2008 Annual Air Quality Report

DEQ

Michigan Department of Environmental Quality

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The AQD also wishes to acknowledge the significant contributions of Mark Bird and William Endres of the **City of Grand Rapids, Air Pollution Control Division**, which operates and maintains air monitoring equipment in West Michigan.

Cover photo courtesy of Stephen Weis. Glen Haven, Michigan, overlooking Sleeping Bear Bay (Lake Michigan), late July 2007.

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Executive Summary

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 Michigan Department of Environmental Quality's (MDEQ's) 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), and;
- Sulfur dioxide (SO_2).

The AQD also monitors air toxics. "Air toxics" are other hazardous air pollutants that can affect human health and the environment.[1]

The purpose of this report is to provide a snapshot of Michigan's 2008:

- Air quality data,
- Air quality trends,
- Overview of the monitoring network (available in much greater detail in the 2010 Network Review),[2]
- Air toxics monitoring program, and;
- Other AQD programs, such as MIAir and Emissions Inventory.[3]

Effective December 18, 2006, the EPA amended the federal ambient air monitoring regulations and so changed the requirements of Michigan's existing monitoring network. These changes require the MDEQ to annually review its air monitoring network to ensure that objectives laid out by the EPA in 40 Code of Federal Regulation (CFR) Part 58 and elsewhere are being met. The amendments may result in increased frequency of $PM_{2.5}$ sampling and will also establish National CORE (NCore) monitoring stations, multi-pollutant in nature, beginning in 2011.

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[1] A fact sheet entitled What is an Air Contaminant/Pollutant? is available on the MDEQ's website at http://www.deq.state.mi.us/documents/deq-ead-caap-airconfs.pdf.

[2] 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."

[3] The 2008 NEI inventory will not be finalized by the EPA until late 2010 or early 2011. The EPA still hasn't released the final 2005 Comprehensive NEI inventory. The pie charts for the 2002 NEI inventory can be viewed in the 2007 Air Quality Report at http://www.michigan.gov/documents/deq/deq-aqd-air-reports-07AQReport_279111_7.pdf.

Copies of this year's network review are available on the AQD's website, at www.michigan.gov/deq/air, then select "Air Monitoring" on the left menu.

In 2007, the MDEQ's air monitoring network was reduced due to budget cuts. Federally mandated monitors were retained, such as those in nonattainment areas or areas likely to become designated as nonattainment, those required by network design specification that address general public health issues, deposition and national trends, and those that are needed to collect background data.

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 assurance of the data.

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 at the end of 2007. The concentrations are listed as parts per million (ppm), microgram per cubic meter (µg/m^3), and/or milligram per cubic meter (mg/m^3).

Table 1-1: NAAQS in Effect During 2008 for Criteria Pollutants

Criteria Pollutant	Primary (health-related)		Secondary (welfare-related)	
	Type of Average	Standard Level Concentration	Type of Average	Standard Level Concentration
CO	2nd highest 8-hour	9 ppm (10 mg/m^3)	No secondary standard	
	2nd highest 1-hour	35 ppm (40 mg/m^3)		
Pb	Maximum 3-month average	0.15 µg/m^3	Same as primary standard	
NO_2	Annual arithmetic mean	0.053 ppm (100 µg/m^3)	Same as primary standard	
O_3	4th highest 8-hour daily max. averaged over 3 yrs.	0.075 ppm (147 µg/m^3)	Same as primary standard	
PM	PM_{10} 24-hour	150 µg/m^3	Same as primary standard	
	$PM_{2.5}$ Annual arithmetic mean	15 µg/m^3	Same as primary standard	
	$PM_{2.5}$ 98th percentile 24-hr averaged over 3 yrs.	35 µg/m^3		
SO_2	Annual arithmetic mean	0.03 ppm (80 µg/m^3)	3-hour	0.5 ppm (1300 µg/m^3)
	2nd highest 24-hour	0.14 ppm (365 µg/m^3)		

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 (by calendar quarter) are averaged and do not exceed the 0.15 $\mu g/m^3$ 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 0.08 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 $\mu g/m^3$ 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 $\mu g/m^3$. The 24-hour $PM_{2.5}$ primary and secondary standards are met when the 3-year average of the 98th percentile 24-hour concentration is less than or equal to 35 $\mu g/m^3$.
SO_2	To determine compliance, the annual average concentration shall not exceed 0.03 ppm, the 24-hour 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.

Criteria pollutants cause adverse effects to individuals with compromised health conditions and can also have adverse effects to healthy individuals who regularly exercise or work outside. Information on the elements, their effects, and the types of sources that generate the criteria pollutants are discussed in **Table 1-3**.

Table 1-3: Exposure to Criteria Pollutants – Sources and Effects

Criteria Pollutant	Characteristics	Types of Source	Health & Environmental Effects	Population Most at Risk
CO	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.	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.	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 O3, which can trigger serious respiratory problems.	Those who suffer from cardiovascular (heart and respiratory) disease. 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.
Pb	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.	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.	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.	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 are 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.
SO_2	Colorless gas formed by the burning of sulfur-containing material, odorless at typical ambient concentrations, 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 $PM_{2.5}$.	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.	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.	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.

Table 1-3, Continued: Exposure to Criteria Pollutants – Sources and Effects

Criteria Pollutant	Characteristics	Types of Source	Health & Environmental Effects	Population Most at Risk
NO_2	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.	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.	Exposure to NO_2 occurs through the respiratory system, irritating the lungs. Short-term NO_2 exposures (i.e., less than 3 hours) include cough 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.	Individuals with preexisting 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.
O_3	Ground-level O_3 is created by photochemical reactions involving NO_X and VOCs in the presence of sunlight. 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.	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.	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.	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.

Table 1-3, Continued: Exposure to Criteria Pollutants – Sources and Effects

Criteria Pollutant	Characteristics	Types of Source	Health & Environmental Effects	Population Most at Risk
PM	PM 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 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.	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.	$PM_{2.5}$ 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.

FIGURE 1-1: 2008 MASN MONITORING SITES

As part of the EPA's grant to the MDEQ, the AQD provides an annual review of the MASN 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 (beginning 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 MDEQ's AQD, along with other governmental agencies. For instance, the O_3 monitor in Leelanau County (Peshawbestown) is owned and managed by the Grand Traverse Band of Ottawa and Chippewa Indians, and the Manistee County site is handled by the Little River Band of Ottawa Indians. **Figure 1-1** shows the 2008 MASN monitoring sites.

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 MDEQ's air quality reporting web page (discussed in Chapter 4). The types of monitoring conducted in 2008 and the MASN locations are shown on **Table 1-4**.

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 4). 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 Chapter 2.

Metropolitan Statistical Areas

Michigan is divided into geographical planning units called Metropolitan Statistical Areas or MSAs, Micropolitan Statistical Areas (MiSAs), and Combined Statistical Areas (CSAs). Both MSAs and MiSAs are defined in terms of whole counties. If specified criteria are met, adjacent MSAs and MiSAs, in various combinations, may become the components of complementary areas called CSAs. CSAs can be characterized as representing larger regions that reflect broader social and economic interactions, such as wholesaling, commodity distribution, and weekend recreation activities, and are likely to be of considerable interest to regional authorities and the private sector.

The EPA has usually relied upon MSA boundaries when designating nonattainment areas for air pollutants relative to NAAQS. The monitoring network assists in determining nonattainment/attainment status in these MSAs for each criteria pollutant (also discussed in Chapter 2).

The two largest CSAs are in Southeast Michigan and West Michigan. **Tables 1-5** through **1-10** show Michigan's CSAs broken down to include the MSA/MiSA and their counties:

Table 1-4: Types of Monitoring Conducted in 2008 and MASN Location

AIRS ID	SITE NAME	Trace CO	NO_2	Trace NOY	O_3	PM_{10}	$PM_{2.5}$	$PM_{2.5}$ TEOM	$PM_{2.5}$ Speciation	SO_2	Trace SO_2	VOC	Carbonyl Aldehydes / Ketone	Trace Metals	Wind Speed	Wind Direction	Temp.	Relative Humidity	Solar Radiation	Barometric Pressure
26005000	Holland				√		√								√	√	√	√	√	√
26017001	Bay City						√	√							√	√	√			
26019000	Benzonia				√															
26021001	Coloma				√		√								√	√	√			
26027000	Cassopolis				√										√	√	√			
26037000	Rose Lake				√															
26049002	Flint				√		√	√						√ #	√	√	√			√
26049200	Otisville				√										√	√	√			
26063000	Harbor Beach				√										√	√	√			
26065001	Lansing				√		√	√							√	√	√			√
26077000	Kalamazoo				√		√	√	•											
26081000	Grand Rapids – Wealthy					√														
26081002	Grand Rapids – Monroe	√		√	√	√	√	√	√		√				√	√	√			√
26081002	Evans				√										√	√	√			
26089000	Peshawbestown+				√										√	√	√			
26091000	Tecumseh				√				√						√	√	√			√
26099000	New Haven				√		√								√	√	√	√	√	
26099100	Warren				√															
26101092	Manistee ++				√		√								√	√	√		√	√
26105000	Scottville				√										√	√	√			
26113000	Houghton Lake				√		√	√	◊						√	√	√			√
26115000	Luna Pier						√		√						√	√	√			
26121003	Muskegon – Green				√										√	√	√			
26121004	Muskegon – Apple Ave						√													
26125000	Oak Park				√		√								√	√	√			
26139000	Jenison				√		√								√	√	√			
26147000	Port Huron				√		√	√	o						√	√	√			
26153000	Seney Nat'l Wildlife				√			√							√	√	√	√	√	√
26161000	Ypsilanti				√		√	√	•						√	√	√			√
26163000	Allen Park	√		√	√	√	√	√	√		√			√@	√	√	√	√		√
26163000	River Rouge												√	√@	√	√	√			

AIRS ID	SITE NAME	Trace CO	NO_2	Trace NOY	O_3	PM_{10}	$PM_{2.5}$	$PM_{2.5}$ TEOM	$PM_{2.5}$ Speciation	SO_2	Trace SO_2	VOC	Carbonyl Aldehydes / Ketone	Trace Metals	Wind Speed	Wind Direction	Temp.	Relative Humidity	Solar Radiation	Barometric Pressure
26163001	Detroit – W. Fort					√	√		o	√		√	√	√@	√	√	√	√		√
26163001	Detroit – Linwood						√													
26163001	Detroit – E. Seven Mile		√		√		√								√	√	√	√		√
26163002	Livonia						√								√	√	√	√		√
26163002	Detroit – W. Jefferson													√@						
26163003	Dearborn					√	√	√	√			√	√	√	√	√	√	√		√
26163003	Wyandotte						√													
26163003	Detroit – Newberry						√	√							√	√	√			
26163003	Detroit – W. Lafayette						√	√							√	√	√			

√ Data collected
\# Mn only, as of 4/1/2007
\+ Operated by Grand Traverse Band of Ottawa & Chippewa Indians

• Stopped spring 2008
◊ Contingent upon funding
++ Operated by the Little River Band of Ottawa Indians

@ Mn,As,Cd and Ni,as of 4/1/2007
o Began spring 2008

Table 1-5: Detroit-Warren-Flint CSA

Ann Arbor MSA Washtenaw Co.	Detroit-Warren-Livonia MSA Lapeer, Livingston, Macomb, Oakland, St. Clair, & Wayne Co.	Flint MSA Genesee Co.	Monroe MSA Monroe Co.

Table 1-6: Grand Rapids-Muskegon-Holland CSA

Grand Rapids-Wyoming MSA Kent, Barry, Ionia, & Newaygo Co.	Muskegon-Norton Shores MSA Muskegon Co.	Holland-Grand Haven MSA Ottawa Co.	Allegan MiSA Allegan Co.

Table 1-7: Lansing-East Lansing-Owosso CSA

Lansing-East Lansing MSA Clinton, Eaton, & Ingham Co.	Owosso MiSA Shiawassee Co.

Table 1-8: Saginaw-Bay City-Saginaw Twp. North CSA

Bay City MSA Bay Co.	Saginaw-Saginaw Twp. North MSA Saginaw Co.

Those MSAs and MiSAs that are not part of any CSA are shown in **Tables 1-9** and **1-10**:

Table 1-9: Additional Michigan MSAs

Battle Creek MSA Calhoun Co.	Jackson MSA Jackson Co.	Kalamazoo-Portage MSA Kalamazoo & Van Buren Co.	Niles-Benton Harbor MSA Berrien Co.	South Bend-Mishawaka (IN-MI) MSA Cass Co. (MI)

Table 1-10: Other Michigan MiSAs

Alma MiSA Gratiot Co.	Alpena MiSA Alpena Co.	Big Rapids MiSA Mecosta Co.	Cadillac MiSA Missaukee & Wexford Co.	Coldwater MiSA Branch Co.
Escanaba MiSA Delta Co.	Houghton MiSA Houghton & Keweenaw Co.	Iron Mountain (MI-WI) MiSA Dickinson Co. (MI)	Marinette WI-MI MiSA Menominee Co. (MI)	Marquette MiSA Marquette Co.
Midland MiSA Midland Co.	Mount Pleasant MiSA Isabella Co.	Sault Ste. Marie MiSA Chippewa Co.	Sturgis MiSA St. Joseph Co.	Traverse City MiSA Benzie, Grand Traverse, Kalkaska, & Leelanau Co.

Chapter 2: Criteria Pollutants Monitored in Michigan

This Chapter provides information on each of the six criteria pollutants (subsections 2.1 through 2.6) and includes:

- Michigan's monitoring requirements for 2008,
- Attainment/nonattainment status,
- Monitoring site locations (tables show all the monitors active in 2008),
- Air quality trends from 2003-2008 broken down by location (only sites that have one complete year of data will be included in the trend figures).[4]

The actual 2008 data for each criteria pollutant is available in **Appendix A**.

2.1 CARBON MONOXIDE (CO)

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 2.1-1 provides the maximum second highest 1-hour CO level trends for Michigan from 2003-2008, which demonstrates that there have not been any exceedances of the 1-hour CO NAAQS.

Figure 2.1-1: CO Levels in MI from 2003-2008 (2nd Highest 1-Hr Maximum Values)

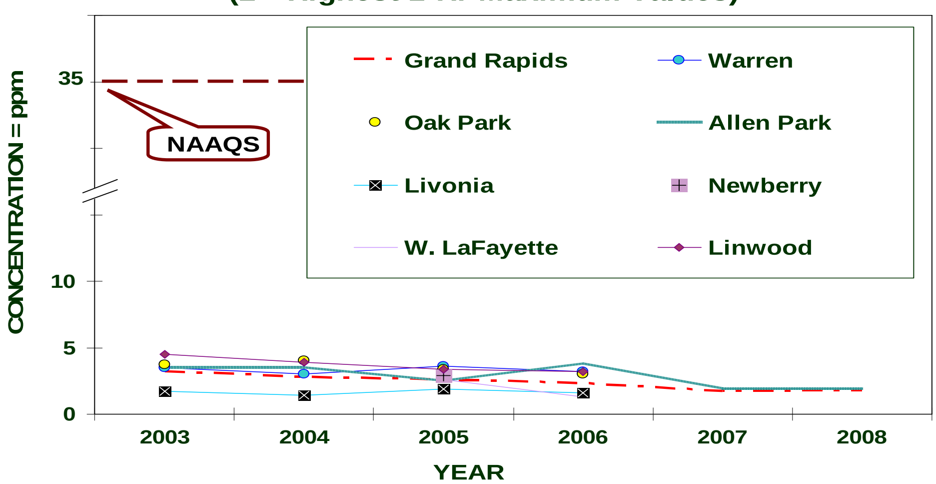

Figure 2.1-2 provides the second highest 8-hour CO maximum values for Michigan from 2003-2008. CO values continue to remain well below the standard and Michigan did not experience any exceedances of the NAAQS.

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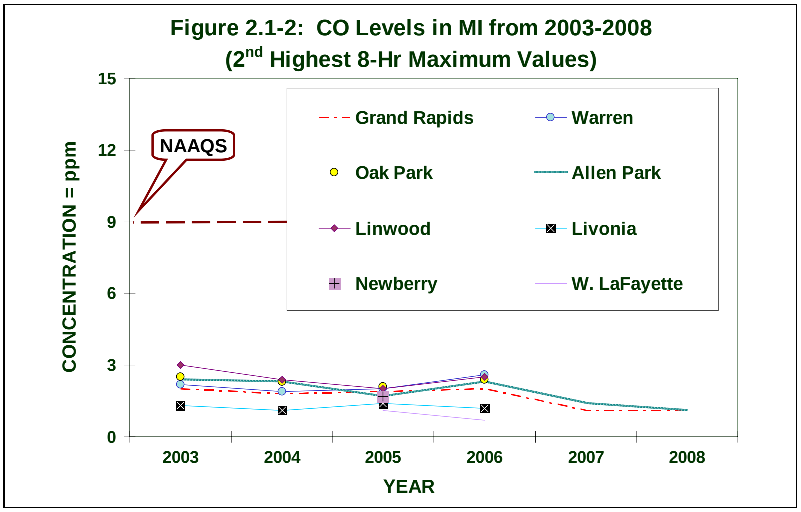
[4] The air quality trends are based on actual statewide monitored readings, which are also listed in EPA's Air Quality Subsystem Quick Look Report Data.

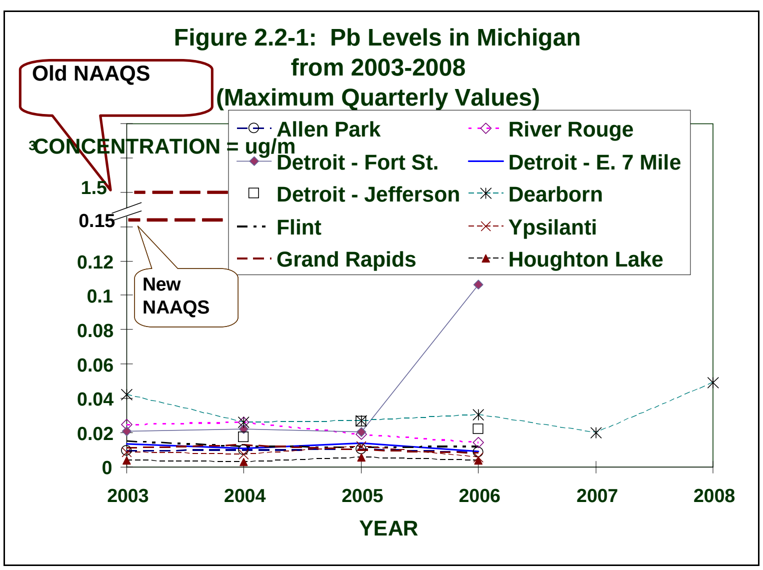


2.2 Lead (Pb)

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 to 0.15 µg/m^3 as a 3-month rolling average. 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 will begin 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 2.2-1 provides the maximum Quarterly Pb level values.



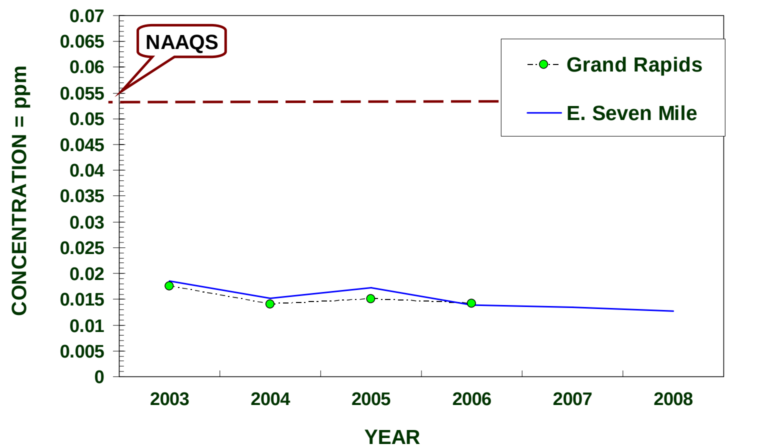
2.3 Nitrogen Dioxide (NO_2)

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.

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. For 2008, **Figure 1-4** shows that there are three NO_2 monitors in operation. 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.)

There has never been an exceedance of the NO_2 standard in Michigan. As shown in **Figure 2.3-1**, all monitoring sites have had an annual NO_2 concentration at less than half of the 0.053 ppm NAAQS.

Figure 2.3-1: NO_2 Levels in MI from 2003-2008 (Annual Arithmetic Mean)



2.4 Ozone (O_3)

In the Earth's lower atmosphere (also known as the troposphere - the layer of the atmosphere nearest the Earth's surface), ground level ozone is an air pollutant. Ozone is created by photochemical reactions involving nitrogen oxides (NOx) and volatile organic compounds (VOCs) or hydrocarbons in the presence of sunlight. These reactions usually occur during the hot summer months as ultraviolet radiation from the sun initiates a sequence of photochemical reactions. 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.

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 0.075 ppm.

Nonattainment designations are assigned to areas that violate the NAAQS, or contribute to violations in a nearby area. The EPA plans to make attainment and nonattainment designations for this standard no later than March 12, 2010.

The 1997 ozone NAAQS is 0.08 ppm. To attain this 1997 standard, the 3-year average of the 4th highest daily maximum 8-hour average concentration within an area must not exceed 0.08 ppm. In 2008, both ozone standards were in effect.

Attainment and nonattainment designations for the 0.08 ppm standard were made in 2004. Twenty-five counties were designated nonattainment. On May 16, 2007, the EPA redesignated 16 counties as attainment. These counties are Benzie, Mason, Muskegon, Kent, Ottawa, Van Buren, Kalamazoo, Calhoun, Berrien, Cass, Eaton, Ingham, Clinton, Genesee, Lapeer, and Huron. In 2008, the Southeast Michigan area, consisting of the counties of St. Clair, Livingston, Washtenaw, Lenawee, Monroe, Oakland, Macomb, and Wayne, retained a nonattainment designation and were classified as Marginal. Only one county in West Michigan, Allegan, retained an ozone nonattainment designation.

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 4**).

This data helps in attainment designation applications, to assess urban air quality, and population exposure.

Table 1.4 shows all 27 O_3 air quality monitors active in Michigan at the beginning of 2008. 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]

[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-9-6-07.pdf.

