2014 Annual Air Quality Report

Michigan

Department of Environmental Quality

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

Cover Photos: Top – Mackinac Bridge, and Lower Left – Bald Eagle at Golson Park*, Courtesy of Andrew Kent, Lower Right – Fayette State Park, Courtesy of Peter DeHart

*****Golson Park was established as part of a DEQ multimedia settlement with a facility in the mid 1990's for PCB releases & now we have had 3 plus years of successful nesting eagles. Mr. Golson was the Bay City former (and first) Environmental Coordinator who helped coordinate cleanup & make accessible many current green spaces in the area.

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Appendix B 2014 Air Toxics Monitoring Summary for Metals, VOCs, Carbonyl Compounds, PAHs, Hexavalent Chromium and Speciated $PM_{2.5}$

Appendix C 2014 AQI Pie Charts

Appendix D Acronyms and Their Definitions

2014 Air Quality Report

Introduction

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

The six criteria pollutants are monitored by the Michigan Department of Environmental Quality (DEQ), 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).

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

- Michigan's monitoring requirements for 2014,
- Attainment/nonattainment status,
- Monitoring site locations (tables show all the monitors active in 2014), and
- Air quality trends from 2009-2014 broken down by location.[1]

The 2014 data for each criteria pollutant is available in **Appendix A.**

The AQD also monitors air toxics. Air toxics are other hazardous air pollutants that can affect human health and the environment.[2] This data can be found in **Appendix B.**

The purpose of this report is to provide a snapshot of Michigan's 2014 air quality data, air quality trends, overview of the monitoring network (available in much greater detail in the 2015 Network Review)[3], air toxics monitoring program, and other AQD programs such as MIair and Emissions Inventory[4].

[1] The air quality trends are based on actual statewide monitored readings, which are also listed in the EPA's Air Quality Subsystem Quick Look Report Data at http://www.epa.gov/air/airtrends/

[2] A fact sheet and a citizen's guide to participation is available on the DEQ's website at http://www.michigan.gov/documents/deq/deq-ess-caap-citizensguidetomiairpollutioncontrol_195548_7.pdf and at http://www.michigan.gov/documents/deq/deq-ead-guide-aqdguide_273529_7.pdf.

[3] Available online at http://www.michigan.gov/documents/deq/deq-aqd-amu-2015_air_mon_network_review_461700_7.pdf?20150507095302

[4] Online information about criteria pollutants and air toxics, along with this and previous annual air quality reports, are available via the AQD's website at http://www.michigan.gov/deq/0,4561,7-135-3310_4195---,00.html

Chapter 1: Background Information

This chapter provides a summary of the development of the NAAQS and how compliance with the standards is determined. Also included is an overview of Michigan's air sampling network, long-term air quality trends, and the variety of monitoring techniques and requirements used to ensure quality data is obtained.

National Ambient Air Quality Standards (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 health effects involved and 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 impacts on visibility and climate, as well as 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 (immediate) effects, whereas long-term averaging times are designed to protect against chronic (long-term) effects.

NAAQS have been established for CO, Pb, SO_2, NO_2, O_3, and PM. **Table 1.1** lists the primary and secondary NAAQS, averaging time, and concentration level for each criteria pollutant in effect in 2014. The concentrations are listed as parts per million (ppm), micrograms per cubic meter (µg/m^3), and/or milligrams per cubic meter (mg/m^3).

Table 1.1: NAAQS in Effect during 2014 for Criteria Pollutants

Pollutant	Primary (health-related)		Secondary (welfare-related)	
	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide (CO)	9 ppm (10 mg/m^3)	8-hour average, not to be exceeded more than once per year	None*	
	35 ppm (40 mg/m^3)	1-hour average, not to be exceeded more than once per year		
Lead (Pb)	0.15 µg/m^3	Maximum rolling 3-month average	Same as Primary	
Nitrogen Dioxide (NO_2)	0.053 ppm (100 µg/m^3)	Annual mean	Same as Primary	
	0.100 ppm	98th percentile of 1-hour average, averaged over 3-years	None	
Particulate Matter (PM_{10})	150 µg/m^3	24-hour average, not to be exceeded more than once per year over 3 years	Same as Primary	
Particulate Matter ($PM_{2.5}$)	12.0 µg/m^3	Annual mean, averaged over 3 years	15.0 µg/m^3	Annual mean
	35 µg/m^3	98th percentile of 24-hour concentration, averaged over 3 years	Same as Primary	
Ozone (O_3)	0.075 ppm	Annual 4th highest 8-hour daily max averaged over 3 years	Same as Primary	
Sulfur Dioxide (SO_2)	0.075 ppm	99th percentile of 1-hour daily max averaged over 3 years	0.5 ppm	3 hours

*****(In 1985, EPA revoked the secondary standard for CO (for public welfare) due to a lack of evidence of adverse effects on public welfare at or near ambient concentrations.)

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 second highest, non-overlapping 35 ppm 1-hour average standard and/or the 9 ppm 8-hour average standard is not exceeded more than once per year.
Pb	Compliance with the Pb standard is met when daily values collected for 3 consecutive months are averaged and do not exceed the 0.15 µg/m^3 standard.
NO_2	Compliance is met when the annual arithmetic mean concentration does not exceed the 0.053 ppm standard and the 98th percentile* averaged over 3 years of the 1-hour concentration does not exceed 100 ppb.
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-hour average concentration is less than or equal to 0.075 ppm.
PM	**PM_{10}:** The 24-hour PM_{10} primary and secondary standards are met when 150 µg/m^3 is not exceeded more than once per year on average over 3 years.
	$PM_{2.5}$: The annual $PM_{2.5}$ primary and secondary standards are met when the annual arithmetic mean concentration is less than or equal to 12 µg/m^3 and 15 µg/m^3, respectively. 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 µg/m^3.
SO_2	To determine compliance, the 99th percentile*** 1-hour concentration averaged over a 3-year period does not exceed 0.075 ppm, and the 3-hour average concentration shall not exceed 0.5 ppm more than once per calendar year.

***** *98th percentile daily maximum 1-hour value* is the value below which nominally 98 percent of all daily maximum 1-hour concentration values fall, using the ranking and selection method specified in section 5.2 of Appendix S of CFR Part 50.

****** *98th percentile* is the daily value out of a year of $PM_{2.5}$ monitoring data below which 98 percent of all daily values fall using the ranking and selection method specified in section 4.5(a) of Appendix N of CFR Part 50.

******* *99th percentile daily maximum 1-hour value* is the value below which nominally 99 percent of all daily maximum 1-hour concentration values fall, using the ranking and selection method specified in section 5 of Appendix T of CFR Part 50.

As part of the EPA's grant to the DEQ, the AQD provides an annual Network Review document[5] of all monitoring data collected from the previous year and recommendations on any network changes. These recommendations are based on each monitor's exceedance history, changes in population distribution, and modifications to federal monitoring requirements under the CAA. Under the amended air monitoring regulations that began in 2007, states are required to solicit public comment (in May of each year) on their future air monitoring network design prior to submitting the annual review to the EPA in July.

Michigan Air Sampling Network

The Michigan Air Sampling Network (MASN) is operated by the DEQ's AQD, along with other governmental agencies. For instance, the O_3 and $PM_{2.5}$ monitors in Manistee County and Chippewa County are tribal monitors managed by the Little River Band of Ottawa Indians and the Inter-tribal Council of Michigan, respectively. **Figure 1.1** shows the 2014 MASN monitoring sites. **Figures 1.2** and **1.3** are pictures of two monitoring stations; one at Detroit-East 7 Mile and the other in Harbor Beach.

[5] Most recent Network Reviews found online at: http://www.michigan.gov/documents/deq/deq-aqd-amu-2015_air_mon_network_review_461700_7.pdf?20150422122738

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 particulate concentrations over a 24-hour period; and high volume samplers for Pb. In addition, continuous $PM_{2.5}$ and PM_{10} monitors provide real-time hourly data, and $PM_{2.5}$ chemical speciation monitors determine the chemical composition of $PM_{2.5}$. The MASN data is also used to provide timely reporting to the DEQ's air quality reporting web page (discussed in **Chapter 9**). Types of monitoring conducted in 2014 and the MASN locations are shown in **Table 1.3.**

The **NCore network** began January 1, 2011, as part of EPA's 2006 amended air monitoring requirements. NCore is a multi-pollutant network that integrates several advance measurement systems for particles, pollutant gases and meteorology. This information will support scientific studies ranging across technological, health and atmospheric process disciplines. Michigan has two NCore sites; Allen Park and Grand Rapids-Monroe Street. Further information on the effects of these criteria pollutants are discussed in **Chapters 2** through **7**.

The **Near-Road-NO_2 Monitoring network** will focus on vehicle emissions and how they disperse near roadways. In 2011, Michigan took over the EPA's pre-existing near-roadway sites at Eliza Howell Park in Detroit. Data from these sites are discussed further in **Chapters 2** and **5.**

Figure 1.1: 2014 MASN Monitoring Sites

Figure 1.2: Detroit-East 7 Mile Monitoring Site

Figure 1.3: Harbor Beach Monitoring Site

Table 1.3 Types of Monitoring Conducted in 2014 and MASN Location

Area	AIRS ID	Site Name	CO	NO_2	Trace NO_y	O_3	PM_{10}	$PM_{2.5}$	$PM_{2.5}$ TEOM	$PM_{2.5}$ Speciation	SO_2	Trace SO_2	VOC	Carbonyls	Trace Metals	Wind Speed & Direction, Temp.	Relative Humidity	Solar Radiation	Barometric Pressure
Detroit-Ann Arbor	260910007	Tecumseh				√		√	√	√+E						√			√
	260990009	New Haven				√		√								√	√	√	
	260991003	Warren				√													
	261250001	Oak Park				√		√								√			
	261470005	Port Huron				√		√	√	√	√					√			
	261470031	Port Huron-Rural St.													√@+Pb				
	261610008	Ypsilanti				√		√	√							√			√
	261630001	Allen Park	√*		√	√	√	√	√	√+A		√			√@+Pb	√	√		√
	261630005	River Rouge					√							√	√@	√			
	261630015	Detroit-W. Fort St.					√	√		√	√		√	√	√@	√	√		√
	261630016	Detroit-Linwood						√											
	261630019	Detroit-East 7 Mile		√		√		√								√	√		√
	261630025	Livonia						√								√	√		√
	261630027	Detroit-W. Jefferson													√@				
	261630033	Dearborn					√	√	√	√+EA			√	√	√ + Pb	√	√		√
	261630036	Wyandotte						√											
	261630039	Detroit-W. Lafayette						√	√							√			
	261630093	Eliza Howell-Near Roadwa	√	√												√			
	261630094	Eliza Howell-Downwind	√	√												√	√		√
Flint	260490021	Flint				√		√	√							√			√
	260492001	Otisville				√										√			
Grand Rapids	261390005	Jenison				√										√			
	260810007	Grand Rapids-Wealthy						√											
	260810020	Grand Rapids-Monroe	√*		√	√	√	√	√	√		√			√@+Pb	√			√
	260810022	Evans				√										√			
Lansing/East Lansing	260650012	Lansing		√		√		√	√		√					√			√
	260370001	Rose Lake				√													
Monroe Co	261150006	Sterling State Park						√		√	√					√			
Huron Co	260630007	Harbor Beach				√										√			
Bay Co	260170014	Bay City						√	√							√			
MissaukeeCo	261130001	Houghton Lake		√		√		√	√	√						√			√
Allegan Co	260050003	Holland				√		√								√	√	√	√
Benzie Co	260190003	Benzonia				√													
Berrien Co	260210014	Coloma				√		√								√			
Cass Co	260270003	Cassopolis				√										√			
Kalamazoo Co	260770008	Kalamazoo				√		√	√							√			
Manistee Co	261010922	Manistee $				√		√								√		√	√
Mason Co	261050007	Scottville				√										√			
Muskegon Co	261210039	Muskegon-Green				√										√			
Schoolcraft Co	261530001	Seney Nat'l Wildlife				√			√							√	√	√	√
Chippewa Co	260330901	Sault Ste. Marie $				√		√	√							√			
Ionia Co	260670002	Belding-Reed St.													√@+Pb	√			
	260670003	Belding-Merrick St.													√@+Pb				
Tuscola Co	261570001	Vassar					√								√@+Pb				

√ = Data Collected
= Mn only
@ = Mn, As, Cd, Ni
$ = Tribal monitor
* = Trace CO monitor
E = EC/OC monitor
A = Aethalometer monitor

Quality Assurance

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

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

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

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

Long-term Trends

Congress passed the Clean Air Act (CAA) in 1970; however, Michigan has had a long-standing history of environmental awareness well before the Act was established. In 1887, Detroit was the first city in Michigan to adopt an air quality ordinance, which declared that the dense smoke from burning coal was a public nuisance.

The EPA is required to review criteria pollutant standards every five years. Over time, based upon toxicological data, the standards (NAAQS) have been tightened to better protect public health. Areas that meet the NAAQS are considered to be in "attainment." Locations where air pollution levels persistently exceed the NAAQS may be designated as "nonattainment." That is why some areas in the state may be designated to nonattainment from attainment even though monitoring shows that air quality continues to improve.

Due to the vast availability of historical data, criteria pollutant data from Southeast Michigan are shown in **Figures 1.4** through **1.7.** These figures show how ambient levels and standards for these pollutants have changed over the last 35-plus years. Since this area is highly industrialized, it is a good indicator of the Air Quality improvement for the rest of the state.

Figure 1.4 shows the ozone levels at the Detroit-East 7 Mile Road site. This graph shows how the standard changed from a 1-hour average of 0.120 ppm to an 8-hour average of 0.08 ppm in 1997. The standard was further lowered to 0.075 ppm in 2008.

Figure 1.4: Historical Ozone at DEQ's Detroit-East 7 Mile Site

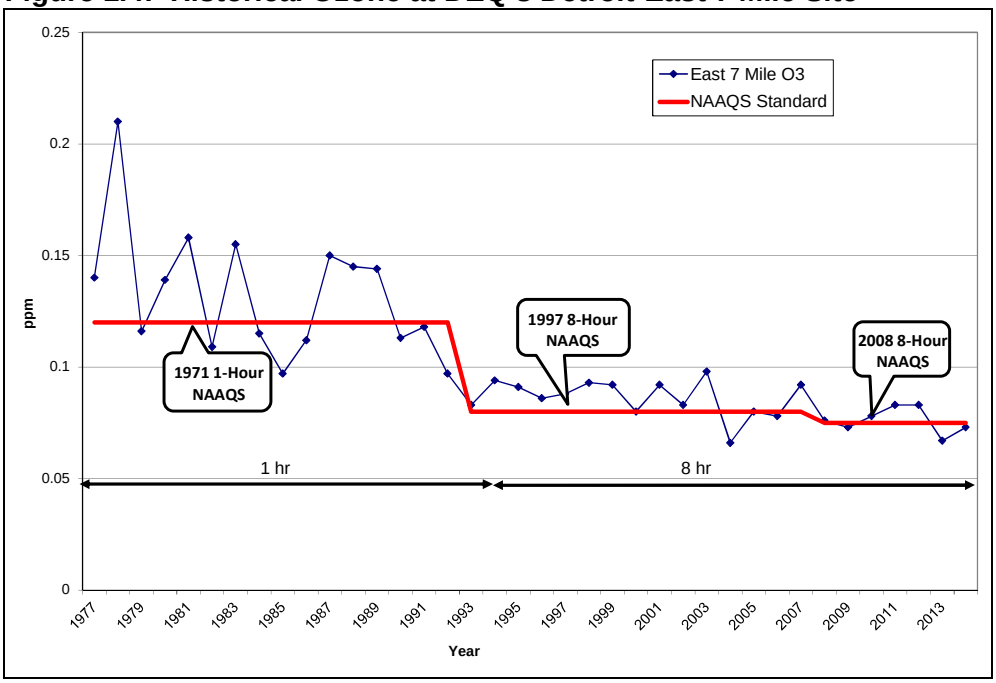


Figure 1.5 shows the SO_2 trend for the old annual standard and the new 1-hour standard for W. Fort Street (SWHS) in Detroit. In 2010, the EPA changed the standard from an annual average to 99th percentile of a 1-hour standard in which the SO_2 concentration cannot exceed 0.075 ppm averaged over 3 years. This resulted in nonattainment status for a portion of Wayne County (see **Chapter 4** for additional details). Even though the area is in nonattainment for the 1-hour SO_2 standard, levels of SO_2 have decreased significantly over the years.

Figure 1.5: Historical Annual and 1-Hour SO_2 Averages at Detroit–W. Fort Street (SWHS)

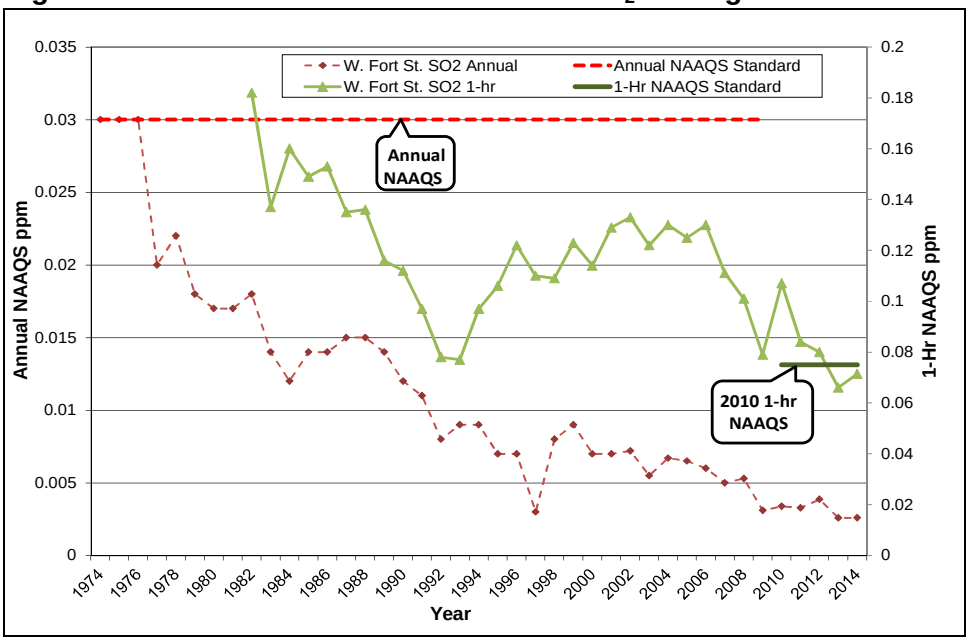


Figure 1.6 shows the CO trend to be well below the 1-hour standard of 35 ppm, which has not changed since 1971.

Figure 1.6: Historical 1-Hour CO Averages at Allen Park

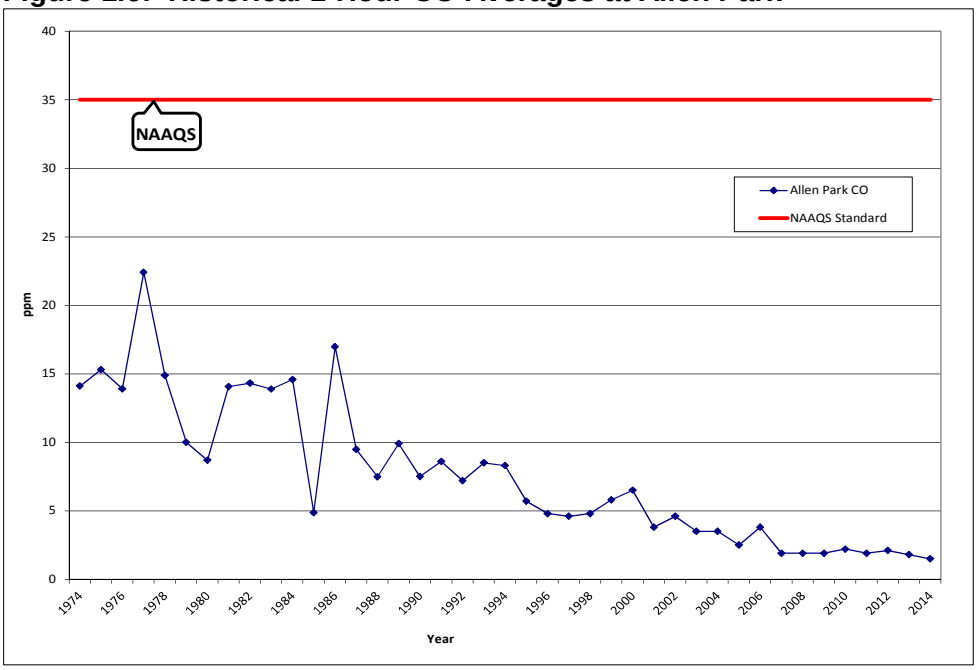
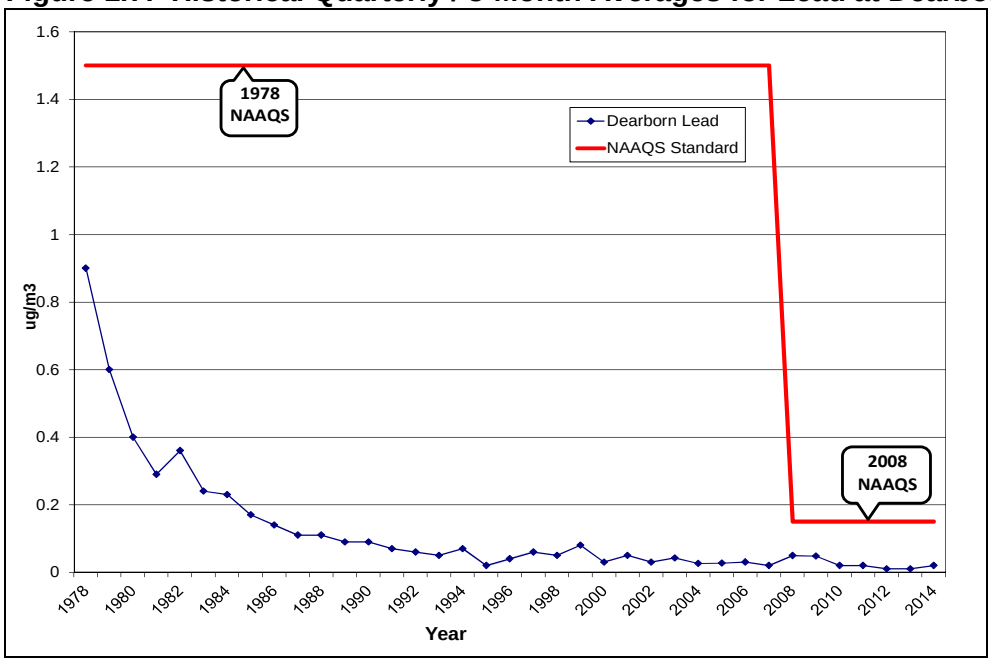


Figure 1.7 shows the trend for lead. Lead is of concern because it is harmful to the neurological development of children. The largest decrease in lead in the air is due to the removal of lead in gasoline. By 1975, most newly manufactured vehicles no longer required leaded gasoline, and as a result, there was a dramatic decrease in ambient lead levels. In 1996, the EPA banned the sale of leaded fuel for use in on-road vehicles. The graph also shows the decrease in the lead standard that occurred in 2008.

Figure 1.7: Historical Quarterly / 3-Month Averages for Lead at Dearborn



Chapter 2: Carbon Monoxide (CO)

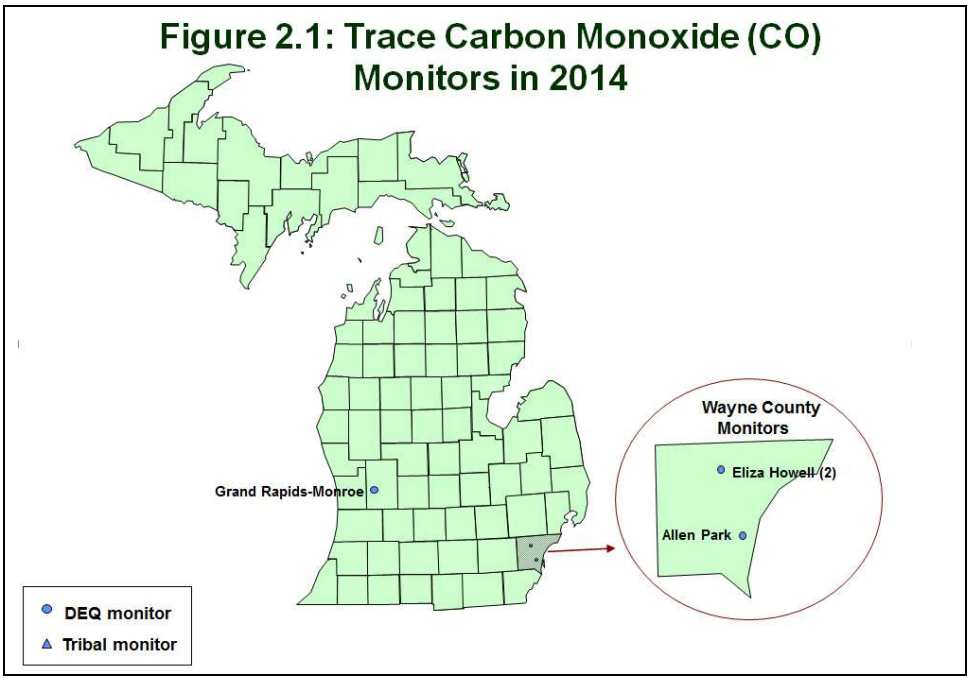
Carbon monoxide is a colorless, odorless, tasteless, and poisonous gas, formed during incomplete burning of fuel. Levels peak during colder months primarily due to cold temperatures that affect combustion efficiency of engines. It has a standard of 9 ppm for the second highest 8-hour average and 35 ppm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

Sources: CO is given off whenever fuel or other carbon-based materials are burned. Outdoor exposure sources include automobile exhaust, industrial processes (metal processing and chemical production), and non-vehicle fuel combustion. Natural sources include volcanos, forest fires and photochemical reactions in the atmosphere. Indoor exposure sources include wood stoves and fireplaces, gas ranges with continuous pilot flame ignition, unvented gas or kerosene heaters, and cigarette smoke.

Effects: CO enters the bloodstream through the lungs, where it displaces oxygen delivered to the organs and tissues. Elevated levels can cause visual impairment, interfere with mental acuity by reducing learning ability and manual dexterity, and can decrease work performance in the completion of complex tasks. In extreme cases, unconsciousness and death can occur. CO also alters atmospheric photochemistry contributing to the formation of ground-level O_3, which can trigger serious respiratory problems.

Population most at risk: Those who suffer from cardiovascular (heart and respiratory) disease, unborn babies, infants and the elderly are most at risk for exposure to elevated levels of CO. People with angina and peripheral vascular disease are especially at risk, as their circulatory systems are already compromised and less efficient at carrying oxygen; however, elevated CO levels can also affect healthy people.

Figure 2.1 shows the locations in Detroit where CO is monitored. These are the Eliza Howell Park sites that are required under the Near-Roadway Network. The other two sites, Grand Rapids and Allen Park, are where trace CO (lower detection levels 1 ppm-50 ppb) is being monitored as part of the NCore Network.



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

Figure 2.2: CO Emissions by Source Sector

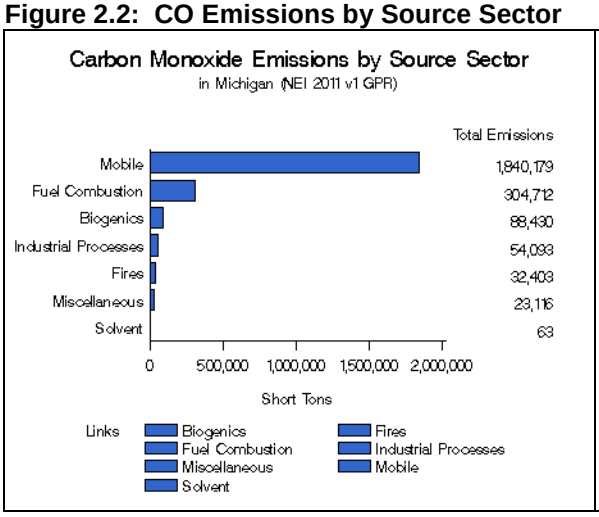
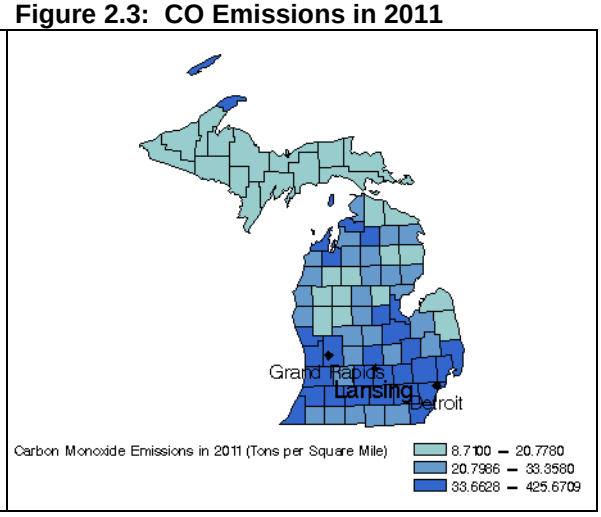
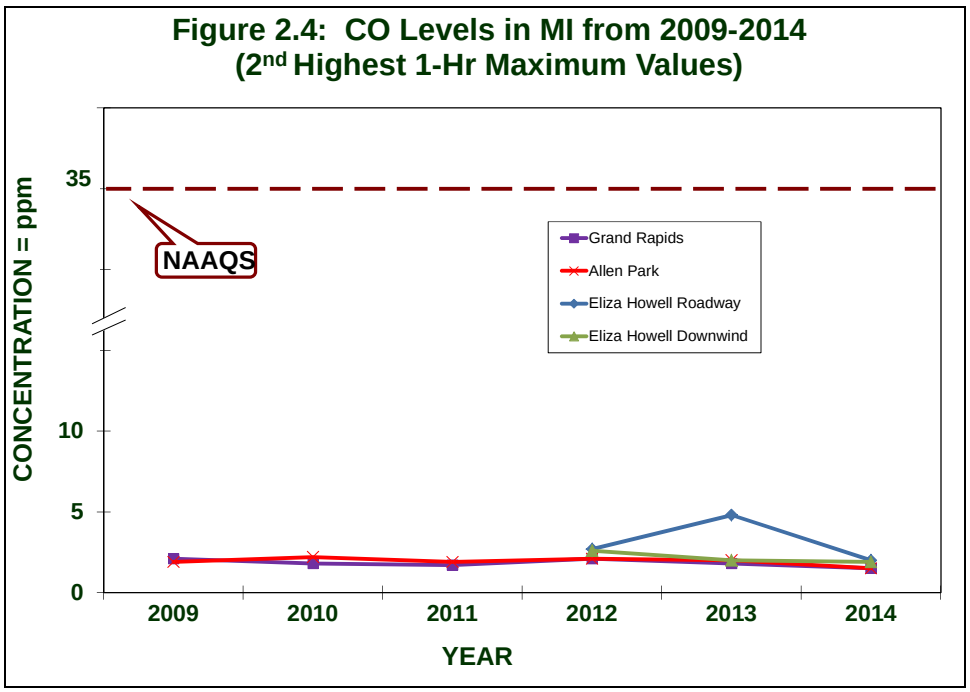


Figure 2.3: CO Emissions in 2011



Near-roadway Monitoring: On August 31, 2011, the EPA approved design changes to part of the CO ambient monitoring network. This network, now referred to as the near-roadway network, is focused on high traffic urban roads in Core-based Statistical Areas (CBSAs) with more than one million people. The DEQ took over two of the EPA's pre-existing, near-roadway sites at Eliza Howell Park, Detroit in June 2011.

