SO_2 emissions. SO_2 is also emitted from smelters, petroleum refineries, pulp and paper mills, transportation sources, and steel mills. Other sources include residential, commercial and industrial space heating. SO_2 and PM are often emitted together.
- **Effects:** Exposure to elevated levels aggravates existing cardiovascular and pulmonary disease. SO_2 and PM together may cause respiratory illness, alteration of the body's defense and clearance mechanisms, and aggravation of existing cardiovascular disease. SO_2 and NO_X together are the major precursors to acid rain, associated with the acidification of soils, lakes, and streams and accelerated corrosion of buildings and monuments.
- **Population most at risk:** Asthmatics, children, and the elderly are especially sensitive to SO_2 exposure. Asthmatics receiving short-term exposures during moderate exertion may experience reduced lung function and symptoms, such as wheezing, chest tightness, or shortness of breath. Depending on the concentration, SO_2 may also cause symptoms in people who do not have asthma.

Figure 4.1 shows the location of each SO_2 monitor.

Figure 4.1 Sulfur Dioxide (SO_2) / Trace SO_y Monitors in 2009

Figures 4.2 – 4.3 show SO_2 emission sources and SO_2 emissions by county (courtesy of EPA's State and County Emission Summaries).

Figure 4.2

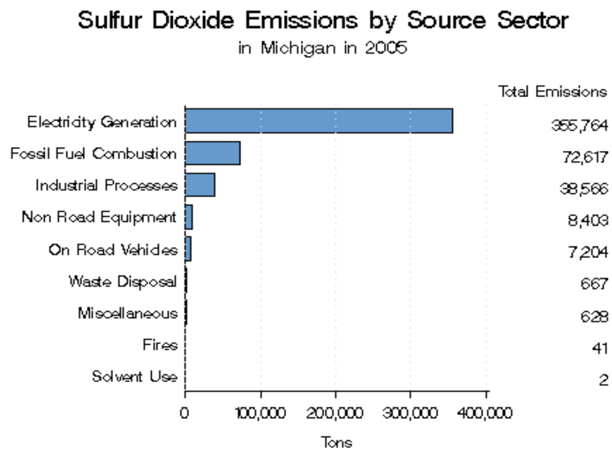
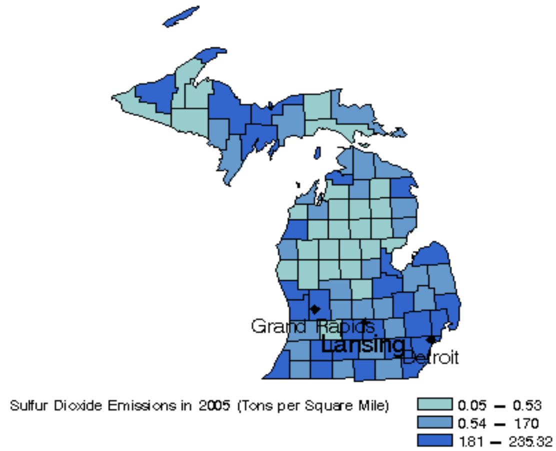
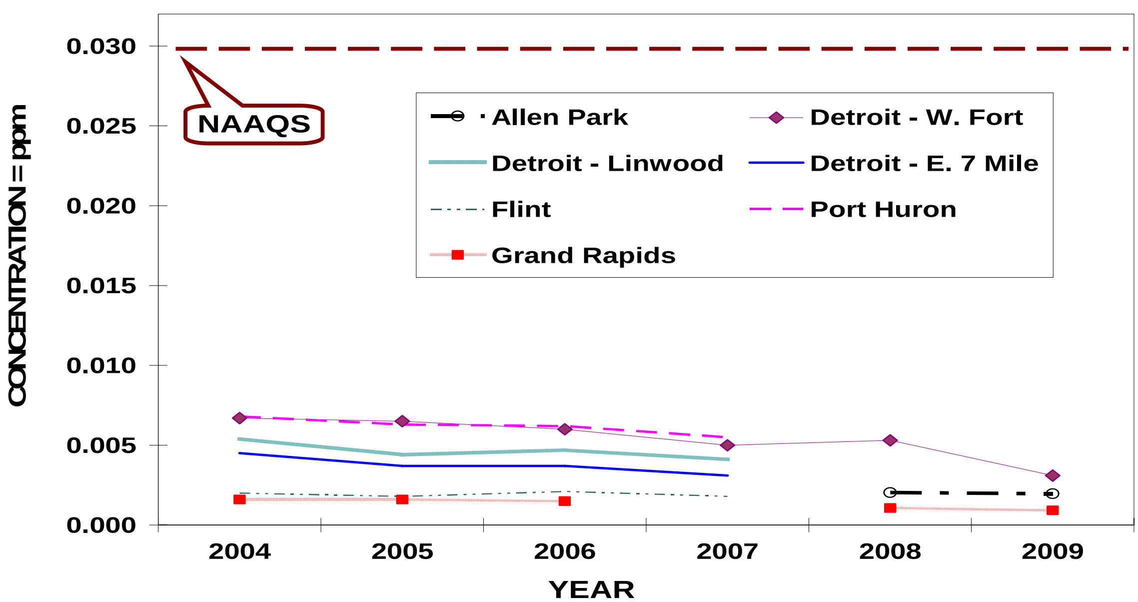


Figure 4.3



Michigan has been in attainment for SO_2 since 1982 with levels consistently well below the SO_2 NAAQS. The SO_2 monitor at W. Fort Street (Southwestern High School) in Detroit is located in the old nonattainment area for SO_2 and is important for trend level studies having been active for more than 32 years. However, for the NCore Network, that must be operational by 2011, trace SO_2 monitoring is required. Trace SO_2 is monitored at the Grand Rapids and Allen Park NCore sites. For trend purposes, the W. Fort Street, Allen Park and Grand Rapids SO_2 monitors are shown in **Figure 4.4.**

Figure 4.4: SO_2 Levels in Michigan from 2004-2009 (Annual Arithmetic Mean)



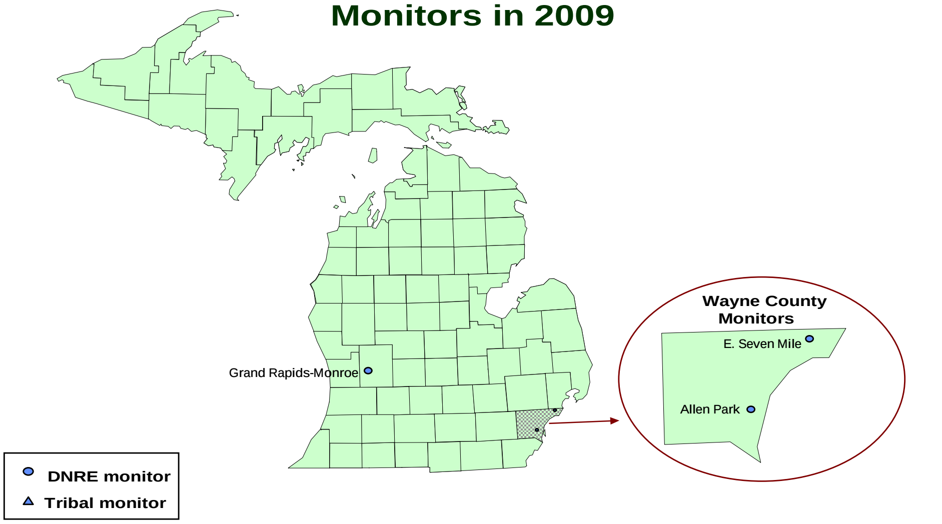
Chapter 5: Nitrogen Dioxide (NO_2)

Nitrogen Dioxide is a reddish-brown, highly reactive gas formed through oxidation of nitric oxide (NO). Upon dilution, it becomes yellow or invisible. High concentrations produce a pungent odor and lower levels have an odor similar to bleach. NO_X is the term used to describe the sum of NO, NO_2, and other nitrogen oxides. NO_X can lead to the formation of O_3 and NO_2, and can react with other substances in the atmosphere to form acidic products that are deposited in rain (acid rain), fog, snow, or as PM. The standard for NO_2 is an annual mean of 0.053 ppm. Its sources and effects are as follows:

- **Sources:** NO_X compounds and their transformation products occur both naturally and as a result of human activities. Natural sources of NO_X are lightning, biological and abiological processes in soil, and stratospheric intrusion. Ammonia and other nitrogen compounds produced naturally are important in the cycling of nitrogen through the ecosystem. The major sources of man-made (anthropogenic) NO_X emissions, which account for a large majority of all nitrogen inputs to the environment, come from high-temperature combustion processes (such as those occurring in automobiles and power plants). Home heaters and gas stoves produce substantial amounts of NO_2 in indoor settings.
- **Effects:** Exposure to NO_2 occurs through the respiratory system, irritating the lungs. Short-term NO_2 exposures (i.e. less than 3 hours) can produce coughing and changes in airway responsiveness and pulmonary function. Evidence suggests that long-term exposures to NO_2 may lead to increased susceptibility to respiratory infection and may cause structural alterations in the lungs. Exercise increases the ventilation rate and hence exposure to NO_2. Nitrate particles and NO_2 can block the transmission of light, thus causing visibility impairment. Deposition of nitrogen can lead to fertilization, eutrophication, or acidification of terrestrial, wetland, and aquatic systems.
- **Population most at risk:** Individuals with pre-existing respiratory illnesses and asthmatics are more sensitive to the effects of NO_2 than the general population. Short-term NO_2 exposure can increase respiratory illnesses in children.

Figure 5.1 shows the location of each NO_2 monitor.

Figure 5.1: Nitrogen Dioxide (NO_2) / Trace NO_y Monitors in 2009



The E. Seven Mile monitor in Detroit is a downwind urban scale site that measures NO_2. The Grand Rapids and Allen Park sites monitor trace NO_Y, which began in early January 2008 as part of the NCore program (only NO_2 monitors can be used for attainment/nonattainment purposes, however).

Figures 5.2 – 5.3 show NO_2 emission sources and NO_2 emissions by county (courtesy of EPA's State and County Emission Summaries).

Figure 5.2

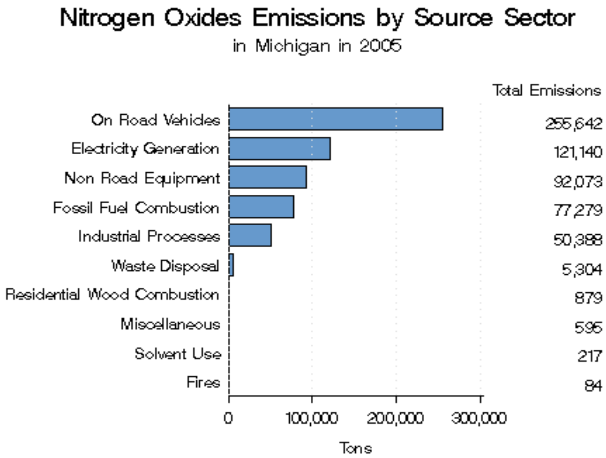
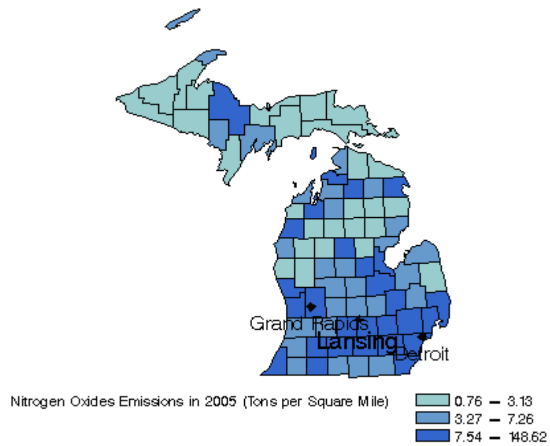
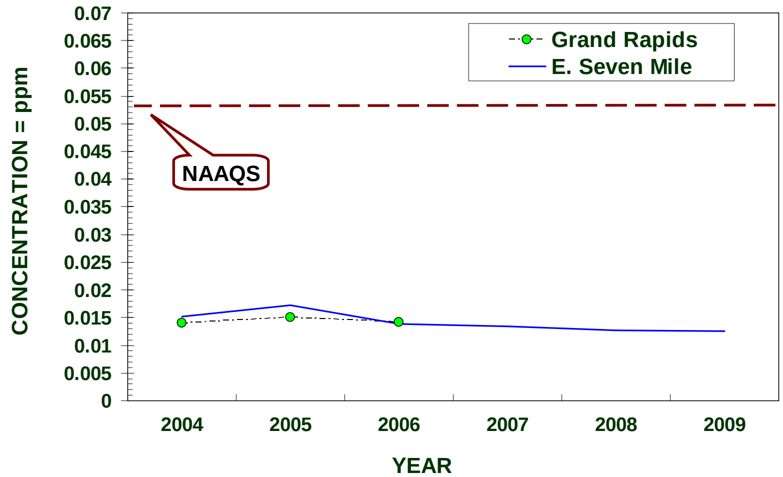


Figure 5.3



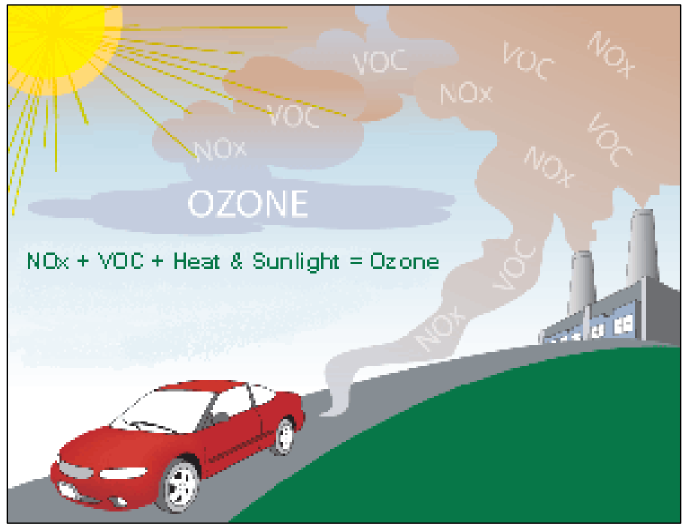
Michigan ambient NO_2 levels have always been well below the NAAQS. Since March 3, 1978, all areas in Michigan have been in attainment for NO_2. As shown in **Figure 5.4**, all monitoring sites have had an annual NO_2 concentration at less than half of the 0.053 ppm NAAQS.

Figure 5.4: NO_2 Levels in MI from 2004-2009 (Annual Arithmetic Mean)



Even though there are no nonattainment areas for NO_2 in Michigan and monitoring for attainment purposes is not required, monitors continue to operate to support photochemical model validation work.

Chapter 6: Ozone (O_3)



Ground-level O_3 is created by photochemical reactions involving nitrogen oxides (NOx) and volatile organic compounds (VOCs), or hydrocarbons, in the presence of sunlight as the illustration to the right depicts (image courtesy of EPA). These reactions usually occur during the hot summer months as ultraviolet radiation from the sun initiates a sequence of photochemical reactions. O_3 is also a key ingredient of urban smog. In the Earth's lower atmosphere (also known as the troposphere), ozone is an air pollutant. Ground level ozone can also be transported hundreds of miles under favorable meteorological conditions. Ozone levels are often higher in rural areas than in cities due to transport to regions downwind from the actual emissions of ozone forming air pollutants. Shoreline monitors along Lake Michigan often measure high ozone concentrations due to transport from upwind states. Its sources and effects are as follows:

- **Sources:** Major sources of NO_X and VOCs are engine exhaust, emissions from industrial facilities, combustion from power plants, gasoline vapors, chemical solvents, and biogenic emissions from natural sources. Ground-level O_3 can also be transported hundreds of miles under favorable meteorological conditions. As a result, the long-range transport of air pollutants impacts the air quality of regions downwind from the actual area of formation.
- **Effects:** Elevated O_3 exposure can irritate a person's airways, reduce lung function, aggravate asthma and chronic lung diseases like emphysema and bronchitis, and inflame and damage the cells lining the lungs. Other effects include increased respiratory related hospital admissions with symptoms such as chest pain, shortness of breath, throat irritation, and cough. O_3 may also reduce the immune system's ability to fight off bacterial infections in the respiratory system, and long-term, repeated exposure may cause permanent lung damage. O_3 also impacts vegetation and the forest ecosystem, including agricultural crop and forest yield reductions, diminished resistance to pest and pathogens, and reduced survivability of tree seedlings.
- **Population most at risk:** Individuals most susceptible to the effects of O_3 exposure include those with a pre-existing or chronic respiratory disease, children who are active outdoors and adults who actively exercise or work outdoors.

Figure 6.1 shows the location of each O_3 monitor.

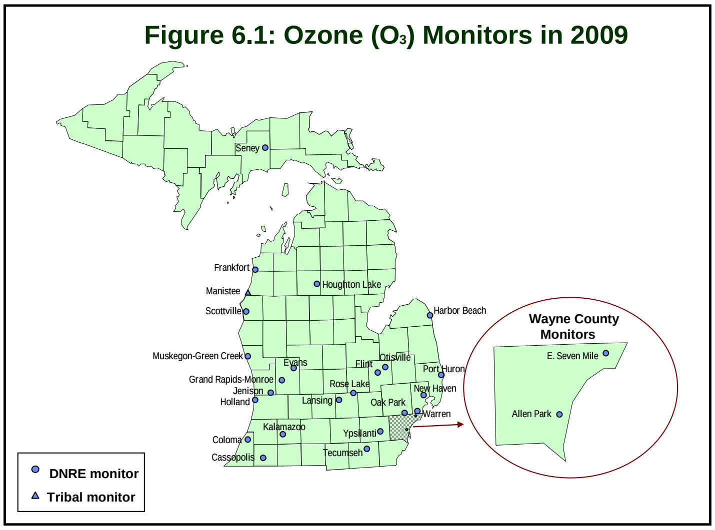


Figure 6.1: Ozone (O_3) Monitors in 2009

Figures 6.2 – 6.3 show VOC emission sources and VOC emissions by county (courtesy of EPA's State and County Emission Summaries).

Figure 6.2

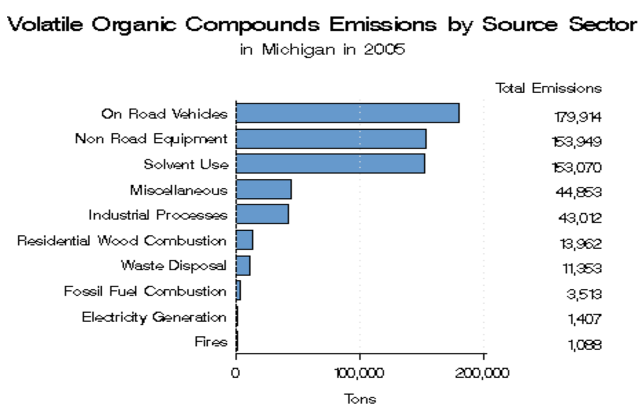
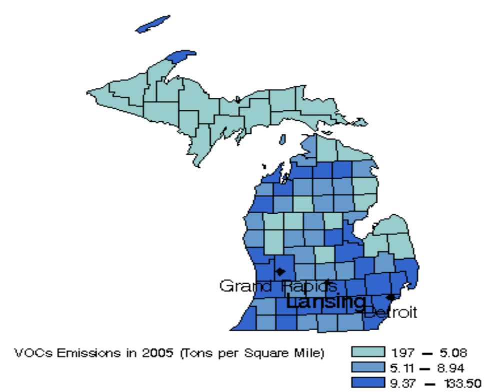


Figure 6.3



The ozone NAAQS was revised by the EPA on March 12, 2008 to 0.075 ppm and became effective on May 27, 2008. To attain this 2008 standard, the 3-year average of the 4th highest daily maximum 8-hour average concentration within an area must not exceed 0.075ppm.

Nonattainment designations are assigned to areas that exceed the NAAQS, or contribute to exceedances in a nearby area. The EPA planned to make attainment and nonattainment designations for this standard no later than March 12, 2010, however, the EPA decided to re-evaluate the standard instead. Attainment and nonattainment designations for the 0.08 ppm standard were made in 2004. Twenty-five counties were designated nonattainment. Only one county in West Michigan, Allegan, remains nonattainment for ozone.

The O_3 monitoring season in Michigan is from April 1 through September 30, during which time O_3 monitoring data is available for the public via the AQD's website (discussed in **Chapter 9**). This data helps in attainment designation applications, to assess urban air quality, and population exposure.

Table 1.3 from **Chapter 1** shows all 26 O_3 air quality monitors active in Michigan at the beginning of 2009. It is important to note that under the 2006 amended air monitoring regulations, MSA boundaries have been modified and population totals tied to measurements of ambient air quality have increased. Basically, the amended regulations state that any monitors with a design value, using the most recent three years of data greater than or equal to 85% of the O_3 NAAQS, have a higher probability of violating the standard. Therefore, more monitors could be required in these MSAs.[5]

Table 6.1 shows the three year average of the 4^{th} highest 8-hour ozone values from 2006-2009.

Table 6.1: Three-Year Average of the 4^{th} Highest 8-Hr O_3 Values from 2006-2009

	Areas	County	Monitoring Sites	2006	2007	2008	2009
	Detroit-Ann Arbor, MI	Lenawee	Tecumseh	0.077	0.079	0.076	0.073
		Livingston					
		Macomb	New Haven	0.082	0.086	0.081	0.079
			Warren	0.079	0.086	0.080	0.078
		Oakland	Oak Park	0.075	0.079	0.077	0.077
		St. Clair	Port Huron	0.080	0.085	0.078	0.075
		Washtenaw	Ypsilanti	0.077	0.079	0.074	0.070
		Wayne	Allen Park	0.070	0.075	0.071	0.069
			E 7 Mile	0.075	0.083	0.082	0.080
	Flint, MI	Genesee	Flint	0.075	0.078	0.074	0.072
			Otisville	0.077	0.080	0.076	0.074
		Lapeer					
	Grand Rapids, MI	Ottawa	Jenison	0.079	0.086	0.079	0.075
		Kent	Grand Rapids	0.078	0.083	0.077	0.072
			Evans	0.079	0.082	0.078	0.075
	Muskegon Co, MI	Muskegon	Muskegon	0.083	0.087	0.083	0.077
	Allegan Co, MI	Allegan	Holland	0.088	0.093	0.086	0.081
	Huron Co, MI	Huron	Harbor Beach	0.073	0.078	0.074	0.072
	Kalamazoo- Battle Creek, MI	Calhoun					
		Kalamazoo	Kalamazoo	0.072	0.077	0.073	0.074
		Van Buren					
	Lansing East-Lansing, MI	Ingham	Lansing	0.074	0.078	0.074	0.073
		Clinton	Rose Lake	0.073	0.077	0.073	0.071
		Eaton					
	Benton Harbor, MI	Berrien	Coloma	0.080	0.084	0.078	0.076
	Benzie Co, MI	Benzie	Frankfort	0.080	0.083	0.076	0.072
	Cass Co, MI	Cass	Cassopolis	0.079	0.081	0.076	0.075
	Mason Co, MI	Mason	Scottville	0.077	0.081	0.076	0.073
	Missaukee Co, MI	Missaukee	Houghton Lake	0.073	0.074	0.072	0.069
	Manistee Co, MI	Manistee	Manistee		0.083	0.077	0.072
	Schoolcraft Co, MI	Schoolcraft	Seney	0.078	0.082	0.075	0.070

[5] Additional information is available in Michigan's 2006 Ambient Air Monitoring Network Review Final Report at http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-Monitoring-Network-Review-final-9-607.pdf

Tables 6.2 and 6.3 highlight the number of days when two or more monitors exceeded 0.075 ppm. They also specify in which month they occurred and the temperature range.