Table 2.4-1: Three-Year Average of the 4th Highest 8-Hr O_3 Values From 2003-2008

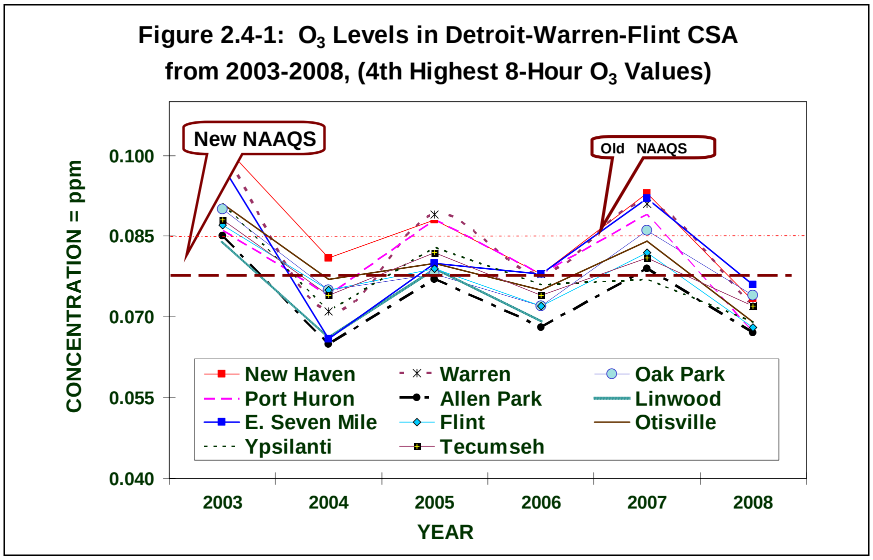
AIRS ID	SITE NAME	VALUES	2003	2004	2005	2006	2007	2008
260050003	Holland	4th Highest 8-hr Value ppm	0.095	0.079	0.094	0.091	0.094	0.073
		Three-year Average ppm	0.097	0.093	0.089	0.088	0.093	0.086
		Rounded to 0.01 ppm	0.1	0.1	0.09	0.09	0.09	0.090
260190003	Frankfort / Benzonia	4th Highest 8-hr Value ppm	0.089	0.075	0.086	0.08	0.082	0.066
		Three-year Average ppm	0.088	0.083	0.083	0.08	0.083	0.076
		Rounded to 0.01 ppm	0.09	0.08	0.08	0.08	0.08	0.080
260210014	Coloma	4th Highest 8-hr Value ppm	0.089	0.073	0.09	0.076	0.086	0.073
		Three-year Average ppm	0.091	0.086	0.084	0.08	0.84	0.078
		Rounded to 0.01 ppm	0.09	0.09	0.08	0.08	0.08	0.080
260270003	Cassopolis	4th Highest 8-hr Value ppm	0.089	0.077	0.086	0.073	0.083	0.071
		Three-year Average ppm	0.093	0.089	0.084	0.079	0.081	0.076
		Rounded to 0.01 ppm	0.09	0.09	0.08	0.08	0.08	0.080
260370001	Rose Lake	4th Highest 8-hr Value ppm	0.086	0.07	0.078	0.071	0.081	0.068
		Three-year Average ppm	0.086	0.08	0.078	0.073	0.077	0.073
		Rounded to 0.01 ppm	0.09	0.08	0.08	0.07	0.08	0.070
260490021	Flint	4th Highest 8-hr Value ppm	0.087	0.075	0.079	0.072	0.082	0.068
		Three-year Average ppm	0.088	0.083	0.08	0.075	0.078	0.074
		Rounded to 0.01 ppm	0.09	0.08	0.08	0.08	0.08	0.070
260492001	Otisville	4th Highest 8-hr Value ppm	0.091	0.077	0.08	0.075	0.084	0.069
		Three-year Average ppm	0.09	0.085	0.082	0.077	0.08	0.076
		Rounded to 0.01 ppm	0.09	0.09	0.08	0.08	0.08	0.080
260630007	Harbor Beach	4th Highest 8-hr Value ppm	0.086	0.068	0.077	0.073	0.084	0.066
		Three-year Average ppm	0.087	0.08	0.077	0.073	0.078	0.074
		Rounded to 0.01 ppm	0.09	0.08	0.08	0.07	0.08	0.070
260650012	Lansing	4th Highest 8-hr Value ppm	0.085	0.068	0.082	0.071	0.08	0.070
		Three-year Average ppm	0.085	0.08	0.078	0.074	0.078	0.074
		Rounded to 0.01 ppm	0.09	0.08	0.08	0.07	0.08	0.070
260770905	Kalamazoo	4th Highest 8-hr Value ppm	0.085	0.068	0.081	0.068	0.081	0.070
260770008	Kalamazoo	Three-year Average ppm	0.086	0.081	0.078	0.072	0.077	0.073
		Rounded to 0.01 ppm	0.09	0.08	0.08	0.07	0.08	0.070

AIRS ID	SITE NAME	VALUES	2003	2004	2005	2006	2007	2008
260810020	Grand Rapids (Monroe)	4th Highest 8-hr Value ppm	0.085	0.068	0.083	0.082	0.084	0.066
		Three-year Average ppm	0.085	0.08	0.078	0.078	0.083	0.077
		Rounded to 0.01 ppm	0.09	0.08	0.08	0.08	0.08	0.080
260812001	Parnell	4th Highest 8-hr Value ppm	0.093	0.072	0.083	0.081	0.085	0.069
260810022	Evans	Three-year Average ppm	0.088	0.084	0.082	0.079	0.082	0.078
		Rounded to 0.01 ppm	0.09	0.08	0.08	0.08	0.08	0.080
260890001	Peshaw-bestown	4th Highest 8-hr Value ppm	0.079	0.07	0.08	0.073	0.079	0.062
		Three-year Average ppm			0.076	0.074	0.077	0.071
		Rounded to 0.01 ppm			0.08	0.07	0.07	0.070
260910007	Tecumseh	4th Highest 8-hr Value ppm	0.088	0.074	0.082	0.074	0.081	0.072
		Three-year Average ppm	0.087	0.083	0.081	0.077	0.079	0.076
		Rounded to 0.01 ppm	0.09	0.08	0.08	0.08	0.08	0.080
260990009	New Haven	4th Highest 8-hr Value ppm	0.102	0.081	0.088	0.078	0.093	0.073
		Three-year Average ppm	0.097	0.092	0.09	0.082	0.86	0.081
		Rounded to 0.01 ppm	0.1	0.09	0.09	0.08	0.09	0.080
260991003	Warren	4th Highest 8-hr Value ppm	0.101	0.071	0.089	0.078	0.091	0.072
		Three-year Average ppm	0.095	0.088	0.087	0.079	0.086	0.080
		Rounded to 0.01 ppm	0.1	0.09	0.09	0.08	0.09	0.080
261010922	Manistee	4th Highest 8-hr Value ppm				0.083	0.083	0.065
		Three-year Average ppm					0.083	0.077
		Rounded to 0.01 ppm					0.08	0.080
261050006	Ludington	4th Highest 8-hr Value ppm	0.087	0.071	0.085	0.076	0.083	0.068
261050007	Scottville	Three-year Average ppm	0.089	0.082	0.081	0.077	0.081	0.076
		Rounded to 0.01 ppm	0.09	0.08	0.08	0.08	0.08	0.080
261130001	Houghton Lake	4th Highest 8-hr Value ppm	0.082	0.071	0.074	0.073	0.076	0.066
		Three-year Average ppm	0.081	0.076	0.075	0.073	0.074	0.072
		Rounded to 0.01 ppm	0.08	0.08	0.08	0.07	0.07	0.070

AIRS ID	SITE NAME	VALUES	2003	2004	2005	2006	2007	2008
261210039	Muskegon	4th Highest 8-hr Value ppm	0.094	0.07	0.09	0.09	0.086	0.072
		Three-year Average ppm	0.095	0.086	0.084	0.083	0.087	0.083
		Rounded to 0.01 ppm	0.1	0.09	0.08	0.08	0.09	0.080
261250001	Oak Park	4th Highest 8-hr Value ppm	0.09	0.075	0.078	0.072	0.086	0.074
		Three-year Average ppm	0.091	0.086	0.081	0.075	0.079	0.077
		Rounded to 0.01 ppm	0.09	0.09	0.08	0.08	0.08	0.080
261390005	Jenison	4th Highest 8-hr Value ppm	0.09	0.069	0.086	0.083	0.088	0.067
		Three-year Average ppm	0.089	0.084	0.081	0.079	0.086	0.079
		Rounded to 0.01 ppm	0.09	0.08	0.08	0.08	0.09	0.080
261470005	Port Huron	4th Highest 8-hr Value ppm	0.086	0.074	0.088	0.078	0.089	0.067
		Three-year Average ppm	0.09	0.086	0.082	0.08	0.085	0.078
		Rounded to 0.01 ppm	0.09	0.09	0.08	0.08	0.08	0.080
261530001	Seney Nat'l Wildlife Refuge	4th Highest 8-hr Value ppm	0.076	0.074	0.085	0.076	0.085	0.064
		Three-year Average ppm		0.077	0.078	0.078	0.082	0.075
		Rounded to 0.01 ppm		0.08	0.08	0.08	0.08	0.080
261610005	Ann Arbor	4th Highest 8-hr Value ppm	0.091	0.071	0.083	0.076	0.077	0.069
261610007	Ann Arbor[1]	Three-year Average ppm	0.091	0.084	0.081	0.077	0.079	0.074
261610008	Ypsilanti	Rounded to 0.01 ppm	0.09	0.08	0.08	0.08	0.08	0.080
261630001	Allen Park	4th Highest 8-hr Value ppm	0.085	0.065	0.077	0.068	0.079	0.067
		Three-year Average ppm	0.084	0.079	0.075	0.07	0.075	0.071
		Rounded to 0.01 ppm	0.08	0.08	0.08	0.07	0.07	0.070
261630016	Linwood	4th Highest 8-hr Value ppm	0.084	0.066	0.079	0.069		
		Three-year Average ppm	0.087	0.08	0.076	0.071		
		Rounded to 0.01 ppm	0.09	0.08	0.08	0.07		
261630019	E. Seven Mile	4th Highest 8-hr Value ppm	0.098	0.066	0.08	0.078	0.092	0.076
		Three-year Average ppm	0.091	0.082	0.081	0.075	0.083	0.082
		Rounded to 0.01 ppm	0.09	0.08	0.08	0.08	0.08	0.080

1. Ann Arbor site monitor was relocated elsewhere in Ann Arbor and later moved to Ypsilanti due to site access difficulty.

Figure 2.4-1 shows the 4th highest 8-hour O_3 values for all of Michigan's monitoring sites in Southeast Michigan from 2003-2008. During the 2008 monitoring season, none of the 27 O_3 monitoring sites registered readings at or above the current 8-hour O_3 value of 0.08 ppm (4th highest value). When the 3-year averages were calculated (2006-2008), there was only one monitor that exceeded the O_3 NAAQS, the one site is in West Michigan (Holland). Holland (at 0.086 ppm) had the highest O_3 3-year average value in the state and is influenced by regional O_3 transport across or along Lake Michigan shoreline from other major urban areas.



Figures 2.4-2 through **2.4-4** show the 4th highest 8-hour O_3 value trends for the other monitoring sites in Michigan over the last five years (see Table 2.4-1 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.

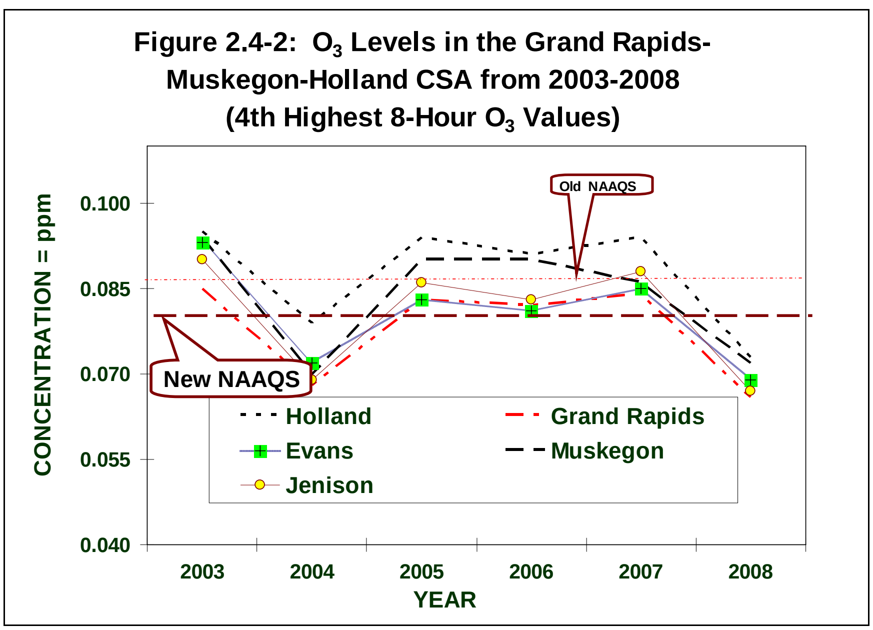


Figure 2.4-3: O_3 Levels in the Kalamazoo-Portage MSA, Lansing-E. Lansing-Owosso CSA, Niles-Benton Harbor MSA, & South Bend-Mishawaka (IN-MI) MSAs from 2003-2008 (4th Highest 8-Hour O_3 Values)

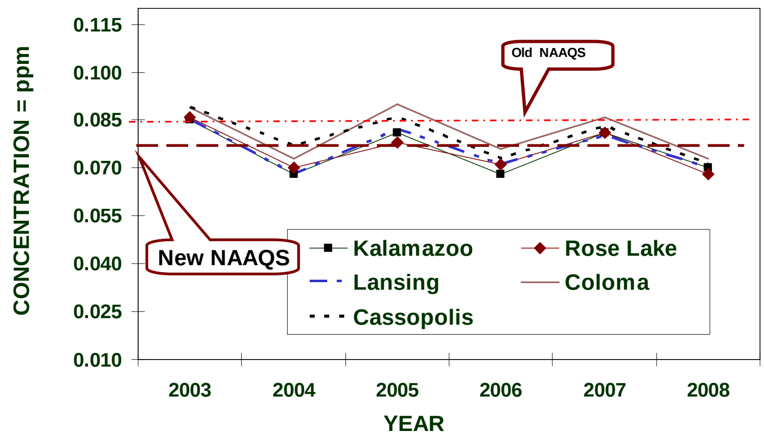


Figure 2.4-4: O_3 Levels in MI's Northern Lower and Upper Peninsula Areas from 2003-2008 (4th Highest 8-Hour O_3 Values)

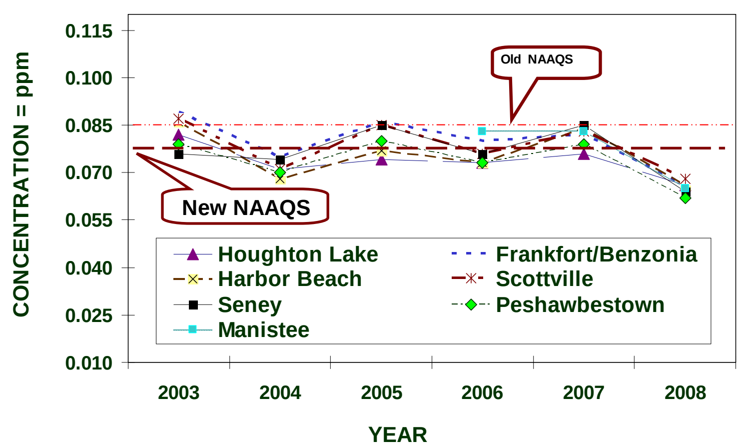
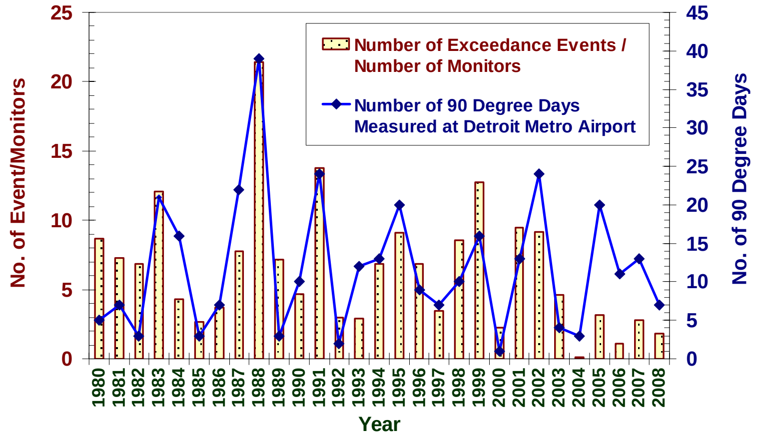


Figure 2.4-5 shows 8-hour O_3 readings ≥ 0.085 ppm with the number of 90°F days (≥ 90°F) measured at the Detroit Metropolitan Airport. The total number of statewide 8-hour readings above 0.085 ppm, were divided by the number of monitors that were in operation each year to provide a relative indication of the frequency of elevated 8-hour O_3 values.

Figure 2.4-5: 8-Hour O_3 Level Events Exceeding the NAAQS from 1980-2008



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 2008, the highest number of 90°F days occurred in 1988 (39 days), while the lowest number occurred in 2000 (one day). For 2008, there were seven 90°F days.

During the 2008 monitoring season, none of the 27 O_3 monitoring sites registered readings at or above 0.085 ppm (4th highest value), and only one of the sites recorded a reading above 0.075 ppm (4th highest). When all the sites had their 3-year averages calculated (2006-2008), 17 sites were above the new 0.075 ppm NAAQS. Holland (at 0.086 ppm) had the highest O_3 3-year average value in the state. The Holland site is influenced by regional O_3 transport across or along the Lake Michigan shoreline from other major urban areas.

NOTE: The new 2008 O_3 standard of 0.075 ppm is also shown in **Figures 2.4-1** through **2.4-4** to show its impact.

2.5 Particulate Matter

PM_{10}, $PM_{2.5}$, $PM_{2.5}$ CHEMICAL SPECIATION, AND TSP

Particular matter is categorized according to size, which is the major factor in determining which particles will enter the lungs and how deeply they will penetrate. PM_{10} particulates are equal to or less than 10 μm in diameter. $PM_{2.5}$ particles are equal to or less than 2.5 μm in diameter, and cause the most serious health effects because they penetrate deeper into the lungs.

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 1-4** identifies the locations of PM_{10} monitoring stations that were operating in Michigan during 2008. 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 2.5-1 shows the annual arithmetic means for the Detroit-Warren-Flint CSA from 2003-2008. For 2008, all monitoring sites in the Detroit area had readings below the PM_{10} standard with Dearborn continuing to have the highest maximum annual mean (26.5 μg/m^3) in the state.

Figure 2.5-1: PM_{10} Levels in MI's Detroit-Warren-Flint CSA from 2003-2008 (Annual Arithmetic Means)

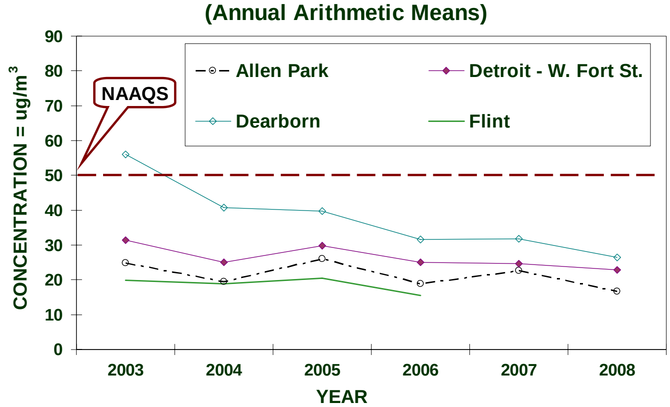
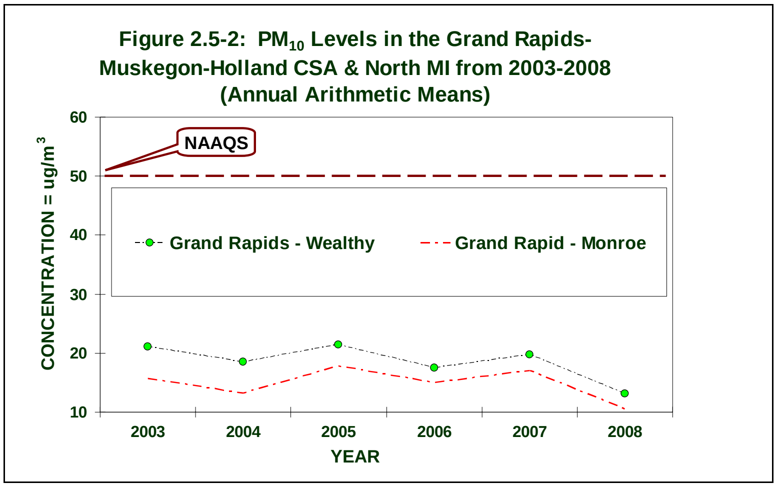


Figure 2.5-2 shows the annual arithmetic means for the Grand Rapids-Muskegon-Holland CSA and Northern Michigan from 2003-2008. In 2008, the two PM_{10} monitoring sites located in the Grand Rapids area continue to show a decline in the annual mean levels. For the decade, all the monitoring sites in western 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.

$PM_{2.5}$ 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 station.

[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].

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 MDEQ operated all TEOM units with an inlet temperature of 50ºC, but this high inlet temperature was volatilizing nitrate during the winter months. Therefore, the MDEQ 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 2008. The remaining sites will be changed over in 2009. There are 8 SASS monitors operating in Michigan; see **Table 1-4.**

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, in 2008, the MDEQ operated four aethalometers and three elemental carbon/organic carbon (EC/OC) monitors.

- 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 2008, the MDEQ'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 instrument at located at Dearborn, Allen Park, and Tecumseh.

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

[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.

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 MDEQ 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 $PM_{10-2.5}$ will need to be added to the NCore sites.[9] The MDEQ is still awaiting a finalization of a $PM_{10-2.5}$ monitoring methodology before implementing this monitoring. Continued operation of the speciation trend site in Detroit (Allen Park) is required.

Table 1-4 shows all of Michigan's 26 $PM_{2.5}$ FRM monitoring stations operating in 2008 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 in because it does not have a $PM_{2.5}$ FRM monitor to verify its accuracy.

Table 2.5-1 provides the 2003-2008 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 Holland, Grand Rapids #1, Allen Park #1, and Linwood, which sample daily.

[9] Current information on both proposals can be found at http://www.epa.gov/air/particles/actions.html.
[10] For comparison to the standard, the average annual means is rounded to the nearest 0.1 $\mu g/m^3$.

Table 2.5-1: 2003-2008 Annual Mean $PM_{2.5}$ Concentrations by Individual Monitoring Stations

AIRS ID – Station Name	2003	2004	2005	2006	2007	2008	2006-2008 Mean
260050003 - Holland	12.38	11.21	12.39	11.48	11.69	9.68	10.9
260170014 - Bay City	10.89	9.85	12.44	10.16	10.17	8.89	9.7
260210014 - Coloma	12.46	10.23	13.05	10.95	11.53	9.78	10.8
260490021 - Flint	12.01	10.49	12.89	10.92	11.07	9.77	10.6
260650012 - Lansing	13.01	11.06	13.54	11.47	11.48	9.85	10.9
260770008 - Kalamazoo #1	13.92	11.33	13.83	12.57*	12.62	11.19	12.1
260770008 - Kalamazoo #2	14.27*	11.09	14.64*	12.76*	13.95	11.08	12.6
260810007 – Grand Rapids - Wealthy					12.84	11.15	
260810020 - Grand Rapids #1	13.51	12.00	13.72	12.62	12.25	10.67	11.8
260810020 - Grand Rapids #2	14.00	11.26	**15.37**	13.04	14.66	10.66	12.8
260910007 – Tecumseh						7.28	
260990009 - New Haven	12.8	11.96	14.37	11.28	11.94	10.66	11.3
261010922 – Manistee				9.13*	8.54	7.62	8.4
261130001 - Houghton Lake	7.96	7.29	9.38	7.77	7.88	6.48	7.4
261150005 - Luna Pier	13.73	12.98	**15.70**	12.72	13.08	11.36	12.4
261210040 - Muskegon	11.87	10.16	13.07	11.30	10.51	9.64	10.5
261250001 - Oak Park	14.58	12.76	**15.46**	12.11	13.33	10.86	12.1
261390005 - Jenison	12.69	11.33	13.99	12.02	11.68	10.82	11.5
261470005 - Port Huron	14.16	12.10	**15.09**	12.04	12.44	11.08	11.9
261610008 - Ypsilanti #1	14.64	12.87	**15.61**	12.55*	12.98	10.91	12.1
261610008 - Ypsilanti #2	**15.12**	11.09	**16.70**	13.52	14.30	12.99	13.6
261630001 - Allen Park #1	**15.2**	14.24	**15.94**	13.18	12.76	11.83	12.6
261630001 - Allen Park #2	**17.51***	12.32	**17.66**	13.86	**15.65**	13.92	14.5
261630015 - Detroit - W. Fort	**16.63**	**15.39**	**17.21**	14.68	14.54	12.85	14.0
261630016 - Detroit - Linwood	**15.82**	13.69	**16.01**	13.04	13.86	11.94	12.9
261630019 - Detroit - E Seven Mile	14.63	13.23	**16.48**	12.71	13.01	11.33	12.3
261630025 - Livonia	14.14	12.57	14.94	11.80	12.75	11.01	11.9
261630033 - Dearborn	**19.11**	**16.83**	**18.55**	**16.13**	**16.89**	13.34	**15.4**
261630036 - Wyandotte	**16.26**	13.66	**16.41**	12.92	13.45	10.94	12.4
261630038 - Detroit - Newberry			**16.41***	12.47*	14.02	11.81	11.7
261630039 - Detroit - W. Lafayette			**16.22***	13.13	13.83	12.23	13.1

* The mean does not satisfy summary criteria.

Table 2.5-2 is a detailed assessment of the 24-hour 98th percentile $PM_{2.5}$ concentrations for 2003-2008 showing Michigan's levels are consistently below the old 65 μg/m^3 standard (3-year average).[11] However under the new 24-hour $PM_{2.5}$ NAAQS, only Dearborn at 37 μg/m^3 is above the 35 μg/m^3 NAAQS.

Table 2.5-2: 24-hr. 98th Percentile $PM_{2.5}$ Concentration

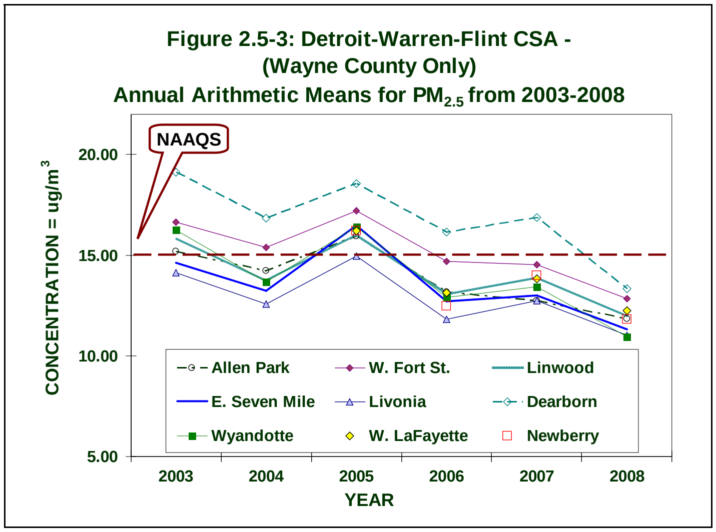
AIRS ID – Station Name	2003	2004	2005	2006	2007	2008	2006-2008 Mean
260050003 - Holland	35.6	30.3	36.1	34.1	31.7	24.5	30
260170014 - Bay City	26.7	28.0	40.5	27.9	25.2	23.6	26
260210014 - Coloma	34.1	29.0	33.8	27.7	33.0	24.8	29
260490021 - Flint	32.2	27.9	35.9	26.7	25.1	25.8	26
260650012 - Lansing #1	29.0	29.4	38.1	28.3	29.0	24.0	27
260770008 - Kalamazoo #1	36.9	27.3	33.3	29.1	29.2	26.0	28
260770008 - Kalamazoo #2	35.7	28.9	31.5	29.1	32.5	24.1	29
260810007- Grand Rapids- Wealthy					29.7	26.8	
260810020 - Grand Rapids #1	35.0	31.8	44.7	33.2	29.7	24.9	29
260810020 - Grand Rapids #2	29.6	30.5	45.6	31.5	31.7	22.5	29
260910007 – Tecumseh						23.4	
260990009 - New Haven	31.8	31.9	41.5	34.4	29.0	28.9	31
261010922 – Manistee				25.9	26.5	21.2	25
261130001 - Houghton Lake	23.6	21.0	30.8	21.6	23.2	21.1	22
261150005 - Luna Pier	34.7	35.0	49.3	32.6	32.2	28.6	31
261210040 - Muskegon	36.3	32.7	41.0	29.8	28.1	26.3	28
261250001 - Oak Park	36.6	32.5	52.2	33.0	35.3	30.4	33
261390005 - Jenison	31.0	30.9	42.3	30.2	28.1	27.1	28
261470005 - Port Huron	37.2	32.2	47.6	37.9	36.3	31.0	**35**
261610008 - Ypsilanti #1	38.8	31.5	52.1	31.3	34.5	28.2	31
261610008 - Ypsilanti #2	32.5	31.2	54.6	33.0	30.6	31.3	32
261630001 - Allen Park #1	40.5	36.9	43.0	32.8	31.0	30.3	31
261630001 - Allen Park #2	39.2	33.8	58.0	34.2	36.2	32.3	34
261630015 - Detroit - W. Fort St.	33.6	36.0	49.7	36.2	34.0	34.3	**35**
261630016 - Detroit - Linwood	46.2	38.3	51.8	36.9	34.3	30.0	34
261630019 - Detroit - E Seven Mile	37.1	35.0	52.3	36.2	31.9	31.9	33
261630025 - Livonia	38.1	32.2	40.2	30.4	32.8	28.3	31
261630033 - Dearborn	42.8	39.4	50.2	43.1	36.6	31.7	**37**
261630036 - Wyandotte	34.8	32.3	46.7	33.2	28.6	26.3	29
261630038 - Detroit - Newberry			57.5	28.6	33.4	31.5	31
261630039 - Detroit - W. Lafayette			43.9	32.4	34.8	31.7	33

* The 2006-2008 mean cannot be calculated as there is not three years worth of data or monitoring ended prior to 2007.