Figure 2.4 provides the maximum second highest 1-hour CO level trends for Michigan from 2009-2014, which demonstrates that there have not been any exceedances of the 1-hour CO NAAQS.



Chapter 3: Lead (Pb)

Lead is a highly toxic metal found in coal, oil, and other fuels. It is also found in older paints, municipal solid waste and sewage sludge, and may be released to the atmosphere during combustion. On November 12, 2008, the EPA lowered the Pb NAAQS from a maximum quarterly average of 1.5 $\mu g/m^3$ to a 3-month rolling average of 0.15 $\mu g/m^3$. Its sources and effects are as follows:

Sources: With the phase-out of leaded gas in the 1970s, the major sources of lead emissions have been due to ore and metals processing and piston-engine aircraft operating on leaded aviation fuel. Other industrial sources include lead acid battery manufacturers, waste incinerators and utilities. The highest air concentrations of lead are usually found near lead smelters.

Effects: Exposure occurs through the inhalation or ingestion of Pb in food, water, soil, or dust particles. Pb primarily accumulates in the body's blood, bones, and soft tissues, and adversely affects the kidneys, liver, nervous system, and other organs.

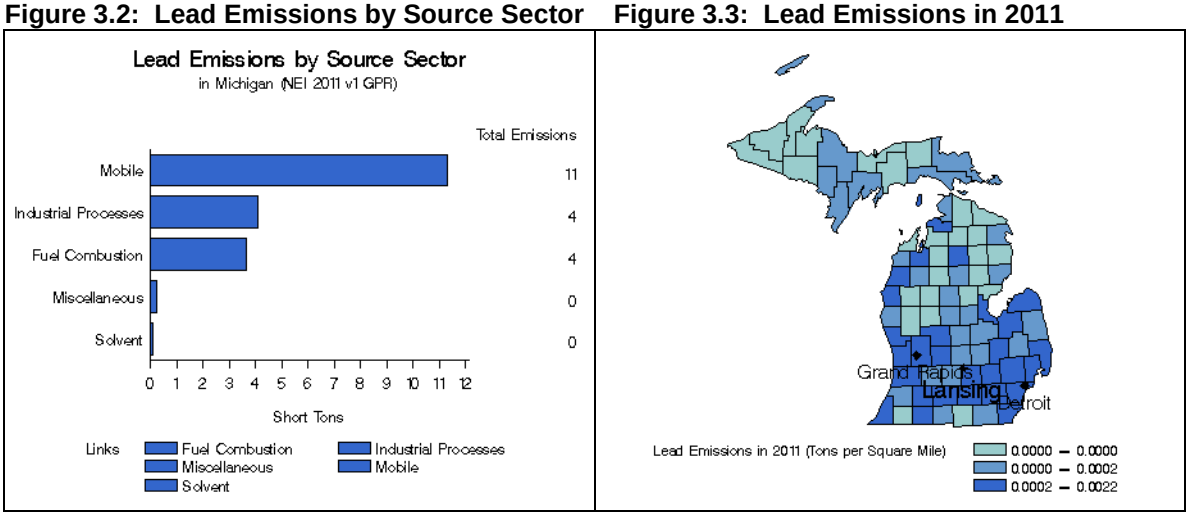
Population most at risk: Fetuses and children are most at risk since low levels of lead may cause central nervous system damage. Excessive lead exposure during the early years of life is associated with lower IQ scores and neurological impairment (seizures, mental development, and behavioral disorders). Even at low doses, lead exposure is associated with changes in fundamental enzymatic, metabolic, and homeostatic mechanisms in the body, and Pb may be a factor in high blood pressure and subsequent heart disease.

Figure 3.1 shows the location of the lead monitors in the MASN in 2014.

Figure 3.1: Lead (Pb) Monitors in 2014

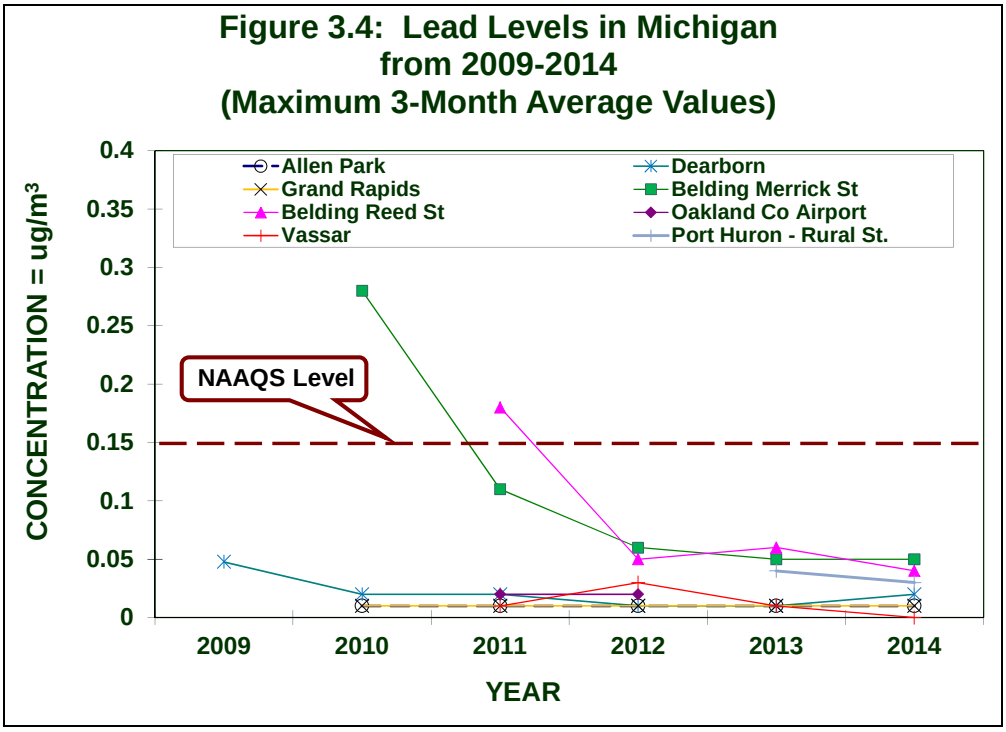
Figures 3.2 and **3.3** show Pb emission sources and Pb emissions by county (courtesy of the EPA's State and County Emission Summaries).

Figure 3.2: Lead Emissions by Source Sector **Figure 3.3: Lead Emissions in 2011**

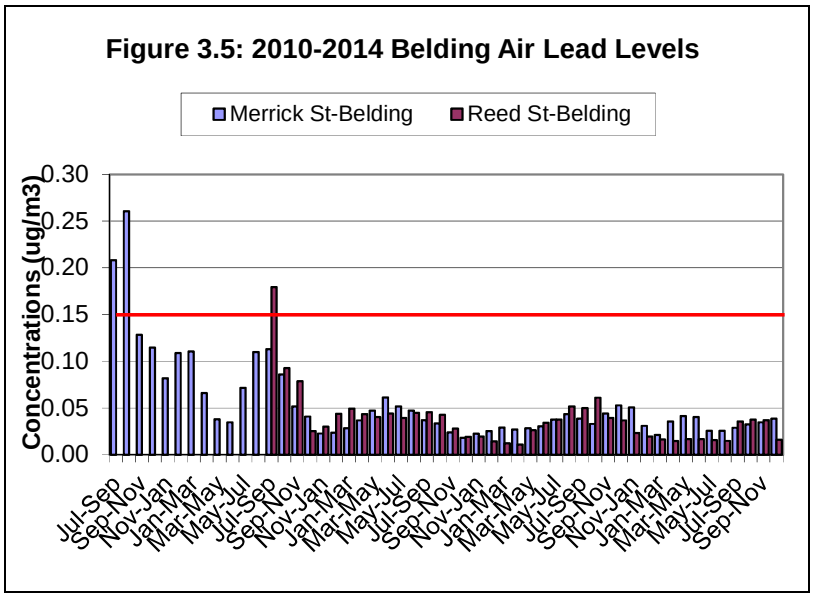


On November 12, 2008, the EPA modified the Pb NAAQS by reducing the level of the standard from a maximum quarterly average of 1.5 µg/m^3 to a 3-month rolling average of 0.15 µg/m^3. The monitoring network design was modified to consist of source-oriented monitors and population-oriented monitors.

Figure 3.4 shows the maximum 3-month rolling average values for lead from 2009 to 2014.



As part of the new standard, the DEQ is required to monitor near stationary lead sources emitting more than one-half ton per year. Initially, six point-source lead monitoring sites were established: East Jordan (November 2011-November 2012), Oakland International Airport (July 2011-November 2012), Vassar (started October 2011), Rural St. in Port Huron (started November 2012); Merrick St. in Belding (started January 2010) and Reed St. in Belding (started July 2011). The Merrick St. monitor located in Belding recorded a violation of the new health standard in 2010, as shown in **Figure 3.5.** Therefore the second site, Reed St., was added in July 2011 at Belding and this site also recorded a violation of the new health standard in 2011. Values for both the sites have been below the NAAQS for the past three years.



All other lead sites in Michigan are well below the standard. The Dearborn site is part of the National Air Toxics Trend Sites (NATTS) and monitors lead and trace metals, both as total suspended particulate (TSP) and PM_{10}. Lead measurements as $PM_{2.5}$ are also made throughout the $PM_{2.5}$ speciation network.

Chapter 4: Sulfur Dioxide (SO_2)

Sulfur dioxide is a gas formed by the burning of sulfur-containing material. Odorless at typical ambient concentrations, SO_2 can react with other atmospheric chemicals to form sulfuric acid. At higher concentrations it has a pungent irritating odor similar to a struck match. When sulfur-bearing fuel is burned, the sulfur is oxidized to form SO_2, which then reacts with other pollutants to form aerosols. These aerosols can form particles in the air causing increases in $PM_{2.5}$ levels. In liquid form, it is found in clouds, fog, rain, aerosol particles, and in surface films on these particles. In June 2010, the EPA changed the primary SO_2 standard to a 99th percentile of 1-hour concentrations not to exceed 0.075 ppm, averaged over a 3-year period. The secondary standard has not changed and is a 3-hour average of 0.5 ppm. Its sources and effects are as follows:

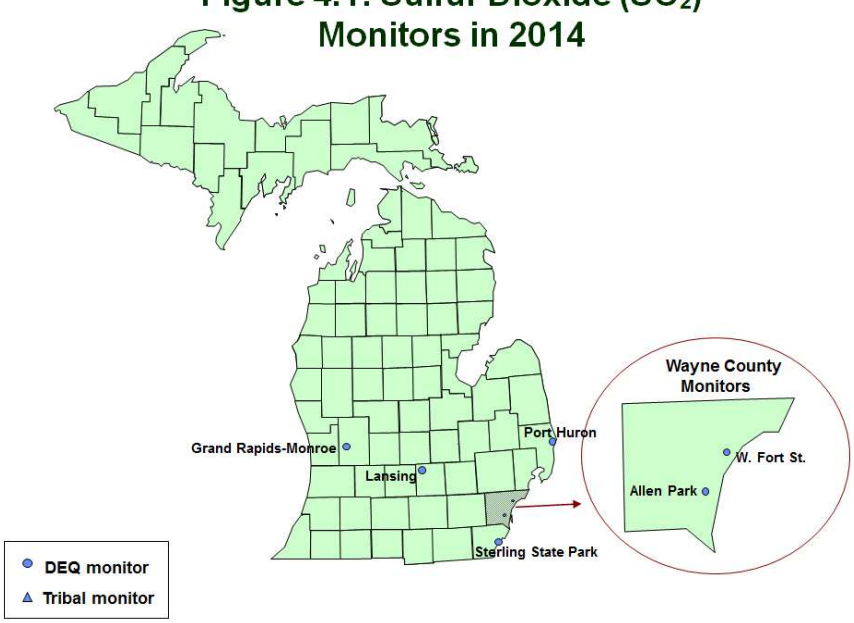
Sources: Coal-burning power plants are the largest source of SO_2 emissions. Other sources include petroleum refineries, ore smelters, pulp and paper mills, steel mills and non-road transportation sources. SO_2 and particulate matter are often emitted together.

Effects: Exposure to elevated levels can affect breathing, cause respiratory illnesses, aggravate existing cardiovascular and pulmonary diseases, and alter the body's immune system. SO_2 and NO_X together are the major precursors to acid rain and are associated with the acidification of soils, lakes, and streams; as well as accelerated corrosion of buildings and monuments.

Population most at risk: Asthmatics, children, and the elderly are especially sensitive to SO_2 exposure. Asthmatics receiving short-term exposures during moderate exertion may experience reduced lung function and symptoms, such as wheezing, chest tightness, or shortness of breath. Depending upon the concentration, SO_2 may also cause symptoms in people who do not have asthma.

Figure 4.1 shows the location of each SO_2 monitor. The two NCore Sites, Allen Park and Grand Rapids, have trace SO_2 monitors that have lower detection limits than traditional monitors.

Figure 4.1: Sulfur Dioxide (SO_2) Monitors in 2014



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

Figure 4.2: SO_2 Emissions by Source Sector

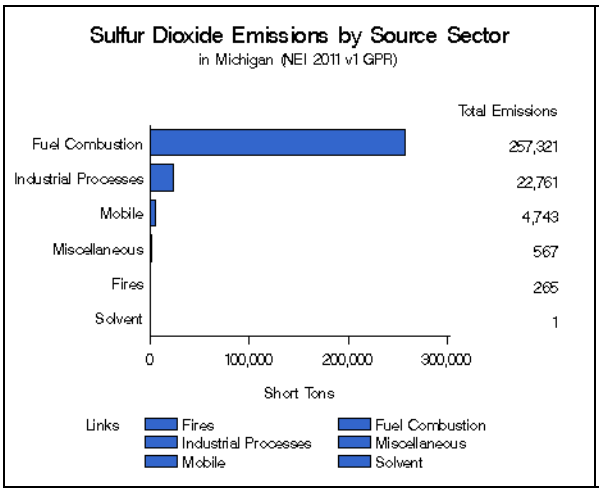
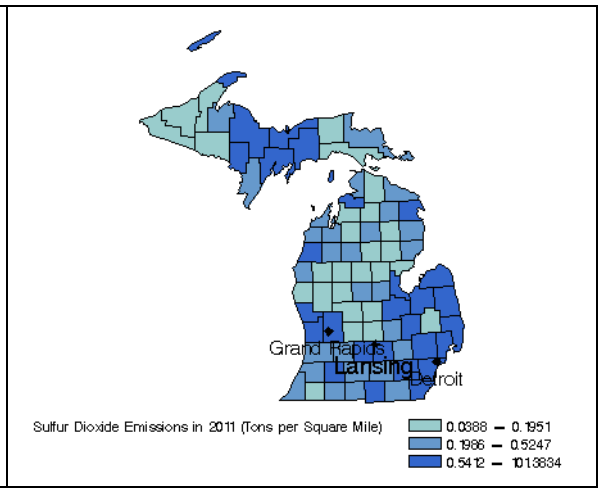
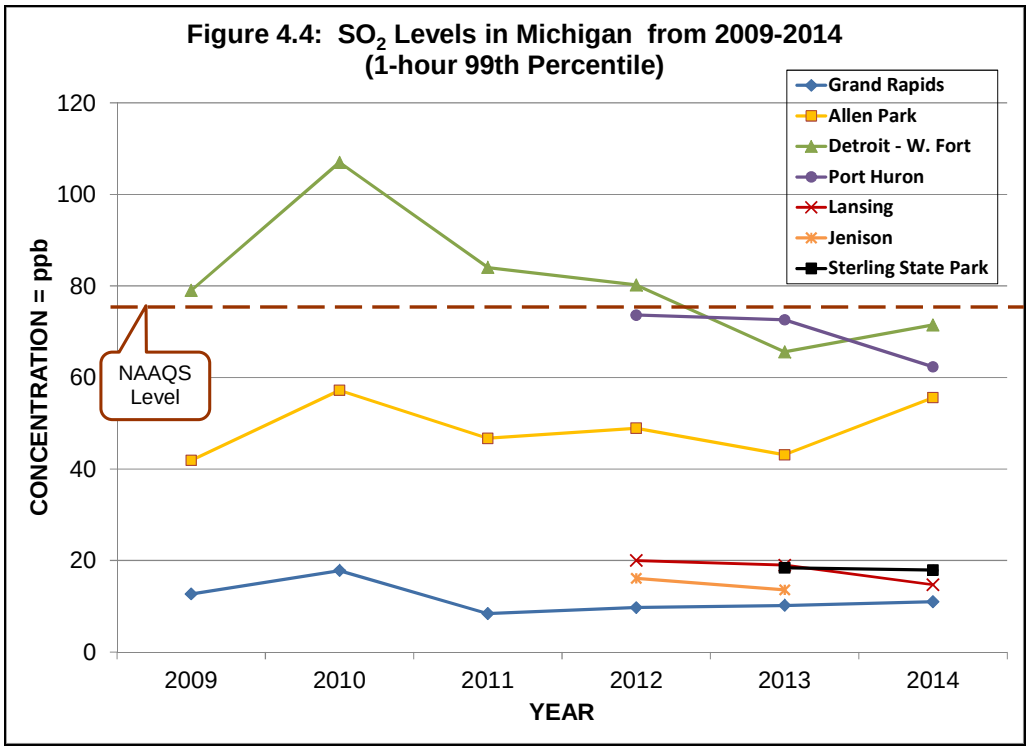


Figure 4.3: SO_2 Emissions in 2011



Michigan had been in attainment for SO_2 since 1982 with levels consistently well below the annual SO_2 NAAQS. However, the SO_2 monitor at W. Fort Street (SWHS) in Detroit currently does not meet the 2010 1-hour NAAQS (see Appendix A). The NCore sites, Grand Rapids and Allen Park, monitor for trace SO_2. For trend purposes, all SO_2 data is graphed together in **Figure 4.4**. Jenison and Port Huron were added to the SO_2 network in December 2011, and Sterling State Park in Monroe County was added to the SO_2 network in December 2012**.** The Jenison monitor was shut down on January 1, 2014 and was moved in January 2015 to a new site in West Olive.



Chapter 5: Nitrogen Dioxide (NO_2)

Nitrogen dioxide is a reddish-brown, highly reactive gas formed through oxidation of nitric oxide (NO). Upon dilution, it becomes yellow or invisible. High concentrations produce a pungent odor and lower levels have an odor similar to bleach. NO_x is a 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 particulate matter. Since 1971, the primary and secondary standard for NO_2 was an annual mean of 0.053 ppm. In January 2010, the EPA added a 1-hour NO_2 standard of 100 ppb, taking the form of the 98th percentile averaged over three years. The sources and effects of NO_2 are as follows:

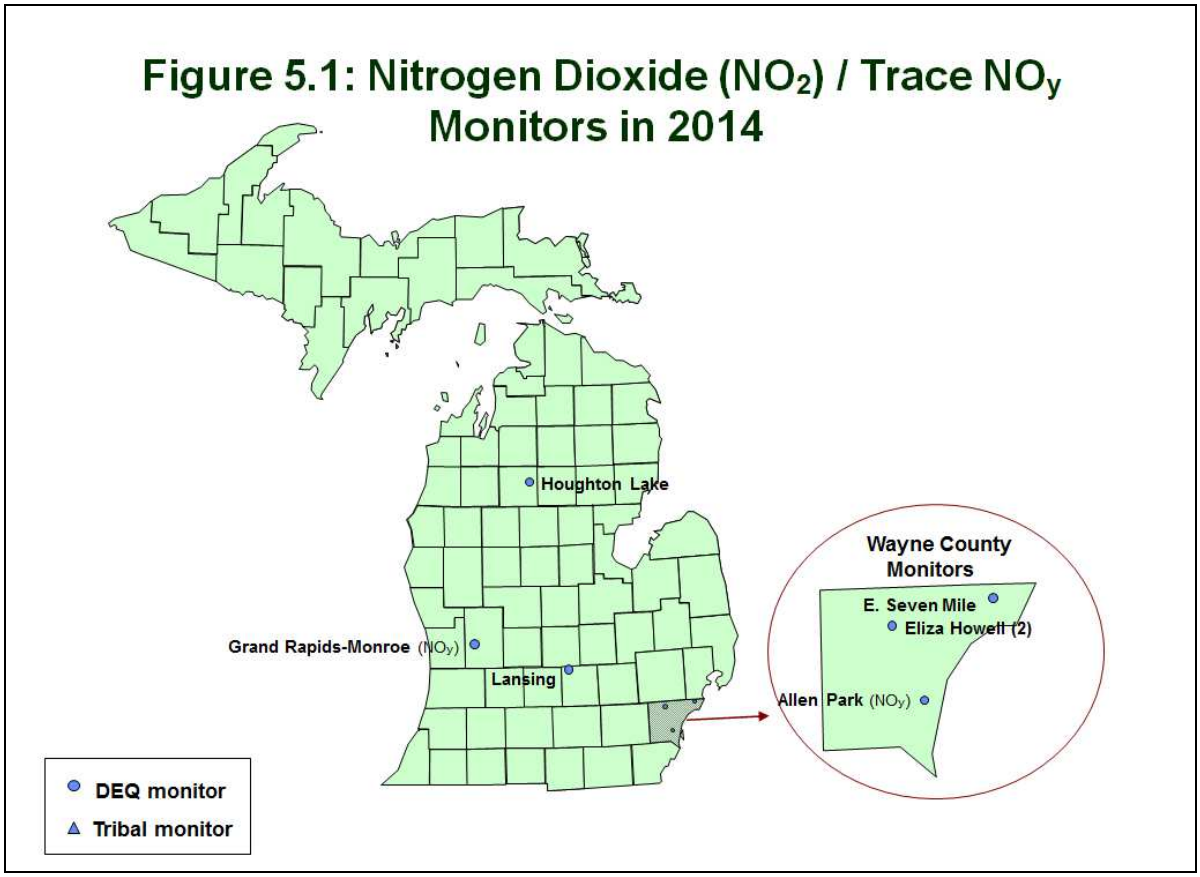
Sources: NO_X compounds and their transformation products occur both naturally and as a result of human activities. Natural sources of NO_X are lightning, forest fires, bacterial processes in soil, and stratospheric intrusion. Stratospheric intrusion is when the stratospheric air descends towards the surface of the earth and mixes with the air at breathing level. Ammonia and other nitrogen compounds produced naturally are important in the cycling of nitrogen through the ecosystem. Major sources of man-made (anthropogenic) NO_x emissions come from high-temperature combustion processes such as those occurring in automobiles and power plants. Home heaters and gas stoves produce substantial amounts of NO_2 in indoor settings.

Effects: Exposure to NO_2 occurs through the respiratory system, irritating the lungs. Short-term NO_2 exposures (i.e., less than three hours) can produce coughing and changes in airway responsiveness and pulmonary function. Evidence suggests that long-term exposures to NO_2 may lead to increased susceptibility to respiratory infection and may cause structural alterations in the lungs. Exercise increases the ventilation rate and hence exposure to NO_2. Nitrate particles and NO_2 can block the transmission of light, resulting in visibility impairment (i.e., smog or haze). Deposition of nitrogen can lead to fertilization, eutrophication, or acidification of terrestrial, wetland, and aquatic systems.

Population most at risk: Individuals with pre-existing respiratory illnesses and asthmatics are more sensitive to the effects of NO_2 than the general population. Short-term NO_2 exposure can increase respiratory illnesses in children.

The East 7 Mile monitor in Detroit is a downwind urban scale site that measures NO_2. The Detroit Eliza Howell sites measure NO_2 in a near-road environment. The NCore sites of Grand Rapids and Allen Park monitor trace NO_Y, which includes NO_x, nitric acid, and organic and inorganic nitrates. However, only NO_2 monitors can be used for attainment/nonattainment purposes. In addition, in 2010, the AQD added NO_2 monitors at Lansing and Houghton Lake to provide background information for modeling applications.

Figure 5.1 shows the location of each NO_2 monitor.



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

Figure 5.2: NO_2 Emissions by Source Sector

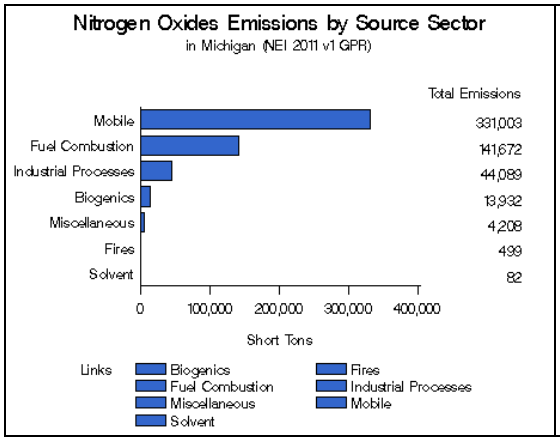
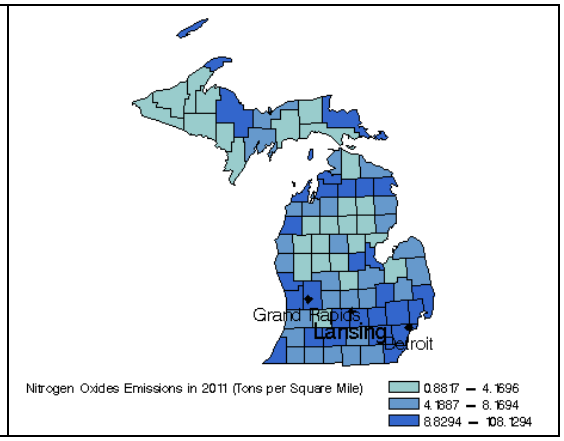
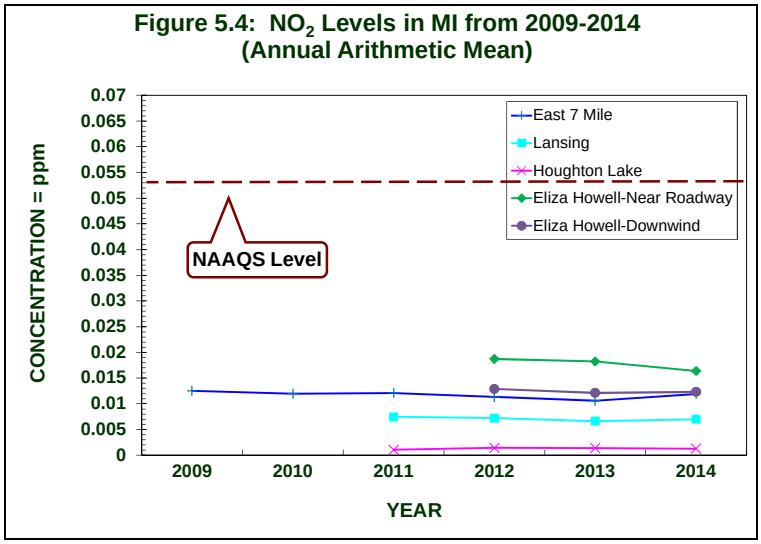


Figure 5.3: NO_2 Emissions in 2011



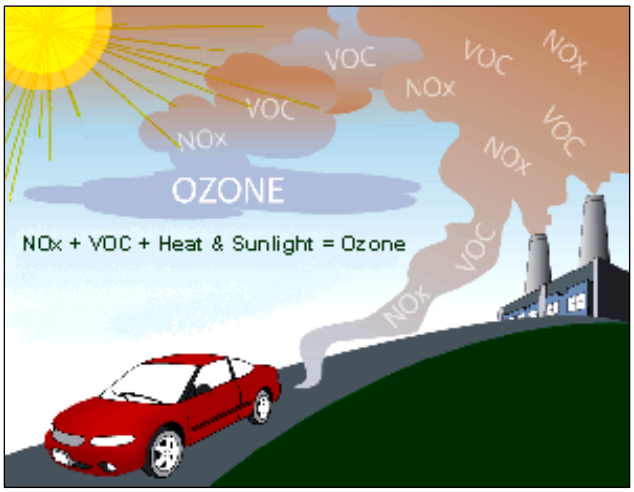
Michigan ambient NO_2 levels have always been well below the NAAQS. Since March 3, 1978, all areas in Michigan have been in attainment for the annual NO_2 NAAQS. As shown in **Figure 5.4**, all monitoring sites have had an annual NO_2 concentration at less than half of the 0.053 ppm NAAQS. As such, the DEQ requested a designation of unclassifiable/attainment for the entire state. Unclassifiable/attainment means that there are no air quality measurements that would justify classifying these attainment areas as either serious or moderate nonattainment areas.