Table 6.2

Daily High Temperature Range			2009 WEST MICHIGAN OZONE SEASON											
			April		May		June		July		August		September	
			Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days
	>=	95					1	**1**						
90	<=	94					1	**1**			1			
85	<=	89	1				4				5			
80	<=	84			2	**2**	6		11		11		5	
75	<=	79	2		5		8		13		6		13	
70	<=	74	2		7		4		4		2		6	
65	<=	69	3		9		5		2		5		3	
60	<=	64	5		5		1		1		1			
55	<=	59	2		3								3	
50	<=	54	6											
49	<=		9											
Totals			**30**	**0**	**31**	**2**	**30**	**2**	**31**	**0**	**31**	**0**	**30**	**0**

Days:	Number of days during month when daily high temperature falls within specified temperature range.
O_3 Days:	Number of days, during specified temperature range, when two or more area monitors exceeded 0.075 ppm.

Table 6.3

Daily High Temperature Range			2009 SOUTHEAST MICHIGAN OZONE SEASON											
			April		May		June		July		August		September	
			Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days
	>=	95												
90	<=	94					2	**1**			2			
85	<=	89	2				1		2		8	**1**	1	
80	<=	84	2		2		8		11		9		9	
75	<=	79	1		4		8		11		5		10	
70	<=	74	1		7		5		6		3		6	
65	<=	69	4		13		5		1		4		1	
60	<=	64	2		5		1						2	
55	<=	59	6										1	
50	<=	54	8											
49	<=		4											
Totals			**30**	**0**	**31**	**0**	**30**	**1**	**31**	**0**	**31**	**1**	**30**	**0**

Days:	Number of days during month when daily high temperature falls within specified temperature range.
O_3 Days:	Number of days, during specified temperature range, when two or more area monitors exceeded 0.075 ppm.

There were two days in May and two days in June where ozone exceeded 0.075 ppm at two or more monitors in West Michigan. The respective temperatures for those days were between 80F – 84F, and above 90F. There was one day in June and one day in August where ozone exceeded 0.075 ppm at two or more monitors in Southeast Michigan. The respective temperatures for those days were between 90F – 94F, and between 85F – 89F. **Table 6.4** gives a breakdown of those days and the specific monitors that went over the standard in the western, central/upper, and eastern portions of the state.

Table 6.4

Date	Monitors			Total
	Western Michigan	Central/Upper Michigan	Eastern Michigan	
5/20/2009	Holland, Benzonia, Muskegon, Scottville, Manistee	Seney		6
5/21/2009	Holland, Coloma, Grand Rapids, Evans, Muskegon, Jenison		New Haven	7
6/5/2009	Holland			1
6/24/2009	Holland, Jenison		New Haven, Warren, East-7 Mile	5
6/25/2009	Cassopolis, Kalamazoo		Tecumseh	3
8/14/2009			Harbor Beach, Oak Park	2

May 21, 2009 had the most number of monitor readings exceeding the standard. Six out of seven of these monitors were in the western portion of Michigan. Out of all the locations during the spring and summer season, the Holland monitor exceeded the level of the standard four times, compared to two times for Muskegon and New Haven, and one time for the rest of the monitors.

NOTE: Even though several monitors exceeded the standard on particular days, the following graphs show that the 3-year average for ozone did not exceed the NAAQS.

Figure 6.4: O_3 Levels in Detroit-Warren-Flint CSA from 2004-2009 (4th Highest 8-Hour O_3 Values)

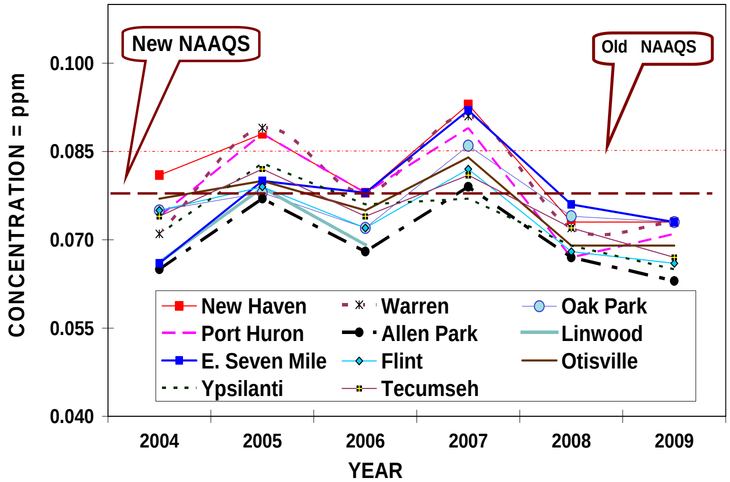


Figure 6.4 shows the 4th highest 8-hour O_3 values for all of Michigan's monitoring sites in Southeast Michigan from 2004-2009. During the 2009 monitoring season, none of the 26 O_3 monitoring sites registered readings at or above the current 8-hour O_3 value of 0.075 ppm (4th highest value).

Figure 6.5: O_3 Levels in the Grand Rapids-Muskegon-Holland CSA from 2004-2009 (4th Highest 8-Hour O_3 Values)

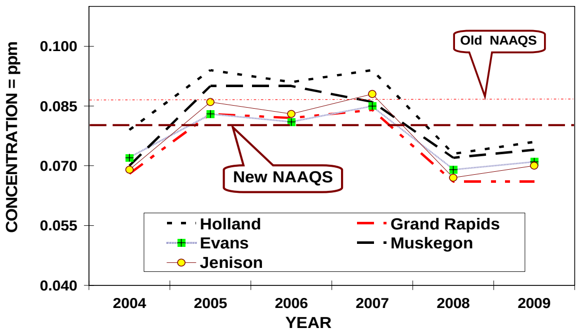


Figure 6.6: O_3 Levels in the Kalamazoo-Portage MSA, Lansing-E. Lansing-Owosso CSA, Niles-Benton Harbor MSA, & South Bend-Mishawaka (IN-MI) MSAs from 2004-2009 (4th Highest 8-Hour O_3 Values)

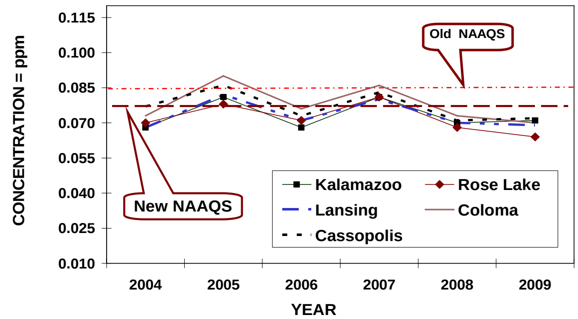
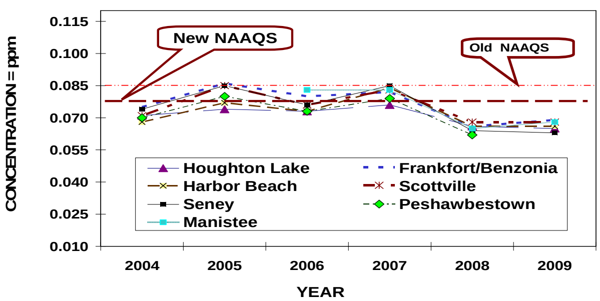


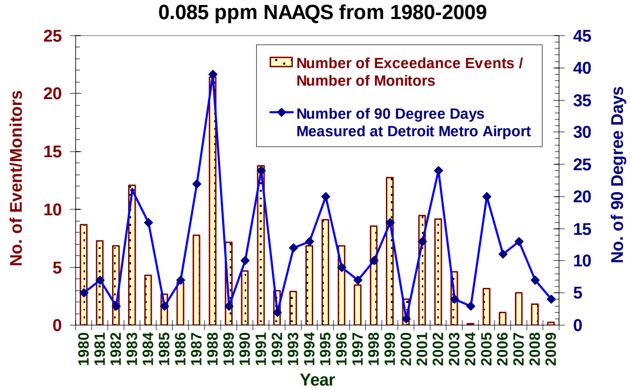
Figure 6.7: O_3 Levels in MI's Northern Lower and Upper Peninsula Areas from 2003-2008 (4th Highest 8-Hour O_3 Values)



Figures 6.5 - 6.7 show the 4th highest 8-hour O_3value trends for the other monitoring sites in Michigan over the last five years (see **Table 6.1** for reference). These figures are broken down by location to enable readers to view specific parts of Michigan to see how O_3 has affected their area of interest.

Figure 6.8 shows 8-hour O_3 readings ≥ 0.085 ppm with the number of 90°F days (≥ 90°F) measured at the Detroit Metropolitan Airport. The total number of statewide 8-hour readings above 0.085 ppm were divided by the number of monitors that were in operation each year to provide a relative indication of the frequency of elevated 8-hour O_3 values.

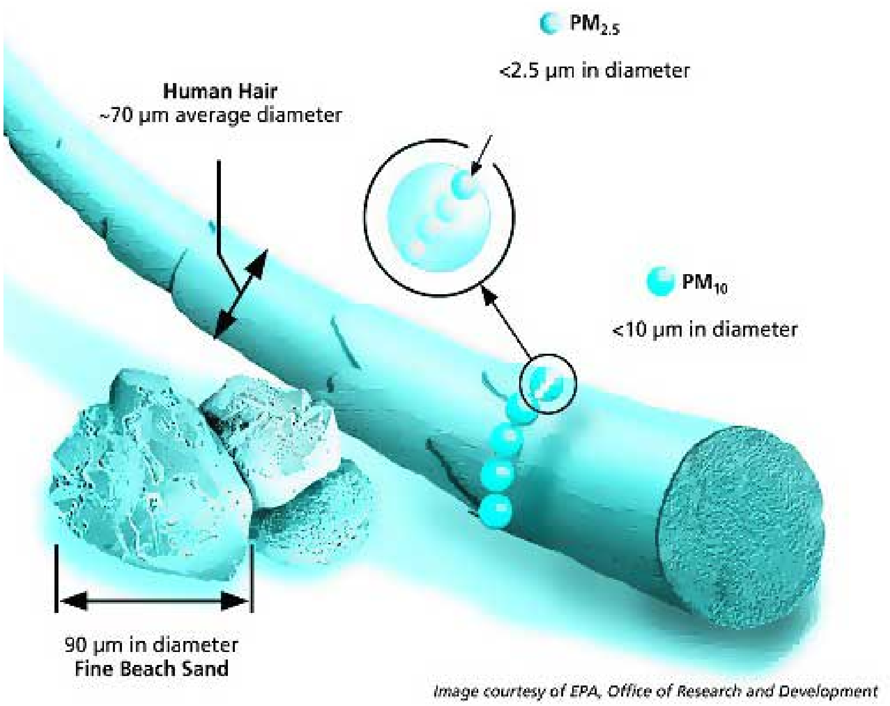
Figure 6.8: 8-Hour O_3 Level Events Exceeding the 0.085 ppm NAAQS from 1980-2009



This comparison shows the influence of temperature with respect to elevated O_3 levels. Over the past 28 years, a typical summer would have 12 ½ days with the maximum daily temperature exceeding 90°F. Over the time period from 1980 through 2009, the highest number of 90°F days occurred in 1988 (39 days), while the lowest number occurred in 2000 (one day). For 2009, there were four 90°F days.

Chapter 7: Particulate Matter (PM_{10}, $PM_{2.5}$, $PM_{2.5}$ Chemical Speciation and TSP)

Particulate matter is a general term used for a mixture of solid particles and liquid droplets found in the air, which is further categorized according to size. Large particles with diameters of less than 50 micrometers (μm) are classified as total suspended particulates (TSP). PM_{10} are "coarse particles" less than 10 μm in diameter (about one-seventh the diameter of a human hair) and $PM_{2.5}$ are much smaller "fine particles" equal to or less than 2.5 μm in diameter. PM_{10} has a 24-hour average standard of 150 μg/m^3. $PM_{2.5}$ has an annual average standard of 15 μg/m^3, and a 98th percentile 24-hour average over 3 years of 35 μg/m^3. Its sources and effects are as follows:

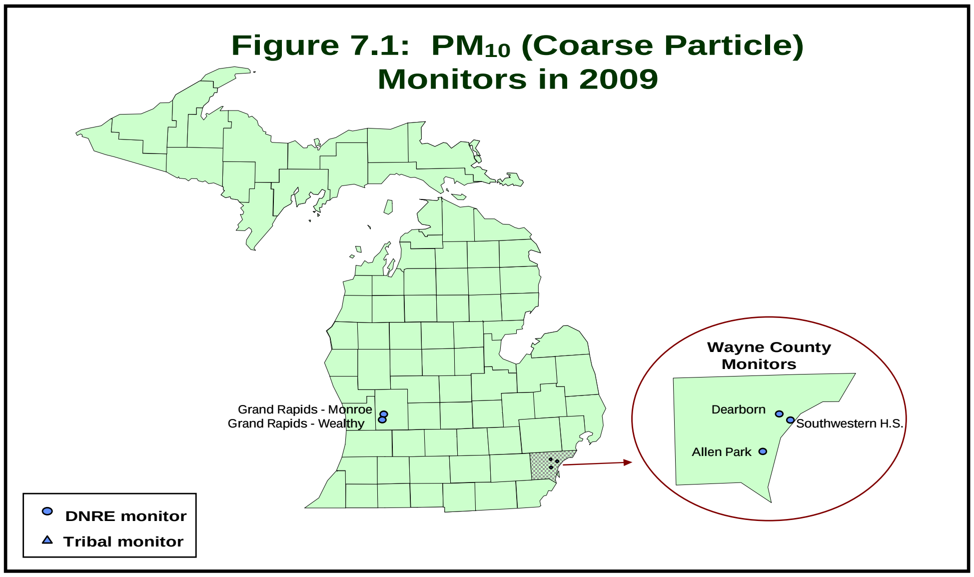


- **Sources:** PM can be emitted directly (primary) or may form in the atmosphere (secondary). Most man-made particulate emissions are classified as TSP. PM_{10} consists of primary particles that can originate from power plants, various manufacturing processes, wood stoves and fireplaces, agriculture and forestry practices, fugitive dust sources (road dust and wind blown soil), and forest fires. $PM_{2.5}$ can come directly from primary particle emissions or through secondary reactions that include VOCs, SO_2, and NO_X emissions originating from power plants, motor vehicles (especially diesel trucks and buses), industrial facilities, and other types of combustion sources.
- **Effects:** Exposure to PM affects breathing and the cellular defenses of the lungs, aggravates existing respiratory and cardiovascular ailments, and has been linked with heart and lung disease. Particle size is the major factor that determines which particles will enter the lungs and how deeply the particles will penetrate. PM is the major cause of reduced visibility in many parts of the U.S. $PM_{2.5}$ is considered a primary visibility-reducing component of urban and regional haze. Airborne particles impact vegetation ecosystems and damage paints, building materials and surfaces. Deposition of acid aerosols and salts increases corrosion of metals and impacts plant tissue.
- **Population most at risk:** $PM_{2.5}$ has been linked to the most serious health effects. People with heart or lung disease, the elderly, and children are at highest risk from exposure to PM.

PM_{10}

Since October 4, 1996, all areas in Michigan have been in attainment with the PM_{10} NAAQS. Due to the recent focus upon $PM_{2.5}$ and because of the relatively low concentrations of PM_{10} measured in recent years, Michigan's PM_{10} network has been reduced to a minimum level. **Table 1-3** identifies the locations of PM_{10} monitoring stations that were operating in Michigan during 2009. These monitors are located in the state's largest populated urban areas - three in the Detroit area and two in Grand Rapids. To better characterize the nature of PM in Michigan, many of the existing PM_{10} monitors are co-located with $PM_{2.5}$ monitors in population-oriented areas.

Figure 7.1 shows the location of each PM_{10} monitor.



Figures 7.2 – 7.3 show PM_{10} emission sources and PM_{10} emissions by county (courtesy of EPA's State and County Emission Summaries).

Figure 7.2

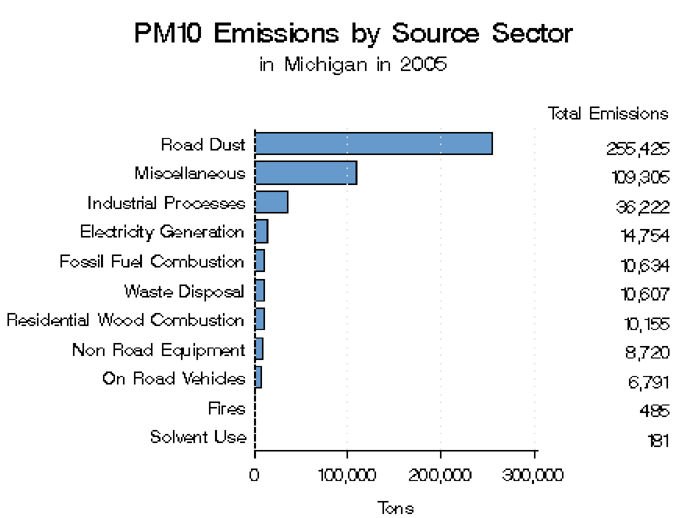


Figure 7.3

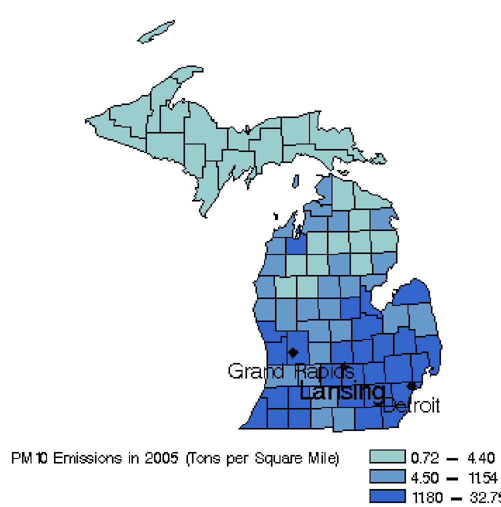


Figure 7.4: PM_{10} Levels in MI's Detroit-Warren-Flint CSA from 2004-2009 (Annual Arithmetic Means)

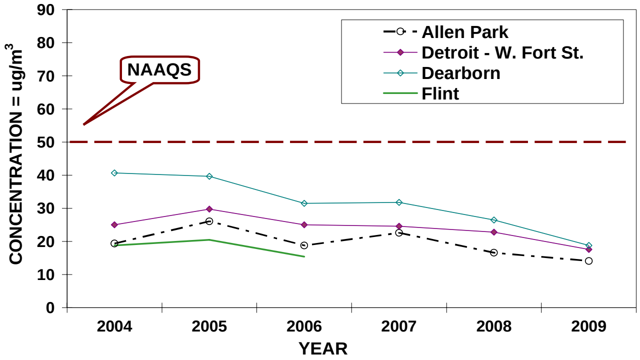


Figure 7.4 shows the annual arithmetic means for the Detroit-Warren-Flint CSA from 2004 - 2009. For 2009, all monitoring sites in the Detroit area had readings below the PM_{10} standard, with Dearborn continuing to have the highest maximum annual mean (18.8 $\mu g/m^3$) in the state.

Figure 7.5: PM_{10} Levels in the Grand Rapids-Muskegon-Holland CSA & North MI from 2004-2009 (Annual Arithmetic Means)

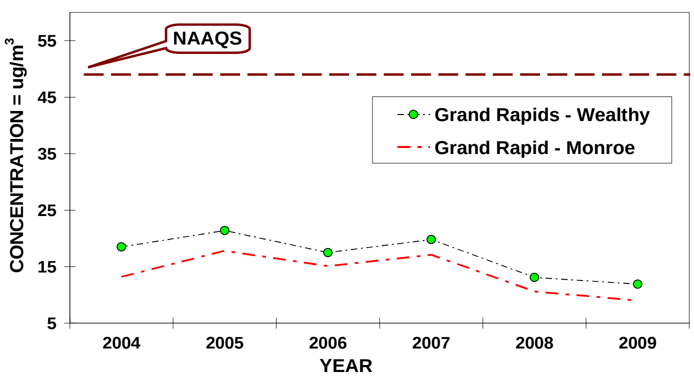


Figure 7.5 shows the annual arithmetic means for the Grand Rapids-Muskegon-Holland CSA and Northern Michigan from 2004-2009. In 2009, the two PM_{10} monitoring sites located in the Grand Rapids area continue to show a decline in the annual mean levels. For the decade, all the monitoring sites in western Michigan have maintained a level well below the PM_{10} NAAQS.

$PM_{2.5}$

On August 18, 2008, the EPA proposed the 7-county Southeast Michigan area as nonattainment based on 2005-2007 data. In addition, the EPA proposed Kent and Ottawa Counties, on the west side of the state, as nonattainment areas. The $PM_{2.5}$ particulate network consists of the following components, which together provide a picture of the nature of PM within the state.

- **$PM_{2.5}$ FRM monitoring.** The concentrations of $PM_{2.5}$ measured over a 24-hour time period are determined using the gravimetric FRM. Only data generated by FRM monitors are used for comparisons to the NAAQS. The sites are located in urban, commercial, and residential areas where people are exposed to $PM_{2.5}$.
- **Continuous $PM_{2.5}$ monitoring (*Tapered Element Oscillating Microbalance [TEOM]*).** Continuous monitoring is beneficial as it provides real-time hourly data that supplements the $PM_{2.5}$ data collected by FRM monitors.
- **Chemical Speciation monitoring.** Speciated monitoring provides a better understanding of the chemical composition of $PM_{2.5}$ material and better characterizes background levels.

Figure 7.6 shows the location of each $PM_{2.5}$ monitor.

Figure 7.6: $PM_{2.5}$ (Fine Particle) Monitors in 2009

$PM_{2.5}$ FRM Monitoring Network: $PM_{2.5}$ FRM monitors are deployed at all of Michigan's 26 $PM_{2.5}$ monitoring sites to characterize background or regional $PM_{2.5}$ transport collectively from upwind sources. The two monitoring sites in Detroit's W. Lafayette and Newberry investigate PM levels in an area of Detroit heavily impacted by mobile source emissions. In addition, five $PM_{2.5}$ FRM monitoring sites are co-located with PM_{10} monitors to allow for $PM_{2.5}$ and PM_{10} comparisons[6]. Co-located PM_{10} and $PM_{2.5}$ sites include Grand Rapids (Monroe and Wealthy), Dearborn, Allen Park, and Detroit's W. Fort Street (Southwestern High School) station.

Continuous $PM_{2.5}$ Network: Short-term measurements of $PM_{2.5}$ or PM_{10} are updated on an hourly basis using TEOM instruments. At least one continuous TEOM is required at a core monitoring $PM_{2.5}$ site in a metropolitan area with a population greater than one million. Both Detroit (Allen Park) and Grand Rapids (Monroe) meet this requirement[7]. Under the revised 2006 air monitoring regulations, 50% of the FRM monitoring sites are now required to have a continuous $PM_{2.5}$ monitor. For Michigan, there are 26 FRM monitoring sites; 13 of which also have TEOMS. Initially, the DNRE operated all TEOM units with an inlet temperature of 50ºC, but this high inlet temperature was volatilizing nitrate during the winter months. Therefore, the DNRE began operating TEOMs with a 30°C inlet temperature October through March and a 50°C inlet temperature between April and September.

Chemical Speciation Monitoring: Single event Met-One spiral ambient speciation samplers (SASS) are used throughout Michigan's speciation network and are placed in population-oriented stations in both urban and rural locations. $PM_{2.5}$ chemical speciation samples are collected on three types of filters – Teflon, nylon, and quartz – over a 24-hour period. Each filter is analyzed by a different method to determine various components of $PM_{2.5}$. In 2008, the EPA changed the protocol for the SASS monitors by removing the carbon channel and replacing it with an URG 3000 N sampler. The Dearborn and the Ypsilanti sites were changed over in

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[6] Requirements for $PM_{2.5}$ FRM sites are obtained from the Revised Requirements for Designation of Reference and Equivalent Methods for $PM_{2.5}$ and Ambient Air Quality Surveillance for PM [62 FR 38763]; Guidance for Using Continuous Monitors in $PM_{2.5}$ Monitoring Networks [EPA-454/R-98-012, May 1998]; and Appendix N to Part 50 - Interpretation of the National Ambient Air Quality Standards for PM [40 CFR Part 50, July 1, 1998].