[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.

The following **Figures 2.5-3** through **2.5-6** 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 2.5-3** shows those sites in Wayne County and **Figure 2.5-4** shows the remaining counties within the CSA.

As shown in Figure-2.5-3, 2008 levels in Wayne County have remained below the standard except for the Dearborn site. After the 3-year annual means are calculated, Dearborn (15.4 µg/m) did not meet the annual $PM_{2.5}$ NAAQS. Historically, Dearborn has had the highest readings in the state.



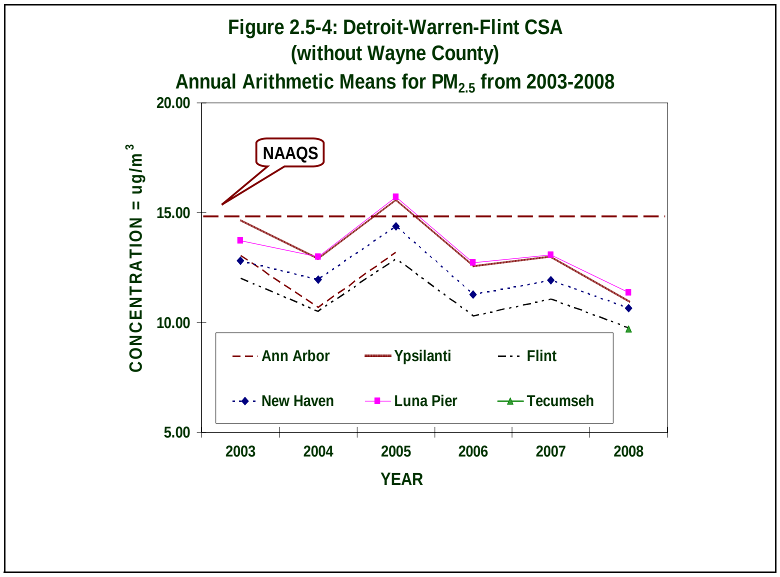


Figure 2.5-4 contains the remainder of those sites in the Detroit-Warren-Flint CSA that are outside of Wayne County. These sites show readings in 2008 below the $PM_{2.5}$ standard and after the 3-year annual mean is averaged, they remain below the current $PM_{2.5}$ NAAQS.

Figure 2.5-5 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 2002.

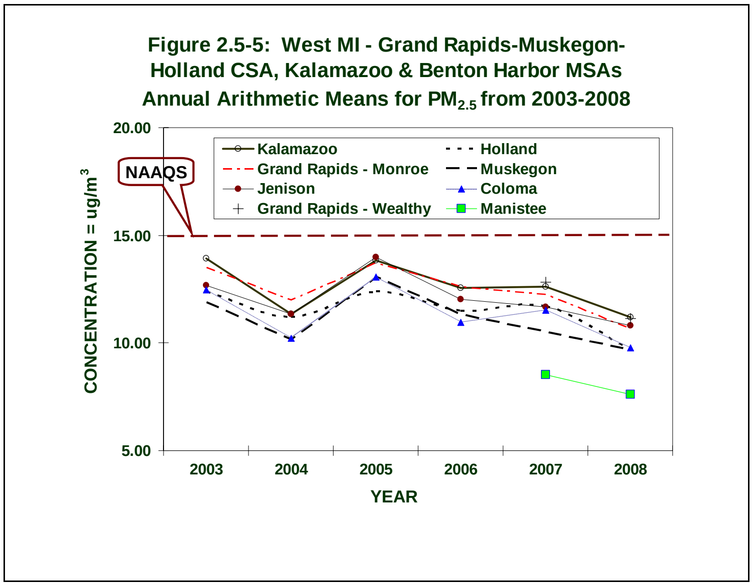
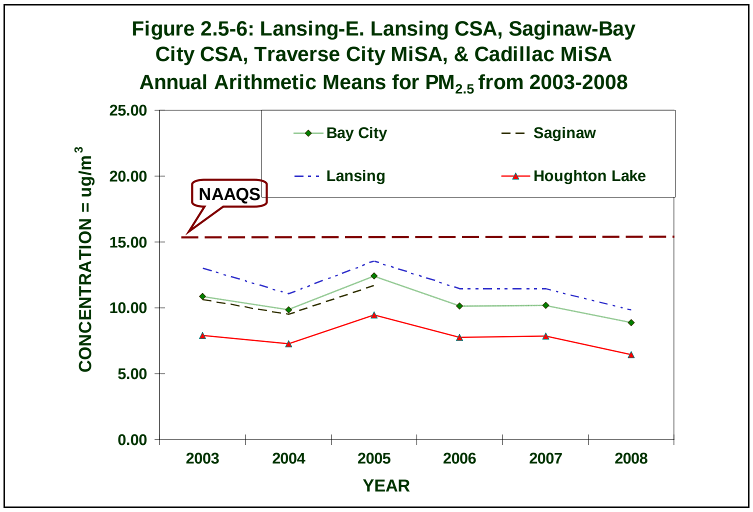


Figure 2.5-6, below, displays the remaining monitoring sites in Michigan's Lower Peninsula. All these sites have 2008 levels below the standard and their 3-year averages also remain below the annual $PM_{2.5}$ NAAQS.



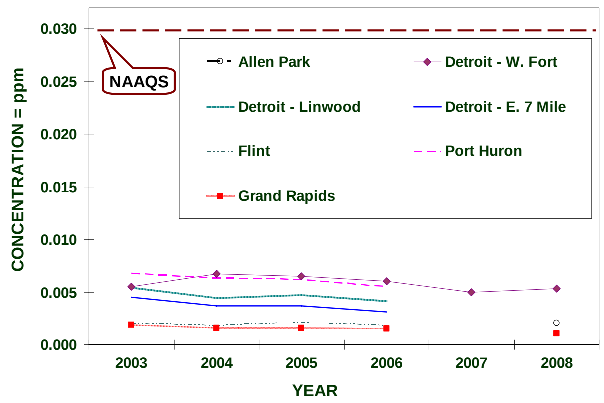
2.6 Sulfur Dioxide (SO_2)

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 in Detroit is located in the old nonattainment area for SO_2 and is important for trend levels 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 2.6-1**.

Figure 2.6-1: SO_2 Levels in Michigan from 2003-2008 (Annual Arithmetic Mean)



Chapter 3: 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.

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), perchlorethlyene (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).

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

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.

EXPOSURE AND HEALTH EFFECTS OF AIR TOXICS

People are exposed to air toxics in many ways, such as: breathing contaminated air (e.g., industrial emissions), ingesting contaminated food products from animals that feed on contaminated plants (fish, meat, milk, eggs, etc.), drinking from contaminated waters, and coming in contact with contaminated soil, dust, or water.

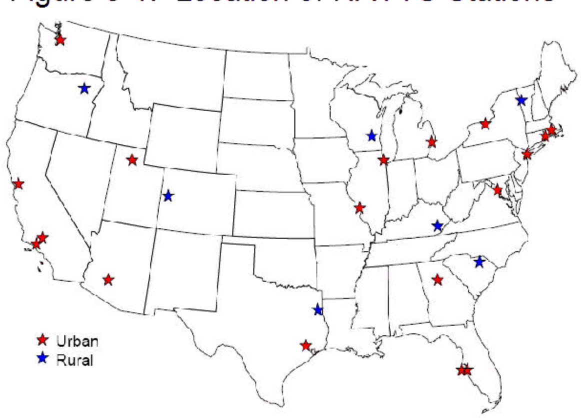
Once air toxics enter the body, there is a wide range of potential health effects. They include the aggravation of asthma; irritation to the eyes, nose, and throat; carcinogenicity; developmental toxicity (birth defects); nervous system effects and various other effects on internal organs.

Air toxic substances may have one “critical” effect, while others may have several. 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, further complicating the assessment of air toxics concerns due to the broad range of susceptibility that various people may have.

NATIONAL MONITORING EFFORTS AND DATA ANALYSIS

The EPA administers national programs that identify air toxics levels, detect trends, and prioritize air toxics research. The MDEQ 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, 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 3-1**). 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 3-1: Location of NATTS Stations



Chapter 4: *MIair* – Air Quality Information in Real-Time

MIair is the internet tool that provides real-time air quality information on the MDEQ "AIR" webpage. The icon hotlink opens directly 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; publishes *Action! Day* information; provides raw data from continuous air monitors in near real-time; and, shows static and animated O_3 and $PM_{2.5}$ maps. Webpage features are discussed in this chapter.

AIR QUALITY INDEX:

Air Quality Index

The Air Quality Index (AQI) was developed and federally mandated to quickly communicate short-term, current air information to the public. Simply put, the AQI is a health indicator for people who want to know whether the air they are breathing 'right now' is healthy. **MIair** AQI values are displayed in a forecast table and shown as color-coded dots plotted on a Michigan map. It is calculated in near real-time using hourly data [primarily ozone and $PM_{2.5}$] from continuous air monitors. The AQI identifies air pollutant concentrations as one of six, color-coded category levels ranging from good to hazardous.[13] This simple tool allows people to make health decisions about daily activities, such as whether to adjust physical exertion levels. Staff meteorologists include a Forecast Discussion to provide upcoming conditions.

A relative scale of 0 to 500 (shown below in **Table 4-1**) is used to display AQI values; the higher the AQI number, the greater the pollution concentration and potential for short-term health concerns. The index is not intended to provide an indication of long-term chronic air pollution exposure (months or years), nor does it reflect additive or synergistic health effects that may result from exposure to multiple air pollutants. Note that during 2008, the AQI values for $PM_{2.5}$ and O_3 concentrations were adjusted to align closely with National Ambient Air Quality Standard changes.

Table 4.1: BREAKPOINTS FOR AQI POLLUTANT CONCENTRATIONS

AQI VALUE	$PM_{2.5}$ (24 hr) $\mu g/m^3$	PM_{10} (24 hr) $\mu g/m^3$	SO_2 (24 hr) ppm	O_3 (8 hr) ppm	O_3 (1 hr) ppm	CO (8 hr) ppm	NO_2 (1 hr) ppm
301-500 **Hazardous**	250.5 – 500.4	425 – 604	0.605 – 1.004	→	0.405 – 0.604	30.5 – 50.4	1.25 – 2.04
201-300 **Very Unhealthy**	150.5 – 250.4	355 – 424	0.305 – 0.604	0.116 – 0.374	0.205 – 0.404	15.5 – 30.4	0.65 – 1.24
151-200 **Unhealthy**	65.5 – 150.4	255 – 354	0.225 – 0.304	0.096 – 0.115	0.165 – 0.204	12.5 – 15.4	-
101-150 **USG**	35-5 – 65.4	155 – 254	0.145 – 0.224	0.076 – 0.095	0.125 – 0.164	9.5 – 12.4	-
51-100 **Moderate**	15.5 – 35.4	55 – 154	0.035 – 0.144	0.060 – 0.075	-	4.5 – 9..4	-
0-50 **Good**	0.0 – 15.4	0 – 54	0.00 – 0.03	0.000 – 0.059	-	0.0 – 4.4	-

[13] The AQI must not be confused with NAAQS, which determine an area's compliance with provisions set forth in the federal CAA.

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.

Table 4.2 identifies the AQI colors and the associated health statements by individual air pollutant.

Table 4.2: The AQI Colors and Health Statements

AQI COLOR, CATEGORY & VALUE	PARTICULATE MATTER ($\mu g/m^3$) 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.

Appendix E contains pie charts created to show the AQI values for each of Michigan's 2008 monitoring sites.

***Action!* Days:**

Voluntary *"Actions!"* to reduce air emissions improve air quality, save money and allow people to protect their health (by reducing exposure) when poor air quality is forecasted. *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 of ground-level O_3 or $PM_{2.5}$ concentrations.

People are encouraged to make voluntary choices to reduce air pollution everyday – at home, in the car or in the office or school. These actions include:

- conserve energy - reduce electricity use and adjust home thermostat controls;
- maintain vehicle engines and keep tires properly inflated;
- combine several errands into one trip and limit vehicle idling;
- use energy efficient appliances and products (i.e., Energy Star);
- waste less by buying in bulk and don't buy what you don't need;
- recycle household trash and give unused items to charity;
- compost yard waste into useful topsoil;
- burn fuel wood only in EPA-certified stoves or fireplace inserts, and;
- use environmentally safe paints, household solvents and cleaners.

On *Action!* Days, businesses, industries, government, and the general public are all encouraged to take further action to reduce air pollution. Clean air choices can include the following:

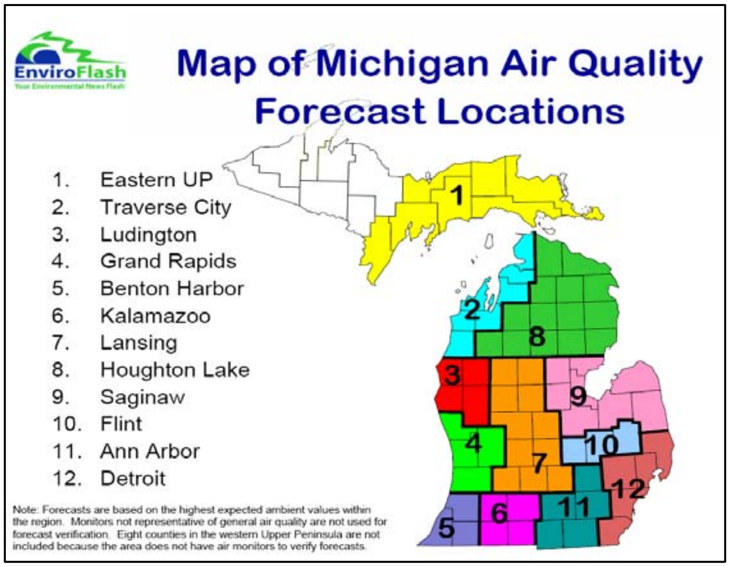
- reduce vehicle use where possible;
- avoid refueling or refuel after 6 PM;
- choose alternative transportation options, such as carpool, bus, walk or bike;
- defer the use of gasoline-powered lawn and recreation equipment;
- avoid use of volatile household chemicals, and;
- avoid all burning.

Table 4-3 shows that during the summer of 2008, a total of six *Action!* Days were declared.[14]

Location	Year	Number	Dates
Ann Arbor	2008	3	7/17, 8/21, 9/2
Benton Harbor	2008	4	7/11, 7/17, 7/18, 9/2
Detroit	2008	5	7/11, 7/17, 7/18, 8/21, 9/2
Eastern U.P.	2008	0	
Flint	2008	0	
Grand Rapids	2008	5	7/11, 7/17, 7/18, 8/21, 9/2
Houghton Lake	2008	0	
Kalamazoo	2008	2	7/17, 9/2
Lansing	2008	0	
Ludington	2008	4	7/11, 7/17, 7/18, 9/2
Saginaw	2008	0	
Traverse City	2008	1	7/17

[14] More information is available under the Action Day tab in **MIair** at http://www.deqmiair.org/.

Figure 4-1:



Air Quality Notification

AIR QUALITY NOTIFICATION:

EnviroFlash is a free service that sends automated air quality forecast notifications to subscribers. This allows the ability to adjust daily activity when poor air conditions are expected. Those enrolled get only the information they choose to receive, which is sent directly to their computer e-mail or mobile phone with text messaging. Parents with small children, family members with asthma or other health problems, older adults, and people engaged in strenuous outdoor work or exercise usually select the orange "unhealthy for sensitive groups" level.

EnviroFlash is available in many locations across the nation. The Michigan network has the potential to reach up to 98% of the state's population as shown in **Figure 4-1**.

The EnviroFlash webpage also provides the option for people to receive UV (ultraviolet) radiation forecast notifications. Exposure to UV radiation can lead to skin cancer. These notices are made available via the National Weather Service and EPA.

To receive notices and learn more about this program, go to www.michigan.gov/deqair and select EnviroFlash or MIair.

MONITORING DATA, MAPS AND OTHER LINKS:

Monitoring Data

Hourly raw air quality and meteorological measurements from monitor sites across Michigan are reported in end-hour local time. Continuous monitor data for O_3 (collected from April through September), $PM_{2.5}$, CO, SO_2, NO_2 temperature, wind direction, and wind speed are graphed and can be viewed in near real-time. Past raw air data is available using the calendar navigation feature.

Ozone Maps

The O_3 season runs from April 1st through September 30th. Current day O_3 concentrations are reported as an average of the previous 6-hour values plus a 2-hour statistical surrogate calculation. Current data is reported in end-hour local time. Past data are reported in beginning-hour standard time. The choice to animate the data map is available. After the ozone season has ended, past data and maps can still be viewed using the calendar feature (remember to mouse-click on "go" after selecting the date).

$PM_{2.5}$ Maps The current 24-hour average $PM_{2.5}$ concentrations are reported as an average of the previous 24 hourly values. Current data are reported in end-hour local time. Past data are midnight-to-midnight averages to align with the NAAQS reporting methodologies. (The continuous TEOM $PM_{2.5}$ monitors are sited along side the filter-based $PM_{2.5}$ monitors, which determine compliance with federal standards.)

Links The Links page includes information about the MIair Website, MDEQ, Local Partners, the Great Lakes Region, EPA (including AIRNow) and various tools (including web links to other national programs).

<u>AIRNOW:</u>

The MDEQ supplies Michigan air monitor data to the EPA for AIRNow, a national air quality map. AIRNow uses state and local air agency O_3 and $PM_{2.5}$ data to produce regional AQI maps for the Midwest, New England, Mid-Atlantic, Southeastern, South Central, and Pacific Coast. Animations show pollutant transport across regions over time. There are also links that provide forecasts, previous AQI data, health information, and more.[15]

[15] Addition information is available at http://www.epa.gov/airnow/. Note that AIRNow forecast information and data maps are generated over less frequent time intervals than **MIair**.

Chapter 5: Meteorological Information

The following **Figures 5-1** through **5-3** (average daily temperatures) and **Figures 5-4** through **5-6** (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 2008.

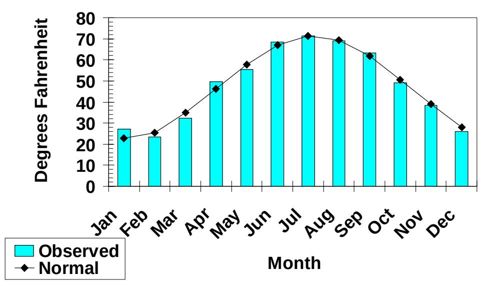


Figure 5-1: Southern Lower Peninsula Observed Average Daily Temperatures vs. Normal Average Daily Temperatures

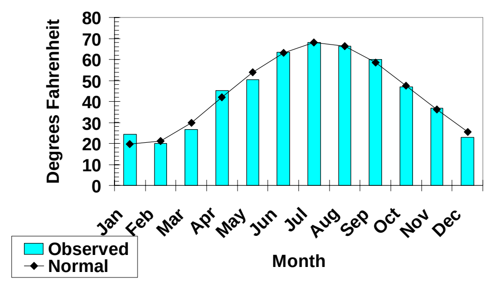


Figure 5-2: Northern Lower Peninsula Observed Average Daily Temperatures vs. Normal Average Daily Temperatures

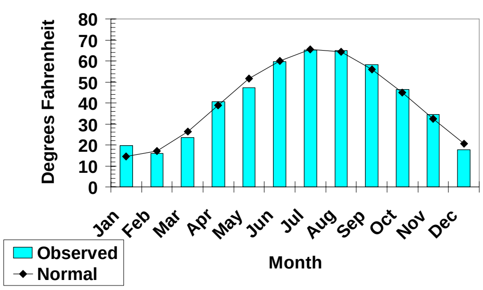


Figure 5-3: Upper Peninsula Observed Average Daily Temperatures vs. Normal Average Daily Temperatures

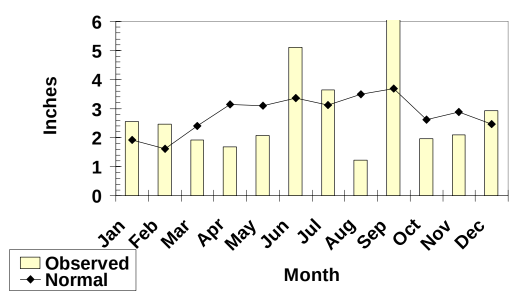


Figure 5-4: Southern Lower Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation

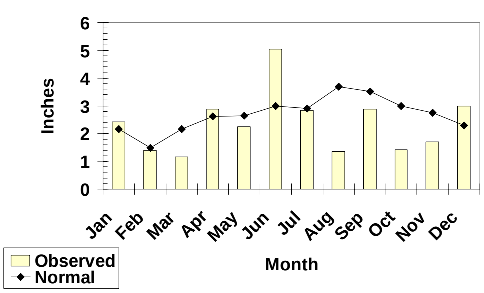


Figure 5-5: Northern Lower Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation

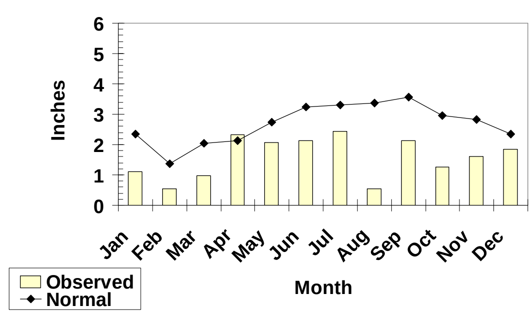


Figure 5-6: Upper Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation

Appendix A

Appendix A utilizes the EPA's 2008 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 and has replaced the MASN number. Prior to 1989, each site was labeled with a five-digit MASN code number.