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

Chapter 6: Ozone (O_3)

Ground-level O_3 is created by reactions involving nitrogen oxides (NO_X) and volatile organic compounds (VOCs), or hydrocarbons, in the presence of sunlight as the illustration to the right depicts (image courtesy of the EPA). These reactions usually occur during the hot summer months as ultraviolet radiation from the sun initiates a sequence of photochemical reactions. In Earth's upper atmosphere (the stratosphere) O_3 helps by absorbing much of the sun's ultraviolet radiation, but in the lower atmosphere (the troposphere), ozone is an air pollutant. O_3 is also a key ingredient of urban smog and can be transported hundreds of miles under certain meteorological conditions. Ozone levels are often higher in rural areas than in cities due to transport to regions downwind from the actual emissions of NO_X and VOCs. Shoreline monitors along Lake Michigan often measure high ozone concentrations due to transport from upwind states. The ozone NAAQS was revised by the EPA and became effective on May 27, 2008. The new standard is a 3-year average of the 4th highest daily maximum 8-hour average concentration within an area that must not exceed 0.075 ppm. The sources and effects of ozone follow:

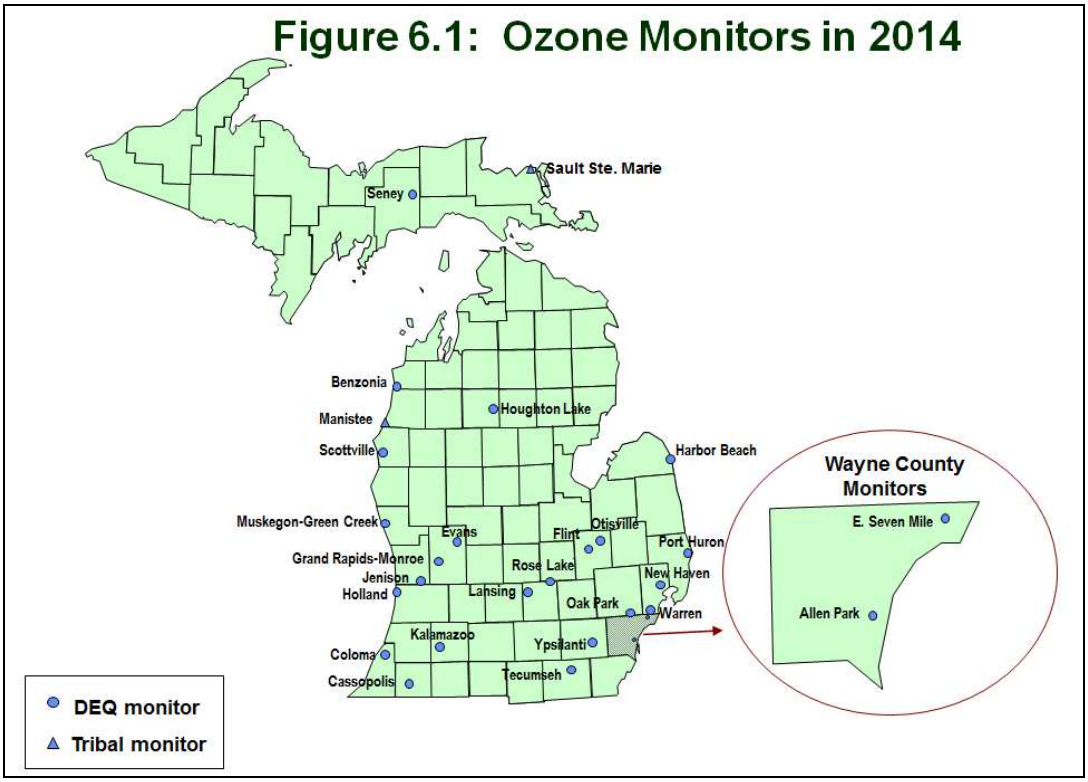


Sources: Major sources of NO_X and VOCs are engine exhaust, emissions from industrial facilities, combustion from power plants, gasoline vapors, chemical solvents, and biogenic emissions from natural sources. Ground-level O_3 can also be transported hundreds of miles under certain wind regimes. As a result, the long-range transport of air pollutants impacts the air quality of regions downwind from the actual area of formation.

Effects: Elevated O_3 exposure can irritate 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 forest ecosystems, including agricultural crop and forest yield reductions, diminished resistance to pests and pathogens, and reduced survivability of tree seedlings.

Population most at risk: Individuals most susceptible to the effects of O_3 exposure include those with a pre-existing or chronic respiratory disease, children who are active outdoors and adults who actively exercise or work outdoors.

Figure 6.1 shows the location of the DEQ's O_3 monitors in Michigan.



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

Figure 6.2: VOC Emissions by Source Sector

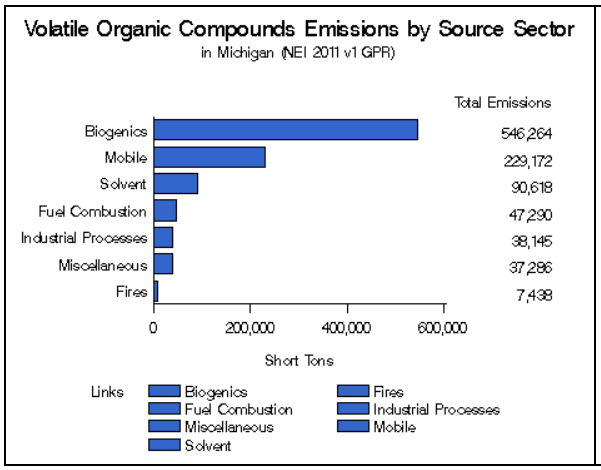
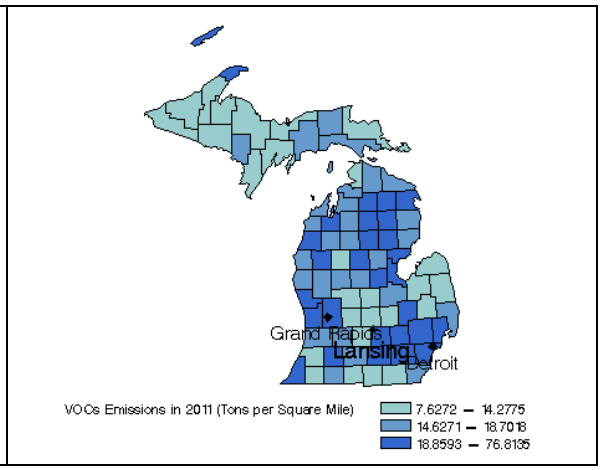


Figure 6.3: VOC Emissions in 2011



The primary 8-hour ozone NAAQS was revised by the EPA in March 2008 to 0.075 ppm and became effective in May 2008. To attain the 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. The secondary 8-hour ozone was also revised, making it identical to the primary standard.

According to the EPA's April 30, 2012 letter, no areas in Michigan violated the 2008 standards or contributed to a violation of the ozone standards. As a result, all of Michigan was designated as unclassifiable/attainment. Although Michigan is designated unclassifiable/ attainment based on 2008-2010 ozone data, many monitors throughout the state are now showing violations of

the 0.075 ppm ozone standard (see **Table 6.1** and **Figure 6.4**)

The O_3 monitoring season in Michigan is from April 1 through September 30, the hottest portion of the year. During this time O_3 monitoring data is available for the public via the AQD's web site (discussed in **Chapter 9**). However, year round O_3 monitoring is done at four sites: Allen Park, Grand Rapids, Houghton Lake and Lansing. This data helps in attainment designations and urban air quality and population exposure assessments.

Figure 6.1 shows all O_3 air quality monitors active in Michigan at the beginning of the 2014 ozone season.

Table 6.1: Three-year Average of the 4th Highest 8-hour Ozone Values from 2010-2012, 2011-2013, and 2012-2014 (concentrations in ppm). Numbers in Bold Indicate 3-year Averages Over the Ozone Standard.

Areas	County	Monitor Sites	2010-2012	2011-2013	2012-2014
Detroit-Ann Arbor	Lenawee	Tecumseh	**0.076**	0.075	0.073
	Macomb	New Haven	**0.078**	**0.077**	0.074
		Warren	**0.080**	**0.077**	0.072
	Oakland	Oak Park	**0.078**	**0.076**	0.071
	St. Clair	Port Huron	**0.077**	0.075	0.074
	Washtenaw	Ypsilanti	**0.076**	0.075	0.073
	Wayne	Allen Park	0.074	0.072	0.068
		Detroit-East 7 Mile	**0.081**	**0.077**	0.074
Flint	Genesee	Flint	**0.076**	0.074	0.072
		Otisville	0.074	0.074	0.072
Grand Rapids	Ottawa	Jenison	**0.078**	**0.077**	0.075
	Kent	Grand Rapids	0.075	0.074	0.071
		Evans	0.074	0.074	0.070
Muskegon Co	Muskegon	Muskegon	**0.082**	**0.081**	**0.079**
Allegan Co	Allegan	Holland	**0.084**	**0.086**	**0.083**
Huron	Huron	Harbor Beach	0.074	0.072	0.071
Kalamazoo-Battle Creek	Kalamazoo	Kalamazoo	0.075	0.075	0.073
Lansing-East Lansing	Ingham	Lansing	0.072	0.072	0.070
	Clinton	Rose Lake	0.071	0.071	0.069
Benton Harbor	Berrien	Coloma	**0.082**	**0.082**	**0.079**
Benzie Co	Benzie	Benzonia	0.075	0.074	0.073
Cass Co	Cass	Cassopolis	**0.078**	**0.078**	0.073
Chippewa Co	Chippewa	Sault Ste. Marie	0.064	0.067	0.065
Mason Co	Mason	Scottville	**0.076**	0.075	0.074
Missaukee Co	Missaukee	Houghton Lake	0.070	0.070	0.070
Manistee Co	Manistee	Manistee	0.074	0.074	0.072
Schoolcraft Co	Schoolcraft	Seney	0.075	0.072	0.073

Tables 6.2 and **6.3** highlight the number of days when two or more O_3 monitors exceeded 0.075 ppm. It also specifies in which month they occurred and the temperature range.

Table 6.2

Daily High Temperature Range			2014 WEST MICHIGAN OZONE SEASON											
			April		May		June		July		August		September	
			Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days
	>=	95	0	0	0	0	0	0	0	0	0	0	0	0
90	<=	94	0	0	0	0	0	0	0	0	0	0	0	0
85	<=	89	0	0	3	0	7	0	3	0	6	1	0	0
80	<=	84	0	0	7	0	8	1	10	1	16	0	5	0
75	<=	79	1	0	4	0	10	0	13	0	6	0	10	0
70	<=	74	3	0	3	0	3	0	4	0	2	0	4	0
65	<=	69	5	0	3	0	2	0	1	0	1	0	4	0
60	<=	64	5	0	2	0	0	0	0	0	0	0	5	0
55	<=	59	9	0	5	0	0	0	0	0	0	0	2	0
50	<=	54	2	0	2	0	0	0	0	0	0	0	0	0
49	<=		5	0	2	0	0	0	0	0	0	0	0	0
Totals			30	0	31	0	30	1	31	1	31	1	30	0

Days: Number of days during month when the daily high temperature falls within the specified temperature range.
O_3 Days: Number of days, during specified temperature range, when two or more area monitors exceeded 75 ppb.

For West Michigan there were no O_3 exceedance days in April, May and September. There was only one day each, in June, July, and August, when ozone exceeded 0.075 ppm at two or more ozone monitors. The temperatures for those days were between 80^0F and 89^0F.

Table 6.3

Daily High Temperature Range			2014 SOUTHEAST MICHIGAN OZONE SEASON											
			April		May		June		July		August		September	
			Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days
	>=	95	0	0	0	0	0	0	0	0	0	0	0	0
90	<=	94	0	0	0	0	1	0	1	0	1	0	1	0
85	<=	89	0	0	4	0	5	0	5	0	3	0	2	0
80	<=	84	1	0	4	0	13	0	8	0	15	1	2	0
75	<=	79	2	0	6	0	8	0	11	0	9	0	10	0
70	<=	74	4	0	4	0	2	0	6	0	3	0	4	0
65	<=	69	3	0	2	0	1	0	0	0	0	0	6	0
60	<=	64	4	0	6	0	0	0	0	0	0	0	4	0
55	<=	59	7	0	5	0	0	0	0	0	0	0	1	0
50	<=	54	6	0	0	0	0	0	0	0	0	0	0	0
49	<=		3	0	0	0	0	0	0	0	0	0	0	0
Totals			30	0	31	0	30	0	31	0	31	1	30	0

Days: Number of days during month when the daily high temperature falls within the specified temperature range.
O_3 Days: Number of days, during specified temperature range, when two or more area monitors exceeded 75 ppb.

For southeast Michigan, there were no O_3 exceedance days in April, May, June, July and September. There was one day in August when ozone exceeded 0.075 ppm at two or more ozone monitors. The temperature for that day was between 80^0F and 84^0F.

Table 6.4 gives a breakdown of the O_3 days and specific monitors that went over the standard in western, central/upper, and eastern Michigan.

Table 6.4: Eight-hour Exceedance Days (>0.075 ppm) and Locations

Date	Monitors with Exceedances of the Ozone Standard			Total
	Western Michigan	Central/Upper Michigan	Eastern Michigan	
05/26/2014	Muskegon			1
06/07/2014	Holland, Coloma, Muskegon		Tecumseh	4
06/09/2014			Ypsilanti	1
07/20/2014	Holland, Coloma			2
07/21/2014		Seney		1
08/03/2014	Holland, Muskegon		New Haven, Warren, East 7 Mile	5
08/16/2014	Holland			1
			TOTAL	15

On June 7, 2014, there were four monitors that exceeded the level of the standard. On August 3, 2014, there were five monitor readings that exceeded the level of the standard. Sites with the most exceedances in the western region of Michigan were Holland and Muskegon, with four and three, respectively. The central/upper Michigan site with the most exceedances was Seney, with one. Tecumseh, Ypsilanti, New Haven, Warren, and East 7 Mile each had one exceedance in eastern Michigan.

Figure 6.4: O_3 Levels in Detroit-Warren-Flint CSA from 2009-2014, (4th Highest 8-Hour O_3 Values)

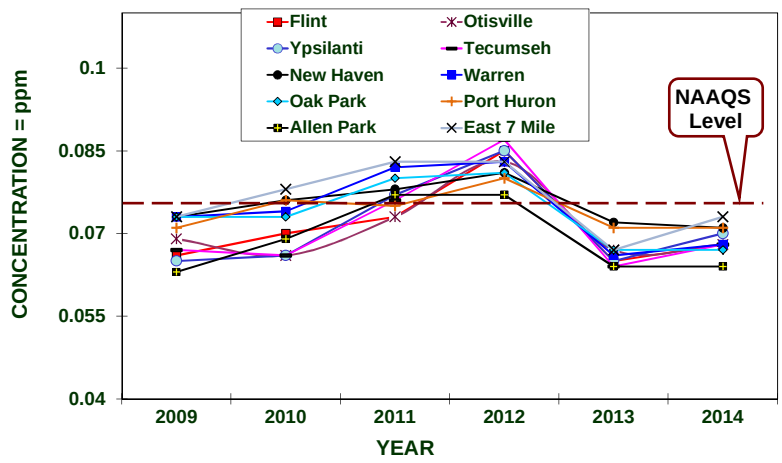


Figure 6.4 shows the 4th highest 8-hour O_3 values for southeast Michigan monitoring sites from 2009-2014. No sites violated the 3-year standard.

Figure 6.5: O_3 Levels in the Grand Rapids-Muskegon-Holland CSA from 2009-2014 (4th Highest 8-Hour O_3 Values)

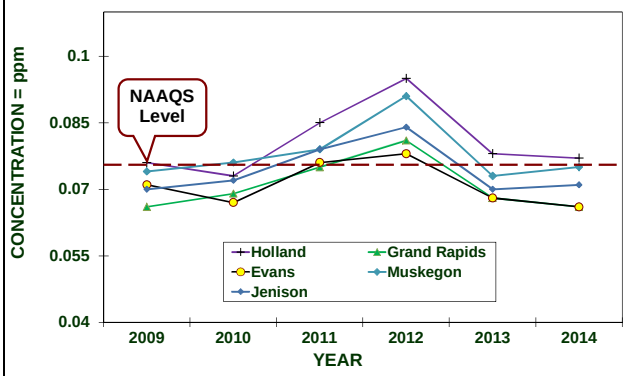


Figure 6.6: O_3 Levels in the Kalamazoo-Portage MSA, Lansing-E. Lansing-Owosso CSA, Niles-Benton Harbor MSA, & South Bend-Mishawaka (IN-MI) MSAs from 2009-2014 (4th Highest 8-Hour O_3 Values)

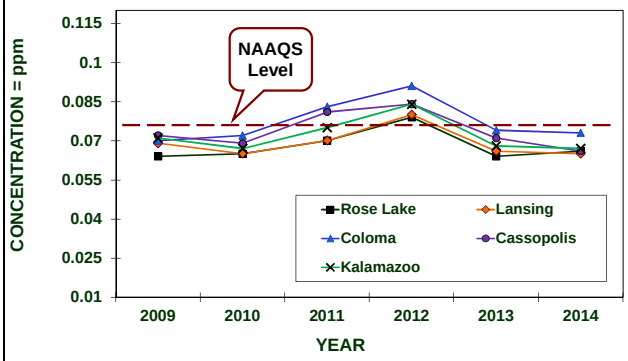


Figure 6.7: O_3 Levels in MI's Northern Lower and Upper Peninsula Areas from 2009-2014 (4th Highest 8-Hour O_3 Values)

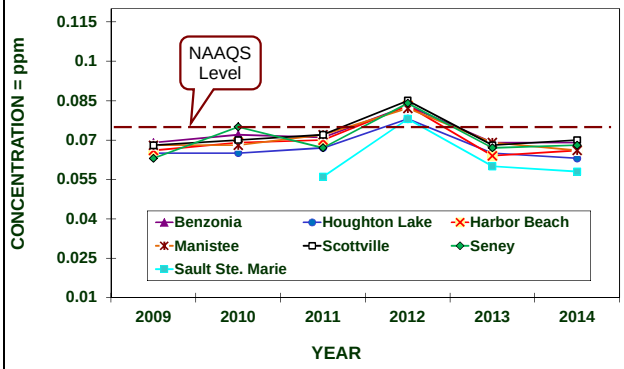
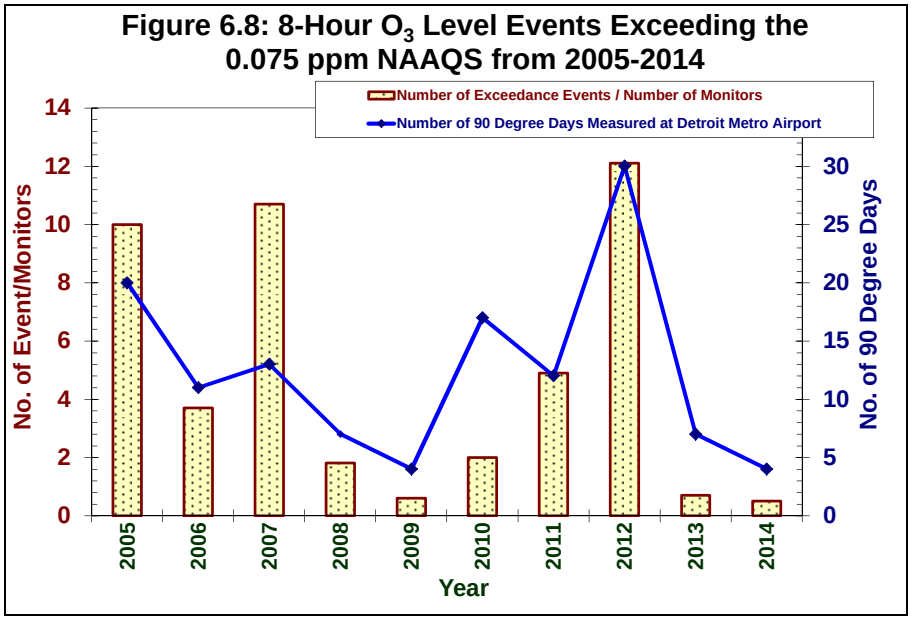


Figure 6.5 shows the 4th highest 8-hour O_3 values for Grand Rapids-Muskegon-Holland CSA. Two sites, Muskegon and Holland, violated the 3-year standard.

Figure 6.6 shows 4th highest 8-hour O_3 values for mid-Michigan. Coloma violated the 3-year standard.

Figure 6.7 shows 4th highest 8-hour O_3 values for the northern Lower and Upper Peninsulas. No sites violated the 3-year standard.

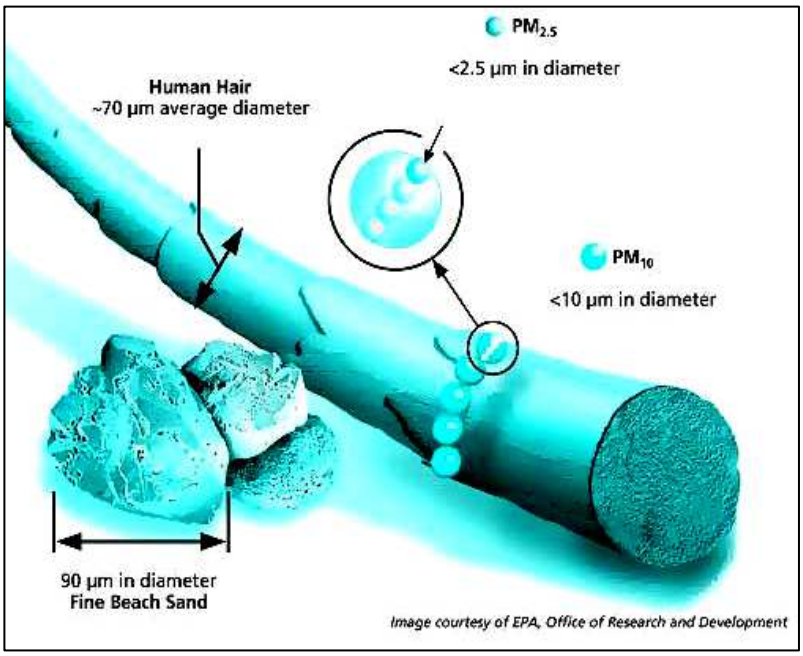
Figure 6.8 shows 8-hour O_3 readings ≥ 0.075 ppm with the number of 90°F days (≥ 90°F) measured at the Detroit Metropolitan Airport. The total number of southeastern Michigan-area 8-hour readings above 0.075 ppm was divided by the number of monitors that were in operation each year to provide a relative indication of the frequency of elevated 8-hour O_3 values.



This comparison shows the influence of temperature with respect to elevated O_3 levels. Over the past 10 years, a typical summer would have an average of 12.5 days with the maximum daily temperature exceeding 90°F. Over the time period from 2005 through 2014, the highest number of 90°F days occurred in 2012 (30 days), while the lowest number occurred in 2009 and 2014 (four days).

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

Particulate matter (PM) is a general term used for a mixture of solid particles and liquid droplets (aerosols) found in the air. These are further categorized according to size; larger particles with diameters of less than 50 micrometers (µm) are classified as total suspended particulates (TSP). PM_{10} consists of "coarse particles" less than 10 µm in diameter (about one-seventh the diameter of a human hair) and $PM_{2.5}$ are much smaller "fine particles" equal to or less than 2.5 µm in diameter. PM_{10} has a 24-hour average standard of 150 µg/m^3. $PM_{2.5}$ has an annual average standard of 12 µg/m^3, and a 98th percentile 24-hour average of 35 µg/m^3 over three years. The sources and effects of PM are as follows:



Sources: PM can be emitted directly (primary) or may form in the atmosphere (secondary). Most man-made particulate emissions are classified as TSP. PM_{10} consists of primary particles that can originate from power plants, various manufacturing processes, wood stoves and fireplaces, agriculture and forestry practices, fugitive dust sources (road dust and windblown soil), and forest fires. $PM_{2.5}$ can come directly from primary particle emissions or through secondary reactions that include VOCs, SO_2, and NO_X emissions originating from power plants, motor vehicles (especially diesel trucks and buses), industrial facilities, and other types of combustion sources.

Effects: Exposure to PM affects breathing and the cellular defenses of the lungs, aggravates existing respiratory and cardiovascular ailments, and has been linked with heart and lung disease. Smaller particles (PM_{10} or smaller) pose the greatest problems because they can penetrate deep in the lungs and possibly into the bloodstream. PM is the major cause of reduced visibility in many parts of the U.S. $PM_{2.5}$ is considered a primary visibility-reducing component of urban and regional haze. Airborne particles impact vegetation ecosystems and damage paints, building materials and surfaces. Deposition of acid aerosols and salts increases corrosion of metals and impacts plant tissue.

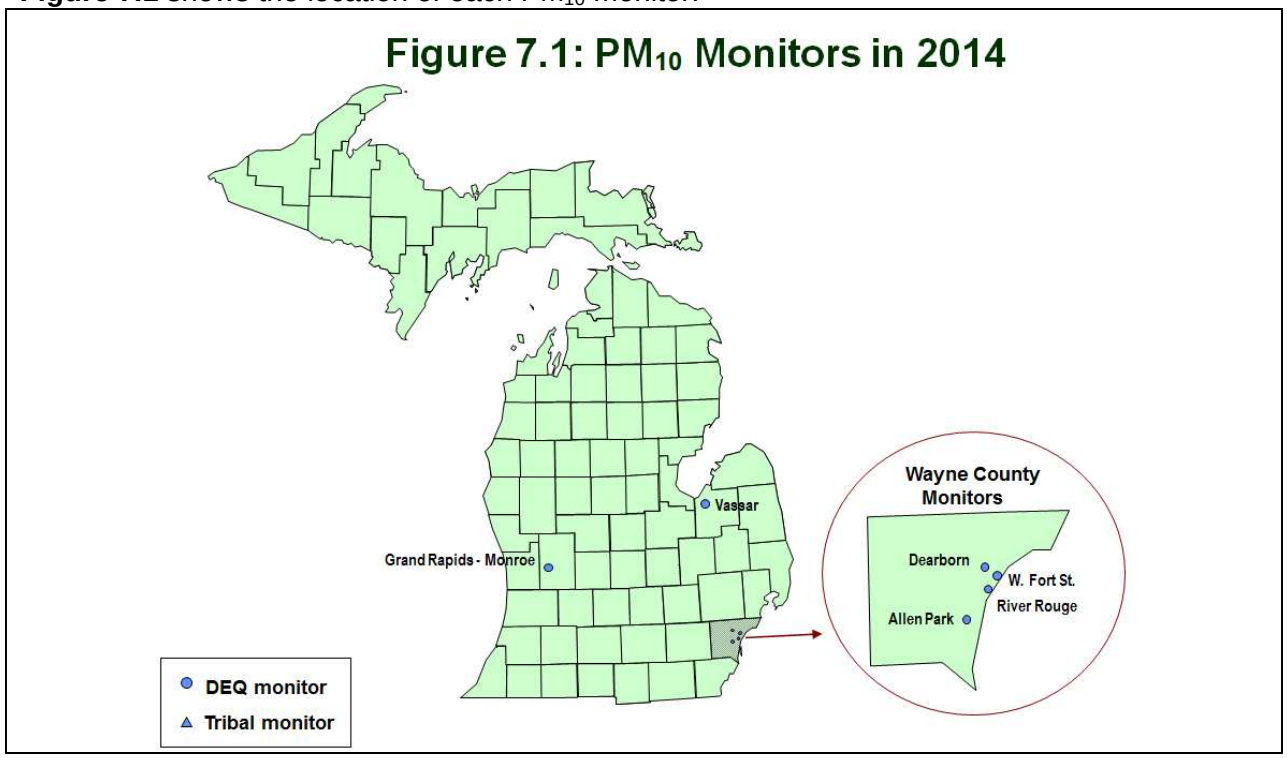
Population most at risk: People with heart or lung disease, the elderly, and children are at highest risk from exposure to PM.

PM_{10}

Since October 1996, all areas in Michigan have been in attainment with the PM_{10} NAAQS. Due to the recent focus upon $PM_{2.5}$ and because of the relatively low concentrations of PM_{10} measured in recent years, Michigan's PM_{10} network has been reduced to a minimum level. **Table 1-3** identifies the locations of PM_{10} monitoring stations that were operating in Michigan

during 2014. These monitors are located mostly in the state's largest populated urban areas: four in the Detroit area, one in Grand Rapids and one Vassar. The second PM_{10} monitor in Grand Rapids (Wealthy Street) was shut down in January 2014 due to similar concentrations to nearby networks sites. To better characterize the nature of particulate matter in Michigan, many of the existing PM_{10} monitors are co-located with $PM_{2.5}$ monitors in population-oriented areas.