[7] Under the Guidance for Using Continuous Monitors in $PM_{2.5}$ Monitoring Networks [EPA-454/R-98-012, May 1998].

2008. The remaining sites were changed over in 2009. There are eight SASS monitors operating in Michigan; see **Table 1.3.**

The primary objectives of the chemical speciation monitoring sites are to provide data that will be used to determine the sources of poor air quality and to support the development of attainment strategies. Historical speciation data for Michigan indicates that $PM_{2.5}$ is made up of 30% nitrate compounds, 30% sulfate compounds, 30% organic carbon[8], and 10% unidentified or trace elements.

Continuous $PM_{2.5}$ Speciation Monitoring (EC/OC and Aethalometer): To determine diurnal changes in $PM_{2.5}$ composition, the DNRE operated four aethalometers and three elemental carbon/organic carbon (EC/OC) monitors in 2009.

- Aethalometers measure carbon black, a combustion by-product typical of transportation sources, by concentrating particulate on a filter tape and measuring changes in optical transmissivity and absorption. In 2009, the DNRE's aethalometers were located at Dearborn and Allen Park. Two aethalometers that were on loan from the EPA were located at Detroit's Newberry and W. Lafayette sites and were operational for January and February only.
- The EC/OC instruments measure elemental carbon, using pyroloysis coupled with a nondispersive infrared detector to separate the elemental and organic carbon fractions. These instruments are located at Dearborn, Allen Park and Tecumseh.

The Midwest Rail Study conducted by Region 5 EPA will help to develop a better understanding of rail yard PM emissions and their air quality impacts. The first phase of this study focused on emission inventory development, special purpose monitoring, and dispersion modeling for a rail yard in Dearborn.

To support the monitoring activities planned in this project, the DNRE temporarily shut down the continuous EC/OC samplers at Tecumseh and Newberry School in September and August 2008, respectively. Aethalometers borrowed from LADCO and EPA/OAQPS and the two continuous EC/OC samplers were deployed to the new stations established at Miller Road and Ten Tyck. Monitoring continued at both sites until December 2008. All monitors were later moved to the Dearborn so that inter-sampler precision could be assessed through January 2009. The EC/OC monitors resumed operation at Tecumseh and Newberry School by February 2009.

It is important to note that the 2006 amended air monitoring regulations specify speciation monitoring but did not provide much detail except that measurements of PM_{10}-$PM_{2.5}$ will need to be added to the NCore sites[9]. The DNRE is still awaiting a finalization of a PM_{10}-$PM_{2.5}$ monitoring methodology before implementing this monitoring. Continued operation of the speciation trend site in Detroit (Allen Park) is required.

Table 1.3 shows all of Michigan's 26 $PM_{2.5}$ FRM monitoring stations operating in 2009 and denotes which sites also have TEOM and/or SASS monitors in operation.
NOTE: A TEOM is operating at the Seney site along with an O_3 monitor, but is not included because it does not have a $PM_{2.5}$ FRM monitor to verify its accuracy.

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[8] To better understand the chemical composition of the organic carbon fraction, a number of studies have been conducted in Southeast Michigan to further investigate organic carbon. Information can be found in the Michigan 2006 Ambient Air Monitoring Network Review, available at http://www.michigan.gov/deqair.
[9] Current information on both proposals can be found at http://www.epa.gov/air/particles/actions.html.

Table 7.1 provides the 2007-2009 annual mean $PM_{2.5}$ concentrations by individual monitoring stations[10]. Stations labeled #2 provide a precision estimate of the overall measurement and operate on a one in six sampling schedule. All other monitors sampled on a one in three day schedule except for Allen Park #1, which samples daily. Daily sampling was discontinued at Grand Rapids #1, Jenison and Muskegon on April 1, 2009. Daily sampling was started Detroit – W Lafayette on October 1, 2009.

Table 7.1: Three-Year Average of the Annual Mean $PM_{2.5}$ Concentrations

Areas	County	Monitoring Sites	2007	2008	2009	2007-2009 Mean
Detroit-Ann Arbor, MI	Lenawee	Tecumseh		7.28	9.74	8.5
	Livingston					
	Macomb	New Haven	11.94	10.66	9.49	10.7
	Oakland	Oak Park	13.33	10.86	10.03	11.4
	St. Clair	Port Huron	12.44	11.08	9.74	11.1
	Washtenaw	Ypsilanti #1	12.98	10.91	9.94	11.3
		Ypsilanti #2	14.30	12.99	9.80	12.4
	Wayne	Allen Park #1	12.76	11.83	11.06	11.9
		Allen Park #2	**15.65**	13.92	11.32	13.6
		Detroit- Linwood	13.86	11.94	10.36	12.1
		Detroit - E 7 Mile	13.01	11.33	10.54	11.6
		Detroit - W Fort	14.54	12.85	11.12	12.8
		Detroit - Newberry	14.02	11.81	10.17	12.0
		Detroit - W. Lafayette	13.83	12.23	10.70	12.3
		Wyandotte	13.45	10.94	10.36	11.6
		Dearborn	**16.89**	13.34	12.07	14.1
		Livonia	12.75	11.01	9.88	11.2
Flint, MI	Genesee	Flint	11.07	9.77	8.73	9.9
	Lapeer					
Grand Rapids, MI	Ottawa	Jenison	11.68	10.82	9.19	10.6
	Kent	Grand Rapids-Wealthy	12.84	11.15	9.88	10.5
		Grand Rapids #1	12.25	10.67	9.42	10.8
		Grand Rapids #2	14.66	10.66	9.67	11.7
Muskegon Co, MI	Muskegon	Muskegon	10.51	9.64	8.75	9.6
Allegan Co, MI	Allegan	Holland	11.69	9.68	8.57	10.0
Monroe Co, MI	Monroe	Luna Pier	13.08	11.36	10.33	11.6
Kalamazoo-Battle Creek, MI	Calhoun					
	Kalamazoo	Kalamazoo #1	12.62	11.19	10.02	11.3
		Kalamazoo #2	13.95	11.08	9.92	11.6
	Van Buren					
Lansing East-Lansing, MI	Ingham	Lansing	11.48	9.85	9.06	10.1
	Clinton					
	Eaton					
Benton Harbor, MI	Berrien	Coloma	11.53	9.78	9.04	10.1
Bay Co, MI	Bay	Bay City	10.17	8.89	8.19	9.1
Missaukee Co, MI	Missaukee	Houghton Lake	7.88	6.48	5.91	6.8
Manistee Co, MI	Manistee	Manistee	8.54	7.62	6.14	7.4

[10] For comparison to the standard, the average annual means is rounded to the nearest 0.1 μg/m^3.

Table 7.2 is a detailed assessment of the 24-hour 98th percentile $PM_{2.5}$ concentrations for 2007-2009 showing Michigan's levels are below the 35 μg/m^3 standard (3-year average)[11].

Table 7.2: 98th Percentile $PM_{2.5}$ Values Averaged over 3 Years

Areas	County	Monitoring Sites	2007	2008	2009	2007-2009 Mean
Detroit-Ann Arbor, MI	Lenawee	Tecumseh		23.4	29.9	26.7
	Livingston					
	Macomb	New Haven	29.0	28.9	26.2	28.0
	Oakland	Oak Park	35.3	30.4	30.1	31.9
	St. Clair	Port Huron	36.3	31.0	29.9	32.4
	Washtenaw	Ypsilanti #1	34.5	28.2	28.2	30.3
		Ypsilanti #2	30.6	31.3	29.4	30.4
	Wayne	Allen Park #1	31.0	30.3	29.2	30.2
		Allen Park #2	36.2	32.3	32.4	33.6
		Detroit- Linwood	34.3	30.0	31.0	31.8
		Detroit - E 7 Mile	31.9	31.9	29.2	31.0
		Detroit - W Fort	34.0	34.3	30.9	33.1
		Detroit - Newberry	33.4	31.5	25.9	30.3
		Detroit - W. Lafayette	34.8	31.7	31.7	32.7
		Wyandotte	28.6	26.3	26.9	27.3
		Dearborn	36.6	31.7	35.7	34.7
		Livonia	32.8	28.3	29.3	30.1
Flint, MI	Genesee	Flint	25.1	25.8	26.2	25.7
	Lapeer					
Grand Rapids, MI	Ottawa	Jenison	28.1	27.1	26.5	27.2
	Kent	Grand Rapids-Wealthy	29.7	26.8	28.8	28.4
		Grand Rapids #1	29.7	24.9	30.0	28.2
		Grand Rapids #2	31.7	22.5	31.4	28.5
Muskegon Co, MI	Muskegon	Muskegon	28.1	26.3	27.3	27.2
Allegan Co, MI	Allegan	Holland	31.7	24.5	25.4	27.2
Monroe Co, MI	Monroe	Luna Pier	32.2	28.6	23.6	28.1
Kalamazoo-Battle Creek, MI	Calhoun					
	Kalamazoo	Kalamazoo #1	29.2	26.0	29.0	28.1
		Kalamazoo #2	32.5	24.1	36.4	31.0
	Van Buren					
Lansing East Lansing, MI	Ingham	Lansing	29.0	24.0	27.1	26.7
	Clinton					
	Eaton					
Benton Harbor, MI	Berrien	Coloma	33	24.8	22.2	26.7
Bay Co, MI	Bay	Bay City	25.2	23.6	23.3	24.0
Missaukee Co, MI	Missaukee	Houghton Lake	23.2	21.1	17.5	20.6
Manistee Co, MI	Manistee	Manistee	26.5	21.2	19.8	22.5

[11] The 98th percentile value was obtained from the EPA AQS. For the purpose of comparing calculated values, the 3-year 24-hour average is rounded to the nearest 1 μg/m^3.

Figures 7.7 - 7.8 show $PM_{2.5}$ emission sources and $PM_{2.5}$ emissions by county (from the EPA's State and County Emission Summaries).

Figure 7.7

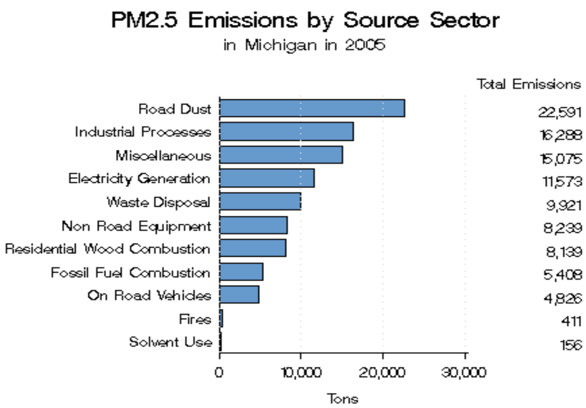
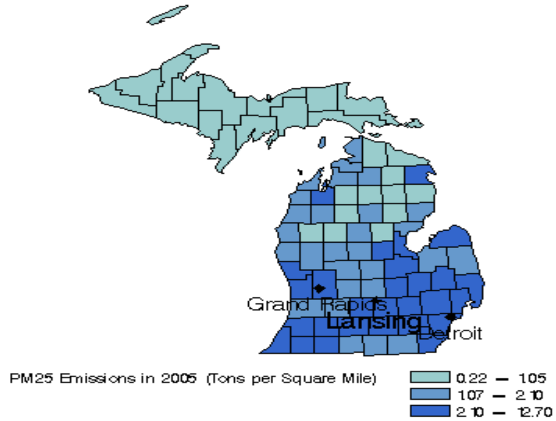
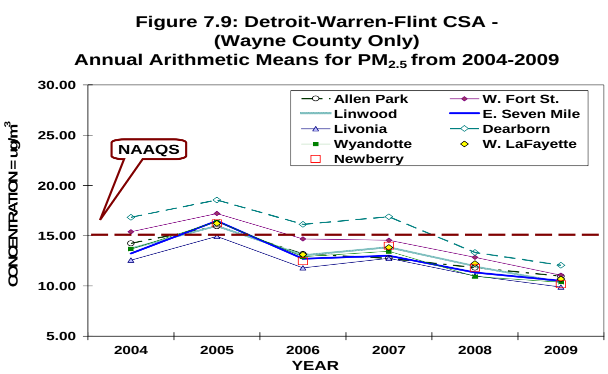


Figure 7.8



Figures 7.9 – 7.12 show the current annual mean $PM_{2.5}$ trend for each monitoring site in Michigan for the years monitoring was conducted. For clarity, the monitoring sites within the Detroit-Warren-Flint CSA, which are currently designated as nonattainment for the $PM_{2.5}$ NAAQS, have been broken down into two graphs. **Figure 7.9** shows those sites in Wayne County and **Figure 7.10** shows the remaining counties within the CSA.



As shown in **Figure 7.9**, 2009 levels in Wayne County have remained below the standard. For the first time, the Dearborn site has meet the standard. Historically, Dearborn has had the highest readings in the state.

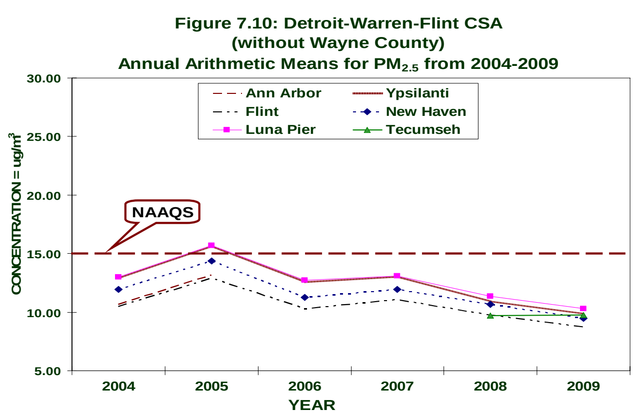


Figure 7.10 contains the remainder of those sites in the Detroit-Warren-Flint CSA that are outside of Wayne County. These sites show readings in 2009 below the $PM_{2.5}$ standard and after the 3-year annual mean is averaged, they remain below the current $PM_{2.5}$ NAAQS.

Figure 7.11: West MI - Grand Rapids-Muskegon-Holland CSA, Kalamazoo & Benton Harbor MSAs Annual Arithmetic Means for $PM_{2.5}$ from 2004-2009

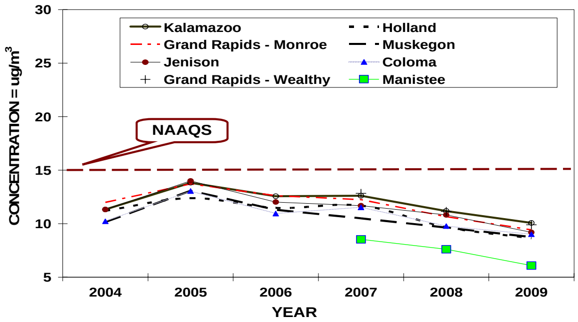


Figure 7.11 combines the $PM_{2.5}$ monitoring sites located in West Michigan. As shown, all sites in West Michigan have been below the annual $PM_{2.5}$ NAAQS since 2004.

Figure 7.12: Lansing-E. Lansing CSA, Saginaw-Bay City CSA, Traverse City MiSA, & Cadillac MiSA Annual Arithmetic Means for $PM_{2.5}$ from 2004-2009

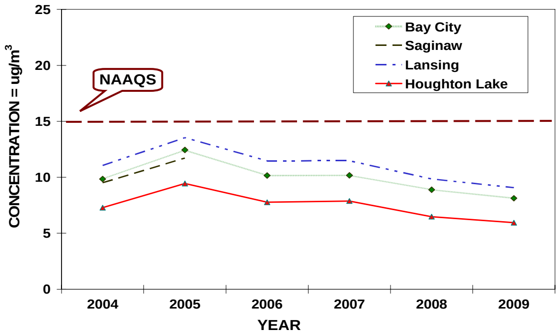


Figure 7.12 displays the remaining monitoring sites in Michigan's Lower Peninsula. All these sites have 2009 levels below the standard and their 3-year averages also remain below the annual $PM_{2.5}$ NAAQS.

Chapter 8: Toxic Air Pollutants

In addition to the six criteria pollutants discussed in the previous chapter, the AQD monitors a wide variety of substances classified as Toxic Air Pollutants (Air Toxics), and or Hazardous Air Pollutants (HAPs). The list of compounds and substances included in this category are determined by state and federal regulations that address these materials. Under the Clean Air Act (CAA), the EPA specifically addresses a group of 188 Toxics or HAPs. Under Michigan's air regulations, Toxic Air Contaminants (TACs) are defined as all non-criteria pollutants that may be *"…harmful to public health or the environment when present in the outdoor atmosphere in sufficient quantities and duration."* The definition of TACs lists 41 substances that are not TACs, indicating that all others are TACs.

- **Sources:** Air toxics come from a variety of mobile, stationary, indoor, and outdoor natural sources. Mobile sources include motor vehicles, stationary sources include industrial factories and power plants, indoor sources include household cleaners, and natural sources include forest fires and eruptions from volcanoes.
- **Effects:** Once air toxics enter the body, there is a wide range of potential health effects. They include cancer, the aggravation of asthma; irritation to the eyes, nose, and throat; carcinogenicity; developmental toxicity (birth defects); nervous system effects and various other effects on internal organs. Some effects appear after a shorter period of exposure, while others may appear after long-term exposure or after a long period of time has passed since the exposure ended. Most toxic effects are not unique to one substance, and some effects may be of concern only after the substance has deposited to the ground or to a water body (e.g., mercury, dioxin), followed by exposure through an oral pathway such as the eating of fish or produce. This further complicates the assessment of air toxics concerns due to the broad range of susceptibility that various people may have.
- **Population most at risk:** People with asthma, children, and the elderly**.**

Air Toxics can be categorized as:

- *Metals:* Examples include aluminum, arsenic, beryllium, barium, cadmium, chromium, cobalt, copper, iron, mercury, manganese, molybdenum, nickel, lead, vanadium, and zinc.
- *Organic Substances*: Further divided into sub-categories that include -
    - VOCs, include benzene (found in gasoline), perchlorethylene (emitted from some dry cleaning facilities), and methylene chloride (a solvent and paint stripper used by industry);
    - carbonyl compounds (aldehydes and ketones);
    - semi-volatile compounds (SVOCs);
    - polycyclic aromatic hydrocarbons (PAHs)/polynuclear aromatic hydrocarbons (PNAs);
    - pesticides;
    - polychlorinated biphenyls (PCBs); and
    - polycyclic organic matter.
- *Other substances*: Asbestos, dioxin, and radionuclides such as radon.

Because air toxics are such a large and diverse group of substances, regulatory agencies sometimes further refine these classifications to address specific concerns. For example:

- Some initiatives have targeted those substances that are *persistent, bioaccumulative and toxic* (PBT), such as mercury, which accumulates in body tissues.
- The EPA has developed an Integrated *Urban Air Toxics Strategy* with a focus on 33 substances (the Urban HAPs List).[12]

The evaluation of Air Toxics levels is hindered due to several factors.

- There are no health-protective NAAQS. Instead, air quality assessments utilize various short- and long-term screening levels and health benchmark levels estimated to be safe considering the critical effects of concern for specific substances.
- There is incomplete toxicity information for many substances. For some air toxics, the analytical detection limits are too high to consistently measure the amount present, and in some cases, the risk assessment-based "safe" levels are below the detection limits.
- Data gaps are present regarding the potential for interactive toxic effects for co-exposure to multiple substances present in emissions and in ambient air. Air toxics also pose a challenge due to monitoring and analytical methods that are either unavailable for some compounds or cost-prohibitive for others (e.g., dioxins).

These factors make it difficult to accurately assess the potential health concerns of all air toxics. Nevertheless, it is feasible and important to characterize the potential health hazards and risks associated with many air toxics.

Table 8.1 shows the monitoring stations and what was monitored at each station in 2009 (this table can also be found in **Appendix B** with the Air Toxics Monitoring Summary).

Table 8.1

SITE NAME	VOC	SVOC	Carbonyl	PAHs	Metals TSP	Metals PM_{10}	Hex Chrome	Speciated $PM_{2.5}$
Allen Park					x	Mn only		x
Dearborn	x	x	x	x	x	x	x	x
Detroit W. Fort St	x		x		x	Mn only		x
Detroit W. Jefferson					x			
Flint					Mn only			
Grand Rapids								x
Houghton Lake								x
Kalamazoo								x
Luna Pier								x
Port Huron, Nat'l Guard Arm.								x
River Rouge			x		x	Mn only		
Tecumseh								x
Ypsilanti								x

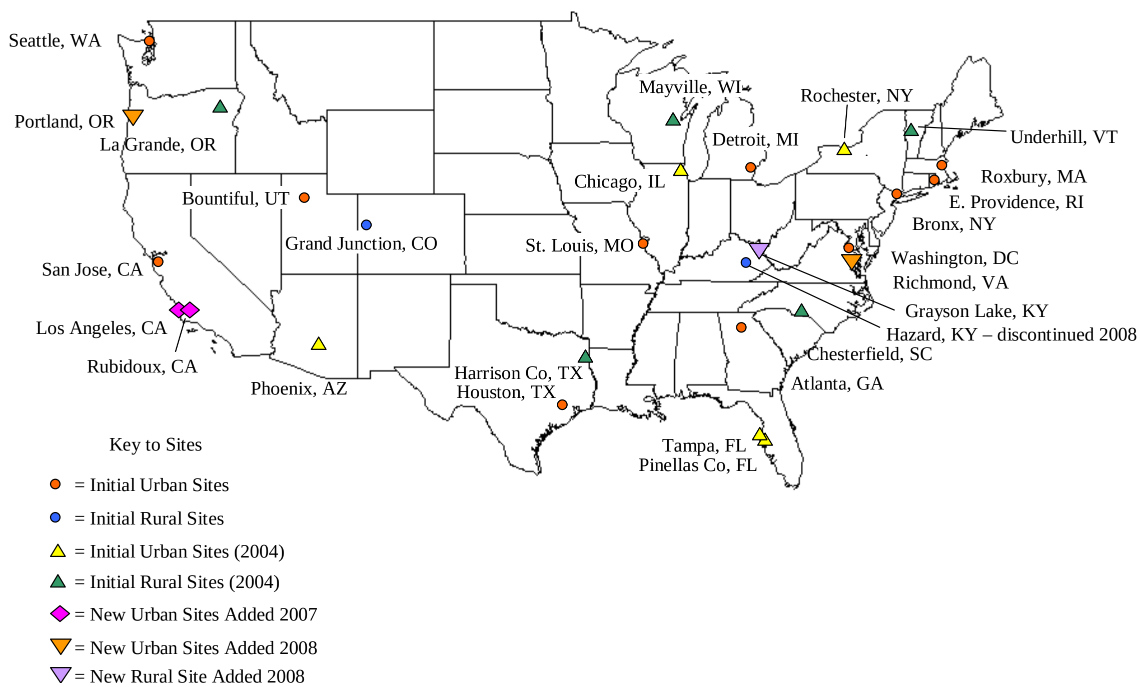
National Monitoring Efforts and Data Analysis

The EPA administers national programs that identify air toxics levels, detect trends, and prioritize air toxics research. The DNRE participates in these programs. In addition, the AQD operates a site in Dearborn that is part of EPA's National Air Toxics Trend Stations (NATTS). The purpose of the NATTS network is to detect trends in high-risk air toxics such as benzene,

[12] EPA's Air Toxics Website – Urban Strategy is located at http://www.epa.gov/ttn/atw/urban/urbanpg.html.

formaldehyde, chromium, and 1,3-butadiene and to measure the progress of air toxics regulatory programs at the national level. Currently, the NATTS network contains 25 stations (18 urban, 7 rural), Michigan has one located in Dearborn (see **Figure 8.1**). The EPA requires that the NATTS sites measure VOCs, carbonyls, and trace metals on a once every six day sampling schedule. The Dearborn site also measures trace metals as both TSP and $PM_{2.5}$ along with the required PM_{10} metals. In 2007, the EPA decided to measure PAHs, at NATTS sites, which began operation in 2008.