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 numbers 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 2008

CO Measured in ppm

Site ID	POC	City	County	Year	# OBS	1-hr Highest Value	1-hr 2nd Highest Value	# > 35	8-hr Highest Value	8-hr 2nd Highest Value	# > 9
260810020	1	Grand Rapids	Kent	2008	6260	2.0	1.8	0	1.4	1.1	0
261630001	1	Allen Park	Wayne	2008	5733	2.0	1.9	0	1.2	1.1	0

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	2008	59	.0127	.0222	.0232	.0115	0	.0492	.0472

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	2008	8506	.058	.053	.0127

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	2008	6179	.2014	.2014	.01660
261630001	1	Allen Park	Wayne	2008	3968	.2016	.2001	.02496*

*Indicates the mean does not satisfy summary criteria

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	2008	183	183	.118	.095	.093	.084	0	0.0	0
260190003	1	Benzonia	Benzie	2008	183	183	.107	.094	.077	.074	0	0.0	0
260210014	1	Coloma	Berrien	2008	175	183	.103	.099	.092	.085	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	2008	183	183	.091	.092	.080	.080	0	0.0	0
260370001	2	Rose Lake	Clinton	2008	178	183	.085	.081	.080	.079	0	0.0	1
260490021	1	Flint	Genesee	2008	183	183	.091	.084	.081	.077	0	0.0	0
260492001	1	Otisville	Genesee	2008	182	183	.089	.083	.078	.078	0	0.0	1
260630007	1	Harbor Beach	Huron	2008	183	183	.082	.078	.077	.076	0	0.0	0
260650012	2	Lansing	Ingham	2008	180	183	.084	.083	.080	.079	0	0.0	0
260770008	1	Kalamazoo	Kalamazoo	2008	183	183	.090	.086	.084	.083	0	0.0	0
260810020	1	Grand Rapids	Kent	2008	183	183	.100	.085	.079	.077	0	0.0	0
260810022	1	Evans	Kent	2008	183	183	.101	.087	.079	.076	0	0.0	0
260890001	1	Peshawbestown	Leelanau	2008	182	183	.077	.075	.073	.070	0	0.0	1
260910007	1	Tecumseh	Lenawee	2008	163	183	.090	.083	.082	.080	0	0.0	2
260990009	1	New Haven	Macomb	2008	183	183	.122	.099	.095	.084	0	0.0	0
260991003	1	Warren	Macomb	2008	178	183	.101	.087	.086	.086	0	0.0	0
261010933	1	Manistee	Manistee	2008	182	183	.103	.086	.075	.073	0	0.0	1
261050007	1	Scottville	Mason	2008	183	183	.106	.081	.078	.076	0	0.0	0
261130001	1	Houghton Lake	Missaukee	2008	183	183	.085	.082	.080	.077	0	0.0	0
261210039	1	Muskegon	Muskegon	2008	182	183	.114	..097	.086	.081	0	0.0	1
261250001	2	Oak Park	Oakland	2008	183	183	.095	.091	.082	.081	0	0.0	0
261390005	1	Jenison	Ottawa	2008	182	183	.105	.086	.081	.078	0	0.0	1
261470005	1	Port Huron	St .Clair	2008	182	183	.093	.085	.083	.083	0	0.0	1

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
261530001	1	Seney	Schoolcraft	2008	177	183	.075	.074	.071	.071	0	0.0	0
261610008	1	Ypsilanti	Washtenaw	2008	183	183	.086	.080	.077	.077	0	0.0	0
261630001	2	Allen Park	Wayne	2008	174	183	.088	.087	.078	.078	0	0.0	6
261630019	2	Detroit - E. Seven Mile	Wayne	2008	177	183	.096	.093	.088	.086	0	0.0	2

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	2008	100	183	.100	.077	.074	.073	2
260190003	1	Benzonia	Benzie	2008	100	183	.087	.076	.066	.066	2
260210014	1	Coloma	Berrien	2008	96	175	.085	.082	.075	.073	2
260270003	2	Cassopolis	Cass	2008	100	183	.075	.075	.074	.071	0
260370001	2	Rose Lake	Clinton	2008	97	177	.078	.073	.068	.068	1
260490021	1	Flint	Genesee	2008	100	183	.079	.075	.069	.068	1
260492001	1	Otisville	Genesee	2008	99	182	.080	.071	.070	.069	1
260630007	1	Harbor Beach	Huron	2008	100	183	.077	.074	.069	.066	1
260650012	2	Lansing	Ingham	2008	98	179	.075	.072	.071	.070	0
260770008	1	Kalamazoo	Kalamazoo	2008	99	182	.079	.078	.076	.070	3
260810020	1	Grand Rapids	Kent	2008	99	182	.082	.067	.067	.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	2008	99	182	.083	.072	.070	.069	1
260890001	1	Peshawbestown	Leelanau	2008	99	182	.068	.064	.062	.062	0
260910007	1	Tecumseh	Lenawee	2008	87	159	.080	.076	.074	.072	2
260990009	1	New Haven	Macomb	2008	100	183	.082	.080	.078	.073	3
260991003	1	Warren	Macomb	2008	97	177	.084	.081	.075	.072	2
261010922	1	Manistee	Manistee	2008	99	182	.080	.077	.065	.065	2
261050007	1	Scottville	Mason	2008	100	183	.083	.076	.070	.068	2
261130001	1	Houghton Lake	Missaukee	2008	98	180	.081	.076	.072	.066	2
261210039	1	Muskegon	Muskegon	2008	99	182	.099	.080	.072	.072	2
261250001	2	Oak Park	Oakland	2008	100	183	.077	.076	.076	.074	3
261390005	1	Jenison	Ottawa	2008	99	181	.084	.068	.067	.067	1
261470005	1	Port Huron	St .Clair	2008	99	182	.077	.072	.069	.067	1
261530001	1	Seney	Schoolcraft	2008	97	177	.070	.069	.068	.064	0
261610008	1	Ypsilanti	Washtenaw	2008	100	183	.073	.071	.070	.069	0
261630001	2	Allen Park	Wayne	2008	95	174	.079	.072	.068	.067	1
261630019	2	Detroit - E. Seven Mile	Wayne	2008	97	177	.083	.078	.078	.076	4

$PM_{2.5}$ (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	2008	115	37.6	26.0	24.5	23.7	24.5	9.68
260170014	1	FRM	Bay City	Bay	2008	114	28.5	27.4	23.6	22.5	23.6	8.89
260210014	1	FRM	Coloma	Berrien	2008	113	32.8	27.2	24.8	24.7	24.8	9.78
260490021	1	FRM	Flint	Genesee	2008	108	33.2	28.2	25.8	25.1	25.8	9.77*
260650012	1	FRM	Lansing	Ingham	2008	122	26.2	26.1	24.0	23.5	24.0	9.85
260770008	1	FRM	Kalamazoo	Kalamazoo	2008	115	28.7	26.8	24.0	26.0	26.0	11.19
260770008	2[a]	FRM	Kalamazoo	Kalamazoo	2008	27	24.1	22.5	20.5	19.2	24.1	11.08*
260810007	1	FRM	Grand Rapids - Wealthy	Kent	2008	117	34.7	26.8	26.8	24.7	26.8	11.15
260810020	1	FRM	Grand Rapids - Monroe	Kent	2008	352	30.7	30.6	28.3	28.2	24.9	10.66
260810020	2[a]	FRM	Grand Rapids - Monroe	Kent	2008	27	22.5	20.9	20.7	16.6	22.5	10.65*
260910007	1	FRM	Tecumseh	Lenawee	2008	80	27.0	23.4	23.3	23.0	23.4	9.70*
260990009	1	FRM	New Haven	Macomb	2008	117	32.0	29.1	28.9	25.6	28.9	10.66
261010922	1	FRM	Manistee	Manistee	2008	111	30.6	28.6	21.2	20.4	21.2	7.61
261130001	1	FRM	Houghton Lake	Missaukee	2008	114	23.2	22.3	21.1	18.8	21.1	6.48
261150005	1	FRM	Luna Pier	Monroe	2008	117	34.8	29.3	28.6	28.3	28.6	11.36
261210040	1	FRM	Muskegon	Muskegon	2008	348	35.2	28.4	26.9	26.8	26.3	9.64
261250001	1	FRM	Oak Park	Oakland	2008	118	37.1	31.9	30.4	29.0	30.4	10.86

$PM_{2.5}$ (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	2008	355	37.7	34.7	30.1	28.7	27.1	10.86
261470005	1	FRM	Port Huron	St. Clair	2008	118	37.2	31.0	30.3	26.4	31.0	11.08
261610008	1	FRM	Ypsilanti	Washtenaw	2008	118	30.5	29.4	28.2	27.8	28.2	10.91
261610008	2[a]	FRM	Ypsilanti	Washtenaw	2008	34	31.3	29.4	25.1	22.5	31.3	12.99
261630001	1	FRM	Allen Park	Wayne	2008	351	34.3	33.9	32.7	31.6	30.3	11.83
261630001	2[a]	FRM	Allen Park	Wayne	2008	28	32.3	28.6	28.3	23.7	32.3	13.97*
261630015	1	FRM	Detroit - W. Fort	Wayne	2008	122	39.6	35.1	34.3	31.8	34.3	12.85
261630016	1	FRM	Detroit - Linwood	Wayne	2008	118	36.3	32.1	30.0	28.9	30.0	11.94
261630019	1	FRM	Detroit - E. Seven Mile	Wayne	2008	116	33.7	32.4	31.9	30.9	31.9	11.33
261630025	1	FRM	Livonia	Wayne	2008	117	30.8	30.5	28.3	26.1	28.3	11.01
261630033	1	FRM	Dearborn	Wayne	2008	119	38.3	35.0	31.7	30.5	31.7	13.33
261630036	1	FRM	Wyandotte	Wayne	2008	120	31.3	26.6	26.3	25.0	26.3	10.94
261630038	1	FRM	Detroit - Newberry.	Wayne	2008	115	33.4	32.4	31.5	28.8	31.5	11.81
261630039	1	FRM	Detroit – W. Lafayette	Wayne	2008	116	36.3	62.2	31.7	27.7	31.7	12.23

*Indicates the mean does not satisfy summary criteria. [a] POC 2 FRM: used primarily for precision purposes.

$PM_{2.5}$ 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	2008	8713	76.0	62.0	61.0	47.0	9.34
260490021	3	TEOM	Flint	Genesee	2008	8558	94.0	88.0	77.0	71.0	9.98
260650012	5	TEOM	Lansing	Ingham	2008	8660	47.0	48.0	47.0	46.0	9.63
260770008	3	TEOM	Kalamazoo	Kalamazoo	2008	8475	123.0	94.0	72.0	58.0	10.86
260810020	3	TEOM	Grand Rapids	Kent	2008	8607	95.0	72.0	68.0	64.0	10.37
261130001	3	TEOM	Houghton Lake	Missaukee	2008	8581	76.0	37.0	36.0	35.0	7.34
261470005	3	TEOM	Port Huron	St. Clair	2008	8725	59.0	57.0	56.0	56.0	10.71
261530001	3	TEOM	Seney	Schoolcraft	2008	8642	53.0	49.0	47.0	46.0	6.15
261610008	3	TEOM	Ypsilanti	Washtenaw	2008	8709	220.0	193.0	125.0	90.0	10.49
261630001	3	TEOM	Allen Park	Wayne	2008	7790	88.0	84.0	77.0	73.0	11.45
261630033	3	TEOM	Dearborn	Wayne	2008	8562	132.0	116.0	107.0	80.0	12.71
261630039	3	TEOM	Detroit – 29th Street	Wayne	2008	7932	63.0	52.0	52.0	51.0	11.49
261630039	4	TEOM	Detroit – W. Lafayette	Wayne	2008	8623	144.0	132.0	53.0	53.0	11.75

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	2008	59	61	97	43	36	31	29	13.1
260810020	1	GRAV	Grand Rapids - Monroe	Kent	2008	57	61	93	25	25	24	24	10.6
261630001	1	GRAV	Allen Park	Wayne	2008	60	61	98	38	37	35	35	16.6
261630015	1	GRAV	Detroit - W. Fort	Wayne	2008	58	61	95	58	52	49	47	22.8
261630033	1	GRAV	Dearborn	Wayne	2008	59	61	97	73	61	59	57	26.5

*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	2008	8524	418	408	263	258	26.4

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
260810020	1	Grand Rapids	Kent	2008	5090	.005	.005	0	.013	.011	0	.0202	.0195	.00107
261630015	1	Detroit - W. Fort	Wayne	2008	4380	.013	.011	0	.059	.042	0	.0992	.0700	.00204*
261630019	1	Detroit - E. Seven Mile	Wayne	2008	8370	.053	.045	0	.099	.09	0	.115	.110	.0053

*Indicates the mean does not satisfy summary criteria.

Appendix B – Precision and Accuracy Report for 2008

Appendix B provides the quality assurance assessment summary for precision and accuracy of the AQD's Air Monitoring Unit (AMU) network monitors for the criteria air pollutants. The AMU follows a quality system where quality assurance project plans are developed and implemented, as well as standard operating procedures to ensure that the monitoring data is accurate and defendable. Precision (repeatability of a measurement) and accuracy (closeness of the measurement to a true value) are the two primary components of the quality system.

The AMU adheres to the quality assurance requirements of the EPA for gaseous and particulate air pollutant monitors as specified in Title 40 CFR, Part 58. Gaseous monitors are used for O_3, CO, SO_2, and NO_2; particulate monitors are used for PM (TSP, PM_{10} and $PM_{2.5}$); and Pb is collected using a High Volume Sampler (Hi-Vol).

Precision Measurements:

Gaseous Monitors

Title 40 CFR, Part 58 specifies the concentration levels of calibration gas to be used for gaseous monitor precision and span checks. These checks are conducted on the criteria pollutant monitors by the site operators every two weeks. The precision checks are performed by challenging the monitor with a level of gas that is closest to the expected ambient level. The span check is conducted by challenging the monitor with a higher level of gas that is at the upper end of the monitor's calibration range.

Particulate Monitors

Precision, or reproducibility of the measurements, must be reported for particulate monitors, as required in the *Federal Register* (Title 40 CFR, Part 58). To determine precision, pairs of measurements are made using the separate monitors.

Accuracy Measurements:

Gaseous Monitors

Accuracy is evaluated for gaseous monitors by the site operator conducting the two-week calibration checks and the quarterly, multi-point calibration gas checks. Accuracy for gaseous monitors is also evaluated by a yearly independent audit where three levels of audit gas are used to challenge the gaseous monitors. Quality Assurance Team members conduct audits using dedicated audit equipment and gases. The assessment summary in this appendix reports the results of the accuracy calculations.

Particulate Monitors

The site operator evaluates the accuracy of the particulate monitors by conducting quarterly flow checks on the PM_{10} and Hi-Vol samplers, four-week checks on the $PM_{2.5}$ (FRM), and two-week checks on the continuous $PM_{2.5}$ TEOMs. The accuracy of the flow rates on the $PM_{2.5}$, PM_{10}, Hi-Vol, and TEOMs are audited at least once every six months. Quality Assurance Team members conduct these independent flow audits using dedicated audit equipment.

To ensure the accuracy of the AMU's monitoring equipment, all flow measurement devices, flow orifices, thermometer and met equipment (measuring wind speed and wind direction at the sites) are recertified once a year using a certified standard. In addition, once each year, the EPA laboratory certifies two of the AMU's ozone analyzers, which are then used as Reference Method instruments. The calibrators with photometers that are used in the field to quality-assure the station ozone analyzers are certified against the Reference Method instruments. Each calibrator with a photometer is certified at the beginning of the ozone season and within six months.

APPENDIX B
MICHIGAN AIR SAMPLING NETWORK
2008 DATA ASSESSMENT SUMMARY FOR CRITERIA AIR POLLUTANTS

PM-10:

	PRECISION					ACCURACY			
YR-QTR	#Co-located Samples	#Co-located Sites	# Samples < Limit	% CV	No. of Valid Co-located Data Pairs	# of Sites	# Flow Audits	Probability Lower	Probability Upper
2008	56	1	16	10.08	40	5	14	-6.83	+8.91
1st	13	1	3	12.33	10	5	3	-6.04	+12.03
2nd	13	1	3	4.05	10	5	4	-6.32	+5.82
3rd	15	1	3	19.26	12	5	3	-9.18	+6.50
4th	15	1	7	3.95	8	5	4	-6.18	+11.47

LEAD:

	PRECISION				ACCURACY				LAB ACCURACY	
YR-Q	# of Co-loc Samples	# of Co-loc Sites	# of Samples < Limit	% CV	# Valid Co-loc DataPair	# of Flow Audits	# of Sites	Field & Lab Results Signed Bias	# Audits Level 1	# Audits Level 2
2008	67	1	44	4.63	23	4	1	+/- 11.68 %	12	12
1st		1				2	1		3	3
2nd		1				0	1		3	3
3rd		1				2	1		3	3
4th		1				0	1		3	3

APPENDIX B
MICHIGAN AIR SAMPLING NETWORK
2008 DATA ASSESSMENT SUMMARY FOR CRITERIA AIR POLLUTANTS

SULFUR DIOXIDE:

	PRECISION				ACCURACY			
						1-Point Conf. Limits		% Btwn
YR-QTR	#Analyzer	# Checks	%CV	%Bias	# Audits	Lower	Upper	Conf.
2008	3	65	4.85	-4.51	3	-11.28	+5.52	91
1st	1	7	2.04	-2.81	0			
2nd	3	18	4.90	-6.92	1			
3rd	3	19	5.29	-4.16	0			
4th	3	21	6.07	+/-5.24	2			

CARBON MONOXIDE:

	PRECISION				ACCURACY			
						1-Point Conf. Limits		% Btwn
YR-QTR	#Analyzer	# Checks	%CV	%Bias	# Audits	Lower	Upper	Conf.
2008	2	39	6.51	+/-5.21	2	-11.41	10.23	83
1st	0	0	*	*	0			
2nd	2	13	5.93	-4.96	1			
3rd	2	13	9.36	+/-7.48	1			
4th	2	13	6.77	-5.40	0			

Note: * Measurements less than amount needed to calculate.

APPENDIX B
MICHIGAN AIR SAMPLING NETWORK
2008 DATA ASSESSMENT SUMMARY FOR CRITERIA AIR POLLUTANTS

PM-2.5:

	PRECISION					ACCURACY		
YR-QTR	# of Co-located Samples	#Co-located Sites	# Samples < Limit	% CV	No. of Valid Colocated Data Pairs	# Audits	95 Per Cent Probability Lower	95 Per Cent Probability Upper
2008	108	4	10	5.42	98	62	-3.25	+1.65
1st	28	4	0	6.33	28	5	-3.35	+.84
2nd	24	4	4	6.09	20	22	-2.84	+2.04
3rd	27	4	5	3.40	23	5	-1.33	+1.67
4th	28	4	1	7.16	27	30	-3.55	+1.19

OZONE:

	PRECISION				ACCURACY			
YR-QTR	#Analyzer	# Checks	%CV	%Bias	# Audits	1-Point Conf. Limits Lower	1-Point Conf. Limits Upper	% Btwn Conf.
2008	2	39	1.77	+/-1.29	27	-3.42	+3.18	95
1st	No data due to ozone season							
2nd	2	13	1.73	+/-1.23	15			
3rd	2	13	1.81	-1.43	12			
4th	No data due to ozone season							

Note: Michigan's ozone season runs from April thru September.

APPENDIX B
MICHIGAN AIR SAMPLING NETWORK
2008 DATA ASSESSMENT SUMMARY FOR CRITERIA AIR POLLUTANTS

NITROGEN DIOXIDE:

	PRECISION				ACCURACY			
						1-Point Conf. Limits		% Btwn
YR-QTR	#Analyzer	# Checks	%CV	%Bias	# Audits	Lower	Upper	Conf.
2008	1	28	3.69	+2.89	2	-5.73	+6.13	63
1st	1	7	2.04	+3.33	1			
2nd	1	6	3.44	-5.03	0			
3rd	1	7	2.81	-2.92	1			
4th	1	8	6.65	-7.34	0			

Appendix C: 2008 Air Toxics Monitoring Summary for Metals, VOCs, Carbonyl Compounds and Speciated $PM_{2.5}$

Appendix C provides annual summary statistics of ambient air concentrations of various substances monitored in Michigan during 2008. At each monitoring site, air samples were taken over a 24-hour period (midnight to midnight); one calendar day. These air samples are called "observations" and represent the average air concentration during that 24-hour period. The frequency of observation can change by site and chemical substance, but was typically done once every 6 or 12 days. For some substances the sampled air concentration was lower than the laboratory's analytical method detection level (MDL). The annual average values in the following tables are calculated in two different ways, which will give different annual averages, depending on how many samples during the year were above or below the MDL. Air concentrations that are lower than the MDL are given the value of "non-detect." Each substance analyzed has its own MDL, which varies from laboratory to laboratory and from year to year. The cited MDLs represent the detection limits that are routinely attained. In the calculation of the minimum and maximum annual averages (also called "means"), zero (0.0 $\mu g/m^3$) or the ½ MDL, respectively, are substituted for non-detected air contaminant levels.

The 2008 data in this appendix are divided into two sections: **Appendix C-1** summarizes the air concentrations of various metals (TSP and PM_{10}), VOCs, SVOCs, Hexavalent Chromium and carbonyls; whereas **Appendix C-2** summarizes the air concentrations of various metals found in speciated $PM_{2.5}$.

Table C shows the monitoring stations and what was monitored at each station in 2008.

Table C. Monitoring Stations and Types of Air Samples Collected

	Appendix C-1						Appendix C-2
Site Name	**VOC**	**SVOC**	**Carbonyl**	**Metals TSP**	**Metals PM_{10}**	**Hex Chrome**	**Speciated $PM_{2.5}$**
Allen Park				x			x
Dearborn	x	x	x	x	x	x	x
Detroit W. Fort St	x		x	x			x
Detroit W. Jefferson				x			
Flint				x			
Grand Rapids							x
Houghton Lake							x
Kalamazoo							x
Luna Pier							x
Port Huron, Nat'l Guard Arm.							x
River Rouge			x	x			
Tecumseh							x
Ypsilanti							x

The following terms and acronyms are used in the **Appendix C** data tables:

MDL: Analytical MDL in units of $\mu g/m^3$
 # Obs: Number of Observations (number of daily air samples taken during the year)
Num > MDL: Number of daily samples above the MDL
Max1: Highest daily air concentration during 2008
Max2: Second highest daily air concentration during 2008
Max3: Third highest daily air concentration during 2008
Min Mean: Average air concentration, assuming daily samples below MDL were equal to 0.0 $\mu g/m^3$.
Max Mean: Average air concentration, assuming daily samples below MDL were equal to one half MDL (MDLx0.5).
AIRS ID: Aerometric Information Retrieval System identification number used by EPA and MDEQ to identify each monitoring site.

APPENDIX C-1
Air Toxics Monitoring Data Summary for Metals, VOCs, Carbonyls and SVOCs

Allen Park								
Chemical Name	**Num Obs**	**Obs >MDL**	**MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Arsenic (TSP)	58	58	0.00014	0.0123	0.006	0.00528	0.00166	0.00166
Cadmium (TSP)	58	58	0.000134	0.00126	0.000537	0.00053	0.000295	0.000295
Manganese (TSP)	58	58	0.000334	0.0553	0.0479	0.0379	0.0211	0.0211
Nickel (TSP)	58	58	0.00013	0.00274	0.00264	0.00254	0.00133	0.00133

Dearborn								
Chemical Name	**Num Obs**	**Obs >MDL**	**MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Arsenic (TSP)	62	62	0.000141	0.00777	0.00451	0.00426	0.0019	0.0019
Beryllium (TSP)	62	62	0.000199	0.000304	0.000261	0.00024	0.0000969	0.0000969
Barium (TSP)	62	62		0.343	0.0689	0.0682	0.0331	0.0331
Cadmium (TSP)	62	62	0.000135	0.00238	0.00164	0.00148	0.00052	0.00052
Chromium (TSP)	62	62	0.000232	0.0203	0.0139	0.0134	0.00639	0.00639
Cobalt (TSP)	62	62	0.000179	0.000938	0.00076	0.000757	0.000308	0.000308
Copper (TSP)	62	62	0.000412	0.571	0.468	0.456	0.23	0.23
Chromium VI (TSP)	58	53	7.3E-06	0.000392	0.000145	0.000132	0.0000446	0.0000449
Iron (TSP)	62	62		6.45	5.24	4.96	1.81	1.81
Lead (TSP)	62	62	0.00019	0.0513	0.049	0.048	0.0175	0.0175
Manganese (TSP)	62	62	0.000336	0.303	0.274	0.239	0.101	0.101
Molybdenum (TSP)	62	62	0.000135	0.0105	0.00672	0.00451	0.00155	0.00155
Nickel (TSP)	62	62	0.00013	0.0149	0.0081	0.00774	0.00318	0.00318
Vanadium (TSP)	62	62	0.000185	0.0129	0.0108	0.0103	0.00412	0.00412
Zinc (TSP)	62	62		0.748	0.463	0.461	0.162	0.162
Naphthalene	41	41	0.000578	0.432	0.374	0.365	0.138	0.138
Acenaphthene	41	41	0.000052	0.16	0.141	0.0394	0.0163	0.0163
Acenaphthylene	41	35	4.64E-05	0.00974	0.0046	0.0046	0.0015	0.0015
Fluorene	41	41	6.71E-05	0.117	0.0888	0.0339	0.0134	0.0134
Phenanthrene	41	41	0.000124	0.197	0.134	0.067	0.0269	0.0269
Anthracene	41	31	0.000039	0.00682	0.00275	0.00271	0.000826	0.000831
Fluoranthene	41	41	5.65E-05	0.0267	0.0194	0.0143	0.00562	0.00562
Pyrene	41	41	5.74E-05	0.0136	0.00881	0.00629	0.00294	0.00294
Chrysene	41	41	7.91E-05	0.00207	0.00156	0.00143	0.0005	0.0005
Benzo(a)anthracene	41	40	7.78E-05	0.001	0.000735	0.0007	0.000218	0.000219
Benzo(b)fluoranthene	41	41	0.00011	0.0023	0.00132	0.00129	0.000448	0.000448
Benzo(k)fluoranthene	41	40	6.21E-05	0.000626	0.000385	0.00037	0.00013	0.00013
Dibenzo(ah)anthracene	41	7	0.000109	0.000191	0.00014	0.000124	0.0000145	0.0000601
Benzo(ghi)perylene	41	40	0.000126	0.00118	0.000829	0.00062	0.00023	0.000232
Benzo(a)pyrene	41	37	8.89E-05	0.000752	0.000576	0.00054	0.000164	0.000169
Indeno(123-cd)pyrene	41	36	0.000118	0.00128	0.000663	0.0006	0.000216	0.000224

