MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

AIR QUALITY ANNUAL REPORT

2017

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Air Quality Annual Report

2017

INTRODUCTION

The federal Clean Air Act (CAA) requires the United States Environmental Protection Agency (USEPA) 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 USEPA 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 2017,
- Attainment/nonattainment status,
- Monitoring site locations (tables and maps show all the monitors active in 2017), and
- Air quality trends from 2012-2017 broken down by location.[1]

The 2017 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 2017 air quality data, air quality trends, overview of the monitoring network (available in much greater detail in the 2018 Network Review),[3] air toxics monitoring program, and other AQD programs, such as MIair and the Emissions Inventory.[4]

[1] Air quality trends are based on actual statewide monitored readings, which are also listed in the USEPA's Air Quality Subsystem Quick Look Report Data at www3.epa.gov/airtrends/

[2] An Overview of Michigan Air Toxic Rules is available on the AQD website at www.michigan.gov/deqair (select "Permits," then "Toxics Laws and Rules.")

[3] Available online at www.michigan.gov/documents/deq/deq-aqd-amu-2018_air_monitoring_network_review__565062_7.pdf

[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 www.michigan.gov/deqair (select "Monitoring).

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CHAPTER 1: BACKGROUND INFORMATION

This section summarizes the development of the NAAQS (see Appendix D) and how compliance with these 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 USEPA established a primary and secondary NAAQS for each pollutant for which air quality criteria have been issued. The primary standard is designed to protect the public health with an adequate margin of safety, including the health of the most susceptible individuals in a population, such as children, the elderly, and those with chronic respiratory ailments. Factors in selecting the margin of safety for the primary standard include the nature and severity of the health effects involved and the size of the sensitive population at risk. Secondary standards are chosen to protect public welfare (personal comfort and well-being) and the environment by limiting economic damage, impacts on visibility and climate, and 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, NO_2, PM, O_3, and SO_2. **Table 1.1** lists the primary and secondary NAAQS, averaging time and concentration level for each criteria pollutant in effect in 2017. The concentrations are listed as parts per million (ppm), micrograms per cubic meter ($\mu g/m^3$), and/or milligrams per cubic meter (mg/m^3).

Table 1.1: NAAQS in Effect during 2017 for Criteria Pollutants

Pollutant	Primary (health) Level	Primary Averaging Time	Secondary (welfare) Level	Secondary Averaging Time
Carbon Monoxide (CO) 8-hour average	9 ppm (10 mg/m^3)	8-hour average, not to be exceeded more than once per year *(1971)*	None*	None*
Carbon Monoxide (CO) 1-hour average	35 ppm (40 mg/m^3)	1-hour average, not to be exceeded more than once per year *(1971)*	None*	None*
Lead (Pb)	0.15 µg/m^3	Maximum rolling 3-month average *(2008)*	Same as Primary	Same as Primary
Nitrogen Dioxide (NO_2) Annual mean	0.053 ppm (100 µg/m^3)	Annual mean *(1971)*	Same as Primary	Same as Primary
Nitrogen Dioxide (NO_2) 1-hour average	0.100 ppm	98th percentile of 1-hour average, averaged over 3 years *(2010)*	None	None
Particulate Matter (PM_{10})	150 µg/m^3	24-hour average, not to be exceeded more than once per year over 3 years *(1987)*	Same as Primary	Same as Primary
Particulate Matter ($PM_{2.5}$) Annual average	12.0 µg/m^3	Annual mean averaged over 3 years *(2012)*	15.0 µg/m^3	Annual mean
Particulate Matter ($PM_{2.5}$) 24-hour average	35 µg/m^3	98th percentile of 24-hour concentration, averaged over 3 years *(2006)*	Same as Primary	Same as Primary
Ozone (O_3)	0.070 ppm	Annual 4th highest 8-hour daily max averaged over 3 years *(2015)*	Same as Primary	Same as Primary
Sulfur Dioxide (SO_2)	0.075 ppm	99th percentile of 1-hour daily max averaged over 3 years *(2010)*	0.5 ppm	3 hours

*****In 1985, the USEPA 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 USEPA 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 three consecutive months are averaged and do not exceed the 0.15 $\mu g/m^3$ standard.
NO_2	Compliance is met when the annual arithmetic mean concentration does not exceed the 0.053 ppm standard and the 98^{th} percentile* of the daily maximum 1-hour concentration averaged over 3 years does not exceed 100 ppb.
PM_{10}	The 24-hour PM_{10} primary and secondary standards are met when 150 $\mu g/m^3$ 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 $\mu g/m^3$ and 15 $\mu g/m^3$, respectively. The 24-hour $PM_{2.5}$ primary and secondary standards are met when the 3-year average of the 98^{th} percentile** 24-hour concentration is less than or equal to 35 $\mu g/m^3$.
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 0.070 ppm.
SO_2	To determine compliance, the 99^{th} 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 USEPA'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 USEPA in July.

[5] Most recent Network Reviews are available online at:
https://www.michigan.gov/deq/0,4561,7-135-3310_70316_4195---,00.html

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 handled by the Little River Band of Ottawa Indians and the Inter-tribal Council of Michigan, respectively. **Figure 1.1** shows the 2017 MASN monitoring sites. **Figures 1.2** and **1.3** are pictures of two monitoring stations; one at Seney and the other at Livonia Roadway, respectively.

The MASN consists of federal reference method (FRM) monitors that enable continuous monitoring for the gaseous pollutants CO, $NO_{2,}$ O_3, 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. $PM_{2.5}$ 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**). The types of monitoring conducted in 2017 and the MASN locations are shown in **Table 1.3.**

The **NCore network** began January 1, 2011, as part of the USEPA'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 is provided in **Chapters 2** through **7**.

The **Near-road Monitoring Network** focuses on vehicle emissions and how they disperse near roadways. In 2011 Michigan took over the USEPA's pre-existing near-roadway site at Eliza Howell Park in Detroit. A second near-road site was added in Livonia in January 2015. Data from these sites are presented in **Chapters 2** and **5.**

Figure 1.1: 2017 MASN Monitoring Sites

Figure 1.2: Seney Monitoring Site

Figure 1.3: Livonia Roadway Monitoring Site

Table 1.3 Types of Monitoring Conducted in 2017 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-E. 7 Mile		√		√		√								√	√		√
	261630025	Livonia						√											
	261630027	Detroit-W. Jefferson													√@				
	261630033	Dearborn					√	√	√	√+EA			√	√	√ + Pb	√	√		√
	261630036	Wyandotte						√											
	261630039	Detroit-W. Lafayette						√	√							√			
	261630093	Eliza Howell-Roadway	√	√		√										√			
	261630094	Eliza Howell-Downwind	√	√		√										√	√		√
	261630095	Livonia-Roadway	√	√				√								√	√		√
	261630097	NMH 48217							√		√		√		√ + Pb				
Flint	260490021	Flint				√		√	√							√			√
	260492001	Otisville				√										√			
Grand Rapids	261390005	Jenison				√										√			
	261390011	West Olive									√					√			
	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						√	√							√			
Missaukee Co	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				

√ = Data Collected
\# = Mn only
@ = Mn, As, Cd, Ni
Pb = Lead
$ = 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 the 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. The quality assurance checks and audits are reported to the USEPA each quarter.

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

Long-term Trends

Congress passed the 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 USEPA is required to review the criteria pollutant standards every five years. Over time, based upon toxicological data, the standards (NAAQS) have been tightened to better protect public health (see Appendix D). 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." The tightening standards are 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 **1.9.** These figures show how the ambient levels and the standards for these pollutants have changed over the last 35-plus years. Since Southeast Michigan is highly industrialized, it is a good indicator of the air quality improvement for the rest of the state.

Figure 1.4: Historical Ozone at the DEQ's Detroit E. 7 Mile Site shows the ozone levels at the Detroit E. 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 and to 0.070 ppm at the end of 2015.

Figure 1.4: Historical 1-hour and 8-hour Ozone at E. 7 Mile

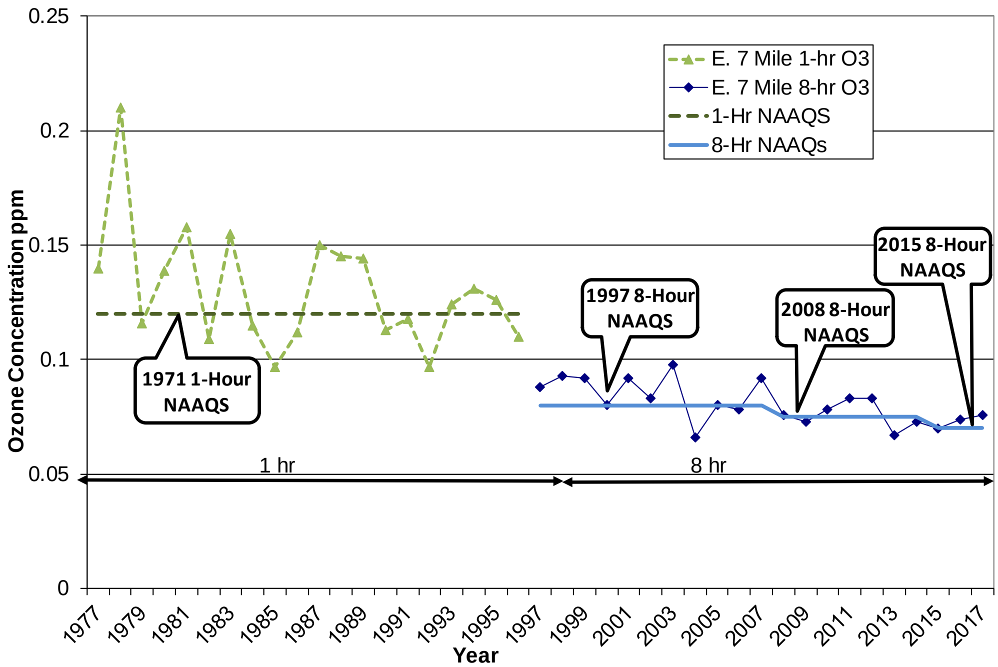


Figure 1.5: Historical Annual and 1-hour SO_2 Averages at Detroit–W. Fort Street (SWHS)
This figure shows the SO_2 trend for the old annual standard and the new 1-hour standard for W. Fort Street (Southwest High School [SWHS]) in Detroit. In 2010, the USEPA changed the standard from an annual average 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 W. Fort St.

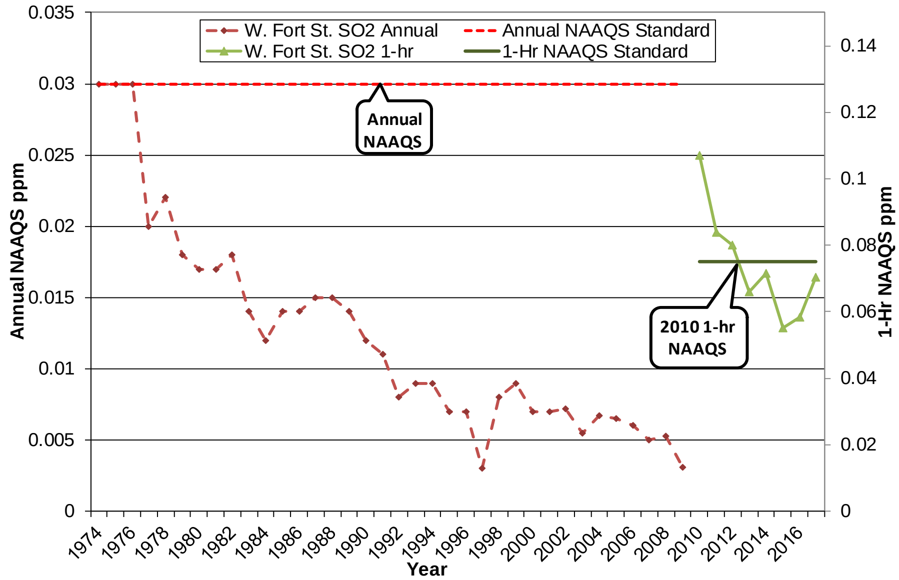


Figure 1.6 shows the CO trend at Allen Park to be well below the 1-hour standard of 35 ppm, which has not changed since 1971.

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

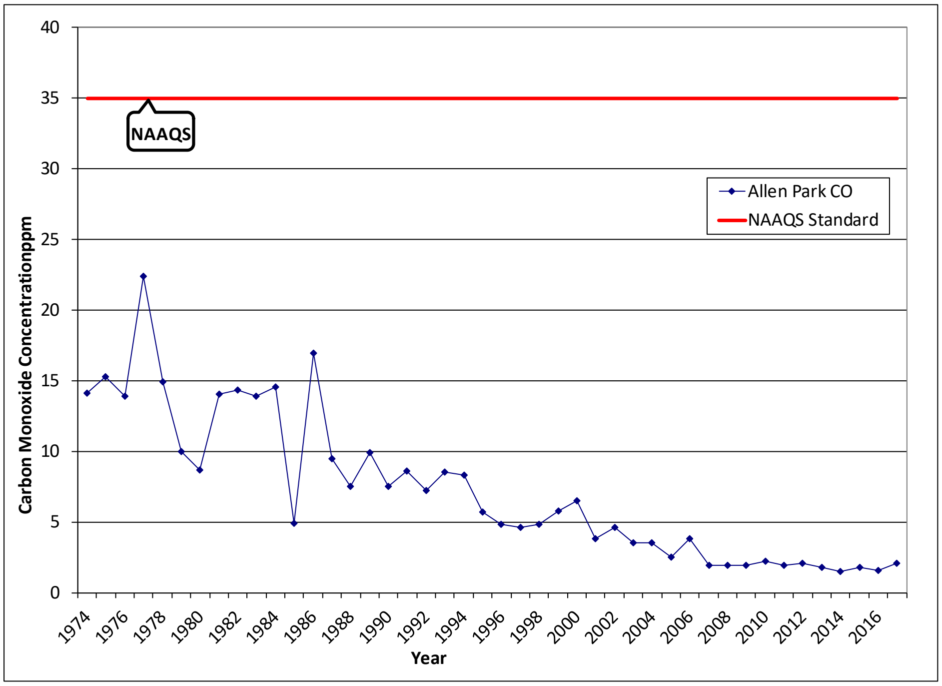


Figure 1.7 shows the trend for lead at Dearborn. Lead (Pb) is of concern because it is harmful to the neurological development of children. The largest decrease in Pb in the air is due to the removal of Pb in gasoline. By 1975, most newly manufactured vehicles no longer required leaded gasoline, and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

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

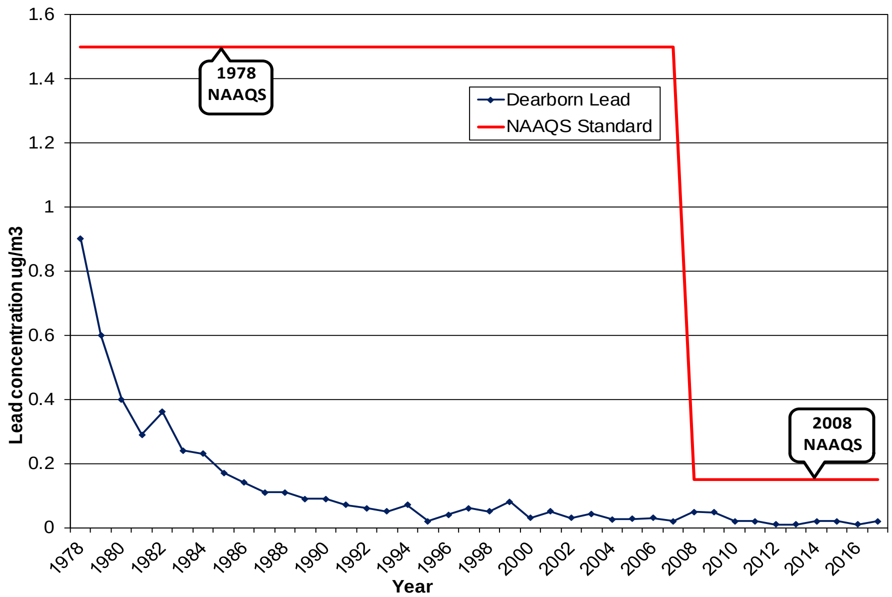


Figure 1.8 shows the trend for NO_2, which has been well below the annual standard of 53 ppb and shows a downward trend. In 2010, the USEPA added a 1-hour standard of the 98th percentile not to exceed 100 ppb averaged over 3 years. One-hour NO_2 concentrations in Michigan have also remained well below the standard.

Figure 1.8: Historical Annual and 1-hour NO_2 at E. 7 Mile Road.

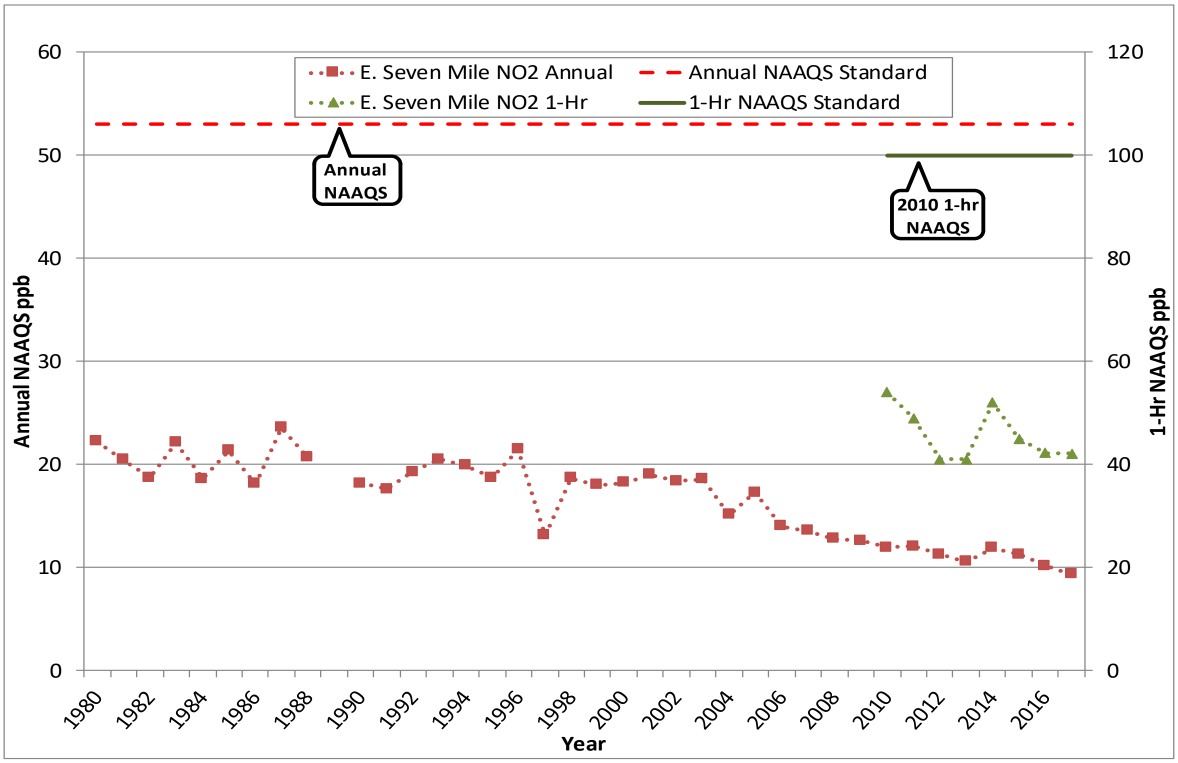
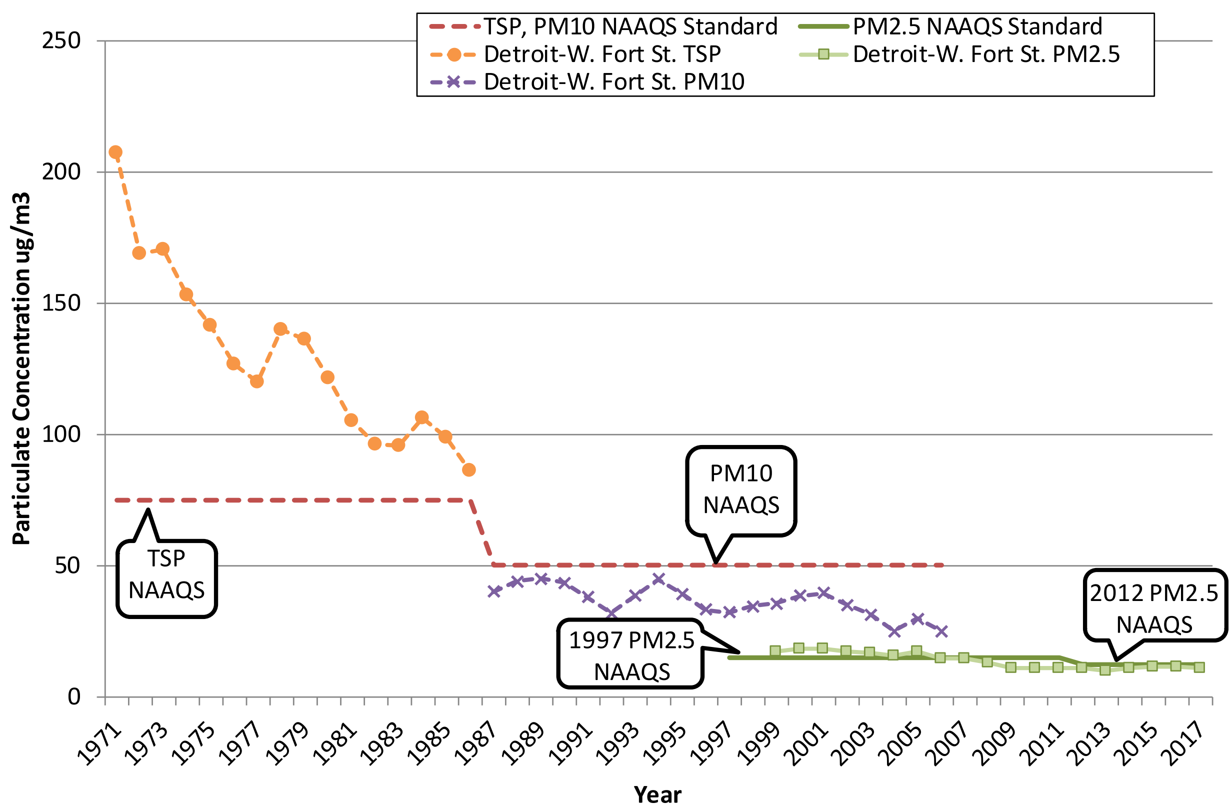


Figure 1.9 shows the trends for particulate matter. In 1971, the USEPA promulgated an annual and 24-hour particulate standard based on total suspended particulates (TSP). In 1987, the USEPA changed the standard to PM_{10}. Health studies indicated that particles smaller than 10 microns affect respiration. In 1997, the USEPA added additional NAAQS for a smaller particle fraction size, $PM_{2.5}$, which can get deeper into the lungs and possibly into the blood stream. In 2006, the USEPA revoked the PM_{10} annual standard but kept the PM_{10} 24-hour standard. The $PM_{2.5}$ 24-hour standard was also reduced from 65 µg/m^3 to 35 µg/m^3. In 2012, the USEPA again reduced the annual standard from 15 µg/m^3 to 12 µg/m^3. Particulate trends show that particulate concentrations have decreased, and the state is in compliance for all particulate NAAQS; however, Michigan has had past nonattainment issues in Southeast Michigan for TSP, PM_{10} and $PM_{2.5}$.

Figure 1.9: Historical Annual Particulate Matter at W. Fort St. (SWHS).



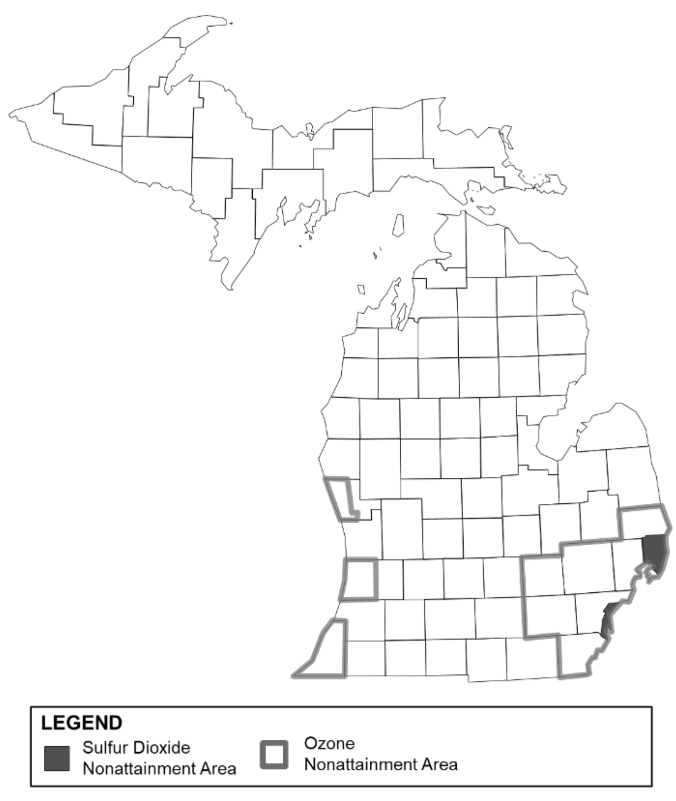
Current Attainment Status

Areas of the state that are below the NAAQS concentration level are called attainment areas. The entire state of Michigan is in attainment for the following pollutants:

- CO
- Pb
- NO_2
- Particulate Matter

Nonattainment areas are those that have concentrations over the NAAQS level. Portions of the state are in nonattainment for SO_2 and O_3 (see map). Nonattainment status for O_3 will be effective in late summer of 2018.