Figure 8.1: National Air Toxics Trends Sites



Chapter 9: MIair – Air Quality Information in Real-Time

MIair is the internet tool that provides real-time air quality information via DNRE's webpage. The www.deqmiair.org hotlink opens to the current Air Quality Index (AQI) map and displays air quality forecasts for "today" and "tomorrow." **MIair** also hosts Enviroflash, the automated air quality notification system.

Air Quality Index:

The Air Quality Index (AQI) is a simple tool developed to communicate current air quality information to the public. The current day's color-coded AQI values, ranging from Good to Hazardous, are displayed in a forecast table and as dots on a Michigan map.

As can be seen from the annual summaries in **Appendix C**, air quality in Michigan generally falls in the good or moderate range. An area will occasionally fall into the Unhealthy for Sensitive Groups range, but rarely reaches unhealthy levels.

Air Quality Forecasts

DNRE meteorologists provide air pollution forecasts to alert the public when air pollution levels may become elevated. *Action!* Days are declared when levels are expected to reach or exceed the Unhealthy for Sensitive Groups AQI health indicator. On *Action!* Days, businesses, industry, government and the public are encouraged to reduce air pollution levels by limiting vehicle use, refueling only after 6 PM, carpooling, walking, biking or taking public transit, deferring the use of gasoline-powered lawn and recreation equipment, limiting the use of volatile chemicals and curtailing all burning. More information on voluntary air pollution control measures can be found under the *Action!* Day tab on **MIair**.

Air Quality Notification:

EnviroFlash is a free service that sends automated air quality and UV (ultraviolet) forecasts to subscribers. Those enrolled receive computer e-mails or text messages to their mobile phones. To receive notices and learn more about this program, select EnviroFlash or **MIair** when logged onto www.michigan.gov/air. Michigan's EnviroFlash network has the potential to reach up to 98% of the state's population.

AIRNow:

The DNRE supplies Michigan air monitoring data to AIRNow, the EPA's nation-wide air quality mapping system. Additional information about AIRNow is available at www.epa.gov/airnow.

Table 9.1 identifies the AQI colors and the associated health statements by individual air pollutant.

Table 9.1: AQI Colors and Health Statements

AQI COLOR, CATEGORY & VALUE	PARTICULATE MATTER (µg/m³) 24-Hour	OZONE (ppm) 8-Hour / 1-Hour	CARBON MONOXIDE (ppm) 8-hour	SULFUR DIOXIDE (ppm) 24-hour	NITROGEN DIOXIDE (ppm) 1-hour
GREEN: Good 1-50	**None**	**None**	**None**	**None**	**None**
YELLOW: Moderate 51-100	Unusually sensitive people should consider reducing prolonged or heavy exertion.	Unusually sensitive people should consider reducing prolonged or heavy exertion.	***None***	**None**	**None**
ORANGE: Unhealthy for Sensitive Groups 101-150	People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.	Active children and adults, and people with lung disease such as asthma, should reduce prolonged or heavy outdoor exertion.	People with cardiovascular disease, such as angina, should limit heavy exertion and avoid sources of CO, such as heavy traffic.	People with asthma should consider limiting outdoor exertion.	**None**
RED: Unhealthy 151-200	People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should limit prolonged exertion.	Active children and adults, and people with lung disease such as asthma, should avoid pro-longed or heavy exertion. Everyone else, especially children, should reduce prolonged outdoor exertion.	People with cardiovascular disease, such as angina, should limit moderate exertion and avoid sources of CO, such as heavy traffic.	Children, asthmatics, and people with heart or lung disease should limit outdoor exertion.	**None**
PURPLE: Very Unhealthy 201-300	People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.	Active children and adults, and people with respiratory disease such as asthma, should avoid all outdoor exertion. Everyone else, especially children should limit outdoor exertion.	People with cardiovascular disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic.	Children, asthmatics, and people with heart or lung disease should avoid outdoor exertion. Everyone else should limit outdoor exertion.	Children and people with respiratory disease, such as asthma, should limit heavy outdoor exertion.
MAROON: Hazardous 301-500	Everyone should avoid any outdoor exertion; people with heart or lung disease, older adults, and children should remain indoors.	Everyone should avoid all outdoor exertion.	People with cardiovascular disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic. Everyone else should limit heavy exertion.	Children, asthmatics, and people with heart or lung disease should remain indoors. Every-one else should avoid outdoor exertion.	Children and people with respiratory disease, such as asthma, should limit moderate or heavy outdoor exertion.

Chapter 10: Meteorological Information

The following **Figures 10.1** through **10.3** (average daily temperatures) and **Figures 10.4** through **10.6** (total monthly precipitation amounts) show total amounts as compared to their climatic norms for sites in the Upper Peninsula, and the northern and southern Lower Peninsula. These figures were constructed by averaging data from several National Weather Service stations and therefore are not meant to be representative of any one single location in Michigan. Instead, they are intended to depict the regional trends that occurred during the year 2009.

Figure 10.1: Southern Lower Peninsula Observed Average Daily Temperatures vs. Normal Average Daily Temperatures

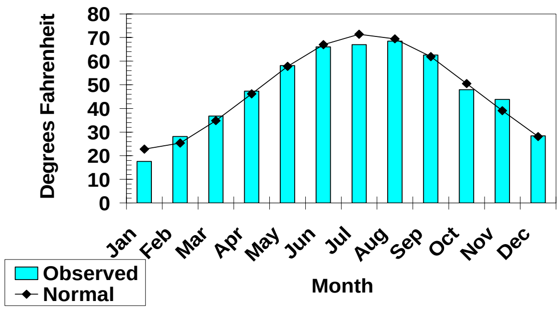


Figure 10.2: Northern Lower Peninsula Observed Average Daily Temperatures vs. Normal Average Daily Temperatures

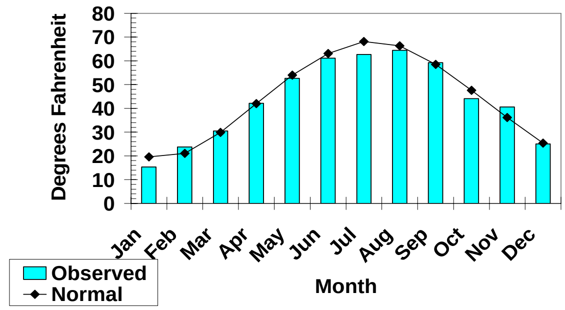


Figure 10.3: Upper Peninsula Observed Average Daily Temperatures vs. Normal Average Daily Temperatures

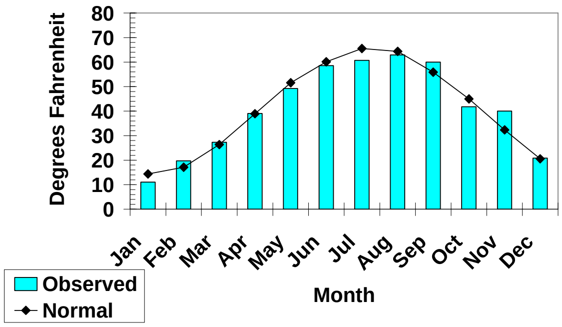


Figure 10.4: Southern Lower Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation

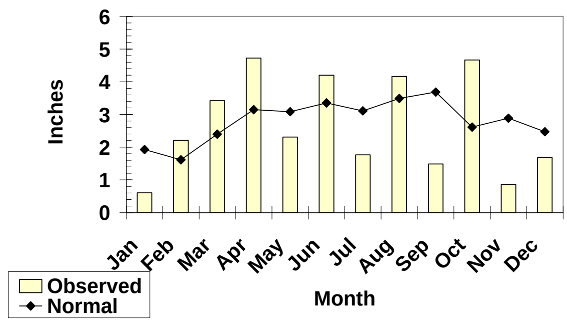


Figure 10.5: Northern Lower Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation

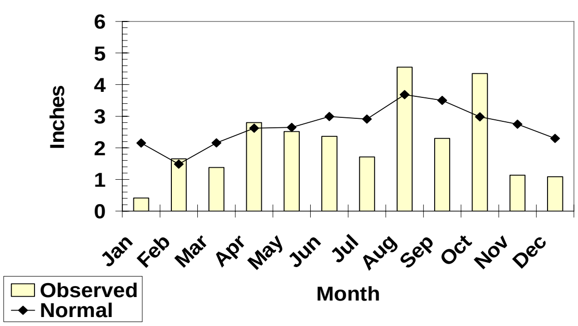
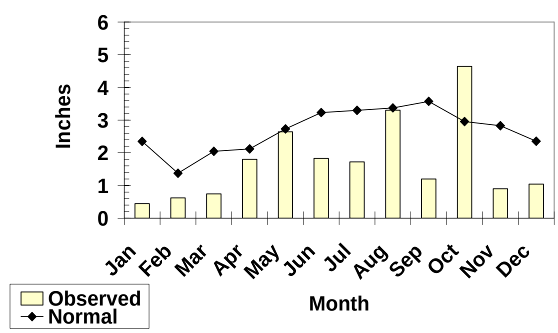


Figure 10.6: Upper Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation



The weather plays a significant role in air quality, and can either help increase or decrease the amount of pollution in the air. *Action!* Days are declared when levels are expected to reach or exceed the Unhealthy for Sensitive Groups AQI health indicator – specifically, when meteorological conditions are conducive for the formation of elevated ground-level O_3 or $PM_{2.5}$ concentrations.

Table 10.1 shows that there were three *Action!* Days declared during the summer of 2009. All six locations exceeded the standard on August 15.

Table 10.1

Location	Year	Number	Dates
Ann Arbor	2009	3	6/24, 8/15, 8/16
Benton Harbor	2009	3	6/24, 8/15, 8/16
Detroit	2009	3	6/24, 8/15, 8/16
Flint	2009	1	8/15
Grand Rapids	2009	3	6/24, 8/15, 8/16
Ludington	2009	3	6/24, 8/15, 8/16

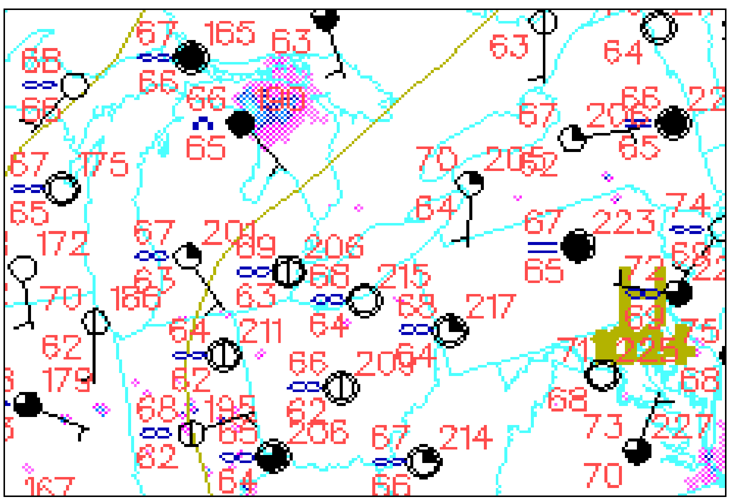


Figure 10.7 shows a surface map (courtesy of Unisys Weather: http://weather.unisys.com/) of the weather conditions on the morning of August 15.

Focusing on the Northeastern tier of the United States, one can see that Michigan was to the west of the center of a high pressure system (located over Southeastern Pennsylvania). The weather conditions in Southern Michigan were hazy with partly cloudy to scattered and clear skies throughout the day. This can enable sunlight to come through and cause photochemical reactions to occur and aid in ozone formation. The hazy conditions were most likely indicative of pollution accumulation. Temperatures were in the upper 60s during the morning hours, but reached the mid 80s in the late afternoon/early evening. Humidity levels were also high. Winds throughout the day were relatively light/calm, thus making it favorable for pollution build up. These types of weather conditions can cause ozone levels to increase and produce higher AQI levels.

APPENDIX A: CRITERIA POLLUTANT SUMMARY FOR 2009

Appendix A utilizes EPA's 2009 AQS Quick Look Report Data to present a summary of ambient air quality data collected for the criteria pollutants at monitoring locations throughout Michigan. Concentrations of non-gaseous pollutants are generally given in $\mu g/m^3$ and in ppm for gaseous pollutants. The following define some of the terms listed in the **Appendix A** reports.

Site I.D.: The AQS site ID is the EPA's code number for these sites.

POC: The Parameter Occurrence Code or POC is used to assist in distinguishing different uses of monitors; i.e., under Pb, NO_2, and SO_2, POC #1-5 are used to help differentiate between monitoring data received. For PM, the POC #'s are used more for the type of monitoring, such as:

- 1 - federal reference method (FRM);
- 2 - co-located FRM;
- 3 - TEOM hourly PM_{10} and $PM_{2.5}$ measurements; and
- 5 - $PM_{2.5}$ speciation monitors (shown at right is a Met One SASS - spiral aerosol speciation sampler).

 # OBS: For Pb, TSP, $PM_{2.5}$, and PM_{10}, the # OBS (number of observations) refers to the number of valid 24-hour values gathered. For continuous monitors (CO, NO_2, O_3, $PM_{2.5}$ TEOM, and SO_2,), # OBS refers to the total valid hourly averages obtained from the analyzer.

Values: The value is listed for each criteria pollutant per its NAAQS (primary and secondary). The number of excursions per site for the primary and secondary standards utilize running averages for continuous monitors, except for O_3, and does not include averages considered invalid due to limited sampling times. For example, a particulate-mean based only on six months could not be considered as violating the annual standard. As noted, each site is allowed one short-term standard excursion before a violation is determined.

>: The "greater than" symbol (>) heads the column reporting values or observations above the corresponding primary or secondary standards.

CRITERIA POLLUTANT SUMMARY FOR 2009

Trace CO Measured in ppm

Site ID	POC	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Arith. Mean
260810020	1	Grand Rapids	Kent	2009	8419	2.1	2.1	1.9	1.9	.29
261630001	1	Allen Park	Wayne	2009	7678	2.0	1.9	1.9	1.6	.29

Pb (24-Hour) Measured in $\mu g/m^3$

Site ID	POC	City	County	Year	# OBS	Qtr 1 Arith Mean	Qtr 2 Arith Mean	Qtr 3 Arith Mean	Qtr 4 Arith Mean	# Means > 1.5	Highest Value	2nd Highest Value
261630033	1	Dearborn	Wayne	2009	60	.0068	.0132	.0155	.0136	0	.0478	.0432

NO_2 Measured in ppm

Site ID	POC	City	County	Year	# OBS	1-Hr Highest Value	1-Hr 2nd Highest Value	Annual Arith Mean
261630019	2	Detroit - E. Seven Mile	Wayne	2009	8658	.059	.058	.0125

NO_y Measured in ppm

Site ID	POC	City	County	Year	# OBS	1-Hr Highest Value	1-Hr 2nd Highest Value	Annual Arith Mean
260810020	1	Grand Rapids	Kent	2009	7626	.1856	.1840	.01845
261630001	1	Allen Park	Wayne	2009	8071	.2006	.2006	.02484

O_3 (1-Hour) Measured in ppm

Site ID	POC	City	County	Year	Num Meas	Num Req	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Day Max >/= 0.125 Measured	Values >/= 0.125 Estimated	Missed Days < 0.125 Standard
260050003	1	Holland	Allegan	2009	183	183	.097	.096	.084	.083	0	0.0	0
260190003	1	Benzonia	Benzie	2009	183	183	.090	.078	.077	.076	0	0.0	0
260210014	1	Coloma	Berrien	2009	183	183	.088	.087	.081	.078	0	0.0	0

O_3 (1-Hour) Measured in ppm (continued)

Site ID	POC	City	County	Year	Num Meas	Num Req	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Day Max >/= 0.125 Measured	Values >/= 0.125 Estimated	Missed Days < 0.125 Standard
260270003	2	Cassopolis	Cass	2009	183	183	.092	.090	.080	.075	0	0.0	0
260370001	2	Rose Lake	Clinton	2009	174	183	.073	.072	.070	.069	0	0.0	1
260490021	1	Flint	Genesee	2009	181	183	.075	.072	.070	.070	0	0.0	0
260492001	1	Otisville	Genesee	2009	183	183	.077	.075	.075	.074	0	0.0	0
260630007	1	Harbor Beach	Huron	2009	175	183	.088	.076	.075	.074	0	0.0	0
260650012	2	Lansing	Ingham	2009	183	183	.077	.073	.073	.071	0	0.0	0
260770008	1	Kalamazoo	Kalamazoo	2009	183	183	.094	.083	.081	.076	0	0.0	0
260810020	1	Grand Rapids	Kent	2009	182	183	.090	.081	.077	.069	0	0.0	1
260810022	1	Evans	Kent	2009	183	183	.087	.086	.077	.076	0	0.0	0
260910007	1	Tecumseh	Lenawee	2009	173	183	.084	.078	.075	.073	0	0.0	0
260990009	1	New Haven	Macomb	2009	183	183	.120	.084	.082	.080	0	0.0	0
260991003	1	Warren	Macomb	2009	183	183	.097	.084	.082	.077	0	0.0	0
261010933	1	Manistee	Manistee	2009	183	183	.090	.078	.077	.075	0	0.0	0
261050007	1	Scottville	Mason	2009	183	183	.087	.079	.077	.075	0	0.0	0
261130001	1	Houghton Lake	Missaukee	2009	181	183	.073	.073	.072	.068	0	0.0	1
261210039	1	Muskegon	Muskegon	2009	182	183	.094	.084	.081	.079	0	0.0	1
261250001	2	Oak Park	Oakland	2009	183	183	.091	.085	.080	.080	0	0.0	0
261390005	1	Jenison	Ottawa	2009	182	183	.088	.087	.074	.074	0	0.0	1
261470005	1	Port Huron	St .Clair	2009	182	183	.084	.082	.080	.079	0	0.0	1
261530001	1	Seney	Schoolcraft	2009	183	183	.090	.073	.069	.066	0	0.0	0
261610008	1	Ypsilanti	Washtenaw	2009	182	183	.080	.079	.071	.071	0	0.0	1
261630001	2	Allen Park	Wayne	2009	180	183	.083	.073	.073	.073	0	0.0	1
261630019	2	Detroit - E. Seven Mile	Wayne	2009	180	183	.095	.089	.079	.079	0	0.0	0

O_3 (8-Hour) Measured in ppm

Site ID	POC	City	County	Year	% OBS	Valid Days Measured	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Day Max >/= 0.075
260050003	1	Holland	Allegan	2009	100	183	.092	.083	.079	.076	4
260190003	1	Benzonia	Benzie	2009	100	183	.082	.075	.072	.069	1
260210014	1	Coloma	Berrien	2009	100	183	.081	.073	.071	.070	1
260270003	2	Cassopolis	Cass	2009	100	183	.079	.075	.073	.072	1
260370001	2	Rose Lake	Clinton	2009	93	170	.070	.070	.067	.064	0
260490021	1	Flint	Genesee	2009	98	180	.072	.068	.067	.066	0
260492001	1	Otisville	Genesee	2009	100	183	.073	.071	.070	.069	0
260630007	1	Harbor Beach	Huron	2009	96	175	.076	.072	.071	.066	1
260650012	2	Lansing	Ingham	2009	100	183	.072	.070	.069	.069	0
260770008	1	Kalamazoo	Kalamazoo	2009	100	183	.078	.075	.074	.071	1
260810020	1	Grand Rapids	Kent	2009	100	183	.082	.074	.071	.066	1

O_3 (8-Hour) Measured in ppm (continued)

Site ID	POC	City	County	Year	% OBS	Valid Days Measured	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Day Max >/= 0.075
260810022	1	Evans	Kent	2009	99	182	.079	.074	.073	.071	1
260910007	1	Tecumseh	Lenawee	2009	95	173	.077	.070	.069	.067	1
260990009	1	New Haven	Macomb	2009	100	183	.095	.077	.074	.073	2
260991003	1	Warren	Macomb	2009	100	183	.083	.075	.073	.073	1
261010922	1	Manistee	Manistee	2009	99	182	.081	.070	.069	.068	1
261050007	1	Scottville	Mason	2009	100	183	.080	.074	.068	.068	1
261130001	1	Houghton Lake	Missaukee	2009	98	180	.069	.068	.065	.065	0
261210039	1	Muskegon	Muskegon	2009	99	182	.088	.079	.075	.074	2
261250001	2	Oak Park	Oakland	2009	100	183	.077	.074	.074	.073	1
261390005	1	Jenison	Ottawa	2009	99	181	.082	.076	.070	.070	2
261470005	1	Port Huron	St .Clair	2009	99	182	.075	.074	.072	.071	0
261530001	1	Seney	Schoolcraft	2009	100	183	.082	.069	.064	.063	1
261610008	1	Ypsilanti	Washtenaw	2009	99	182	.068	.068	.067	.065	0
261630001	2	Allen Park	Wayne	2009	98	180	.073	.066	.065	.063	0
261630019	2	Detroit - E. Seven Mile	Wayne	2009	98	180	.086	.074	.074	.073	1

$PM_{2.5}$ (24-Hour) Measured in $\mu g/m^3$ at Local Conditions

Site ID	POC	Monitor	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	98%	Wtd. Arith. Mean
260050003	1	FRM	Holland	Allegan	2009	117	29.6	26.3	25.4	25.2	25.4	8.64
260170014	1	FRM	Bay City	Bay	2009	116	32.5	23.6	23.3	22.7	23.3	8.13
260210014	1	FRM	Coloma	Berrien	2009	117	33.5	28.0	22.2	20.7	22.2	9.02
260490021	1	FRM	Flint	Genesee	2009	118	29.8	29.5	26.2	23.8	26.2	8.73
260650012	1	FRM	Lansing	Ingham	2009	121	29.5	28.2	27.1	24.5	27.1	9.08
260770008	1	FRM	Kalamazoo	Kalamazoo	2009	119	34.8	31.9	29.0	23.9	29.0	10.07
260770008	2	FRM	Kalamazoo	Kalamazoo	2009	58	36.4	27.3	23.7	19.6	27.3	9.91
260810007	1	FRM	Grand Rapids - Wealthy	Kent	2009	115	31.1	29.3	28.8	28.0	28.8	9.89
260810020	1	FRM	Grand Rapids - Monroe	Kent	2009	180	32.4	32.2	31.8	30.0	30.0	9.43
260810020	2	FRM	Grand Rapids - Monroe	Kent	2009	58	31.4	30.8	24.8	23.0	30.8	9.67
260910007	1	FRM	Tecumseh	Lenawee	2009	114	33.6	31.3	29.9	28.6	29.9	9.74
260990009	1	FRM	New Haven	Macomb	2009	116	32.5	31.6	26.2	25.0	26.2	9.49
261010922	1	FRM	Manistee	Manistee	2009	106	21.5	20.6	19.8	18.7	19.8	6.09
261130001	1	FRM	Houghton Lake	Missaukee	2009	113	22.5	20.4	17.5	16.9	17.5	5.94
261150005	1	FRM	Luna Pier	Monroe	2009	116	36.5	27.5	23.6	22.9	23.6	10.30
261210040	1	FRM	Muskegon	Muskegon	2009	177	30.8	30.5	28.8	27.3	27.3	8.75
261250001	1	FRM	Oak Park	Oakland	2009	118	32.5	30.9	30.1	28.7	30.1	10.03

$PM_{2.5}$ (24-Hour) Measured in $\mu g/m^3$ at Local Conditions (continued)