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



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

Figure 7.2: PM_{10} Emissions by Source Sector

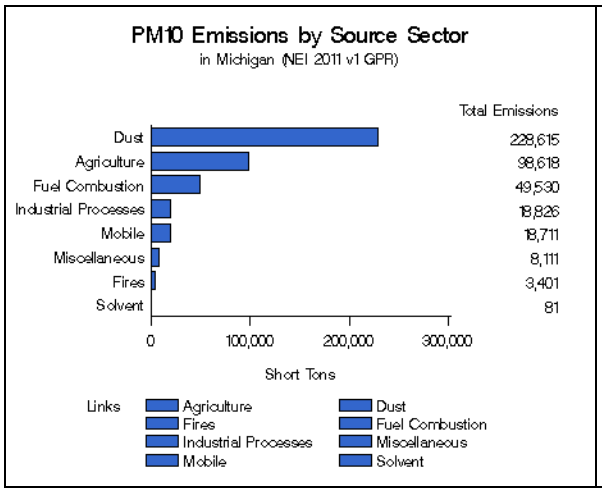


Figure 7.3: PM_{10} Emissions in 2011

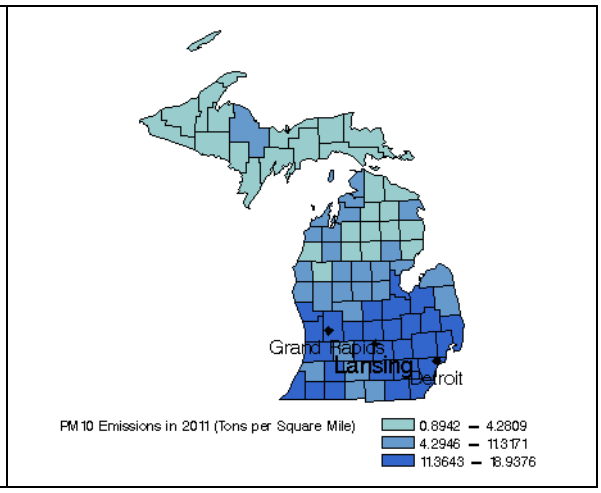
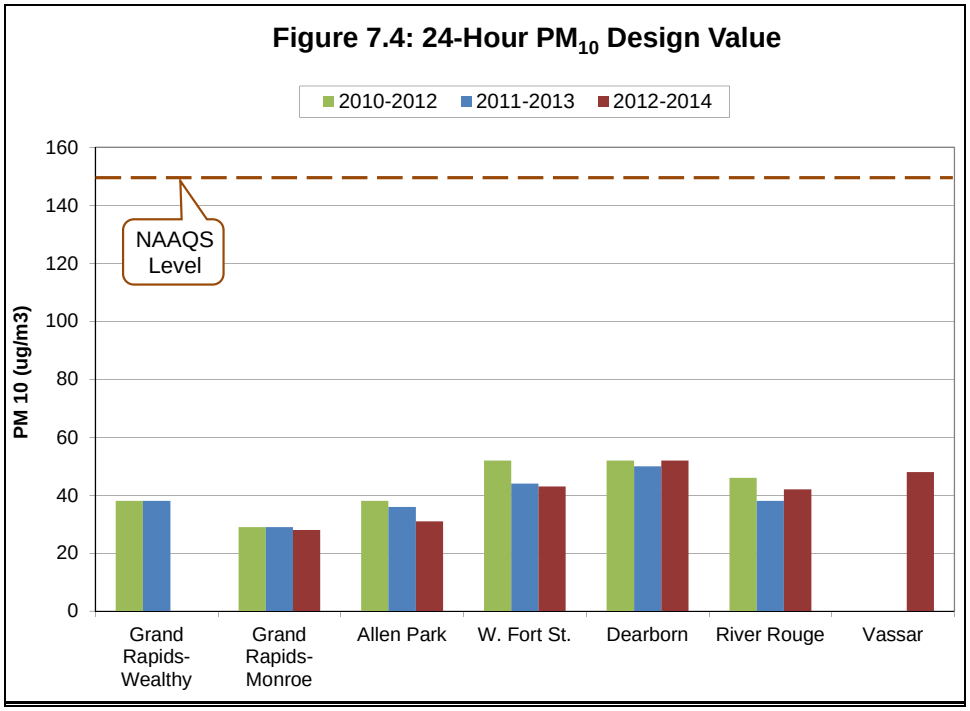


Figure 7.4 shows the PM_{10} levels in Michigan compared to the 24-hour average of 150 µg/m^3. This standard must not be exceeded on average more than once per year over a 3-year period. The design value is the 4th highest value over a 3-year period. The PM_{10} levels at all sites in Michigan are well below the national standard.



PM$_{2.5}$

All Michigan counties from 2010-2014 met the 1997 annual $PM_{2.5}$ standard of 15 µg/m^3 and the 2006 24-hour $PM_{2.5}$ standard of 35 µg/m^3. The EPA designated Michigan in attainment of these standards in August 2013. In December 2012, the EPA revised the annual primary standard to 12 µg/m^3 while the annual secondary standard remained at 15 µg/m^3. The primary and secondary 24-hour standard remained as 35 µg/m^3. The EPA has not made designations for the 2012 NAAQS revisions; however, $PM_{2.5}$ concentrations are below 12 µg/m^3 throughout Michigan.

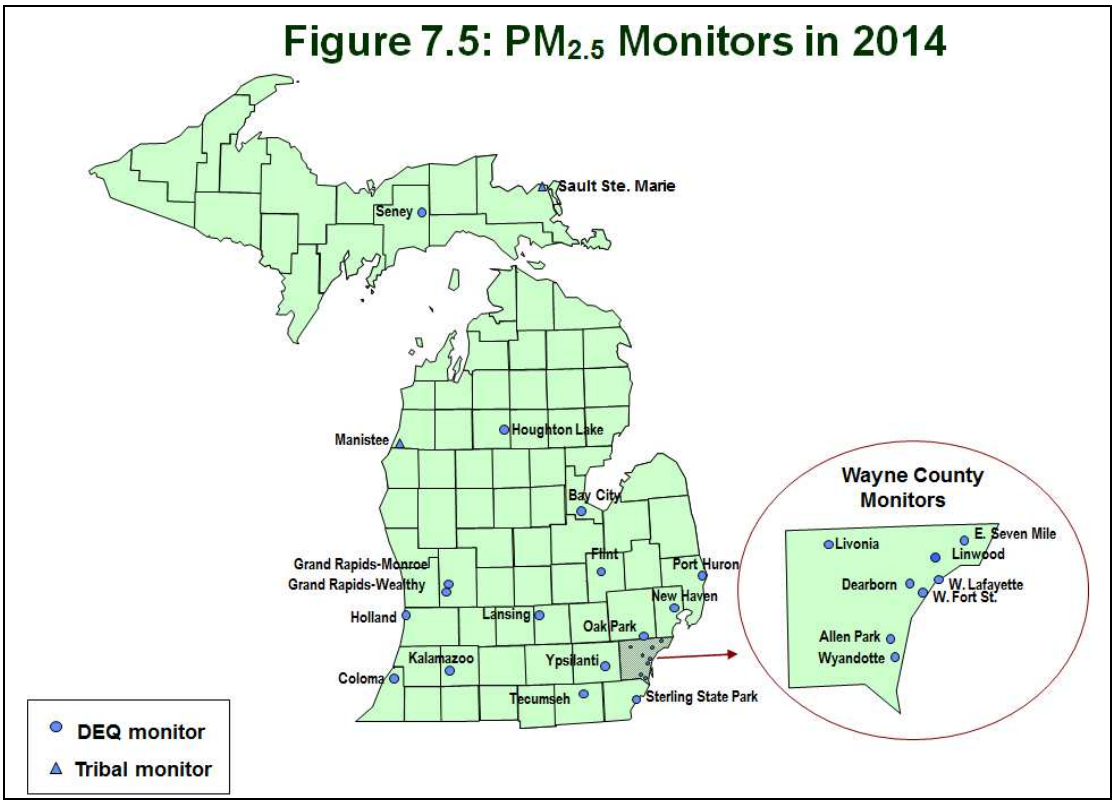
Fine particulate matter ($PM_{2.5}$) is measured using three techniques: Federal Reference Method (FRM), Continuous Methods, and Chemical Speciation Methods. These methods are described in more detail below.

$PM_{2.5}$ FRM monitoring: The concentrations of $PM_{2.5}$ measured over a 24-hour time period are determined using the filter based gravimetric FRM. Only data generated by the FRM monitors are used for comparisons to the NAAQS in Michigan. The sites are located in urban, commercial, and residential areas where people are exposed to $PM_{2.5}$.

Continuous $PM_{2.5}$ monitoring: Continuous monitoring is beneficial as it provides real-time hourly data that supplements the $PM_{2.5}$ data collected by FRM monitors. This data forms the basis of the information reported on AirNow and MIair.

Chemical Speciation monitoring: Speciated monitoring provides a better understanding of the chemical composition of $PM_{2.5}$ material and better characterizes background levels.

Figure 7.5 shows the location of each $PM_{2.5}$ monitor.



$PM_{2.5}$ FRM Monitoring Network: $PM_{2.5}$ FRM monitors are deployed to characterize background or regional $PM_{2.5}$ transport collectively from upwind sources. One of the monitoring sites in west Michigan, Jenison, was shut down due to similar concentrations or redundancy at nearby network sites.

Four $PM_{2.5}$ 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, Dearborn, Allen Park, and Detroit's W. Fort Street (SWHS) station.

Continuous $PM_{2.5}$ Network: Short-term measurements of $PM_{2.5}$ or PM_{10} are updated on an hourly basis using Tapered Element Oscillating Microbalance (TEOM) instruments. At least one continuous TEOM is required at the NCore $PM_{2.5}$ monitoring 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 percent of the FRM monitoring sites are now required to have a continuous $PM_{2.5}$ monitor. For Michigan, there are 26 FRM monitoring sites, 14 of which also have TEOMS. One TEOM at Newberry was shut down due to loss of site access. The DEQ initially operated all TEOM units with an inlet temperature of 50ºC, but this high inlet temperature was volatilizing nitrate levels during the winter months. Therefore, the DEQ began operating TEOMs with a 30°C inlet temperature October through March and a 50°C inlet temperature between April and September.

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

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

$PM_{2.5}$ Chemical Speciation Monitoring Network: Single event Met-One Speciation Air Sampling System (SASS) monitors 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 over a 24-hour period and analyzed to determine various components of $PM_{2.5}$. There are eight SASS monitors operating in Michigan; see **Table 1.3.** The primary objectives of the chemical speciation monitoring sites are to provide data that will be used to determine the sources of poor air quality and to support the development of attainment strategies. Historical speciation data for Michigan indicates that $PM_{2.5}$ is made up of 30 percent nitrate compounds, 30 percent sulfate compounds, 30 percent organic carbon[8], and 10 percent unidentified or trace elements.

Continuous $PM_{2.5}$ Speciation Monitoring (EC/OC and Aethalometer) Network: To determine diurnal changes in $PM_{2.5}$ composition, the DEQ operated two aethalometers and two elemental carbon/organic carbon (EC/OC) monitors in 2014.

- 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 2014, the DEQ's aethalometers were located at Allen Park and Dearborn.
- The EC/OC instruments measure elemental carbon, using pyroloysis coupled with a nondispersive infrared detector to separate the elemental and organic carbon fractions. Instruments are located at Dearborn and Tecumseh.

$PM_{10-2.5}$

The 2006 amended air monitoring regulations specified that measurements of PM_{10}-$PM_{2.5}$ need to be added to the NCore sites[9]. The DEQ began PM_{10}-$PM_{2.5}$ monitoring in 2010 at Allen Park and Grand Rapids–Monroe Street.

Table 1.3 in chapter 1 shows all of Michigan's $PM_{2.5}$ FRM monitoring stations operating in 2014 and denotes which sites also have TEOM, SASS, Aethalometer or EC/OC monitors in operation.

Figures 7.6 and **7.7** show $PM_{2.5}$ emission sources and $PM_{2.5}$ emissions by county (from the EPA's State and County Emission Summaries).

[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 2012 Ambient Air Monitoring Network Review, available at http://www.michigan.gov/documents/deq/deq-aqd-aqe-2012-Air-Mon-Network-Review_357137_7.pdf

[9] Current information can be found at http://www.epa.gov/air/particles/actions.html.

Figure 7.6: $PM_{2.5}$ Emissions by Source Sector

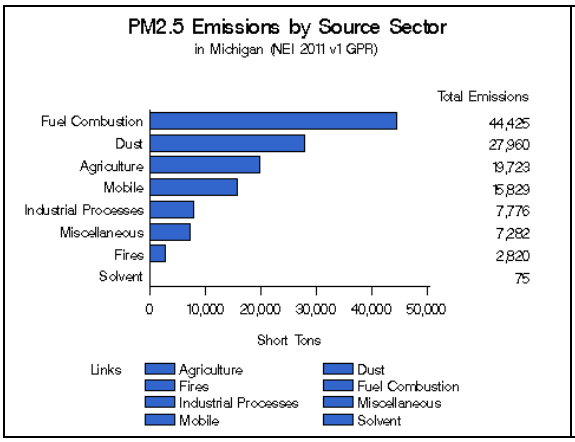


Figure 7.7: $PM_{2.5}$ Emissions in 2011

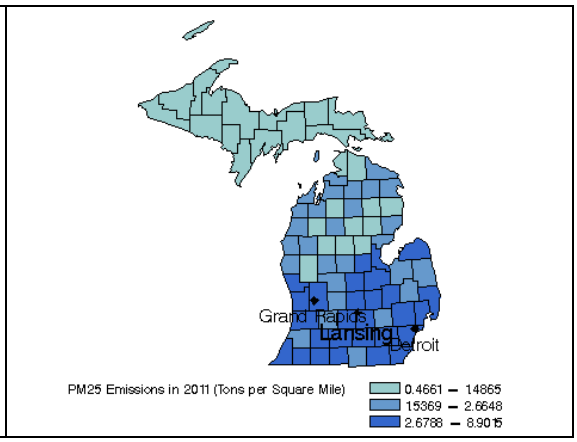


Table 7.1 provides the three year average of the annual mean $PM_{2.5}$ concentrations for 2011-2014. Michigan's levels are below the 12 µg/m^3 primary standard[10]. Stations labeled #2 provide a precision estimate of the overall measurement and operate on a one in six sampling schedule. All other monitors are sampled on a one-in-three-day schedule, except for Allen Park #1 and Detroit – W. Lafayette, which sample daily.

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

Areas	County	Monitoring Sites	2012	2013	2014	2012-2014 Mean
Detroit-Ann Arbor	Lenawee	Tecumseh	9.00	7.93	8.78	8.6
	Livingston					
	Macomb	New Haven	8.74	7.95	9.10	8.6
	Oakland	Oak Park	9.52	8.38	9.33	9.1
	St. Clair	Port Huron	9.37	8.44	9.40	9.1
	Washtenaw	Ypsilanti #1	9.20	8.64	9.79	9.2
		Ypsilanti #2	9.91	9.18	9.37	9.5
	Wayne	Allen Park	10.07	9.49	10.13	9.9
		Detroit-Linwood	10.00	8.86	9.74	9.5
		Detroit-East 7 Mile	9.90	8.71	9.64	9.4
		Detroit-W. Fort	11.14	10.11	10.99	10.7
		Detroit-W. Lafayette	10.14	9.34	9.68	9.7
		Wyandotte	9.31	8.00	9.71	9.0
		Dearborn #1	11.89	11.01	11.77	11.6
		Dearborn #2	12.30	10.80	11.64	11.6
		Livonia	9.62	8.67	9.46	9.3
Flint	Genesee	Flint	7.98	7.44	8.92	8.1
	Lapeer					
Grand Rapids	Ottawa	Jenison	8.98	8.09		8.5
	Kent	Grand Rapids-Wealthy	9.64	8.99	9.91	9.5
		Grand Rapids #1	9.33	8.38	9.49	9.1
		Grand Rapids #2	9.36	8.80	9.30	9.2
Muskegon Co	Muskegon	Muskegon	8.81	9.95*		9.4
Allegan Co	Allegan	Holland	8.51	7.82	8.68	8.3
Monroe Co	Monroe	Luna Pier	9.40	9.71*		9.6
		Sterling State Park	--	8.91*	9.03*	9.0
Kalamazoo-Battle Creek	Calhoun					
	Kalamazoo	Kalamazoo #1	9.52	8.27	9.64	9.1
		Kalamazoo #2	10.04	8.79	9.45	9.4
	Van Buren					
Lansing-East Lansing	Ingham	Lansing	8.65	7.58	9.38	8.5
	Clinton					
	Eaton					
Benton Harbor	Berrien	Coloma	8.71	7.97	8.49	8.4
Bay Co	Bay	Bay City	7.73	7.47	8.17	7.8
Missaukee Co	Missaukee	Houghton Lake	5.92	5.49	5.62	5.7
Manistee Co	Manistee	Manistee	7.16	6.45	6.16	6.6
Chippewa Co	Chippewa	Sault Ste. Marie #1	6.30	6.04	6.23	6.2
		Sault Ste. Marie #2	6.37	6.21	5.67	6.1

*Indicates mean does not meet completeness criteria.

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

Table 7.2 is a detailed assessment of the 24-hour 98th percentile $PM_{2.5}$ concentrations for 2011-2014 showing Michigan's levels are below the 35 µg/m^3 standard (3-year average)[11].

Table 7.2: 98th Percentile $PM_{2.5}$ Values Averaged over 3 Years						
Areas	County	Monitoring Sites	2012	2013	2014	2012-2014 Mean
Detroit-Ann Arbor	Lenawee	Tecumseh	26.6	16.8	22.8	22.1
	Livingston					
	Macomb	New Haven	22.2	18.3	27.0	22.5
	Oakland	Oak Park	25.2	18.9	23.3	22.5
	St. Clair	Port Huron	22.3	18.9	25.2	22.1
	Washtenaw	Ypsilanti #1	22.6	18.5	24.5	21.9
		Ypsilanti #2	21.8	18.9	23.7	21.5
	Wayne	Allen Park	23.2	22.8	26.4	24.1
		Detroit-Linwood	24.6	20.0	23.6	22.7
		Detroit-East 7 Mile	32.5	19.9	22.0	24.8
		Detroit-W. Fort St.	24.5	21.2	23.8	23.2
		Detroit-Newberry	24.3	10.2*		17.3
		Detroit-W. Lafayette	24.0	22.0	25.5	23.8
		Wyandotte	20.9	17.7	25.6	21.4
		Dearborn #1	24.3	24.1	26.5	25.0
		Dearborn #2	25.5	20.8	26.7	24.3
		Livonia	22.7	19.6	25.7	22.7
Flint	Genesee	Flint	21.2	16.6	24.3	20.7
	Lapeer					
Grand Rapids	Ottawa	Jenison	27.2	18.2		22.7
	Kent	Grand Rapids-Wealthy	28.9	19.0	24.3	24.1
		Grand Rapids #1	26.0	18.3	23.0	22.4
		Grand Rapids #2	21.7	18.7	26.9	22.4
Muskegon Co	Muskegon	Muskegon	23.9	18*		21.0
Allegan Co	Allegan	Holland	23.4	17.7	23.4	21.5
Monroe Co	Monroe	Luna Pier	23.7	9.7*		16.7
		Sterling State Park	--	19.5*	23.9*	21.7
Kalamazoo-Battle Creek	Calhoun					
	Kalamazoo	Kalamazoo #1	26.5	17.7	23.9	22.7
		Kalamazoo #2	24.5	17.9	30.6	24.3
	Van Buren					
Lansing-East Lansing	Ingham	Lansing	24.3	17.4	22.1	21.3
	Clinton					
	Eaton					
Benton Harbor	Berrien	Coloma	21.6	17.4	19.8	19.6
Bay Co	Bay	Bay City	22	16	21.1	19.7
Missaukee Co	Missaukee	Houghton Lake	15.4	17.1	16.3	16.3
Manistee Co	Manistee	Manistee	16.8	18.2	17.3	17.4
Chippewa Co	Chippewa	Sault Ste. Marie #1	16.6	14.4	15.3	15.4
		Sault Ste. Marie #2	15.7	15.5	12.7	14.6

*Indicates mean does not meet completeness criteria.

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

Figures 7.8 through **7.11** illustrate the current annual mean $PM_{2.5}$ trend for each monitoring site in Michigan. For clarity, the monitoring sites within the Detroit-Warren-Flint CSA have been broken down into two graphs. **Figure 7.8** shows those sites in Wayne County, and **Figure 7.9** shows the remaining counties within the CSA.

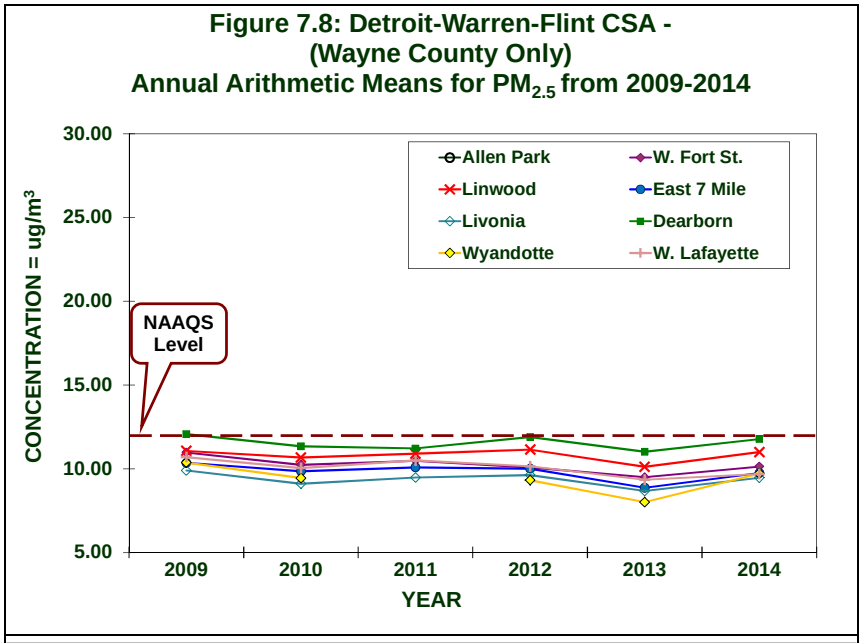


Figure 7.8 shows that 2014 levels in Wayne County remained below the standard. Historically, Dearborn has had the highest readings in the state.

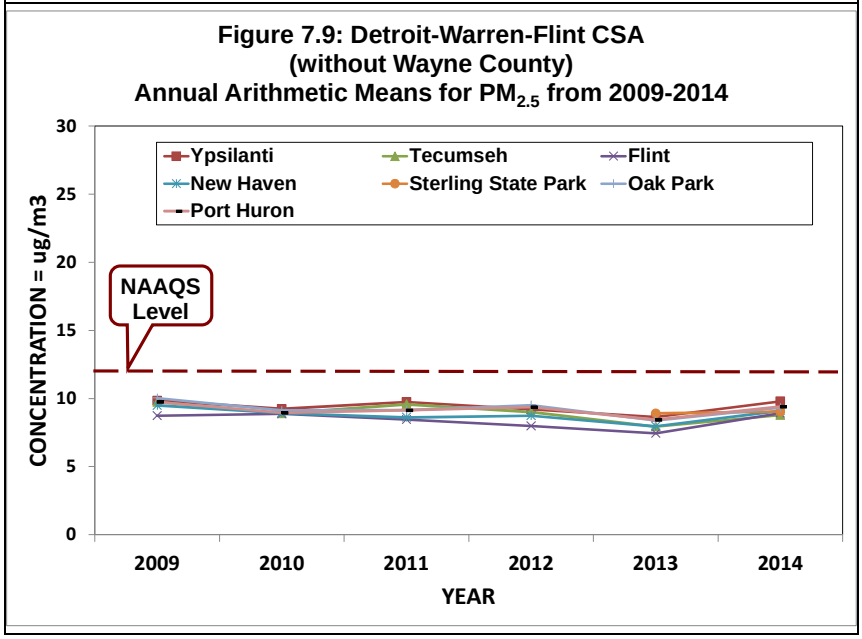


Figure 7.9 contains the remainder of those sites in the Detroit-Warren-Flint CSA that are outside of Wayne County. These sites also show readings in 2014 to be below the $PM_{2.5}$ NAAQS.

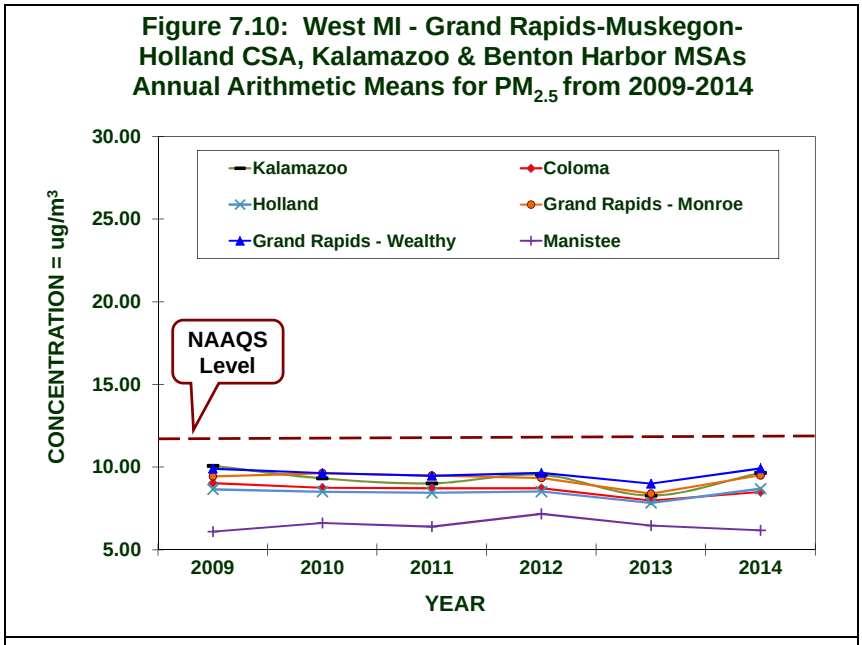


Figure 7.10 combines the $PM_{2.5}$ monitoring sites located in West Michigan-Grand Rapids-Muskegon-Holland CSA, Kalamazoo and Benton Harbor MSAs. All sites are below the annual $PM_{2.5}$ NAAQS.

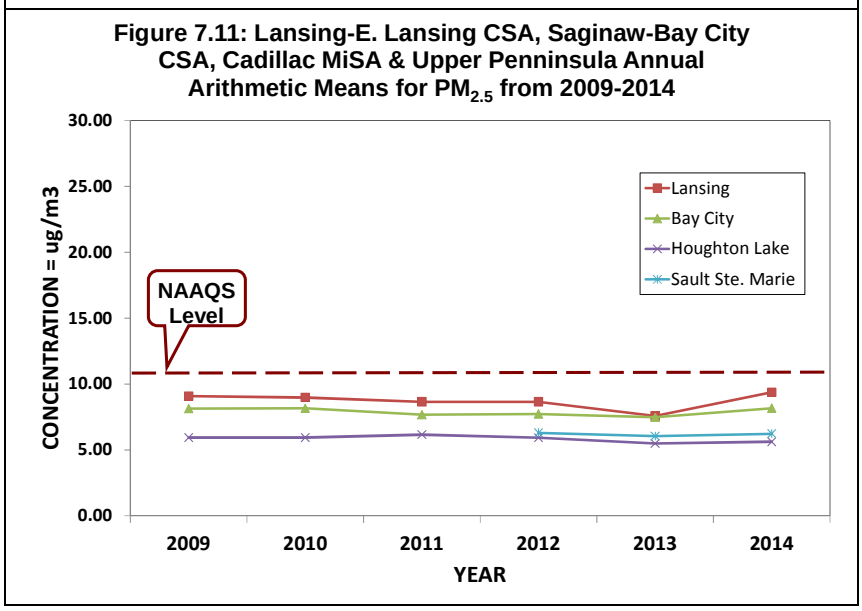


Figure 7.11 displays the remaining monitoring sites in the northern Lower and Upper Peninsulas. All of these sites are below the annual $PM_{2.5}$ NAAQS standard.

Chapter 8: Toxic Air Pollutants

In addition to the six criteria pollutants discussed in the previous chapters, the AQD monitors for a wide variety of substances classified as toxic air pollutants and/or Hazardous Air Pollutants (HAPs). Under the Clean Air Act, the EPA specifically addresses a group of 187 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. The sources and effects of toxics are as follows:

Sources: Air toxics come from a variety of mobile, stationary, and indoor man-made sources as well as outdoor natural sources. Mobile sources include motor vehicles, stationary sources include industrial factories and power plants, indoor sources include household cleaners, and natural sources include forest fires and volcanic eruptions.

Effects: 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. Some effects appear after a shorter period of exposure, while others may appear after long-term exposure or after a long period of time has passed since the exposure ended. Most toxic effects are not unique to one substance, and some effects may be of concern only after the substance has deposited to the ground or to a water body (e.g., mercury, dioxin), followed by exposure through an oral pathway such as the eating of fish or produce. This further complicates the assessment of air toxics concerns due to the broad range of susceptibility that various people may have.

Population most at risk: People with asthma, children, and the elderly are at the highest risk from exposure to air toxics**.**

Air Toxics can be categorized as:

- *Metals:* Examples include aluminum, arsenic, beryllium, barium, cadmium, chromium, cobalt, copper, iron, mercury, manganese, molybdenum, nickel, lead, vanadium, and zinc.
- *Organic Substances*: Further divided into sub-categories that include -
    - VOCs, include benzene (found in gasoline), perchlorethylene (emitted from some dry cleaning facilities), and methylene chloride (a solvent and paint stripper used by industry);
    - carbonyl compounds (formaldehyde, acetone, and acetyladehyde);
    - semi-volatile compounds (SVOCs);
    - polycyclic aromatic hydrocarbons (PAHs)/polynuclear aromatic hydrocarbons (PNAs);
    - pesticides and;
    - polychlorinated biphenyls (PCBs).
- *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 difficult due to several factors:

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

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

Table 8.1 shows the monitoring stations and what air toxic was monitored at each station in 2014. This table can also be found in **Appendix B** with the Air Toxics Monitoring Summary.