Figure 1.10: Attainment Status for the National Ambient Air Quality Standards



CHAPTER 2: CARBON MONOXIDE (CO)

Carbon monoxide is a gas formed during incomplete burning of fuel. CO is colorless, odorless, and tasteless, and is lethal at elevated concentrations. Levels peak during colder months primarily due to cold temperatures that affect combustion efficiency of engines. The CO NAAQS is 9 ppm for the second highest 8-hour average and 35 ppm for the second highest 1-hour average. Its sources and effects are provided below.

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, fetuses, 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 location of each CO monitor that operated in 2017. The Eliza Howell Park and Livonia sites are required under the Near-roadway Network. A second downwind site at Eliza Howell Park provides a comparison to the near-roadway sites. The other two sites, Grand Rapids and Allen Park, are where CO (lower detection levels 1 ppm-50 ppm) is being monitored as part of the NCore Network.

Figure 2.1: Carbon Monoxide (CO) Monitors in 2017

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

Figure 2.2: CO Emissions by Source Sector

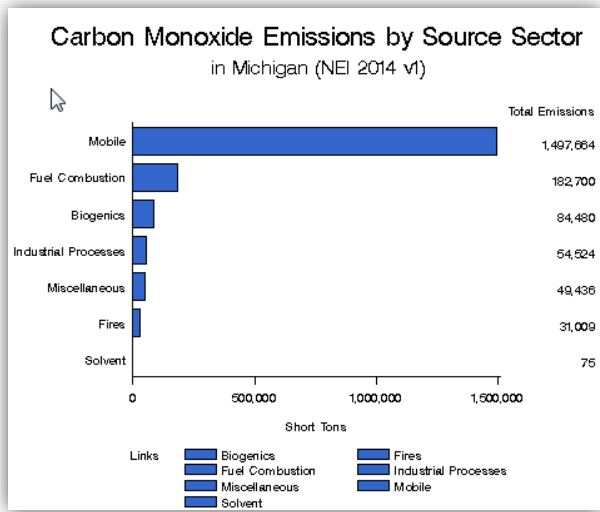
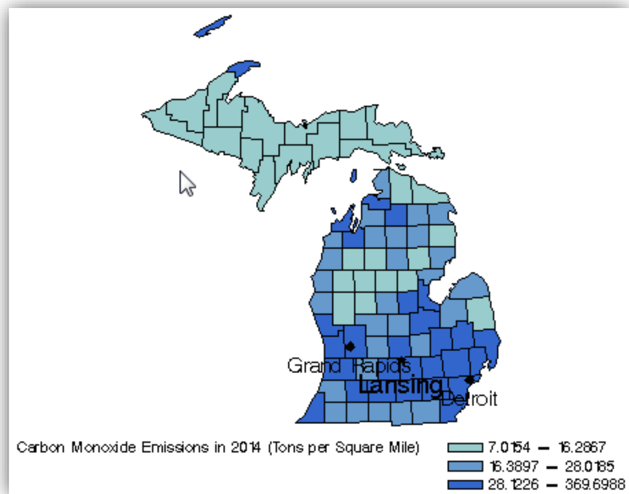
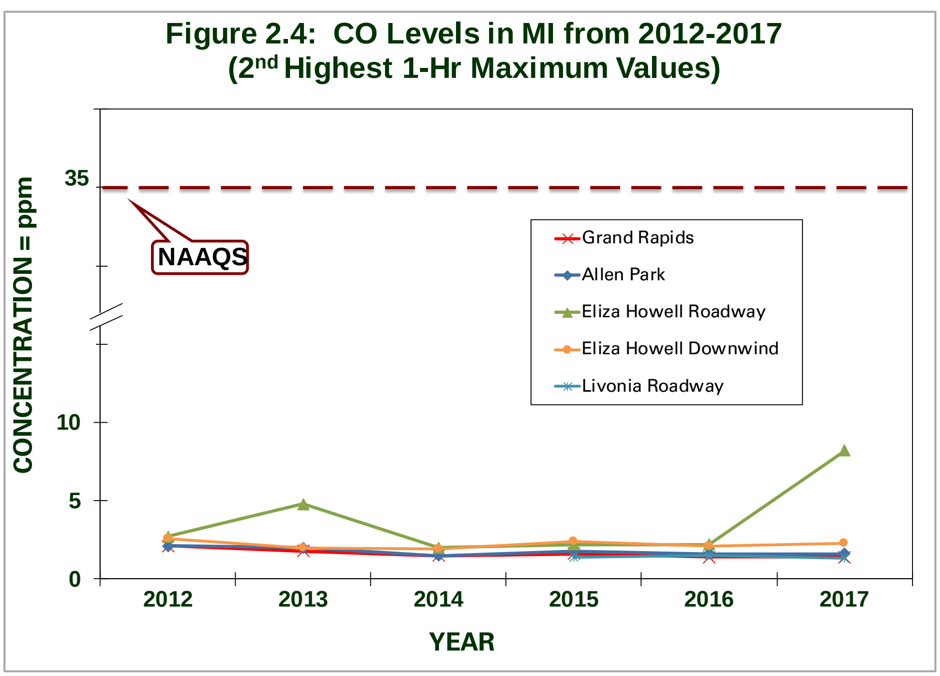


Figure 2.3: CO Emissions in 2014



Near-roadway Monitoring: On August 31, 2011, the USEPA 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 USEPA's pre-existing, near-roadway sites at Eliza Howell Park, Detroit in June 2011. In January 2015, the second required near-road site started sampling in Livonia.

Figure 2.4 shows the maximum second highest 1-hour CO level trends for Michigan from 2012-2017, 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 USEPA lowered the Pb NAAQS from a maximum quarterly average of 1.5 µg/m^3 to a 3-month rolling average of 0.15 µg/m^3. Its sources and effects are presented below.

Sources: With the phase-out of leaded gas in the 1970s, the major sources of Pb emissions have been due to ore and metals processing and piston-engine aircraft operating on leaded aviation fuel. Other industrial sources include Pb acid battery manufacturers, waste incinerators, and utilities. The highest air concentrations of Pb 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 nervous system as well as the cardiovascular system, reproductive system, blood, kidneys and other organs.

Population most at risk: Fetuses and children are most at risk since low levels of Pb may cause central nervous system damage. Excessive Pb exposure during the early years of life is associated with lower IQ scores and neurological impairment (seizures, mental develop-ment, 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: Lead (Pb) Monitors in 2017

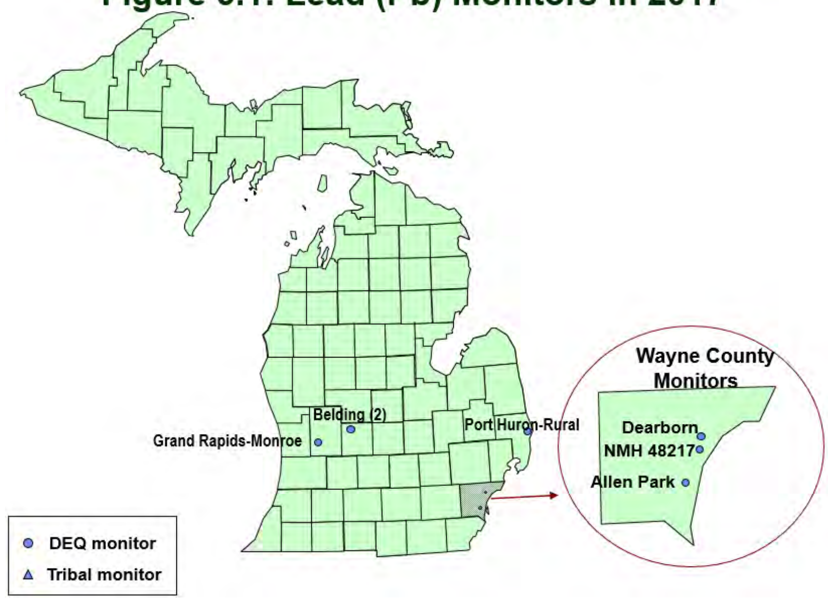


Figure 3.1 shows the location of the Pb monitors in the MASN in 2017.

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

Figure 3.2: Pb Emissions by Source Sector

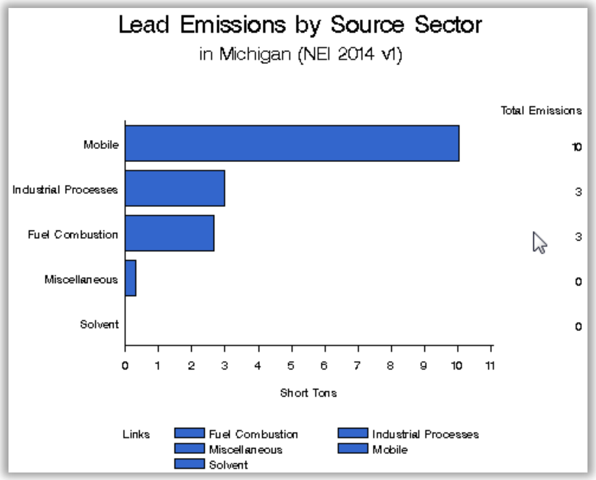
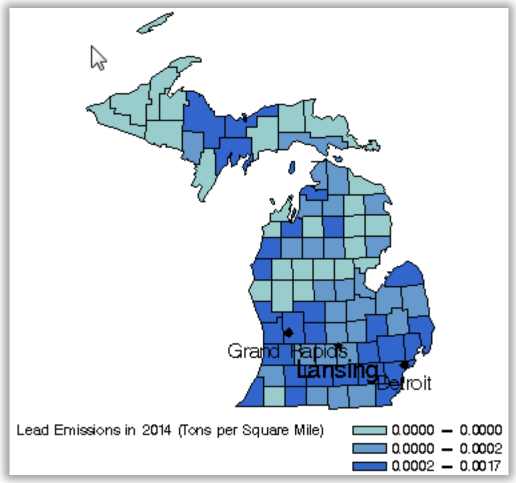


Figure 3.3: Pb Emissions in 2014



On November 12, 2008, the USEPA 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.

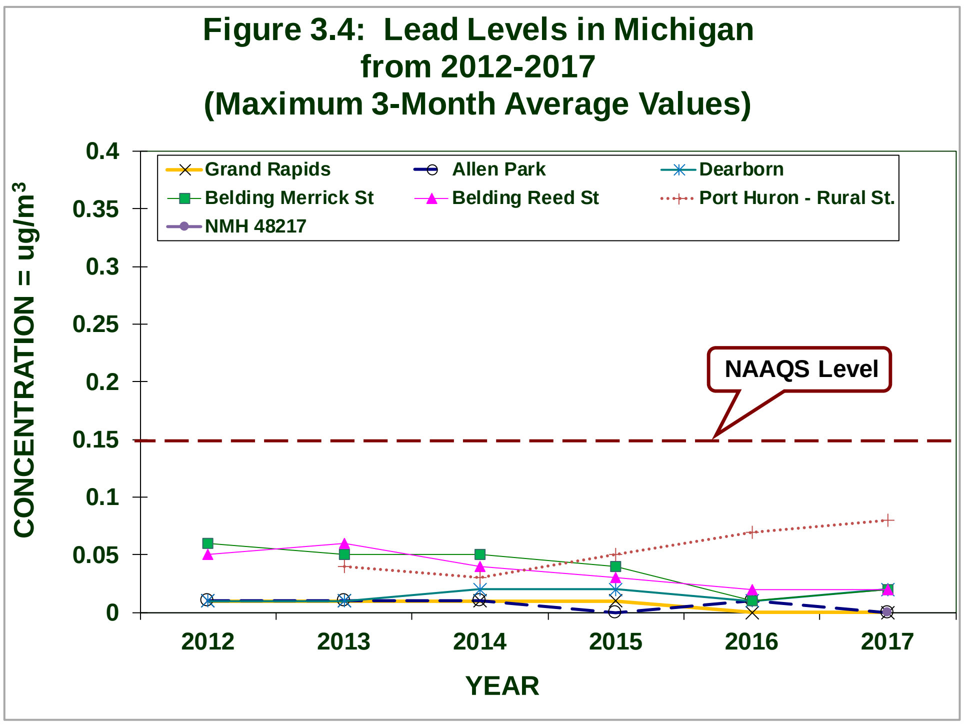


Figure 3.4 shows the maximum 3-month rolling average values for Pb from 2012 to 2017. As part of the 2008 Pb NAAQS, the DEQ is required to monitor near stationary Pb sources emitting more than 1/2 ton per year. The DEQ currently has three point-source Pb monitoring sites: Rural St. in Port Huron (started November 2012), Merrick St. in Belding (started January 2010), and Reed St. in Belding (started July 2011). The two sites in Belding previously were above the standard, but values for both the sites have been below the NAAQS for the past five years. Belding was predesignated to attainment on July 31, 2017.

All Pb monitor sites in Michigan are 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 USEPA 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 that cannot exceed 0.5 ppm once per year. Its sources and effects are presented below.

Sources: Coal-burning power plants are the largest source of SO_2 emissions. Other sources include industrial processes such as extracting metal from ore, and non-road transportation sources, and natural sources such as volcanoes. SO_2 and particulate matter are often emitted together.

Effects: Exposure to elevated levels can aggravate symptoms in asthmatics and cause respiratory problems in healthy groups as well. SO_2 and NOx 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 on the concentration, SO_2 may also cause symptoms in people who do not have asthma.

Figure 4.1: Sulfur Dioxide (SO_2) Monitors in 2017

Figure 4.1 shows the location of each SO_2 monitor that operated in 2017. The two NCore sites, Allen Park and Grand Rapids, have trace SO_2 monitors that have lower detection limits than traditional SO_2 monitors.

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

Figure 4.2: SO_2 Emissions by Source Sector

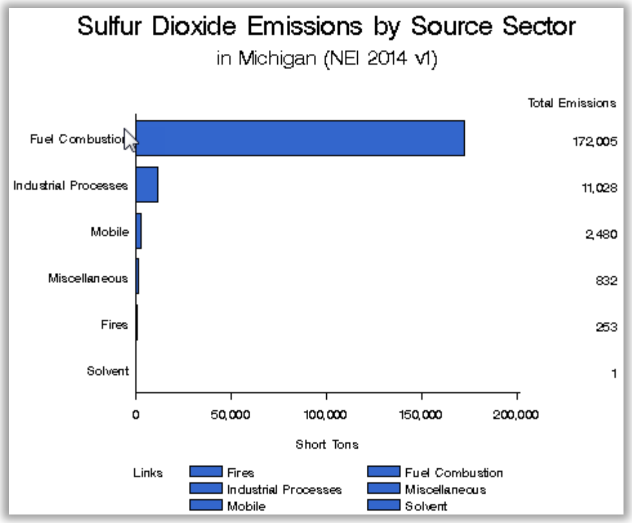
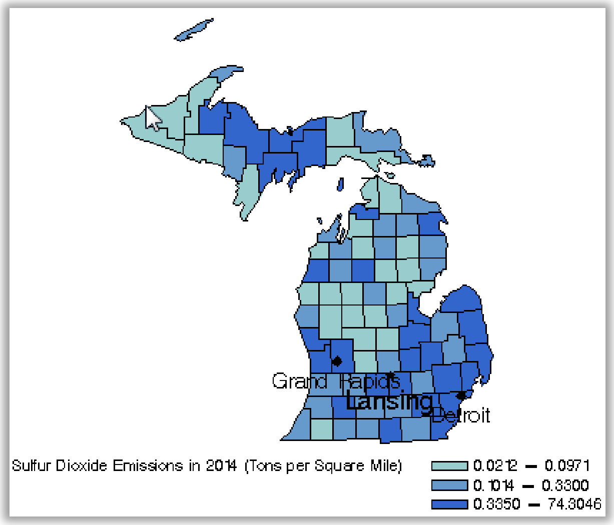


Figure 4.3: SO_2 Emissions in 2014



Historically, Michigan had been in attainment for SO_2 since 1982 with levels consistently well below the annual SO_2 NAAQS. However, in 2010, the USEPA changed the SO_2 NAAQS to a 1-hour standard, which showed that the SO_2 monitor at W. Fort Street (SWHS) in Detroit did not meet the new NAAQS. SO_2 concentrations have decrease at this site and are currently under the NAAQS, although modeling concentrations are not below the NAAQS. In September 2016, a portion of St. Clair County was also designated as nonattainment by the USEPA based on emissions and modeling (see **Figure 1.10**).

The NCore sites, Grand Rapids and Allen Park, monitor for trace SO_2. For trend purposes, all SO_2 data are 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 later moved to West Olive, where it started sampling in January 2015.

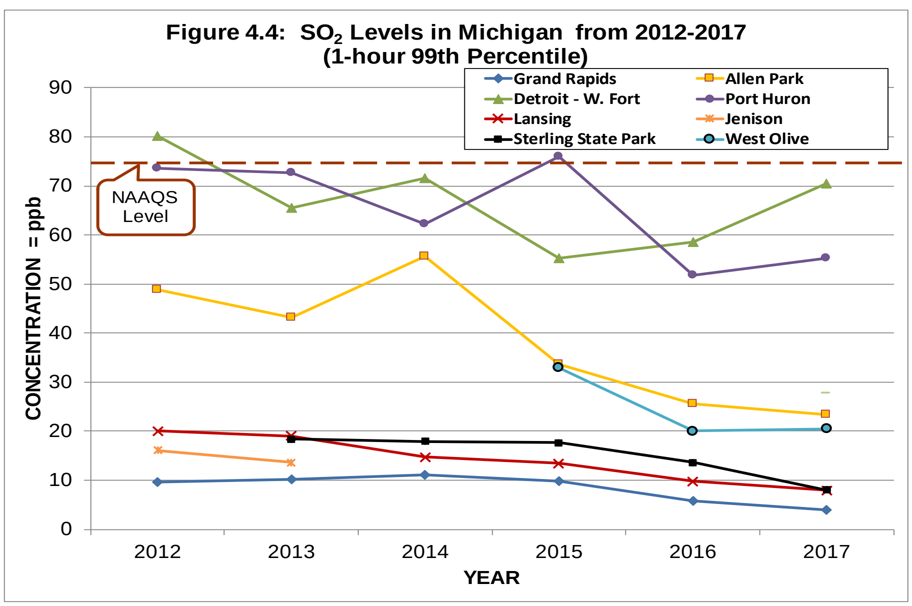


Figure 4.4: SO_2 Levels in Michigan from 2012-2017 (1-hour 99th Percentile)

CHAPTER 5: NITROGEN DIOXIDE (NO_2)

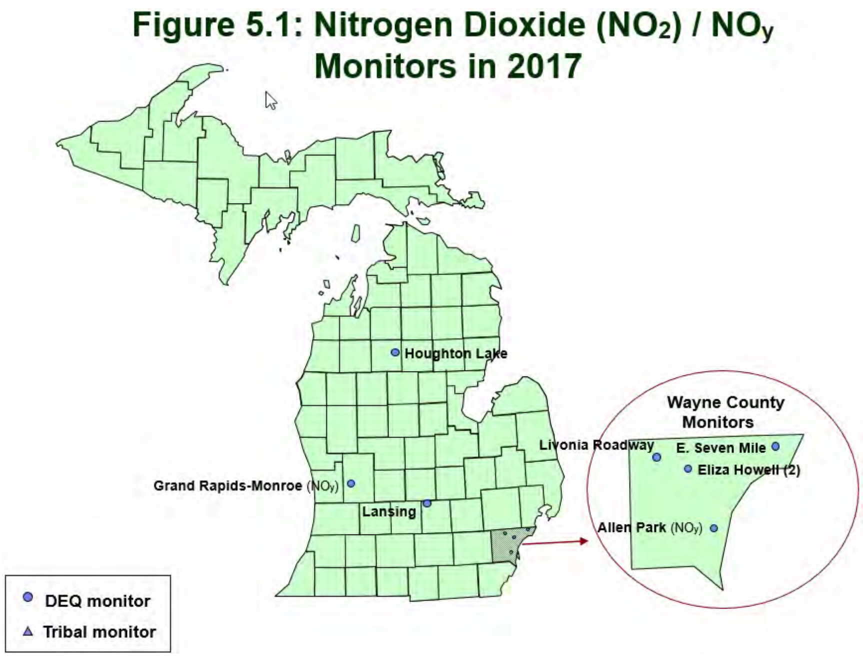
Nitrogen dioxide is a reddish-brown, highly reactive gas formed through oxidation of nitric oxide (NO). Upon dilution, it becomes yellow or invisible. High concentrations produce a pungent odor and lower levels have an odor similar to bleach. NO_X is the term used to describe the sum of NO, NO_2, and other nitrogen oxides. NO_X can lead to the formation of O_3 and NO_2 and can react with other substances in the atmosphere to form particulate matter or acidic products that are deposited in rain (acid rain), fog, or snow. Since 1971, the primary and secondary standard for NO_2 was an annual mean of 0.053 ppm. In January 2010, the USEPA added a 1-hour NO_2 standard of 100 ppb, taking the form of the 98^{th} percentile averaged over three years. The sources and effects of NO_2 are as follows:

Sources: NO_X compounds and their transformed 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. The 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.

Figure 5.1 shows the location of all NO_2 monitors that operated in 2017. The E. 7 Mile monitor in Detroit is a downwind urban scale site that measures NO_2. The Detroit Eliza Howell (roadway and downwind sites) and Livonia sites measure NO_2 in a near-road environment. The NCore sites, Grand Rapids and Allen Park, monitor 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.



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

Figure 5.2: NO_2 Emissions by Source Sector

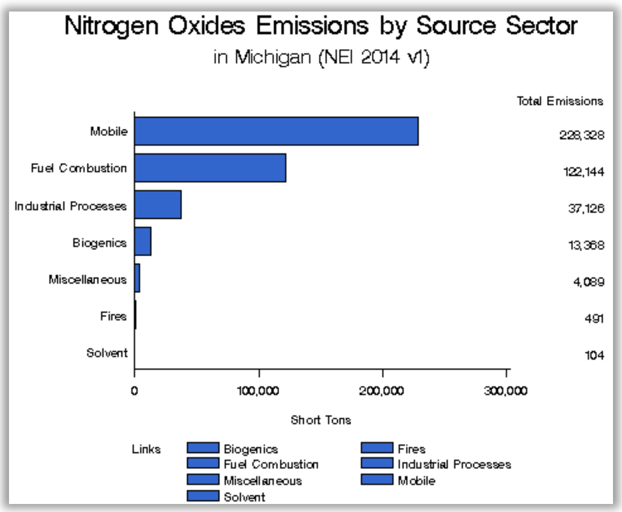
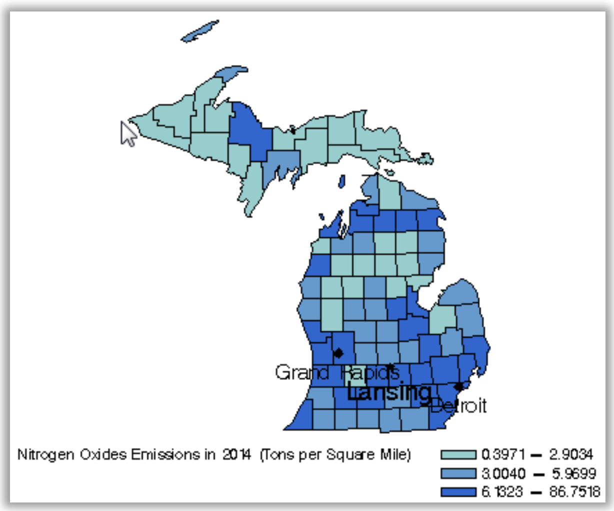
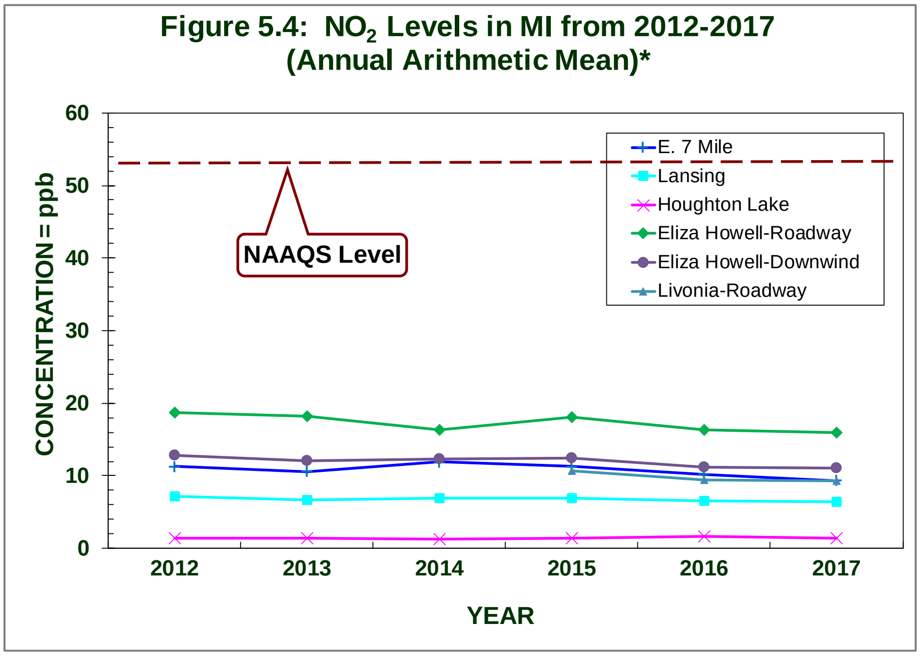


Figure 5.3: NO_2 Emissions in 2014



Michigan's 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, when the USEPA lowered the NO_2 NAAQS in 2010, they designated Michigan as unclassifiable/attainment, since the existing NO_2 network did not provide adequate evidence that the NAAQS was met in all areas; however, there were no violations of the NO_2 standard. Thus, unclassifiable/attainment better reflects the current air quality conditions.