Dearborn								
Chemical Name	Num Obs	Obs >MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Carbon Disulfide	61	61	0.0125	8.13	1.6	1.59	0.392	0.392
Propylene	61	61	0.0327	2.94	1.91	1.82	0.702	0.702
Acetylene	61	61	0.00959	3.64	2.94	2.58	1.22	1.22
Halocarbon 114	61	60	0.021	0.14	0.14	0.14	0.104	0.104
1,3-Butadiene	61	60	0.0111	0.597	0.412	0.199	0.0869	0.087
n-Octane	61	56	0.0234	0.514	0.308	0.28	0.121	0.122
Methyl Tert-Butyl Ether	61	0	0.018	0	0	0	0	0.00902
Ethyl Tert-Butyl Ether	61	0	0.0209	0	0	0	0	0.0104
Ethyl Acrylate	61	0	0.086	0	0	0	0	0.043
Methyl Methacrylate	61	2	0.0491	0.336	0.041	0	0.00618	0.0299
Formaldehyde	45	45	0.0105	7.71	7.44	5.43	3.01	3.01
Acetaldehyde	45	45	0.0188	4.72	3.15	2.81	1.62	1.62
Propionaldehyde	45	45	0.00618	0.974	0.594	0.497	0.303	0.303
Isovaleraldehyde	45	14	0.00705	0.13	0.106	0.0705	0.0164	0.0188
Hexanaldehyde	45	45	0.0107	0.328	0.25	0.221	0.114	0.114
Valeraldehyde	45	45	0.00736	0.218	0.176	0.169	0.0895	0.0895
Acetone	45	45	0.00496	7.38	6.22	5.89	2.85	2.85
Methyl Ethyl Ketone	61	61	0.0826	3.1	3.07	1.86	0.822	0.822
Methyl Isobutyl Ketone	61	61	0.0656	1.08	0.819	0.733	0.296	0.296
Acetonitrile	61	59	0.0369	6.67	2.57	1.01	0.482	0.483
Acrylonitrile	61	4	0.0195	0.152	0.0716	0.0499	0.00523	0.0144
Chloromethane	61	61	0.0165	1.88	1.84	1.8	1.39	1.39
Methylene Chloride	61	61	0.0625	5.18	3.27	1.71	0.53	0.53
Chloroform	61	61	0.0342	2.08	1.79	1.68	0.975	0.975
Carbon Tetrachloride	61	61	0.0252	1.38	1.26	1.13	0.772	0.772
Bromoform	61	0	0.0517	0	0	0	0	0.0258
Trichloroflouromethane	61	61	0.0169	4.1	3.09	2.92	1.64	1.64
Chloroethane	61	59	0.0106	0.214	0.15	0.15	0.0733	0.0735
1,1-Dichloroethane	61	1	0.0283	0.0121	0	0	0.000199	0.0141
1,1,1-Trichloroethane	61	61	0.0273	0.175	0.115	0.109	0.0827	0.0827
1,2-Dichloroethane	61	0	0.0364	0	0	0	0	0.0182
Tetrachloroethene	61	59	0.0407	1.09	0.692	0.678	0.22	0.221
1,1,2,2-Tetrachloroethane	61	0	0.0618	0	0	0	0	0.0309
Bromomethane	61	58	0.0155	0.0777	0.0505	0.0505	0.0368	0.0371
1,1,2-Trichloroethane	61	1	0.0436	0.0546	0	0	0.000894	0.0224
Dichlorodiflouromethane	61	61	0.0247	4.6	4.35	4.25	2.8	2.8
Trichloroethene	61	10	0.0215	0.322	0.215	0.107	0.0175	0.0265
1,1-Dichloroethene	61	0	0.0198	0	0	0	0	0.00991
Bromodichloromethane	61	1	0.0469	0.067	0	0	0.0011	0.0242
1,2-Dichloropropane	61	0	0.0462	0	0	0	0	0.0231
trans-1,3-Dichloropropene	61	0	0.0318	0	0	0	0	0.0159
cis-1,3-Dichloropropene	61	0	0.0318	0	0	0	0	0.0159
Dibromochloromethane	61	0	0.0426	0	0	0	0	0.0213

Dearborn								
Chemical Name	**Num Obs**	**Obs >MDL**	**MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
2-Chloro-1,3-Butadiene	61	0	0.0253	0	0	0	0	0.0127
Bromochloromethane	61	0	0.0318	0	0	0	0	0.0159
trans-1,2-Dichloroethene	61	1	0.0198	0.0317	0	0	0.00052	0.0103
cis-1,2-Dichloroethene	61	0	0.0278	0	0	0	0	0.0139
1,2-Dibromoethane	61	0	0.0538	0	0	0	0	0.0269
Hexachloro-1,3-Butadiene	61	0	0.181	0	0	0	0	0.0906
Vinyl Chloride	61	12	0.0128	0.0511	0.0204	0.0204	0.00316	0.0083
m/p -Xylene	61	61	0.0825	4.43	3.39	3.37	0.854	0.854
Benzene	61	61	0.032	3.77	2.1	2.01	0.958	0.958
Toluene	61	61	0.0867	8.18	5.54	3.09	1.3	1.3
Ethylbenzene	61	61	0.0347	1.26	1.2	0.973	0.298	0.298
o-xylene	61	61	0.0347	1.22	0.925	0.808	0.278	0.278
1,3,5-Trimethylbenzene	61	60	0.0787	0.796	0.639	0.595	0.147	0.148
1,2,4-Trimethylbenzene	61	61	0.0787	2.32	2.02	1.72	0.461	0.461
Styrene	61	51	0.0895	0.213	0.213	0.136	0.0457	0.0534
Benzaldehyde	45	45	0.00868	0.304	0.256	0.226	0.105	0.105
2,5-dimethylbenzaldehyde	45	0	0.011	0	0	0	0	0.00548
Tolualdehydes	45	45	0.0103	0.295	0.295	0.221	0.106	0.106
Chlorobenzene	61	59	0.0368	0.994	0.939	0.898	0.507	0.507
1,2-Dichlorobenzene	61	0	0.0902	0	0	0	0	0.0451
1,3-Dichlorobenzene	61	0	0.0902	0	0	0	0	0.0451
1,4-Dichlorobenzene	61	54	0.0721	0.481	0.24	0.24	0.0764	0.0805
Chloromethyl Benzene	61	19	0.057	0.104	0.0518	0.0518	0.011	0.0306
1,2,4-Trichlorobenzene	61	1	0.223	0.594	0	0	0.00973	0.119
Arsenic (PM-10)	61	61	0.000174	0.00723	0.00447	0.00403	0.00164	0.00164
Beryllium (PM-10)	61	59	0.000245	0.000144	0.000106	0.0000973	0.0000304	0.0000346
Barium (PM-10)	61	61		0.369	0.0816	0.0551	0.023	0.023
Cadmium (PM-10)	61	61	0.000166	0.00234	0.00153	0.00151	0.000437	0.000437
Chromium (PM-10)	61	61	0.000286	0.18	0.00956	0.00905	0.00762	0.00762
Cobalt (PM-10)	61	61	0.000221	0.00332	0.000832	0.000742	0.000325	0.000325
Copper (PM-10)	61	61	0.00103	0.324	0.257	0.207	0.0689	0.0689
Iron (PM-10)	61	61		2.45	2.23	2.18	0.79	0.79
Lead (PM-10)	61	61	0.000234	0.0462	0.0417	0.0408	0.0132	0.0132
Manganese (PM-10)	61	61	0.000413	1.69	0.548	0.198	0.0757	0.0757
Molybdenum (PM-10)	61	61	0.000166	0.0102	0.00563	0.00414	0.00126	0.00126
Nickel (PM-10)	61	60	0.000161	0.187	0.012	0.0073	0.00535	0.00535
Vanadium (PM-10)	61	61	0.000228	0.00797	0.00758	0.00705	0.00215	0.00215
Zinc (PM-10)	61	61		0.647	0.339	0.32	0.101	0.101

Detroit, W. Fort St., SWHS								
Chemical Name	Num Obs	Obs >MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Arsenic (TSP)	59	59	0.000142	0.00495	0.0048	0.00443	0.00178	0.00178
Cadmium (TSP)	59	59	0.000135	0.00484	0.00158	0.0014	0.000526	0.000526
Manganese (TSP)	59	59	0.000336	0.158	0.126	0.115	0.0575	0.0575
Nickel (TSP)	59	59	0.000131	0.0106	0.00757	0.00654	0.00279	0.00279
Halocarbon 113	28	27	0.387	0.81	0.76	0.73	0.615	0.626
Halocarbon 114	29	0	0.51	0	0	0	0	0.255
1,3-Butadiene	29	1	0.19	0.23	0	0	0.00793	0.1
n-Hexane	29	26	0.259	3.5	3	2	1.09	1.13
2,2,4-Trimethylpentane	29	11	0.34	1.3	0.95	0.87	0.249	0.356
Methyl Tert-Butyl Ether	29	0	0.193	0	0	0	0	0.0967
Formaldehyde	30	30	0.0252	4.83	4.06	2.95	1.84	1.84
Acetaldehyde	30	30	0.0234	4.48	2.59	2.3	1.52	1.52
Propionaldehyde	30	14	0.0387	1.11	0.759	0.694	0.259	0.269
n-Butyraldehyde	30	4	0.0135	0.653	0.491	0.388	0.0605	0.0664
Isovaleraldehyde	30	0	0.0261	0	0	0	0	0.013
Crotonaldehyde (trans)	30	0	0.0126	0	0	0	0	0.0063
Hexanaldehyde	30	1	0.0414	0.93	0	0	0.031	0.051
Valeraldehyde	30	2	0.0396	0.59	0.583	0	0.0391	0.0576
Acetone	30	30	0.0755	5.32	4.74	4.59	2.46	2.46
Methyl Ethyl Ketone	29	29	0.33	27	8	5.2	3.38	3.38
Methyl Isobutyl Ketone	29	26	0.397	58	7.5	2.3	3.01	3.03
Acetonitrile	29	21	0.252	4.7	1.7	1.6	0.704	0.738
Acrylonitrile	29	3	0.106	3.9	0.11	0.1	0.142	0.189
Chloromethane	29	29	0.193	1.9	1.8	1.6	1.24	1.24
Methylene Chloride	29	22	0.333	1.4	1.2	1	0.482	0.533
Chloroform	29	29	0.299	6.1	4.5	4.1	2.6	2.6
Carbon Tetrachloride	29	27	0.4	1	0.76	0.74	0.559	0.577
Bromoform	29	0	1.26	0	0	0	0	0.631
Trichloroflouromethane	29	29	0.263	2.5	1.6	1.6	1.29	1.29
Chloroethane	29	0	0.429	0	0	0	0	0.214
1,1-Dichloroethane	29	0	0.211	0	0	0	0	0.105
1,1,1-Trichloroethane	29	0	0.29	0	0	0	0	0.145
1,2-Dichloroethane	29	0	0.275	0	0	0	0	0.138
Tetrachloroethene	29	0	0.842	0	0	0	0	0.421
1,1,2,2-Tetrachloroethane	29	0	0.769	0	0	0	0	0.384
Bromomethane	29	0	0.271	0	0	0	0	0.135
1,1,2-Trichloroethane	29	0	0.753	0	0	0	0	0.377
Dichlorodiflouromethane	29	29	0.373	4.4	3.3	3.1	2.5	2.5
Trichloroethene	29	0	0.479	0	0	0	0	0.239
1,1-Dichloroethene	29	0	0.186	0	0	0	0	0.0929
Bromodichloromethane	29	0	0.774	0	0	0	0	0.387
1,2-Dichloropropane	29	0	0.41	0	0	0	0	0.205
trans-1,3-	29	0	0.519	0	0	0	0	0.259

Detroit, W. Fort St., SWHS								
Chemical Name	**Num Obs**	**Obs >MDL**	**MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Dichloropropene								
cis-1,3-Dichloropropene	29	0	0.47	0	0	0	0	0.235
Dibromochloromethane	29	0	1.15	0	0	0	0	0.575
2-Chloro-1,3-Butadiene	29	0	0.188	0	0	0	0	0.0942
trans-1,2-Dichloroethene	29	0	0.223	0	0	0	0	0.112
cis-1,2-Dichloroethene	29	0	0.227	0	0	0	0	0.113
1,2-Dibromoethane	29	0	1.01	0	0	0	0	0.506
Hexachloro-1,3-Butadiene	29	1	1.6	4.5	0	0	0.155	0.928
Vinyl Chloride	29	0	0.19	0	0	0	0	0.095
m/p -Xylene	29	18	0.789	6.7	3.2	2.6	1.11	1.26
Benzene	29	29	0.133	7.3	5.3	3	1.47	1.47
Toluene	29	28	0.37	5.2	4.9	4.4	2.1	2.12
Ethylbenzene	29	5	0.646	2.1	0.85	0.73	0.177	0.444
o-xylene	29	7	0.665	2.7	1.1	1	0.282	0.533
1,3,5-Trimethylbenzene	29	1	0.617	0.7	0	0	0.0241	0.322
1,2,4-Trimethylbenzene	29	10	0.619	2.3	1.5	1.4	0.399	0.602
Styrene	29	2	0.722	15	1.1	0	0.555	0.894
Benzaldehyde	30	1	0.0216	0.965	0	0	0.0322	0.0426
2,5-dimethylbenzaldehyde	30	0	0.053	0	0	0	0	0.0265
o-Tolualdehyde	30	0	0.0333	0	0	0	0	0.0166
m,p-Tolualdehyde	30	1	0.0396	2.89	0	0	0.0962	0.115
Chlorobenzene	29	0	0.759	0	0	0	0	0.379
1,2-Dichlorobenzene	29	0	0.799	0	0	0	0	0.399
1,3-Dichlorobenzene	29	0	0.806	0	0	0	0	0.403
1,4-Dichlorobenzene	29	0	0.852	0	0	0	0	0.426
Chloromethyl Benzene	29	0	0.55	0	0	0	0	0.275
1,2,4-Trichlorobenzene	29	1	1.23	3	0	0	0.103	0.693

Detroit, W. Jefferson, Near Zug Island								
Chemical Name	**Num Obs**	**Obs >MDL**	**MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Arsenic (TSP)	57	57	0.000142	0.00678	0.00542	0.00472	0.00231	0.00231
Cadmium (TSP)	57	57	0.000136	0.00513	0.00315	0.00274	0.000844	0.000844
Manganese (TSP)	57	57	0.000338	0.604	0.319	0.311	0.121	0.121
Nickel (TSP)	57	57	0.000131	0.00971	0.00871	0.007	0.00329	0.00329

Flint								
Chemical Name	Num Obs	Obs >MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Manganese (TSP)	61	61	0.00034	0.0273	0.0254	0.0242	0.00891	0.00891

River Rouge								
Chemical Name	Num Obs	Obs >MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Arsenic (TSP)	57	57	0.000141	0.00621	0.00475	0.00442	0.00165	0.00165
Cadmium (TSP)	57	57	0.000135	0.00297	0.0028	0.00232	0.000718	0.000718
Manganese (TSP)	57	57	0.000336	0.342	0.29	0.254	0.0758	0.0758
Nickel (TSP)	57	57	0.00013	0.00723	0.00713	0.00682	0.00244	0.00244
Formaldehyde	59	59	0.0252	5.93	5.89	5.55	3.07	3.07
Acetaldehyde	59	59	0.0234	3.67	3.56	2.49	1.61	1.61
Propionaldehyde	59	27	0.0387	1.46	1.14	0.964	0.299	0.31
n-Butyraldehyde	59	12	0.0135	0.791	0.657	0.566	0.0984	0.104
Isovaleraldehyde	59	3	0.0261	0.908	0.847	0.783	0.043	0.0554
Crotonaldehyde (trans)	59	0	0.0126	0	0	0	0	0.00631
Hexanaldehyde	59	2	0.0414	0.82	0.664	0	0.0252	0.0452
Valeraldehyde	59	1	0.0396	0.727	0	0	0.0123	0.0318
Acetone	59	59	0.0756	4.22	4.19	3.92	2.37	2.37
Benzaldehyde	59	1	0.0216	0.925	0	0	0.0157	0.0263
2,5-dimethylbenzaldehyde	59	0	0.053	0	0	0	0	0.0265
o-Tolualdehyde	59	0	0.0333	0	0	0	0	0.0166
m,p-Tolualdehyde	59	0	0.0396	0	0	0	0	0.0198

APPENDIX C-2
Air Toxics Monitoring Data Summary for Speciated $PM_{2.5}$

Allen Park								
Chemical Name	NumObs	Obs> MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Antimony	120	29	0.0358	0.083	0.0539	0.0373	0.00474	0.0191
Arsenic	120	71	0.00154	0.0149	0.00781	0.00737	0.00114	0.00147
Aluminum	120	79	0.0139	0.134	0.111	0.105	0.0209	0.0233
Barium	120	20	0.0173	0.182	0.0125	0.0116	0.00235	0.00668
Bromine	120	115	0.0016	0.00962	0.00843	0.00809	0.00299	0.00302
Cadmium	120	29	0.0163	0.0152	0.014	0.0129	0.0014	0.00778
Calcium	120	119	0.00602	0.163	0.15	0.128	0.0442	0.0442
Chromium	120	65	0.00228	0.0221	0.0188	0.0127	0.00149	0.002
Cobalt	120	64	0.00134	0.00781	0.00256	0.00237	0.000477	0.000817
Copper	120	119	0.00166	0.129	0.108	0.0535	0.0102	0.0102
Chlorine	120	103	0.00721	0.474	0.392	0.262	0.0323	0.033
Cerium	120	1	0.0193	0.00047	0	0	0.00000392	0.00961
Cesium	120	21	0.0246	0.0084	0.00585	0.00444	0.000441	0.00933
Europium	120	21	0.00558	0.0107	0.0086	0.00619	0.000539	0.00269
Gallium	120	21	0.00232	0.00141	0.00118	0.00108	0.000104	0.00099
Iron	120	120	0.00187	1.37	0.213	0.2	0.102	0.102
Hafnium	120	22	0.00826	0.0092	0.00512	0.00477	0.000424	0.00372
Indium	120	21	0.0178	0.0316	0.0234	0.021	0.00172	0.00895
Manganese	120	98	0.00196	0.00885	0.00833	0.00675	0.00191	0.00208
Iridium	120	7	0.00519	0.00828	0.00256	0.00222	0.000135	0.00258
Molybdenum	120	10	0.0065	0.00689	0.00479	0.00128	0.000141	0.00314
Nickel	120	76	0.00133	0.00743	0.00575	0.00525	0.000846	0.00109
Magnesium	120	52	0.0133	0.315	0.0348	0.0324	0.00691	0.0108
Mercury	120	24	0.00629	0.00478	0.00338	0.00327	0.000401	0.00279
Gold	120	18	0.00434	0.00387	0.00281	0.00233	0.000228	0.00215
Lanthanum	120	13	0.0169	0.0137	0.0112	0.00688	0.000394	0.00688
Niobium	120	18	0.00401	0.0049	0.0028	0.00244	0.000171	0.00187
Phosphorus	120	3	0.0115	0.00891	0.00164	0.00152	0.000101	0.00576
Selenium	120	51	0.00191	0.00798	0.00374	0.00372	0.000742	0.00126
Tin	120	32	0.024	0.0374	0.0339	0.0338	0.00305	0.0119
Titanium	120	52	0.00467	0.0132	0.0114	0.00886	0.00149	0.00284
Samarium	120	15	0.00546	0.00794	0.00536	0.00535	0.000312	0.00255
Scandium	120	8	0.0204	0.00291	0.00135	0.00128	0.0000655	0.00976
Vanadium	120	45	0.00314	0.00538	0.00525	0.00384	0.000602	0.0016
Silicon	120	119	0.0111	0.319	0.201	0.178	0.0537	0.0538
Silver	120	19	0.0132	0.0151	0.0105	0.00938	0.000814	0.00637
Zinc	120	116	0.00259	0.238	0.163	0.056	0.017	0.0171
Strontium	120	37	0.00235	0.059	0.014	0.00268	0.00088	0.00168
Sulfur	120	120	0.00788	3.93	3.79	2.69	0.944	0.944
Tantalum	120	10	0.0072	0.0069	0.00688	0.00351	0.000203	0.00344
Terbium	120	9	0.00489	0.00571	0.00373	0.00093	0.000121	0.00236
Rubidium	120	40	0.00193	0.00209	0.00163	0.00161	0.000248	0.00088

Allen Park								
Chemical Name	NumObs	Obs> MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Potassium	120	119	0.006	3.69	0.253	0.137	0.0828	0.0829
Yttrium	120	21	0.00265	0.00303	0.00232	0.0021	0.00021	0.00129
Sodium	120	85	0.0387	0.276	0.237	0.233	0.0375	0.0431
Zirconium	120	37	0.00389	0.0198	0.0129	0.0129	0.00112	0.00243
Tungsten	120	14	0.00558	0.00747	0.00652	0.00362	0.000281	0.00274
Ammonium Ion	120	120	0.0179	6.53	5.42	4.75	1.64	1.64
Sodium Ion	120	119	0.0273	0.592	0.587	0.467	0.113	0.113
Potassium Ion	120	85	0.0154	3.77	0.246	0.208	0.0854	0.0875
Oc Csn Unadjusted Tot	120	120	0.24	12.5	11.1	9.66	3.92	3.92
Total Nitrate	120	120	0.00705	10.9	10.7	8.22	2.27	2.27
Ec Csn Tot	120	120	0.24	2.85	2.59	1.75	0.714	0.714
Oc1 Csn Unadjusted Tot	120	120	0.24	3	2.29	2.1	0.889	0.889
Oc2 Csn Unadjusted Tot	120	120	0.24	5.28	4.58	3.88	1.34	1.34
Oc3 Csn Unadjusted Tot	120	120	0.24	3.18	2.49	2.34	0.884	0.884
Oc4 Csn Unadjusted Tot	120	119	0.24	2.26	2.23	2.09	0.785	0.786
Op Csn Tot	120	15	0.24	0.523	0.51	0.448	0.0191	0.124
Sulfate	120	120	0.00907	11.8	11.7	9.06	2.86	2.86

Dearborn								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Antimony	59	10	0.0348	0.0525	0.0311	0.0152	0.00252	0.0176
Arsenic	59	39	0.00147	0.0121	0.00444	0.00421	0.00127	0.00151
Aluminum	59	42	0.0146	0.154	0.0922	0.0874	0.0243	0.0265
Barium	59	9	0.0171	0.276	0.0105	0.00594	0.00531	0.0102
Bromine	59	57	0.00152	0.0117	0.0114	0.00933	0.00378	0.00381
Cadmium	59	7	0.0155	0.0163	0.00817	0.00467	0.000674	0.00772
Calcium	59	59	0.00637	0.51	0.466	0.407	0.0968	0.0968
Chromium	59	26	0.00229	0.00787	0.00714	0.007	0.000847	0.00149
Cobalt	59	34	0.00136	0.00688	0.00618	0.00466	0.00102	0.00133
Copper	59	59	0.00176	0.157	0.0453	0.0331	0.0147	0.0147
Chlorine	59	53	0.00757	1.09	0.493	0.38	0.0816	0.0822
Cerium	59	2	0.019	0.00444	0.00222	0	0.000113	0.00948
Cesium	59	9	0.0214	0.0134	0.00362	0.00349	0.000601	0.00808
Europium	59	6	0.00548	0.0124	0.00626	0.00478	0.000532	0.0029
Gallium	59	13	0.00221	0.00256	0.00198	0.00105	0.000172	0.00102
Iron	59	59	0.00192	1.24	0.741	0.722	0.297	0.297
Hafnium	59	13	0.01	0.00454	0.00373	0.0028	0.000377	0.00405
Indium	59	15	0.0168	0.0315	0.0257	0.0245	0.00313	0.00942
Manganese	59	56	0.00195	0.031	0.0243	0.0222	0.00751	0.00756
Iridium	59	5	0.00466	0.00269	0.0021	0.00163	0.000119	0.00232
Molybdenum	59	5	0.00607	0.00489	0.00397	0.00163	0.000194	0.00293
Nickel	59	41	0.00137	0.00439	0.00403	0.00376	0.000974	0.00119
Magnesium	59	34	0.0138	0.437	0.084	0.0818	0.02	0.0227
Mercury	59	12	0.00549	0.0163	0.00595	0.00338	0.000653	0.00265

Dearborn								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Gold	59	6	0.00395	0.00397	0.00222	0.0014	0.00018	0.002
Lanthanum	59	13	0.0166	0.0202	0.0182	0.0117	0.00136	0.00667
Niobium	59	8	0.00378	0.00584	0.0021	0.00175	0.000233	0.00185
Phosphorus	59	1	0.012	0.00046	0	0	0.0000078	0.00596
Selenium	59	37	0.00191	0.00446	0.00386	0.00384	0.00101	0.00131
Tin	59	19	0.0225	0.0313	0.0292	0.028	0.00451	0.012
Titanium	59	22	0.00478	0.0214	0.00875	0.00642	0.00144	0.00298
Samarium	59	7	0.00542	0.0028	0.00208	0.00152	0.000154	0.00241
Scandium	59	2	0.0173	0.00035	0.00011	0	0.0000078	0.00863
Vanadium	59	30	0.00322	0.012	0.00931	0.00922	0.00158	0.00234
Silicon	59	59	0.0115	0.319	0.281	0.235	0.0709	0.0709
Silver	59	5	0.0126	0.007	0.00467	0.0035	0.000336	0.00612
Zinc	59	59	0.00242	0.31	0.243	0.206	0.0563	0.0563
Strontium	59	20	0.00231	0.0761	0.00537	0.00536	0.00177	0.00251
Sulfur	59	59	0.00816	4.27	3.88	3.15	1.16	1.16
Tantalum	59	3	0.00667	0.00326	0.00303	0.00198	0.00014	0.00326
Terbium	59	12	0.00496	0.0229	0.0139	0.0128	0.00133	0.00339
Rubidium	59	23	0.00191	0.00432	0.0021	0.00175	0.000423	0.00102
Potassium	59	59	0.00671	5.06	0.4	0.159	0.16	0.16
Yttrium	59	9	0.00256	0.00198	0.00175	0.00152	0.000158	0.00125
Sodium	59	45	0.0391	0.291	0.246	0.21	0.0634	0.0679
Zirconium	59	6	0.00369	0.0187	0.00582	0.00117	0.000477	0.0021
Tungsten	59	3	0.00516	0.00525	0.00443	0.00093	0.00018	0.00263
Ammonium Ion	59	59	0.0185	5.61	4.81	4.74	1.94	1.94
Sodium Ion	59	59	0.0261	0.493	0.365	0.363	0.127	0.127
Potassium Ion	59	46	0.0159	4.13	0.447	0.148	0.144	0.146
Total Nitrate	59	59	0.00704	11.7	7.28	7.16	2.46	2.46
Oc Csn_Rev Unadjust Tot	52	52		8.52	6.22	5.67	3.11	3.11
Ec Csn_Rev Unadjust Tot	52	52		2.34	2.05	1.52	0.687	0.687
Sulfate	59	59	0.00903	12.1	11.8	9.17	3.61	3.61