Table 8.1: 2014 Toxics Sampling Sites

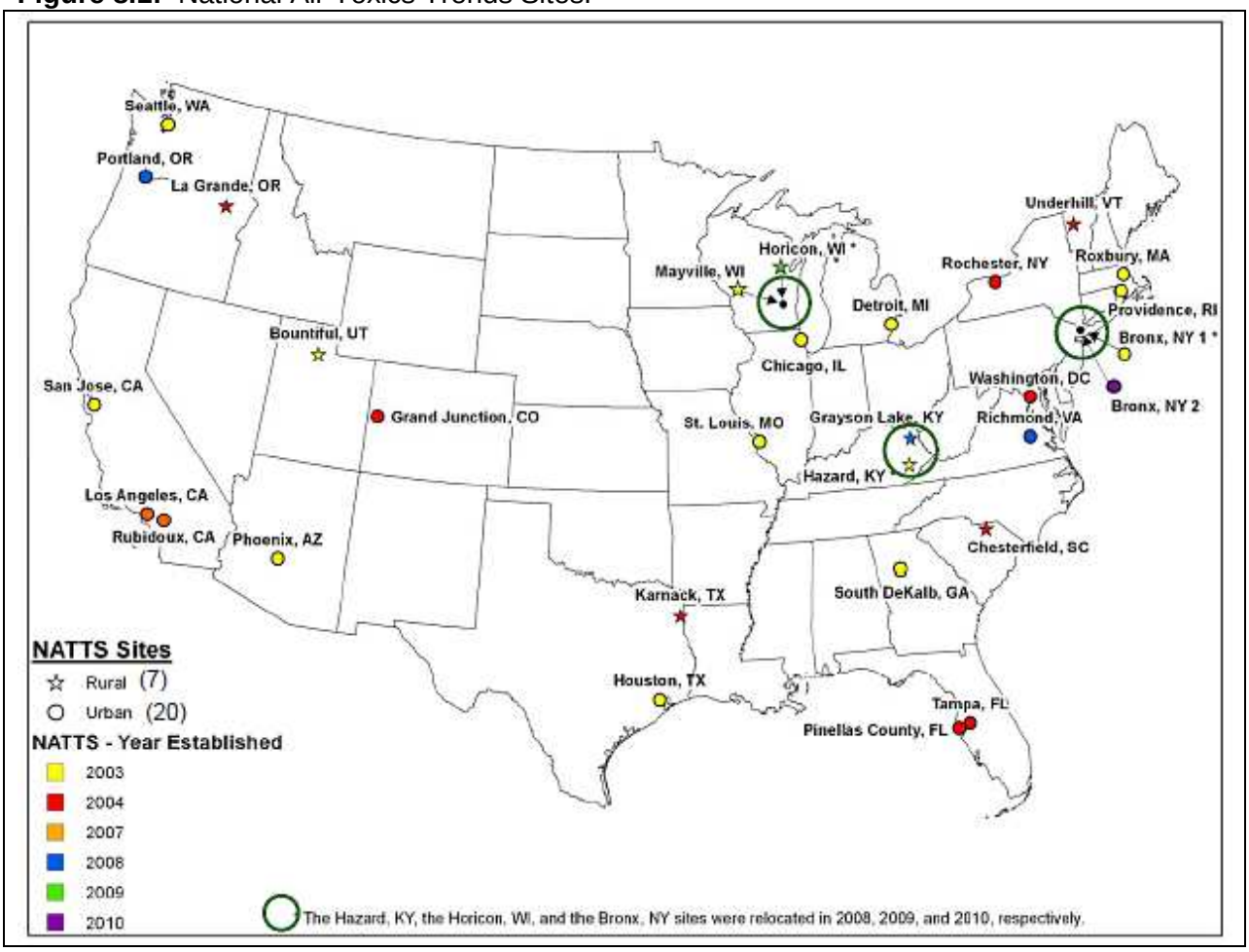
SITE NAME	VOC	Carbonyl	PAHs	Metals TSP	Metals PM_{10}	Speciated $PM_{2.5}$
Allen Park				x	x	x
Dearborn	x	x	x	x	x	x
Detroit-W. Fort St.	x	x		x	Mn	x
Detroit-W. Jefferson				x		
Grand Rapids-Monroe				x		x
Belding-Merrick St.				x		
Belding-Reed St.				x		
Vassar				x	x	
Houghton Lake						x
Sterling State Park						x
Port Huron-Nat'l Guard Arm.						x
Port Huron-Rural St.				x		
River Rouge		x		x	Mn	
Tecumseh						x

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

National Monitoring Efforts and Data Analysis

The EPA administers national programs that identify air toxics levels, detect trends, and prioritize air toxics research. The DEQ 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 27 stations, 20 urban and seven rural (see **Figure 8.1**). The EPA requires that NATTS sites measure VOCs, carbonyls, PAHs and trace metals on a once-every-six-day sampling schedule. Hexavalent chromium is no longer required at NATTS sites and data collection was discontinued July 2013. The Dearborn NATTS site measures trace metals as TSP, PM_{10}, and $PM_{2.5}$.

Figure 8.1: National Air Toxics Trends Sites.



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

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

Air Quality Index

The Air Quality Index (AQI) is a simple tool developed to communicate current air quality information to the public. The current day's color-coded AQI values, ranging from Good to Hazardous (**Table 9.1**), are displayed in a forecast table and as dots on a Michigan map.

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

MIair includes an 'Actions to Protect Health' link: http://www.deqmiair.org/assets/AQIActionsToProtectHealth_2011.pdf which contains activity recommendations based on AQI levels.

Air Quality Forecasts

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

Air Quality Notification

EnviroFlash is a free service that provides automated air quality (AQI) and ultraviolet (UV) forecasts to subscribers. Those enrolled receive e-mail or mobile phone text messages when the health level they select is predicted to occur. AIRNow iPhone and Android applications deliver ozone and fine particle air quality forecasts plus detailed real-time information that can be used to better protect health when planning daily activities. To receive notices and learn more about this program, select the 'Air Quality Notification' tab in **MIair** when logged onto www.michigan.gov/air. Michigan's EnviroFlash network has the potential to reach up to 98% of the state's population.

AIRNow

The DEQ supplies Michigan air monitoring data to AIRNow, the EPA's nation-wide air quality mapping system. Information about AIRNow is available at www.epa.gov/airnow or you can select the AIRNow hot link at the bottom of each **MIair** webpage.

Table 9.1: AQI Colors and Health Statements

AQI Color, Category & Value	PARTICULATE MATTER (µg/m3) 24-hour	OZONE (ppm) 8-hour / 1-hour	CARBON MONOXIDE (ppm) 8-hour	SULFUR DIOXIDE (ppm) 24-hour	NITROGEN DIOXIDE (ppm) 1-hour
GREEN: Good 1- 50	**None**	**None**	**None**	**None**	**None**
YELLOW: Moderate 51- 100	**Unusually sensitive people should consider reducing prolonged or heavy exertion.**	**Unusually sensitive people should consider reducing prolonged or heavy exertion.**	**None**	**None**	**None**
ORANGE: Unhealthy For Sensitive Groups 101- 150	**People with heart or lung disease, Children, and Older adults should reduce prolonged or heavy exertion.**	**People with heart or lung disease, Children & older adults, and People who are active outdoors should reduce prolonged or heavy exertion.**	**People with heart 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, Children, and Older adults should avoid prolonged or heavy exertion.** **Everyone should reduce prolonged or heavy exertion.**	**People with heart or lung disease, Children & older adults, and People who are active outdoors should avoid prolonged or heavy exertion.** **Everyone should reduce prolonged or heavy exertion.**	**People with heart disease, such as angina, should reduce moderate exertion and avoid sources of CO, such as heavy traffic.**	**Children, Asthmatics, and People with heart or lung disease should reduce outdoor exertion.**	**None**
PURPLE: Very Unhealthy 201- 300	**People with heart or lung disease, Children, and Older adults should avoid all physical exertion outdoors.** **Everyone else should limit outdoor exertion.**	**People with heart or lung disease, Children & older adults, and People who are active outdoors should avoid all physical exertion outdoors. Everyone else should limit outdoor exertion.**	**People with heart 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 should reduce outdoor exertion.**	**Children and People with respiratory disease, such as asthma, should reduce outdoor exertion.**
MAROON: Hazardous 301- 500	**People with heart or lung disease, Children, and Older adults should remain indoors.** **Everyone should avoid prolonged or heavy exertion.**	**People with heart or lung disease, Children, and Older adults should remain indoors.** **Everyone should avoid all outdoor exertion.**	**People with heart 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.** **Everyone should avoid outdoor exertion.**	**Children and People with respiratory disease, such as asthma, should avoid outdoor exertion.**

Chapter 10: Meteorological Information

Figures 10.1 through **10.3** show average daily temperatures and **Figures 10.4** through **10.6** show total monthly precipitation amounts compared to their climatic norms for sites in the northern, southern Lower, and Upper Peninsulas. 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 2014.

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

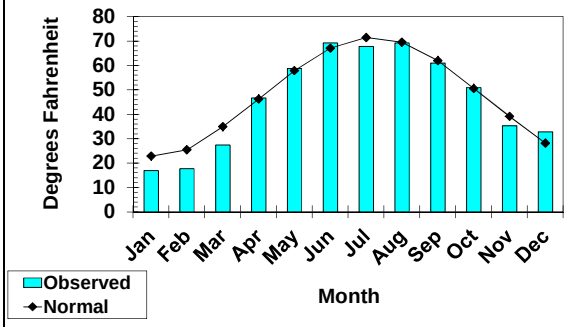


Figure 10.2: Northern Lower Peninsula Observed Average Daily Temperatures vs. Normal Average Daily Temperatures

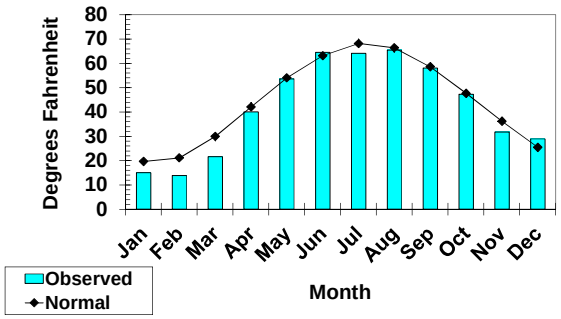


Figure 10.3: Upper Peninsula Observed Average Daily Temperatures vs. Normal Average Daily Temperatures

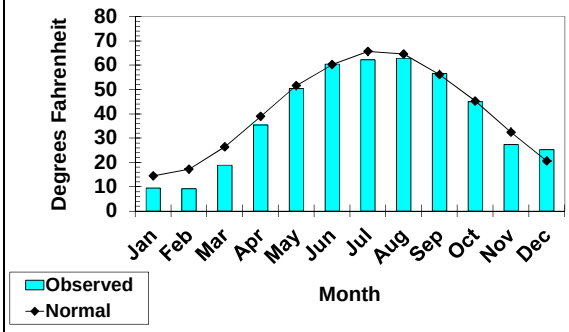


Figure 10.4: Southern Lower Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation

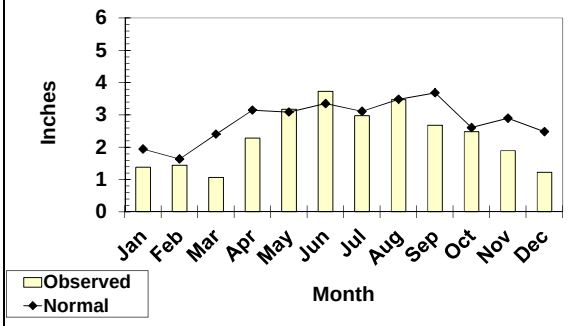


Figure 10.5: Northern Lower Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation

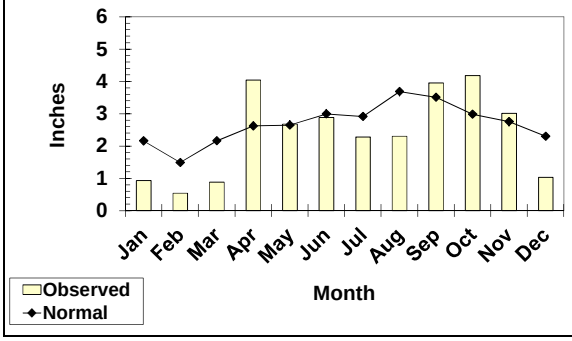
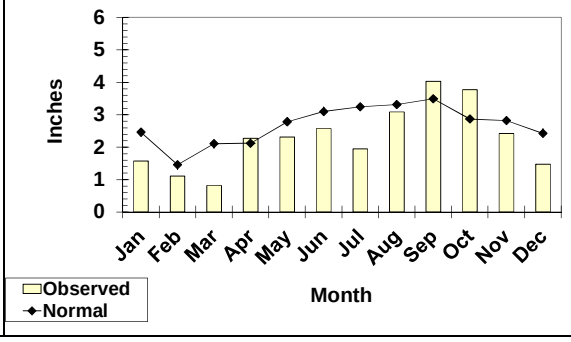


Figure 10.6: Upper Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation



The weather plays a significant role in air quality, and can either help increase or decrease the amount of pollution in the air. High temperatures, sun and longer days (i.e., more daylight hours) are conducive to ozone formation, whereas rain tends to wash pollutants out of the air. *Action!* Days are declared when levels are expected to reach or exceed the Unhealthy for Sensitive Groups AQI health indicator; specifically, when meteorological conditions are conducive for the formation of elevated ground-level O_3 or $PM_{2.5}$ concentrations.

Table 10.1 Shows that there were only 3 *Action!* Days declared during the summer of 2014.

Table 10.1: *Action!* Days Declared During the Summer of 2014

Location	Year	Number	Dates
Ann Arbor	2014	2	7/21, 7/22
Benton Harbor	2014	2	7/20, 7/21
Detroit	2014	2	7/21, 7/22
Grand Rapids	2014	3	7/20, 7/21, 7/22
Ludington	2014	2	7/21, 7/22

Appendix A: Criteria Pollutant Summary for 2014

Appendix A utilizes EPA's 2014 Air Quality System (AQS) Quick Look Report Data to present a summary of ambient air quality data collected for the criteria pollutants at monitoring locations throughout Michigan. Concentrations of non-gaseous pollutants are generally given in $\mu g/m^3$ and in ppm for gaseous pollutants. The following define some of the terms listed in the **Appendix A** reports.

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

POC: The Parameter Occurrence Code or POC is used to assist in distinguishing different uses of monitors, i.e. under Pb, NO_2, and SO_2, POC #1-5 are used to help differentiate between individual monitors. 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 – speciation air sampling system).

 # 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 exceedances 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 exceedance 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 2014

CO Measured in ppm

Site ID	POC	City	County	Year	# OBS	1-hr Highest Value	1-hr 2nd Highest Value	1-hr OBS > 35	8-hr Highest Value	8-hr 2nd Highest Value	8-hr OBS > 9
260810020	1	Grand Rapids	Kent	2014	8134	1.6	1.5	0	1.2	0.9	0
261630001	1	Allen Park	Wayne	2014	8146	1.5	1.5	0	1.1	1.1	0
261630093	1	Eliza Howell-Near Roadway	Wayne	2014	8019	2.2	2.0	0	1.6	1.5	0
261630094	1	Eliza Howell-Downwind	Wayne	2014	8300	2.3	1.9	0	1.6	1.4	0

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

Site ID	POC	City	County	Year	# OBS	Highest rolling 3-month Arith Mean	Highest Value (24 hr)	2nd Highest Value (24hr)
260670002	1	Belding-Reed St.	Ionia	2014	60	0.04	0.270	0.083
260670003	1	Belding-Merrick St.	Ionia	2014	60	0.05	0.210	0.099
260810020	1	Grand Rapids	Kent	2014	60	0.01	0.012	0.009
261470031	1	Port Huron Rural St.	St. Clair	2014	60	0.03	0.130	0.083
261570001	1	Vassar	Tuscola	2014	61	0.00	0.014	0.013
261630001	1	Allen Park	Wayne	2014	59	0.01	0.027	0.017
261630033	1	Dearborn	Wayne	2014	60	0.02	0.060	0.033

NO_2 Measured in ppb

Site ID	POC	City	County	Year	# OBS	1-Hr Highest Value	1-Hr 2nd Highest Value	Annual Arith Mean
260650012	1	Lansing	Ingham	2014	7460	48.0	43.0	6.97
261130001	1	Houghton Lake	Missaukee	2014	8357	16.0	13.0	1.24
261630019	2	Detroit-East 7 Mile	Wayne	2014	8342	66.0	57.0	11.91
261630093	1	Eliza Howell-Near Roadway	Wayne	2014	8584	62.0	61.0	16.35
261630094	1	Eliza Howell-Downwind	Wayne	2014	8583	65.0	59.0	12.30

NO_Y Measured in ppb

Site ID	POC	City	County	Year	# OBS	1-Hr Highest Value	1-Hr 2nd Highest Value	Annual Arith Mean
260810020	1	Grand Rapids	Kent	2014	7936	372.0	326.9	15.02
261630001	1	Allen Park	Wayne	2014	5816	218.5	212.5	21.05*

* 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	2014	179	183	0.103	0.090	0.089	0.087	0	0	2
260190003	1	Benzonia	Benzie	2014	174	183	0.079	0.074	0.074	0.074	0	0	0
260210014	1	Coloma	Berrien	2014	183	183	0.084	0.084	0.080	0.079	0	0	0
260270003	2	Cassopolis	Cass	2014	167	183	0.079	0.076	0.075	0.075	0	0	1
260330901	1	Sault Ste. Marie	Chippewa	2014	178	183	0.072	0.067	0.065	0.060	0	0	3
260370001	2	Rose Lake	Clinton	2014	182	183	0.079	0.077	0.074	0.072	0	0	1
260490021	1	Flint	Genesee	2014	183	183	0.079	0.074	0.074	0.073	0	0	0
260492001	1	Otisville	Genesee	2014	182	183	0.076	0.074	0.074	0.072	0	0	1
260630007	1	Harbor Beach	Huron	2014	167	183	0.085	0.074	0.074	0.071	0	0	1
260650012	2	Lansing	Ingham	2014	181	183	0.073	0.071	0.071	0.070	0	0	0
260770008	1	Kalamazoo	Kalamazoo	2014	183	183	0.077	0.077	0.074	0.074	0	0	0
260810020	1	Grand Rapids	Kent	2014	178	183	0.074	0.074	0.074	0.072	0	0	1
260810022	1	Evans	Kent	2014	183	183	0.076	0.075	0.073	0.073	0	0	0
260910007	1	Tecumseh	Lenawee	2014	172	183	0.087	0.080	0.075	0.075	0	0	3
260990009	1	New Haven	Macomb	2014	182	183	0.085	0.083	0.081	0.080	0	0	1
260991003	1	Warren	Macomb	2014	180	183	0.086	0.078	0.076	0.076	0	0	0
261010922	1	Manistee	Manistee	2014	178	183	0.081	0.080	0.076	0.075	0	0	2
261050007	1	Scottville	Mason	2014	183	183	0.086	0.081	0.080	0.075	0	0	0
261130001	1	Houghton Lake	Missaukee	2014	183	183	0.072	0.071	0.068	0.067	0	0	0
261210039	1	Muskegon	Muskegon	2014	183	183	0.091	0.089	0.086	0.081	0	0	0
261250001	2	Oak Park	Oakland	2014	178	183	0.085	0.080	0.077	0.076	0	0	0
261390005	1	Jenison	Ottawa	2014	177	183	0.081	0.079	0.079	0.076	0	0	0
261470005	1	Port Huron	St .Clair	2014	183	183	0.090	0.085	0.079	0.077	0	0	0
261530001	1	Seney	Schoolcraft	2014	181	183	0.086	0.080	0.080	0.078	0	0	0
261610008	1	Ypsilanti	Washtenaw	2014	181	183	0.091	0.083	0.080	0.079	0	0	0
261630001	2	Allen Park	Wayne	2014	179	183	0.080	0.074	0.072	0.071	0	0	1
261630019	2	Detroit-East 7 Mile	Wayne	2014	179	183	0.090	0.087	0.084	0.078	0	0	1

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	2014	98	179	0.086	0.083	0.081	0.077	4
260190003	1	Benzonia	Benzie	2014	95	174	0.072	0.072	0.071	0.069	0
260210014	1	Coloma	Berrien	2014	100	183	0.080	0.076	0.074	0.073	2
260270003	2	Cassopolis	Cass	2014	89	163	0.075	0.070	0.069	0.066	0
260330901	1	Sault Ste. Marie	Chippewa	2014	96	175	0.063	0.063	0.061	0.058	0
260370001	2	Rose Lake	Clinton	2014	99	182	0.074	0.068	0.067	0.066	0
260490021	1	Flint	Genesee	2014	100	183	0.070	0.070	0.069	0.068	0
260492001	1	Otisville	Genesee	2014	99	182	0.072	0.072	0.068	0.068	0
260630007	1	Harbor Beach	Huron	2014	91	167	0.075	0.068	0.068	0.066	0
260650012	2	Lansing	Ingham	2014	99	181	0.068	0.068	0.068	0.065	0

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
260770008	1	Kalamazoo	Kalamazoo	2014	100	183	0.073	0.070	0.068	0.067	0
260810020	1	Grand Rapids	Kent	2014	96	175	0.071	0.069	0.068	0.066	0
260810022	1	Evans	Kent	2014	100	183	0.071	0.068	0.067	0.066	0
260910007	1	Tecumseh	Lenawee	2014	93	170	0.079	0.073	0.072	0.068	1
260990009	1	New Haven	Macomb	2014	99	181	0.080	0.073	0.072	0.071	1
260991003	1	Warren	Macomb	2014	98	180	0.081	0.070	0.070	0.068	1
261010922	1	Manistee	Manistee	2014	96	175	0.071	0.069	0.068	0.066	0
261050007	1	Scottville	Mason	2014	100	183	0.075	0.071	0.070	0.070	0
261130001	1	Houghton Lake	Missaukee	2014	100	183	0.069	0.066	0.065	0.063	0
261210039	1	Muskegon	Muskegon	2014	100	183	0.079	0.076	0.076	0.075	3
261250001	2	Oak Park	Oakland	2014	97	178	0.074	0.071	0.071	0.067	0
261390005	1	Jenison	Ottawa	2014	96	176	0.074	0.072	0.071	0.071	0
261470005	1	Port Huron	St .Clair	2014	100	183	0.074	0.074	0.073	0.071	0
261530001	1	Seney	Schoolcraft	2014	98	180	0.076	0.075	0.069	0.068	1
261610008	1	Ypsilanti	Washtenaw	2014	99	181	0.078	0.074	0.074	0.070	1
261630001	2	Allen Park	Wayne	2014	96	176	0.074	0.068	0.066	0.064	0
261630019	2	Detroit-East 7 Mile	Wayne	2014	97	178	0.084	0.074	0.074	0.073	1

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

Site ID	POC	Monitor	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	98%	Wtd. Arith. Mean
260050003	1	FRM	Holland	Allegan	2014	118	28.0	25.1	23.4	20.5	23.4	8.68
260170014	1	FRM	Bay City	Bay	2014	118	33.4	22.0	21.1	20.3	21.1	8.17
260210014	1	FRM	Coloma	Berrien	2014	117	30.7	23.8	19.8	19.4	19.8	8.49
260330901	1	FRM	Sault Ste. Marie	Chippewa	2014	105	15.6	15.5	15.3	14.3	15.3	6.23
260330901	2	FRM	Sault Ste. Marie	Chippewa	2014	56	15.8	12.7	12.2	12.2	12.7	5.67
260490021	1	FRM	Flint	Genesee	2014	119	36.7	28.0	24.3	23.3	24.3	8.92
260650012	1	FRM	Lansing	Ingham	2014	116	31.8	27.0	22.1	20.3	22.1	9.38
260770008	1	FRM	Kalamazoo	Kalamazoo	2014	117	30.6	27.8	23.9	22.1	23.9	9.64
260770008	2	FRM	Kalamazoo	Kalamazoo	2014	58	36.1	30.6	24.4	20.2	30.6	9.45
260810007	1	FRM	Grand Rapids-Wealthy	Kent	2014	112	32.3	25.4	24.3	22.8	24.3	9.91
260810020	1	FRM	Grand Rapids-Monroe	Kent	2014	120	30.3	24.2	23.0	22.9	23.0	9.49
260810020	2	FRM	Grand Rapids-Monroe	Kent	2014	60	35.1	26.9	22.2	21.8	26.9	9.30
260910007	1	FRM	Tecumseh	Lenawee	2014	115	23.7	23.5	22.8	21.5	22.8	8.78
260990009	1	FRM	New Haven	Macomb	2014	122	30.8	28.3	27.0	25.2	27.0	9.10

*Indicates the mean does not satisfy summary criteria

$PM_{2.5}$ (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
261010922	1	FRM	Manistee	Manistee	2014	111	21.9	17.8	17.3	17.0	17.3	6.16
261130001	1	FRM	Houghton Lake	Missaukee	2014	118	17.7	16.8	16.3	14.6	16.3	5.62
261150006	1	FRM	Sterling State Park	Monroe	2014	106	32.5	24.0	23.9	22.9	23.9	9.03*
261250001	1	FRM	Oak Park	Oakland	2014	120	30.3	25.8	23.3	23.0	23.3	9.33
261470005	1	FRM	Port Huron	St. Clair	2014	120	38.8	26.4	25.2	22.3	25.2	9.40
261610008	1	FRM	Ypsilanti	Washtenaw	2014	119	27.5	25.0	24.5	24.2	24.5	9.79
261610008	2	FRM	Ypsilanti	Washtenaw	2014	58	24.5	23.7	23.5	22.0	23.7	9.37
261630001	1	FRM	Allen Park	Wayne	2014	341	28.9	28.4	28.3	27.9	26.4	10.13
261630015	1	FRM	Detroit-W. Fort St.	Wayne	2014	116	25.4	25.1	23.8	23.2	23.8	10.99
261630016	1	FRM	Detroit-Linwood	Wayne	2014	121	27.5	24.5	23.6	22.7	23.6	9.74
261630019	1	FRM	Detroit-East 7 Mile	Wayne	2014	117	26.0	24.9	22.0	21.8	22.0	9.64
261630025	1	FRM	Livonia	Wayne	2014	119	33.3	26.0	25.7	24.0	25.7	9.46
261630033	1	FRM	Dearborn	Wayne	2014	120	40.1	28.3	26.5	26.3	26.5	11.77
261630033	2	FRM	Dearborn	Wayne	2014	59	39.8	26.7	26.2	24.0	26.7	11.64
261630036	1	FRM	Wyandotte	Wayne	2014	109	27.3	26.8	25.6	25.6	25.6	9.71
261630039	1	FRM	Detroit-W. Lafayette	Wayne	2014	346	29.6	29.4	28.0	26.0	25.5	9.68

*Indicates the mean does not satisfy summary criteria

$PM_{2.5}$ 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
260170014	3	TEOM	Bay City	Bay	2014	8203	188.0	124.0	95.0	52.0	8.86
260330901	3	BAM	Sault Ste. Marie	Chippewa	2014	6674	69.8	62.4	55.4	45.4	6.68
260490021	3	TEOM	Flint	Genesee	2014	7961	278.0	223.0	203.0	93.0	9.21
260650012	5	TEOM	Lansing	Ingham	2014	8440	139.0	106.0	77.0	70.0	9.16
260770008	3	TEOM	Kalamazoo	Kalamazoo	2014	8525	131.0	107.0	87.0	65.0	9.35
260810020	3	TEOM	Grand Rapids	Kent	2014	8598	164.0	156.0	127.0	117.0	9.59
260910007	3	TEOM	Tecumseh	Lenawee	2014	7338	103.0	81.0	46.0	46.0	9.37
261130001	3	TEOM	Houghton Lake	Missaukee	2014	8578	37.0	36.0	35.0	33.0	7.14
261470005	3	TEOM	Port Huron	St. Clair	2014	8718	92.0	63.0	53.0	50.0	9.29
261530001	3	TEOM	Seney	Schoolcraft	2014	8666	315.0	209.0	143.0	132.0	6.18
261610008	3	TEOM	Ypsilanti	Washtenaw	2014	8600	191.0	114.0	110.0	71.0	9.64
261630001	3	TEOM	Allen Park	Wayne	2014	8067	250.0	230.0	159.0	138.0	11.06
261630033	3	TEOM	Dearborn	Wayne	2014	8309	390.0	254.0	209.0	165.0	12.13
261630039	3	TEOM	Detroit-W. Lafayette	Wayne	2014	8445	117.0	115.0	108.0	106.0	10.33
261630039	3	BAM	Detroit-W. Lafayette	Wayne	2014	7351	135.5	120.7	112.8	107.4	11.98

*Indicates the mean does not satisfy summary criteria

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

Site ID	POC	Monitor	City	County	Year	# OBS	# Req.	Valid Days	% OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Wtd Arith Mean
260810020	1	GRAV	Grand Rapids-Monroe	Kent	2014	57	61	57	93	29	27	25	21	12.1
261570001	1	GRAV	Vassar	Tuscola	2014	60	61	60	98	31	27	25	23	11.7
261630001	1	GRAV	Allen Park	Wayne	2014	59	61	59	97	45	33	31	29	16.1
261630005	1	GRAV	River Rouge	Wayne	2014	60	61	59	97	72	43	42	36	19.4
261630015	1	GRAV	Detroit-W. Fort St.	Wayne	2014	59	61	59	97	41	38	37	33	17.8
261630033	1	GRAV	Dearborn	Wayne	2014	60	61	60	98	67	58	45	43	23.7
261630033	9	GRAV	Dearborn	Wayne	2014	32	30	30	100	58	44	43	37	26.9

*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	2014	8612	382	288	283	273	22.3

SO_2 Measured in ppb

Site ID	POC	City	County	Year	# OBS	1-hr Highest Value	1-hr 2nd Highest Value	99th %ile 1-hr	24-hr Highest Value	24-hr 2nd Highest Value	OBS >0.5	Arith Mean
260650012	1	Lansing	Ingham	2014	8299	24.7	17.2	14.7	10.4	5.8	0	1.20
260810020	2	Grand Rapids	Kent	2014	8210	16.8	11.9	11.0	5.0	3.9	0	0.89
261150006	1	Sterling State Park	Monroe	2014	8324	30.6	27.7	17.9	5.9	5.7	0	1.15
261470005	1	Port Huron	St. Clair	2014	8284	83.5	67.8	62.3	16.6	14.5	0	2.77
261630001	1	Allen Park	Wayne	2014	7810	73.0	70.8	55.6	12.5	11.9	0	1.64
261630015	1	Detroit-W. Fort St.	Wayne	2014	8339	102.2	79.1	71.5	33.2	22.8	0	2.60

Appendix B: 2014 Air Toxics Monitoring Summary for Metals, VOCs, Carbonyl Compounds, PAHs & Speciated $PM_{2.5}$

Appendix B provides summary statistics of ambient air concentrations of various substances monitored in Michigan during 2014. At each monitoring site, air samples were taken over a 24-hour period (midnight to midnight). These air samples represent the average air concentration during that 24-hour period. The frequency of air samples collected is typically done once every 6 or 12 days. Sometimes the sampled air concentration is lower than the laboratory's analytical method detection level (MDL). When the concentration is lower than the MDL, two options are used to estimate the air concentration. The calculation of the minimum average ("Average (ND=0)") uses 0.0 $\mu g/m^3$ for a value less than the MDL. In the calculation of the maximum average ("Average (ND=MDL/2)") the MDL divided by 2 (i.e., ½ the MDL) is substituted for air concentrations less than the MDL.