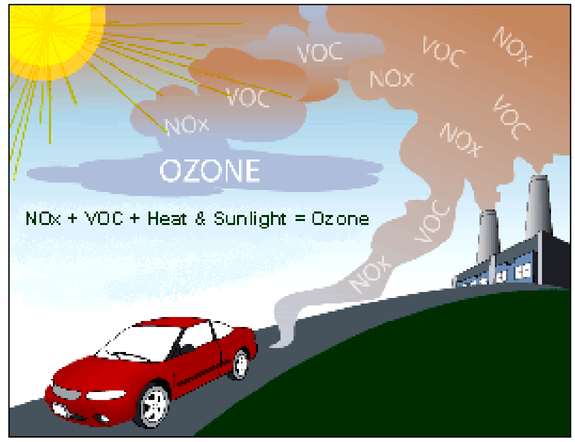


*Since Allen Park and Grand Rapids are monitoring NO_Y, those sites are not included in graph.

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 USEPA). 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 USEPA and became effective in November 2015. It is a 3-year average of the 4th highest daily maximum 8-hour average concentration that must not exceed 0.070 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 all O_3 air quality monitors active in Michigan at the beginning of the 2017 ozone season.

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

Figure 6.1: Ozone Monitors in 2017

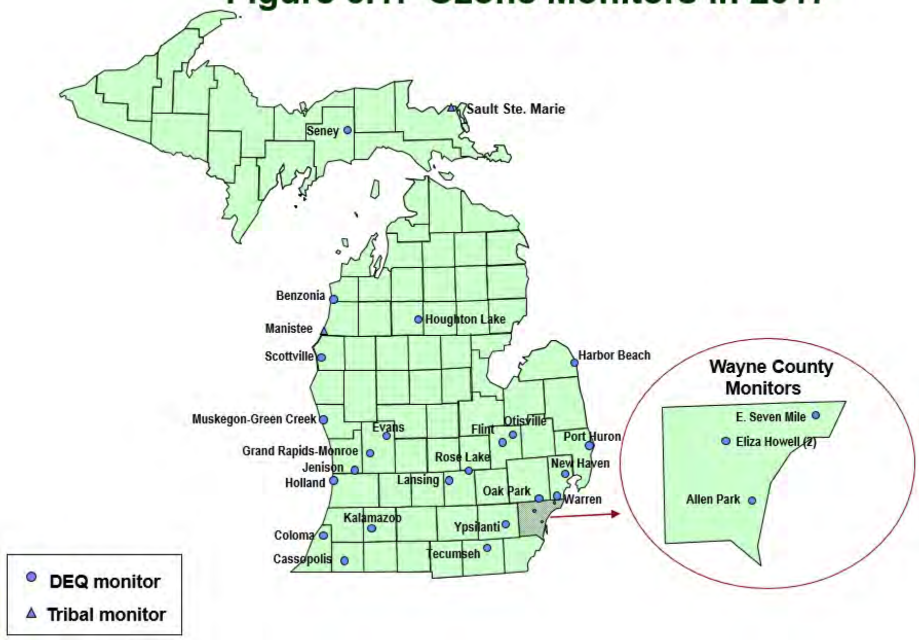


Figure 6.2: VOC Emissions by Source Sector

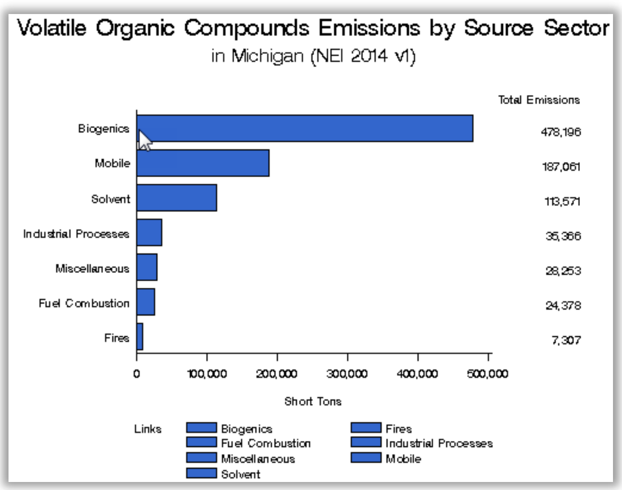
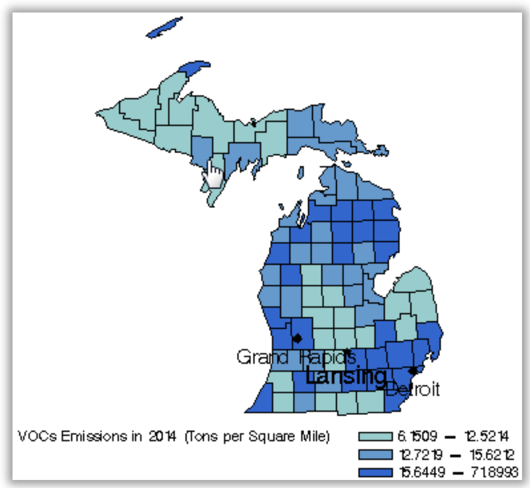


Figure 6.3: VOC Emissions in 2014



The USEPA revised the primary 8-hour ozone NAAQS to 0.070 ppm in November 2015, which became effective for the 2016 ozone season. To attain the 2015 standard, the 3-year average of the 4th highest daily maximum 8-hour average concentration within an area must not exceed 0.070 ppm. The secondary 8-hour ozone NAAQS was also revised, making it identical to the primary standard.

In 2017, several monitors violated the 2015 standard of 0.070 ppm. The AQD has recommended several counties be designated as nonattainment. The USEPA made their final designations for the 2015 standard on April 30, 2018, which will be effective August 3, 2018. Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw and Wayne Counties were designated nonattainment in Southeast Michigan, and all of Berrien County, and portions of Allegan and Muskegon Counties were designated nonattainment.

The O_3 monitoring season in Michigan was from April 1 through September 30, the hottest portion of the year. In 2017, the ozone season was extended to March 1 through October 31, based on the 2015 NAAQS. During this time O_3 monitoring data is available for the public via the AQD's website (discussed in **Chapter 9**). However, year-round O_3 monitoring is conducted at the following four sites: Allen Park, Grand Rapids, Houghton Lake, and Lansing. This data helps in attainment designations, and urban air quality and population exposure assessments.

Table 6.1: 3-Year Average of the 4th Highest 8-hour Ozone Values from 2013-2015, 2014-2016, 2015-2017 (concentrations in ppm).

Numbers in bold indicate 3-year averages over the 2015 ozone standard of 0.070 ppm for 2014-2016 and 2015-2017, for 2013-2015 bold numbers indicate values below 0.075 ppm.

Areas	County	Monitor Sites	2013-2015*	2014-2016*	2015-2017*
Detroit-Ann Arbor	Lenawee	Tecumseh	0.065	0.067	0.066
	Macomb	New Haven	0.071	**0.072**	0.066
		Warren	0.066	0.067	0.064
	Oakland	Oak Park	0.066	0.069	0.069
	St. Clair	Port Huron	0.072	**0.073**	0.067
	Washtenaw	Ypsilanti	0.066	0.067	0.068
	Wayne	Allen Park	0.064	0.065	0.067
		Detroit-E. 7 Mile	0.070	**0.072**	**0.076**
Flint	Genesee	Flint	0.066	0.068	0.064
		Otisville	0.067	0.069	0.063
Grand Rapids	Ottawa	Jenison	0.068	0.070	0.065
	Kent	Grand Rapids	0.067	0.069	0.064
		Evans	0.066	0.067	0.066
Muskegon Co	Muskegon	Muskegon	0.074	**0.075**	**0.074**
Allegan Co	Allegan	Holland	0.075	**0.075**	**0.071**
Huron	Huron	Harbor Beach	0.065	0.068	0.064
Kalamazoo-Battle Creek	Kalamazoo	Kalamazoo	0.067	0.069	0.068
Lansing-East Lansing	Ingham	Lansing	0.065	0.067	0.066
	Clinton	Rose Lake	0.064	0.067	0.062
Benton Harbor	Berrien	Coloma	0.073	**0.074**	0.069
Benzie Co	Benzie	Benzonia	0.068	0.069	0.065
Cass Co	Cass	Cassopolis	0.068	0.070	**0.072**
Chippewa Co	Chippewa	Sault Ste. Marie	0.059	0.059	0.051
Mason Co	Mason	Scottville	0.068	0.070	0.064
Missaukee Co	Missaukee	Houghton Lake	0.064	0.067	0.062
Manistee Co	Manistee	Manistee	0.067	0.068	0.065
Schoolcraft Co	Schoolcraft	Seney	0.068	0.070	0.056

* Only 2014-2016 and 2015-2017 data are subject to the 2015 NAAQS level of 0.070 ppm; the previous year's level was 0.075 ppm from the 2008 NAAQS standard.

Tables 6.2 and **6.3** highlight the number of days when two or more O_3 monitors exceeded 0.070 ppm. It also specifies in which month they occurred and the temperature range.

Table 6.2: 2017 West Michigan Ozone Season

table of number of days when 2 or more monitors exceed 70 ppb ozone concentrations compared to daily high temperatures per month for west Michigan in 2017.

Daily High Temperature Range			2017 WEST MICHIGAN OZONE SEASON															
			March		April		May		June		July		August		September		October	
					Days	O_3 Days	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	3	0	0	0
90	<=	94	0	0	0	0	0	0	4	1	1	0	0	0	3	1	0	0
85	<=	89	0	0	0	0	2	0	5	3	10	0	4	0	3	0	0	0
80	<=	84	0	0	2	0	0	0	7	1	16	0	13	0	6	0	4	0
75	<=	79	0	0	2	0	6	0	8	0	4	0	8	0	4	0	4	0
70	<=	74	1	0	5	0	6	0	4	0	0	0	4	0	5	0	3	0
65	<=	69	0	0	5	0	8	0	2	0	0	0	2	0	5	0	7	0
60	<=	64	0	0	3	0	4	0	0	0	0	0	0	0	1	0	1	0
55	<=	59	3	0	5	0	2	0	0	0	0	0	0	0	0	0	4	0
50	<=	54	6	0	4	0	1	0	0	0	0	0	0	0	0	0	4	0
49	<=		21	0	4	0	2	0	0	0	0	0	0	0	0	0	4	0
Totals			**31**	**0**	**30**	**0**	**31**	**0**	**30**	**5**	**31**	**0**	**31**	**0**	**30**	**1**	**31**	**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 70 ppb.

For West Michigan, there were five O_3 exceedance days in June, and one day in September when ozone exceeded 0.070 ppm at two or more ozone monitors. The temperatures for those days ranged between 80°F and 94°F.

Table 6.3: 2017 Southeast Michigan Ozone Season

Daily High Temperature Range			2017 SOUTHEAST MICHIGAN OZONE SEASON															
			March		April		May		June		July		August		September		October	
					Days	O_3 Days	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	0	0	0	0
90	<=	94	0	0	0	0	0	0	3	0	1	0	0	0	3	1	0	0
85	<=	89	0	0	0	0	3	0	10	1	13	1	9	1	4	0	1	0
80	<=	84	0	0	1	0	1	0	5	0	14	0	13	0	5	0	3	0
75	<=	79	1	0	5	0	3	0	7	0	3	0	5	0	6	0	2	0
70	<=	74	0	0	4	0	6	0	4	0	0	0	4	0	5	0	9	0
65	<=	69	0	0	3	0	7	0	1	0	0	0	0	0	7	0	5	0
60	<=	64	2	0	7	0	6	0	0	0	0	0	0	0	0	0	0	0
55	<=	59	5	0	5	0	2	0	0	0	0	0	0	0	0	0	5	0
50	<=	54	2	0	4	0	2	0	0	0	0	0	0	0	0	0	2	0
49	<=		21	0	1	0	1	0	0	0	0	0	0	0	0	0	4	0
Totals			**31**	**0**	**30**	**0**	**31**	**0**	**30**	**1**	**31**	**1**	**31**	**1**	**30**	**1**	**31**	**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 70 ppb.

For Southeast Michigan, there was one day in each of the months of June, July, August, and September when ozone exceeded 0.070 ppm at two or more ozone monitors. The temperature for those days ranged between 85°F and 94°F.

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

Table 6.4: 8-Hour Exceedance Days (>0.070 ppm) and Locations

Date	Monitors with Exceedances of the Ozone Standard			Total
	Western Michigan	Central / Upper Michigan	Eastern Michigan	
06/02/2017	Holland			1
06/04/217	Cassopolis, Coloma			2
06/09/2017	Cassopolis, Coloma, Muskegon, Kalamazoo			4
06/10/2017	Benzonia, Cassopolis, Holland, Muskegon, Scottville, Manistee	Houghton Lake, Seney	Tecumseh, E. 7 Mile, New Haven, Port Huron	12
06/11/2017	Muskegon			1
06/12/2017	Holland, Muskegon			2
06/15/2017	Holland, Cassopolis, Coloma			3
07/06/2017	Cassopolis		New Haven, Port Huron, Oak Park, Warren, E. 7 Mile	6
7/7/2017			E. 7 Mile	1
07/18/2017	Cassopolis		E. 7 Mile	2
7/19/2017			E. 7 Mile	1
07/21/2017			Ypsilanti	1
08/01/217			New Haven, E. 7 Mile	2
8/10/2017			E. 7 Mile	1
09/23/2017			Oak Park, Ypsilanti	2
09/26/2017	Benzonia, Muskegon			2
			TOTAL	43

On June 10, 2017, there were 12 monitors and on July 6, 2017, there were six monitor readings that exceeded the level of the standard. The site with the most exceedances in the western region of Michigan was Cassopolis with six. The central / upper Michigan site with the most exceedances were Seney and Houghton Lake with one. The monitor at E. 7 Mile had seven exceedances in eastern Michigan.

Figure 6.4: O_3 Levels in Detroit-Warren-Flint CSA from 2012-2017 (4th Highest 8-Hour O_3 Values)

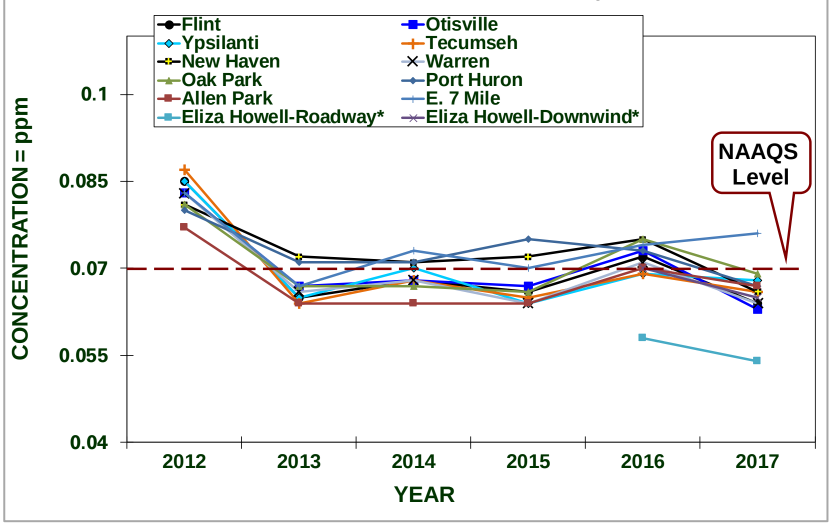


Figure 6.4 shows the 4th highest 8-hour O_3 values for Southeast Michigan monitoring sites from 2012-2017. Detroit E. 7 Mile site violated the 3-year standard.

*Note: The two Eliza Howell sites are part of a 2-year special study. Ozone monitoring will not continue after the 2-year study.

Figure 6.5: O_3 Levels in the Grand Rapids-Muskegon-Holland CSA from 2012-2017 (4th Highest 8-Hour O_3 Values)

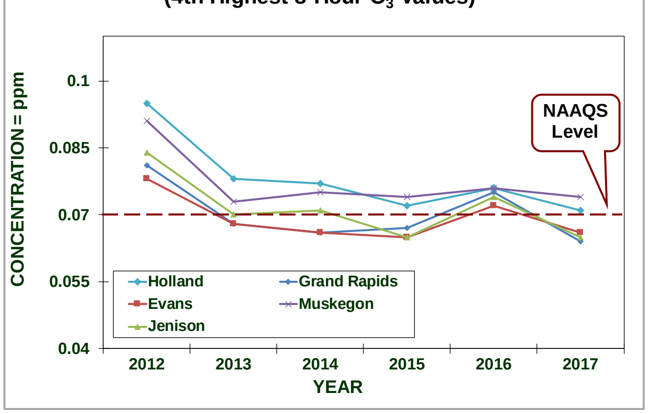


Figure 6.6: O_3 Levels in the Kalamazoo-Portage MSA, Lansing-E. Lansing-Owosso CSA, Niles-Benton Harbor MSA, & South Bend-Mishawaka (IN-MI) MSAs from 2012-2017 (4th Highest 8-Hour O_3 Values)

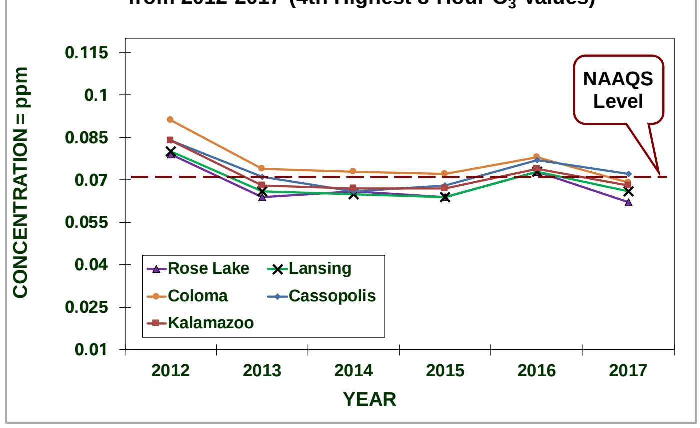


Figure 6.7: O_3 Levels in MI's Northern Lower and Upper Peninsula Areas from 2012-2017 (4th Highest 8-Hour O_3 Values)

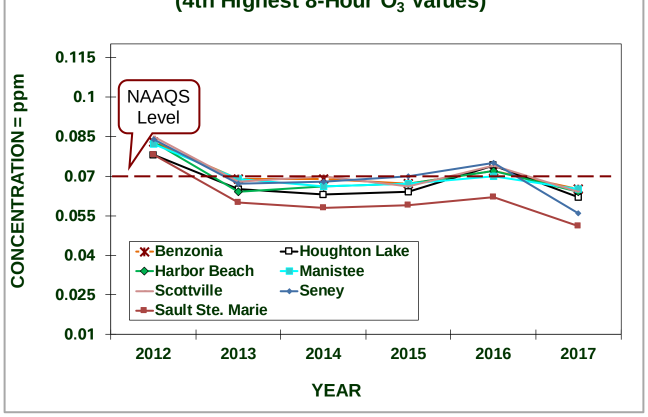


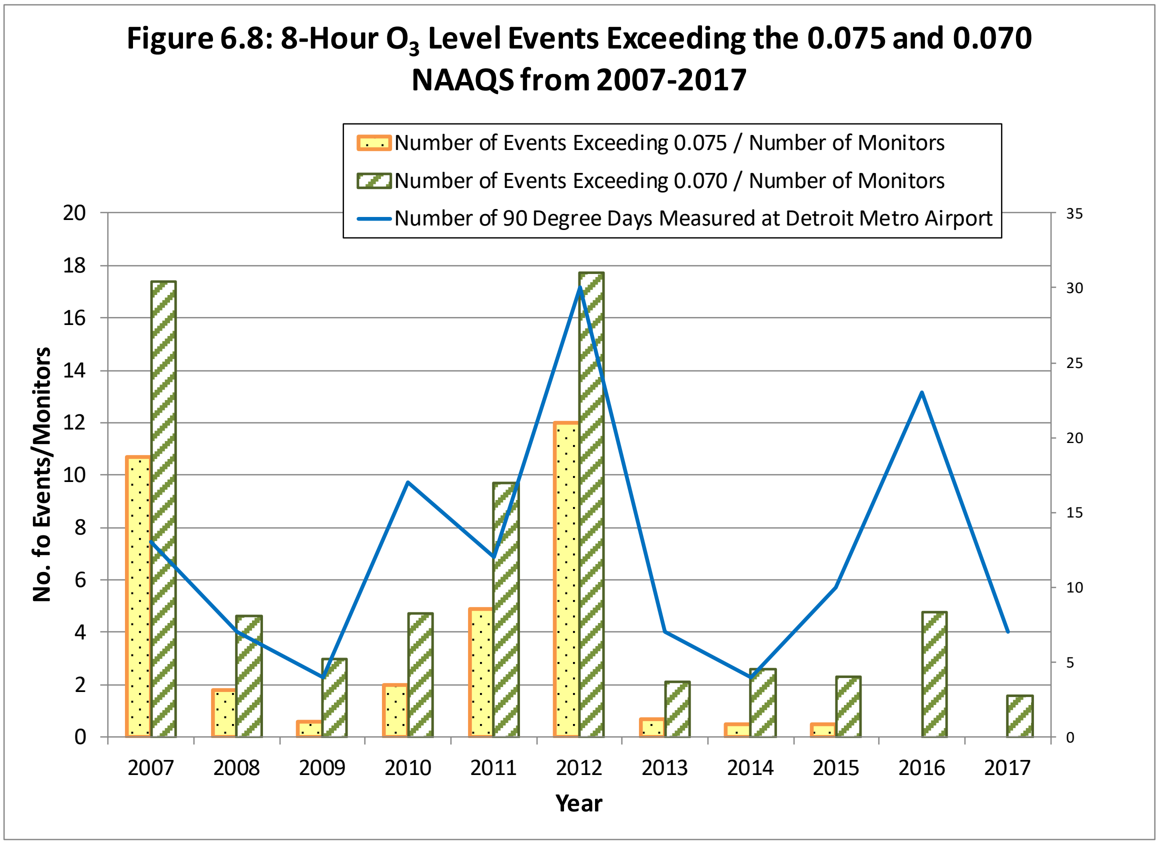
Figure 6.5 shows the 4th highest 8-hour O_3 values for Grand Rapids-Muskegon-Holland CSA. Muskegon and Holland violated the 3-year standard.

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

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

Figure 6.8 shows 8-hour O3 readings ≥ 0.070 ppm and ≥ 0.075 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 the standard (events) 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.

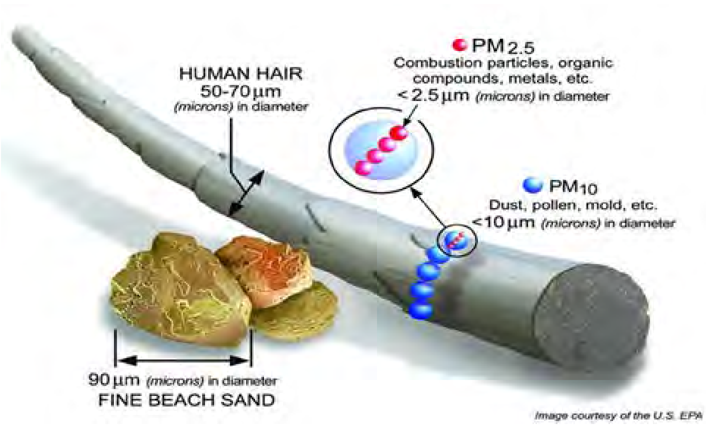
Since the ozone NAAQS level changed from 0.075 ppm to 0.070 ppm staring in the 2016 ozone season, Figure 6.8 shows the events/monitors at the 0.075 ppm level and the additional days that would be included at the 0.070 ppm level. Since 2016 and following years are subject to the 0.070 NAAQS standard, it only shows the events exceeding the 0.070 ppm level.