Site ID	POC	Monitor	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	98%	Wtd. Arith. Mean
261390005	1	FRM	Jenison	Ottawa	2009	166	31.7	31.0	27.2	26.5	26.5	9.19
261470005	1	FRM	Port Huron	St. Clair	2009	117	30.0	29.9	28.2	28.2	29.9	9.74
261610008	1	FRM	Ypsilanti	Washtenaw	2009	120	33.9	32.2	28.2	27.9	28.2	9.85
261610008	2	FRM	Ypsilanti	Washtenaw	2009	58	29.4	28.3	23.3	20.4	28.3	9.80
261630001	1	FRM	Allen Park	Wayne	2009	344	32.1	31.8	31.7	31.1	29.2	10.97
261630001	2	FRM	Allen Park	Wayne	2009	56	32.4	32.1	30.2	27.3	32.1	11.32*
261630015	1	FRM	Detroit - W. Fort	Wayne	2009	117	32.3	32.0	30.9	30.4	30.9	11.06
261630016	1	FRM	Detroit - Linwood	Wayne	2009	111	33.4	32.5	31.0	26.7	31.0	10.35
261630019	1	FRM	Detroit - E. Seven Mile	Wayne	2009	118	33.2	32.6	29.2	27.2	29.2	10.5
261630025	1	FRM	Livonia	Wayne	2009	116	34.6	34.1	29.3	28.8	29.3	9.89
261630033	1	FRM	Dearborn	Wayne	2009	119	45.2	35.8	35.7	34.0	35.7	12.06
261630036	1	FRM	Wyandotte	Wayne	2009	111	35.1	30.3	36.9	26.6	26.9	10.36
261630038	1	FRM	Detroit - Newberry.	Wayne	2009	110	31.4	26.1	25.9	25.5	25.9	10.17
261630039	1	FRM	Detroit – W. Lafayette	Wayne	2009	174	35.6	33.5	32.4	31.7	31.7	10.69

*Indicates the mean does not satisfy summary criteria

$PM_{2.5}$ TEOM (1-Hour) Measured in $\mu g/m^3$

Site ID	POC	Monitor (with FDMS)	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Wtd. Arith. Mean
260170014	3	TEOM	Bay City	Bay	2009	8684	48.0	45.0	45.0	42.0	8.53
260490021	3	TEOM	Flint	Genesee	2009	8686	428.0	301.0	261.0	106.0	9.21
260650012	5	TEOM	Lansing	Ingham	2009	7842	157.0	141.0	132.0	116.0	8.73
260770008	3	TEOM	Kalamazoo	Kalamazoo	2009	8490	66.0	63.0	62.0	57.0	10.03
260810020	3	TEOM	Grand Rapids	Kent	2009	8088	239.0	185.0	169.0	165.0	9.64
261130001	3	TEOM	Houghton Lake	Missaukee	2009	5095	105.0	102.0	58.0	58.0	9.48
261470005	3	TEOM	Port Huron	St. Clair	2009	8525	52.0	40.0	36.0	33.0	6.71
261530001	3	TEOM	Seney	Schoolcraft	2009	8705	120.0	90.0	64.0	61.0	9.63
261610008	3	TEOM	Ypsilanti	Washtenaw	2009	8336	42.0	37.0	37.0	36.0	5.81
261630001	3	TEOM	Allen Park	Wayne	2009	8725	209.0	99.0	70.0	46.0	9.65
261630033	3	TEOM	Dearborn	Wayne	2009	8533	92.0	91.0	91.0	88.0	10.96
261630038	3	TEOM	Detroit – 29th Street	Wayne	2009	8548	149.0	131.0	109.0	97.0	11.58
261630039	4	TEOM	Detroit – W. Lafayette	Wayne	2009	8707	182.0	171.0	164.0	121.0	10.46

PM_{10} (24-Hour) Measured in $\mu g/m^3$

Site ID	POC	Monitor	City	County	Year	# OBS	# Req.	% OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Wtd Arith Mean
260810007	1	GRAV	Grand Rapids - Wealthy	Kent	2009	56	61	92	34	27	24	23	11.9*
260810020	1	GRAV	Grand Rapids - Monroe	Kent	2009	46	61	75	29	21	20	19	9.0*
261630001	1	GRAV	Allen Park	Wayne	2009	59	61	97	36	36	34	32	14.1
261630005	1	GRAV	River Rouge	Wayne	2009	57	61	93	52	36	32	27	15.4*
261630015	1	GRAV	Detroit - W. Fort	Wayne	2009	59	61	97	50	43	40	40	17.6
261630033	1	GRAV	Dearborn	Wayne	2009	60	61	98	48	47	46	44	18.8

*Indicates the mean does not satisfy summary criteria

PM_{10} TEOM (1-Hour) Measured in $\mu g/m^3$

Site ID	POC	Monitor	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Wtd. Arith. Mean
261630033	3	TEOM	Dearborn	Wayne	2009	8623	338	305	294	259	21.0

SO_2 Measured in ppm

Site ID	POC	City	County	Year	# OBS	24-hr Highest Value	24-hr 2nd Highest Value	OBS > 0.14	3-hr Highest Value	3-hr 2nd Highest Value	OBS > 0.5	1-hr Highest Value	1-hr 2nd Highest Value	Arith Mean
261630015	1	Detroit - W. Fort	Wayne	2009	8711	.029	.029	0	.072	.059	0	.104	.092	.0031

Trace SO_2 Measured in ppm

Site ID	POC	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Arith. Mean
260810020	2	Grand Rapids	Kent	2009	8180	.0188	.0182	.0171	.0160	.00092
261630001	1	Allen Park	Wayne	2009	7814	.0697	.0466	.0458	.0435	.00196

APPENDIX B: 2009 AIR TOXICS MONITORING SUMMARY FOR METALS, VOCS, CARBONYL COMPOUNDS, & SPECIATED $PM_{2.5}$

Appendix B provides summary statistics of ambient air concentrations of various substances monitored in Michigan during 2009. At each monitoring site, air samples were taken over a 24-hour period (midnight to midnight). These air samples represent the average air concentration during that 24-hour period. The frequency of air samples collected is typically done once every 6 or 12 days. Sometimes the sampled air concentration is lower than the laboratory's analytical method detection level (MDL). When the concentration is lower than the MDL, two options are used to estimate the air concentration. The calculation of the minimum average ("Average (ND=0)") uses 0.0 μg/m³ for a value less than the MDL. In the calculation of the maximum average ("Average (ND=MDL/2)") the MDL divided by 2 (i.e., ½ the MDL) is substituted for air concentrations less than the MDL.

Table B shows the monitoring stations and what types of air toxics were monitored at each station in 2009. The following terms and acronyms are used in **Appendix B-1** and **B-2** data tables:

- Num Obs: Number of Observations (number of daily air samples taken during the year)
- Obs>MDL: Number of daily samples above the MDL
- Average (ND=0): average air concentration in 2009, assuming daily samples below MDL were equal to 0.0 μg/m³.
- Average (ND=MDL/2): average air concentration in 2009, assuming daily samples below MDL were equal to one half MDL.
- MDL: Analytical MDL in units of μg/m³
- Max1: Highest daily air concentration during 2009
- Max2: Second highest daily air concentration during 2009
- Max3: Third highest daily air concentration during 2009
- μg/m³: Micrograms per cubic meter (1,000,000 μg = 1 g)

Table B: Monitoring Stations and Types of Air Samples Collected

	Appendix B-1							Appendix B-2
Site Name	VOC	SVOC	Carbonyl	PAHs	Metals TSP	Metals PM_{10}	Hex Chrome	Speciated PM2.5
Allen Park					x	Mn Only		x
Dearborn	x	x	x	x	x	x	x	x
Detroit, W. Fort Street (North. Delray)(SWHS)	x		x		x	Mn Only		x
Detroit, W. Jefferson (South Delray)					x			
Flint					Mn Only			
Grand Rapids								x
Houghton Lake								x
Luna Pier								x
Port Huron, National Guard Armory								x
River Rouge			x		x	Mn Only		
Tecumseh								x

VOC = volatile organic compound; SVOC = semi-volatile organic compound; TSP = total suspended particulate; PM_{10} = particulate matter with aerodynamic diameter less than 10 μm; Hex Chrome = hexavalent chromium (Cr+6)

APPENDIX B-1

Allen Park (261630001) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs >MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Arsenic (TSP)	60	60	0.00119	0.00119	0.00014	0.00519	0.00372	0.00352
Cadmium (TSP)	60	60	0.000191	0.000191	0.000134	0.000469	0.000422	0.000378
Manganese (PM-10)	55	55	0.00795	0.00795	0.000415	0.023	0.0156	0.0141
Manganese (TSP)	60	60	0.0159	0.0159	0.000333	0.0351	0.0332	0.0308
Nickel (TSP)	60	59	0.0013	0.0013	0.000129	0.00401	0.00357	0.00314

Dearborn (261630033) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs >MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
1,1,1-Trichloroethane	59	59	0.0811	0.0811	0.00546	0.131	0.115	0.115
1,1,2,2-Tetrachloroethane	59	0	0	0.0103	0.0206	0	0	0
1,1,2-Trichloroethane	59	1	0.00046	0.00851	0.0164	0.0273	0	0
1,1-Dichloroethane	59	1	0.00021	0.00418	0.00809	0.0121	0	0
1,1-Dichloroethene	59	2	0.00041	0.00615	0.0119	0.0119	0.0119	0
1,2,4-Trichlorobenzene	59	0	0	0.026	0.0519	0	0	0
1,2,4-Trimethylbenzene	59	59	0.38	0.38	0.0246	3.4	1.33	1.08
1,2-Dibromoethane	59	0	0	0.00384	0.00768	0	0	0
1,2-Dichlorobenzene	59	0	0	0.012	0.024	0	0	0
1,2-Dichloroethane	59	4	0.00412	0.00789	0.00809	0.0688	0.0607	0.0567
1,2-Dichloropropane	59	0	0	0.00693	0.0139	0	0	0
1,3,5-Trimethylbenzene	59	59	0.127	0.127	0.0197	1.19	0.467	0.344
1,3-Butadiene	59	57	0.066	0.0661	0.00664	0.221	0.186	0.173
1,3-Dichlorobenzene	59	0	0	0.012	0.024	0	0	0
1,4-Dichlorobenzene	59	49	0.0668	0.0689	0.024	0.271	0.265	0.253
2,5-dimethylbenzaldehyde	59	1	0.00084	0.00244	0.00327	0.0493	0	0
2-Chloro-1,3-Butadiene	59	0	0	0.00543	0.0109	0	0	0
Acenaphthene	60	60	0.00863	0.00863	0.000055	0.0377	0.0286	0.0265
Acenaphthylene	60	41	0.00072	0.000725	0.0000623	0.00399	0.00292	0.00248
Acetaldehyde	59	59	1.43	1.43	0.00852	3.53	3.5	2.88
Acetone	59	59	3.06	3.06	0.00942	13.2	13.2	4.84
Acetonitrile	59	57	0.845	0.846	0.0974	26	1.14	0.972
Acetylene	59	59	1.01	1.01	0.0128	3.76	3.07	2.85
Acrylonitrile	59	13	0.0116	0.0242	0.0326	0.0955	0.0912	0.0868
Anthracene	60	50	0.00065	0.000658	0.000067	0.00233	0.00195	0.00183
Benzaldehyde	59	59	0.0956	0.0956	0.00441	0.278	0.239	0.182
Benzene	59	59	0.813	0.813	0.0192	2.35	1.78	1.73
Benzo(a)anthracene	60	59	0.00016	0.000166	0.0000821	0.000617	0.00058	0.000511
Benzo(a)pyrene	60	55	0.00014	0.00015	0.000079	0.00050	0.00046	0.00036
Benzo(b)fluoranthene	60	59	0.0004	0.0004	0.00008	0.00136	0.00097	0.00086
Benzo(ghi)perylene	60	60	0.00021	0.00021	0.000046	0.00066	0.000538	0.000434

Dearborn (261630033) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs >MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Benzo(k)fluoranthene	60	56	0.00012	0.000123	0.0000763	0.00115	0.000291	0.000241
Bromochloromethane	59	0	0	0.0132	0.0265	0	0	0
Bromodichloromethane	59	0	0	0.0067	0.0134	0	0	0
Bromoform	59	0	0	0.0103	0.0207	0	0	0
Bromomethane	59	58	0.0428	0.0429	0.00777	0.113	0.0971	0.066
Carbon Disulfide	59	59	0.314	0.314	0.00623	11	1.82	0.321
Carbon Tetrachloride	59	58	0.732	0.732	0.0126	1.36	1.11	1.07
Chlorobenzene	59	1	0.00086	0.00538	0.00921	0.0506	0	0
Chloroethane	59	57	0.0624	0.0625	0.00528	0.24	0.142	0.129
Chloroform	59	59	0.648	0.648	0.00976	2.51	1.82	1.49
Chloromethane	59	59	1.37	1.37	0.0124	2.03	1.99	1.93
Chloromethyl Benzene	59	1	0.00044	0.00553	0.0104	0.0259	0	0
Chrysene	60	60	0.00041	0.00041	0.000053	0.00126	0.00123	0.000764
cis-1,2-Dichloroethene	59	0	0	0.0337	0.0674	0	0	0
cis-1,3-Dichloropropene	59	0	0	0.00681	0.0136	0	0	0
Dibenzo(ah) anthracene	60	13	0.00001	0.000035	0.000065	0.000088	0.000060	0.000053
Dibromochloro methane	59	1	0.00013	0.00432	0.00852	0.00767	0	0
Dichlorodifluoro methane	59	59	3.02	3.02	0.0198	4.55	4.18	4.15
Ethyl Acrylate	59	0	0	0.0123	0.0246	0	0	0
Ethyl Tert-Butyl Ether	59	0	0	0.0146	0.0293	0	0	0
Ethylbenzene	59	59	0.307	0.307	0.0174	1.88	1.58	1.38
Fluoranthene	60	60	0.0044	0.0044	0.000060	0.0158	0.0124	0.0116
Fluorene	60	60	0.00773	0.00773	0.000050	0.0347	0.0243	0.0235
Formaldehyde	59	59	2.45	2.45	0.00914	6.62	5.37	4.16
Halocarbon 114	59	59	0.123	0.123	0.00699	0.182	0.175	0.168
Hexachloro-1,3-Butadiene	59	0	0	0.064	0.128	0	0	0
Hexanaldehyde	59	59	0.112	0.112	0.0039	0.713	0.381	0.315
Indeno(123-cd)pyrene	60	59	0.00019	0.00019	0.000055	0.00057	0.00050	0.000467
Isovaleraldehyde	59	11	0.0107	0.0122	0.00358	0.0846	0.081	0.0634
m,p-Xylene	59	59	0.92	0.92	0.0304	6.73	6.12	5.17
Methyl Ethyl Ketone	59	59	0.878	0.878	0.115	8.44	2.93	1.91
Methyl Isobutyl Ketone	59	58	0.19	0.19	0.0205	0.676	0.516	0.451
Methyl Methacrylate	59	1	0.0039	0.0602	0.115	0.229	0	0
Methyl Tert-Butyl Ether	59	0	0	0.0252	0.0505	0	0	0
Methylene Chloride	59	59	1.02	1.02	0.0278	9.55	9.48	2.95
Naphthalene	60	60	0.122	0.122	0.000326	0.413	0.287	0.256
n-Octane	59	46	0.0777	0.0798	0.0187	0.608	0.407	0.22
o-xylene	59	59	0.241	0.241	0.013	1.12	0.786	0.634
Phenanthrene	60	60	0.0181	0.0181	0.000079	0.0779	0.0539	0.0497
Propionaldehyde	59	59	0.257	0.257	0.00705	0.703	0.622	0.411
Propylene	59	59	0.724	0.724	0.0637	3.32	2.53	2.38
Pyrene	60	60	0.0023	0.0023	0.000076	0.0067	0.0055	0.0054
Styrene	59	45	0.0336	0.0351	0.0128	0.26	0.132	0.102

Dearborn (261630033) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs >MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Tetrachloroethene	59	53	0.172	0.173	0.0203	1	0.495	0.461
Tolualdehydes	59	59	0.132	0.132	0.0147	0.319	0.31	0.29
Toluene	59	59	1.12	1.12	0.0302	5.92	3.34	3.32
trans-1,2-Dichloroethene	59	0	0	0.00595	0.0119	0	0	0
trans-1,3-Dichloropropene	59	1	0.00062	0.0073	0.0136	0.0363	0	0
Trichloroethene	59	12	0.0176	0.0219	0.0107	0.172	0.161	0.113
Trichlorofluoromethane	59	59	1.72	1.72	0.0112	2.63	2.57	2.49
Valeraldehyde	59	59	0.0784	0.0784	0.00358	0.264	0.208	0.155
Vinyl Chloride	59	10	0.0029	0.00503	0.00511	0.0511	0.0358	0.0128
Arsenic (PM-10)	60	60	0.00136	0.00136	0.000173	0.00509	0.00374	0.00309
Arsenic (TSP)	60	60	0.00157	0.00157	0.000141	0.00641	0.0045	0.00321
Barium (PM-10)	60	60	0.0118	0.0118	0	0.0466	0.0283	0.0226
Barium (TSP)	60	60	0.0311	0.0311	0	0.0879	0.0563	0.0511
Beryllium (PM-10)	60	56	0.00002	0.000023	0.00024	0.00013	0.000093	0.000070
Beryllium (TSP)	60	60	0.00008	0.00008	0.0002	0.000278	0.000274	0.000273
Cadmium (PM-10)	60	58	0.00032	0.00032	0.00017	0.00242	0.00093	0.00083
Cadmium (TSP)	60	60	0.00041	0.000405	0.000134	0.00288	0.00105	0.00103
Chromium (PM-10)	60	60	0.00302	0.00302	0.000285	0.0077	0.00549	0.00514
Chromium (TSP)	60	60	0.00441	0.00441	0.000231	0.0133	0.0104	0.0099
Chromium VI (TSP)	62	45	0.000036	0.000036	0.000005	0.000372	0.000317	0.000126
Cobalt (PM-10)	60	60	0.0002	0.000197	0.00022	0.000586	0.000505	0.000419
Cobalt (TSP)	60	60	0.00027	0.000268	0.000179	0.000915	0.000811	0.000519
Copper (PM-10)	60	60	0.0477	0.0477	0.000506	0.155	0.122	0.119
Copper (TSP)	60	60	0.191	0.191	0.00041	0.399	0.393	0.345
Iron (PM-10)	60	60	0.567	0.567		2.1	1.57	1.56
Iron (TSP)	60	60	1.21	1.21		5.66	4.2	3.56
Lead (PM-10)	60	60	0.00974	0.00974	0.000233	0.0385	0.0379	0.0362
Lead (PM-10)(LC)	60	60	0.00966	0.00966	0.000221	0.0387	0.0376	0.0362
Lead (TSP)	60	60	0.0123	0.0123	0.000189	0.0479	0.0432	0.0385
Lead (TSP)(LC)	60	60	0.0122	0.0122	0.00018	0.0481	0.0428	0.0385
Manganese (PM-10)	60	60	0.0267	0.0267	0.000412	0.114	0.107	0.102
Manganese (TSP)	60	60	0.0774	0.0774	0.000334	0.289	0.282	0.274
Molybdenum (PM-10)	60	60	0.00146	0.00146	0.000165	0.0121	0.0098	0.0084
Molybdenum (TSP)	60	60	0.00158	0.00158	0.000134	0.012	0.0111	0.0109
Nickel (PM-10)	60	60	0.00197	0.00197	0.00016	0.00966	0.00876	0.00531
Nickel (TSP)	60	60	0.00303	0.00303	0.00013	0.0325	0.00997	0.00943
Vanadium (PM-10)	60	59	0.00198	0.00198	0.000227	0.0147	0.014	0.00771
Vanadium (TSP)	60	60	0.00328	0.00328	0.000184	0.0141	0.0122	0.00914
Zinc (PM-10)	60	60	0.0694	0.0694	0.000005	0.302	0.221	0.195
Zinc (TSP)	60	60	0.109	0.109	0	0.536	0.299	0.292

Detroit, Fort Street (N.Delray-SWHS)(261630015) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs >MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
1,1,1-Trichloroethane	36	0	0	0.275	0.55	0	0	0
1,1,2,2-Tetrachloroethane	36	0	0	0.381	0.761	0	0	0
1,1,2-Trichloroethane	36	0	0	0.496	0.992	0	0	0
1,1-Dichloroethane	36	0	0	0.138	0.276	0	0	0
1,1-Dichloroethene	36	0	0	0.135	0.27	0	0	0
1,2,4-Trichlorobenzene	36	7	0.525	1.17	1.6	4	3.7	2.6
1,2,4-Trimethylbenzene	36	11	0.419	0.645	0.653	2.1	2.1	1.9
1,2-Dibromoethane	36	0	0	0.597	1.19	0	0	0
1,2-Dichlorobenzene	36	0	0	0.356	0.711	0	0	0
1,2-Dichloroethane	36	0	0	0.208	0.415	0	0	0
1,2-Dichloropropane	36	0	0	0.265	0.529	0	0	0
1,3,5-Trimethylbenzene	36	3	0.0675	0.358	0.633	1.1	0.69	0.64
1,3-Butadiene	36	0	0	0.266	0.533	0	0	0
1,3-Dichlorobenzene	36	0	0	0.377	0.754	0	0	0
1,4-Dichlorobenzene	36	3	0.0631	0.373	0.676	0.83	0.75	0.69
2,2,4-Trimethylpentane	36	9	0.2	0.351	0.404	1.5	1.3	1
2,5-dimethylbenzaldehyde	31	0	0	0.0268	0.0535	0	0	0
2-Chloro-1,3-Butadiene	36	0	0	0.123	0.246	0	0	0
Acetaldehyde	31	31	1.58	1.58	0.0236	3.28	2.43	2.27
Acetone	31	31	3.34	3.34	0.0762	9.97	6.11	5.83
Acetonitrile	36	1	0.0306	0.565	1.1	1.1	0	0
Acrylonitrile	36	3	0.0167	0.0826	0.144	0.3	0.15	0.15
Benzaldehyde	31	0	0	0.0109	0.0218	0	0	0
Benzene	36	36	0.971	0.971	0.218	3.4	2.3	1.9
Bromodichloromethane	36	0	0	0.55	1.1	0	0	0
Bromoform	36	0	0	0.85	1.7	0	0	0
Bromomethane	36	0	0	0.5	0.999	0	0	0
Carbon Tetrachloride	36	8	0.179	0.431	0.649	1.2	0.93	0.8
Chlorobenzene	36	0	0	0.364	0.728	0	0	0
Chloroethane	36	0	0	0.367	0.734	0	0	0
Chloroform	36	36	1.51	1.51	0.511	2.4	2.2	2.2
Chloromethane	36	36	1.25	1.25	0.598	2.3	2	1.7
Chloromethyl Benzene	36	0	0	0.394	0.789	0	0	0
cis-1,2-Dichloroethene	36	0	0	0.107	0.214	0	0	0
cis-1,3-Dichloropropene	36	0	0	0.312	0.624	0	0	0
Crotonaldehyde (trans)	31	1	0.0363	0.0425	0.0127	1.13	0	0
Dibromochloromethane	36	0	0	0.739	1.48	0	0	0
Dichlorodifluoromethane	36	36	3.87	3.87	0.633	41	8.1	6.2
Ethylbenzene	36	3	0.121	0.447	0.711	2.4	1.2	0.75
Formaldehyde	31	31	1.76	1.76	0.0254	3.03	2.72	2.56
Halocarbon 113	35	21	0.453	0.578	0.625	1.4	1	0.85
Halocarbon 114	36	0	0	0.853	1.71	0	0	0
Hexachloro-1,3-Butadiene	36	4	0.275	0.985	1.6	3.7	2.6	1.9
Hexanaldehyde	31	0	0	0.0209	0.0418	0	0	0
Isovaleraldehyde	31	0	0	0.0132	0.0264	0	0	0