Table B shows the monitoring stations and what types of air toxics were monitored at each station in 2014. The following terms and acronyms are used in **Appendix B-1** and **B-2** data tables:

- Num Obs: Number of Observations (number of daily air samples taken during the year)
- Obs>MDL: Number of daily samples above the MDL
- Average (ND=0): average air concentration in 2014, assuming daily samples below MDL were equal to 0.0 $\mu g/m^3$.
- Average (ND=MDL/2): average air concentration in 2014, assuming daily samples below MDL were equal to one half the MDL.
- MDL: Analytical MDL in units of $\mu g/m^3$
- Max1: Highest daily air concentration during 2014
- Max2: Second highest daily air concentration during 2014
- Max3: Third highest daily air concentration during 2014
- $\mu g/m^3$: Micrograms per cubic meter (1,000,000 µg = 1 g)

Table B: Monitoring Stations and Types of Air Samples Collected						
	Appendix B-1					Appendix B-2
Site Name	**VOC**	**Carbonyl**	**PAHs**	**Metals TSP**	**Metals PM_{10}**	**Speciated PM2.5**
Allen Park				x	x	x
Dearborn	x	x	x	x	x	x
Detroit-W. Fort St.	x	x		x	Mn	x
Detroit-W. Jefferson				x		
Grand Rapids-Monroe				x		x
Belding-Merrick St.				x		
Belding-Reed St.				x		
Vassar				x	x	
Houghton Lake						x
Sterling State Park						x
Port Huron-Nat'l Guard Arm.						x
Port Huron-Rural St.				x		
River Rouge		x		x	Mn	
Tecumseh						x

VOC = volatile organic compound; PAHs = polycyclic aromatic hydrocarbon; TSP = total suspended particulate; PM_{10} = particulate matter with aerodynamic diameter less than 10 µm; Mn = manganese;

APPENDIX B-1

Allen Park (261630001) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	59	58	0.0016	0.0016	1.47E-05	0.00692	0.00676	0.00645
Arsenic Pm10 Stp	59	59	0.00135	0.00135	1.81E-05	0.00727	0.00647	0.006
Cadmium (Tsp) Stp	59	59	0.000167	0.000167	2.00E-05	0.00045	0.00043	0.00042
Cadmium Pm10 Stp	59	59	0.000283	0.000283	2.97E-05	0.00155	0.0013	0.001
Lead (Tsp) Lc Frm/Fem	59	59	0.00539	0.00539		0.0271	0.017	0.0159
Lead Pm10 Lc	59	58	0.00363	0.0037		0.025	0.0174	0.0114
Manganese (Tsp) Stp	59	59	0.0253	0.0253	9.12E-05	0.0744	0.058	0.0557
Manganese Pm10 Stp	59	59	0.0089	0.0089	0.000115	0.0227	0.0193	0.017
Nickel (Tsp) Stp	59	59	0.0014	0.0014	5.19E-05	0.00385	0.00304	0.00267
Nickel Pm10 Stp	59	59	0.000917	0.000917	6.59E-05	0.00222	0.00211	0.00175

Dearborn (261630033) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
1,1,2,2-Tetrachloroethane	60	0	0	0.0481	0.0961	0	0	0
1,1,2-Trichloroethane	60	0	0	0.0491	0.0982	0	0	0
1,1-Dichloroethane	60	0	0	0.0364	0.0729	0	0	0
1,1-Dichloroethylene	60	0	0	0.0278	0.0555	0	0	0
1,2,4-Trichlorobenzene	60	0	0	0.186	0.371	0	0	0
1,2,4-Trimethylbenzene	60	59	0.592	0.593	0.0885	4.07	3.45	2.2
1,2-Dichlorobenzene	60	0	0	0.0451	0.0902	0	0	0
1,2-Dichloropropane	60	0	0	0.0347	0.0693	0	0	0
1,3,5-Trimethylbenzene	60	55	0.191	0.195	0.0836	1.39	1.21	0.718
1,3-Butadiene	60	60	0.102	0.102	0.0288	0.429	0.358	0.294
1,3-Dichlorobenzene	60	0	0	0.0421	0.0842	0	0	0
1,4-Dichlorobenzene	60	14	0.0196	0.0542	0.0902	0.156	0.114	0.114
2,5-Dimethylbenzaldehyde	68	0	0	0.00548	0.011	0	0	0
Acenaphthene (Tsp) Stp	66	65	0.00795	0.00795	0.000126	0.0363	0.0342	0.032
Acenaphthylene (Tsp) Stp	66	49	0.000715	0.000718	1.90E-05	0.00385	0.00355	0.00333
Acetaldehyde	68	68	1.84	1.84	0.00882	3.28	3.26	2.85
Acetone	68	68	2.99	2.99	0.0316	6.53	6.32	5.84
Acetonitrile	60	60	1.32	1.32	0.0772	19.8	12.5	4.67
Acetylene	60	60	1.04	1.04	0.0138	4.58	2.6	2.48
Acrylonitrile	60	1	0.00134	0.0184	0.0347	0.0803	0	0
Anthracene (Tsp) Stp	66	62	0.000685	0.000687	6.15E-05	0.00454	0.00244	0.00241
Arsenic (Tsp) Stp	87	87	0.00193	0.00193	1.46E-05	0.00655	0.00615	0.00514
Arsenic Pm10 Stp	92	92	0.0018	0.0018	1.80E-05	0.00707	0.00647	0.00573

Dearborn (261630033) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Barium (Tsp) Stp	87	87	0.0297	0.0297	0.00128	0.817	0.0485	0.0423
Barium Pm10 Stp	92	92	0.0193	0.0193	0.0016	0.725	0.0301	0.0275
Benzaldehyde	68	68	0.157	0.157	0.00868	0.391	0.382	0.317
Benzene	60	60	0.725	0.725	0.0479	2.21	1.95	1.73
Benzo[A]Anthracene (Tsp) Stp	66	66	0.000186	0.000186	2.53E-05	0.000654	0.000632	0.000617
Benzo[A]Pyrene (Tsp) Stp	66	66	0.000193	0.000193	3.63E-05	0.000909	0.000639	0.000587
Benzo[B]Fluoranthene (Tsp) Stp	66	66	0.000482	0.000482	3.51E-05	0.0017	0.00148	0.000995
Benzo[G,H,I]Perylene (Tsp) Stp	66	66	0.000265	0.000265	3.26E-05	0.000922	0.000775	0.000648
Benzo[K]Fluoranthene (Tsp) Stp	66	66	0.000144	0.000144	3.87E-05	0.000435	0.00043	0.000365
Beryllium (Tsp) Stp	87	85	0.0000695	0.0000696	6.79E-06	0.00026	0.00026	0.00024
Beryllium Pm10 Stp	92	49	0.0000145	0.0000163	7.80E-06	0.00013	0.00012	0.00005
Bromochloromethane	60	0	0	0.0397	0.0794	0	0	0
Bromodichloromethane	60	0	0	0.0603	0.121	0	0	0
Bromoform	60	0	0	0.0672	0.134	0	0	0
Bromomethane	60	37	0.0238	0.0328	0.0466	0.0583	0.0544	0.0505
Butyraldehyde	68	68	0.422	0.422	0.0059	1.68	1.18	1.15
Cadmium (Tsp) Stp	87	86	0.000308	0.000308	2.02E-05	0.00104	0.0008	0.00079
Cadmium Pm10 Stp	92	91	0.00025	0.00025	3.00E-05	0.00064	0.0006	0.0006
Carbon Disulfide	60	60	0.107	0.107	0.0405	0.355	0.336	0.286
Carbon Tetrachloride	60	60	0.672	0.672	0.107	0.824	0.812	0.78
Chlorobenzene	60	34	0.0702	0.0851	0.0691	0.18	0.18	0.175
Chloroethane	60	44	0.099	0.104	0.0369	0.216	0.216	0.19
Chloroform	60	60	0.562	0.562	0.0684	1.09	1.05	1.04
Chloromethane	60	60	1.3	1.3	0.0289	1.53	1.5	1.5
Chloroprene	60	0	0	0.029	0.0579	0	0	0
Chromium (Tsp) Stp	87	87	0.00606	0.00606	0.000121	0.0286	0.0249	0.0182
Chromium Pm10 Stp	92	92	0.00392	0.00392	0.000151	0.0152	0.0144	0.0124
Chrysene (Tsp) Stp	66	66	0.000437	0.000437	3.05E-05	0.00111	0.00107	0.000878
Cis-1,2-Dichloroethene	60	0	0	0.0278	0.0555	0	0	0
Cis-1,3-Dichloropropene	60	0	0	0.0408	0.0817	0	0	0
Cobalt (Tsp) Stp	87	87	0.000259	0.000259	9.02E-06	0.00091	0.0008	0.00073
Cobalt Pm10 Stp	92	91	0.00015	0.00015	1.00E-05	0.00064	0.00053	0.00053
Copper (Tsp) Stp	87	87	0.0584	0.0584	0.000357	0.301	0.272	0.21
Copper Pm10 Stp	92	92	0.0467	0.0467	0.000448	0.268	0.125	0.118
Dibenzo[A,H]Anthracene (Tsp) Stp	66	47	0.0000332	0.0000381	3.36E-05	0.000157	0.000101	0.00009
Dibromochloromethane	60	0	0	0.0596	0.119	0	0	0
Dichlorodifluoromethane	60	60	2.63	2.63	0.0692	3.16	3.1	2.89
Dichloromethane	60	60	2.73	2.73	0.0486	15	13.7	9.52
Ethyl Acrylate	60	0	0	0.0369	0.0737	0	0	0
Ethylbenzene	60	60	0.364	0.364	0.0565	1.55	1.54	1.06
Ethylene Dibromide	60	0	0	0.0499	0.0999	0	0	0
Ethylene Dichloride	60	55	0.0679	0.0703	0.0567	0.101	0.0971	0.0971
Fluoranthene (Tsp) Stp	66	66	0.00448	0.00448	3.20E-05	0.019	0.0165	0.0161
Fluorene (Tsp) Stp	66	57	0.00714	0.00715	9.75E-05	0.0314	0.0289	0.027
Formaldehyde	68	68	3.25	3.25	0.0116	7.15	6.91	6.28
Freon 114	60	60	0.112	0.112	0.0909	0.133	0.126	0.126

Dearborn (261630033) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Hexachlorobutadiene	60	0	0	0.144	0.288	0	0	0
Hexanaldehyde	68	68	0.133	0.133	0.00385	0.332	0.303	0.299
Indeno[1,2,3-Cd]Pyrene (Tsp) Stp	66	66	0.000263	0.000263	3.67E-05	0.00101	0.000927	0.000552
Iron (Tsp) Stp	87	87	1.45	1.45	0.00313	7.12	6.37	5.68
Iron Pm10 Stp	92	92	0.754	0.754	0.00389	3.63	3.21	2.63
Isovaleraldehyde	68	0	0	0.00352	0.00705	0	0	0
Lead (Tsp) Lc Frm/Fem	87	87	0.0116	0.0116		0.0645	0.0605	0.033
Lead Pm10 Lc	94	94	0.00954	0.00954		0.0596	0.0462	0.0255
M/P Xylene	60	60	1.07	1.07	0.0999	5.04	5.04	3.48
Manganese (Tsp) Stp	87	87	0.0882	0.0882	8.87E-05	0.352	0.324	0.314
Manganese Pm10 Stp	92	92	0.0286	0.0286	0.000112	0.0976	0.0964	0.0932
Methyl Chloroform	60	21	0.0116	0.0382	0.0818	0.0491	0.0436	0.0436
Methyl Ethyl Ketone	68	68	0.453	0.453	0.0059	1.17	1.07	0.95
Methyl Isobutyl Ketone	60	57	0.228	0.23	0.0778	0.922	0.709	0.5
Methyl Methacrylate	60	1	0.0111	0.0474	0.0737	0.668	0	0
Methyl Tert-Butyl Ether	60	0	0	0.0325	0.0649	0	0	0
Molybdenum (Tsp) Stp	87	87	0.00173	0.00173	3.94E-05	0.0194	0.0182	0.0145
Molybdenum Pm10 Stp	92	92	0.00171	0.00171	4.99E-05	0.0191	0.0179	0.0154
Naphthalene (Tsp) Stp	66	66	0.115	0.115	0.00053	0.369	0.323	0.294
Nickel (Tsp) Stp	87	87	0.00276	0.00276	5.09E-05	0.0165	0.0153	0.0103
Nickel Pm10 Stp	92	92	0.00226	0.00226	6.46E-05	0.0145	0.0125	0.0104
N-Octane	60	58	0.154	0.155	0.0561	0.495	0.439	0.379
O-Xylene	60	59	0.371	0.372	0.0521	1.34	1.3	1.2
Phenanthrene (Tsp) Stp	66	66	0.0153	0.0153	8.00E-05	0.0686	0.062	0.0617
Propionaldehyde	68	68	0.325	0.325	0.00475	0.658	0.641	0.63
Propylene	60	60	0.68	0.68	0.0516	2.08	1.91	1.84
Pyrene (Tsp) Stp	66	66	0.00243	0.00243	3.11E-05	0.00855	0.00779	0.00712
Styrene	60	59	1.04	1.04	0.0596	9.41	3.37	2.53
Tert-Butyl Ethyl Ether	60	0	0	0.0334	0.0669	0	0	0
Tetrachloroethylene	60	59	0.255	0.256	0.0882	1.47	1.17	0.59
Tolualdehydes	66	66	0.143	0.143	0.0147	0.457	0.418	0.275
Toluene	60	60	1.42	1.42	0.049	6.14	5.84	5.69
Trans-1,2-Dichloroethylene	60	0	0	0.0238	0.0476	0	0	0
Trans-1,3-Dichloropropene	60	0	0	0.0454	0.0908	0	0	0
Trichloroethylene	60	6	0.00941	0.0505	0.0913	0.167	0.14	0.0967
Trichlorofluoromethane	60	60	1.45	1.45	0.0843	2.22	2.07	1.86
Valeraldehyde	67	67	0.0986	0.0986	0.00705	0.215	0.187	0.183
Vanadium (Tsp) Stp	87	87	0.0031	0.0031	1.53E-05	0.0128	0.0108	0.00965
Vanadium Pm10 Stp	92	92	0.00132	0.00132	1.95E-05	0.00521	0.00468	0.00381
Vinyl Chloride	60	3	0.000766	0.0153	0.0307	0.0281	0.0102	0.00767
Zinc (Tsp) Stp	87	87	0.108	0.108	0.000786	0.457	0.413	0.372
Zinc Pm10 Stp	92	92	0.0699	0.0699	0.000998	0.315	0.298	0.258

Detroit, W. Fort St. (N. Delray-SWHS) (261630015) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
1,1,2,2-Tetrachloroethane	30	0	0	0.162	0.324	0	0	0
1,1,2-Trichloroethane	30	0	0	0.0767	0.153	0	0	0
1,1-Dichloroethane	30	0	0	0.105	0.21	0	0	0
1,1-Dichloroethylene	30	0	0	0.105	0.21	0	0	0
1,2,4-Trichlorobenzene	30	0	0	0.697	1.39	0	0	0
1,2,4-Trimethylbenzene	30	10	0.32	0.422	0.306	3.2	1.3	0.96
1,2-Dichlorobenzene	30	0	0	0.189	0.378	0	0	0
1,2-Dichloropropane	30	1	0.04	0.48	0.917	1.2	0	0
1,3,5-Trimethylbenzene	30	1	0.028	0.152	0.255	0.84	0	0
1,3-Butadiene	30	1	0.0133	0.0748	0.127	0.4	0	0
1,3-Dichlorobenzene	30	0	0	0.146	0.292	0	0	0
1,4-Dichlorobenzene	30	0	0	0.198	0.395	0	0	0
Acetaldehyde	30	30	1.84	1.84		3.24	3.09	2.83
Acetone	30	30	2.58	2.58		7.4	4.36	4.34
Acetonitrile	30	12	0.384	0.501	0.42	3.2	1.4	1.3
Acrylonitrile	30	0	0	0.352	0.705	0	0	0
Arsenic (Tsp) Stp	60	60	0.00154	0.00154	1.46E-05	0.00772	0.00405	0.00399
Benzaldehyde	30	30	0.123	0.123		0.343	0.29	0.216
Benzene	30	29	0.73	0.731	0.128	2.4	1.4	1.3
Bromodichloromethane	30	0	0	0.0998	0.2	0	0	0
Bromoform	30	0	0	0.171	0.342	0	0	0
Bromomethane	30	0	0	0.164	0.328	0	0	0
Cadmium (Tsp) Stp	60	60	0.000289	0.000289	1.98E-05	0.00263	0.00115	0.00096
Carbon Tetrachloride	30	2	0.031	0.155	0.268	0.5	0.43	0
Chlorobenzene	30	0	0	0.109	0.218	0	0	0
Chloroethane	30	0	0	0.0693	0.139	0	0	0
Chloroform	30	23	0.443	0.466	0.162	1.3	0.96	0.73
Chloromethane	30	30	1.1	1.1	0.147	2.1	1.8	1.4
Chloroprene	30	0	0	0.078	0.156	0	0	0
Cis-1,2-Dichloroethene	30	0	0	0.0867	0.173	0	0	0
Cis-1,3-Dichloropropene	30	0	0	0.0883	0.177	0	0	0
Dibromochloromethane	30	0	0	0.175	0.35	0	0	0
Dichlorodifluoromethane	30	30	2.16	2.16	0.237	3.1	2.7	2.6
Dichloromethane	30	25	0.519	0.548	0.36	1.7	0.99	0.75
Ethylbenzene	30	3	0.126	0.294	0.364	1.8	1.1	0.89
Ethylene Dibromide	30	0	0	0.17	0.34	0	0	0
Ethylene Dichloride	30	0	0	0.108	0.215	0	0	0
Formaldehyde	30	30	2.74	2.74		5.03	4.76	4.73
Freon 114	30	0	0	0.182	0.365	0	0	0
Hexachlorobutadiene	30	1	0.0733	0.55	0.983	2.2	0	0
Hexanaldehyde	30	29	0.152	0.158		0.368	0.342	0.341
M/P Xylene	30	11	0.685	0.939	0.781	5.8	3.1	1.9

Detroit, W. Fort St. (N. Delray-SWHS) (261630015) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Manganese (Tsp) Stp	60	60	0.0416	0.0416	8.82E-05	0.213	0.107	0.0981
Manganese Pm10 Stp	59	59	0.0151	0.0151	0.000116	0.0699	0.0376	0.0363
Methyl Chloroform	30	0	0	0.143	0.286	0	0	0
Methyl Ethyl Ketone	30	25	1.6	1.69	1.08	4.1	3.3	3.2
Methyl Isobutyl Ketone	30	4	1.95	2.34	0.91	21	17	16
Methyl Tert-Butyl Ether	30	0	0	0.117	0.234	0	0	0
Nickel (Tsp) Stp	60	60	0.00233	0.00233	5.07E-05	0.00672	0.00664	0.00569
O-Xylene	30	10	0.249	0.356	0.324	2.2	1.1	0.67
Propionaldehyde	30	30	0.369	0.369		0.799	0.668	0.626
Styrene	30	1	0.0257	0.337	0.648	0.77	0	0
Tetrachloroethylene	30	0	0	0.151	0.302	0	0	0
Tolualdehydes	30	10	0.0188	0.0564		0.0961	0.0884	0.0641
Toluene	30	29	1.62	1.63	0.405	9.5	4.9	3.6
Trans-1,2-Dichloroethylene	30	0	0	0.1	0.2	0	0	0
Trans-1,3-Dichloropropene	30	0	0	0.0621	0.124	0	0	0
Trichloroethylene	30	0	0	0.112	0.225	0	0	0
Trichlorofluoromethane	30	29	1.14	1.15	0.307	1.5	1.5	1.4
Valeraldehyde	30	30	0.298	0.298		0.667	0.616	0.519
Vinyl Chloride	30	0	0	0.077	0.154	0	0	0

Detroit, W. Jefferson, South Delray (261630027) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	61	61	0.00188	0.00188	1.49E-05	0.00817	0.00565	0.00396
Cadmium (Tsp) Stp	61	61	0.000365	0.000365	2.03E-05	0.00152	0.00102	0.00101
Manganese (Tsp) Stp	61	61	0.114	0.114	9.33E-05	0.347	0.326	0.323
Nickel (Tsp) Stp	61	61	0.00289	0.00289	5.31E-05	0.0137	0.00654	0.00639

River Rouge (261630005) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Acetaldehyde	29	29	1.95	1.95		3.75	3	2.69
Acetone	29	29	2.38	2.38		4.48	3.88	3.87
Arsenic (Tsp) Stp	61	61	0.00185	0.00185	1.49E-05	0.0135	0.0101	0.00507
Benzaldehyde	29	29	0.136	0.136		0.303	0.201	0.192
Cadmium (Tsp) Stp	61	61	0.000317	0.000317	2.00E-05	0.00173	0.0009	0.00067
Formaldehyde	29	29	4.27	4.27		6.62	6.22	5.98
Hexanaldehyde	29	29	0.186	0.186		0.409	0.352	0.309
Manganese (Tsp) Stp	61	61	0.046	0.046	9.07E-05	0.159	0.129	0.116
Manganese Pm10 Stp	60	60	0.0151	0.0151	0.000116	0.0504	0.0381	0.036
Nickel (Tsp) Stp	61	61	0.00182	0.00182	5.21E-05	0.0115	0.00421	0.00376
Propionaldehyde	29	29	0.311	0.311		0.697	0.537	0.442
Tolualdehydes	29	8	0.015	0.0546		0.073	0.0645	0.0618
Valeraldehyde	29	29	0.239	0.239		0.512	0.489	0.403

Vassar (261570001) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	61	58	0.000761	0.000761	1.49E-05	0.00413	0.00371	0.00244
Arsenic Pm10 Stp	60	60	0.000732	0.000732	1.67E-05	0.00372	0.00368	0.00249
Cadmium (Tsp) Stp	61	60	0.000121	0.000121	2.00E-05	0.00076	0.0007	0.00049
Cadmium Pm10 Stp	60	57	0.000102	0.000103	2.92E-05	0.00061	0.0004	0.00037
Lead (Tsp) Lc Frm/Fem	61	61	0.00323	0.00323		0.0146	0.0131	0.0102
Manganese (Tsp) Stp	61	61	0.0113	0.0113	9.13E-05	0.0678	0.0579	0.0575
Manganese Pm10 Stp	60	60	0.00557	0.00557	0.00011	0.0372	0.0276	0.0263
Nickel (Tsp) Stp	61	61	0.000984	0.000984	5.23E-05	0.00295	0.00266	0.00217
Nickel Pm10 Stp	60	60	0.000659	0.000659	6.33E-05	0.00359	0.00203	0.00165

Grand Rapids-Monroe St. (260810020) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	60	60	0.00129	0.00129	1.53E-05	0.00663	0.00464	0.00342
Cadmium (Tsp) Stp	60	60	0.000125	0.000125	2.03E-05	0.00073	0.00032	0.00028
Lead (Tsp) Lc Frm/Fem	60	60	0.00414	0.00414		0.0128	0.00929	0.00825
Manganese (Tsp) Stp	60	60	0.0112	0.0112	9.25E-05	0.0367	0.024	0.0229
Nickel (Tsp) Stp	60	60	0.0012	0.0012	5.30E-05	0.00293	0.00207	0.00206

Belding-Merrick St. (260670003) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	60	60	0.00146	0.00146	1.50E-05	0.0309	0.00469	0.00326
Cadmium (Tsp) Stp	60	60	0.000269	0.000269	2.00E-05	0.00176	0.0011	0.00076
Lead (Tsp) Lc Frm/Fem	60	60	0.0322	0.0322		0.21	0.099	0.0863
Manganese (Tsp) Stp	60	60	0.00891	0.00891	9.18E-05	0.0231	0.0181	0.0177
Nickel (Tsp) Stp	60	60	0.00116	0.00116	5.28E-05	0.00271	0.00255	0.00252

Belding-Merrick St. (260670003) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	60	60	0.00146	0.00146	1.47E-05	0.0309	0.00469	0.00326
Cadmium (Tsp) Stp	60	60	0.000269	0.000269	2.00E-05	0.00176	0.0011	0.00076
Lead (Tsp) Lc Frm/Fem	60	60	0.0322	0.0322		0.21	0.099	0.0863
Manganese (Tsp) Stp	60	60	0.00891	0.00891	8.87E-05	0.0231	0.0181	0.0177
Nickel (Tsp) Stp	60	60	0.00116	0.00116	5.12E-05	0.00271	0.00255	0.00252

Port Huron-Rural St. (261470031) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	59	57	0.00182	0.00182	1.51E-05	0.0287	0.0162	0.00741
Cadmium (Tsp) Stp	59	59	0.000843	0.000843	2.00E-05	0.00715	0.00415	0.00391
Lead (Tsp) Lc Frm/Fem	60	59	0.016	0.0162		0.13	0.0831	0.0795
Manganese (Tsp) Stp	59	59	0.00877	0.00877	9.20E-05	0.0323	0.0276	0.02
Nickel (Tsp) Stp	59	59	0.00186	0.00186	5.31E-05	0.0336	0.00343	0.00311

APPENDIX B-2

Allen Park (261630001), Speciated PM2.5 (µg/m3)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	119	76	0.0187	0.022	0.0183	0.214	0.151	0.144
Ammonium Ion Pm2.5 Lc	121	121	1.04	1.04	0.0136	4.04	3.8	3.46
Antimony Pm2.5 Lc	119	30	0.00487	0.0195	0.0381	0.0501	0.0443	0.0443
Arsenic Pm2.5 Lc	119	75	0.00114	0.00144	0.00163	0.00782	0.007	0.00653
Barium Pm2.5 Lc	119	33	0.00432	0.0079	0.0102	0.301	0.0177	0.0173
Bromine Pm2.5 Lc	119	114	0.00387	0.00391	0.00155	0.0133	0.012	0.0101
Cadmium Pm2.5 Lc	119	18	0.000769	0.00755	0.016	0.0128	0.00933	0.00816
Calcium Pm2.5 Lc	119	117	0.0538	0.0539	0.0061	1.72	0.194	0.171
Cerium Pm2.5 Lc	119	8	2.83E-05	0.00398	0.00832	0.00093	0.0007	0.00047
Cesium Pm2.5 Lc	119	22	0.000638	0.00719	0.0173	0.007	0.00665	0.00642
Chlorine Pm2.5 Lc	119	96	0.0288	0.0295	0.00661	1.67	0.154	0.128
Chromium Pm2.5 Lc	119	90	0.00257	0.00284	0.00223	0.0476	0.0217	0.017
Cobalt Pm2.5 Lc	119	82	0.000435	0.000639	0.0013	0.00274	0.00155	0.00149
Copper Pm2.5 Lc	119	107	0.00954	0.00965	0.00187	0.176	0.0334	0.0276
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	118	118	0.402	0.402		1.26	1.22	1.18
Indium Pm2.5 Lc	119	33	0.00303	0.0101	0.0198	0.0373	0.0257	0.0198
Iron Pm2.5 Lc	119	119	0.117	0.117	0.00178	0.341	0.337	0.315
Lead Pm2.5 Lc	119	83	0.00213	0.00273	0.00367	0.0221	0.0126	0.0107
Magnesium Pm2.5 Lc	119	54	0.0116	0.0152	0.0134	0.579	0.0804	0.0361
Manganese Pm2.5 Lc	119	105	0.0024	0.0025	0.00178	0.01	0.00916	0.00728
Nickel Pm2.5 Lc	119	81	0.000819	0.00104	0.00134	0.016	0.0057	0.00449
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	118	118	2.24	2.24		6.84	6.14	5.44
Phosphorus Pm2.5 Lc	119	4	0.00019	0.00564	0.0112	0.0202	0.00105	0.00093
Potassium Ion Pm2.5 Lc	121	107	0.115	0.115	0.0141	7.56	0.667	0.343
Potassium Pm2.5 Lc	119	119	0.118	0.118	0.00695	7.67	0.426	0.208
Rubidium Pm2.5 Lc	119	49	0.000262	0.000794	0.00184	0.00303	0.00226	0.00191
Selenium Pm2.5 Lc	119	54	0.000597	0.00116	0.00214	0.007	0.00482	0.00467
Silicon Pm2.5 Lc	119	117	0.0545	0.0546	0.0132	0.646	0.214	0.209
Silver Pm2.5 Lc	119	26	0.00128	0.00706	0.0159	0.014	0.0128	0.0128
Sodium Ion Pm2.5 Lc	121	119	0.0698	0.0698	0.0133	0.453	0.376	0.345
Sodium Pm2.5 Lc	119	85	0.0351	0.0414	0.0406	0.363	0.222	0.176
Strontium Pm2.5 Lc	119	41	0.00141	0.00216	0.0023	0.112	0.00909	0.00701
Sulfate Pm2.5 Lc	121	121	1.95	1.95	0.0101	7.54	6.45	5.34
Sulfur Pm2.5 Lc	119	119	0.688	0.688	0.0081	2.49	2.46	1.9
Tin Pm2.5 Lc	119	31	0.0031	0.0125	0.0261	0.0326	0.0233	0.0222
Titanium Pm2.5 Lc	119	66	0.00173	0.00277	0.00472	0.0187	0.0157	0.00993
Total Nitrate Pm2.5 Lc	121	121	2.07	2.07	0.0138	9.16	8.89	8.52
Vanadium Pm2.5 Lc	119	53	0.000554	0.00145	0.00322	0.00397	0.00373	0.00327
Zinc Pm2.5 Lc	119	117	0.0131	0.0131	0.00262	0.0891	0.0453	0.0401
Zirconium Pm2.5 Lc	119	18	0.000707	0.00357	0.00664	0.0113	0.0105	0.0102