This comparison shows the influence of temperature with respect to elevated O3 levels. Over the past 10 years, a typical summer would have an average of 12.2 days with the maximum daily temperature exceeding 90°F. Over the time period from 2007 through 2017, 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}, $PM_{10\text{-}2.5}$, $PM_{2.5}$, $PM_{2.5}$ 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 not to be exceeded more than once per year over 3 years. $PM_{2.5}$ has an annual average standard of 12 µg/m^3, and a 98th percentile 24-hour concentration of 35 µg/m^3 averaged over 3 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 can aggravate existing cardiovascular ailments and even cause death in susceptible populations. PM may affect breathing and the cellular defenses of the lungs 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 United States. $PM_{2.5}$ 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 2016. These monitors are located mostly in the state's largest populated urban areas: four in the Detroit area and one in Grand Rapids. 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.

Figure 7.1: PM_{10} Monitors in 2017

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

Figure 7.2: PM_{10} Emissions by Source Sector

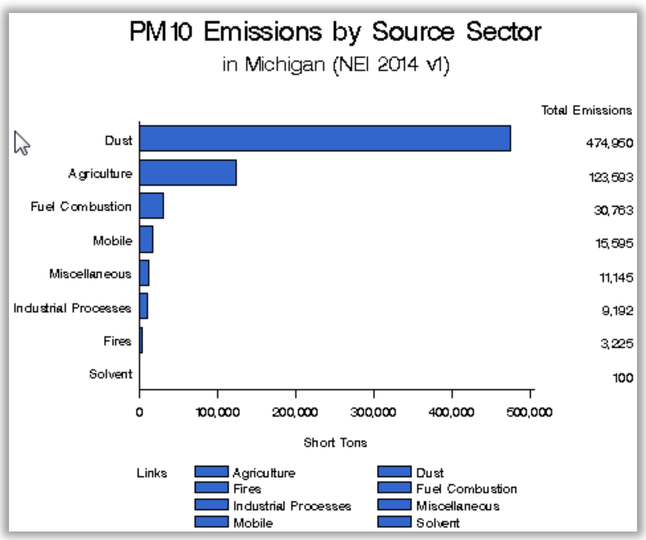


Figure 7.3: PM_{10} Emissions in 2014

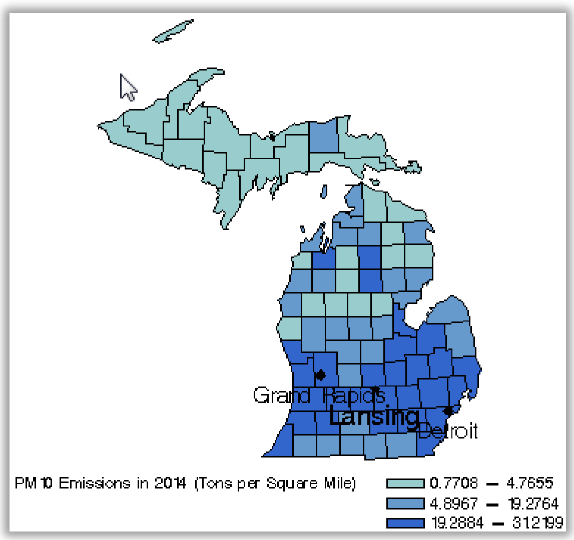
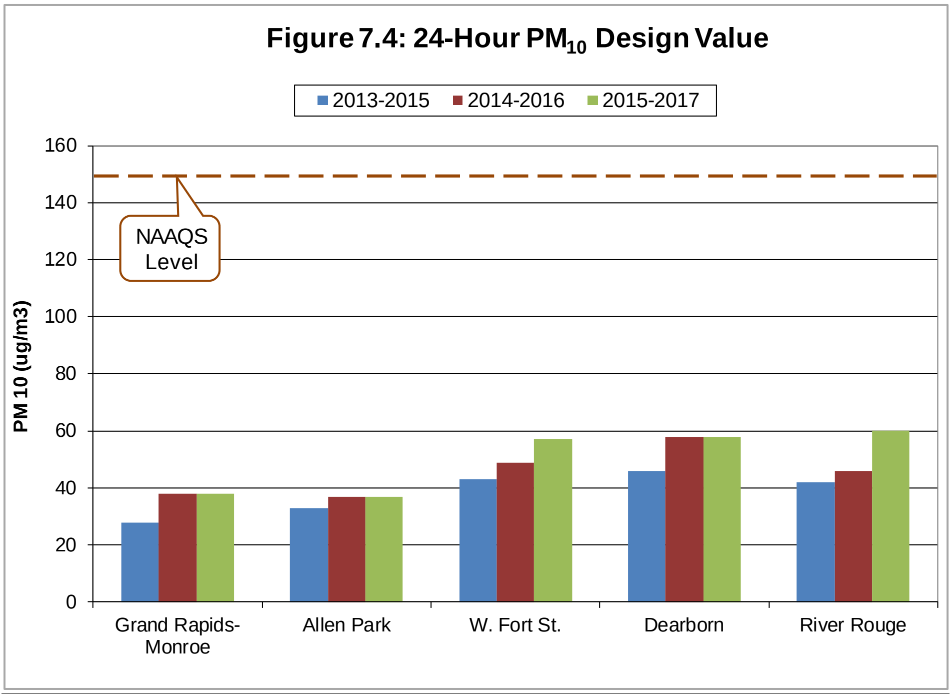
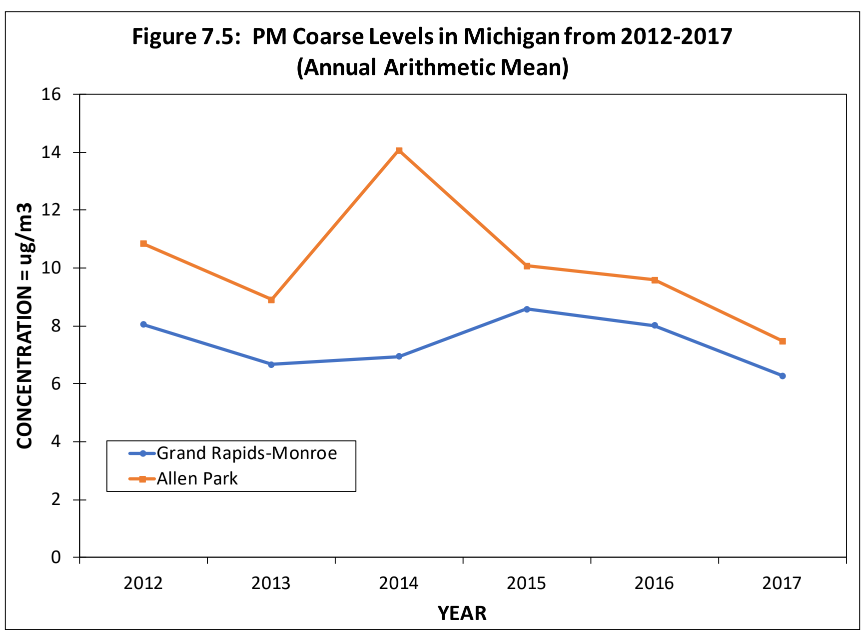


Figure 7.4 shows the PM_{10} levels in Michigan compared to the 24-hour average of 150 µg/m^3. This standard must not be exceeded on average more than once per year over a 3-year period. The design value is the 4th highest value over a 3-year period. The PM_{10} levels at all sites in Michigan are well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



$PM_{10\text{-}2.5}$

The 2006 amended air monitoring regulations specified that measurements of PM_{10}-$PM_{2.5}$ needed to be added to the NCore sites.[6] The DEQ began PM course ($PM_{10\text{-}2.5}$) monitoring at Allen Park and Grand Rapids-Monroe Street in 2010. **Figure 7.5** shows the $PM_{10\text{-}2.5}$ levels in Michigan.



[6] Current information can be found at https://www3.epa.gov/ttn/amtic/ncoreguidance.html.

$PM_{2.5}$

The USEPA designated Michigan in attainment of 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 in August 2013. In December 2012, the USEPA 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 at 35 µg/m^3. In December 2014, the USEPA determined that no area in Michigan violated the 2012 standard and the state was classified as unclassifiable/attainment.

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

Figure 7.6: $PM_{2.5}$ Monitors in 2017

$PM_{2.5}$ FRM Monitoring Network: $PM_{2.5}$ FRM monitors are deployed to characterize background or regional $PM_{2.5}$ transport collectively from upwind sources. On March 31, 2017 the $PM_{2.5}$ FRM was shut down at the Sault Ste. Marie tribal monitor. The USEPA did not renew their contract and funding for the FRM monitor; however, a continuous $PM_{2.5}$ monitor (BAM) continues to operate at this site.

Four $PM_{2.5}$ FRM monitoring sites are co-located with PM_{10} monitors to allow for $PM_{2.5}$ and PM_{10} comparisons.[7] Co-located PM_{10} and $PM_{2.5}$ sites include Grand Rapids-Monroe, Dearborn, Allen Park, and Detroit's W. Fort Street (SWHS).

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.[8] 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, 13 of which also have TEOMs. 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.

$PM_{2.5}$ 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 five SASS monitors operating in Michigan. Houghton Lake, Port Huron and Sterling State Park monitors were shut down on January 24, 2015, due to lack of funding. The primary objectives of the chemical speciation monitoring sites are to provide data that will be used to determine 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,[9] 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 operates two aethalometers and two elemental carbon/organic carbon (EC/OC) monitors.

- Aethalometers measure carbon black, a combustion by-product typical of transportation sources, by concentrating particulate on a filter tape and measuring changes in optical transmissivity and absorption. The DEQ's aethalometers are located at Allen Park and Dearborn.
- The EC/OC instruments measure elemental carbon using pyrolysis coupled with a nondispersive infrared detector to separate the elemental and organic carbon fractions. EC/OC instruments are located at Dearborn and Tecumseh. The EC/OC instrument began to malfunction at Dearborn in September 2017 and was later shut down.

[7] 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].

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

[9] 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

Table 1.3 in chapter 1 shows all of Michigan's $PM_{2.5}$ FRM monitoring stations operating in 2016 and denotes which sites have TEOM, SASS, Aethalometer or EC/OC monitors in operation.

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

Figure 7.7: $PM_{2.5}$ Emissions by Source Sector

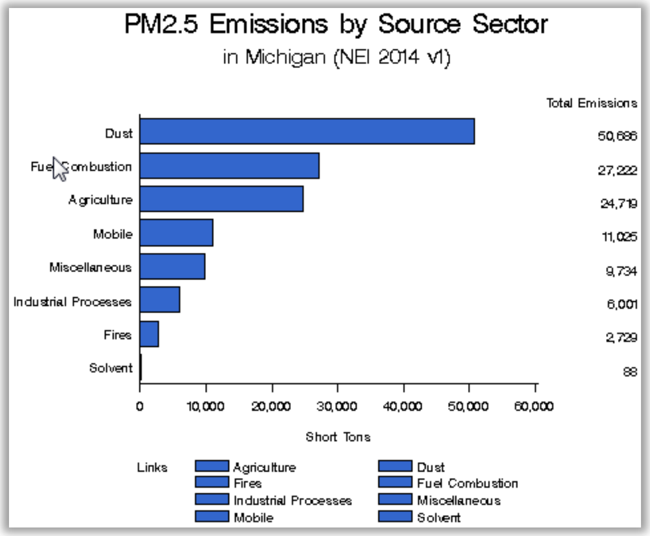


Figure 7.8: $PM_{2.5}$ Emissions in 2014

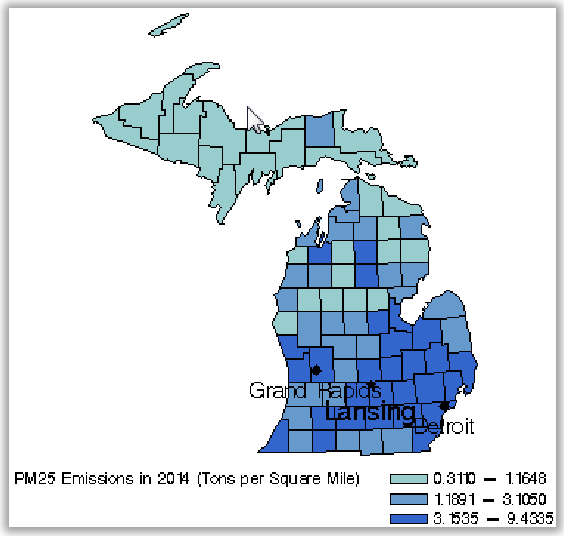


Table 7.1 provides the 3-year average of the annual mean $PM_{2.5}$ concentrations for 2015-2017. Michigan's levels are below the 12 µg/m^3 primary standard.[10] Stations labeled #2 provide a precision estimate of the overall measurement and operate on a one-in-six sampling schedule. All other monitors are sampled on a one-in-three-day schedule, except for Allen Park #1, which samples daily.

Table 7.1: 3-Year Average of the Annual Mean $PM_{2.5}$ Concentrations

Areas	County	Monitoring Sites	2015	2016	2017	2015-2017 Mean
Detroit-Ann Arbor	Lenawee	Tecumseh	8.58	7.46	7.34	8.0
	Livingston					
	Macomb	New Haven	9.73	7.51	7.41	8.4
	Oakland	Oak Park	9.37	7.87	8.11	8.7
	St. Clair	Port Huron	9.51	7.77	8.01	8.7
	Washtenaw	Ypsilanti #1	9.56	7.84	7.93	8.8
		Ypsilanti #2	9.08	8.06	8.32	8.7
	Wayne	Allen Park	9.66	8.72	8.47	9.2
		Detroit-Linwood	10.18	8.94	8.99	9.5
		Detroit-E. 7 Mile	9.79	8.11	7.88	8.9
		Detroit-W. Fort St.	11.26	11.32	11.01	11.1
		Detroit-W. Lafayette	9.12	8.38	7.93*	8.5
		Wyandotte	8.62	7.70	7.18	8.3
		Dearborn #1	11.50	10.67	10.57	11.1
		Dearborn #2	11.65	10.52	10.82	11.2
		Livonia	9.31	8.16	7.98	8.7
		Livonia-Roadway	9.53	8.53	8.46	8.8
Flint	Genesee	Flint	8.16	7.18	7.10	7.8
	Lapeer					
Grand Rapids	Ottawa	Jenison				
	Kent	Grand Rapids-Wealthy	9.37	8.79	9.15	9.3
		Grand Rapids #1	9.30	8.16	8.12	8.8
		Grand Rapids #2	10.37	8.48	8.31	9.1
Allegan Co	Allegan	Holland	7.88	6.99	7.49	7.8
Monroe Co	Monroe	Luna Pier				
		Sterling State Park	9.26	7.75	7.71	8.2
Kalamazoo-Battle Creek	Calhoun					
	Kalamazoo	Kalamazoo #1	8.90	8.09	8.03	8.7
		Kalamazoo #2	9.34	8.25	8.36	8.9
	Van Buren					
Lansing-East Lansing	Ingham	Lansing	8.56	7.31	7.23	8.1
	Clinton					
	Eaton					
Benton Harbor	Berrien	Coloma	8.15	7.35	7.99	8.0
Bay Co	Bay	Bay City	7.74	6.84	6.75	7.4
Missaukee Co	Missaukee	Houghton Lake	5.59	4.87	4.81	5.2
Manistee Co	Manistee	Manistee	6.37	5.50	5.84	6.0
Chippewa Co	Chippewa	Sault Ste. Marie #1	5.79*	5.04*	6.10*	5.6
		Sault Ste. Marie #2	6.18*	5.03*	5.88*	5.7

*Indicates mean does not meet completeness criteria.

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

Table 7.2 provides the 24-hour 98th percentile $PM_{2.5}$ concentrations for 2015-2017 showing Michigan's levels are below the 35 µg/m³ standard (3-year average).[11]

Table 7.2: 24-Hour 98th Percentile $PM_{2.5}$ Values Averaged over 3 Years

Areas	County	Monitoring Sites	2015	2016	2017	2015-2017 Mean
Detroit-Ann Arbor	Lenawee	Tecumseh	25.2	15.1	17.5	21
	Livingston					
	Macomb	New Haven	31.6	20.1	17.0	26
	Oakland	Oak Park	29.6	19.8	20.1	24
	St. Clair	Port Huron	28.7	19.1	19.2	24
	Washtenaw	Ypsilanti #1	25.9	17.6	18.8	23
		Ypsilanti #2	20.6	17.4	19.0	21
	Wayne	Allen Park	23.1	20.3	21.8	23
		Detroit-Linwood	27.1	22.5	25.0	24
		Detroit-E. 7 Mile	25.6	19.5	16.6	22
		Detroit-W. Fort St.	27.1	25.6	30.0	26
		Detroit-W. Lafayette	22.4	20.5	19.5	23
		Wyandotte	21.1	18.8	19.3	22
		Dearborn #1	28.1	25.8	24.5	27
		Dearborn #2	24.7	24.7	23.5	25
		Livonia	26.8	19.9	19.1	24
		Livonia-Roadway	25.2	21.4	19.0	23
Flint	Genesee	Flint	22.3	18.8	16.8	22
	Lapeer					
Grand Rapids	Ottawa	Jenison				
	Kent	Grand Rapids-Wealthy	25.5	22.7	26.2	24
		Grand Rapids #1	25.6	19.5	22.6	23
		Grand Rapids #2	24.3	19.5	22.8	24
Allegan Co	Allegan	Holland	21.2	17.2	24.6	21
Monroe Co	Monroe	Luna Pier				
		Sterling State Park	25.7	18.3	20.5	23
Kalamazoo-Battle Creek	Calhoun					
	Kalamazoo	Kalamazoo #1	22.3	20.1	22.6	22
		Kalamazoo #2	21.3	20.2	22.5	24
	Van Buren					
Lansing-East Lansing	Ingham	Lansing	24.5	18.0	17.1	22
	Clinton					
	Eaton					
Benton Harbor	Berrien	Coloma	19.4	17.2	26.2	19
Bay Co	Bay	Bay City	23.3	19.6	22.4	21
Missaukee Co	Missaukee	Houghton Lake	17.9	12.4	14.9	16
Manistee Co	Manistee	Manistee	19.3	12.6	19.2	16
Chippewa Co	Chippewa	Sault Ste. Marie #1	15.8	11.3	25.3	14
		Sault Ste. Marie #2	16.4	10.8	16.4	13

*Indicates mean does not meet completeness criteria.

[11] The 98th percentile value was obtained from the USEPA AQS. For the purpose of comparing calculated values, the 3-year 24-hour average is rounded to the nearest 1 µg/m³.

Figures 7.9 through **7.12** 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 7.9 shows those sites in Wayne County, and **Figure 7.10** shows the remaining counties within the CSA.

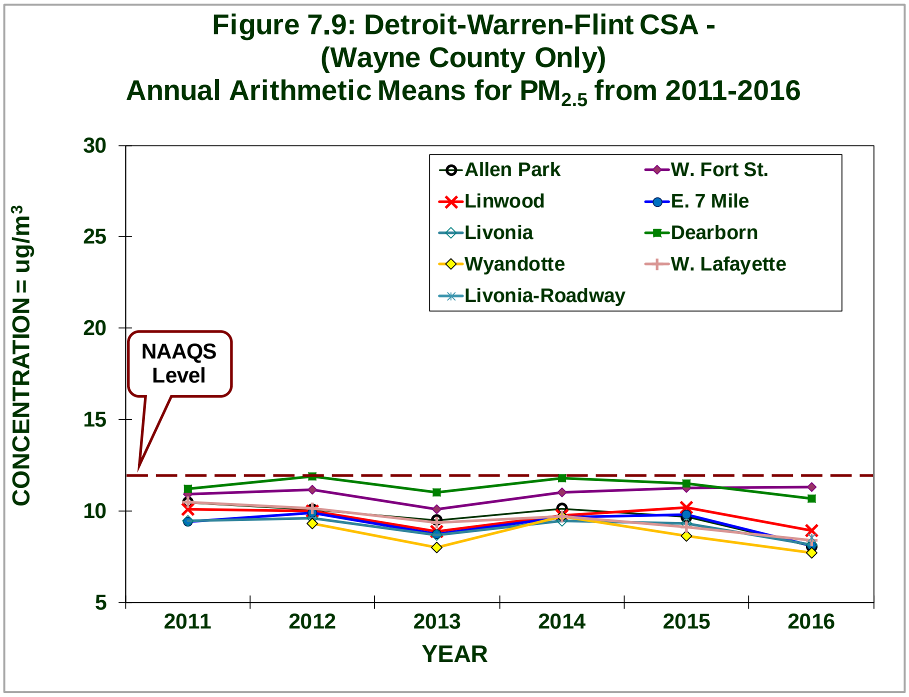


Figure 7.9 shows the 2017 levels in Wayne County remained below the $PM_{2.5}$ NAAQS standard. Historically, Dearborn has had the highest concentrations in the state, but W. Fort St. now has the highest concentrations.

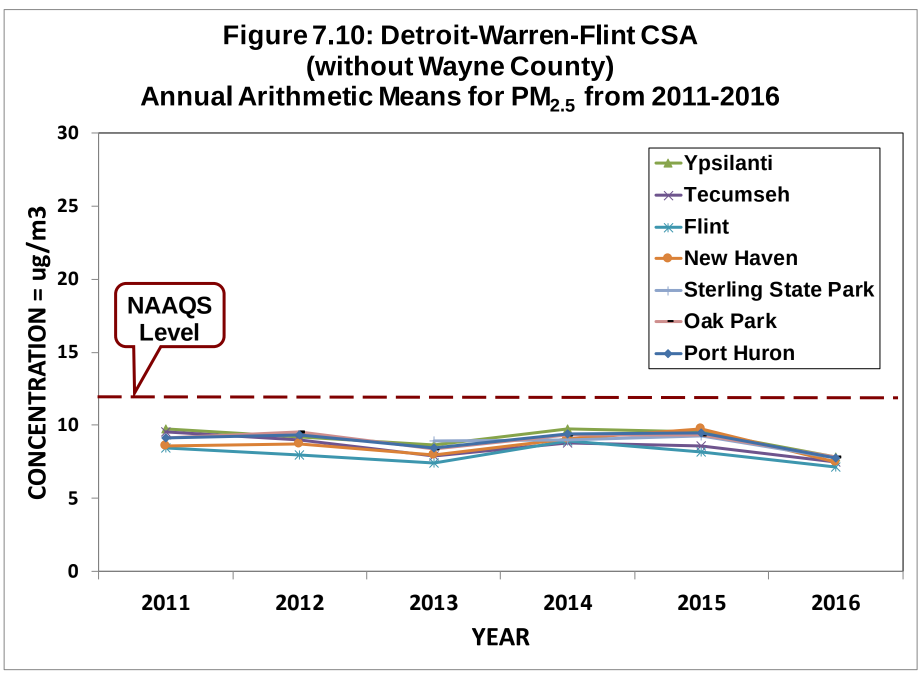


Figure 7.10 contains the remainder of those sites in the Detroit-Warren-Flint CSA that are outside of Wayne County. These sites also show readings in 2017 to be below the $PM_{2.5}$ NAAQS.

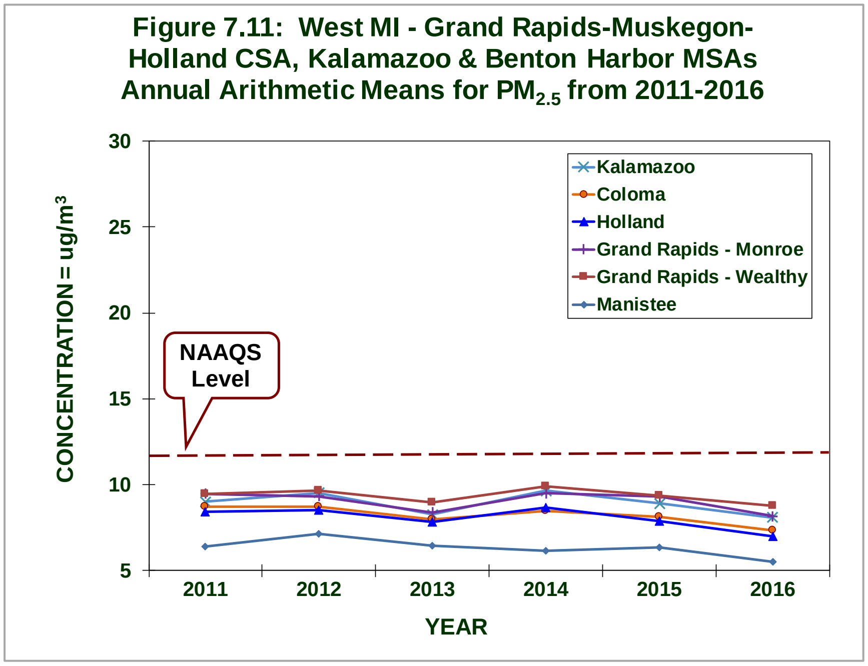


Figure 7.11 combines the $PM_{2.5}$ monitoring sites located in West Michigan-Grand Rapids-Muskegon-Holland CSA, Kalamazoo and Benton Harbor MSAs. All sites are below the annual $PM_{2.5}$ NAAQS.