Detroit, Fort St, S.W.H.S.								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Antimony	29	6	0.0367	0.0269	0.0268	0.0211	0.00375	0.0186
Arsenic	29	23	0.00143	0.00654	0.00489	0.00443	0.00191	0.00206
Aluminum	29	21	0.0145	0.122	0.0783	0.0781	0.022	0.0238
Barium	29	3	0.0138	0.101	0.00351	0.00081	0.00363	0.0083
Bromine	29	29	0.00151	0.00978	0.00972	0.00841	0.00355	0.00355
Cadmium	29	10	0.0162	0.0174	0.0151	0.0117	0.00293	0.00843
Calcium	29	29	0.00623	0.552	0.144	0.144	0.0635	0.0635
Chromium	29	14	0.0023	0.00485	0.00373	0.00349	0.000717	0.00132
Cobalt	29	21	0.00129	0.0064	0.00355	0.00279	0.00115	0.00134
Copper	29	29	0.00167	0.0835	0.0409	0.0396	0.0121	0.0121
Chlorine	29	24	0.00698	0.464	0.387	0.206	0.0566	0.0573
Cerium	29	0	0.0136	0	0	0	0	0.00681
Cesium	29	3	0.022	0.00616	0.00186	0.00128	0.000321	0.0101
Europium	29	2	0.00508	0.00314	0.00023	0	0.000116	0.00251
Gallium	29	3	0.0021	0.00105	0.00047	0.00012	0.0000566	0.000901
Iron	29	29	0.00177	0.9	0.5	0.327	0.166	0.166
Hafnium	29	4	0.00884	0.00397	0.00198	0.00186	0.000306	0.00428
Indium	29	6	0.0178	0.0362	0.0209	0.0128	0.00314	0.0103
Manganese	29	24	0.00187	0.0135	0.0113	0.00886	0.00343	0.00359
Iridium	29	4	0.00484	0.00105	0.0007	0.00059	0.000101	0.00224
Molybdenum	29	3	0.00641	0.00395	0.00198	0.00094	0.000237	0.00319
Nickel	29	15	0.0013	0.00287	0.00199	0.00167	0.000477	0.000778
Magnesium	29	17	0.0131	0.19	0.0659	0.0186	0.0134	0.0161
Mercury	29	3	0.00599	0.00911	0.00175	0.00047	0.000391	0.00297
Gold	29	8	0.00393	0.00441	0.00221	0.00093	0.000325	0.00199
Lanthanum	29	4	0.0125	0.005	0.00152	0.00116	0.000273	0.00488
Niobium	29	5	0.00382	0.00477	0.00409	0.00163	0.000418	0.00208
Phosphorus	29	0	0.012	0	0	0	0	0.00602
Selenium	29	14	0.00187	0.00632	0.00442	0.00396	0.000874	0.00133
Tin	29	7	0.0243	0.0514	0.0291	0.00701	0.00349	0.0127
Titanium	29	14	0.00476	0.00454	0.00361	0.00303	0.000768	0.00202
Samarium	29	0	0.00508	0	0	0	0	0.00254
Scandium	29	1	0.021	0.00011	0	0	0.00000379	0.0105
Vanadium	29	14	0.00326	0.00512	0.00234	0.00221	0.000666	0.00153
Silicon	29	29	0.0115	0.33	0.16	0.119	0.0559	0.0559
Silver	29	6	0.013	0.0105	0.00817	0.00699	0.00112	0.00631
Zinc	29	28	0.0026	0.0555	0.0526	0.0468	0.0204	0.0205
Strontium	29	11	0.00226	0.0375	0.00151	0.0014	0.00163	0.00233
Sulfur	29	29	0.00828	3.55	3.48	2.61	1.1	1.1
Tantalum	29	4	0.007	0.00595	0.00186	0.00105	0.000322	0.00343
Terbium	29	5	0.00448	0.00966	0.00919	0.00199	0.000755	0.00263
Rubidium	29	7	0.00185	0.00337	0.0021	0.00163	0.00033	0.00106
Potassium	29	29	0.00639	2.47	0.267	0.185	0.142	0.142
Yttrium	29	6	0.00254	0.00105	0.00093	0.0007	0.000121	0.00111

Detroit, Fort St, S.W.H.S.								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Sodium	29	20	0.0389	0.135	0.0923	0.085	0.0309	0.0368
Zirconium	29	2	0.00376	0.00464	0.0035	0	0.000281	0.00203
Tungsten	29	0	0.00529	0	0	0	0	0.00264
Ammonium Ion	29	29	0.0185	5.16	4.04	3.12	1.42	1.42
Sodium Ion	29	29	0.0261	0.415	0.273	0.261	0.0994	0.0994
Potassium Ion	29	17	0.016	2.56	0.205	0.194	0.141	0.144
Oc Csn Unadjusted Tot	10	10	0.24	6.35	5.89	5.64	4.7	4.7
Total Nitrate	29	29	0.00755	4.35	2.99	2.75	1.19	1.19
Ec Csn Tot	10	10	0.24	1.28	1.22	1.02	0.929	0.929
Oc1 Csn Unadjusted Tot	10	10	0.24	2.12	1.83	1.37	1.18	1.18
Oc2 Csn Unadjusted Tot	10	10	0.24	1.99	1.78	1.72	1.46	1.46
Oc3 Csn Unadjusted Tot	10	10	0.24	1.64	1.56	1.38	1.08	1.08
Oc4 Csn Unadjusted Tot	10	10	0.24	1.65	1.42	1.39	0.978	0.978
Op Csn Tot	10	0	0.24	0	0	0	0	0.12
Oc Csn_Rev Unadjust Tot	20	20		4.8	4.03	3.82	2.28	2.28
Ec Csn_Rev Unadjust Tot	20	20		2.25	1.67	0.934	0.617	0.617
Sulfate	29	29	0.0088	12.9	12.1	7.47	3.27	3.27

Grand Rapids								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Antimony	54	6	0.036	0.0163	0.0153	0.0145	0.00112	0.0174
Arsenic	54	30	0.00136	0.00479	0.00292	0.00283	0.000778	0.00106
Aluminum	54	20	0.0148	0.106	0.0916	0.0408	0.00949	0.014
Barium	54	2	0.0141	0.00549	0.00082	0	0.000117	0.00608
Bromine	54	52	0.00145	0.00596	0.00564	0.00549	0.00268	0.00271
Cadmium	54	12	0.0158	0.0175	0.0175	0.00933	0.00172	0.00813
Calcium	54	54	0.0066	0.105	0.0937	0.0879	0.0325	0.0325
Chromium	54	21	0.00234	0.00528	0.00281	0.00226	0.000467	0.00117
Cobalt	54	30	0.00133	0.00219	0.00174	0.0016	0.000431	0.000746
Copper	54	54	0.00174	0.0425	0.0341	0.0183	0.00809	0.00809
Chlorine	54	49	0.00742	0.394	0.224	0.205	0.0368	0.0373
Cerium	54	0	0.0144	0	0	0	0	0.0072
Cesium	54	4	0.0189	0.0042	0.0021	0.00152	0.000171	0.00794
Europium	54	6	0.00513	0.00198	0.00164	0.00163	0.000143	0.00245
Gallium	54	6	0.00196	0.00146	0.00075	0.00035	0.000055	0.000931
Iron	54	54	0.00183	0.157	0.152	0.134	0.0643	0.0643
Hafnium	54	8	0.0099	0.00771	0.00245	0.00175	0.000281	0.00419
Indium	54	11	0.0169	0.0152	0.0128	0.00467	0.000851	0.00752
Manganese	54	42	0.00189	0.0176	0.0139	0.0125	0.00261	0.00283
Iridium	54	4	0.00427	0.0063	0.00093	0.00023	0.00014	0.00212
Molybdenum	54	2	0.00576	0.00338	0.00244	0	0.000108	0.0029
Nickel	54	31	0.00133	0.00245	0.00145	0.0014	0.000359	0.000636
Magnesium	54	23	0.0134	0.0248	0.0172	0.0169	0.00398	0.00768
Mercury	54	7	0.00518	0.00666	0.00245	0.00152	0.000244	0.00239
Gold	54	5	0.00351	0.0042	0.0035	0.00187	0.000197	0.00186
Lanthanum	54	2	0.0129	0.00175	0.00093	0	0.0000496	0.00576
Niobium	54	9	0.0036	0.00292	0.00257	0.00152	0.000223	0.0017
Phosphorus	54	0	0.0128	0	0	0	0	0.00639
Selenium	54	14	0.00182	0.00339	0.00257	0.00222	0.000277	0.000919
Tin	54	14	0.0226	0.0339	0.0292	0.0291	0.00342	0.0119
Titanium	54	17	0.00489	0.01	0.00501	0.00385	0.000799	0.00251
Samarium	54	7	0.00513	0.00502	0.00396	0.0014	0.00027	0.00243
Scandium	54	2	0.0176	0.00105	0.00035	0	0.0000259	0.00875
Vanadium	54	11	0.00334	0.0035	0.00339	0.00245	0.00035	0.00167
Silicon	54	52	0.0116	0.229	0.207	0.154	0.0469	0.0471
Silver	54	6	0.0125	0.0105	0.00816	0.00583	0.000568	0.00629
Zinc	54	54	0.00239	0.0335	0.0266	0.0262	0.0123	0.0123
Strontium	54	18	0.00226	0.0101	0.00863	0.00304	0.000714	0.00145
Sulfur	54	54	0.00856	3.47	3.39	2.61	0.877	0.877
Tantalum	54	5	0.00632	0.00571	0.00467	0.00281	0.000307	0.00322
Terbium	54	4	0.00462	0.00362	0.00257	0.00175	0.000179	0.00234
Rubidium	54	13	0.00187	0.00245	0.00234	0.00114	0.000212	0.000919
Potassium	54	54	0.00695	0.104	0.0992	0.096	0.0444	0.0444
Yttrium	54	12	0.00246	0.00152	0.00105	0.00105	0.000134	0.00106

Grand Rapids								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Sodium	54	33	0.0384	0.14	0.14	0.0945	0.0207	0.0279
Zirconium	54	5	0.00359	0.0071	0.00584	0.00233	0.000302	0.00188
Tungsten	54	2	0.00476	0.0021	0.00105	0	0.0000583	0.00235
Ammonium Ion	54	54	0.0184	5.82	4.46	4.43	1.59	1.59
Sodium Ion	54	52	0.0261	1.2	0.431	0.384	0.118	0.119
Potassium Ion	54	37	0.016	0.113	0.112	0.103	0.0434	0.0457
Oc Csn Unadjusted Tot	53	53	0.24	6.97	6.66	5.99	3.52	3.52
Total Nitrate	54	54	0.00702	14	10	8.41	2.32	2.32
Ec Csn Tot	53	53	0.24	1.32	1.06	1.05	0.537	0.537
Oc1 Csn Unadjusted Tot	53	53	0.24	1.82	1.77	1.49	0.819	0.819
Oc2 Csn Unadjusted Tot	53	53	0.24	2.83	2.26	2.24	1.27	1.27
Oc3 Csn Unadjusted Tot	53	53	0.24	1.78	1.71	1.4	0.79	0.79
Oc4 Csn Unadjusted Tot	53	53	0.24	1.71	1.7	1.68	0.623	0.623
Op Csn Tot	53	4	0.24	0.656	0.197	0.145	0.0195	0.13
Sulfate	54	54	0.00906	10.4	9.18	6.98	2.6	2.6

Houghton Lake								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Antimony	58	15	0.0344	0.0314	0.028	0.0268	0.00327	0.0169
Arsenic	58	23	0.0015	0.00301	0.00175	0.00163	0.00034	0.000827
Aluminum	58	30	0.0146	0.0572	0.0569	0.0431	0.0102	0.0139
Barium	58	8	0.018	0.00701	0.0042	0.00338	0.000388	0.00532
Bromine	58	51	0.00154	0.00501	0.00446	0.00419	0.0016	0.00169
Cadmium	58	6	0.0154	0.0256	0.0187	0.00584	0.00108	0.00803
Calcium	58	47	0.00636	0.0676	0.0508	0.0407	0.012	0.0126
Chromium	58	21	0.00229	0.00445	0.00418	0.00336	0.000371	0.00111
Cobalt	58	24	0.00138	0.00138	0.00133	0.00095	0.000207	0.000626
Copper	58	25	0.00178	0.00533	0.00305	0.00254	0.000499	0.00101
Chlorine	58	31	0.00768	0.13	0.0362	0.0232	0.00662	0.00857
Cerium	58	1	0.0206	0.00082	0	0	0.0000141	0.0103
Cesium	58	14	0.0218	0.00525	0.00397	0.00338	0.000555	0.00724
Europium	58	5	0.0056	0.014	0.00421	0.00326	0.000451	0.00284
Gallium	58	14	0.00227	0.0021	0.00187	0.00128	0.000197	0.000928
Iron	58	56	0.00196	0.0526	0.0431	0.0418	0.0147	0.0147
Hafnium	58	2	0.0102	0.00035	0.00023	0	0.00001	0.00478
Indium	58	10	0.0167	0.0234	0.0222	0.0187	0.00159	0.0085
Manganese	58	29	0.00197	0.00198	0.00193	0.00169	0.000371	0.000864
Iridium	58	8	0.00471	0.00362	0.00315	0.00186	0.000203	0.00221
Molybdenum	58	6	0.00609	0.00362	0.00117	0.00093	0.000115	0.00283
Nickel	58	24	0.00139	0.00213	0.00175	0.00152	0.00029	0.000689
Magnesium	58	17	0.0139	0.0229	0.0202	0.0177	0.00275	0.00755
Mercury	58	9	0.00549	0.0112	0.00805	0.00643	0.000662	0.00282
Gold	58	6	0.00404	0.00164	0.00163	0.00151	0.000131	0.00204
Lanthanum	58	9	0.0179	0.00362	0.00244	0.00198	0.000265	0.00483
Niobium	58	11	0.00381	0.00245	0.00222	0.00199	0.000246	0.00177
Phosphorus	58	2	0.0119	0.00152	0.0007	0	0.0000383	0.00587
Selenium	58	14	0.00192	0.00379	0.00166	0.00152	0.000244	0.000915
Tin	58	13	0.0223	0.028	0.0245	0.0175	0.0024	0.011
Titanium	58	10	0.00477	0.00548	0.00187	0.00175	0.000276	0.0023
Samarium	58	9	0.00553	0.0135	0.00807	0.00128	0.000458	0.00268
Scandium	58	4	0.0168	0.00128	0.00105	0.00105	0.0000703	0.00839
Vanadium	58	17	0.00319	0.00233	0.0021	0.00164	0.000293	0.00148
Silicon	58	45	0.0115	0.128	0.118	0.0885	0.0228	0.024
Silver	58	11	0.0125	0.00931	0.00816	0.00479	0.000647	0.0058
Zinc	58	46	0.00241	0.011	0.011	0.00892	0.0031	0.0033
Strontium	58	9	0.00232	0.00245	0.00198	0.00152	0.000151	0.00111
Sulfur	58	58	0.00808	3.21	1.9	1.34	0.625	0.625
Tantalum	58	6	0.00669	0.00711	0.0028	0.00233	0.000262	0.00317
Terbium	58	5	0.00508	0.00245	0.00222	0.00035	0.0000926	0.0024
Rubidium	58	27	0.00192	0.00178	0.00165	0.00154	0.000254	0.000733
Potassium	58	57	0.00671	0.11	0.0748	0.0661	0.0272	0.0272
Yttrium	58	10	0.00258	0.00128	0.00058	0.00058	0.0000803	0.00113

Houghton Lake								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Sodium	58	19	0.0392	0.152	0.142	0.0706	0.0115	0.0245
Zirconium	58	9	0.00369	0.0117	0.0105	0.00932	0.000757	0.00226
Tungsten	58	8	0.00523	0.00607	0.00501	0.00256	0.000311	0.00245
Ammonium Ion	57	57	0.0194	3.62	2.82	2.5	0.822	0.822
Sodium Ion	57	57	0.024	0.552	0.442	0.365	0.118	0.118
Potassium Ion	57	30	0.0171	0.123	0.115	0.0996	0.0281	0.0318
Oc Csn Unadjusted Tot	58	58	0.24	4.63	4.49	4.44	2.43	2.43
Total Nitrate	57	57	0.00732	8.68	4.62	4.39	0.994	0.994
Ec Csn Tot	58	57	0.24	0.615	0.542	0.481	0.207	0.21
Oc1 Csn Unadjusted Tot	58	58	0.24	1.09	1.05	0.799	0.422	0.422
Oc2 Csn Unadjusted Tot	58	58	0.24	2.14	2.1	1.89	0.981	0.981
Oc3 Csn Unadjusted Tot	58	58	0.24	1.32	1.31	1.25	0.639	0.639
Oc4 Csn Unadjusted Tot	58	57	0.24	1.35	1.19	1.04	0.383	0.385
Op Csn Tot	58	7	0.24	0.192	0.11	0.0939	0.00733	0.113
Sulfate	57	57	0.0091	9.73	5.9	4.52	1.92	1.92

Kalamazoo Fairgrounds								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Antimony	28	6	0.0365	0.0197	0.0148	0.0116	0.00206	0.0168
Arsenic	28	13	0.00141	0.00384	0.00187	0.00093	0.000383	0.000684
Aluminum	28	14	0.0138	0.143	0.0906	0.0525	0.0197	0.0235
Barium	28	3	0.0157	0.00314	0.00244	0.00198	0.00027	0.00584
Bromine	28	24	0.00154	0.00629	0.00572	0.00548	0.00284	0.00294
Cadmium	28	6	0.0165	0.0128	0.00933	0.00769	0.00146	0.00807
Calcium	28	25	0.00627	0.101	0.098	0.0857	0.0314	0.0318
Chromium	28	8	0.00234	0.0195	0.00158	0.00052	0.000817	0.00166
Cobalt	28	15	0.00132	0.00162	0.0015	0.00132	0.000468	0.000802
Copper	28	25	0.00164	0.00547	0.00477	0.00427	0.00181	0.00188
Chlorine	28	23	0.00725	0.163	0.102	0.0532	0.02	0.0209
Cerium	28	1	0.0168	0.00105	0	0	0.0000375	0.00827
Cesium	28	4	0.022	0.00723	0.00478	0.00244	0.000579	0.00853
Europium	28	2	0.0054	0.00117	0.00035	0	0.0000543	0.00258
Gallium	28	9	0.00204	0.00132	0.00111	0.00105	0.000224	0.000869
Iron	28	28	0.00182	0.186	0.173	0.116	0.0584	0.0584
Hafnium	28	1	0.00774	0.00128	0	0	0.0000457	0.00377
Indium	28	3	0.0175	0.021	0.00396	0.00093	0.000925	0.00878
Manganese	28	20	0.00194	0.00649	0.00615	0.0052	0.00182	0.00211
Iridium	28	0	0.00466	0	0	0	0	0.00233
Molybdenum	28	0	0.00584	0	0	0	0	0.00292
Nickel	28	17	0.0013	0.00442	0.00209	0.00077	0.000494	0.00074
Magnesium	28	7	0.013	0.0221	0.0212	0.0193	0.00309	0.00795
Mercury	28	6	0.00579	0.0065	0.0021	0.00152	0.000449	0.00259
Gold	28	2	0.00382	0.00151	0.00035	0	0.0000664	0.00181
Lanthanum	28	3	0.0148	0.00337	0.00232	0.0014	0.000253	0.00614
Niobium	28	3	0.00376	0.00338	0.00047	0.00012	0.000142	0.00186
Phosphorus	28	0	0.0124	0	0	0	0	0.0062
Selenium	28	12	0.00179	0.00293	0.00218	0.00175	0.00052	0.000979
Tin	28	6	0.0234	0.028	0.0233	0.0189	0.00367	0.0132
Titanium	28	4	0.00479	0.00734	0.00326	0.00303	0.000553	0.00265
Samarium	28	1	0.00532	0.0014	0	0	0.00005	0.00253
Scandium	28	3	0.0192	0.00233	0.00116	0.0007	0.00015	0.00958
Vanadium	28	7	0.00328	0.00396	0.00151	0.00105	0.000297	0.00151
Silicon	28	24	0.0108	0.243	0.169	0.166	0.0571	0.0579
Silver	28	5	0.0132	0.0117	0.00757	0.00699	0.00116	0.00662
Zinc	28	27	0.00245	0.0394	0.0306	0.029	0.0137	0.0137
Strontium	28	7	0.00233	0.00128	0.00035	0.00024	0.0000839	0.000968
Sulfur	28	28	0.00826	1.63	1.61	1.6	0.885	0.885
Tantalum	28	1	0.00656	0.0035	0	0	0.000125	0.00323
Terbium	28	4	0.00474	0.00279	0.0014	0.00128	0.00022	0.00219
Rubidium	28	9	0.00193	0.00291	0.00163	0.00123	0.000358	0.00099
Potassium	28	28	0.00621	0.129	0.106	0.105	0.0534	0.0534
Yttrium	28	4	0.00255	0.0014	0.00082	0.00035	0.0001	0.00117

Kalamazoo Fairgrounds								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Sodium	28	14	0.0372	0.216	0.139	0.103	0.0246	0.0334
Zirconium	28	6	0.00377	0.00814	0.00582	0.00466	0.000748	0.00215
Tungsten	28	3	0.00497	0.00537	0.00128	0.00082	0.000267	0.00252
Ammonium Ion	27	27	0.0196	4.62	3.72	3.08	1.56	1.56
Sodium Ion	27	26	0.0237	2.08	0.462	0.413	0.177	0.177
Potassium Ion	27	20	0.0173	0.369	0.126	0.103	0.0543	0.0561
Oc Csn Unadjusted Tot	28	28	0.24	15.4	10.8	6.25	4.06	4.06
Total Nitrate	27	27	0.00704	9.16	9.09	7.92	2.76	2.76
Ec Csn Tot	28	28	0.24	4.93	2.36	1.34	0.728	0.728
Oc1 Csn Unadjusted Tot	28	28	0.24	2.68	1.28	1.21	0.789	0.789
Oc2 Csn Unadjusted Tot	28	28	0.24	6.06	4.8	2.11	1.48	1.48
Oc3 Csn Unadjusted Tot	28	28	0.24	3.74	2.52	1.38	0.919	0.919
Oc4 Csn Unadjusted Tot	28	28	0.24	2.91	2.28	1.95	0.868	0.868
Op Csn Tot	28	2	0.24	0.0592	0.0291	0	0.00315	0.115
Sulfate	27	27	0.00903	5.97	5.13	4.78	2.82	2.82

Luna Pier								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Antimony	56	9	0.0359	0.0455	0.0279	0.0143	0.00207	0.0177
Arsenic	56	36	0.00142	0.00805	0.0035	0.00327	0.00107	0.00131
Aluminum	56	36	0.0151	0.0711	0.0688	0.0606	0.0157	0.0185
Barium	56	5	0.0139	0.0325	0.00409	0.00256	0.000743	0.00548
Bromine	56	49	0.00148	0.00677	0.00641	0.0056	0.00241	0.0025
Cadmium	56	6	0.0157	0.00697	0.00234	0.00163	0.00025	0.0074
Calcium	56	53	0.00637	0.113	0.0908	0.0898	0.0304	0.0305
Chromium	56	24	0.00229	0.0136	0.0122	0.00838	0.00115	0.0018
Cobalt	56	24	0.00131	0.00377	0.00145	0.0014	0.00029	0.000668
Copper	56	43	0.00174	0.0225	0.00591	0.0058	0.00197	0.00216
Chlorine	56	46	0.00718	0.0721	0.0649	0.0583	0.0115	0.0123
Cerium	56	1	0.0139	0.00419	0	0	0.0000748	0.00694
Cesium	56	7	0.0207	0.00535	0.00268	0.00268	0.000331	0.00811
Europium	56	5	0.00504	0.00105	0.00094	0.00081	0.0000543	0.00237
Gallium	56	10	0.00212	0.00175	0.00175	0.00134	0.000162	0.000998
Iron	56	56	0.00181	0.281	0.192	0.148	0.0511	0.0511
Hafnium	56	4	0.0103	0.0029	0.00268	0.00256	0.000154	0.00485
Indium	56	9	0.0173	0.0257	0.0187	0.0164	0.00154	0.00872
Manganese	56	31	0.00187	0.00544	0.00464	0.00388	0.00111	0.00152
Iridium	56	5	0.00468	0.00268	0.00209	0.00175	0.000164	0.0023
Molybdenum	56	1	0.0064	0.00047	0	0	0.00000839	0.00313
Nickel	56	32	0.00133	0.00362	0.0029	0.00281	0.000555	0.000836
Magnesium	56	21	0.0135	0.0675	0.0223	0.0191	0.00528	0.00927
Mercury	56	9	0.00564	0.00733	0.00618	0.0056	0.000589	0.00287
Gold	56	10	0.00386	0.00245	0.00222	0.00163	0.000248	0.00189
Lanthanum	56	3	0.0127	0.00769	0.0014	0.00058	0.000173	0.00518
Niobium	56	6	0.00375	0.00443	0.00186	0.0014	0.000166	0.00183
Phosphorus	56	1	0.012	0.00151	0	0	0.000027	0.00598
Selenium	56	23	0.00191	0.0121	0.00733	0.00361	0.00091	0.00144
Tin	56	9	0.0236	0.0221	0.0128	0.0116	0.00143	0.0111
Titanium	56	19	0.0048	0.00548	0.00442	0.00374	0.000599	0.0022
Samarium	56	7	0.00506	0.00186	0.00163	0.00117	0.000131	0.00237
Scandium	56	2	0.0196	0.00058	0.00011	0	0.0000123	0.00977
Vanadium	56	22	0.00327	0.00513	0.00455	0.00327	0.000704	0.00168
Silicon	56	53	0.0119	0.161	0.153	0.123	0.0421	0.0424
Silver	56	7	0.0126	0.00816	0.00699	0.00697	0.000582	0.00619
Zinc	56	54	0.00255	0.0356	0.0327	0.0308	0.0104	0.0104
Strontium	56	18	0.00223	0.0182	0.0162	0.0085	0.00123	0.00199
Sulfur	56	55	0.00834	4.14	3.94	3.53	1.03	1.03
Tantalum	56	4	0.0069	0.0035	0.00233	0.00198	0.000167	0.00337
Terbium	56	11	0.00454	0.00304	0.00245	0.00244	0.000304	0.00219
Rubidium	56	16	0.00184	0.00247	0.00126	0.00105	0.0002	0.000863
Potassium	56	55	0.0068	1.11	0.136	0.113	0.0637	0.0638
Yttrium	56	6	0.00251	0.0021	0.00105	0.00047	0.0000813	0.00119