Dearborn (261630033), Speciated $PM_{2.5}$ (µg/m^3)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	61	44	0.021	0.0234	0.0169	0.309	0.0724	0.0548
Ammonium Ion Pm2.5 Lc	61	61	1.01	1.01	0.015	3.38	3.35	2.75
Antimony Pm2.5 Lc	61	15	0.00369	0.018	0.0375	0.049	0.0292	0.0222
Arsenic Pm2.5 Lc	61	39	0.00104	0.00136	0.00159	0.00594	0.00584	0.00431
Barium Pm2.5 Lc	61	15	0.00919	0.013	0.0124	0.507	0.00955	0.00653
Bromine Pm2.5 Lc	61	60	0.00394	0.00395	0.00157	0.0128	0.00992	0.00874
Cadmium Pm2.5 Lc	61	12	0.00113	0.0075	0.0162	0.0233	0.00934	0.007
Calcium Pm2.5 Lc	61	61	0.0727	0.0727	0.00609	0.286	0.171	0.157
Cerium Pm2.5 Lc	61	5	0.0000593	0.00561	0.0117	0.0014	0.0007	0.0007
Cesium Pm2.5 Lc	61	16	0.000669	0.0075	0.0193	0.0091	0.00513	0.0049
Chlorine Pm2.5 Lc	61	55	0.0958	0.0962	0.0068	4.03	0.254	0.118
Chromium Pm2.5 Lc	61	36	0.00176	0.00221	0.00225	0.0152	0.0122	0.0113
Cobalt Pm2.5 Lc	61	37	0.00101	0.00127	0.00131	0.00874	0.00536	0.00455
Copper Pm2.5 Lc	61	60	0.0163	0.0163	0.0018	0.169	0.0809	0.0662
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	61	60	0.496	0.505		2.16	1.26	1.1
Indium Pm2.5 Lc	61	14	0.00139	0.00913	0.0192	0.0198	0.014	0.0117
Iron Pm2.5 Lc	61	61	0.468	0.468	0.0018	2.96	2.61	2.12
Lead Pm2.5 Lc	61	46	0.00623	0.00674	0.00376	0.0652	0.019	0.0181
Magnesium Pm2.5 Lc	61	31	0.0247	0.0278	0.0133	0.942	0.101	0.0397
Manganese Pm2.5 Lc	61	57	0.00817	0.00823	0.00184	0.0349	0.0251	0.0232
Nickel Pm2.5 Lc	61	40	0.00134	0.00158	0.00133	0.0115	0.00887	0.00766
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	61	61	2.52	2.52		6.54	5.96	5.21
Phosphorus Pm2.5 Lc	61	6	0.000938	0.00615	0.0114	0.0255	0.0116	0.0107
Potassium Ion Pm2.5 Lc	61	56	0.278	0.278	0.015	13.8	0.165	0.138
Potassium Pm2.5 Lc	61	61	0.28	0.28	0.00664	13.3	0.155	0.139
Rubidium Pm2.5 Lc	61	30	0.000363	0.000829	0.00188	0.00338	0.00166	0.00165
Selenium Pm2.5 Lc	61	46	0.00103	0.00125	0.00206	0.00793	0.00339	0.0032
Silicon Pm2.5 Lc	61	60	0.0783	0.0784	0.0124	0.626	0.19	0.174
Silver Pm2.5 Lc	61	10	0.00133	0.00726	0.0152	0.0222	0.0198	0.00932
Sodium Ion Pm2.5 Lc	61	61	0.0735	0.0735	0.0142	0.249	0.167	0.167
Sodium Pm2.5 Lc	61	54	0.0607	0.0633	0.0397	0.274	0.219	0.198
Strontium Pm2.5 Lc	61	22	0.0035	0.00424	0.00232	0.194	0.00199	0.00183
Sulfate Pm2.5 Lc	61	61	2.1	2.1	0.00934	10.2	7.48	5.78
Sulfur Pm2.5 Lc	61	61	0.729	0.729	0.00805	3.67	2.47	1.98
Tin Pm2.5 Lc	61	12	0.00219	0.0126	0.0254	0.0256	0.0245	0.0213
Titanium Pm2.5 Lc	61	33	0.00146	0.00253	0.00471	0.00851	0.00839	0.007
Total Nitrate Pm2.5 Lc	61	61	1.98	1.98	0.0142	8.72	7.75	6.47
Vanadium Pm2.5 Lc	61	32	0.000748	0.00151	0.00321	0.00385	0.00373	0.00351
Zinc Pm2.5 Lc	61	61	0.0464	0.0464	0.00258	0.355	0.193	0.131
Zirconium Pm2.5 Lc	61	12	0.00108	0.00347	0.00587	0.0126	0.0114	0.00875

Detroit, W Fort St. (N. Delray-SWHS) (261630015), Speciated PM2.5 (µg/m3)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	59	41	0.0228	0.0255	0.0175	0.121	0.12	0.103
Ammonium Ion Pm2.5 Lc	59	59	0.963	0.963	0.0141	3.53	3.13	2.96
Antimony Pm2.5 Lc	59	18	0.00439	0.0177	0.0368	0.0339	0.0268	0.0257
Arsenic Pm2.5 Lc	59	33	0.00104	0.0014	0.0016	0.00583	0.00361	0.00355
Barium Pm2.5 Lc	59	14	0.00363	0.00742	0.0116	0.166	0.0122	0.0091
Bromine Pm2.5 Lc	59	57	0.00391	0.00393	0.00153	0.00946	0.00931	0.00865
Cadmium Pm2.5 Lc	59	12	0.00116	0.00766	0.0156	0.0152	0.0128	0.00817
Calcium Pm2.5 Lc	59	58	0.0827	0.0827	0.00614	0.478	0.414	0.259
Cerium Pm2.5 Lc	59	5	5.36E-05	0.005	0.0104	0.00105	0.00082	0.0007
Cesium Pm2.5 Lc	59	15	0.00107	0.00724	0.019	0.0138	0.00981	0.00899
Chlorine Pm2.5 Lc	59	52	0.059	0.0594	0.00679	1.11	0.403	0.234
Chromium Pm2.5 Lc	59	35	0.000985	0.00143	0.00222	0.00701	0.00581	0.00559
Cobalt Pm2.5 Lc	59	41	0.00073	0.000938	0.0013	0.00256	0.00232	0.00229
Copper Pm2.5 Lc	59	55	0.0103	0.0104	0.00185	0.0877	0.0326	0.0267
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	60	60	0.467	0.467		1.1	1.06	1.04
Indium Pm2.5 Lc	59	15	0.00139	0.00818	0.0189	0.0128	0.0105	0.00816
Iron Pm2.5 Lc	59	59	0.217	0.217	0.00181	0.947	0.632	0.62
Lead Pm2.5 Lc	59	51	0.00596	0.00623	0.00371	0.0359	0.0355	0.0322
Magnesium Pm2.5 Lc	59	33	0.0132	0.0159	0.0137	0.289	0.0695	0.035
Manganese Pm2.5 Lc	59	57	0.00397	0.004	0.0018	0.016	0.0127	0.0102
Nickel Pm2.5 Lc	59	42	0.000633	0.000843	0.00136	0.00513	0.00327	0.00284
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	60	60	2.36	2.36		8.25	5.57	4.87
Phosphorus Pm2.5 Lc	59	7	0.000589	0.00568	0.0112	0.0168	0.0087	0.00328
Potassium Ion Pm2.5 Lc	59	55	0.128	0.128	0.0143	4.86	0.178	0.161
Potassium Pm2.5 Lc	59	59	0.125	0.125	0.00698	4.17	0.158	0.144
Rubidium Pm2.5 Lc	59	16	0.000142	0.000811	0.00181	0.00128	0.00125	0.00086
Selenium Pm2.5 Lc	59	35	0.000576	0.00101	0.00213	0.00408	0.00329	0.00269
Silicon Pm2.5 Lc	59	57	0.0752	0.0754	0.0131	0.354	0.25	0.237
Silver Pm2.5 Lc	59	9	0.000667	0.0069	0.0145	0.0105	0.00817	0.00584
Sodium Ion Pm2.5 Lc	59	59	0.0709	0.0709	0.0136	0.463	0.179	0.171
Sodium Pm2.5 Lc	59	47	0.047	0.0515	0.0415	0.292	0.264	0.258
Strontium Pm2.5 Lc	59	25	0.00198	0.00261	0.00225	0.0802	0.00421	0.00304
Sulfate Pm2.5 Lc	59	59	1.94	1.94	0.00906	7.77	6.34	4.27
Sulfur Pm2.5 Lc	59	59	0.67	0.67	0.00809	2.76	2.05	1.5
Tin Pm2.5 Lc	59	19	0.0049	0.0135	0.0254	0.0385	0.0373	0.0338
Titanium Pm2.5 Lc	59	34	0.00174	0.00275	0.00471	0.0161	0.00653	0.00618
Total Nitrate Pm2.5 Lc	59	59	1.86	1.86	0.014	8.44	7.98	6.8
Vanadium Pm2.5 Lc	59	40	0.00097	0.00149	0.00319	0.00444	0.00443	0.00397
Zinc Pm2.5 Lc	59	59	0.0207	0.0207	0.00266	0.073	0.0575	0.057
Zirconium Pm2.5 Lc	59	12	0.000809	0.00287	0.00556	0.0131	0.0091	0.00584

Port Huron-Nat'l Guard Arm. (261470005), Speciated PM2.5 (µg/m3)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	61	43	0.0136	0.0161	0.0178	0.072	0.0598	0.0526
Ammonium Ion Pm2.5 Lc	61	60	0.836	0.836	0.014	4.68	2.77	2.63
Antimony Pm2.5 Lc	61	18	0.00776	0.0205	0.0356	0.0794	0.0722	0.0549
Arsenic Pm2.5 Lc	61	37	0.000857	0.00119	0.00159	0.00361	0.0035	0.00315
Barium Pm2.5 Lc	61	9	0.000662	0.00492	0.0124	0.00886	0.00736	0.0056
Bromine Pm2.5 Lc	61	61	0.00412	0.00412	0.0015	0.0192	0.0124	0.00981
Cadmium Pm2.5 Lc	61	17	0.00241	0.00826	0.015	0.028	0.0152	0.014
Calcium Pm2.5 Lc	61	59	0.0552	0.0553	0.00623	1.01	0.164	0.156
Cerium Pm2.5 Lc	61	4	4.75E-05	0.00567	0.0117	0.00197	0.00058	0.00023
Cesium Pm2.5 Lc	61	13	0.000801	0.00709	0.0189	0.00817	0.00595	0.00559
Chlorine Pm2.5 Lc	61	46	0.0166	0.0175	0.00698	0.377	0.161	0.0549
Chromium Pm2.5 Lc	61	30	0.000552	0.00111	0.00219	0.00317	0.00293	0.00233
Cobalt Pm2.5 Lc	61	34	0.00036	0.000639	0.00132	0.00135	0.00121	0.00119
Copper Pm2.5 Lc	61	37	0.000976	0.00142	0.00191	0.00607	0.00459	0.00387
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	60	60	0.242	0.242		0.759	0.553	0.549
Indium Pm2.5 Lc	61	16	0.00228	0.00912	0.0183	0.0363	0.0164	0.014
Iron Pm2.5 Lc	61	61	0.0402	0.0402	0.00185	0.13	0.112	0.111
Lead Pm2.5 Lc	61	37	0.00119	0.00193	0.00368	0.007	0.007	0.00664
Magnesium Pm2.5 Lc	61	30	0.0111	0.0145	0.0142	0.311	0.068	0.033
Manganese Pm2.5 Lc	61	37	0.000845	0.00118	0.0018	0.00652	0.00408	0.00367
Nickel Pm2.5 Lc	61	42	0.00049	0.00069	0.0014	0.00349	0.00168	0.0014
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	60	60	2.31	2.31		9.34	7.76	4.46
Phosphorus Pm2.5 Lc	61	7	0.000879	0.0059	0.011	0.0215	0.0116	0.00818
Potassium Ion Pm2.5 Lc	61	51	0.0697	0.0705	0.0142	2.06	0.18	0.147
Potassium Pm2.5 Lc	61	61	0.0827	0.0827	0.0073	2.31	0.193	0.166
Rubidium Pm2.5 Lc	61	24	0.000209	0.000748	0.00178	0.0016	0.00109	0.00105
Selenium Pm2.5 Lc	61	35	0.000647	0.00112	0.00218	0.00421	0.00385	0.00278
Silicon Pm2.5 Lc	61	57	0.0506	0.0511	0.0134	0.213	0.213	0.179
Silver Pm2.5 Lc	61	4	0.00021	0.00652	0.0137	0.00816	0.00233	0.00117
Sodium Ion Pm2.5 Lc	61	58	0.0606	0.0608	0.0143	0.592	0.298	0.212
Sodium Pm2.5 Lc	61	37	0.0335	0.0424	0.0427	0.483	0.259	0.165
Strontium Pm2.5 Lc	61	17	0.000349	0.00114	0.00221	0.00443	0.00338	0.00256
Sulfate Pm2.5 Lc	61	61	1.79	1.79	0.00989	6.31	6.02	5.8
Sulfur Pm2.5 Lc	61	61	0.646	0.646	0.00808	2.39	2.27	1.78
Tin Pm2.5 Lc	61	13	0.00206	0.0116	0.0247	0.0221	0.0187	0.0151
Titanium Pm2.5 Lc	61	30	0.00129	0.00249	0.00472	0.0121	0.0055	0.00465
Total Nitrate Pm2.5 Lc	61	61	1.62	1.62	0.0131	11.8	7.35	6.13
Vanadium Pm2.5 Lc	61	40	0.000983	0.00155	0.00317	0.0046	0.00385	0.00351
Zinc Pm2.5 Lc	61	61	0.0119	0.0119	0.00265	0.0593	0.0486	0.0389
Zirconium Pm2.5 Lc	61	10	0.000708	0.00297	0.00514	0.00933	0.00748	0.00584

Sterling State Park (261150006), Speciated PM2.5 (µg/m3)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	59	40	0.0128	0.0156	0.0186	0.0667	0.0657	0.0618
Ammonium Ion Pm2.5 Lc	60	60	0.878	0.878	0.0137	3.78	2.76	2.41
Antimony Pm2.5 Lc	59	19	0.00638	0.018	0.0339	0.0744	0.0465	0.0442
Arsenic Pm2.5 Lc	59	34	0.000897	0.00124	0.00158	0.00709	0.00407	0.00291
Barium Pm2.5 Lc	59	8	0.000665	0.00496	0.0116	0.0233	0.00721	0.00256
Bromine Pm2.5 Lc	59	58	0.00335	0.00336	0.00142	0.00966	0.00884	0.00825
Cadmium Pm2.5 Lc	59	15	0.00141	0.00681	0.0143	0.014	0.014	0.0139
Calcium Pm2.5 Lc	59	56	0.0291	0.0293	0.00631	0.118	0.0848	0.0799
Cerium Pm2.5 Lc	59	1	1.97E-05	0.00518	0.0104	0.00116	0	0
Cesium Pm2.5 Lc	59	20	0.00124	0.00637	0.0181	0.0115	0.0105	0.00733
Chlorine Pm2.5 Lc	59	40	0.00675	0.00799	0.007	0.0529	0.0462	0.0327
Chromium Pm2.5 Lc	59	40	0.00266	0.00302	0.00215	0.0782	0.0136	0.00871
Cobalt Pm2.5 Lc	59	34	0.00041	0.000688	0.00132	0.0036	0.00221	0.00113
Copper Pm2.5 Lc	59	44	0.00164	0.00195	0.00199	0.021	0.0173	0.00637
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	58	58	0.235	0.235		0.572	0.547	0.544
Indium Pm2.5 Lc	59	15	0.00292	0.00955	0.0178	0.0314	0.0232	0.0198
Iron Pm2.5 Lc	59	59	0.0838	0.0838	0.00186	1.39	0.444	0.166
Lead Pm2.5 Lc	59	32	0.00133	0.00222	0.00358	0.00744	0.00699	0.00523
Magnesium Pm2.5 Lc	59	25	0.00556	0.00963	0.0147	0.058	0.0517	0.026
Manganese Pm2.5 Lc	59	40	0.00161	0.00188	0.00173	0.0193	0.0074	0.00725
Nickel Pm2.5 Lc	59	33	0.000583	0.000892	0.00144	0.00837	0.00348	0.00311
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	58	58	2.03	2.03		7.39	4.87	4.17
Phosphorus Pm2.5 Lc	59	2	8.71E-05	0.00516	0.0105	0.00444	0.0007	0
Potassium Ion Pm2.5 Lc	60	54	0.0587	0.059	0.0139	0.809	0.225	0.119
Potassium Pm2.5 Lc	59	59	0.0594	0.0594	0.00779	0.841	0.149	0.115
Rubidium Pm2.5 Lc	59	18	0.000254	0.000853	0.00168	0.00279	0.00192	0.00115
Selenium Pm2.5 Lc	59	29	0.000921	0.00148	0.00226	0.0104	0.00383	0.00376
Silicon Pm2.5 Lc	59	59	0.0485	0.0485	0.0142	0.204	0.171	0.143
Silver Pm2.5 Lc	59	9	0.00112	0.00669	0.0129	0.0151	0.0116	0.0105
Sodium Ion Pm2.5 Lc	60	60	0.0615	0.0615	0.0127	0.51	0.152	0.152
Sodium Pm2.5 Lc	59	33	0.0223	0.032	0.0448	0.189	0.134	0.0755
Strontium Pm2.5 Lc	59	22	0.000667	0.00135	0.00211	0.0119	0.00268	0.00233
Sulfate Pm2.5 Lc	60	60	1.77	1.77	0.00926	8.14	5.12	4.68
Sulfur Pm2.5 Lc	59	59	0.601	0.601	0.00812	2.71	1.88	1.56
Tin Pm2.5 Lc	59	11	0.00159	0.0115	0.0244	0.0174	0.0174	0.0151
Titanium Pm2.5 Lc	59	28	0.00102	0.00223	0.00473	0.00686	0.00535	0.00478
Total Nitrate Pm2.5 Lc	60	60	1.8	1.8	0.0137	8.8	7.41	6.09
Vanadium Pm2.5 Lc	59	24	0.00043	0.00136	0.00316	0.00361	0.00279	0.00221
Zinc Pm2.5 Lc	59	54	0.0123	0.0125	0.00271	0.106	0.0611	0.0541
Zirconium Pm2.5 Lc	59	6	0.000378	0.00258	0.00477	0.00813	0.00697	0.00348

Houghton Lake (261130001), Speciated $PM_{2.5}$ (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	61	23	0.00448	0.0103	0.019	0.0443	0.0292	0.0219
Ammonium Ion Pm2.5 Lc	60	56	0.4	0.401	0.0169	2.45	1.85	1.62
Antimony Pm2.5 Lc	61	20	0.00708	0.0195	0.0367	0.084	0.0619	0.0572
Arsenic Pm2.5 Lc	61	25	0.000302	0.000779	0.00163	0.0026	0.00166	0.0014
Barium Pm2.5 Lc	61	2	0.000021	0.00479	0.00983	0.0007	0.00058	0
Bromine Pm2.5 Lc	61	57	0.00207	0.00214	0.00149	0.00686	0.00607	0.00524
Cadmium Pm2.5 Lc	61	11	0.00121	0.00767	0.0151	0.0187	0.0175	0.0117
Calcium Pm2.5 Lc	61	31	0.00661	0.00815	0.00622	0.0428	0.0367	0.033
Cerium Pm2.5 Lc	61	3	6.31E-05	0.00374	0.00764	0.0014	0.00128	0.00117
Cesium Pm2.5 Lc	61	6	0.00019	0.0074	0.017	0.00514	0.00385	0.00082
Chlorine Pm2.5 Lc	61	23	0.00242	0.00457	0.00671	0.0281	0.02	0.0199
Chromium Pm2.5 Lc	61	23	0.00154	0.00221	0.00218	0.0767	0.00281	0.00245
Cobalt Pm2.5 Lc	61	26	0.000163	0.000532	0.0013	0.00118	0.00092	0.00085
Copper Pm2.5 Lc	61	18	0.000219	0.00097	0.00195	0.00397	0.00167	0.00099
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	61	61	0.0695	0.0695		0.214	0.165	0.159
Indium Pm2.5 Lc	61	15	0.00245	0.00985	0.0191	0.0222	0.0222	0.0175
Iron Pm2.5 Lc	61	60	0.0139	0.0139	0.0018	0.0803	0.0439	0.0398
Lead Pm2.5 Lc	61	22	0.000362	0.00158	0.00361	0.00234	0.00233	0.00198
Magnesium Pm2.5 Lc	61	21	0.00228	0.00659	0.014	0.0265	0.0162	0.014
Manganese Pm2.5 Lc	61	20	0.000227	0.000806	0.00174	0.00226	0.00184	0.00113
Nickel Pm2.5 Lc	61	19	8.39E-05	0.00056	0.00139	0.00093	0.00065	0.0005
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	61	61	1.22	1.22		5.22	4.53	2.64
Phosphorus Pm2.5 Lc	61	2	8.07E-05	0.00546	0.0111	0.0048	0.00012	0
Potassium Ion Pm2.5 Lc	60	51	0.0277	0.0287	0.0167	0.0753	0.0698	0.0597
Potassium Pm2.5 Lc	61	61	0.0272	0.0272	0.00748	0.0726	0.0606	0.0507
Rubidium Pm2.5 Lc	61	22	0.000236	0.000782	0.00175	0.00166	0.00135	0.00131
Selenium Pm2.5 Lc	61	20	0.000207	0.000956	0.00224	0.00242	0.00195	0.0011
Silicon Pm2.5 Lc	61	58	0.022	0.0223	0.014	0.125	0.0576	0.0565
Silver Pm2.5 Lc	61	7	0.000601	0.00716	0.0148	0.00934	0.00817	0.007
Sodium Ion Pm2.5 Lc	60	57	0.0389	0.0391	0.0141	0.174	0.099	0.0885
Sodium Pm2.5 Lc	61	28	0.00959	0.0212	0.0432	0.114	0.0716	0.0674
Strontium Pm2.5 Lc	61	13	0.000216	0.00107	0.0022	0.00339	0.00222	0.00161
Sulfate Pm2.5 Lc	60	60	1.14	1.14	0.00842	5.17	4.18	3.32
Sulfur Pm2.5 Lc	61	61	0.4	0.4	0.00815	2.12	1.41	1.24
Tin Pm2.5 Lc	61	6	0.000861	0.0124	0.0256	0.0222	0.014	0.00584
Titanium Pm2.5 Lc	61	16	0.0004	0.00212	0.00473	0.0042	0.00409	0.00257
Total Nitrate Pm2.5 Lc	60	60	0.665	0.665	0.015	6.48	4.07	3.22
Vanadium Pm2.5 Lc	61	27	0.000446	0.00135	0.00319	0.00289	0.00241	0.00222
Zinc Pm2.5 Lc	61	42	0.00217	0.0026	0.0027	0.0127	0.00806	0.00717
Zirconium Pm2.5 Lc	61	7	0.000608	0.00339	0.00602	0.0105	0.00783	0.00699

Tecumseh (260910007), Speciated PM2.5 (µg/m3)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	60	29	0.00938	0.0139	0.0183	0.0689	0.0518	0.0512
Ammonium Ion Pm2.5 Lc	60	60	0.878	0.878	0.0141	3.83	3.47	2.79
Antimony Pm2.5 Lc	60	15	0.00585	0.0195	0.036	0.0584	0.0513	0.0455
Arsenic Pm2.5 Lc	60	39	0.00081	0.00111	0.00161	0.00426	0.00373	0.00303
Barium Pm2.5 Lc	60	5	0.00213	0.00755	0.0132	0.0909	0.0262	0.00607
Bromine Pm2.5 Lc	60	59	0.00358	0.00359	0.00152	0.0128	0.0127	0.0112
Cadmium Pm2.5 Lc	60	18	0.00145	0.007	0.0152	0.0128	0.0105	0.00815
Calcium Pm2.5 Lc	60	54	0.0214	0.0217	0.00635	0.125	0.104	0.0865
Cerium Pm2.5 Lc	60	2	7.58E-05	0.00657	0.0132	0.00362	0.00093	0
Cesium Pm2.5 Lc	60	12	0.000581	0.00595	0.016	0.00537	0.00489	0.00397
Chlorine Pm2.5 Lc	60	39	0.0115	0.0128	0.00723	0.256	0.0539	0.0503
Chromium Pm2.5 Lc	60	40	0.00101	0.00139	0.00224	0.00687	0.00537	0.00467
Cobalt Pm2.5 Lc	60	29	0.000276	0.000632	0.00137	0.00171	0.0015	0.00148
Copper Pm2.5 Lc	60	32	0.00132	0.00182	0.00196	0.0496	0.00248	0.00224
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	57	57	0.161	0.161		0.38	0.327	0.305
Indium Pm2.5 Lc	60	13	0.00132	0.00849	0.0186	0.0198	0.0128	0.0105
Iron Pm2.5 Lc	60	60	0.0434	0.0434	0.00192	0.129	0.122	0.102
Lead Pm2.5 Lc	60	37	0.0014	0.00204	0.00354	0.00804	0.00748	0.00549
Magnesium Pm2.5 Lc	60	30	0.01	0.0132	0.0141	0.18	0.0634	0.0344
Manganese Pm2.5 Lc	60	48	0.00305	0.00323	0.00184	0.0231	0.0188	0.0184
Nickel Pm2.5 Lc	60	29	0.000255	0.000623	0.00142	0.0028	0.00184	0.00117
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	57	57	1.84	1.84		6.24	4.62	3.81
Phosphorus Pm2.5 Lc	60	0	0	0.00567	0.0113	0	0	0
Potassium Ion Pm2.5 Lc	60	53	0.072	0.0724	0.0144	1.77	0.165	0.124
Potassium Pm2.5 Lc	60	60	0.0797	0.0797	0.0074	1.81	0.173	0.14
Rubidium Pm2.5 Lc	60	22	0.00023	0.00083	0.00188	0.00128	0.00123	0.00105
Selenium Pm2.5 Lc	60	36	0.000485	0.000922	0.00214	0.00249	0.00246	0.00221
Silicon Pm2.5 Lc	60	59	0.0445	0.0446	0.0132	0.149	0.125	0.115
Silver Pm2.5 Lc	60	13	0.0016	0.0079	0.0153	0.021	0.014	0.0128
Sodium Ion Pm2.5 Lc	60	59	0.0477	0.0478	0.0129	0.158	0.154	0.142
Sodium Pm2.5 Lc	60	38	0.0261	0.0334	0.0406	0.307	0.152	0.0867
Strontium Pm2.5 Lc	60	20	0.000743	0.00155	0.00232	0.0322	0.00244	0.00187
Sulfate Pm2.5 Lc	60	60	1.69	1.69	0.00875	6.8	4.57	4.14
Sulfur Pm2.5 Lc	60	60	0.59	0.59	0.00812	2.37	1.53	1.43
Tin Pm2.5 Lc	60	12	0.00253	0.012	0.024	0.035	0.0222	0.0198
Titanium Pm2.5 Lc	60	30	0.00123	0.00245	0.00478	0.009	0.00876	0.00631
Total Nitrate Pm2.5 Lc	60	60	1.74	1.74	0.0146	8.15	7.38	7.36
Vanadium Pm2.5 Lc	60	31	0.000395	0.00119	0.00321	0.00177	0.00163	0.00152
Zinc Pm2.5 Lc	60	57	0.0105	0.0106	0.00241	0.0471	0.0325	0.03
Zirconium Pm2.5 Lc	60	9	0.00062	0.00334	0.00634	0.0175	0.00724	0.00349