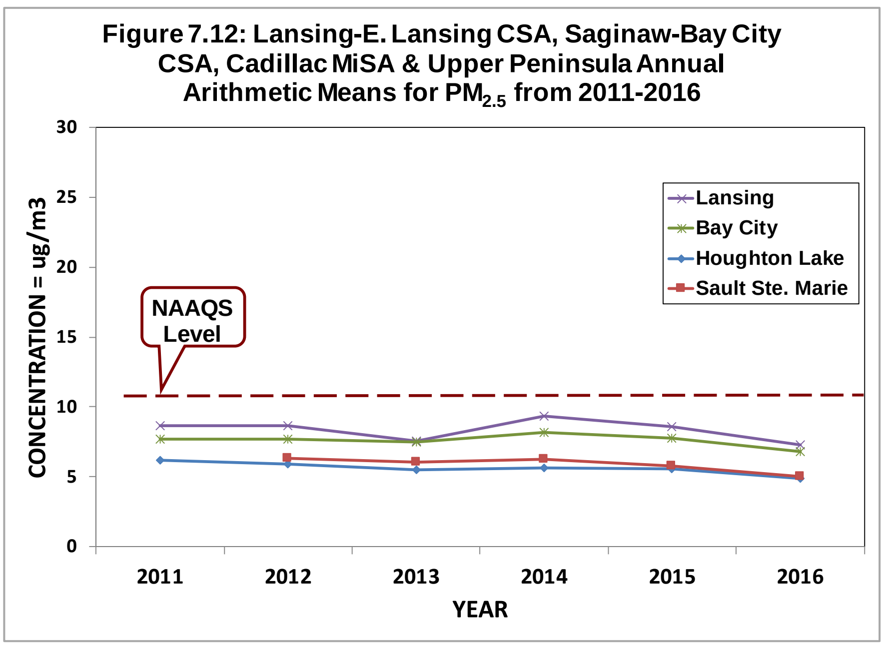


Figure 7.12 displays the remaining monitoring sites in the Northern Lower and Upper Peninsula. All of these sites are below the annual $PM_{2.5}$ NAAQS standard.

CHAPTER 8: TOXIC AIR POLLUTANTS

In addition to the six criteria pollutants discussed in 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 USEPA 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 42 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 eruptions from volcanoes.

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 generally at the highest risk for health effects 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), perchloroethylene (emitted from some dry-cleaning facilities), and methylene chloride (a solvent and paint stripper used by industry);
    - carbonyl compounds (formaldehyde, acetone, and acetaldehyde);
    - 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 USEPA has developed an Integrated *Urban Air Toxics Strategy* with a focus on 30 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-based 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 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 2016. This table can also be found in **Appendix B** with the Air Toxics Monitoring Summary.

The $PM_{2.5}$ speciation network was reduced due to USEPA funding cuts. In January 2015, the DEQ shut down three monitors at Houghton Lake in Missaukee County, Sterling State Park in Monroe County, and Port Huron in St. Clair County.

Table 8.1: 2017 Toxics Sampling Sites

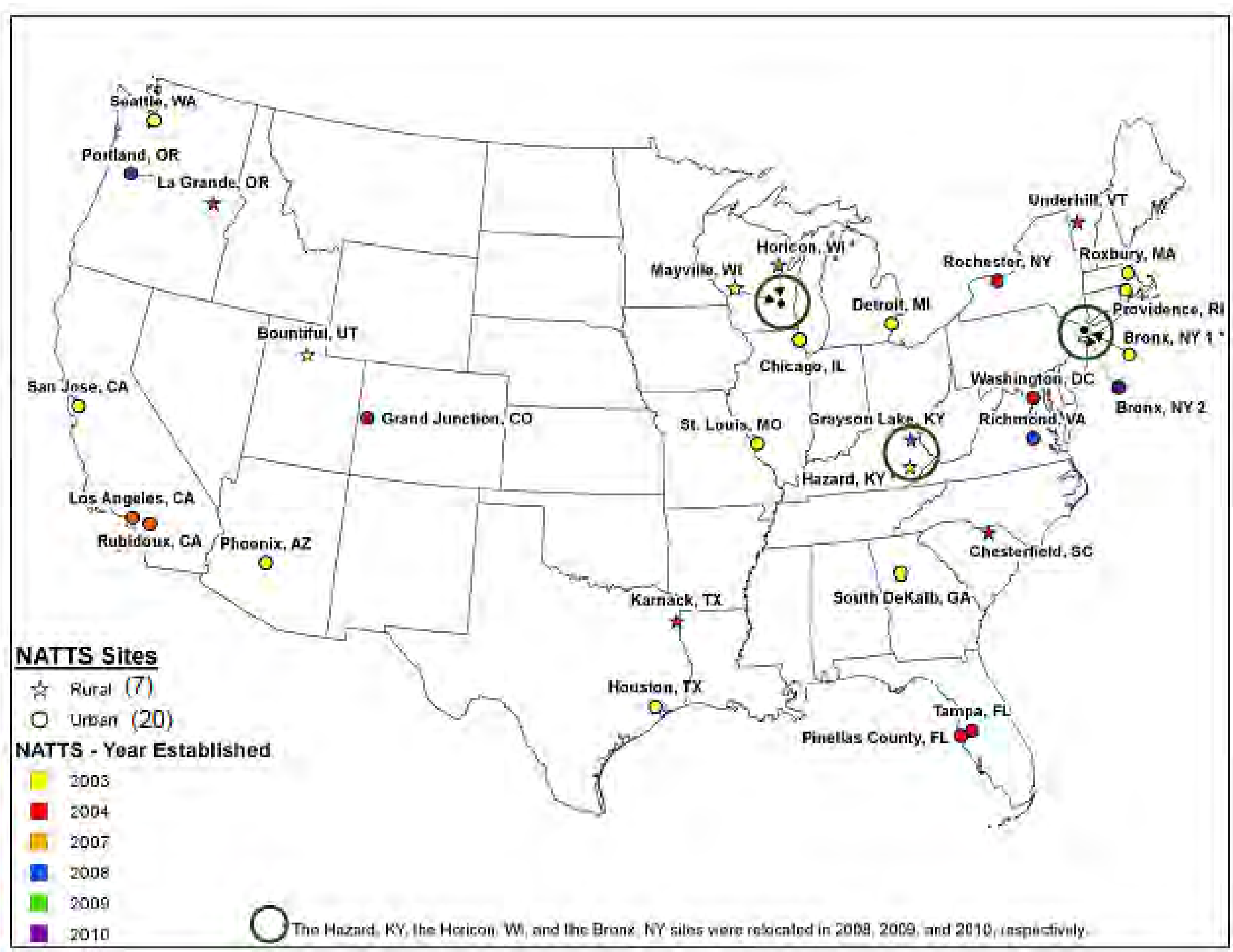
Site Name	VOC	Carbonyl	PAHs	Metals TSP	Metals PM_{10}	Speciated $PM_{2.5}$
Allen Park				x	x	x
Dearborn	x	x	x	x	x	x
Detroit-W. Fort St.	x	x		x	Mn	x
Detroit-W. Jefferson				x		
Grand Rapids-Monroe				x		x
Belding-Merrick St.				x		
Belding-Reed St.				x		
NMH 48217	x		x	x		
Port Huron-Rural St.				x		
River Rouge		x		x	Mn	
Tecumseh						x

[12] USEPA's Air Toxics website: Urban Strategy is located at https://www.epa.gov/urban-air-toxics.

National Monitoring Efforts and Data Analysis

The USEPA 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 the USEPA's 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 7 rural (see **Figure 8.1**). The USEPA requires that the 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 web page. 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 "Air Quality Index Fact Sheet" link: www.michigan.gov/documents/deq/deq-aqd-aqifacts_273090_7.pdf which contains activity recommendations based on the AQI levels.

Air Quality Forecasts

AQD 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 learn more about this program, select the **MIair** button from Michigan's Air Quality page www.michigan.gov/air. To receive notices, choose the "Air Quality Notification" tab and click the "Enroll in AQI EnviroFlash" link. 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 USEPA'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** web page.

Table 9.1: AQI Colors and Health Statements

AQI Color, Category and Value	Particulate Matter ($\mu g/m^3$) 24-hour	Ozone (ppm) 8-hour/1-hour	Carbon Monoxide (ppm) 8-hour	Sulfur Dioxide (ppm) 24-hour	Nitrogen Dioxide (ppm) 1-hour
GREEN: Good 1- 50	None	None	None	None	None
YELLOW: Moderate 51- 100	Unusually sensitive people should consider reducing prolonged or heavy exertion.	Unusually sensitive people should consider reducing prolonged or heavy exertion.	None	None	None
ORANGE: Unhealthy for Sensitive Groups 101- 150	People with heart or lung disease, 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 Peninsula. These figures were constructed by averaging data from several National Weather Service stations and therefore are not meant to be representative of any one single location in Michigan. Instead, they are intended to depict the regional trends that occurred during the year 2017.

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

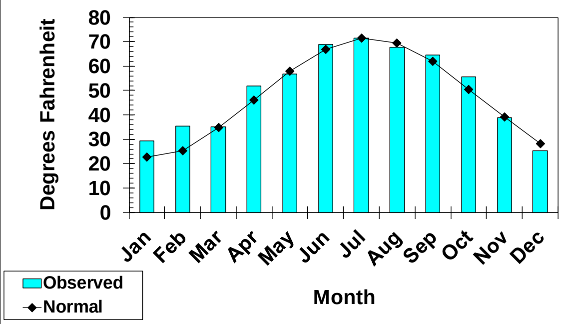


Figure 10.2: Northern Lower Peninsula Observed Average Monthly Temperatures vs. Normal Average Monthly Temperatures

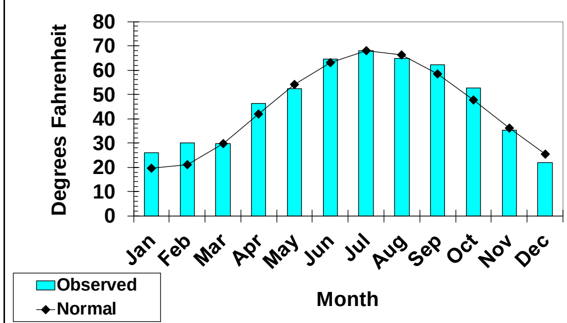


Figure 10.3: Upper Peninsula Observed Average Monthly Temperatures vs. Normal Average Monthly Temperatures

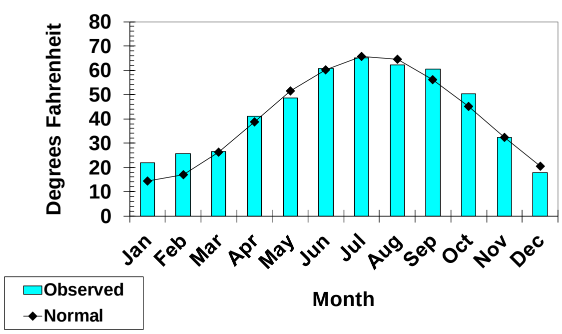


Figure 10.4: Southern Lower Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation

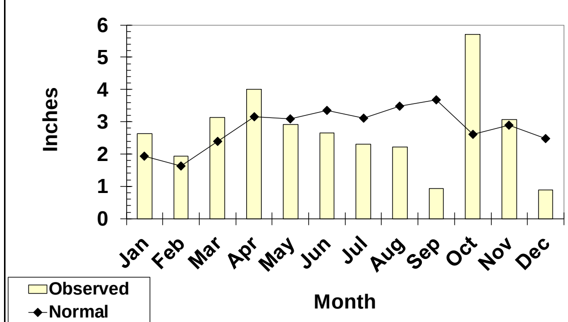


Figure 10.5: Northern Lower Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation

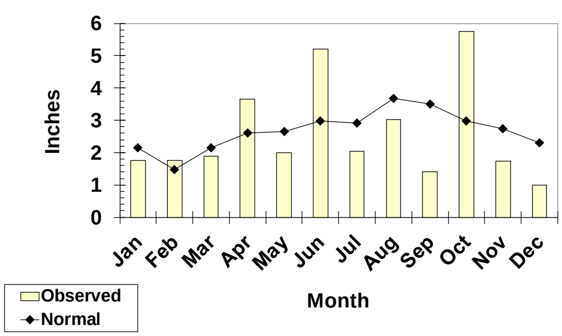
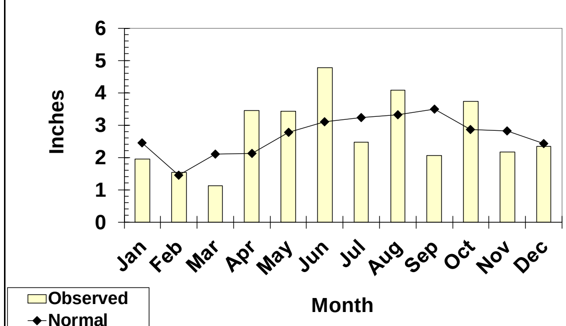


Figure 10.6: Upper Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation



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 some *Action!* Days declared during the summer of 2017.

Table 10.1: *Action!* Days Declared During Summer 2017

Location	Year	Number	Dates
Ann Arbor	2017	4	6/11, 6/12, 7/18, 7/21
Benton Harbor	2017	4	6/10, 6/11, 6/12, 7/18
Detroit	2017	3	6/11, 7/18, 7/21
Grand Rapids	2017	3	6/10, 6/11, 6/12
Ludington	2017	2	6/10, 6/11

CHAPTER 11: SPECIAL PROJECTS

Near-road Air Toxics Grant: The DEQ is currently working on two special projects. The first project is a Community Scale Air Toxics Ambient Monitoring (CSATAM) grant. In 2015, the DEQ applied for a CSATAM grant to study near-roadway emissions at three sites in Detroit: Eliza Howell Near-road, Eliza Howell Downwind, and Livonia Near-road. The grant involved two years of monitoring at these sites, with an intensive 3-month sampling period when additional samples and increased sampling frequency were employed. The additional measurements at these sites are listed in **Table 11.1**. The 3-month intensive sampling period allowed for the analysis of toxic compounds that are more labor intensive to collect. The schedule for the intensive period was delayed due to road construction at the Livonia Near-road site but ran May through July 2017. The sampling phase of this project ended, and the data analysis phase has begun. The data analysis phase will continue through the end of 2018, after which a final report will be developed.

Table 11.1. Types of Measurements, Duration and Purpose at Near-road Sites

Measurement	Duration	Purpose
Hourly Black Carbon (BC[1])	2 years	Characterize diesel PM
Hourly BTEX	2 years	Characterize benzene and mobile source indicators
Hourly PM	2 years	Characterize hourly particulate matter
Hourly $NO/NO_2/NOx$	2 years	Mandated near-road measurement
Hourly CO	2 years	Mandated near-road measurement
Hourly Ozone	2 years	Help differentiate NOx and NO_2 concentrations
Hourly UFP[2]	6-12 months	Determine Ultra Fine Particulate Matter (UFP) levels, which have acute and likely chronic health affects
Hourly PM_{10} toxic metals	1 month	Use high–time-resolution measurements to apportion roadway influence, upwind versus downwind, and variations with traffic
Every other day 24-hour TSP toxic metals	3 months	Obtain full suite of toxics metals, for comparison among near-road and urban sites, apportion roadway influence
Every other day 24-hour carbonyls	3 months	Obtain toxics formaldehyde, acetaldehyde, acrolein to best determine risk from these air toxics
Meteorology	2 years	Provide capability to differentiate upwind from downwind
Traffic counts	2 years	Provide data on traffic patterns to link traffic mix and speed to air toxics concentrations

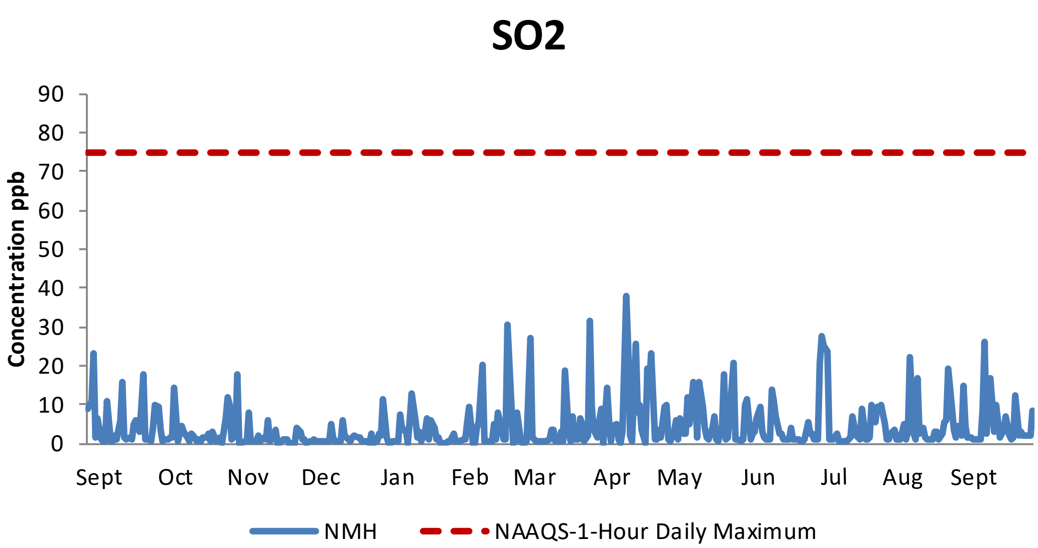
[1] BC is a marker for diesel particulate matter (DPM), which the USEPA has concluded ranks with the other substances that the national-scale assessment suggests pose the greatest relative risk; see https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=29060

[2] Mobile sources are a key source of exposure to ambient UFP emissions. Epidemiological studies have so far been inconclusive regarding UFP toxicity, but more data are needed, as discussed in detail in Health Effects Institute Perspectives.

[3] Understanding the Health Effects of Ambient Ultrafine Particles is available at: www.healtheffects.org/system/files/Perspectives3.pdf

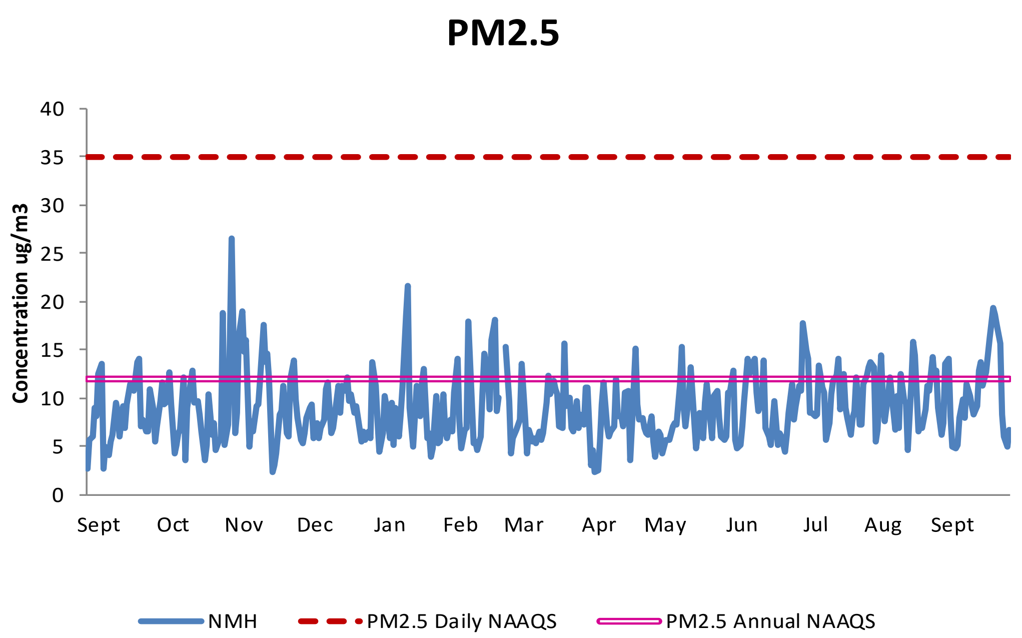
Community Monitoring Project: The second special purpose monitoring project resulted from a request from community members in the Detroit 48217 ZIP code for an air monitoring station in their neighborhood. The 48217 community has many industrial sources located in and around it. In a collaborative effort, the DEQ was able to establish an air monitoring station in the community for a 1-year study. The monitor site, known as "NMH 48217," is located at New Mount Hermon Baptist Church at 3225 South Deacon Street in Detroit. The site monitored for SO_2, continuous $PM_{2.5}$, VOCs, PAHs, TSP metals, hydrochloric acid, sulfuric acid, and hydrogen cyanide. Sampling was conducted in September 2016 through September 2017. The data was analyzed at the end of the 1-year study and a final report was developed, which is available on www.michigan.gov/48217monitoring. The study found that all sampled compounds were below the levels of concern with the exception of two samples of sulfuric acid. At the completion of the study, all of the parameters were discontinued except for continuous $PM_{2.5}$, and SO_2; and the list of TSP metals was reduced to arsenic, cadmium, manganese, nickel, and lead. Figure 11.1 shows the 1-hour maximum SO_2 per day and Figure 11.2 shows the daily $PM_{2.5}$ concentrations. See Appendix B-1 for a summary of the other air pollutants sampled at this site, or the 48217 ZIP Code Project[13] page for more information and the complete report[14].

Figure 11.1. 1-Hour Maximum SO_2 Concentrations per Day at NMH 48217



[13] See www.michigan.gov/deqair (select "Monitoring") for the 48217 ZIP Code Project web page.
[14] See the complete 48217 Project Report at www.michigan.gov/deqair, (select "Monitoring.")

Figure 11.2. Daily $PM_{2.5}$ Concentrations at NMH 48217



APPENDIX A: CRITERIA POLLUTANT SUMMARY FOR 2017

Appendix A utilizes the USEPA's 2017 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 USEPA'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 - 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.