Luna Pier								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Sodium	56	32	0.0398	0.148	0.117	0.105	0.0257	0.0337
Zirconium	56	6	0.00366	0.0116	0.00815	0.00699	0.000631	0.00224
Tungsten	56	6	0.00523	0.00525	0.00198	0.00047	0.000148	0.00239
Ammonium Ion	56	56	0.0184	5.56	4.55	4.36	1.59	1.59
Sodium Ion	56	53	0.0263	0.435	0.332	0.33	0.112	0.112
Potassium Ion	56	38	0.0159	1.09	0.139	0.135	0.0641	0.0664
Oc Csn Unadjusted Tot	59	59	0.24	8.41	8.01	6.56	3.45	3.45
Total Nitrate	56	56	0.00704	11.8	7.47	4.97	1.93	1.93
Ec Csn Tot	59	59	0.24	2.01	1.89	1.54	0.532	0.532
Oc1 Csn Unadjusted Tot	59	59	0.24	1.78	1.57	1.47	0.774	0.774
Oc2 Csn Unadjusted Tot	59	59	0.24	3.58	2.48	2.1	1.19	1.19
Oc3 Csn Unadjusted Tot	59	59	0.24	2.31	1.74	1.58	0.77	0.77
Oc4 Csn Unadjusted Tot	59	59	0.24	2.85	1.94	1.88	0.685	0.685
Op Csn Tot	59	7	0.24	0.961	0.637	0.177	0.0327	0.138
Sulfate	56	56	0.00918	12.5	11.6	9.95	3.13	3.13

Port Huron, Nat'l Guard Arm.								
Chemical Name	**NumObs**	**Obs>MDL**	**MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Antimony	29	6	0.0353	0.0116	0.00828	0.00583	0.00107	0.0156
Arsenic	29	19	0.0015	0.00792	0.0042	0.00419	0.00148	0.00181
Aluminum	29	20	0.0151	0.0561	0.0454	0.041	0.0157	0.0178
Barium	29	4	0.0154	0.0964	0.00501	0.00491	0.00368	0.00815
Bromine	29	27	0.00153	0.0342	0.00616	0.00606	0.00382	0.00387
Cadmium	29	3	0.0156	0.0198	0.00817	0.00455	0.00112	0.0081
Calcium	29	29	0.0062	0.148	0.0693	0.0589	0.0327	0.0327
Chromium	29	13	0.00226	0.00289	0.00163	0.0016	0.000449	0.00107
Cobalt	29	12	0.00133	0.0012	0.0012	0.00093	0.000214	0.000587
Copper	29	19	0.00176	0.0635	0.0058	0.00406	0.00341	0.00372
Chlorine	29	23	0.00722	0.199	0.058	0.0554	0.0188	0.0197
Cerium	29	0	0.0163	0	0	0	0	0.00813
Cesium	29	5	0.0223	0.00712	0.00315	0.00268	0.000591	0.009
Europium	29	3	0.0052	0.00934	0.00093	0.00035	0.000366	0.00251
Gallium	29	1	0.0023	0.00105	0	0	0.0000362	0.0011
Iron	29	29	0.00186	0.0767	0.0727	0.072	0.0339	0.0339
Hafnium	29	5	0.0105	0.00128	0.00093	0.00047	0.000101	0.00485
Indium	29	6	0.0174	0.0222	0.0163	0.0128	0.00233	0.00926
Manganese	29	20	0.0019	0.00269	0.00216	0.00197	0.000748	0.00103
Iridium	29	4	0.00498	0.00256	0.00175	0.00117	0.000213	0.00242
Molybdenum	29	2	0.00671	0.00128	0.00035	0	0.0000562	0.00315
Nickel	29	17	0.00136	0.00793	0.00353	0.00345	0.00101	0.00127
Magnesium	29	13	0.0137	0.176	0.0572	0.0251	0.0124	0.016
Mercury	29	4	0.0059	0.00489	0.0035	0.00117	0.000334	0.00267
Gold	29	7	0.00417	0.00315	0.00256	0.00233	0.00047	0.00213
Lanthanum	29	3	0.0146	0.00105	0.00093	0.0007	0.0000924	0.00592
Niobium	29	7	0.00388	0.00361	0.00233	0.0021	0.000458	0.0019
Phosphorus	29	2	0.0115	0.017	0.0114	0	0.000979	0.00615
Selenium	29	10	0.00198	0.00537	0.00338	0.00243	0.000594	0.00123
Tin	29	2	0.0237	0.014	0.00466	0	0.000643	0.0116
Titanium	29	7	0.00473	0.00607	0.00303	0.00186	0.00045	0.00226
Samarium	29	3	0.0052	0.00257	0.00128	0.00012	0.000137	0.00241
Scandium	29	1	0.0199	0.00082	0	0	0.0000283	0.00994
Vanadium	29	19	0.00318	0.0147	0.00653	0.00559	0.0023	0.00287
Silicon	29	28	0.012	0.112	0.101	0.094	0.0407	0.0409
Silver	29	4	0.0126	0.00583	0.00233	0.00116	0.000325	0.00573
Zinc	29	27	0.0026	0.0892	0.0567	0.0463	0.0181	0.0182
Strontium	29	8	0.00224	0.0318	0.00268	0.00176	0.00142	0.00222
Sulfur	29	29	0.00809	4.39	3.04	2.32	1.02	1.02
Tantalum	29	1	0.00722	0.00256	0	0	0.0000883	0.00357
Terbium	29	5	0.0047	0.0028	0.00244	0.00175	0.000273	0.00231
Rubidium	29	5	0.00185	0.00063	0.00056	0.00056	0.000081	0.000864
Potassium	29	29	0.00666	2.32	0.0698	0.0687	0.113	0.113
Yttrium	29	3	0.00256	0.00105	0.00035	0.00012	0.0000524	0.0012

Port Huron, Nat'l Guard Arm.								
Chemical Name	**NumObs**	**Obs>MDL**	**MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Sodium	29	20	0.0405	0.129	0.107	0.0664	0.0261	0.0321
Zirconium	29	3	0.00373	0.00816	0.00291	0.00233	0.000462	0.00211
Tungsten	29	2	0.00557	0.0021	0.00209	0	0.000144	0.00266
Ammonium Ion	29	29	0.0188	4.49	4.37	3.14	1.3	1.3
Sodium Ion	29	28	0.0254	0.168	0.154	0.14	0.0687	0.0692
Potassium Ion	29	13	0.0163	2.23	0.078	0.0737	0.098	0.102
Oc Csn Unadjusted Tot	29	29	0.24	8.01	6.43	6.17	3.45	3.45
Total Nitrate	29	29	0.00756	4.64	3.84	3.72	1.27	1.27
Ec Csn Tot	29	29	0.24	1.27	1.15	0.789	0.475	0.475
Oc1 Csn Unadjusted Tot	29	29	0.24	1.99	1.63	1.57	0.837	0.837
Oc2 Csn Unadjusted Tot	29	29	0.24	2.59	2.36	1.77	1.14	1.14
Oc3 Csn Unadjusted Tot	29	29	0.24	2.08	1.67	1.49	0.816	0.816
Oc4 Csn Unadjusted Tot	29	28	0.24	2.02	1.98	1.37	0.641	0.645
Op Csn Tot	29	1	0.24	0.255	0	0	0.00879	0.125
Sulfate	29	29	0.00888	13.3	9.36	6.83	2.94	2.94

Tecumseh								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Antimony	42	8	0.0352	0.0294	0.0104	0.00933	0.00138	0.0166
Arsenic	42	24	0.00142	0.0049	0.00327	0.00247	0.000718	0.00102
Aluminum	42	27	0.0145	0.0724	0.0513	0.0498	0.0134	0.0159
Barium	42	5	0.0163	0.0107	0.00607	0.00361	0.000574	0.00522
Bromine	42	37	0.0015	0.00599	0.00583	0.00524	0.00192	0.002
Cadmium	42	6	0.0157	0.0233	0.0105	0.00585	0.00125	0.00802
Calcium	42	42	0.00648	0.171	0.108	0.0898	0.0318	0.0318
Chromium	42	16	0.00232	0.00747	0.00486	0.00294	0.000675	0.00137
Cobalt	42	22	0.00136	0.00129	0.00121	0.00117	0.000319	0.000631
Copper	42	35	0.00175	0.0544	0.00357	0.00351	0.00237	0.0025
Chlorine	42	25	0.00756	0.0156	0.0153	0.0147	0.0039	0.00558
Cerium	42	0	0.0178	0	0	0	0	0.00891
Cesium	42	8	0.0205	0.00361	0.00291	0.0028	0.000384	0.00722
Europium	42	5	0.0054	0.00629	0.00152	0.0014	0.000239	0.00251
Gallium	42	9	0.0021	0.00177	0.00152	0.00145	0.00021	0.000981
Iron	42	41	0.0019	0.0994	0.0908	0.0878	0.0378	0.0378
Hafnium	42	4	0.00972	0.0065	0.00174	0.00071	0.000221	0.00452
Indium	42	9	0.0169	0.0303	0.00584	0.00468	0.00129	0.00785
Manganese	42	34	0.00194	0.00946	0.00689	0.00448	0.00162	0.00182
Iridium	42	4	0.00448	0.00373	0.00175	0.00153	0.000192	0.00213
Molybdenum	42	2	0.00585	0.00082	0.00047	0	0.0000307	0.00289
Nickel	42	22	0.00136	0.00371	0.00187	0.00186	0.000438	0.000762
Magnesium	42	17	0.0136	0.126	0.0237	0.0224	0.00734	0.0111
Mercury	42	7	0.00535	0.00559	0.00513	0.00386	0.000489	0.00243
Gold	42	8	0.00376	0.00456	0.00164	0.0014	0.000265	0.00183
Lanthanum	42	3	0.0157	0.00187	0.00058	0.00046	0.0000693	0.0054
Niobium	42	4	0.0037	0.0028	0.00175	0.0014	0.000155	0.00175
Phosphorus	42	0	0.0124	0	0	0	0	0.00618
Selenium	42	17	0.00186	0.00557	0.00203	0.00202	0.000561	0.00105
Tin	42	8	0.0224	0.014	0.014	0.0105	0.00152	0.0106
Titanium	42	17	0.00483	0.00992	0.00467	0.00339	0.000862	0.00234
Samarium	42	8	0.00537	0.00338	0.0021	0.0014	0.000236	0.00227
Scandium	42	4	0.0171	0.00117	0.00093	0.0007	0.0000805	0.00849
Vanadium	42	18	0.00327	0.0042	0.00385	0.00362	0.00078	0.0017
Silicon	42	41	0.0114	0.209	0.148	0.126	0.0525	0.0527
Silver	42	6	0.0126	0.0035	0.00163	0.00128	0.000211	0.00569
Zinc	42	38	0.00238	0.0283	0.0192	0.0183	0.00756	0.00765
Strontium	42	9	0.0023	0.0256	0.00187	0.00163	0.000815	0.00171
Sulfur	42	42	0.00832	4.02	3.51	2.67	0.945	0.945
Tantalum	42	3	0.00645	0.00466	0.00175	0.00082	0.000172	0.00316
Terbium	42	2	0.00488	0.00023	0.00023	0	0.000011	0.00236
Rubidium	42	9	0.00191	0.00152	0.00137	0.00092	0.000164	0.000932
Potassium	42	41	0.00678	1.77	0.109	0.104	0.0857	0.0858
Yttrium	42	5	0.00253	0.0028	0.0007	0.0007	0.000108	0.00121

Tecumseh								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Sodium	42	22	0.0385	0.125	0.112	0.0979	0.0195	0.0294
Zirconium	42	8	0.00365	0.0128	0.007	0.00699	0.00083	0.00227
Tungsten	42	2	0.00495	0.0029	0.00128	0	0.0000995	0.0024
Ammonium Ion	42	42	0.0186	4.4	4.05	2.72	1.27	1.27
Sodium Ion	42	40	0.0255	0.414	0.176	0.17	0.075	0.0757
Potassium Ion	42	24	0.0163	1.7	0.145	0.132	0.0779	0.0811
Oc Csn Unadjusted Tot	42	42	0.24	6.89	5.65	5.33	3.21	3.21
Total Nitrate	42	42	0.00739	4.55	4.36	4.2	1.34	1.34
Ec Csn Tot	42	41	0.24	3.26	0.859	0.799	0.423	0.426
Oc1 Csn Unadjusted Tot	42	42	0.24	1.82	1.42	1.37	0.693	0.693
Oc2 Csn Unadjusted Tot	42	42	0.24	2.36	2.2	1.8	1.1	1.1
Oc3 Csn Unadjusted Tot	42	42	0.24	1.79	1.6	1.49	0.793	0.793
Oc4 Csn Unadjusted Tot	42	42	0.24	1.54	1.42	1.36	0.622	0.622
Op Csn Tot	42	3	0.24	0.0852	0.083	0.0322	0.00477	0.116
Sulfate	42	42	0.00883	10.6	10.5	7.25	2.75	2.75

Ypsilanti								
Chemical Name	NumObs	Obs>MDL	MDL	Max1	Max2	Max3	Min Mean	Max Mean
Antimony	27	3	0.0376	0.0444	0.0164	0.0105	0.00264	0.0191
Arsenic	27	13	0.00131	0.00373	0.00264	0.00163	0.000608	0.000927
Aluminum	27	12	0.0144	0.0506	0.0383	0.0337	0.011	0.0151
Barium	27	1	0.0123	0.00304	0	0	0.000113	0.00517
Bromine	27	25	0.00147	0.00723	0.00631	0.00606	0.00313	0.00319
Cadmium	27	2	0.0164	0.00932	0.00116	0	0.000388	0.00794
Calcium	27	26	0.00645	0.134	0.0934	0.0735	0.0291	0.0292
Chromium	27	10	0.00236	0.00295	0.00165	0.00116	0.000413	0.00116
Cobalt	27	16	0.00127	0.00122	0.00112	0.00083	0.000278	0.000543
Copper	27	23	0.00165	0.0046	0.00391	0.00304	0.00161	0.0017
Chlorine	27	23	0.00699	0.248	0.132	0.0717	0.0277	0.0284
Cerium	27	0	0.0113	0	0	0	0	0.00567
Cesium	27	2	0.0198	0.00256	0.00176	0	0.00016	0.00859
Europium	27	4	0.00493	0.00233	0.00222	0.0014	0.000242	0.00225
Gallium	27	5	0.00187	0.00291	0.0028	0.00139	0.000306	0.00102
Iron	27	27	0.00172	0.114	0.107	0.102	0.0525	0.0525
Hafnium	27	2	0.00841	0.00233	0.00047	0	0.000104	0.00366
Indium	27	5	0.0176	0.014	0.00466	0.00465	0.00111	0.00829
Manganese	27	18	0.00186	0.0104	0.00565	0.00511	0.00171	0.00203
Iridium	27	2	0.00442	0.00117	0.00047	0	0.0000607	0.00208
Molybdenum	27	3	0.00588	0.00386	0.00152	0.00058	0.000221	0.00283
Nickel	27	18	0.00127	0.00233	0.00166	0.00153	0.000606	0.000802
Magnesium	27	5	0.0128	0.0148	0.0143	0.0117	0.0018	0.00702
Mercury	27	6	0.00559	0.00501	0.00268	0.00175	0.000493	0.00261
Gold	27	0	0.00351	0	0	0	0	0.00176
Lanthanum	27	2	0.0105	0.00163	0.00093	0	0.0000948	0.00391
Niobium	27	3	0.00363	0.00093	0.00035	0.00012	0.0000519	0.00165
Phosphorus	27	0	0.0128	0	0	0	0	0.0064
Selenium	27	14	0.00177	0.00286	0.00267	0.00257	0.000623	0.001
Tin	27	5	0.0239	0.0267	0.0163	0.00585	0.00212	0.0118
Titanium	27	5	0.00486	0.00268	0.00233	0.00151	0.00028	0.00226
Samarium	27	3	0.00495	0.00302	0.00116	0.00035	0.000168	0.00239
Scandium	27	0	0.0201	0	0	0	0	0.0101
Vanadium	27	12	0.00337	0.00466	0.00268	0.00222	0.000761	0.00165
Silicon	27	25	0.0113	0.169	0.168	0.163	0.0509	0.0513
Silver	27	7	0.013	0.0163	0.0129	0.0128	0.00237	0.00711
Zinc	27	26	0.00249	0.107	0.0296	0.0259	0.015	0.0151
Strontium	27	4	0.00226	0.0021	0.00198	0.00023	0.000168	0.00113
Sulfur	27	27	0.0086	2.3	2.12	1.94	1.04	1.04
Tantalum	27	1	0.00649	0.0028	0	0	0.000104	0.0032
Terbium	27	1	0.00434	0.00012	0	0	0.00000444	0.00209
Rubidium	27	3	0.00186	0.00278	0.00107	0.00035	0.000156	0.000987
Potassium	27	27	0.00655	0.0984	0.0967	0.081	0.0508	0.0508
Yttrium	27	3	0.00246	0.00152	0.00081	0.00023	0.0000948	0.00119

Ypsilanti								
Chemical Name	**NumObs**	**Obs>MDL**	**MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Sodium	27	17	0.0377	0.284	0.149	0.134	0.0396	0.0463
Zirconium	27	4	0.00369	0.0117	0.00702	0.00582	0.000952	0.00249
Tungsten	27	5	0.00479	0.00316	0.00256	0.00199	0.00035	0.00217
Ammonium Ion	27	27	0.0192	5.06	4.22	3.3	2	2
Sodium Ion	27	26	0.0244	0.543	0.343	0.208	0.127	0.128
Potassium Ion	27	19	0.0169	0.0963	0.0894	0.0847	0.0418	0.0441
Total Nitrate	27	27	0.00709	11.2	6.96	5.96	3.06	3.06
Oc Csn_Rev Unadjust Tot	15	15		5.73	3.58	3.56	2.69	2.69
Ec Csn_Rev Unadjust Tot	15	15		0.744	0.492	0.398	0.306	0.306
Sulfate	27	27	0.0093	6.56	6.46	6.08	3.15	3.15

Appendix D: AQD Acronyms and Definitions

AQD ACRONYM	DEFINITION
>	greater than
≥	greater than or equal to
<	less than
≤	less than or equal to
%	percent
AIRS ID	Aerometric Information Retrieval System identification number
AMU	Air Monitoring Unit (AQD)
AQD	Air Quality Division
AQES	Air Quality Evaluation Section
AQI	Air Quality Index
AQS	Air Quality Subsystem
CAA	Clean Air Act
CAIR	Clean Air Interstate Rule (EPA regulation)
CFR	Code of Federal Regulations
CO	carbon monoxide
CSA	Combined Statistical Area
DATI	Detroit Air Toxics Initiative
EGU	electric generating unit (coal-fired power plants)
EI	emissions inventory (EPA)
EPA	United States Environmental Protection Agency
FDMS	filter dynamic measurement system
FR	Federal Register
FRM	Federal Reference Method
HAP	Hazardous Air Pollutant
hr	hour
IN	Indiana
MASN	Michigan Air Sampling Network
MDEQ	Michigan Department of Environmental Quality
MDL	method detection limit
mg/m^3	milligrams per cubic meter
MI	Michigan
MiSA	Micropolitan Statistical Area
MITAMP	Michigan Toxics Air Monitoring Program
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standards
NATA	National Air Toxics Assessment
NATTS	National Air Toxics Trend Site
NCORE	National Core (monitoring site)
NO	nitric oxide
NO_2	nitrogen dioxide
NO_X	oxides of nitrogen
O_3	ozone
OAQPS	Office of Air Quality Planning and Standards (EPA)
OBS	Observations

Appendix D: AQD Acronyms and Definitions

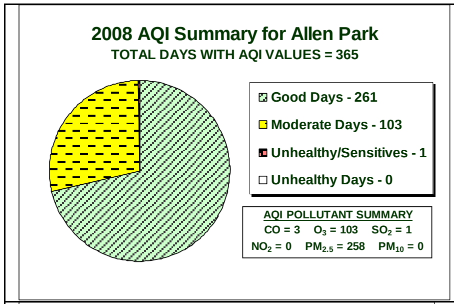
AQD ACRONYM	DEFINITION
PAHs	polycyclic aromatic hydrocarbons
Pb	lead
PBT	Persistent, Bioaccumulative Toxics
PCB	polychlorinated biphenyls
PM	Particulate Matter
$PM_{2.5}$	PM with an aerodynamic diameter $\geq$ 2.5 microns in diameter
PM_{10}	PM with an aerodynamic diameter $\geq$ 10 microns in diameter
$PM_{10\text{-}2.5}$	inhalable course particles
PNAs	polynuclear aromatic hydrocarbons
ppm	parts per million
RTP	Research Triangle Park
SASS	Spiral aerosol speciation sampler
SIP	State Implementation Plan
SO_2	sulfur dioxide
SVOC	Semi-volatile compounds
TACs	Toxic Air Contaminants
TEOM	Tapered Element Oscillating Microbalance
TSP	Total Suspended Particulates
U of M	University of Michigan
$\mu g/m^3$	micrograms per cubic meter
μm	micrometers
U.S.	United States
VOC	Volatile Organic Compounds
WEBMONMAP	Web Monitoring and Mapping
WI	Wisconsin

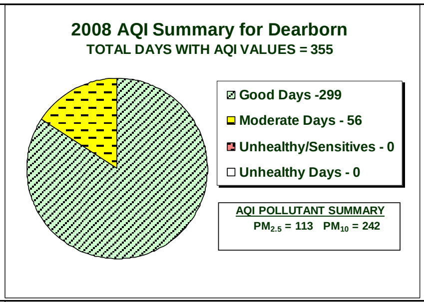
Appendix E: 2008 AQI Pie Charts

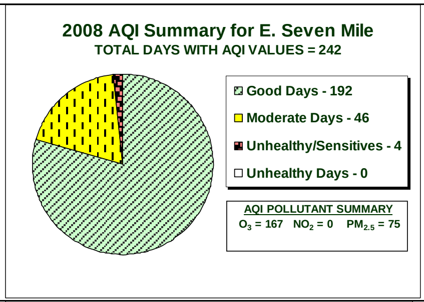
Appendix E contains pie charts that were created to show the AQI values for each of Michigan's 2008 monitoring sites and includes the total number of days measurements were taken, along with the pollutant distribution of the AQI values for those measurements. It is important to note that not all pollutants 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. The following **Figures 1** through **4** are grouped by CSA. **Figure 5** shows the remaining sites (not part of a CSA) located in Michigan's Lower Peninsula.

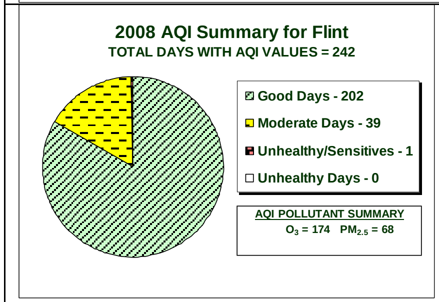
- Figure E-1   AQI Summaries for Detroit-Warren-Flint CSA
- Figure E-2   AQI Summaries for Lansing-East Lansing-Owosso CSA
- Figure E-3   AQI Summaries for Grand Rapids-Muskegon-Holland CSA
- Figure E-4   AQI Summaries for Saginaw-Bay City-Saginaw Twp N. CSA
- Figure E-5   Michigan's Other Lower Peninsula Area AQI Summaries (not in a CSA).