Detroit, Fort Street (N.Delray-SWHS)(261630015) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs >MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
m,p-Tolualdehyde	31	0	0	0.02	0.0399	0	0	0
m,p-Xylene	36	23	0.986	1.12	0.734	6.8	3.4	3
Methyl Ethyl Ketone	36	36	1.69	1.69	0.12	4	3.9	3.1
Methyl Isobutyl Ketone	36	35	2.47	2.47	0.509	19	12	11
Methyl Tert-Butyl Ether	36	0	0	0.103	0.205	0	0	0
Methylene Chloride	36	33	0.437	0.447	0.242	1.2	0.81	0.78
n-Butyraldehyde	31	5	0.0767	0.0824	0.0136	0.549	0.532	0.469
n-Hexane	36	36	0.983	0.983	0.229	3.8	2.7	2.6
o-Tolualdehyde	31	0	0	0.0168	0.0336	0	0	0
o-xylene	36	5	0.205	0.495	0.674	2.6	1.7	1.5
Propionaldehyde	29	21	0.401	0.406	0.0389	1.27	1.25	0.955
Styrene	36	6	0.208	0.417	0.501	2	1.9	1.3
Tetrachloroethene	36	0	0	0.538	1.08	0	0	0
Toluene	36	36	1.85	1.85	0.46	6.9	6.5	5
trans-1,2-Dichloroethene	36	0	0	0.143	0.286	0	0	0
trans-1,3-Dichloropropene	36	0	0	0.315	0.631	0	0	0
Trichloroethene	36	0	0	0.256	0.513	0	0	0
Trichlorofluoromethane	36	36	1.44	1.44	0.505	3.1	2.4	1.9
Valeraldehyde	31	0	0	0.02	0.04	0	0	0
Vinyl Chloride	36	0	0	0.301	0.602	0	0	0
Arsenic (TSP)	60	60	0.00151	0.00151	0.000142	0.00402	0.00402	0.00397
Cadmium (TSP)	60	60	0.000378	0.000378	0.000136	0.00151	0.00146	0.00146
Manganese (PM-10)	55	55	0.02	0.02	0.000419	0.082	0.0513	0.0467
Manganese (TSP)	60	60	0.0463	0.0463	0.000337	0.186	0.127	0.124
Nickel (TSP)	60	60	0.00297	0.00297	0.000131	0.0152	0.00856	0.00662

Flint, Whaley Park (260490021) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs >MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Manganese (TSP)	59	59	0.00952	0.00952	0.000331	0.0287	0.0198	0.0188

River Rouge (261630005) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs >MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
2,5-dimethylbenzaldehyde	60	0	0	0.026	0.0519	0	0	0
Acetaldehyde	60	60	1.58	1.58	0.0229	4.08	3.45	3.01
Acetone	60	60	2.8	2.8	0.074	4.78	4.62	4.61
Benzaldehyde	60	1	0.0255	0.0359	0.0212	1.53	0	0
Crotonaldehyde (trans)	60	0	0	0.00617	0.0123	0	0	0
Formaldehyde	60	60	2.59	2.59	0.0247	4.94	4.53	4.22

River Rouge (261630005) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs >MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Hexanaldehyde	60	2	0.024	0.0436	0.0406	0.807	0.631	0
Isovaleraldehyde	60	0	0	0.0128	0.0256	0	0	0
m,p-Tolualdehyde	60	0	0	0.0194	0.0388	0	0	0
n-Butyraldehyde	60	7	0.0624	0.0682	0.0132	0.861	0.608	0.531
o-Tolualdehyde	60	0	0	0.0163	0.0326	0	0	0
Propionaldehyde	58	38	0.415	0.421	0.0379	2.08	1.4	1.39
Valeraldehyde	60	1	0.0112	0.0303	0.0388	0.673	0	0
Arsenic (TSP)	59	59	0.0014	0.0014	0.000136	0.00892	0.00409	0.00322
Cadmium (TSP)	59	59	0.000384	0.000384	0.00013	0.00165	0.00104	0.00101
Manganese (PM-10)	57	57	0.0156	0.0156	0.000418	0.0903	0.065	0.0478
Manganese (TSP)	59	59	0.0313	0.0313	0.000324	0.105	0.0795	0.0735
Nickel (TSP)	59	59	0.00195	0.00195	0.000126	0.00724	0.00648	0.0054

Detroit, W. Jefferson, South Delray (261630029) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs >MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Arsenic (TSP)	61	61	0.00173	0.00173	0.000143	0.0074	0.00444	0.00408
Cadmium (TSP)	61	61	0.0005	0.0005	0.000137	0.00327	0.00224	0.00132
Manganese (TSP)	61	61	0.0695	0.0695	0.000341	0.272	0.221	0.179
Nickel (TSP)	61	61	0.00278	0.00278	0.000132	0.0133	0.00718	0.00657

APPENDIX B-2

Allen Park (261630001) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Aluminum PM2.5LC	119	88	0.0184	0.0203	0.0147	0.128	0.094	0.0745
Ammonium Ion PM2.5LC	119	119	1.46	1.46	0.018	6.09	5.87	5.76
Antimony PM2.5LC	119	41	0.00678	0.0185	0.0358	0.0865	0.0444	0.0373
Arsenic PM2.5LC	119	57	0.000841	0.00123	0.00139	0.00827	0.00455	0.0042
Barium PM2.5LC	119	14	0.000529	0.0062	0.0154	0.00888	0.00793	0.00745
Bromine PM2.5LC	119	111	0.00285	0.00289	0.00149	0.0097	0.00911	0.00815
Cadmium PM2.5LC	119	40	0.00227	0.00766	0.0159	0.0188	0.0183	0.0175
Calcium PM2.5LC	119	119	0.0348	0.0348	0.00655	0.146	0.1	0.0881
Cerium PM2.5LC	119	12	0.000105	0.00498	0.0165	0.0021	0.00175	0.00163
Cesium PM2.5 LC	119	32	0.000742	0.0063	0.0191	0.00876	0.00676	0.00676
Chlorine PM2.5LC	119	97	0.0234	0.0242	0.00752	0.365	0.353	0.274
Chromium PM2.5LC	119	89	0.00304	0.00333	0.00234	0.093	0.0799	0.0319
Cobalt PM2.5LC	119	54	0.000228	0.000619	0.00135	0.00178	0.00098	0.00097
Copper PM2.5LC	119	117	0.00679	0.00681	0.00174	0.0403	0.0347	0.0313
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	89	89	0.408	0.408		1.43	1.32	1.02
Elemnetal Carbon PM2.5LC	119	115	0.598	0.602	0.24	2.15	1.8	1.66
Europium PM2.5LC	16	1	0.000175	0.00265	0.00563	0.0028	0	0
Gallium PM2.5LC	16	4	0.0001	0.000815	0.00201	0.00082	0.00035	0.00023
Gold PM2.5LC	16	1	0.000191	0.0021	0.00392	0.00305	0	0
Hafnium PM2.5LC	16	7	0.00265	0.00407	0.00546	0.013	0.012	0.00666
Indium PM2.5LC	119	30	0.00252	0.00906	0.017	0.0269	0.0245	0.0233
Iridium PM2.5LC	16	2	0.000204	0.0023	0.00483	0.00316	0.00011	0
Iron PM2.5LC	119	119	0.0756	0.0756	0.00187	0.397	0.25	0.242
Lanthanium PM2.5LC	16	3	0.00035	0.00562	0.0159	0.00373	0.00175	0.00012
Lead PM2.5LC	119	79	0.00247	0.003	0.00352	0.0134	0.013	0.01
Magnesium PM2.5LC	119	23	0.00185	0.00721	0.0134	0.0409	0.0248	0.024
Manganese PM2.5LC	119	104	0.00161	0.00173	0.00193	0.0108	0.00617	0.00496
Mercury PM2.5LC	16	3	0.00054	0.00294	0.00619	0.00397	0.00374	0.00093
Molybdenum PM2.5LC	16	2	0.000328	0.00286	0.00566	0.00454	0.0007	0
Nickel PM2.5LC	119	79	0.00108	0.00133	0.00134	0.0277	0.0157	0.0097
Niobium PM2.5LC	16	2	0.00027	0.00202	0.00386	0.00362	0.0007	0
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	89	89	2.18	2.18		6.38	6.28	5.5
Organic Carbon Peak1 PM2.5LC	119	119	0.772	0.772	0.24	5.68	2.16	2.06
Organic Carbon Peak2 PM2.5LC	119	119	1.21	1.21	0.24	3.6	3.38	2.4
Organic Carbon Peak3 PM2.5LC	119	119	0.783	0.783	0.24	1.91	1.78	1.73
Organic Carbon Peak4 PM2.5LC	119	119	0.853	0.853	0.24	2.94	2.79	1.96
Organic Carbon PM2.5LC	119	119	3.46	3.46	0.24	9.46	8.69	8.16
Organic Carbon Pyrolytic PM2.5LC	119	13	0.0207	0.128	0.24	0.604	0.568	0.43
Phosphorus PM2.5LC	119	1	0.000003	0.0063	0.0126	0.00035	0	0
Potassium Ion PM2.5LC	119	70	0.0541	0.0572	0.0156	0.266	0.221	0.194

Allen Park (261630001) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Potassium PM2.5LC	119	119	0.0498	0.0498	0.00681	0.27	0.208	0.176
Rubidium PM2.5LC	119	32	0.000174	0.000883	0.00192	0.00174	0.00161	0.00144
Samarium PM2.5LC	16	5	0.00043	0.00209	0.00548	0.00187	0.00174	0.00152
Scandium PM2.5LC	16	1	0.000058	0.0101	0.0203	0.00093	0	0
Selenium PM2.5LC	119	68	0.000679	0.00106	0.00182	0.00747	0.00478	0.00456
Silicon PM2.5LC	119	116	0.0424	0.0426	0.0113	0.121	0.119	0.118
Silver PM2.5LC	119	31	0.00153	0.00634	0.013	0.0187	0.014	0.0112
Sodium Ion PM2.5LC	119	114	0.0793	0.0799	0.027	0.63	0.334	0.255
Sodium PM2.5LC	119	92	0.0371	0.0418	0.0377	0.207	0.189	0.186
Strantium PM2.5LC	119	34	0.000554	0.00138	0.00232	0.014	0.00773	0.00549
Sulfate PM2.5LC	119	119	2.35	2.35	0.00872	10.4	7.16	6.12
Sulfur PM2.5LC	119	119	0.781	0.781	0.00845	3.37	2.57	2.01
Tantalum PM2.5LC	16	3	0.000363	0.00301	0.00654	0.0029	0.0021	0.00081
Terbium PM2.5LC	16	0	0	0.0024	0.0048	0	0	0
Tin PM2.5LC	119	32	0.00331	0.0116	0.0224	0.0349	0.0326	0.0304
Titatium PM2.5LC	119	68	0.00155	0.00259	0.00486	0.00847	0.00783	0.00551
Total Nitrate PM2.5LC	119	119	2.28	2.28	0.00936	14.2	13.5	13.2
Tungsten PM2.5LC	16	2	0.00051	0.00268	0.00494	0.00561	0.00255	0
Vanadium PM2.5LC	119	44	0.000623	0.00168	0.00332	0.00908	0.00642	0.00395
Yttrium PM2.5LC	16	3	0.000080	0.00113	0.00264	0.0007	0.00047	0.00012
Zinc PM2.5LC	119	118	0.012	0.012	0.00232	0.056	0.0504	0.0491
Zirconium PM2.5LC	119	17	0.000445	0.00212	0.00393	0.00817	0.00701	0.00699

Dearborn (261630033) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Aluminum PM2.5LC	59	42	0.0233	0.0253	0.0145	0.119	0.109	0.0597
Ammonium Ion PM2.5LC	59	59	1.67	1.67	0.0191	6.49	5.48	4.99
Antimony PM2.5LC	59	15	0.00479	0.0187	0.0374	0.0384	0.0303	0.0268
Arsenic PM2.5LC	59	34	0.000792	0.00112	0.00147	0.00373	0.00332	0.00304
Barium PM2.5LC	59	7	0.000243	0.00563	0.0136	0.0035	0.00257	0.00222
Bromine PM2.5LC	59	54	0.00388	0.00395	0.00156	0.0146	0.0117	0.00836
Cadmium PM2.5LC	59	9	0.00134	0.0085	0.0166	0.0221	0.012	0.0105
Calcium PM2.5LC	59	59	0.0656	0.0656	0.00611	0.251	0.208	0.191
Cerium PM2.5LC	59	7	0.000196	0.00378	0.0134	0.00361	0.00198	0.00176
Cesium PM2.5 LC	59	13	0.000942	0.00855	0.0225	0.00992	0.00841	0.00583
Chlorine PM2.5LC	59	54	0.0688	0.0691	0.00686	0.594	0.452	0.362
Chromium PM2.5LC	59	41	0.00107	0.00141	0.0023	0.00641	0.00572	0.00404

Dearborn (261630033) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Cobalt PM2.5LC	59	42	0.00126	0.00146	0.00128	0.00631	0.00596	0.00576
Copper PM2.5LC	59	59	0.013	0.013	0.00165	0.0713	0.0657	0.0397
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	58	58	0.416	0.416		1.06	1.05	0.937
Europium PM2.5LC	8	0	0	0.00283	0.00565	0	0	0
Gallium PM2.5LC	8	1	0.000305	0.00101	0.002	0.00244	0	0
Gold PM2.5LC	8	3	0.000306	0.00155	0.00391	0.00117	0.00093	0.00035
Hafnium PM2.5LC	8	2	0.000261	0.0021	0.00546	0.00198	0.00011	0
Indium PM2.5LC	59	15	0.00249	0.00936	0.0183	0.0292	0.0162	0.0156
Iridium PM2.5LC	8	3	0.000963	0.0023	0.00483	0.00606	0.00117	0.00047
Iron PM2.5LC	59	59	0.29	0.29	0.00175	1.08	1.05	0.887
Lanthanium PM2.5LC	8	1	0.000073	0.00364	0.0159	0.00058	0	0
Lead PM2.5LC	59	47	0.0064	0.00678	0.00384	0.0367	0.0341	0.0288
Magnesium PM2.5LC	59	31	0.0103	0.0135	0.0129	0.0753	0.0684	0.0496
Manganese PM2.5LC	59	55	0.00673	0.00679	0.00188	0.0331	0.0221	0.0196
Mercury PM2.5LC	8	1	0.00016	0.00267	0.00619	0.00128	0	0
Molybdenum PM2.5LC	8	1	0.000131	0.00278	0.00565	0.00105	0	0
Nickel PM2.5LC	59	42	0.000961	0.00116	0.00128	0.00859	0.00655	0.00377
Niobium PM2.5LC	8	1	0.000146	0.00174	0.00388	0.00117	0	0
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	58	58	2.53	2.53		6.04	5.93	5.31
Phosphorus PM2.5LC	59	0	0	0.00597	0.0119	0	0	0
Potassium Ion PM2.5LC	59	41	0.07	0.0724	0.0169	0.384	0.202	0.199
Potassium PM2.5LC	59	59	0.0696	0.0696	0.00617	0.341	0.188	0.165
Rubidium PM2.5LC	59	12	0.000171	0.000922	0.00188	0.00362	0.00158	0.00157
Samarium PM2.5LC	8	0	0	0.00274	0.00548	0	0	0
Scandium PM2.5LC	8	1	0.000146	0.0101	0.0203	0.00117	0	0
Selenium PM2.5LC	59	37	0.00108	0.00141	0.00188	0.00606	0.00572	0.0056
Silicon PM2.5LC	59	58	0.0567	0.0568	0.0114	0.158	0.155	0.143
Silver PM2.5LC	59	19	0.00168	0.00603	0.0135	0.00932	0.00851	0.00793
Sodium Ion PM2.5LC	59	58	0.0976	0.0977	0.0245	0.575	0.264	0.242
Sodium PM2.5LC	59	57	0.0652	0.0658	0.0386	0.253	0.232	0.219
Strantium PM2.5LC	59	22	0.000605	0.00133	0.0023	0.00817	0.00338	0.00256
Sulfate PM2.5LC	59	59	2.63	2.63	0.00804	10.2	6.84	6.75
Sulfur PM2.5LC	59	59	0.868	0.868	0.00817	2.75	2.46	2.27
Tantalum PM2.5LC	8	1	0.000539	0.0033	0.00654	0.00431	0	0
Terbium PM2.5LC	8	0	0	0.0024	0.0048	0	0	0
Tin PM2.5LC	59	15	0.00262	0.0123	0.0249	0.0256	0.0175	0.0129
Titatium PM2.5LC	59	28	0.00107	0.00232	0.00473	0.00993	0.00432	0.00421
Total Nitrate PM2.5LC	59	59	2.45	2.45	0.0112	15.5	10.5	10.4
Tungsten PM2.5LC	8	3	0.000655	0.00202	0.00494	0.00326	0.00163	0.00035
Vanadium PM2.5LC	59	25	0.000737	0.00167	0.00324	0.00817	0.00466	0.00455
Yttrium PM2.5LC	8	1	0.000116	0.00125	0.00263	0.00093	0	0
Zinc PM2.5LC	59	58	0.037	0.037	0.00263	0.169	0.151	0.124
Zirconium PM2.5LC	59	4	0.000285	0.00206	0.00414	0.00816	0.00583	0.00234

North Delray (SWHS) (261630015) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Aluminum PM2.5LC	61	44	0.0212	0.0232	0.0139	0.0811	0.0725	0.0708
Ammonium Ion PM2.5LC	61	61	1.56	1.56	0.0183	5.99	5.32	4.31
Antimony PM2.5LC	61	18	0.00436	0.0182	0.039	0.0349	0.0338	0.0326
Arsenic PM2.5LC	61	33	0.00107	0.00142	0.00142	0.007	0.00491	0.00489
Barium PM2.5LC	61	5	0.000258	0.00542	0.0119	0.00607	0.0042	0.00233
Bromine PM2.5LC	61	59	0.00357	0.00359	0.00157	0.0187	0.0127	0.0103
Cadmium PM2.5LC	61	7	0.000723	0.00852	0.0174	0.0105	0.00701	0.00699
Calcium PM2.5LC	61	61	0.0537	0.0537	0.00598	0.197	0.172	0.162
Cerium PM2.5LC	61	1	0.000017	0.0046	0.0106	0.00105	0	0
Cesium PM2.5 LC	61	15	0.00108	0.00875	0.0233	0.0147	0.0107	0.00935
Chlorine PM2.5LC	61	59	0.0284	0.0285	0.00647	0.532	0.123	0.116
Chromium PM2.5LC	61	42	0.00146	0.00182	0.00233	0.0239	0.00758	0.00728
Cobalt PM2.5LC	61	44	0.000772	0.000961	0.00123	0.00366	0.00336	0.00292
Copper PM2.5LC	61	60	0.00862	0.00863	0.00154	0.0385	0.0313	0.0292
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	57	57	0.39	0.39		1.26	0.765	0.737
Europium PM2.5LC	9	1	0.000129	0.00227	0.00483	0.00116	0	0
Gallium PM2.5LC	9	1	0.000053	0.000906	0.00181	0.00048	0	0
Gold PM2.5LC	9	3	0.000402	0.00202	0.00381	0.00186	0.00164	0.00012
Hafnium PM2.5LC	9	2	0.000078	0.00182	0.00479	0.00047	0.00023	0
Indium PM2.5LC	61	10	0.00169	0.00975	0.019	0.0232	0.0221	0.0129
Iridium PM2.5LC	9	1	0.000117	0.00249	0.00501	0.00105	0	0
Iron PM2.5LC	61	61	0.187	0.187	0.00164	1.06	1.05	0.586
Lanthanium PM2.5LC	9	0	0	0.00404	0.00808	0	0	0
Lead PM2.5LC	61	49	0.006	0.00637	0.00387	0.0376	0.0365	0.0347
Magnesium PM2.5LC	61	23	0.00364	0.00748	0.0122	0.0374	0.0177	0.0173
Manganese PM2.5LC	61	56	0.00295	0.00303	0.00185	0.0111	0.0088	0.0086
Mercury PM2.5LC	9	3	0.00154	0.00369	0.00678	0.00935	0.00384	0.0007
Molybdenum PM2.5LC	9	0	0	0.00314	0.00629	0	0	0
Nickel PM2.5LC	61	44	0.00114	0.00131	0.00121	0.013	0.00535	0.00459
Niobium PM2.5LC	9	0	0	0.00193	0.00387	0	0	0
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	57	57	2.36	2.36		6.56	4.82	4.79
Phosphorus PM2.5LC	61	1	0.000056	0.00608	0.0121	0.00339	0	0
Potassium Ion PM2.5LC	61	38	0.0537	0.0566	0.0158	0.224	0.207	0.157
Potassium PM2.5LC	61	61	0.051	0.051	0.00573	0.221	0.179	0.116
Rubidium PM2.5LC	61	10	0.000111	0.000894	0.00187	0.00111	0.00107	0.00093
Samarium PM2.5LC	9	1	0.000026	0.00216	0.00479	0.00023	0	0
Scandium PM2.5LC	9	0	0	0.0129	0.0259	0	0	0
Selenium PM2.5LC	61	29	0.00072	0.00117	0.00181	0.00676	0.00489	0.00375
Silicon PM2.5LC	61	61	0.0563	0.0563	0.011	0.171	0.143	0.14

North Delray (SWHS) (261630015) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Silver PM2.5LC	61	10	0.00133	0.00713	0.014	0.0338	0.00899	0.00816
Sodium Ion PM2.5LC	61	57	0.0841	0.085	0.0266	0.402	0.295	0.27
Sodium PM2.5LC	61	53	0.0376	0.0404	0.0375	0.225	0.122	0.116
Strantium PM2.5LC	61	19	0.000587	0.00139	0.00231	0.0078	0.00502	0.00338
Sulfate PM2.5LC	61	61	2.58	2.58	0.00856	10.3	6.8	6.44
Sulfur PM2.5LC	61	61	0.86	0.86	0.00824	3.22	2.35	2.25
Tantalum PM2.5LC	9	1	0.000492	0.00349	0.00709	0.00443	0	0
Terbium PM2.5LC	9	0	0	0.00198	0.00396	0	0	0
Tin PM2.5LC	61	18	0.0035	0.0128	0.026	0.035	0.0314	0.0302
Titatium PM2.5LC	61	33	0.00122	0.00227	0.00472	0.00664	0.00573	0.00548
Total Nitrate PM2.5LC	61	61	2.3	2.3	0.00929	14.7	10.3	9.03
Tungsten PM2.5LC	9	1	0.000233	0.00239	0.00512	0.0021	0	0
Vanadium PM2.5LC	61	17	0.000526	0.0017	0.00328	0.00702	0.00559	0.00537
Yttrium PM2.5LC	9	2	0.000284	0.00125	0.00254	0.00186	0.0007	0
Zinc PM2.5LC	61	60	0.0195	0.0195	0.00271	0.0895	0.0778	0.0508
Zirconium PM2.5LC	61	2	0.000017	0.00205	0.00422	0.00081	0.00024	0