Criteria Pollutant Summary For 2017

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-Monroe	Kent	2017	8323	1.4	1.4	0	1.1	1.0	0
261630001	1	Allen Park	Wayne	2017	8236	2.4	2.1	0	1.7	1.6	0
261630093	1	Eliza Howell-Roadway	Wayne	2017	8167	8.2	8.2	0	2.1	1.7	0
261630094	1	Eliza Howell-Downwind	Wayne	2017	7839	2.5	2.3	0	2.2	1.8	0
261630095	1	Livonia-Roadway	Wayne	2017	8129	2.3	1.3	0	1.1	1.0	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 (24-hr)
260670002	1	Belding-Reed St.	Ionia	2017	61	0.02	0.096	0.039
260670003	1	Belding-Merrick St.	Ionia	2017	61	0.02	0.077	0.058
260810020	1	Grand Rapids-Monroe	Kent	2017	59	0.00	0.007	0.007
261470031	1	Port Huron-Rural St.	St. Clair	2017	61	0.08	0.393	0.283
261630001	1	Allen Park	Wayne	2017	58	0.00	0.014	0.007
261630033	1	Dearborn	Wayne	2017	60	0.02	0.127	0.039
261630097	1	NMH 48217	Wayne	2017	61	0.00	0.009	0.008

NO_2 measured in ppb

Site ID	POC	City	County	Year	# OBS	1-Hr Highest Value	1-Hr 2nd Highest Value	98th Percentile 1-hr	Annual Arith Mean
260650012	1	Lansing	Ingham	2017	7434	46.7	39.6	36.4	6.45
261130001	1	Houghton Lake	Missaukee	2017	8259	10.6	9.1	7.1	1.42
261630019	2	Detroit-E. 7 Mile	Wayne	2017	8084	50.7	46.7	42.1	9.34
261630093	1	Eliza Howell-Roadway	Wayne	2017	8204	49.2	46.0	43.6	15.92
261630094	1	Eliza Howell Downwind	Wayne	2017	7900	49.5	48.3	39.6	11.09
261630095	1	Livonia–Roadway	Wayne	2017	8234	45.9	42.9	36.7	9.35

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-Monroe	Kent	2017	8016	235.4	199.2	12.55
261630001	1	Allen Park	Wayne	2017	7063	157.1	144.8	14.17

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	2017	245	245	0.083	0.081	0.078	0.078	0	0	0
260190003	1	Benzonia	Benzie	2017	245	245	0.079	0.076	0.074	0.073	0	0	0
260210014	1	Coloma	Berrien	2017	244	245	0.083	0.081	0.081	0.077	0	0	1
260270003	2	Cassopolis	Cass	2017	245	245	0.089	0.080	0.078	0.077	0	0	0
260330901	1	Sault Ste. Marie	Chippewa	2017	223	245	0.069	0.062	0.059	0.056	0	0	5
260370002	2	Rose Lake 2	Clinton	2017	238	245	0.075	0.073	0.071	0.071	0	0	0
260490021	1	Flint	Genesee	2017	243	245	0.074	0.073	0.072	0.072	0	0	2
260492001	1	Otisville	Genesee	2017	244	245	0.071	0.071	0.068	0.068	0	0	1
260630007	1	Harbor Beach	Huron	2017	241	245	0.089	0.080	0.070	0.069	0	0	1
260650012	2	Lansing	Ingham	2017	234	245	0.074	0.073	0.072	0.072	0	0	1
260770008	1	Kalamazoo	Kalamazoo	2017	243	245	0.076	0.075	0.072	0.071	0	0	2
260810020	1	Grand Rapids-Monroe	Kent	2017	364	365	0.076	0.072	0.071	0.071	0	0	1
260810022	1	Evans	Kent	2017	241	245	0.075	0.074	0.074	0.074	0	0	0
260910007	1	Tecumseh	Lenawee	2017	243	245	0.077	0.073	0.073	0.072	0	0	1
260990009	1	New Haven	Macomb	2017	242	245	0.089	0.083	0.082	0.077	0	0	0
260991003	1	Warren	Macomb	2017	241	245	0.084	0.072	0.071	0.071	0	0	0
261010922	1	Manistee	Manistee	2017	240	245	0.080	0.077	0.073	0.073	0	0	3
261050007	1	Scottville	Mason	2017	245	245	0.079	0.074	0.074	0.070	0	0	0
261130001	1	Houghton Lake	Missaukee	2017	245	245	0.073	0.068	0.068	0.067	0	0	0
261210039	1	Muskegon	Muskegon	2017	245	245	0.090	0.087	0.087	0.083	0	0	0
261250001	2	Oak Park	Oakland	2017	238	245	0.095	0.094	0.086	0.074	0	0	2
261390005	1	Jenison	Ottawa	2017	245	245	0.079	0.073	0.072	0.071	0	0	0
261470005	1	Port Huron	St. Clair	2017	244	245	0.079	0.079	0.078	0.077	0	0	1
261530001	1	Seney	Schoolcraft	2017	244	245	0.075	0.074	0.063	0.060	0	0	1
261610008	1	Ypsilanti	Washtenaw	2017	245	245	0.083	0.080	0.076	0.075	0	0	0
261630001	2	Allen Park	Wayne	2017	347	365	0.095	0.081	0.081	0.079	0	0	4
261630019	2	Detroit-E. 7 Mile	Wayne	2017	236	245	0.095	0.085	0.078	0.078	0	0	2
261630093	1	Eliza Howell-Roadway*	Wayne	2017	231	245	0.070	0.065	0.065	0.062	0	0	2
261630094	1	Eliza Howell-Downwind*	Wayne	2017	219	245	0.089	0.075	0.071	0.071	0	0	3

***** Indicates sampling is part of a two-year special study.

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 > 0.070
260050003	1	Holland	Allegan	2017	100	245	0.075	0.074	0.074	0.071	0
260190003	1	Benzonia	Benzie	2017	99	243	0.074	0.072	0.066	0.065	0
260210014	1	Coloma	Berrien	2017	99	244	0.074	0.073	0.071	0.069	0
260270003	2	Cassopolis	Cass	2017	100	245	0.078	0.073	0.072	0.072	1
260330901	1	Sault Ste. Marie	Chippewa	2017	90	221	0.066	0.056	0.052	0.051	0
260370002	1	Rose Lake 2	Clinton	2017	97	237	0.068	0.067	0.066	0.062	0
260490021	1	Flint	Genesee	2017	99	243	0.068	0.066	0.065	0.064	0
260492001	1	Otisville	Genesee	2017	99	244	0.068	0.066	0.064	0.063	0
260630007	1	Harbor Beach	Huron	2017	98	241	0.069	0.068	0.065	0.064	0
260650012	2	Lansing	Ingham	2017	96	234	0.069	0.069	0.066	0.066	0
260770008	1	Kalamazoo	Kalamazoo	2017	99	242	0.071	0.069	0.069	0.068	0
260810020	1	Grand Rapids	Kent	2017	99	362	0.068	0.067	0.065	0.064	0
260810022	1	Evans	Kent	2017	98	240	0.070	0.068	0.067	0.066	0
260910007	1	Tecumseh	Lenawee	2017	97	242	0.071	0.069	0.069	0.066	0
260990009	1	New Haven	Macomb	2017	99	242	0.073	0.072	0.071	0.066	0
260991003	1	Warren	Macomb	2017	98	241	0.074	0.066	0.065	0.064	0
261010922	1	Manistee	Manistee	2017	98	239	0.073	0.067	0.066	0.065	0
261050007	1	Scottville	Mason	2017	100	245	0.073	0.067	0.064	0.064	0
261130001	1	Houghton Lake	Missaukee	2017	100	245	0.071	0.063	0.062	0.062	0
261210039	1	Muskegon	Muskegon	2017	100	245	0.082	0.075	0.075	0.074	1
261250001	2	Oak Park	Oakland	2017	96	236	0.084	0.074	0.070	0.069	1
261390005	1	Jenison	Ottawa	2017	100	245	0.069	0.068	0.067	0.065	0
261470005	1	Port Huron	St. Clair	2017	99	243	0.074	0.072	0.069	0.067	0
261530001	1	Seney	Schoolcraft	2017	99	244	0.071	0.057	0.057	0.056	0
261610008	1	Ypsilanti	Washtenaw	2017	100	245	0.073	0.071	0.070	0.068	0
261630001	2	Allen Park	Wayne	2017	94	343	0.068	0.068	0.067	0.067	0
261630019	2	Detroit-E. 7 Mile	Wayne	2017	97	237	0.084	0.082	0.076	0.076	4
261630093	1	Eliza Howell-Roadway**	Wayne	2017	93	229	0.059	0.058	0.056	0.054	0
261630094	1	Eliza Howell-Downwind**	Wayne	2017	89	217	0.077	0.067	0.066	0.065	1

****** Indicates sampling is part of a two-year special study.

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	2017	118	26.2	26.0	24.6	21.2	24.6	7.49
260170014	1	FRM	Bay City	Bay	2017	120	25.8	22.9	22.4	19.6	22.4	6.75
260210014	1	FRM	Coloma	Berrien	2017	120	31.5	28.2	26.2	23.5	26.2	7.99
260330901	1	FRM	Sault Ste. Marie	Chippewa	2017	28	25.3	18.8	16.2	8.8	25.3	6.10*
260330901	2	FRM	Sault Ste. Marie	Chippewa	2017	12	16.4	8.8	8.6	5.6	16.4	5.88*
260490021	1	FRM	Flint	Genesee	2017	121	22.5	20.0	16.8	15.1	16.8	7.10
260650012	1	FRM	Lansing	Ingham	2017	119	25.1	19.8	17.1	16.7	17.1	7.23
260770008	1	FRM	Kalamazoo	Kalamazoo	2017	116	25.3	23.6	22.6	17.7	22.6	8.03
260770008	2	FRM	Kalamazoo	Kalamazoo	2017	60	23.5	22.5	16.5	14.2	22.5	8.36
260810007	1	FRM	Grand Rapids-Wealthy	Kent	2017	120	30.7	26.8	26.2	23.9	26.2	9.15
260810020	1	FRM	Grand Rapids-Monroe	Kent	2017	121	29.0	22.7	22.6	21.7	22.6	8.12
260810020	2	FRM	Grand Rapids-Monroe	Kent	2017	60	23.1	22.8	18.4	18.4	22.8	8.31
260910007	1	FRM	Tecumseh	Lenawee	2017	119	20.7	17.6	17.5	15.6	17.5	7.34
260990009	1	FRM	New Haven	Macomb	2017	121	30.0	25.5	17.0	16.3	17.0	7.41
261010922	1	FRM	Manistee	Manistee	2017	115	27.5	22.2	19.2	18.0	19.2	5.84
261130001	1	FRM	Houghton Lake	Missaukee	2017	116	27.1	15.1	14.9	12.9	14.9	4.81
261150006	1	FRM	Sterling State Park	Monroe	2017	116	28.9	23.7	20.5	16.5	20.5	7.71
261250001	1	FRM	Oak Park	Oakland	2017	114	23.0	20.6	19.8	19.6	19.8	7.87
261470005	1	FRM	Port Huron	St. Clair	2017	121	33.9	25.0	19.2	17.8	19.2	8.01
261610008	1	FRM	Ypsilanti	Washtenaw	2017	117	31.7	21.5	18.8	17.9	18.8	7.93
261610008	2	FRM	Ypsilanti	Washtenaw	2017	61	20.9	19.0	17.5	16.0	19.0	8.32
261630001	1	FRM	Allen Park	Wayne	2017	356	32.1	26.3	25.5	25.4	21.8	8.47
261630015	1	FRM	Detroit-W. Fort St.	Wayne	2017	120	24.3	35.5	30.0	23.8	30.0	11.01
261630016	1	FRM	Detroit-Linwood	Wayne	2017	120	35.7	31.4	35.0	21.8	25.0	8.99
261630019	1	FRM	Detroit-E. 7 Mile	Wayne	2017	119	21.8	19.2	16.6	16.4	16.6	7.88
261630025	1	FRM	Livonia	Wayne	2017	119	34.6	21.3	19.1	18.7	19.1	7.98
261630033	1	FRM	Dearborn	Wayne	2017	121	37.5	25.3	24.5	23.8	24.5	10.57
261630033	2	FRM	Dearborn	Wayne	2017	61	24.9	23.5	18.5	18.1	23.5	10.82
261630036	1	FRM	Wyandotte	Wayne	2017	115	27.6	21.1	19.3	16.1	19.3	7.18
261630039	1	FRM	Detroit-W. Lafayette	Wayne	2017	52	34.1	19.5	17.1	15.2	19.5	7.93*
261630095	1	FRM	Livonia-Roadway	Wayne	2017	113	35.9	19.3	19.0	18.0	19.0	8.64

*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	2017	8631	126.0	58.0	52.0	38.0	7.06
260330901	3	BAM	Sault Ste. Marie	Chippewa	2017	6504	81.3	68.1	55.8	53.5	7.60*
260490021	3	TEOM	Flint	Genesee	2017	8413	68.0	55.0	54.0	47.0	7.35
260650012	3	TEOM	Lansing	Ingham	2017	8558	60.0	50.0	41.0	33.0	7.40
260770008	3	TEOM	Kalamazoo	Kalamazoo	2017	8505	85.0	78.0	55.0	44.0	8.00
260810020	3	TEOM	Grand Rapids-Monroe	Kent	2017	8147	58.0	48.0	43.0	43.0	8.13
260910007	3	TEOM	Tecumseh	Lenawee	2017	8498	51.0	41.0	36.0	36.0	7.56
261130001	3	TEOM	Houghton Lake	Missaukee	2017	8178	32.0	29.0	25.0	24.0	6.00
261470005	3	TEOM	Port Huron	St. Clair	2017	8514	76.0	52.0	46.0	45.0	8.10
261530001	3	TEOM	Seney	Schoolcraft	2017	8374	57.0	40.0	38.0	37.0	5.51
261610008	3	TEOM	Ypsilanti	Washtenaw	2017	8680	238.0	119.0	109.0	98.0	8.20
261630001	3	TEOM	Allen Park	Wayne	2017	8401	152.0	84.0	53.0	50.0	8.74
261630033	3	TEOM	Dearborn	Wayne	2017	8712	176.0	145.0	99.0	60.0	9.94
261630039	3	TEOM	Detroit–W. Lafayette	Wayne	2017	8581	67.0	55.0	51.0	48.0	8.70
261630093	3	BAM	Eliza Howell-Roadway**	Wayne	2017	8397	278.6	130.4	118.3	111.7	11.31
261630098	3	BAM	Eliza Howell–Downwind**	Wayne	2017	7677	183.0	93.5	81.6	49.6	7.33
261630097	3	TEOM	NMH 48217	Wayne	2017	8551	122.7	57.6	54.9	53.0	8.90

**Indicates sampling is part of a 2-year special study

PM_{10} (24-HOUR) measured in μg /m3

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	2017	61	61	61	100	34	29	28	28	14.6
261630001	1	GRAV	Allen Park	Wayne	2017	59	61	59	97	45	35	35	33	18.1
261630005	1	GRAV	River Rouge	Wayne	2017	61	61	61	100	67	60	50	41	22.4
261630015	1	GRAV	Detroit-W. Fort St.	Wayne	2017	60	61	60	98	72	57	57	44	25.9
261630033	1	GRAV	Dearborn	Wayne	2017	61	61	60	98	81	58	58	56	27.5
261630033	9	GRAV	Dearborn	Wayne	2017	29	30	29	97	59	53	49	36	25.0

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	2017	8602	260	219	212	207	20.9

$PM_{10-2.5}$ (24-hour) measured in $\mu g/m^3$

Site ID	Monitor	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Wtd. Arith. Mean
260810020	GRAV	Grand Rapids-Monroe	Kent	2017	116	22.4	20.4	19.4	19.1	6.28
261630001	GRAV	Allen Park	Wayne	2017	114	32.2	22.6	19.4	18.4	7.48

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	2017	8324	9.9	9.3	7.9	2.5	1.9	0	0.72
260810020	2	Grand Rapids-Monroe	Kent	2017	8164	4.9	4.7	4.0	1.5	1.5	0	0.40
261150006	1	Sterling State Park	Monroe	2017	8092	10.4	9.5	8.0	2.8	2.6	0	0.71
261390011	1	West Olive	Ottawa	2017	8367	29.7	28.8	20.5	10.1	7.5	0	0.63
261470005	1	Port Huron	St. Clair	2017	8000	76.1	66.6	55.2	17.7	17.4	0	2.10
261630001	1	Allen Park	Wayne	2017	8317	30.4	26.6	23.4	6.2	4.0	0	0.50
261630015	1	Detroit-W. Fort St.	Wayne	2017	8378	96.7	74.5	70.4	31.8	29.4	0	2.82
261630097	1	NMH 48217	Wayne	2017	8344	37.8	31.4	27.8	7.8	7.8	0	1.25

APPENDIX B: 2017 AIR TOXICS MONITORING SUMMARY FOR METALS, VOCS, CARBONYL COMPOUNDS, PAHS, HEXAVALENT CHROMIUM & SPECIATED $PM_{2.5}$

Appendix B provides summary statistics of ambient air concentrations of various substances monitored in Michigan during 2017. At each monitoring site, air samples were taken over a 24-hour period (midnight to midnight). These air samples represent the average air concentration during that 24-hour period. The frequency of air samples collected is typically done once every 6 or 12 days. Sometimes the sampled air concentration is lower than the laboratory's analytical method detection level (MDL). When the concentration is lower than the MDL, two options are used to estimate the air concentration. The calculation of the minimum average ("Average (ND=0)") uses 0.0 µg/m³ for a value less than the MDL. In the calculation of the maximum average ("Average (ND=MDL/2)") the MDL divided by 2 (i.e., ½ the MDL) is substituted for air concentrations less than the MDL.

Table B shows the monitoring stations and what types of air toxics were monitored at each station in 2017. 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 2017, assuming daily samples below MDL were equal to 0.0 µg/m³.
- Average (ND=MDL/2): average air concentration in 2017, assuming daily samples below MDL were equal to one half the MDL.
- MDL: Analytical MDL in units of µg/m³
- Max1: Highest daily air concentration during 2017
- Max2: Second highest daily air concentration during 2017
- Max3: Third highest daily air concentration during 2017
- µg/m³: Micrograms per cubic meter (1,000,000 µg = 1 g)

SITE NAME	VOC	Carbonyl	PAHs	Metals TSP	Metals PM10	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		
NMH 48217	x		x	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	58	58	0.00144	0.00144	8.62E-06	0.00522	0.00497	0.00448
Arsenic Pm10 Stp	59	59	0.00117	0.00117	1.00E-05	0.00503	0.00499	0.00495
Cadmium (Tsp) Stp	58	58	0.000151	0.000151	8.62E-06	0.00058	0.00038	0.00037
Cadmium Pm10 Stp	59	59	0.000248	0.000248	1.00E-05	0.00107	0.00074	0.00062
Lead (Tsp) Lc Frm/Fem	58	58	0.0037	0.0037		0.0147	0.00799	0.00702
Lead Pm10 Lc	59	59	0.00268	0.00268		0.00866	0.00816	0.00656
Manganese (Tsp) Stp	58	58	0.0222	0.0222	5.83E-05	0.0681	0.0565	0.0523
Manganese Pm10 Stp	59	59	0.00824	0.00824	7.10E-05	0.0216	0.0209	0.0188
Nickel (Tsp) Stp	58	58	0.00124	0.00124	5.43E-05	0.00244	0.00243	0.00212
Nickel Pm10 Stp	59	59	0.000827	0.000827	6.78E-05	0.00209	0.0015	0.00139

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	0.144	0.288	0	0	0
1,1,2-Trichloroethane	60	0	0	0.104	0.207	0	0	0
1,1-Dichloroethane	60	0	0	0.0364	0.0729	0	0	0
1,1-Dichloroethylene	60	0	0	0.0357	0.0714	0	0	0
1,2,4-Trichlorobenzene	60	1	0.00161	0.151	0.304	0.0965	0	0
1,2,4-Trimethylbenzene	60	60	0.961	0.961	0.236	5.26	3.98	3.72
1,2-Dichlorobenzene	60	0	0	0.147	0.295	0	0	0
1,2-Dichloropropane	60	1	0.000617	0.0779	0.157	0.037	0	0
1,3,5-Trimethylbenzene	60	60	0.301	0.301	0.221	1.75	1.23	1.19
1,3-Butadiene	60	59	0.071	0.0713	0.0443	0.204	0.164	0.164
1,3-Dichlorobenzene	60	0	0	0.138	0.277	0	0	0
1,4-Dichlorobenzene	60	4	0.00551	0.123	0.253	0.102	0.0902	0.0721
2,5-Dimethylbenzaldehyde	64	0	0	0.00822	0.0164	0	0	0
9-Fluorenone (Tsp) Stp	64	64	0.00192	0.00192	0.0000693	0.00744	0.0053	0.00449
Acenaphthene (Tsp) Stp	64	64	0.00676	0.00676	3.75E-04	0.0336	0.0257	0.0205
Acenaphthylene (Tsp) Stp	64	52	0.000374	0.000376	0.0000151	0.00259	0.0018	0.00164
Acetaldehyde	64	64	1.86	1.86	0.0396	3.82	3.48	3.15
Acetone	64	64	3.44	3.44	0.326	20.8	18.9	7.17
Acetonitrile	60	60	1.32	1.32	0.0772	2.54	2.49	2.22
Acetylene	60	60	0.814	0.814	0.0117	2.62	2.25	2.23
Acrylonitrile	60	1	0.00094	0.0287	5.64E-02	0.0564	0	0
Anthracene (Tsp) Stp	64	64	0.000366	0.000366	3.62E-05	0.00134	0.000937	0.000838
Arsenic (Tsp) Stp	87	87	0.00162	0.00162	8.68E-06	0.0106	0.00455	0.00443
Arsenic Pm10 Stp	91	91	0.00141	0.00141	0.00001	0.0107	0.00483	0.0048
Barium (Tsp) Stp	87	87	0.0297	0.0297	0.000347	0.0592	0.0552	0.0529
Barium Pm10 Stp	91	91	0.0117	0.0117	0.000424	0.0319	0.0283	0.0258

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
Benzaldehyde	64	64	0.153	0.153	0.013	0.3	0.278	0.273
Benzene	60	60	0.685	0.685	0.0831	1.36	1.26	1.24
Benzo[A]Anthracene (Tsp) Stp	64	64	0.000176	0.000176	1.51E-05	0.00069	0.000623	0.000568
Benzo[A]Pyrene (Tsp) Stp	64	64	0.000148	0.000148	2.41E-05	0.000577	0.000389	0.000386
Benzo[B]Fluoranthene (Tsp) Stp	64	64	0.000418	0.000418	3.01E-05	0.00131	0.00113	0.00109
Benzo[E]Pyrene (Tsp) Stp	64	64	0.000223	0.000223	2.41E-05	0.000585	0.00056	0.000559
Benzo[G,H,I]Perylene (Tsp) Stp	64	64	2.08E-04	2.08E-04	2.31E-05	0.000521	0.000432	0.00043
Benzo[K]Fluoranthene (Tsp) Stp	64	64	1.23E-04	1.23E-04	3.01E-05	3.87E-04	3.50E-04	2.80E-04
Beryllium (Tsp) Stp	87	87	7.94E-05	7.94E-05	5.90E-06	0.00024	0.00019	0.00018
Beryllium Pm10 Stp	91	89	0.0000191	0.0000192	0.00000704	0.00009	0.00007	0.00007
Bromochloromethane	60	9	0.032	0.0702	0.09	0.318	0.254	0.228
Bromodichloromethane	60	0	0	0.111	0.221	0	0	0
Bromoform	60	0	0	0.14	2.79E-01	0	0	0
Bromomethane	60	46	0.0362	0.0444	6.99E-02	0.0777	0.0777	0.0777
Butyraldehyde	64	64	0.589	0.589	1.18E-02	4.13	2.59	2.05
Cadmium (Tsp) Stp	87	87	0.000313	0.000313	8.68E-06	0.00124	0.00121	0.00119
Cadmium Pm10 Stp	91	91	0.000256	0.000256	0.00001	0.00114	0.00106	0.00101
Carbon Disulfide	60	60	0.117	0.117	0.137	0.377	0.28	0.277
Carbon Tetrachloride	60	60	0.606	0.606	0.145	0.742	0.717	0.705
Chlorobenzene	60	2	0.00177	0.0775	0.157	0.0737	0.0322	0
Chloroethane	60	24	0.0238	0.042	0.0607	0.137	0.0765	0.0739
Chloroform	60	60	0.339	0.339	0.0928	0.703	0.547	0.542
Chloromethane	60	60	1.14	1.14	3.92E-02	1.37	1.35	1.33
Chloroprene	60	0	0	0.0362	0.0724	0	0	0
Chromium (Tsp) Stp	87	87	0.0057	0.0057	1.39E-04	0.0169	0.0163	0.0159
Chromium Pm10 Stp	91	91	0.0253	0.0253	1.70E-04	0.0442	0.042	0.0407
Chrysene (Tsp) Stp	64	64	0.000416	0.000416	0.0000181	0.00209	0.00113	0.00103
Cis-1,2-Dichloroethene	60	0	0	0.0436	0.0872	0	0	0
Cis-1,3-Dichloropropene	60	0	0.00E+00	7.94E-02	1.59E-01	0.00E+00	0.00E+00	0.00E+00
Cobalt (Tsp) Stp	87	87	0.000291	0.000291	2.00E-05	0.00084	0.00083	0.00062
Cobalt Pm10 Stp	91	91	0.000127	0.000127	0.00003	0.00052	0.00045	0.00034
Copper (Tsp) Stp	87	87	0.0266	0.0266	0.000231	0.0897	0.0598	0.0557
Copper Pm10 Stp	91	91	0.0351	0.0351	0.000282	0.145	0.122	0.1
Coronene (Tsp) Stp	64	64	9.85E-05	9.85E-05	0.00000402	0.000266	0.000239	0.000223
Crotonaldehyde	0	0						
Cyclopenta[Cd]Pyrene (Tsp) Stp	64	46	0.0000266	0.0000302	0.0000251	0.000193	0.000116	0.000106
Dibenzo[A,H]Anthracene (Tsp) Stp	64	63	0.0000386	0.0000387	0.0000161	0.000156	0.000136	0.0000927
Dibromochloromethane	60	2	0.00128	0.112	0.23	0.0596	0.017	0
Dichlorodifluoromethane	60	60	2.51	2.51	0.0742	3.08	2.96	2.95
Dichloromethane	60	60	2.67	2.67	0.0591	16.8	7.89	6.53
Ethyl Acrylate	60	0	0	0.0614	0.123	0	0	0
Ethylbenzene	60	60	0.778	0.778	0.135	5.6	2.97	1.97