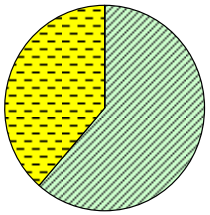
Grand Rapids - Monroe St. (260810020), Speciated PM2.5 (µg/m3)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	118	70	0.0113	0.0146	0.0171	0.0571	0.0564	0.0516
Ammonium Ion Pm2.5 Lc	120	118	1	1	0.0121	5.25	3.69	3.67
Antimony Pm2.5 Lc	118	30	0.00578	0.0201	0.0378	0.0662	0.0614	0.0582
Arsenic Pm2.5 Lc	118	67	0.000815	0.00117	0.00155	0.00664	0.00476	0.0042
Barium Pm2.5 Lc	118	26	0.00242	0.00651	0.0108	0.189	0.0127	0.0112
Bromine Pm2.5 Lc	118	114	0.00331	0.00334	0.00154	0.0109	0.0103	0.00953
Cadmium Pm2.5 Lc	118	27	0.00169	0.00802	0.0162	0.0187	0.0174	0.0152
Calcium Pm2.5 Lc	118	112	0.0219	0.022	0.0061	0.0859	0.0819	0.0697
Cerium Pm2.5 Lc	118	6	6.62E-05	0.00445	0.00911	0.00232	0.00222	0.0014
Cesium Pm2.5 Lc	118	23	0.000683	0.00778	0.019	0.0133	0.0127	0.00586
Chlorine Pm2.5 Lc	118	97	0.0429	0.0436	0.0066	1.31	0.402	0.352
Chromium Pm2.5 Lc	118	73	0.00239	0.00281	0.00225	0.0541	0.0314	0.0221
Cobalt Pm2.5 Lc	118	68	0.00031	0.000579	0.00128	0.00174	0.00163	0.00157
Copper Pm2.5 Lc	118	103	0.00324	0.00338	0.00179	0.0788	0.00944	0.00846
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	113	113	0.317	0.317		0.904	0.894	0.819
Indium Pm2.5 Lc	118	26	0.00191	0.00947	0.0194	0.0267	0.0232	0.0209
Iron Pm2.5 Lc	118	117	0.0618	0.0619	0.00174	0.226	0.18	0.173
Lead Pm2.5 Lc	118	61	0.0013	0.00223	0.0037	0.0157	0.00862	0.00593
Magnesium Pm2.5 Lc	118	53	0.00871	0.0121	0.0132	0.318	0.0389	0.0313
Manganese Pm2.5 Lc	118	109	0.00228	0.00235	0.00179	0.013	0.0126	0.00989
Nickel Pm2.5 Lc	118	67	0.000721	0.00101	0.00132	0.0168	0.00948	0.00447
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	113	113	2.23	2.23		7.38	6.11	5.76
Phosphorus Pm2.5 Lc	118	4	0.000151	0.00569	0.0114	0.0109	0.0041	0.00245
Potassium Ion Pm2.5 Lc	120	103	0.0751	0.0757	0.013	3.81	0.31	0.14
Potassium Pm2.5 Lc	118	117	0.0814	0.0814	0.0067	3.71	0.341	0.15
Rubidium Pm2.5 Lc	118	37	0.00022	0.000832	0.00183	0.0029	0.00171	0.00135
Selenium Pm2.5 Lc	118	50	0.000253	0.00085	0.00206	0.00176	0.00143	0.00133
Silicon Pm2.5 Lc	118	117	0.0432	0.0433	0.0127	0.171	0.17	0.166
Silver Pm2.5 Lc	118	30	0.00167	0.00698	0.0151	0.0268	0.0209	0.014
Sodium Ion Pm2.5 Lc	120	117	0.0595	0.0596	0.0127	0.321	0.217	0.206
Sodium Pm2.5 Lc	118	83	0.0245	0.0306	0.0401	0.176	0.141	0.106
Strontium Pm2.5 Lc	118	28	0.00095	0.00184	0.00229	0.0757	0.0107	0.00466
Sulfate Pm2.5 Lc	120	119	1.69	1.69	0.0104	5.78	5.39	4.66
Sulfur Pm2.5 Lc	118	117	0.576	0.576	0.00816	2	1.88	1.47
Tin Pm2.5 Lc	118	30	0.00294	0.0126	0.0259	0.035	0.0291	0.0222
Titanium Pm2.5 Lc	118	51	0.00127	0.00261	0.00472	0.0121	0.00876	0.00743
Total Nitrate Pm2.5 Lc	120	119	1.98	1.98	0.0139	11.7	11.1	9.91
Vanadium Pm2.5 Lc	118	43	0.000392	0.00143	0.00323	0.00315	0.0028	0.00255
Zinc Pm2.5 Lc	118	117	0.0113	0.0113	0.00265	0.0529	0.0482	0.0478
Zirconium Pm2.5 Lc	118	14	0.00052	0.00317	0.00577	0.0222	0.00651	0.00523

Appendix C: 2014 AQI Pie Charts

Appendix C contains pie charts that were created to show the AQI values for each of Michigan's 2014 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 ozone season; therefore, the number of days for each site may not be equivalent to 365. **Figures C.1** through **C.4** are grouped by Consolidated Statistical Area (CSA). CSAs are geographic regions based on population and employment data that the US Census complies. They are defined by the US Office of Management and Budget. More information on CSAs can be found on the US Census Website: www.census.gov **Figures C.5** and **C.6** show the remaining sites (not part of a CSA) located in Michigan's Upper and Lower Peninsulas.

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

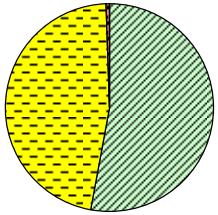
2014 AQI Summary for Allen Park
TOTAL DAYS WITH AQI VALUES = 365



Good Days - 224
Moderate Days - 141
Unhealthy/Sensitives - 1
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 O_3 = 59 SO_2 = 8
NO_2 = 0 $PM_{2.5}$ = 298 PM_{10} = 0

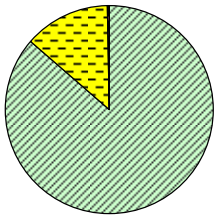
2014 AQI Summary for Dearborn
TOTAL DAYS WITH AQI VALUES = 361



Good Days - 191
Moderate Days - 168
Unhealthy/Sensitives - 2
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
$PM_{2.5}$ = 348 PM_{10} = 13

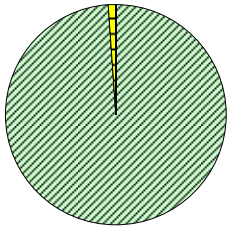
2014 AQI Summary for East 7 Mile
TOTAL DAYS WITH AQI VALUES = 360



Good Days - 311
Moderate Days - 48
Unhealthy/Sensitives - 1
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
O_3 = 154 NO_2 = 138 $PM_{2.5}$ = 68

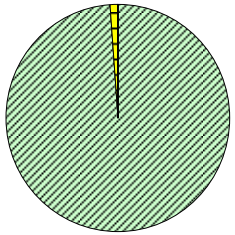
2014 AQI Summary for Eliza Howell-Downwind
TOTAL DAYS WITH AQI VALUES = 363



Good Days - 359
Moderate Days - 4
Unhealthy/Sensitives - 0
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
NO_2 = 363 CO = 0

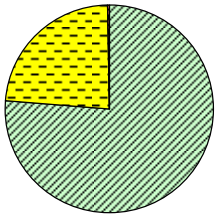
2014 AQI Summary for Eliza Howell-Near-Roadway
TOTAL DAYS WITH AQI VALUES = 364



Good Days - 360
Moderate Days - 4
Unhealthy/Sensitives - 0
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
NO_2 = 364 CO = 0

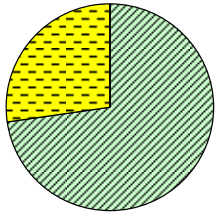
2014 AQI Summary for Flint
TOTAL DAYS WITH AQI VALUES = 341



Good Days - 260
Moderate Days - 80
Unhealthy/Sensitives - 1
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
O_3 = 92 $PM_{2.5}$ = 249

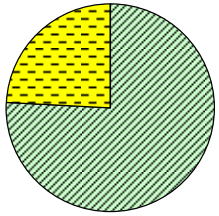
2014 AQI Summary for Detroit - Linwood
TOTAL DAYS WITH AQI VALUES = 121



Good Days - 88
Moderate Days - 33
Unhealthy/Sensitives - 0
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
$PM_{2.5}$ = 121

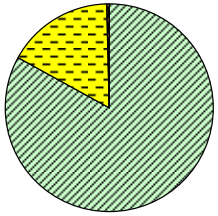
2014 AQI Summary for Livonia
TOTAL DAYS WITH AQI VALUES = 120



Good Days - 91
Moderate Days - 29
Unhealthy/Sensitives - 0
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
$PM_{2.5}$ = 120

2014 AQI Summary for New Haven
TOTAL DAYS WITH AQI VALUES = 247



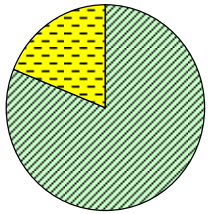
Good Days - 205
Moderate Days - 41
Unhealthy/Sensitives - 1
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
O_3 = 168 $PM_{2.5}$ = 79

Good Days
Moderate Days
Unhealthy/Sensitive Days
Unhealthy Days

Figure C1, continued: AQI Summaries for Detroit-Warren-Flint-CSA

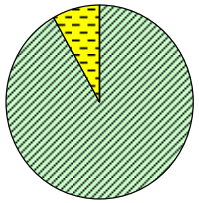
2014 AQI Summary for Oak Park
TOTAL DAYS WITH AQI VALUES = 243



Good Days - 197
Moderate Days - 46
Unhealthy/Sensitives - 0
Unhealthy Days -

AQI POLLUTANT SUMMARY
O_3 = 158 $PM_{2.5}$ = 84

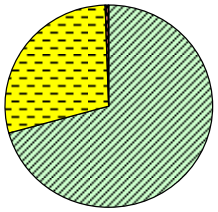
2014 AQI Summary for Otisville
TOTAL DAYS WITH AQI VALUES = 184



Good Days - 169
Moderate Days - 15
Unhealthy/Sensitives - 0
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
O_3 = 184

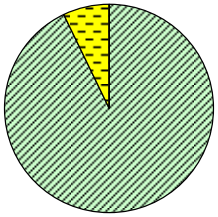
2014 AQI Summary for Port Huron-Nat'l Guard Arm.
TOTAL DAYS WITH AQI VALUES = 365



Good Days -258
Moderate Days - 105
Unhealthy/Sensitives - 2
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
O_3 = 71 $PM_{2.5}$ = 255
SO_2 = 39

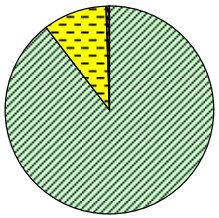
2014 AQI Summary for Sterling State Park
TOTAL DAYS WITH AQI VALUES = 365



Good Days - 339
Moderate Days - 26
Unhealthy/Sensitives - 0
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
SO_2 = 251 $PM_{2.5}$ = 114

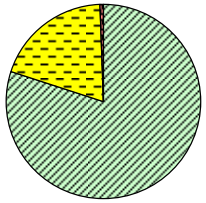
2014 AQI Summary for Warren
TOTAL DAYS WITH AQI VALUES = 183



Good Days - 164
Moderate Days - 18
Unhealthy/Sensitives - 1
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
O_3 = 183

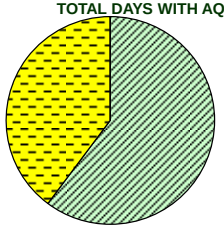
2014 AQI Summary for Detroit - W. Fort Street
TOTAL DAYS WITH AQI VALUES = 365



Good Days - 292
Moderate Days - 71
Unhealthy/Sensitives - 2
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
SO_2 = 256
$PM_{2.5}$ = 108 PM_{10} = 1

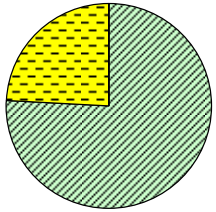
2014 AQI Summary for Detroit - W. Lafayette
TOTAL DAYS WITH AQI VALUES = 357



Good Days - 215
Moderate Days - 142
Unhealthy/Sensitives - 0
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
$PM_{2.5}$ = 357

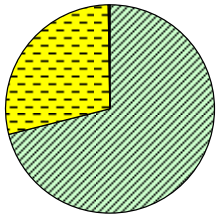
2014 AQI Summary for Wyandotte
TOTAL DAYS WITH AQI VALUES = 120



Good Days - 91
Moderate Days - 29
Unhealthy/Sensitives - 0
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
$PM_{2.5}$ = 120

2014 AQI Summary for Ypsilanti
TOTAL DAYS WITH AQI VALUES = 263



Good Days - 258
Moderate Days - 104
Unhealthy/Sensitives - 1
Unhealthy Days - 0

AQI POLLUTANT SUMMARY
O_3 = 89 $PM_{2.5}$ = 274

Good Days
Moderate Days
Unhealthy/Sensitive Days
Unhealthy Days

Figure C2: AQI Summaries for Lansing-East Lansing-Owosso CSA

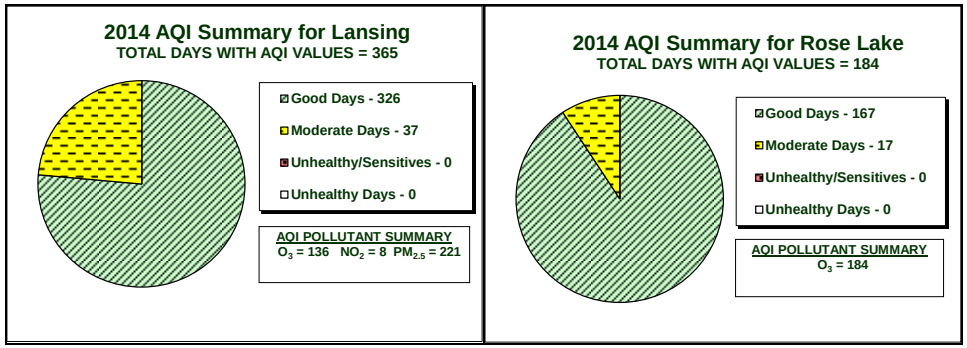


Figure C3: AQI Summary for Saginaw-Bay City-Saginaw Twp North CSA

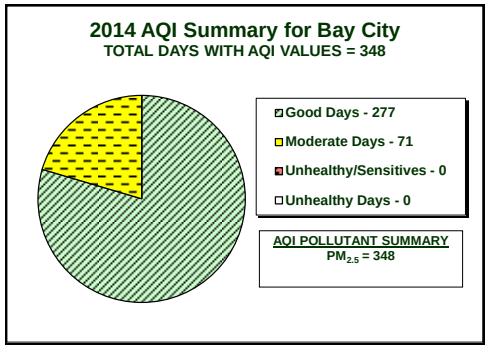
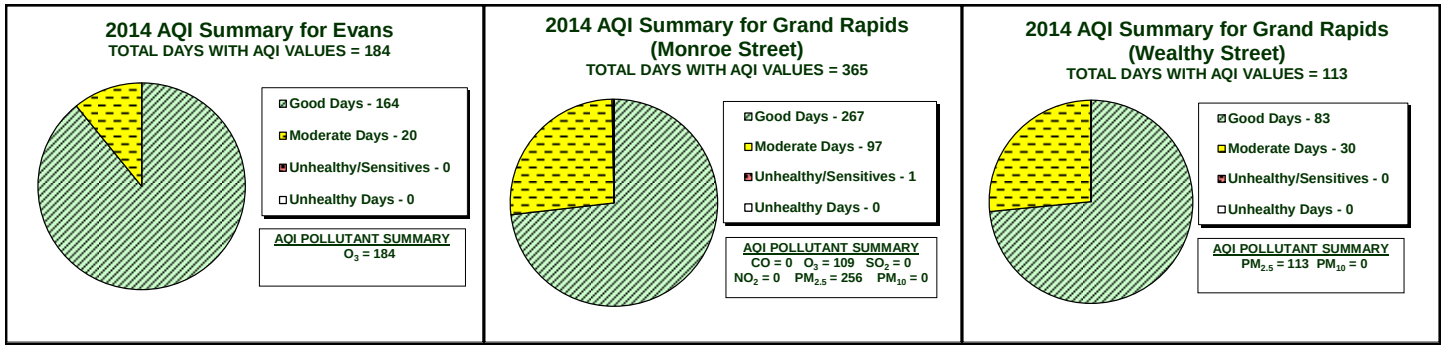


Figure C4: AQI Summaries for Grand Rapids-Muskegon-Holland CSA



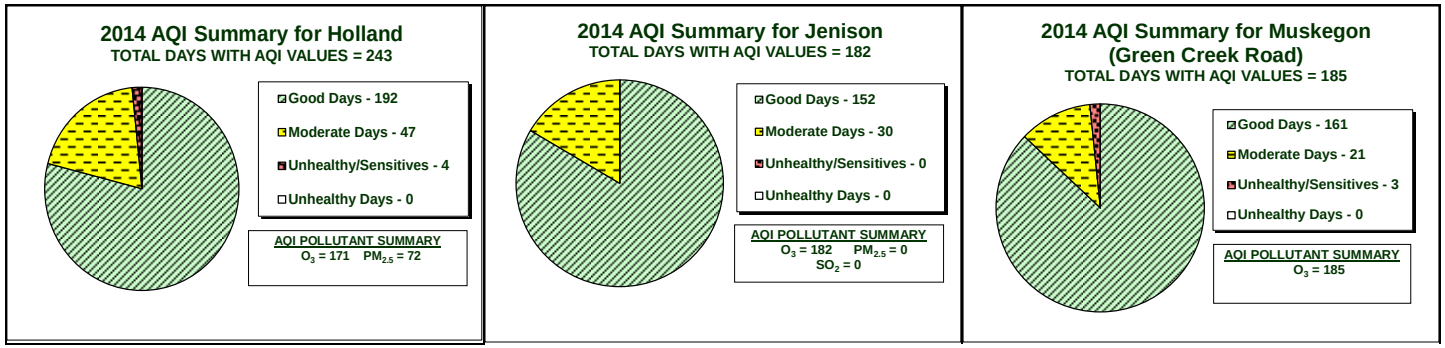


Figure C5: AQI Summary for Upper Peninsula

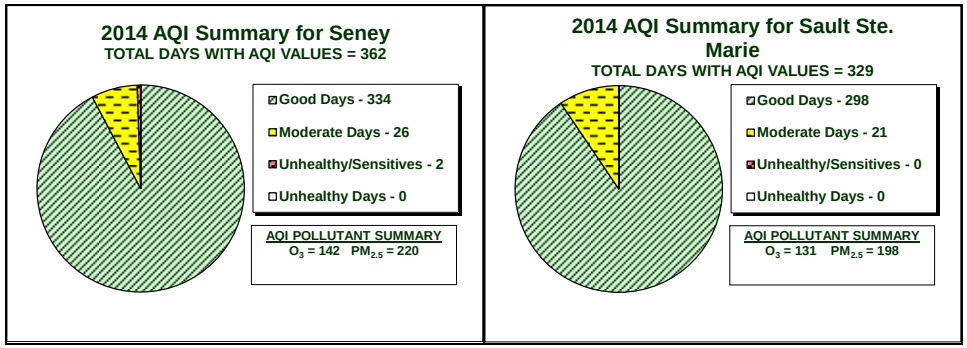
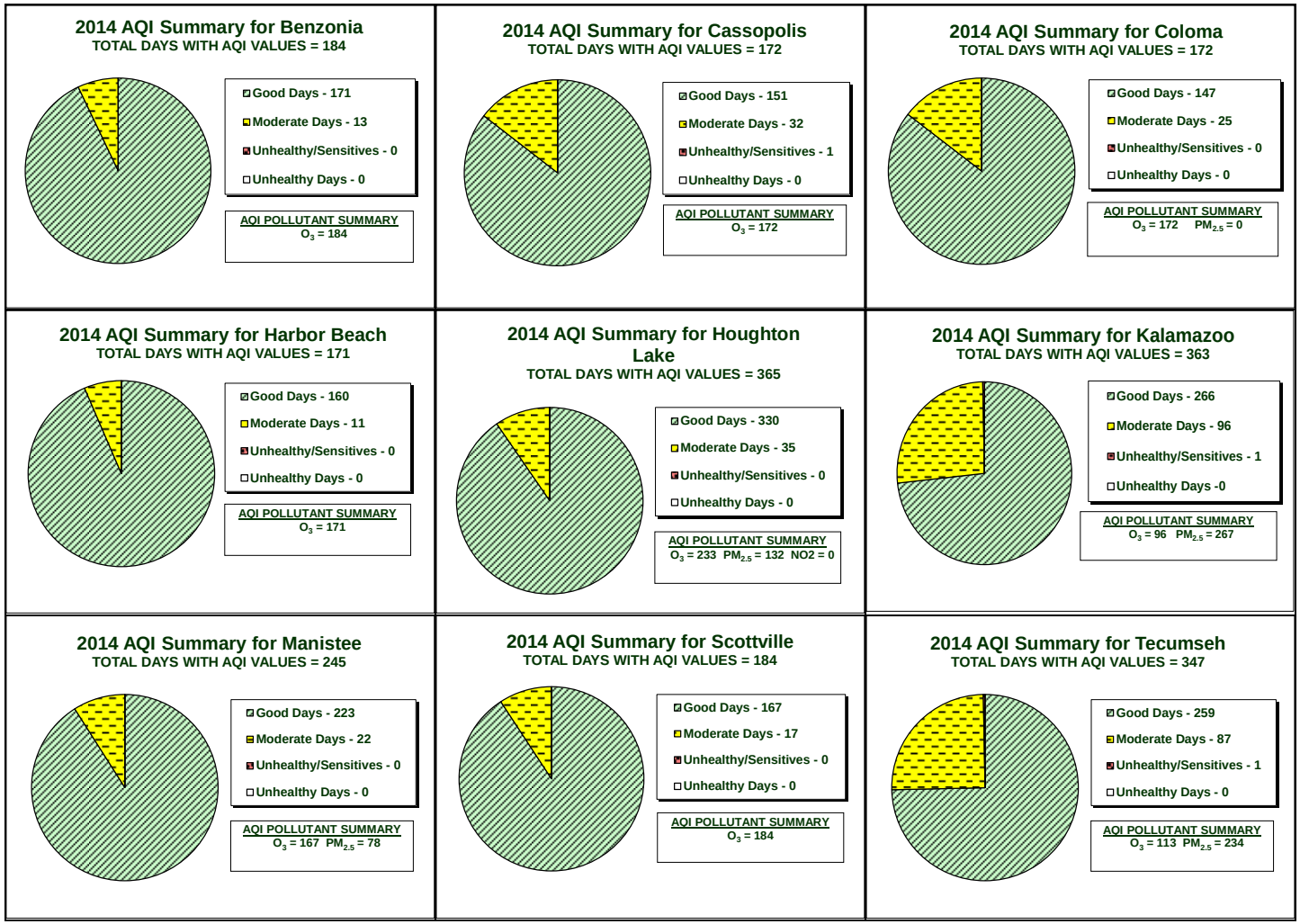


Figure C6: AQI Summaries for Michigan's Other Lower Peninsula Areas



Appendix D: Acronyms and Their Definitions:

>	Greater than
<	Less than
≥	Greater than or equal to
≤	Less than or equal to
%	Percent
$\mu g/m^3$	Micrograms per cubic meter
µm	micrometer
AIRS ID	Aerometric Information Retrieval System Identification Number
AMU	Air Monitoring Unit
AQD	Air Quality Division
AQES	Air Quality Evaluation Section
AQI	Air Quality Index
AQS	Air Quality System (EPA air monitoring data archive)
As	Arsenic
BAM	Beta Attenuation Monitor (hourly $PM_{2.5}$ measurement monitor)
CAA	Clean Air Act
CBSA	Core-Based Statistical Area
Cd	Cadmium
CFR	Code of Federal Regulations
CO	Carbon monoxide
CSA	Consolidated Statistical Area
EC/OC	Elemental carbon/Organic carbon
EPA	U.S. Environmental Protection Agency
FDMS	Filter Dynamic Measurement System
FEM	Federal Equivalent Method
FIA	Family Independence Agency
FR	Federal Register
FRM	Federal Reference Method
HAP	Hazardous Air Pollutant
hr	Hour
Lc	Local Conditions
MASN	Michigan Air Sampling Network
MDEQ	Michigan Department of Environmental Quality
MDL	Method Detection Limit
mg/m^3	Milligrams per meter cubed
MI	Michigan
MiSA	Micropolitan Statistical Area
Mn	Manganese
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standard
NAMS	National Air Monitoring Station
NATTS	National Air Toxics Trend Sites
NCore	National Core Monitoring Sites
ND	Non-detect
NEI	National Emission Inventory
Ni	Nickel

Appendix D: Acronyms and Their Definitions, Continued

NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_X	Oxides of Nitrogen
NO_Y	Oxides of nitrogen + nitric acid + organic and inorganic nitrates
NPAP	National Performance Audit Program
O_3	Ozone
Obs or OBS	Observations
PAH	Polynuclear Aromatic Hydrocarbon
Pb	Lead
PBT	Persistent, Bioaccumulative and Toxic
PCB	Polychorinated biphenyls
PEP	Performance Evaluation Program
PM	Particulate matter
$PM_{2.5}$	Particulate matter with an aerodynamic diameter less than or equal to 2.5 microns
PM_{10}	Particulate matter with a diameter of 10 microns or less
$PM_{10-2.5}$	Coarse PM equal to the concentration difference between PM_{10} and $PM_{2.5}$
PNA	Polynuclear aromatic hydrocarbons
POC	Parameter Occurrence Code
ppb	parts per billion
ppm	parts per million = mg/kg, mg/L, µg/g (1 ppm = 1,000 ppb)
QA	Quality assurance
QAPP	Quality Assurance Project Plan
SASS	Speciation Air Sampling System ($PM_{2.5}$ Speciation Sampler)
SO_2	Sulfur dioxide
SOP	Standard Operating Procedures
STN	Speciation Trend Network ($PM_{2.5}$)
Stp	Standard Temperature and Pressure
SVOC	Semi-Volatile Compound
SWHS	Southwestern High School
TAC	Toxic Air Contaminant
TEOM	Tapered element oscillating microbalance (hourly $PM_{2.5}$ measurement monitor)
tpy	ton per year
TRI	Toxic Release Inventory
TSP	Technical Systems Audit
TSP	Total Suspended Particulate
U.S.	United States
UV	Ultra-violet
VOC	Volatile organic compounds
Vs	Versus

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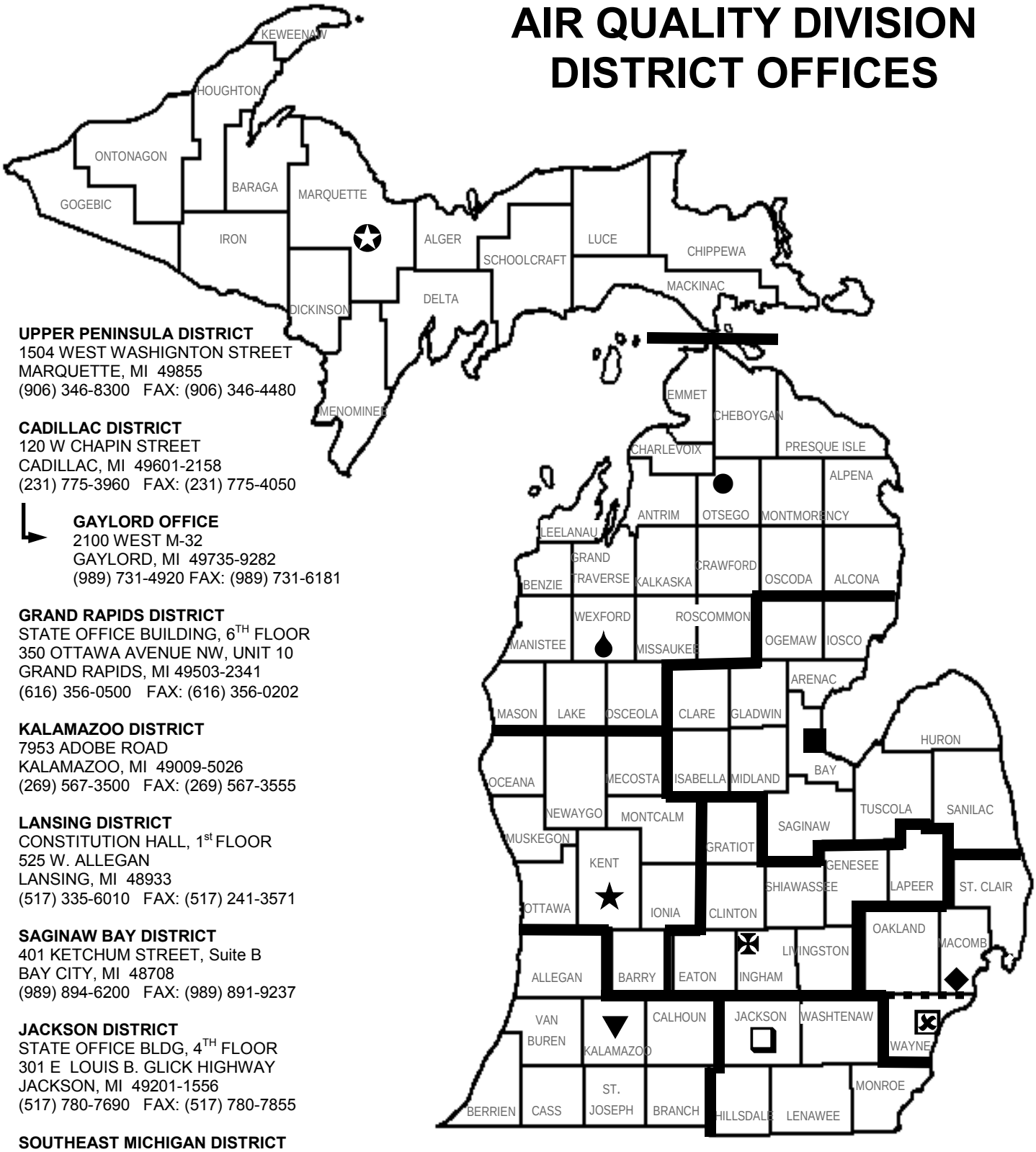
AIR QUALITY DIVISION

AIR QUALITY DIVISION DISTRICT OFFICES



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