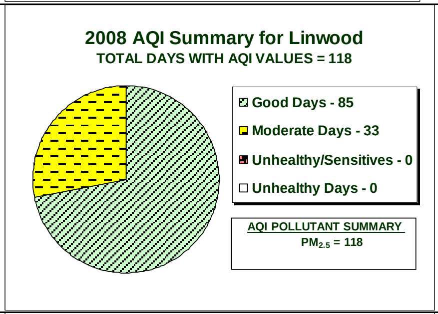
Figure E-1: AQI Summaries for Detroit-Warren-Flint CSA

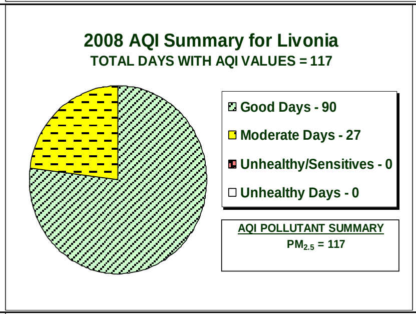


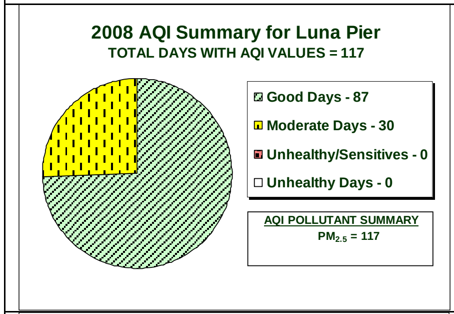


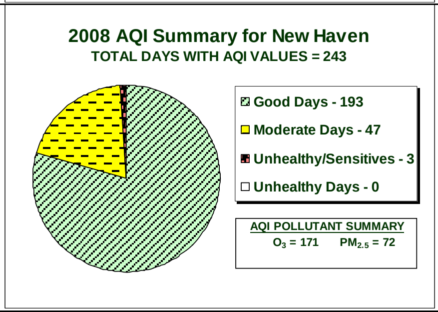


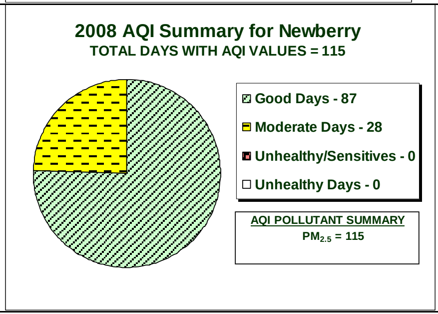


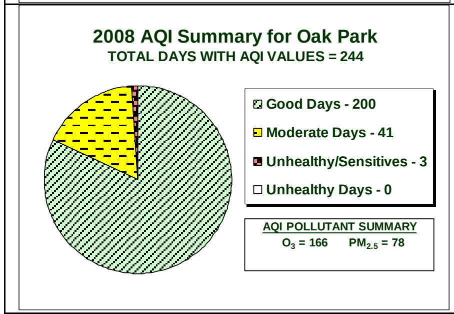


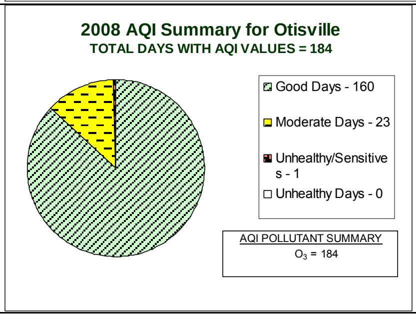












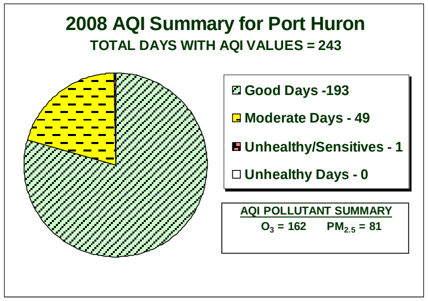
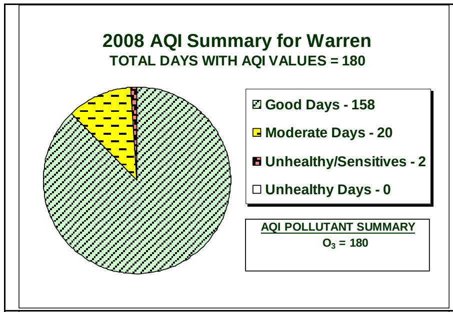
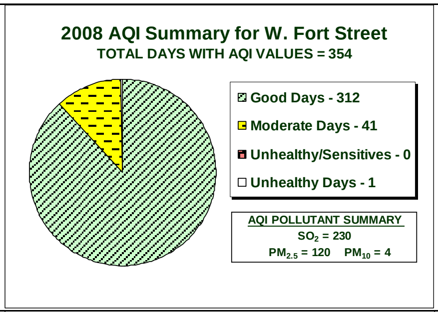
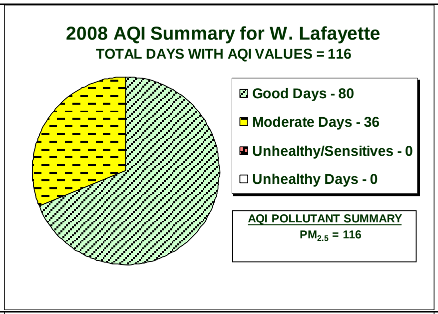
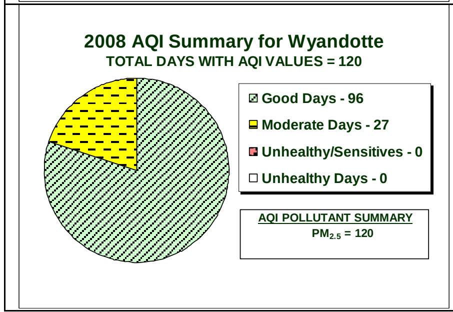


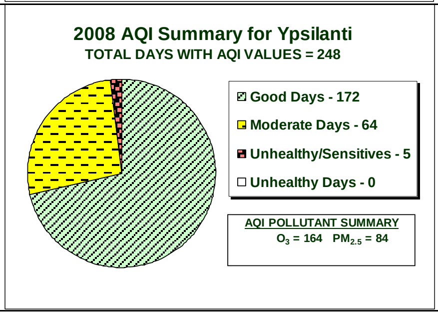
Figure E-1, Continued: AQI Summaries for Detroit-Warren-Flint CSA











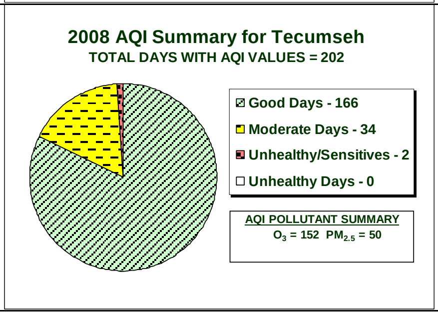
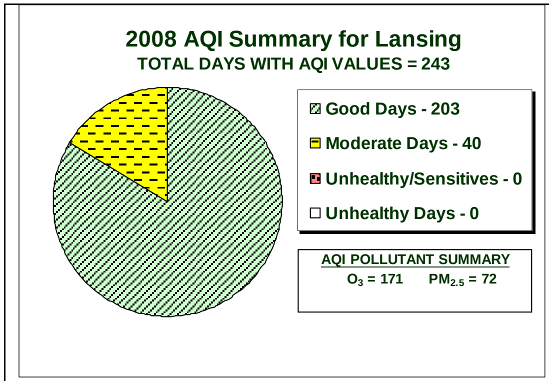


Figure E-2: AQI Summaries for Lansing-East Lansing-Owosso CSA



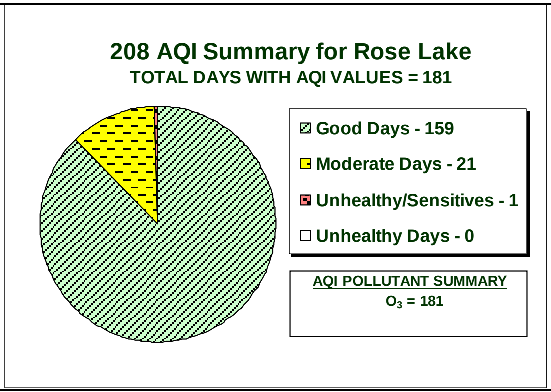


Figure E-3: AQI Summaries for Grand Rapids-Muskegon-Holland CSA

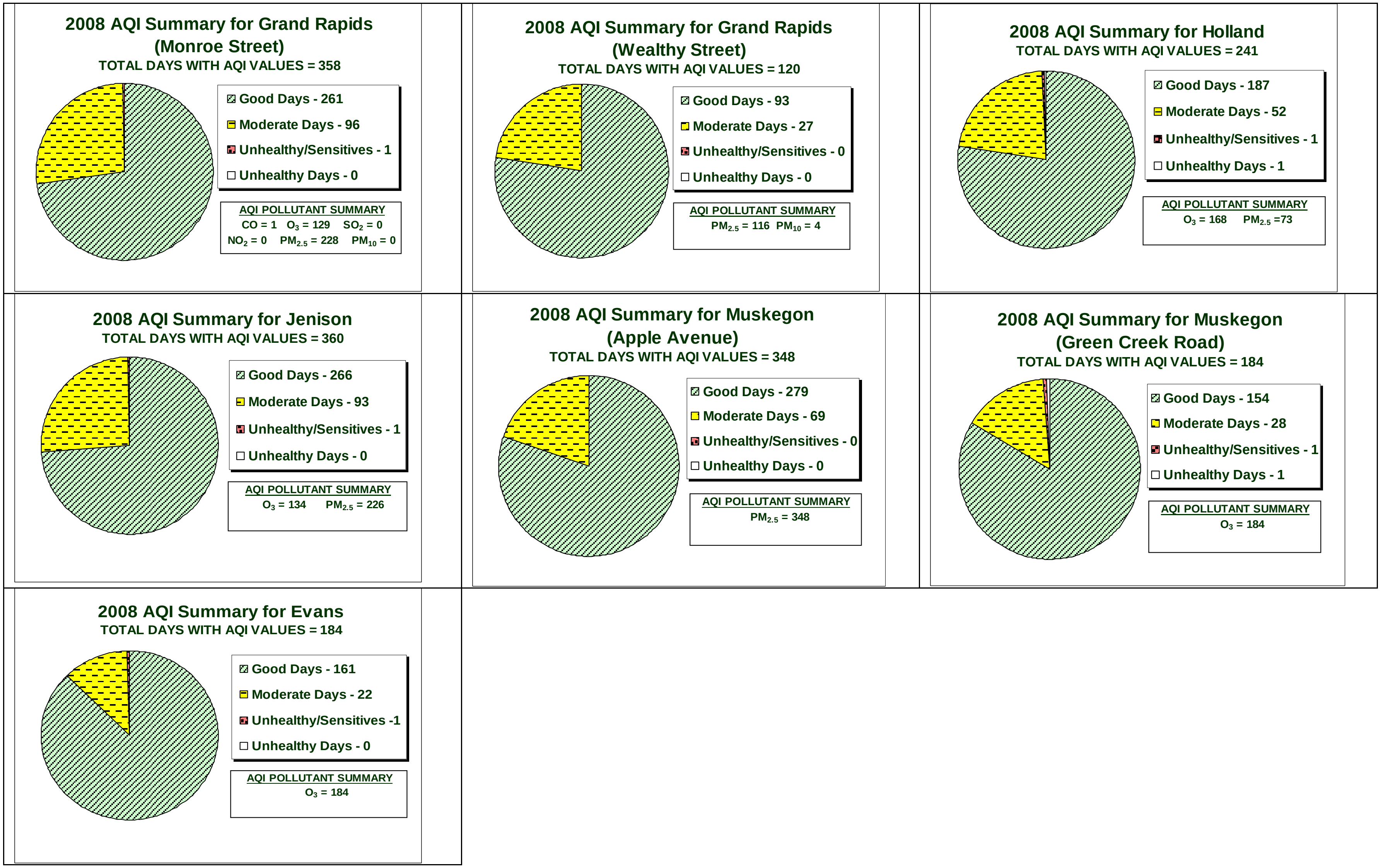


Figure E-4: AQI Summaries for Saginaw-Bay City-Saginaw Township North CSA

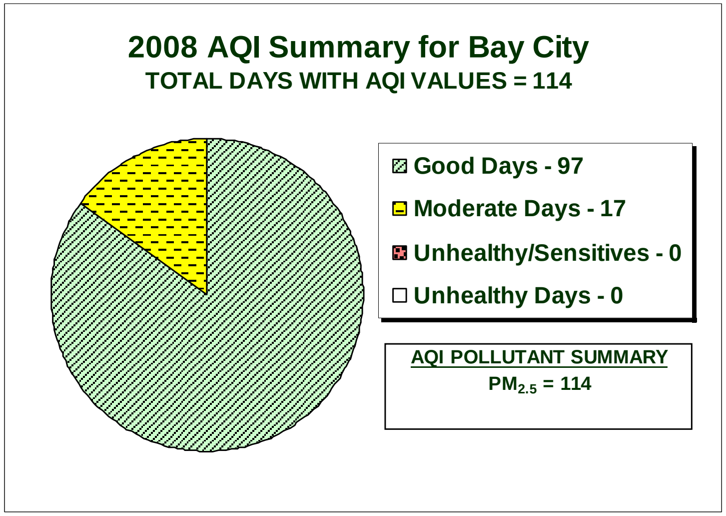
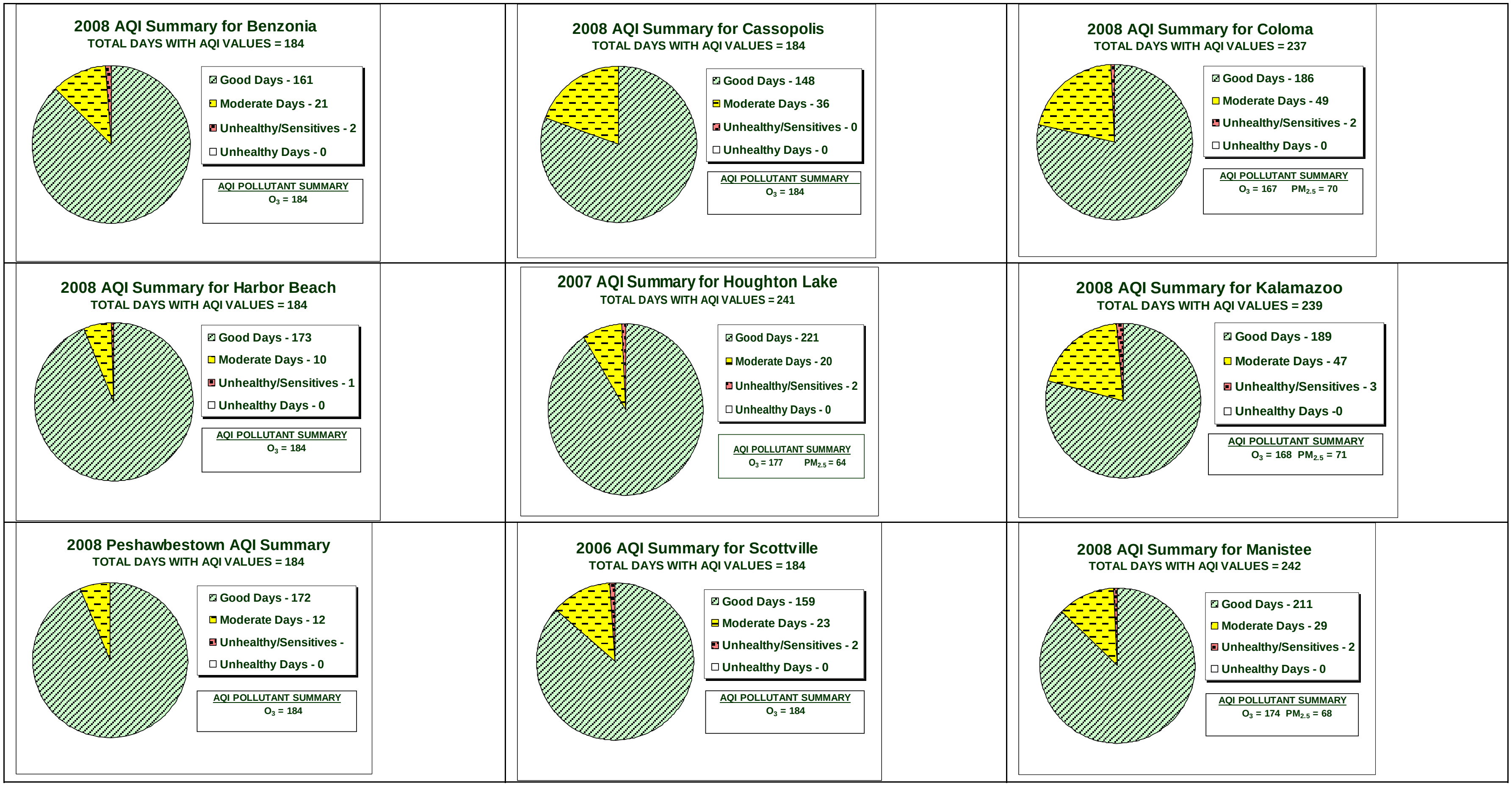
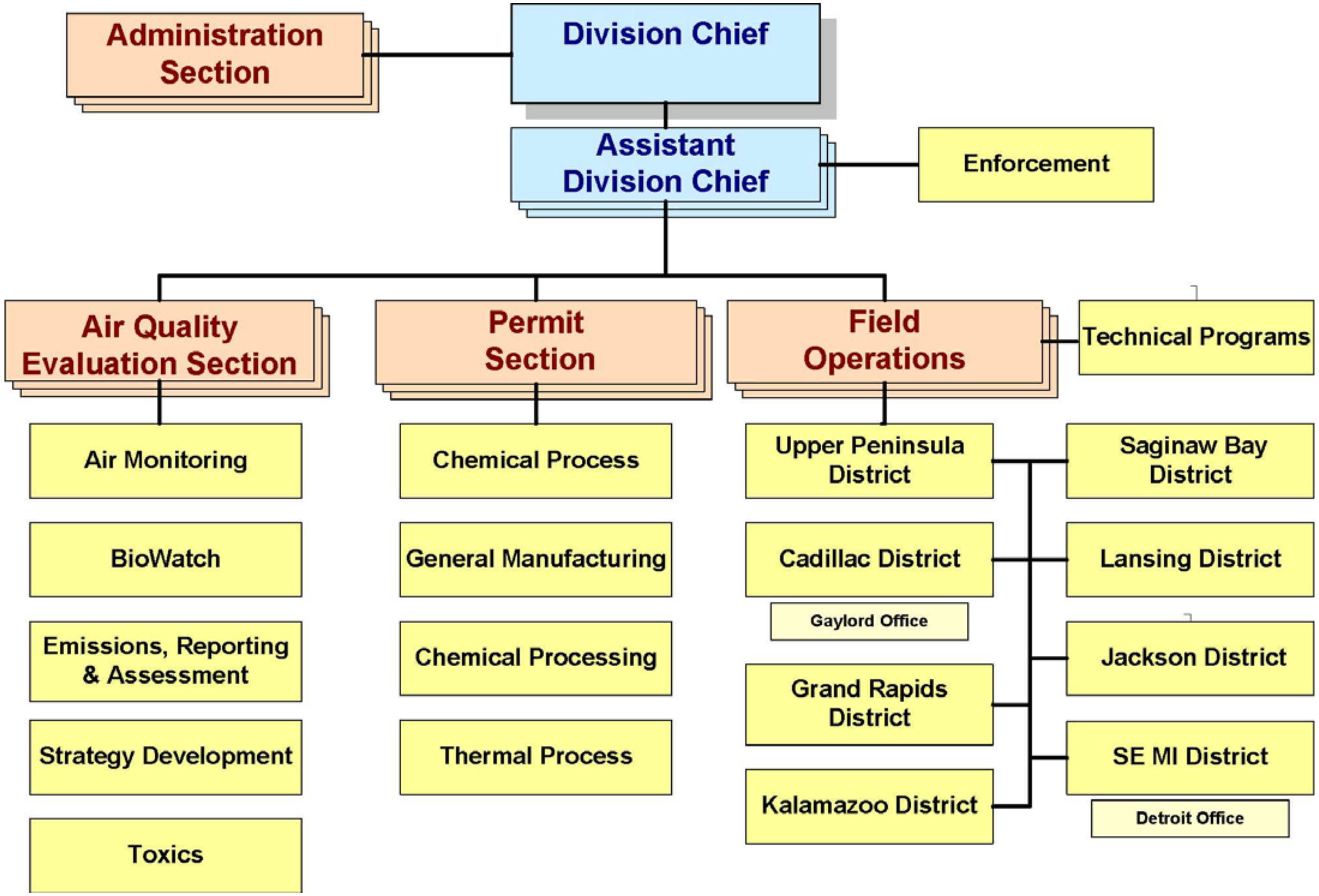


Figure E-5: Michigan's Other Lower Peninsula Area AQI Summaries



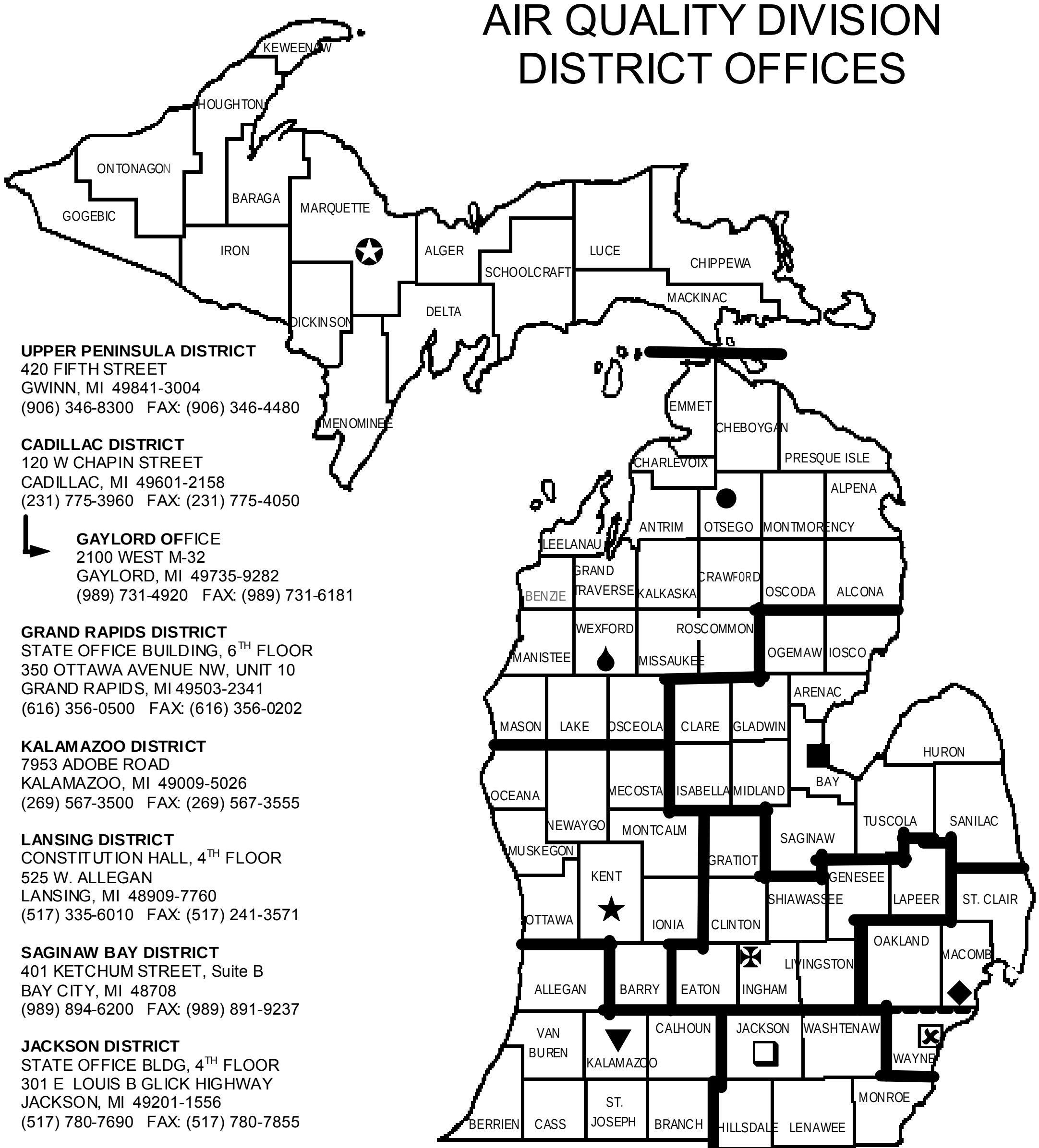
Appendix F: AQD Organizational Chart



Appendix G: AQD District Office Locations

DEQ MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

AIR QUALITY DIVISION
DISTRICT OFFICES



UPPER PENINSULA DISTRICT
420 FIFTH STREET
GWINN, MI 49841-3004
(906) 346-8300 FAX: (906) 346-4480

CADILLAC DISTRICT
120 W CHAPIN STREET
CADILLAC, MI 49601-2158
(231) 775-3960 FAX: (231) 775-4050

GAYLORD OFFICE
2100 WEST M-32
GAYLORD, MI 49735-9282
(989) 731-4920 FAX: (989) 731-6181

GRAND RAPIDS DISTRICT
STATE OFFICE BUILDING, 6TH FLOOR
350 OTTAWA AVENUE NW, UNIT 10
GRAND RAPIDS, MI 49503-2341
(616) 356-0500 FAX: (616) 356-0202

KALAMAZOO DISTRICT
7953 ADOBE ROAD
KALAMAZOO, MI 49009-5026
(269) 567-3500 FAX: (269) 567-3555

LANSING DISTRICT
CONSTITUTION HALL, 4TH FLOOR
525 W. ALLEGAN
LANSING, MI 48909-7760
(517) 335-6010 FAX: (517) 241-3571

SAGINAW BAY DISTRICT
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
(517) 780-7690 FAX: (517) 780-7855

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
(313) 456-4700 FAX: (313) 456-4692
[Wayne County sources]

AIR QUALITY INTERNET ADDRESS:

www.michigan.gov/deqair

9/2009