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
Ethylene Dibromide	60	0	0	0.138	0.277	0	0	0
Ethylene Dichloride	60	59	0.0665	0.0672	0.089	0.089	0.089	0.085
Fluoranthene (Tsp) Stp	64	64	0.00341	0.00341	0.0000652	0.0213	0.0122	0.0109
Fluorene (Tsp) Stp	64	64	0.00651	0.00651	0.000207	0.0279	0.0196	0.0181
Formaldehyde	64	64	3.09	3.09	0.0587	8.12	5.66	5.65
Freon 114	60	60	0.126	0.126	0.0979	0.224	0.21	0.189
Hexachlorobutadiene	60	1	0.00107	0.321	6.51E-01	0.064	0	0
Hexanaldehyde	61	60	0.098	0.098	8.19E-03	0.197	0.193	0.193
Indeno[1,2,3-Cd]Pyrene (Tsp) Stp	64	64	0.000198	0.000198	0.0000251	0.000541	0.00052	0.000508
Iron (Tsp) Stp	87	87	1.47	1.47	0.00318	6.39	5.71	5.48
Iron Pm10 Stp	91	91	0.671	0.671	0.00389	2.72	2.66	2.19
Isovaleraldehyde	64	0	0	0.00352	7.05E-03	0	0	0
Lead (Tsp) Lc Frm/Fem	87	87	0.0119	0.0119		0.128	0.126	0.0397
Lead Pm10 Lc	91	91	0.0103	0.0103		0.153	0.145	0.0295
M/P Xylene	60	60	1.92	1.92	2.39E-01	21.4	10.8	7.04
Manganese (Tsp) Stp	87	87	0.0919	0.0919	5.90E-05	0.315	0.313	0.306
Manganese Pm10 Stp	91	91	0.0327	0.0327	0.0000705	0.134	0.127	0.124
Methyl Chloroform	60	12	0.00455	0.0525	0.12	0.0436	0.0327	0.0218
Methyl Ethyl Ketone	59	59	0.465	0.465	0.0118	1.22	1.1	0.947
Methyl Isobutyl Ketone	60	59	0.282	0.283	0.127	0.783	0.668	0.623
Methyl Methacrylate	60	2	0.00177	0.0928	0.188	0.0573	0.0491	0
Methyl Tert-Butyl Ether	60	0	0	0.0361	7.21E-02	0	0	0
Molybdenum (Tsp) Stp	87	87	0.00121	0.00121	0.00000998	0.0108	0.0102	0.00809
Molybdenum Pm10 Stp	91	91	0.00115	0.00115	1.08E-05	0.0119	0.0113	0.00788
Naphthalene (Tsp) Stp	64	64	0.0895	0.0895	3.24E-03	0.273	0.221	0.212
Nickel (Tsp) Stp	87	87	0.00233	0.00233	0.0000552	0.00538	0.00531	0.00508
Nickel Pm10 Stp	91	91	0.00147	0.00147	0.0000675	0.00556	0.00491	0.00483
N-Octane	60	60	0.532	0.532	0.14	14.3	0.673	0.551
O-Xylene	60	60	0.862	0.862	0.139	5.82	3.15	2.45
Perylene (Tsp) Stp	64	64	0.0000339	0.0000339	0.0000121	0.00012	0.000117	0.0000913
Phenanthrene (Tsp) Stp	64	64	0.0121	0.0121	2.33E-04	0.0635	0.0357	0.0299
Propionaldehyde	64	64	0.37	0.37	1.41E-02	1.04	0.737	0.606
Propylene	60	60	0.61	0.61	0.062	1.44	1.36	1.26
Pyrene (Tsp) Stp	64	64	0.00175	0.00175	0.0000244	0.00949	0.00447	0.00387
Retene (Tsp) Stp	64	64	0.000223	0.000223	0.0000492	0.000666	0.000545	0.000509
Styrene	60	60	2.73	2.73	0.183	15.4	6.48	6.13
Tert-Butyl Ethyl Ether	60	1	0.000278	0.0393	0.0794	0.0167	0	0
Tetrachloroethylene	60	60	0.191	0.191	0.21	0.665	0.556	0.509
Tolualdehydes	46	45	0.143	0.144	0.0806	0.408	0.364	0.334
Toluene	60	60	1.36	1.36	0.098	3.96	3.46	3.34
Trans-1,2-Dichloroethylene	60	0	0	0.0357	0.0714	0	0	0
Trans-1,3-Dichloropropene	60	0	0	0.0772	0.154	0	0	0
Trichloroethylene	60	10	0.0153	0.0936	0.188	0.419	0.0967	0.086
Trichlorofluoromethane	60	60	1.42	1.42	0.107	1.93	1.85	1.79
Valeraldehyde	63	63	0.0901	0.0901	0.0141	0.169	0.169	0.169
Vanadium (Tsp) Stp	87	87	0.00342	0.00342	0.0000199	0.0109	0.0097	0.00827
Vanadium Pm10 Stp	91	90	0.00148	0.00148	0.0000246	0.0039	0.00367	0.00363
Vinyl Chloride	60	10	0.00234	0.0204	0.0435	0.023	0.0179	0.0179
Zinc (Tsp) Stp	87	87	0.161	0.161	0.00114	0.684	0.641	0.614
Zinc Pm10 Stp	91	91	0.106	0.106	0.0014	0.491	0.447	0.421

Detroit-W. Fort St. (N. Delray-SWHS) (261630015) Concentrations in micrograms per cubic meter (µg/m^3)								
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	31	2	0.0435	0.193	0.321	1	0.35	0
1,1,2-Trichloroethane	31	0	0	0.0488	0.0975	0	0	0
1,1-Dichloroethane	31	0	0	0.085	0.17	0	0	0
1,1-Dichloroethylene	31	0	0	0.0765	0.153	0	0	0
1,2,4-Trichlorobenzene	31	2	0.655	1.3	1.38	19	1.3	0
1,2,4-Trimethylbenzene	31	7	0.158	0.277	0.305	1.4	1.3	0.65
1,2-Dichlorobenzene	31	1	0.0839	0.261	0.367	2.6	0	0
1,2-Dichloropropane	31	0	0	0.55	1.1	0	0	0
1,3,5-Trimethylbenzene	31	1	0.0165	0.132	0.239	0.51	0	0
1,3-Butadiene	31	0	0	0.06	0.12	0	0	0
1,3-Dichlorobenzene	31	1	0.0613	0.197	0.282	1.9	0	0
1,4-Dichlorobenzene	31	1	0.0871	0.273	0.384	2.7	0	0
2,2,4-Trimethylpentane	31	9	0.141	0.205	0.17	0.89	0.58	0.56
Acetaldehyde	27	27	1.64	1.64		2.78	2.74	2.33
Acetone	27	27	2.86	2.86		4.84	3.9	3.88
Acetonitrile	31	9	0.183	0.359	0.498	0.94	0.72	0.7
Acrylonitrile	31	0	0	0.395	0.791	0	0	0
Arsenic (Tsp) Stp	60	60	0.00147	0.00147	8.57E-06	0.00444	0.00417	0.00386
Benzaldehyde	27	27	0.103	0.103		0.186	0.179	0.153
Benzene	31	31	0.774	0.774	0.0947	2.1	1.7	1.3
Bromodichloromethane	31	0	0	0.075	0.15	0	0	0
Bromoform	31	0	0	0.174	0.347	0	0	0
Bromomethane	31	0	0	0.11	0.22	0	0	0
Cadmium (Tsp) Stp	60	60	0.000205	0.000205	8.57E-06	0.001	0.00048	0.00039
Carbon Tetrachloride	31	13	0.212	0.278	0.228	0.78	0.68	0.64
Chlorobenzene	31	0	0	0.103	0.206	0	0	0
Chloroethane	31	0	0	0.06	0.12	0	0	0
Chloroform	31	26	0.475	0.485	0.12	0.75	0.75	0.74
Chloromethane	31	30	1.22	1.22	0.159	1.9	1.8	1.6
Chloroprene	10	0	0	0.055	0.11	0	0	0
Cis-1,2-Dichloroethene	31	0	0	0.0623	0.125	0	0	0
Cis-1,3-Dichloropropene	31	0	0	0.065	0.13	0	0	0
Crotonaldehyde	27	1	0.0017	0.0017		0.0459	0	0
Dibromochloromethane	31	0	0	0.147	0.295	0	0	0
Dichlorodifluoromethane	31	30	2.46	2.46	0.25	3.8	3.7	3.2
Dichloromethane	31	28	0.615	0.631	0.345	2.6	1.1	1.1
Ethylbenzene	31	2	0.0268	0.163	0.291	0.51	0.32	0
Ethylene Dibromide	31	1	0.0806	0.225	0.297	2.5	0	0
Ethylene Dichloride	31	0	0	0.0958	0.192	0	0	0
Formaldehyde	27	27	1.71	1.71		3.69	3.46	3.22
Freon 113	10	1	0.086	0.185	0.22	0.86	0	0
Freon 114	10	0	0	0.172	0.344	0	0	0
Hexachlorobutadiene	10	0	0	0.447	0.893	0	0	0
Hexanaldehyde	27	19	0.0447	0.0447		0.126	0.117	0.11

Detroit-W. Fort St. (N. Delray-SWHS) (261630015) Concentrations in micrograms per cubic meter (µg/m^3)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
M/P Xylene	31	4	0.147	0.466	0.732	1.7	1	0.96
Manganese (Tsp) Stp	60	60	0.0633	0.0633	5.77E-05	0.25	0.224	0.195
Manganese Pm10 Stp	60	60	0.0255	0.0255	7.03E-05	0.14	0.0749	0.0615
Methyl Chloroform	31	1	0.0116	0.113	0.21	0.36	0	0
Methyl Ethyl Ketone	31	9	0.613	1	1.1	5.5	2.2	2.1
Methyl Isobutyl Ketone	31	3	0.222	0.61	0.859	5.5	1	0.39
Methyl Tert-Butyl Ether	31	0	0	0.095	0.19	0	0	0
N-Hexane	31	21	0.979	0.993	0.0865	4.9	4	2.9
Nickel (Tsp) Stp	60	60	0.00278	0.00278	5.35E-05	0.00945	0.00797	0.00621
O-Xylene	31	14	0.213	0.303	0.33	0.58	0.56	0.56
Propionaldehyde	27	27	0.244	0.244		0.437	0.42	0.348
Styrene	31	1	0.0484	0.418	0.765	1.5	0	0
Tetrachloroethylene	31	1	0.248	0.36	0.232	7.7	0	0
Tolualdehydes	27	2	0.00351	0.00351		0.052	0.0427	0
Toluene	31	30	0.962	0.969	0.441	2.7	2.3	1.5
Trans-1,2-Dichloroethylene	31	0	0	0.0747	0.149	0	0	0
Trans-1,3-Dichloropropene	31	1	0.0355	0.0788	0.0896	1.1	0	0
Trichloroethylene	31	0	0	0.0835	0.167	0	0	0
Trichlorofluoromethane	31	30	1.35	1.35	0.231	2	2	1.9
Valeraldehyde	27	25	0.0867	0.0867		0.176	0.174	0.172
Vinyl Chloride	31	0	0	0.065	0.13	0	0	0

Detroit, W. Jefferson, South Delray (261630027) Concentrations in micrograms per cubic meter (µg/m^3)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	60	59	0.00173	0.00173	8.76E-06	0.00556	0.00471	0.0044
Cadmium (Tsp) Stp	60	59	0.000261	0.000261	8.76E-06	0.0006	0.00059	0.00053
Manganese (Tsp) Stp	60	59	0.115	0.115	5.95E-05	0.489	0.402	0.399
Nickel (Tsp) Stp	60	59	0.00278	0.00278	5.56E-05	0.00784	0.00723	0.00638

Port Huron-Rural St. (261470031), 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
Arsenic (Tsp) Stp	61	61	0.0018	0.0018	8.52E-06	0.0355	0.0046	0.00405
Cadmium (Tsp) Stp	61	61	0.00142	0.00142	8.52E-06	0.0361	0.0108	0.00481
Lead (Tsp) Lc Frm/Fem	61	61	0.0454	0.0454		0.394	0.284	0.268
Manganese (Tsp) Stp	61	61	0.0124	0.0124	5.79E-05	0.0422	0.0385	0.0343
Nickel (Tsp) Stp	61	61	0.00135	0.00135	5.38E-05	0.00381	0.00283	0.00241

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	30	30	1.44	1.44		3.04	3.02	2.5
Acetone	30	30	2.09	2.09		3.27	3.05	2.84
Arsenic (Tsp) Stp	61	61	0.00142	0.00142	8.66E-06	0.00717	0.0042	0.00393
Benzaldehyde	30	30	0.166	0.166		0.331	0.269	0.239
Cadmium (Tsp) Stp	61	61	0.000333	0.000333	8.66E-06	0.00156	0.00119	0.0008
Crotonaldehyde	30	3	0.00798	0.00798		0.108	0.0736	0.0579
Formaldehyde	30	30	3.95	3.95		9.79	7.57	7.3
Hexanaldehyde	30	30	0.21	0.21		0.515	0.489	0.385
Manganese (Tsp) Stp	61	61	0.0534	0.0534	5.80E-05	0.231	0.194	0.149
Manganese Pm10 Stp	61	61	0.0249	0.0249	7.07E-05	0.144	0.142	0.0889
Nickel (Tsp) Stp	61	61	0.00161	0.00161	5.46E-05	0.00506	0.00355	0.00336
Propionaldehyde	30	30	0.251	0.251		0.503	0.496	0.432
Tolualdehydes	30	4	0.0106	0.0106		0.204	0.0431	0.0379
Valeraldehyde	30	30	0.162	0.162		0.337	0.33	0.295

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	59	59	0.00101	0.00101	8.71E-06	0.00499	0.00419	0.00327
Cadmium (Tsp) Stp	59	59	0.0000888	0.0000888	8.71E-06	0.00025	0.00021	0.0002
Lead (Tsp) Lc Frm/Fem	59	59	0.00326	0.00326		0.00759	0.00719	0.00712
Manganese (Tsp) Stp	59	59	0.0111	0.0111	5.97E-05	0.0372	0.0221	0.0217
Nickel (Tsp) Stp	59	59	0.00134	0.00134	5.54E-05	0.00829	0.00326	0.00303

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	61	61	0.00099	0.00099	8.51E-06	0.00284	0.00257	0.00238
Cadmium (Tsp) Stp	61	61	0.000219	0.000219	8.51E-06	0.0031	0.00088	0.00065
Lead (Tsp) Lc Frm/Fem	61	61	0.012	0.012		0.0777	0.0586	0.046
Manganese (Tsp) Stp	61	61	0.0104	0.0104	5.72E-05	0.0456	0.0244	0.0228
Nickel (Tsp) Stp	61	61	0.0015	0.0015	5.39E-05	0.0116	0.00846	0.00424

Belding-Reed St. (260670002) 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	0.000794	0.000794	8.49E-06	0.00225	0.00221	0.00186
Cadmium (Tsp) Stp	61	61	0.000198	0.000198	8.49E-06	0.00166	0.00099	0.0007
Lead (Tsp) Lc Frm/Fem	61	61	0.00871	0.00871		0.0968	0.0392	0.032
Manganese (Tsp) Stp	61	61	0.00796	0.00796	5.79E-05	0.0209	0.0206	0.0158
Nickel (Tsp) Stp	61	61	0.00109	0.00109	5.41E-05	0.00241	0.00222	0.00207

NMH 48217 (261630097) Concentrations in micrograms per cubic meter (µg/m^3)								
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	45	0	0	1.72	3.43	0	0	0
1,1,2-Trichloroethane	45	0	0	1.36	2.73	0	0	0
1,1-Dichloroethane	45	0	0	1.01	2.02	0	0	0
1,1-Dichloroethylene	45	0	0	0.991	1.98	0	0	0
1,2,4-Trichlorobenzene	45	0	0	1.86	3.71	0	0	0
1,2,4-Trimethylbenzene	45	0	0	1.23	2.46	0	0	0
1,2-Dichlorobenzene	45	0	0	1.5	3.01	0	0	0
1,2-Dichloropropane	45	0	0	1.16	2.31	0	0	0
1,3,5-Trimethylbenzene	45	0	0	1.23	2.46	0	0	0
1,3-Butadiene	45	0	0	0.553	1.11	0	0	0
1,3-Dichlorobenzene	45	0	0	1.5	3.01	0	0	0
1,4-Dichlorobenzene	45	0	0	1.5	3.01	0	0	0
2,2,4-Trimethylpentane	45	0	0	1.17	2.34	0	0	0
2-Methylnaphthalene (Tsp) Stp	19	18	0.0493	0.0496	0.01	0.074	0.068	0.06
Acetone	45	35	8.29	8.81	4.75	19.4	17.1	16.5
Acetonitrile	45	0	0	0.84	1.68	0	0	0
Arsenic (Tsp) Stp	61	61	0.00119	0.00119	0.00000841	0.00516	0.00418	0.00336
Barium (Tsp) Stp	56	56	0.0147	0.0147	0.000335	0.0467	0.0269	0.0247
Benzene	45	1	0.114	0.895	1.6	5.11	0	0
Benzyl Chloride	45	0	0	1.29	2.59	0	0	0
Beryllium (Tsp) Stp	56	56	0.0000199	0.0000199	0.00000563	0.00004	0.00003	0.00003
Bis (2-Chloroethyl)Ether (Tsp) Stp	1	1	0.041	0.041	0.01	0.041		
Bromodichloromethane	45	0	0	1.68	3.35	0	0	0
Bromoform	45	0	0	2.58	5.17	0	0	0
Bromomethane	45	0	0	0.971	1.94	0	0	0
Cadmium (Tsp) Stp	61	61	0.000152	0.000152	0.00000841	0.00062	0.00037	0.00037
Carbon Disulfide	45	2	0.115	0.858	1.56	2.71	2.46	0
Carbon Tetrachloride	45	0	0	1.57	3.15	0	0	0
Chlorobenzene	45	0	0	1.15	2.3	0	0	0
Chloroethane	45	0	0	0.66	1.32	0	0	0
Chloroform	45	0	0	1.22	2.44	0	0	0
Chloromethane	45	39	1.05	1.12	1.03	1.45	1.38	1.38
Chromium (Tsp) Stp	56	56	0.00268	0.00268	0.000135	0.00784	0.00664	0.00623
Cis-1,2-Dichloroethene	45	0	0	0.991	1.98	0	0	0
Cis-1,3-Dichloropropene	45	0	0	1.13	2.27	0	0	0
Cobalt (Tsp) Stp	56	56	0.000138	0.000138	0.00002	0.00026	0.00024	0.00023
Copper (Tsp) Stp	56	56	0.291	0.291	0.000224	0.615	0.481	0.478
Dibromochloromethane	45	0	0	2.13	4.26	0	0	0
Dichlorodifluoromethane	45	35	2.18	2.46	2.47	4.1	3.46	3.36
Dichloromethane	45	0	0	1.74	3.47	0	0	0
Diethyl Phthalate (Tsp) Stp	1	1	0.044	0.044	0.01	0.044		
Ethylbenzene	45	0	0	1.09	2.17	0	0	0
Ethylene Dibromide	45	0	0	1.92	3.84	0	0	0
Ethylene Dichloride	45	0	0	1.01	2.02	0	0	0
Hexachlorobutadiene	45	0	0	2.67	5.33	0	0	0
Hexachloroethane (Tsp) Stp	1	1	0.039	0.039	0.01	0.039		

NMH 48217 (261630097) 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
Iron (Tsp) Stp	56	56	0.426	0.426	0.00307	0.971	0.886	0.853
Lead (Tsp) Lc Frm/Fem	61	61	0.00372	0.00372		0.00913	0.00878	0.00859
M/P Xylene	45	1	0.124	2.25	4.34	5.56	0	0
Manganese (Tsp) Stp	61	61	0.0238	0.0238	0.0000559	0.0964	0.0614	0.0606
Methanol	45	33	18	18.7	6.29	56	43.1	41.2
Methyl Chloroform	45	0	0	1.36	2.73	0	0	0
Methyl Ethyl Ketone	45	2	0.205	1.61	2.95	5.01	4.22	0
Methyl Isobutyl Ketone	45	0	0	1.02	2.05	0	0	0
Methyl Tert-Butyl Ether	45	0	0	0.902	1.8	0	0	0
Molybdenum (Tsp) Stp	56	56	0.000511	0.000511	0.00001	0.00627	0.00129	0.00091
Naphthalene (Tsp) Stp	46	34	0.0582	0.0595	0.01	0.14	0.14	0.14
N-Hexane	45	6	0.345	1.11	1.76	3.42	2.71	2.64
Nickel (Tsp) Stp	61	61	0.00145	0.00145	0.0000513	0.00318	0.00273	0.00248
O-Xylene	45	0	0	1.09	2.17	0	0	0
Propylene	45	0	0	0.861	1.72	0	0	0
Styrene	45	0	0	1.07	2.13	0	0	0
Tetrachloroethylene	45	0	0	1.7	3.39	0	0	0
Toluene	45	15	1.33	1.96	1.88	15.6	6.78	5.24
Trans-1,2-Dichloroethylene	45	0	0	0.991	1.98	0	0	0
Trans-1,3-Dichloropropene	45	0	0	1.13	2.27	0	0	0
Trichloroethylene	45	0	0	1.34	2.69	0	0	0
Trichlorofluoromethane	45	0	0	1.4	2.81	0	0	0
Vanadium (Tsp) Stp	56	56	0.00155	0.00155	0.00002	0.00595	0.00469	0.00373
Vinyl Chloride	45	0	0	0.639	1.28	0	0	0
Zinc (Tsp) Stp	56	56	0.0342	0.0342	0.00111	0.107	0.102	0.0778

APPENDIX B-2

Allen Park (261630001), Speciated $PM_{2.5}$ ($\mu g/m^3$)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	122	88	0.021188852	0.02118885	0.03796025	0.147	0.136	0.0778
Ammonium Ion Pm2.5 Lc	122	116	0.429536803	0.42960566	0.00599746	3.49	2.15	2.07
Antimony Pm2.5 Lc	122	59	0.006247787	0.00624779	0.03989574	0.0563	0.0483	0.0384
Arsenic Pm2.5 Lc	122	44	0.00024041	0.00036488	0.00258492	0.00492	0.00473	0.00428
Barium Pm2.5 Lc	122	79	0.017333852	0.01733385	0.08072254	0.0881	0.0827	0.0746
Bromine Pm2.5 Lc	122	104	0.002859426	0.00285943	0.00452738	0.0145	0.0133	0.0109
Cadmium Pm2.5 Lc	122	57	0.003087869	0.00308787	0.01615959	0.022	0.0177	0.0171
Calcium Pm2.5 Lc	122	122	0.06304541	0.06304541	0.03406164	0.371	0.303	0.246
Cerium Pm2.5 Lc	122	71	0.019524016	0.01952402	0.0960409	0.0951	0.0888	0.0886
Cesium Pm2.5 Lc	122	67	0.011856393	0.01185639	0.05579131	0.0927	0.0661	0.0615
Chlorine Pm2.5 Lc	122	83	0.006219016	0.00621902	0.00669344	0.0605	0.0583	0.0514
Chromium Pm2.5 Lc	122	85	0.004792049	0.00479205	0.00377295	0.211	0.0736	0.0213
Cobalt Pm2.5 Lc	122	43	0.000376721	0.00037672	0.00326779	0.00357	0.00273	0.00273
Copper Pm2.5 Lc	122	114	0.008439836	0.00843984	0.01112082	0.039	0.0279	0.0273
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	119	119	0.315948739	0.31594874	0.01167387	0.785	0.752	0.699
Indium Pm2.5 Lc	122	64	0.004518033	0.00451803	0.03705557	0.0264	0.0263	0.0204
Iron Pm2.5 Lc	122	122	0.097069672	0.09706967	0.02696213	0.782	0.381	0.339
Lead Pm2.5 Lc	122	67	0.003572049	0.00357205	0.01223475	0.0178	0.0169	0.0154
Magnesium Pm2.5 Lc	122	77	0.014127131	0.01412713	0.04189508	0.0787	0.0659	0.0606
Manganese Pm2.5 Lc	122	95	0.00238459	0.00238459	0.00638295	0.0136	0.0117	0.0111
Nickel Pm2.5 Lc	122	83	0.001584672	0.00158467	0.00206951	0.0591	0.0203	0.00747
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	119	119	2.070773109	2.07077311	0.07949387	6.05	5.57	5.06
Phosphorus Pm2.5 Lc	122	122	0.000185902	0.0001859	0.00217443	0.0036	0.00179	0.00127
Potassium Ion Pm2.5 Lc	122	122	0.030361475	0.03036148	0.0465573	0.328	0.179	0.138
Potassium Pm2.5 Lc	122	122	0.065537705	0.0655377	0.01153795	0.467	0.41	0.168
Rubidium Pm2.5 Lc	122	71	0.001127541	0.00112754	0.00870246	0.00653	0.00644	0.00563
Selenium Pm2.5 Lc	122	74	0.001555984	0.00155598	0.00531705	0.00774	0.00738	0.00667
Silicon Pm2.5 Lc	122	121	0.054298361	0.05429836	0.02004336	0.245	0.165	0.14
Silver Pm2.5 Lc	122	63	0.003288934	0.00328893	0.0168127	0.0193	0.018	0.0161
Sodium Ion Pm2.5 Lc	122	122	0.031701148	0.03170115	0.01644385	0.341	0.142	0.107
Sodium Pm2.5 Lc	122	55	0.024937705	0.0249377	0.08791975	0.145	0.143	0.137
Strontium Pm2.5 Lc	122	68	0.001663443	0.00166344	0.00706762	0.0211	0.0135	0.0111
Sulfate Pm2.5 Lc	122	122	1.025877049	1.02587705	0.04752582	3.59	2.77	2.43
Sulfur Pm2.5 Lc	122	122	0.403486066	0.40348607	0.00519205	1.37	1.02	0.93
Tin Pm2.5 Lc	122	66	0.007524016	0.00752402	0.04953164	0.0618	0.0528	0.0345
Titanium Pm2.5 Lc	122	108	0.003261639	0.00327475	0.00329082	0.0203	0.0186	0.0101
Total Nitrate Pm2.5 Lc	122	122	1.344389344	1.34438934	0.03582525	10.6	6.78	6.66
Vanadium Pm2.5 Lc	122	71	0.000522377	0.00055828	0.0016159	0.00272	0.00264	0.00245
Zinc Pm2.5 Lc	122	122	0.016035492	0.01603549	0.00308328	0.154	0.0449	0.0409
Zirconium Pm2.5 Lc	122	63	0.004906148	0.00490615	0.03627557	0.0312	0.026	0.0236