Grand Rapids (260810020) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Aluminum PM2.5LC	58	37	0.012	0.0147	0.0151	0.0656	0.0615	0.033
Ammonium Ion PM2.5LC	58	58	1.43	1.43	0.0189	6.21	5.02	3.45
Antimony PM2.5LC	58	13	0.00429	0.019	0.0381	0.0443	0.0408	0.0374
Arsenic PM2.5LC	58	23	0.00068	0.00114	0.00145	0.0035	0.00315	0.003
Barium PM2.5LC	58	5	0.000161	0.00487	0.0111	0.0028	0.00257	0.0021
Bromine PM2.5LC	58	58	0.00263	0.00263	0.00153	0.00711	0.00687	0.00608
Cadmium PM2.5LC	58	9	0.00122	0.00841	0.0166	0.0176	0.0105	0.0093
Calcium PM2.5LC	58	58	0.0273	0.0273	0.00609	0.1	0.0989	0.0749
Cerium PM2.5LC	58	1	0.0000019	0.00391	0.00931	0.00011	0	0
Cesium PM2.5 LC	58	9	0.000464	0.00916	0.0221	0.00851	0.00455	0.00348
Chlorine PM2.5LC	58	51	0.0228	0.0233	0.00655	0.267	0.226	0.146
Chromium PM2.5LC	58	27	0.0033	0.00392	0.00228	0.121	0.0259	0.00944
Cobalt PM2.5LC	58	33	0.000308	0.000588	0.00124	0.00162	0.00161	0.00114
Copper PM2.5LC	58	57	0.00399	0.004	0.00164	0.0134	0.0128	0.0119
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	46	46	0.279	0.279		0.679	0.631	0.575
Elemnetal Carbon PM2.5LC	17	16	0.473	0.48	0.24	1.25	0.78	0.708
Europium PM2.5LC	9	1	0.000156	0.00229	0.0048	0.0014	0	0
Gallium PM2.5LC	9	0	0	0.00108	0.00216	0	0	0
Gold PM2.5LC	9	1	0.000286	0.00252	0.00466	0.00257	0	0
Hafnium PM2.5LC	9	0	0	0.00217	0.00434	0	0	0
Indium PM2.5LC	58	9	0.00172	0.00967	0.0187	0.0316	0.0187	0.0175
Iridium PM2.5LC	9	1	0.000363	0.00326	0.00606	0.00327	0	0

Grand Rapids (260810020) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Iron PM2.5LC	58	58	0.0608	0.0608	0.00167	0.438	0.181	0.15
Lanthanium PM2.5LC	9	1	0.000103	0.00365	0.00796	0.00093	0	0
Lead PM2.5LC	58	38	0.00171	0.00236	0.00379	0.0065	0.00582	0.00527
Magnesium PM2.5LC	58	16	0.00182	0.0065	0.0127	0.0261	0.0118	0.0098
Manganese PM2.5LC	58	49	0.0026	0.00274	0.00181	0.0289	0.0106	0.0102
Mercury PM2.5LC	9	1	0.000247	0.00377	0.00809	0.00222	0	0
Molybdenum PM2.5LC	9	0	0	0.00382	0.00764	0	0	0
Nickel PM2.5LC	58	31	0.00107	0.00137	0.00126	0.0321	0.00728	0.00415
Niobium PM2.5LC	9	0	0	0.00216	0.00431	0	0	0
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	46	46	1.96	1.96		4.92	4.87	4.15
Organic Carbon Peak1 PM2.5LC	17	17	0.933	0.933	0.24	2.37	1.51	1.49
Organic Carbon Peak2 PM2.5LC	17	17	0.991	0.991	0.24	1.56	1.55	1.46
Organic Carbon Peak3 PM2.5LC	17	17	0.55	0.55	0.24	1.11	0.811	0.809
Organic Carbon Peak4 PM2.5LC	17	17	0.803	0.803	0.24	2.4	1.83	1.65
Organic Carbon PM2.5LC	17	17	3.31	3.31	0.24	7.43	5.63	5.21
Organic Carbon Pyrolytic PM2.5LC	17	4	0.0328	0.125	0.24	0.386	0.114	0.0447
Phosphorus PM2.5LC	58	0	0	0.00595	0.0119	0	0	0
Potassium Ion PM2.5LC	58	36	0.0472	0.0501	0.0166	0.172	0.155	0.149
Potassium PM2.5LC	58	58	0.0462	0.0462	0.00627	0.169	0.157	0.138
Rubidium PM2.5LC	58	10	0.0000816	0.000841	0.00181	0.00149	0.00082	0.00082
Samarium PM2.5LC	9	1	0.0000133	0.0021	0.00469	0.00012	0	0
Scandium PM2.5LC	9	0	0	0.0157	0.0314	0	0	0
Selenium PM2.5LC	58	31	0.00042	0.000858	0.00191	0.00245	0.00234	0.00187
Silicon PM2.5LC	58	55	0.0389	0.0392	0.0119	0.17	0.118	0.118
Silver PM2.5LC	58	15	0.00197	0.00703	0.0135	0.0187	0.0128	0.0128
Sodium Ion PM2.5LC	58	55	0.0765	0.0773	0.0251	0.248	0.229	0.221
Sodium PM2.5LC	58	38	0.0215	0.0288	0.0396	0.163	0.12	0.0642
Strantium PM2.5LC	58	17	0.000397	0.0012	0.00223	0.00631	0.00444	0.00384
Sulfate PM2.5LC	58	58	2.1	2.1	0.00852	7.46	6.51	5.9
Sulfur PM2.5LC	58	58	0.723	0.723	0.00829	2.68	2.38	1.93
Tantalum PM2.5LC	9	1	0.000493	0.00417	0.00844	0.00444	0	0
Terbium PM2.5LC	9	0	0	0.00189	0.00378	0	0	0
Tin PM2.5LC	58	11	0.00201	0.0122	0.0258	0.0222	0.0222	0.0151
Titatium PM2.5LC	58	24	0.00118	0.00259	0.00473	0.0113	0.00769	0.00492
Total Nitrate PM2.5LC	58	58	2.36	2.36	0.00966	14.4	12.6	8.93
Tungsten PM2.5LC	9	0	0	0.00311	0.00621	0	0	0
Vanadium PM2.5LC	58	16	0.000269	0.00145	0.00327	0.00326	0.00233	0.00199
Yttrium PM2.5LC	9	2	0.0000389	0.00106	0.00267	0.00023	0.00012	0
Zinc PM2.5LC	58	56	0.00998	0.01	0.00275	0.051	0.0254	0.0248
Zirconium PM2.5LC	58	8	0.000944	0.00255	0.00414	0.0163	0.0129	0.00583

Houghton Lake (261130001) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Aluminum PM2.5LC	54	36	0.0092	0.0115	0.0145	0.0367	0.0357	0.0337
Ammonium Ion PM2.5LC	55	55	0.89	0.89	0.0185	6.06	3.62	2.29
Antimony PM2.5LC	54	20	0.00421	0.0158	0.0355	0.042	0.0233	0.0221
Arsenic PM2.5LC	54	20	0.000319	0.000753	0.00142	0.00351	0.00304	0.00222
Barium PM2.5LC	54	6	0.000264	0.00584	0.0159	0.00467	0.00269	0.00222
Bromine PM2.5LC	54	46	0.00198	0.00209	0.0015	0.00499	0.00489	0.00486
Cadmium PM2.5LC	54	16	0.00278	0.00858	0.0158	0.0233	0.0175	0.0147
Calcium PM2.5LC	54	50	0.014	0.0142	0.00644	0.0608	0.0524	0.047
Cerium PM2.5LC	54	7	0.0000754	0.00379	0.0172	0.00093	0.00093	0.0007
Cesium PM2.5 LC	54	13	0.000722	0.00716	0.0207	0.00478	0.00466	0.0042
Chlorine PM2.5LC	54	27	0.00376	0.0057	0.00747	0.0532	0.0302	0.0273
Chromium PM2.5LC	54	30	0.000669	0.00119	0.00232	0.00689	0.00441	0.00173
Cobalt PM2.5LC	54	21	0.000159	0.000584	0.00134	0.00096	0.0007	0.0007
Copper PM2.5LC	54	28	0.000401	0.000791	0.00173	0.00331	0.00315	0.0021
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	37	37	0.0752	0.0752		0.263	0.26	0.155
Elemnetal Carbon PM2.5LC	16	15	0.186	0.193	0.24	0.465	0.306	0.246
Europium PM2.5LC	9	1	0.000299	0.00279	0.00621	0.00269	0	0
Gallium PM2.5LC	9	2	0.0000644	0.000778	0.00249	0.00047	0.00011	0
Gold PM2.5LC	9	1	0.0000911	0.0024	0.00481	0.00082	0	0
Hafnium PM2.5LC	9	2	0.0000789	0.00218	0.00557	0.00047	0.00024	0
Indium PM2.5LC	54	18	0.00273	0.00819	0.017	0.0291	0.0171	0.014
Iridium PM2.5LC	9	1	0.000169	0.00258	0.00569	0.00152	0	0
Iron PM2.5LC	54	54	0.0162	0.0162	0.00187	0.045	0.0424	0.0383
Lanthanium PM2.5LC	9	1	0.000169	0.0072	0.0218	0.00152	0	0
Lead PM2.5LC	54	21	0.000682	0.00174	0.00363	0.00467	0.0042	0.00385
Magnesium PM2.5LC	54	8	0.000936	0.00679	0.0135	0.014	0.0101	0.0084
Manganese PM2.5LC	54	30	0.000621	0.00103	0.00193	0.0028	0.00235	0.00217
Mercury PM2.5LC	9	2	0.000194	0.00296	0.00697	0.0014	0.00035	0
Molybdenum PM2.5LC	9	0	0	0.00322	0.00643	0	0	0
Nickel PM2.5LC	54	28	0.000344	0.000674	0.00134	0.00222	0.0022	0.00191
Niobium PM2.5LC	9	3	0.00102	0.00228	0.00426	0.00549	0.0028	0.00093
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	37	37	1.2	1.2		2.98	2.67	2.16
Organic Carbon Peak1 PM2.5LC	16	16	0.448	0.448	0.24	0.963	0.592	0.583
Organic Carbon Peak2 PM2.5LC	16	16	0.874	0.874	0.24	2.83	1.16	1.07
Organic Carbon Peak3 PM2.5LC	16	16	0.485	0.485	0.24	1.52	0.729	0.543
Organic Carbon Peak4 PM2.5LC	16	16	0.456	0.456	0.24	1.13	1.07	1
Organic Carbon PM2.5LC	16	16	2.27	2.27	0.24	6	3.58	2.69
Organic Carbon Pyrolytic PM2.5LC	16	3	0.00564	0.103	0.24	0.0627	0.0242	0.00331
Phosphorus PM2.5LC	54	3	0.000125	0.00614	0.0123	0.00478	0.00117	0.00082
Potassium Ion PM2.5LC	55	27	0.0284	0.0322	0.0161	0.15	0.136	0.129
Potassium PM2.5LC	54	54	0.0319	0.0319	0.0067	0.0878	0.0855	0.0811

Houghton Lake (261130001) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Rubidium PM2.5LC	54	14	0.000182	0.000913	0.0019	0.00373	0.00105	0.00101
Samarium PM2.5LC	9	1	0.000103	0.00251	0.00591	0.00093	0	0
Scandium PM2.5LC	9	2	0.000272	0.0105	0.0211	0.0021	0.00035	0
Selenium PM2.5LC	54	26	0.000309	0.000769	0.00186	0.00234	0.00147	0.00141
Silicon PM2.5LC	54	45	0.0246	0.0257	0.0114	0.0986	0.0898	0.0814
Silver PM2.5LC	54	13	0.00164	0.00637	0.0127	0.012	0.0105	0.0105
Sodium Ion PM2.5LC	55	51	0.0752	0.0763	0.0259	0.216	0.215	0.214
Sodium PM2.5LC	54	31	0.0282	0.0367	0.0385	0.283	0.163	0.0949
Strantium PM2.5LC	54	13	0.000171	0.00103	0.00229	0.00199	0.00128	0.00105
Sulfate PM2.5LC	55	55	1.79	1.79	0.00845	6	5.41	3.94
Sulfur PM2.5LC	54	54	0.599	0.599	0.00831	2.09	1.81	1.69
Tantalum PM2.5LC	9	1	0.000272	0.00352	0.00741	0.00245	0	0
Terbium PM2.5LC	9	0	0	0.00264	0.00529	0	0	0
Tin PM2.5LC	54	15	0.00375	0.0122	0.0227	0.0455	0.0279	0.0175
Titatium PM2.5LC	54	14	0.000676	0.00248	0.00482	0.0237	0.00455	0.00222
Total Nitrate PM2.5LC	55	55	1.29	1.29	0.00954	12.5	8.57	6.46
Tungsten PM2.5LC	9	0	0	0.00292	0.00584	0	0	0
Vanadium PM2.5LC	54	15	0.000282	0.0015	0.00327	0.00327	0.00152	0.00128
Yttrium PM2.5LC	9	3	0.000519	0.00136	0.00281	0.00199	0.00198	0.0007
Zinc PM2.5LC	54	51	0.00368	0.00376	0.00241	0.016	0.0116	0.0102
Zirconium PM2.5LC	54	7	0.000579	0.00217	0.00367	0.0187	0.0035	0.00349

Luna Pier (261150005) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Aluminum PM2.5LC	60	42	0.0271	0.0293	0.0149	0.42	0.104	0.0993
Ammonium Ion PM2.5LC	60	60	1.46	1.46	0.0188	5.6	4.26	4.15
Antimony PM2.5LC	60	16	0.00612	0.0199	0.0374	0.0931	0.0849	0.0303
Arsenic PM2.5LC	60	27	0.000554	0.000962	0.00147	0.00279	0.00256	0.00245
Barium PM2.5LC	60	5	0.00026	0.00539	0.0127	0.00886	0.00442	0.00163
Bromine PM2.5LC	60	54	0.00245	0.00251	0.00154	0.00781	0.00583	0.00547
Cadmium PM2.5LC	60	11	0.00105	0.00789	0.0165	0.0105	0.00932	0.00828
Calcium PM2.5LC	60	58	0.0279	0.028	0.00608	0.121	0.0831	0.0796
Cerium PM2.5LC	60	4	0.000064	0.0038	0.0119	0.00151	0.00128	0.00082
Cesium PM2.5 LC	60	14	0.000762	0.00889	0.0225	0.00654	0.00653	0.00466
Chlorine PM2.5LC	60	48	0.0117	0.0125	0.00673	0.115	0.0732	0.0523
Chromium PM2.5LC	60	33	0.00173	0.00225	0.00228	0.0187	0.0151	0.0146
Cobalt PM2.5LC	60	24	0.000252	0.000643	0.00127	0.00138	0.00132	0.00127
Copper PM2.5LC	60	50	0.0018	0.00193	0.00166	0.0103	0.00934	0.00823
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	44	44	0.281	0.281		0.802	0.727	0.693
Elemnetal Carbon PM2.5LC	18	18	0.432	0.432	0.24	0.891	0.858	0.811
Europium PM2.5LC	9	3	0.00034	0.00195	0.00483	0.00175	0.00116	0.00012
Gallium PM2.5LC	9	0	0	0.000992	0.00198	0	0	0

Luna Pier (261150005) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Gold PM2.5LC	9	0	0	0.00212	0.00423	0	0	0
Hafnium PM2.5LC	9	0	0	0.00228	0.00457	0	0	0
Indium PM2.5LC	60	11	0.00232	0.00976	0.0184	0.028	0.028	0.0154
Iridium PM2.5LC	9	0	0	0.00277	0.00553	0	0	0
Iron PM2.5LC	60	60	0.046	0.046	0.00173	0.204	0.176	0.131
Lanthanium PM2.5LC	9	1	0.000727	0.0043	0.00801	0.00654	0	0
Lead PM2.5LC	60	37	0.00228	0.00298	0.00383	0.0269	0.01	0.00897
Magnesium PM2.5LC	60	16	0.00228	0.00685	0.0129	0.0262	0.0218	0.0183
Manganese PM2.5LC	60	42	0.00108	0.00136	0.00185	0.00526	0.00398	0.00337
Mercury PM2.5LC	9	2	0.000853	0.00353	0.00743	0.00756	0.00012	0
Molybdenum PM2.5LC	9	0	0	0.00348	0.00697	0	0	0
Nickel PM2.5LC	60	38	0.000801	0.00105	0.00128	0.00784	0.00393	0.00374
Niobium PM2.5LC	9	0	0	0.00205	0.0041	0	0	0
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	44	44	2	2		6.16	6.06	4.64
Organic Carbon Peak1 PM2.5LC	18	18	0.761	0.761	0.24	2.25	1.63	1.49
Organic Carbon Peak2 PM2.5LC	18	18	0.879	0.879	0.24	1.74	1.57	1.47
Organic Carbon Peak3 PM2.5LC	18	18	0.514	0.514	0.24	1.19	1.12	0.613
Organic Carbon Peak4 PM2.5LC	18	18	0.682	0.682	0.24	2.08	1.71	1.49
Organic Carbon PM2.5LC	18	18	2.85	2.85	0.24	6.89	5.84	5.81
Organic Carbon Pyrolytic PM2.5LC	18	2	0.0127	0.119	0.24	0.226	0.00179	0
Phosphorus PM2.5LC	60	1	0.00007	0.00587	0.0117	0.0042	0	0
Potassium Ion PM2.5LC	60	34	0.0458	0.0491	0.0165	0.183	0.18	0.165
Potassium PM2.5LC	60	60	0.0423	0.0423	0.00626	0.136	0.128	0.104
Rubidium PM2.5LC	60	12	0.00011	0.000844	0.00184	0.00108	0.00107	0.00099
Samarium PM2.5LC	9	0	0	0.00237	0.00474	0	0	0
Scandium PM2.5LC	9	0	0	0.0143	0.0287	0	0	0
Selenium PM2.5LC	60	37	0.0015	0.00185	0.00192	0.0261	0.0123	0.00465
Silicon PM2.5LC	60	58	0.0419	0.0421	0.0117	0.14	0.134	0.121
Silver PM2.5LC	60	11	0.00131	0.00677	0.0134	0.0175	0.0135	0.0126
Sodium Ion PM2.5LC	60	57	0.0791	0.0797	0.0253	0.336	0.235	0.219
Sodium PM2.5LC	60	43	0.036	0.0417	0.0394	0.223	0.159	0.149
Strantium PM2.5LC	60	24	0.00067	0.00134	0.00226	0.00967	0.00548	0.00443
Sulfate PM2.5LC	60	60	2.51	2.51	0.00853	8.42	7.05	6.5
Sulfur PM2.5LC	60	60	0.791	0.791	0.00818	2.66	2.35	2.01
Tantalum PM2.5LC	9	3	0.000843	0.00343	0.00777	0.00374	0.0035	0.00035
Terbium PM2.5LC	9	1	0.000052	0.00179	0.00387	0.00047	0	0
Tin PM2.5LC	60	23	0.00494	0.0125	0.0253	0.0421	0.0361	0.0233
Titatium PM2.5LC	60	25	0.000972	0.00236	0.00472	0.0155	0.00549	0.00443
Total Nitrate PM2.5LC	60	60	2.09	2.09	0.00931	12.1	8.7	8.17
Tungsten PM2.5LC	9	1	0.000182	0.00261	0.00567	0.00164	0	0
Vanadium PM2.5LC	60	17	0.000339	0.0015	0.00324	0.00407	0.00397	0.00233
Yttrium PM2.5LC	9	0	0	0.0013	0.0026	0	0	0
Zinc PM2.5LC	60	58	0.00749	0.00754	0.0027	0.0319	0.0227	0.0222

Luna Pier (261150005) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Zirconium PM2.5LC	60	2	0.000217	0.0022	0.00412	0.0128	0.00024	0

Port Huron, Nat'l Guard Arm (261470005) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Aluminum PM2.5LC	60	46	0.0239	0.0255	0.0146	0.142	0.094	0.0719
Ammonium Ion PM2.5LC	60	60	1.29	1.29	0.0188	5.65	4.06	4.05
Antimony PM2.5LC	60	15	0.00433	0.0189	0.0382	0.0642	0.0373	0.0291
Arsenic PM2.5LC	60	32	0.000689	0.00102	0.00143	0.00594	0.00443	0.00303
Barium PM2.5LC	60	1	0.000023	0.0055	0.0119	0.0014	0	0
Bromine PM2.5LC	60	54	0.00295	0.00303	0.00155	0.0077	0.00734	0.00687
Cadmium PM2.5LC	60	12	0.00123	0.00816	0.0168	0.0128	0.00932	0.00932
Calcium PM2.5LC	60	60	0.0393	0.0393	0.00607	0.273	0.202	0.167
Cerium PM2.5LC	60	4	0.000066	0.00448	0.0106	0.00186	0.00105	0.00058
Cesium PM2.5 LC	60	17	0.00116	0.00798	0.0223	0.0124	0.00852	0.00851
Chlorine PM2.5LC	60	47	0.0233	0.0241	0.00661	0.376	0.238	0.0796
Chromium PM2.5LC	60	33	0.000885	0.0014	0.00231	0.0162	0.0035	0.00217
Cobalt PM2.5LC	60	31	0.000322	0.000633	0.00125	0.00157	0.0012	0.00114
Copper PM2.5LC	60	46	0.0017	0.00191	0.00162	0.00793	0.00571	0.00569
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	46	46	0.181	0.181		0.453	0.386	0.36
Elemnetal Carbon PM2.5LC	17	16	0.46	0.468	0.24	2.25	0.825	0.562
Europium PM2.5LC	9	2	0.000233	0.00211	0.0048	0.00105	0.00105	0
Gallium PM2.5LC	9	1	0.000016	0.000954	0.00198	0.00014	0	0
Gold PM2.5LC	9	2	0.000208	0.00192	0.00423	0.0014	0.00047	0
Hafnium PM2.5LC	9	1	0.000441	0.0024	0.00457	0.00397	0	0
Indium PM2.5LC	60	17	0.0029	0.00963	0.0186	0.0256	0.021	0.0198
Iridium PM2.5LC	9	0	0	0.00277	0.00553	0	0	0
Iron PM2.5LC	60	60	0.04	0.04	0.00168	0.154	0.145	0.0984
Lanthanium PM2.5LC	9	0	0	0.004	0.008	0	0	0
Lead PM2.5LC	60	38	0.00265	0.00338	0.00379	0.029	0.0147	0.00862
Magnesium PM2.5LC	60	18	0.00611	0.0106	0.0126	0.164	0.0348	0.0314
Manganese PM2.5LC	60	35	0.000953	0.00134	0.00184	0.0123	0.00709	0.00351
Mercury PM2.5LC	9	1	0.000543	0.00374	0.00743	0.00489	0	0
Molybdenum PM2.5LC	9	0	0	0.00348	0.00697	0	0	0
Nickel PM2.5LC	60	50	0.00114	0.00125	0.00125	0.0042	0.00412	0.0041
Niobium PM2.5LC	9	2	0.000441	0.00206	0.00407	0.00385	0.00012	0
Oc Csn_Rev Unadjusted	46	46	1.87	1.87		4.95	4.42	3.35

Port Huron, Nat'l Guard Arm (261470005) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Pm2.5 Lc Tot								
Organic Carbon Peak1 PM2.5LC	17	17	0.804	0.804	0.24	2.23	1.75	0.971
Organic Carbon Peak2 PM2.5LC	17	17	0.854	0.854	0.24	1.39	1.21	1.13
Organic Carbon Peak3 PM2.5LC	17	17	0.535	0.535	0.24	1.13	0.791	0.781
Organic Carbon Peak4 PM2.5LC	17	17	0.84	0.84	0.24	2.43	1.75	1.17
Organic Carbon PM2.5LC	17	17	3.07	3.07	0.24	7.17	4.79	4.76
Organic Carbon Pyrolytic PM2.5LC	17	3	0.0318	0.131	0.24	0.531	0.00768	0.00173
Phosphorus PM2.5LC	60	3	0.000534	0.00627	0.012	0.0167	0.0132	0.00211
Potassium Ion PM2.5LC	60	35	0.0455	0.0487	0.0163	0.202	0.179	0.151
Potassium PM2.5LC	60	60	0.0456	0.0456	0.00613	0.201	0.124	0.121
Rubidium PM2.5LC	60	8	0.000056	0.000853	0.00185	0.00085	0.00082	0.00055
Samarium PM2.5LC	9	2	0.000194	0.00205	0.00473	0.00128	0.00047	0
Scandium PM2.5LC	9	0	0	0.0143	0.0287	0	0	0
Selenium PM2.5LC	60	36	0.000713	0.00109	0.00187	0.00466	0.0035	0.0028
Silicon PM2.5LC	60	59	0.0528	0.053	0.0115	0.543	0.194	0.193
Silver PM2.5LC	60	11	0.000856	0.00648	0.0136	0.00942	0.00933	0.00815
Sodium Ion PM2.5LC	60	55	0.0906	0.0917	0.0256	0.357	0.292	0.26
Sodium PM2.5LC	60	43	0.0379	0.0438	0.0387	0.227	0.135	0.131
Strantium PM2.5LC	60	15	0.00021	0.00106	0.00226	0.0028	0.00268	0.00175
Sulfate PM2.5LC	60	60	2.38	2.38	0.0083	7.23	6.78	6.13
Sulfur PM2.5LC	60	60	0.802	0.802	0.00827	2.34	2.25	2.18
Tantalum PM2.5LC	9	0	0	0.00388	0.00777	0	0	0
Terbium PM2.5LC	9	0	0	0.00193	0.00387	0	0	0
Tin PM2.5LC	60	11	0.00207	0.0126	0.0255	0.0198	0.0198	0.0175
Titatium PM2.5LC	60	26	0.000875	0.0022	0.00474	0.00454	0.00421	0.00384
Total Nitrate PM2.5LC	60	60	1.93	1.93	0.0101	14.1	9.05	8.35
Tungsten PM2.5LC	9	0	0	0.00283	0.00567	0	0	0
Vanadium PM2.5LC	60	25	0.00153	0.00248	0.00327	0.0172	0.00886	0.00852
Yttrium PM2.5LC	9	3	0.000233	0.0011	0.0026	0.00105	0.00082	0.00023
Zinc PM2.5LC	60	57	0.0216	0.0217	0.0027	0.144	0.141	0.0671
Zirconium PM2.5LC	60	3	0.000266	0.00223	0.00414	0.0105	0.0035	0.00198

Tecumseh (260910007) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Aluminum PM2.5LC	58	44	0.0215	0.0232	0.0145	0.11	0.0974	0.0809
Ammonium Ion PM2.5LC	58	58	1.3	1.3	0.0194	5.3	5.13	3.41
Antimony PM2.5LC	58	20	0.00877	0.0209	0.0369	0.0909	0.0829	0.0572
Arsenic PM2.5LC	58	21	0.000383	0.000873	0.00149	0.00373	0.00242	0.00222

Tecumseh (260910007) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Barium PM2.5LC	58	7	0.000294	0.00527	0.0145	0.00584	0.00504	0.00315
Bromine PM2.5LC	58	52	0.00253	0.0026	0.00157	0.0106	0.00725	0.00514
Cadmium PM2.5LC	58	14	0.00257	0.00909	0.0164	0.0337	0.0198	0.0128
Calcium PM2.5LC	58	57	0.0451	0.0451	0.00608	0.171	0.132	0.116
Cerium PM2.5LC	58	7	0.00005	0.00363	0.0149	0.0007	0.00058	0.00058
Cesium PM2.5 LC	58	18	0.00109	0.00787	0.0229	0.00689	0.00642	0.0056
Chlorine PM2.5LC	58	44	0.0124	0.0133	0.00694	0.25	0.0986	0.0389
Chromium PM2.5LC	58	36	0.00151	0.00192	0.00229	0.0181	0.00905	0.00643
Cobalt PM2.5LC	58	28	0.000259	0.000612	0.0013	0.00119	0.00109	0.00107
Copper PM2.5LC	58	44	0.00115	0.00134	0.00166	0.00886	0.00458	0.00348
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	42	42	0.163	0.163		0.542	0.487	0.378
Elemnetal Carbon PM2.5LC	17	16	0.289	0.297	0.24	0.867	0.84	0.522
Europium PM2.5LC	8	2	0.000378	0.0026	0.00561	0.00279	0.00023	0
Gallium PM2.5LC	8	0	0	0.0011	0.00221	0	0	0
Gold PM2.5LC	8	1	0.000118	0.00221	0.0044	0.00094	0	0
Hafnium PM2.5LC	8	2	0.000629	0.00234	0.00521	0.00374	0.00129	0
Indium PM2.5LC	58	20	0.00253	0.00869	0.0182	0.0175	0.0163	0.014
Iridium PM2.5LC	8	1	0.000073	0.0023	0.00543	0.00058	0	0
Iron PM2.5LC	58	58	0.0457	0.0457	0.00178	0.118	0.115	0.11
Lanthanium PM2.5LC	8	1	0.000528	0.00406	0.0158	0.00422	0	0
Lead PM2.5LC	58	40	0.00194	0.0025	0.00388	0.00922	0.00736	0.00687
Magnesium PM2.5LC	58	23	0.00484	0.00883	0.013	0.0486	0.0279	0.0222
Manganese PM2.5LC	58	48	0.00274	0.00291	0.0019	0.0437	0.0347	0.00977
Mercury PM2.5LC	8	0	0	0.00347	0.00694	0	0	0
Molybdenum PM2.5LC	8	1	0.00022	0.00301	0.0064	0.00176	0	0
Nickel PM2.5LC	58	32	0.000536	0.000845	0.0013	0.00622	0.00251	0.002
Niobium PM2.5LC	8	2	0.000294	0.00183	0.0041	0.00129	0.00106	0
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	42	42	1.78	1.78		4.94	3.89	3.78
Organic Carbon Peak1 PM2.5LC	17	17	0.738	0.738	0.24	2.11	1.28	1.25
Organic Carbon Peak2 PM2.5LC	17	17	0.863	0.863	0.24	1.4	1.37	1.32
Organic Carbon Peak3 PM2.5LC	17	17	0.48	0.48	0.24	1.19	0.724	0.708
Organic Carbon Peak4 PM2.5LC	17	17	0.686	0.686	0.24	2	1.25	1.21
Organic Carbon PM2.5LC	17	17	2.86	2.86	0.24	6.67	5.32	4.51
Organic Carbon Pyrolytic PM2.5LC	17	4	0.0885	0.18	0.24	1.04	0.344	0.0606
Phosphorus PM2.5LC	58	1	0.000042	0.00589	0.0118	0.00245	0	0
Potassium Ion PM2.5LC	58	35	0.0453	0.0483	0.0174	0.352	0.173	0.138
Potassium PM2.5LC	58	58	0.0543	0.0543	0.00616	0.321	0.141	0.121
Rubidium PM2.5LC	58	12	0.000137	0.000881	0.00189	0.00233	0.00105	0.00105
Samarium PM2.5LC	8	1	0.00044	0.00253	0.00544	0.00352	0	0
Scandium PM2.5LC	8	1	0.000103	0.0116	0.0234	0.00082	0	0
Selenium PM2.5LC	58	29	0.000596	0.00105	0.0019	0.00397	0.00378	0.00273
Silicon PM2.5LC	58	56	0.0695	0.0697	0.0114	0.228	0.221	0.213

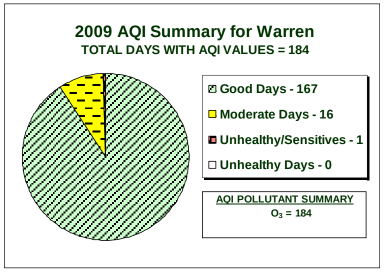
Tecumseh (260910007) Speciated PM2.5 (units= µg/m³)								
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	MAX1	MAX2	MAX3
Silver PM2.5LC	58	14	0.00192	0.00703	0.0135	0.0222	0.0125	0.0121
Sodium Ion PM2.5LC	58	53	0.0681	0.0692	0.0234	0.752	0.325	0.139
Sodium PM2.5LC	58	44	0.0366	0.0415	0.0388	0.21	0.145	0.134
Strantium PM2.5LC	58	22	0.000516	0.00123	0.00231	0.00924	0.0028	0.00198
Sulfate PM2.5LC	58	58	2.2	2.2	0.00823	8.4	5.62	5.38
Sulfur PM2.5LC	58	58	0.769	0.769	0.00808	2.95	1.99	1.79
Tantalum PM2.5LC	8	2	0.000778	0.00331	0.00731	0.00458	0.00164	0
Terbium PM2.5LC	8	0	0	0.00235	0.0047	0	0	0
Tin PM2.5LC	58	22	0.00481	0.0128	0.0247	0.0397	0.0374	0.0257
Titatium PM2.5LC	58	31	0.00148	0.00257	0.00471	0.00887	0.00713	0.00629
Total Nitrate PM2.5LC	58	58	2.1	2.1	0.0102	13.5	12.9	7.05
Tungsten PM2.5LC	8	0	0	0.00278	0.00556	0	0	0
Vanadium PM2.5LC	58	16	0.00024	0.00142	0.00321	0.00339	0.00152	0.00151
Yttrium PM2.5LC	8	2	0.000175	0.00122	0.00271	0.00117	0.00023	0
Zinc PM2.5LC	58	54	0.00675	0.00686	0.00262	0.0282	0.0279	0.0232
Zirconium PM2.5LC	58	6	0.000232	0.00191	0.00415	0.00655	0.00304	0.00163

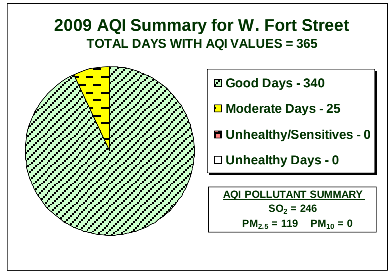
Appendix C: 2009 AQI Pie Charts

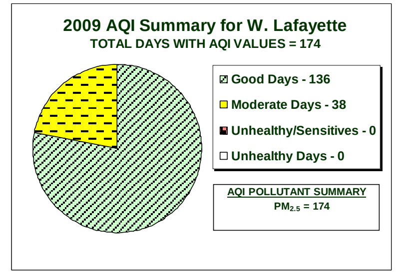
Appendix C contains pie charts that were created to show the AQI values for each of Michigan's 2009 monitoring sites and includes the total number of days measurements were taken, along with the pollutant distribution of the AQI values for those measurements. It is important to note that not all pollutants are measured at each site. In fact, some sites only obtain AQI measurements for that portion of the year corresponding to the O_3 season; therefore, the number of days for each site may not be equivalent to 365 days per year. **Figures C.1 - C.4** are grouped by CSA. **Figures C.5** and **C.6** show the remaining sites (not part of a CSA) located in Michigan's Upper and Lower Peninsula.

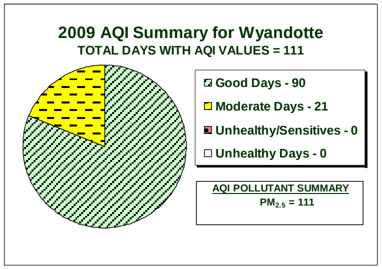
Figure C.1: AQI Summaries for Detroit-Warren-Flint CSA

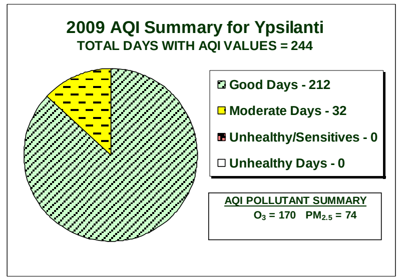
Figure C.1, continued: AQI Summaries for Detroit-Warren-Flint CSA











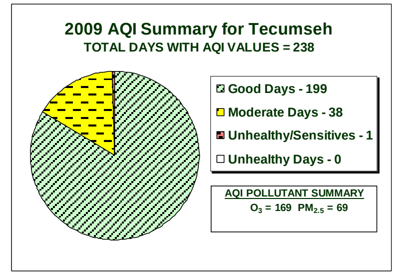
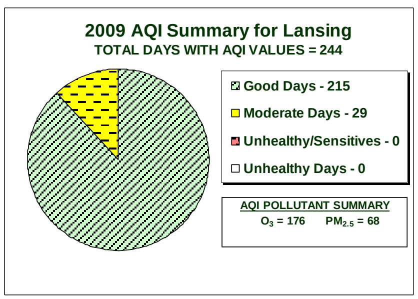


Figure C.2: AQI Summaries for Lansing-East Lansing-Owosso CSA



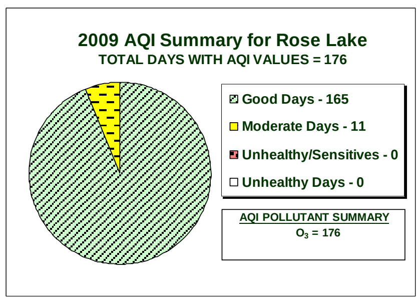


Figure C.3: AQI Summaries for Saginaw-Bay City-Saginaw Twp North CSA

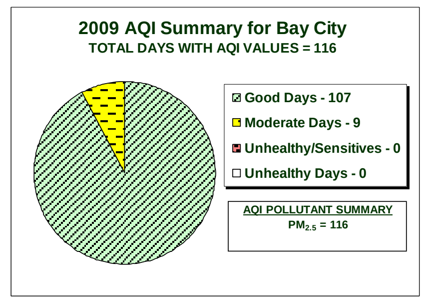
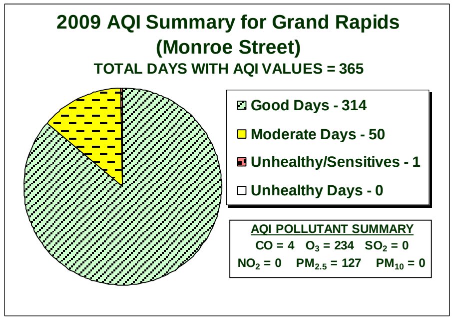
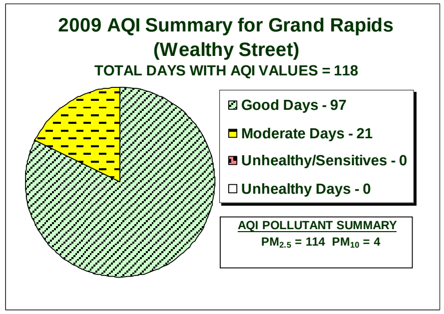
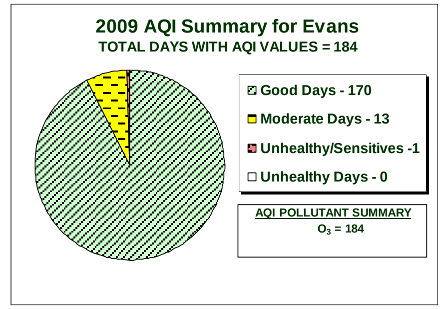
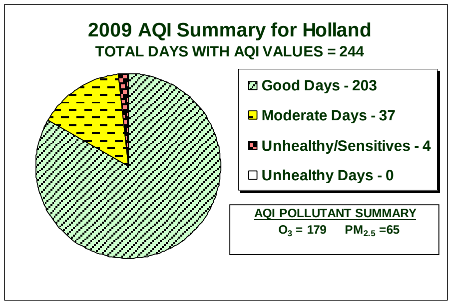


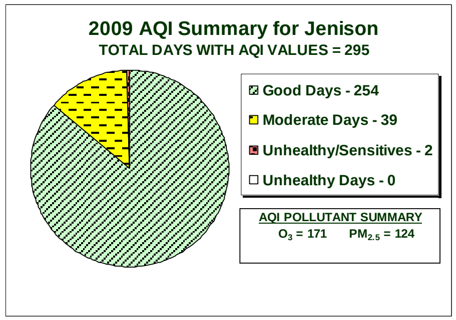
Figure C.4: AQI Summaries for Grand Rapids-Muskegon-Holland CSA

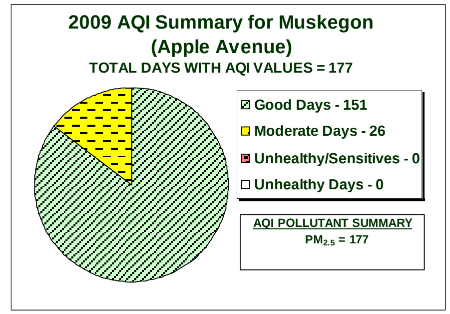












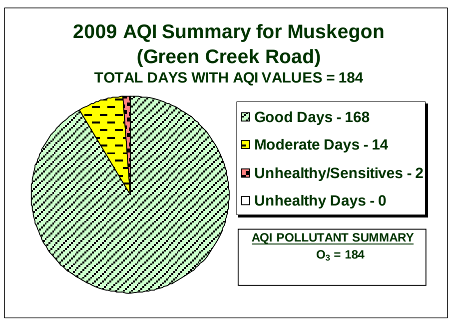


Figure C.5: AQI Summaries for Upper Peninsula

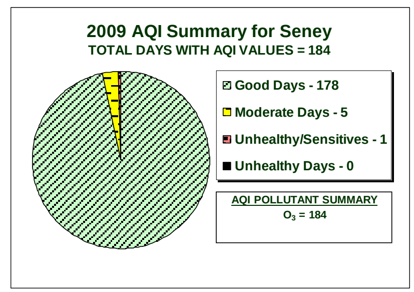
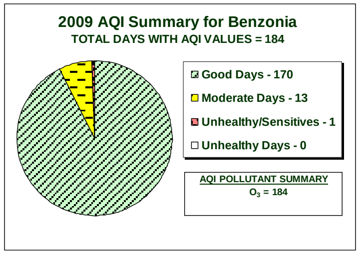
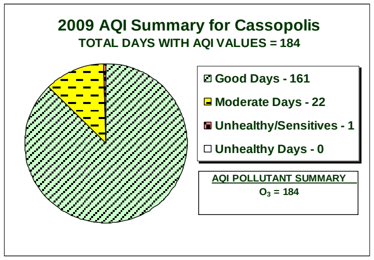
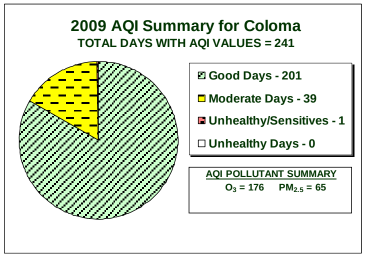
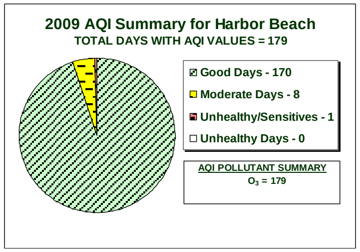


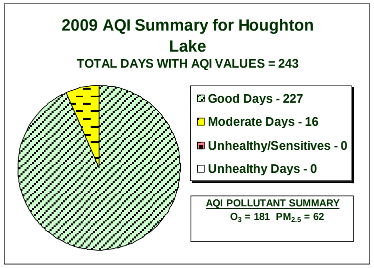
Figure C.6: AQI Summaries for Michigan’s Other Lower Peninsula Area

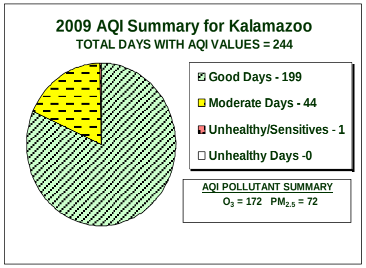


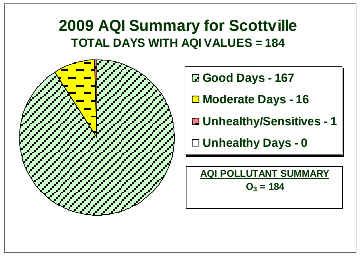


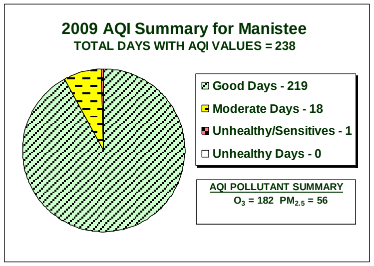












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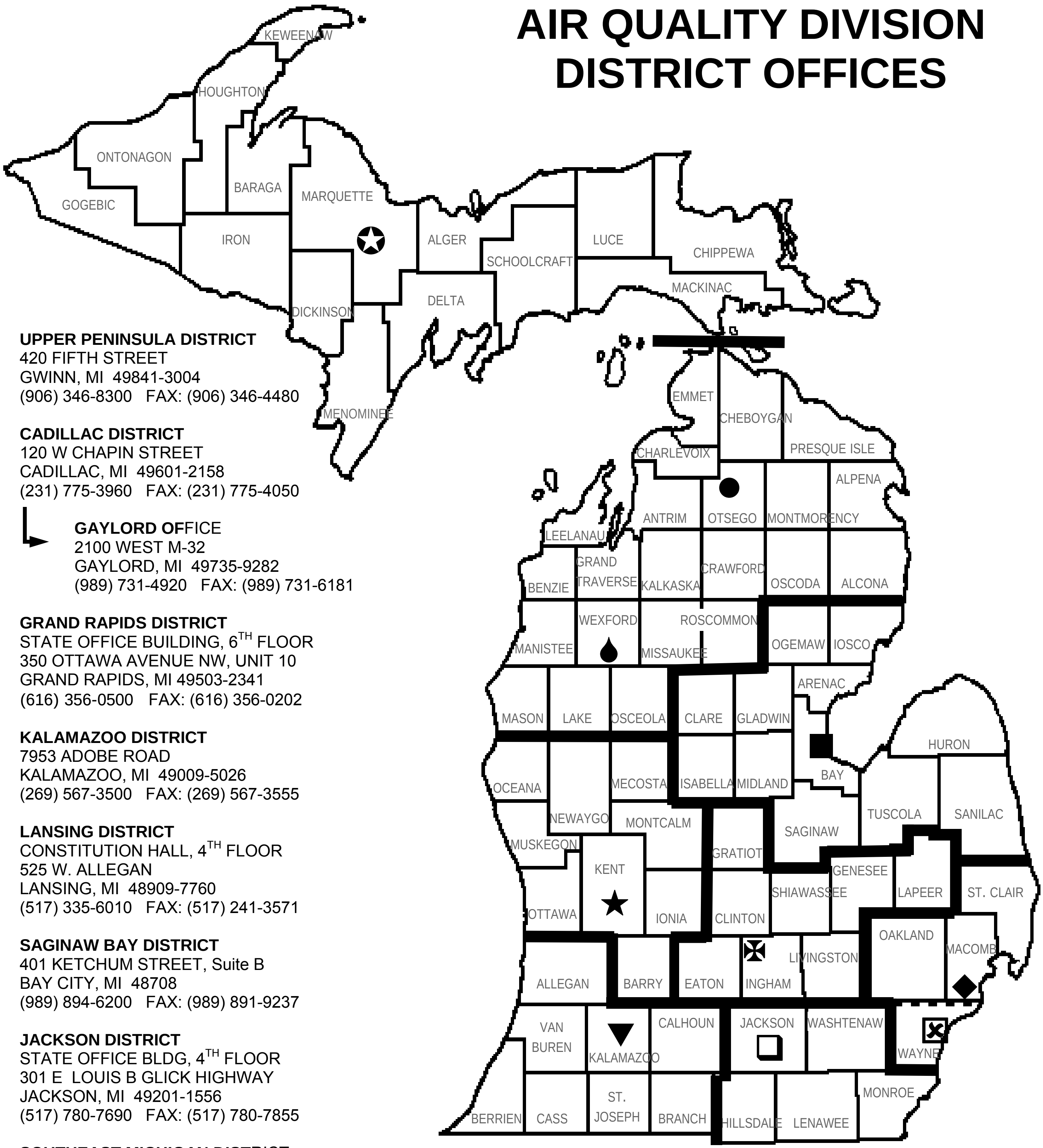
AIR QUALITY DIVISION

AIR QUALITY DIVISION DISTRICT OFFICES



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401 KETCHUM STREET, Suite B
BAY CITY, MI 48708
(989) 894-6200 FAX: (989) 891-9237

JACKSON DISTRICT
STATE OFFICE BLDG, 4TH FLOOR
301 E LOUIS B GLICK HIGHWAY
JACKSON, MI 49201-1556
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SOUTHEAST MICHIGAN DISTRICT
27700 DONALD COURT
WARREN, MI 48092-2793
(586) 753-3700 FAX: (586) 753-3731

DETROIT OFFICE
CADILLAC PLACE, SUITE 2-300
3058 WEST GRAND BLVD
DETROIT, MI 48202-6058
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[Wayne County sources]

AIR QUALITY INTERNET ADDRESS:

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