Dearborn (261630033), Speciated $PM_{2.5}$ ($\mu g/m^3$)								
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	48	0.036477213	0.03647721	0.03816607	0.28	0.124	0.119
Ammonium Ion Pm2.5 Lc	60	58	0.536847667	0.5369125	0.00629983	2.55	2.37	1.89
Antimony Pm2.5 Lc	61	30	0.006651639	0.00696967	0.04001754	0.0346	0.0345	0.0292
Arsenic Pm2.5 Lc	61	18	0.000875246	0.00092918	0.00259508	0.0149	0.00695	0.00572
Barium Pm2.5 Lc	61	35	0.020785902	0.0207859	0.08082377	0.106	0.0665	0.0663
Bromine Pm2.5 Lc	61	52	0.00346377	0.00353852	0.00452852	0.038	0.0272	0.00858
Cadmium Pm2.5 Lc	61	26	0.001877541	0.00187754	0.01618	0.0136	0.0113	0.00954
Calcium Pm2.5 Lc	61	61	0.213442623	0.21344262	0.0340441	1.48	0.767	0.699
Cerium Pm2.5 Lc	61	39	0.019137049	0.01913705	0.09615262	0.0966	0.0897	0.0731
Cesium Pm2.5 Lc	61	34	0.014134426	0.01413443	0.05600656	0.0837	0.0737	0.0705
Chlorine Pm2.5 Lc	61	53	0.038585738	0.03858574	0.0067141	0.216	0.195	0.125
Chromium Pm2.5 Lc	61	49	0.005275738	0.00530311	0.0037877	0.096	0.0531	0.0167
Cobalt Pm2.5 Lc	61	30	0.000805082	0.00080508	0.00326721	0.00555	0.00359	0.00323
Copper Pm2.5 Lc	61	61	0.012130984	0.01213098	0.01110475	0.0458	0.0419	0.031
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	53	52	0.448022642	0.44813283	0.0116683	1.01	0.978	0.926
Indium Pm2.5 Lc	61	31	0.004453607	0.00445361	0.03698098	0.0235	0.0212	0.0193
Iron Pm2.5 Lc	61	61	0.43272623	0.43272623	0.02721869	2.15	1.56	1.27
Lead Pm2.5 Lc	61	50	0.008175738	0.00817574	0.01224689	0.121	0.0344	0.0295
Magnesium Pm2.5 Lc	61	53	0.03717082	0.03717082	0.04199656	0.249	0.154	0.145
Manganese Pm2.5 Lc	61	57	0.011559344	0.01155934	0.00638492	0.0501	0.0381	0.0349
Nickel Pm2.5 Lc	61	51	0.002076885	0.00207689	0.00207541	0.0286	0.0162	0.0112
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	53	53	2.662283019	2.66228302	0.0774683	5.48	5.36	4.82
Phosphorus Pm2.5 Lc	61	61	0.000424754	0.00042475	0.00217934	0.00808	0.00403	0.00333
Potassium Ion Pm2.5 Lc	60	60	0.042988167	0.04298817	0.04637233	0.36	0.158	0.129
Potassium Pm2.5 Lc	61	61	0.096034426	0.09603443	0.01158869	0.382	0.377	0.249
Rubidium Pm2.5 Lc	61	27	0.001114426	0.00111443	0.00869131	0.0059	0.00584	0.00554
Selenium Pm2.5 Lc	61	40	0.001785902	0.0017859	0.00532443	0.00873	0.00776	0.00716
Silicon Pm2.5 Lc	61	61	0.119870492	0.11987049	0.01994213	0.977	0.402	0.303
Silver Pm2.5 Lc	61	28	0.002475902	0.00261049	0.0168577	0.0168	0.0153	0.0134
Sodium Ion Pm2.5 Lc	60	60	0.0561595	0.0561595	0.01685517	0.304	0.179	0.179
Sodium Pm2.5 Lc	61	40	0.053576066	0.05357607	0.08787967	0.305	0.298	0.274
Strontium Pm2.5 Lc	61	38	0.001868197	0.0018682	0.00705705	0.012	0.00698	0.00594
Sulfate Pm2.5 Lc	60	60	1.319083333	1.31908333	0.04797667	1.61	1.09	0.734
Sulfur Pm2.5 Lc	61	61	0.487144262	0.48714426	0.00518049	1.11	0.973	0.956
Tin Pm2.5 Lc	61	37	0.005758197	0.0057582	0.04962344	0.038	0.0204	0.0197
Titanium Pm2.5 Lc	61	56	0.00449918	0.00449918	0.00329443	0.0301	0.0146	0.0116
Total Nitrate Pm2.5 Lc	60	60	1.542433333	1.54243333	0.0362795	7.14	6.9	6.23
Vanadium Pm2.5 Lc	61	39	0.000971803	0.00098689	0.00161852	0.00695	0.0043	0.00406
Zinc Pm2.5 Lc	61	61	0.077041639	0.07704164	0.00308311	0.347	0.344	0.229
Zirconium Pm2.5 Lc	61	35	0.007151475	0.00715148	0.03632787	0.0394	0.0302	0.029

Detroit, W Fort St. (N. Delray-SWHS) (261630015), Speciated $PM_{2.5}$ ($\mu g/m^3$)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	60	44	0.044479833	0.04447983	0.03818483	0.47	0.273	0.115
Ammonium Ion Pm2.5 Lc	60	59	0.5551475	0.5551475	0.0062615	2.67	2.41	2.36
Antimony Pm2.5 Lc	60	32	0.007035667	0.00703567	0.04001617	0.0461	0.0402	0.0354
Arsenic Pm2.5 Lc	60	22	0.000571	0.00059717	0.00261217	0.00803	0.00579	0.0056
Barium Pm2.5 Lc	60	30	0.010465333	0.01046533	0.08079533	0.0681	0.0478	0.0447
Bromine Pm2.5 Lc	60	50	0.004279667	0.00427967	0.00452633	0.0463	0.025	0.0168
Cadmium Pm2.5 Lc	60	34	0.003181667	0.00318167	0.0161795	0.0165	0.0153	0.0124
Calcium Pm2.5 Lc	60	60	0.141906667	0.14190667	0.0338475	0.763	0.539	0.387
Cerium Pm2.5 Lc	60	35	0.0216605	0.0216605	0.09611683	0.0991	0.0916	0.0763
Cesium Pm2.5 Lc	60	38	0.012053667	0.01205367	0.05601333	0.0669	0.0481	0.0452
Chlorine Pm2.5 Lc	60	51	0.030962167	0.03096217	0.00667117	0.64	0.113	0.0997
Chromium Pm2.5 Lc	60	38	0.0012995	0.0012995	0.00378917	0.0219	0.00461	0.0033
Cobalt Pm2.5 Lc	60	23	0.0003535	0.0003535	0.00326517	0.00312	0.00218	0.00205
Copper Pm2.5 Lc	60	59	0.010441	0.010441	0.01109517	0.0286	0.0234	0.0232
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	58	58	0.477068966	0.47706897	0.01167828	1.37	1.33	1.23
Indium Pm2.5 Lc	60	32	0.003949667	0.00394967	0.03694567	0.0195	0.0191	0.0149
Iron Pm2.5 Lc	60	60	0.203318333	0.20331833	0.02701517	0.801	0.685	0.557
Lead Pm2.5 Lc	60	42	0.005261667	0.00536333	0.01224217	0.0237	0.0229	0.0196
Magnesium Pm2.5 Lc	60	46	0.027983167	0.02798317	0.04199167	0.286	0.17	0.128
Manganese Pm2.5 Lc	60	51	0.0056325	0.0056325	0.00638117	0.0265	0.0169	0.0165
Nickel Pm2.5 Lc	60	44	0.000994333	0.00099433	0.002081	0.00633	0.00512	0.00275
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	58	58	2.426327586	2.42632759	0.07916293	8.52	5.33	5.07
Phosphorus Pm2.5 Lc	60	60	0.000164333	0.00016433	0.00218617	0.00139	0.00064	0.00056
Potassium Ion Pm2.5 Lc	60	60	0.059718833	0.05971883	0.04640483	0.499	0.288	0.226
Potassium Pm2.5 Lc	60	60	0.121238333	0.12123833	0.01177033	0.753	0.478	0.378
Rubidium Pm2.5 Lc	60	27	0.001228	0.001228	0.00868367	0.00698	0.00671	0.00587
Selenium Pm2.5 Lc	60	35	0.001509833	0.00150983	0.005323	0.00925	0.00845	0.00818
Silicon Pm2.5 Lc	60	60	0.09492	0.09492	0.019969	0.33	0.324	0.253
Silver Pm2.5 Lc	60	33	0.004393667	0.00439367	0.01685683	0.0278	0.0157	0.0149
Sodium Ion Pm2.5 Lc	60	60	0.0452905	0.0452905	0.01697267	0.628	0.143	0.138
Sodium Pm2.5 Lc	60	38	0.037292333	0.03729233	0.08782667	0.274	0.163	0.144
Strontium Pm2.5 Lc	60	40	0.002003667	0.00200367	0.00705083	0.0093	0.00849	0.00675
Sulfate Pm2.5 Lc	60	60	1.306883333	1.30688333	0.04778133	3.84	3.21	2.97
Sulfur Pm2.5 Lc	60	60	0.506171667	0.50617167	0.00520067	1.42	1.2	1.12
Tin Pm2.5 Lc	60	35	0.007124167	0.00712417	0.0496105	0.045	0.0402	0.0338
Titanium Pm2.5 Lc	60	59	0.0066855	0.0066855	0.00328833	0.0569	0.0371	0.0297
Total Nitrate Pm2.5 Lc	60	60	1.527601667	1.52760167	0.03621817	7.62	7.11	6.48
Vanadium Pm2.5 Lc	60	33	0.000764667	0.00083983	0.00162233	0.00511	0.00487	0.0046
Zinc Pm2.5 Lc	60	60	0.032776833	0.03277683	0.00308117	0.175	0.102	0.0847
Zirconium Pm2.5 Lc	60	24	0.005221	0.005221	0.03631667	0.0455	0.0254	0.0216

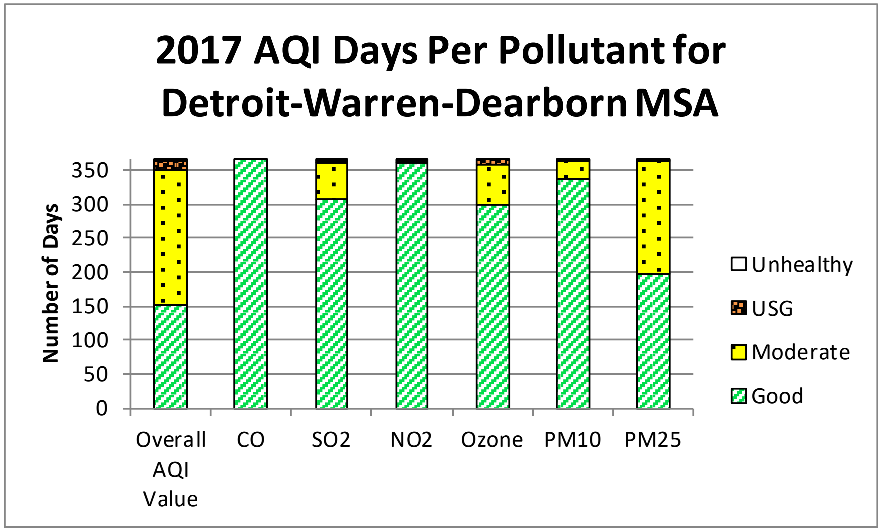
Tecumseh (260910007), Speciated $PM_{2.5}$ ($\mu g/m^3$)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	60	39	0.0247345	0.0247345	0.038244	0.115	0.0938	0.0898
Ammonium Ion Pm2.5 Lc	60	55	0.430704167	0.4307995	0.0062905	2.59	1.94	1.43
Antimony Pm2.5 Lc	60	29	0.008405833	0.00840583	0.0400145	0.056	0.0349	0.0331
Arsenic Pm2.5 Lc	60	27	0.000540833	0.000619	0.0025845	0.00593	0.00513	0.00374
Barium Pm2.5 Lc	60	34	0.013579833	0.01357983	0.080789	0.0756	0.0688	0.0581
Bromine Pm2.5 Lc	60	45	0.0021475	0.0021475	0.0045265	0.00832	0.00698	0.00643
Cadmium Pm2.5 Lc	60	39	0.0036025	0.0036025	0.01617733	0.0211	0.0152	0.0127
Calcium Pm2.5 Lc	60	59	0.068591667	0.06859167	0.03415617	0.265	0.221	0.201
Cerium Pm2.5 Lc	60	37	0.022509167	0.02250917	0.096111	0.108	0.0888	0.0708
Cesium Pm2.5 Lc	60	28	0.0083075	0.0083075	0.05601117	0.0498	0.0465	0.0439
Chlorine Pm2.5 Lc	60	36	0.003238833	0.00323883	0.00673633	0.0299	0.0242	0.0199
Chromium Pm2.5 Lc	60	41	0.002978667	0.00297867	0.00371867	0.0692	0.0131	0.00827
Cobalt Pm2.5 Lc	60	21	0.000373833	0.00037383	0.00326517	0.00372	0.00367	0.00291
Copper Pm2.5 Lc	60	49	0.002931167	0.00293117	0.01109383	0.012	0.00763	0.00722
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	46	46	0.147930435	0.14793043	0.01167913	0.538	0.522	0.293
Indium Pm2.5 Lc	60	35	0.0055865	0.0055865	0.03694217	0.0212	0.0211	0.0195
Iron Pm2.5 Lc	60	60	0.0608755	0.0608755	0.02719967	0.394	0.173	0.134
Lead Pm2.5 Lc	60	33	0.002416667	0.00241667	0.012241	0.0158	0.0145	0.00944
Magnesium Pm2.5 Lc	60	40	0.011909167	0.01190917	0.041989	0.0443	0.043	0.0408
Manganese Pm2.5 Lc	60	40	0.004426	0.00447933	0.00638133	0.0468	0.0382	0.0207
Nickel Pm2.5 Lc	60	37	0.0008835	0.0008835	0.00206583	0.0234	0.0022	0.00219
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	46	46	1.66523913	1.66523913	0.07827935	4.86	4.72	3.53
Phosphorus Pm2.5 Lc	60	59	0.000502667	0.00052233	0.00217433	0.00335	0.00332	0.00308
Potassium Ion Pm2.5 Lc	60	60	0.0231255	0.0231255	0.04634133	0.105	0.103	0.0685
Potassium Pm2.5 Lc	60	59	0.066113333	0.06611333	0.01160583	0.247	0.164	0.145
Rubidium Pm2.5 Lc	60	30	0.001560667	0.00156067	0.00868317	0.00681	0.00631	0.00612
Selenium Pm2.5 Lc	60	28	0.000619333	0.00061933	0.0053215	0.00564	0.00414	0.00355
Silicon Pm2.5 Lc	60	59	0.080372167	0.08037217	0.0199965	0.446	0.295	0.197
Silver Pm2.5 Lc	60	32	0.003838167	0.003975	0.0168565	0.0341	0.0244	0.0119
Sodium Ion Pm2.5 Lc	60	56	0.024041333	0.02404133	0.01665767	0.159	0.15	0.101
Sodium Pm2.5 Lc	60	33	0.022945667	0.023684	0.08781917	0.0973	0.0938	0.0824
Strontium Pm2.5 Lc	60	41	0.0013885	0.0013885	0.00705017	0.00775	0.0066	0.00572
Sulfate Pm2.5 Lc	60	60	0.925289167	0.92528917	0.0468625	3.77	2.12	2.01
Sulfur Pm2.5 Lc	60	59	0.360743333	0.36077433	0.00520033	1.36	0.881	0.785
Tin Pm2.5 Lc	60	30	0.004799667	0.00479967	0.04960783	0.0314	0.019	0.0161
Titanium Pm2.5 Lc	60	53	0.0029575	0.0029575	0.00329333	0.0172	0.0112	0.00722
Total Nitrate Pm2.5 Lc	60	60	1.394571667	1.39457167	0.03605167	7.74	6.19	5.26
Vanadium Pm2.5 Lc	60	30	0.000492833	0.00053883	0.00161683	0.00298	0.00248	0.00238
Zinc Pm2.5 Lc	60	60	0.012783167	0.01278317	0.00308083	0.0455	0.0305	0.0302
Zirconium Pm2.5 Lc	60	33	0.004461	0.004461	0.036313	0.0352	0.0177	0.0163

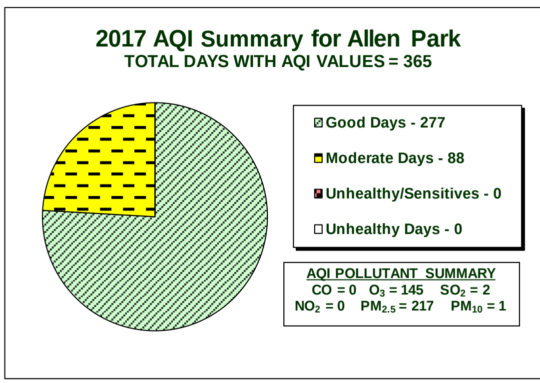
Grand Rapids-Monroe St. (260810020), Speciated $PM_{2.5}$ ($\mu g/m^3$)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	120	79	0.02062225	0.02062225	0.0379338	0.0941	0.0891	0.0628
Ammonium Ion Pm2.5 Lc	116	109	0.40369724	0.40376853	0.0061526	2.49	2.33	2.31
Antimony Pm2.5 Lc	120	67	0.00730767	0.00730767	0.0399079	0.0401	0.0352	0.0334
Arsenic Pm2.5 Lc	120	42	0.00034425	0.00038733	0.0025888	0.00562	0.00523	0.00507
Barium Pm2.5 Lc	120	68	0.01460217	0.01460217	0.0807205	0.0718	0.066	0.0646
Bromine Pm2.5 Lc	120	97	0.00230033	0.00230033	0.0045264	0.00916	0.00862	0.00799
Cadmium Pm2.5 Lc	103	55	0.00396505	0.00396505	0.016155	0.0218	0.0214	0.0213
Calcium Pm2.5 Lc	75	75	0.04678587	0.04678587	0.0338538	0.225	0.201	0.186
Cerium Pm2.5 Lc	120	54	0.01486567	0.01486567	0.0960353	0.126	0.0842	0.0805
Cesium Pm2.5 Lc	120	64	0.01018683	0.01018683	0.0558163	0.0639	0.0581	0.0541
Chlorine Pm2.5 Lc	120	65	0.005368	0.005368	0.0066784	0.0817	0.074	0.0607
Chromium Pm2.5 Lc	120	101	0.00270917	0.00270917	0.0037858	0.0227	0.0186	0.0113
Cobalt Pm2.5 Lc	120	35	0.00027375	0.00027375	0.0032677	0.00322	0.00196	0.00192
Copper Pm2.5 Lc	120	112	0.0054825	0.0054825	0.011115	0.0235	0.0212	0.0181
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	117	117	0.27697949	0.27697949	0.0116737	1.01	0.811	0.736
Indium Pm2.5 Lc	120	69	0.00470842	0.00470842	0.0370331	0.0329	0.0239	0.0214
Iron Pm2.5 Lc	120	120	0.06909467	0.06909467	0.0270058	0.355	0.252	0.188
Lead Pm2.5 Lc	120	73	0.00350033	0.00350033	0.0122344	0.0217	0.0197	0.0186
Magnesium Pm2.5 Lc	120	75	0.01069908	0.01069908	0.0419044	0.0632	0.06	0.0594
Manganese Pm2.5 Lc	120	91	0.002713	0.002713	0.0063813	0.0199	0.0131	0.0122
Nickel Pm2.5 Lc	120	86	0.00087067	0.00087067	0.002072	0.00632	0.0038	0.00302
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	117	117	2.12593162	2.12593162	0.0793033	6.71	6.58	5.92
Phosphorus Pm2.5 Lc	120	120	0.00023542	0.00023542	0.0021765	0.00254	0.00209	0.0016
Potassium Ion Pm2.5 Lc	116	115	0.03053474	0.03053474	0.046878	0.496	0.183	0.165
Potassium Pm2.5 Lc	120	120	0.06867	0.06867	0.0115391	0.651	0.532	0.325
Rubidium Pm2.5 Lc	120	43	0.00096167	0.00096167	0.0086974	0.00823	0.00666	0.00619
Selenium Pm2.5 Lc	120	70	0.00129333	0.00129333	0.0053178	0.011	0.00701	0.00594
Silicon Pm2.5 Lc	120	119	0.04698592	0.04698592	0.0199462	0.262	0.204	0.197
Silver Pm2.5 Lc	120	60	0.0033815	0.0033815	0.0168163	0.0298	0.0214	0.0182
Sodium Ion Pm2.5 Lc	116	115	0.0217425	0.0217425	0.016372	0.218	0.0991	0.0734
Sodium Pm2.5 Lc	120	64	0.03264833	0.03264833	0.0878857	0.162	0.14	0.14
Strontium Pm2.5 Lc	120	68	0.00159242	0.00159242	0.007064	0.0191	0.00857	0.00765
Sulfate Pm2.5 Lc	116	116	0.87168103	0.87168103	0.0466337	3.38	2.62	2.47
Sulfur Pm2.5 Lc	120	120	0.3373575	0.3373575	0.00516	1.18	0.995	0.975
Tin Pm2.5 Lc	120	61	0.00696983	0.00696983	0.0495356	0.0479	0.0382	0.0363
Titanium Pm2.5 Lc	120	101	0.00321667	0.00323008	0.0032898	0.0302	0.0215	0.0193
Total Nitrate Pm2.5 Lc	116	116	1.28471983	1.28471983	0.035682	7.84	7.23	6.01
Vanadium Pm2.5 Lc	120	49	0.00032867	0.00038038	0.0016162	0.00302	0.002	0.00188
Zinc Pm2.5 Lc	120	120	0.01494075	0.01494075	0.0030814	0.0591	0.0432	0.0399
Zirconium Pm2.5 Lc	120	64	0.00559875	0.00559875	0.0362762	0.0296	0.0268	0.0253

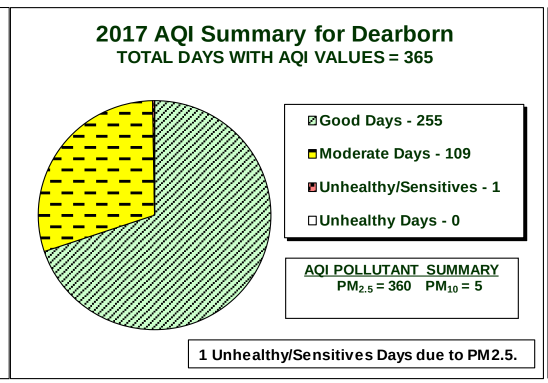
APPENDIX C: 2017 AIR QUALITY INDEX (AQI) PIE CHARTS

Appendix C contains pie charts that were created to show the AQI values for each of Michigan's 2017 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.7** are grouped by Metropolitan Statistical Area (MSA). MSAs are geographic regions based on population and employment data that the US Census compiles. They are defined by the US Office of Management and Budget. More information on MSAs 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-Dearborn MSA







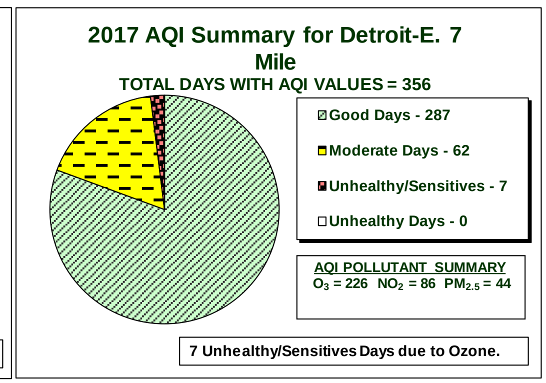


Figure C1, continued: AQI Summaries for Detroit-Warren-Dearborn-MSA

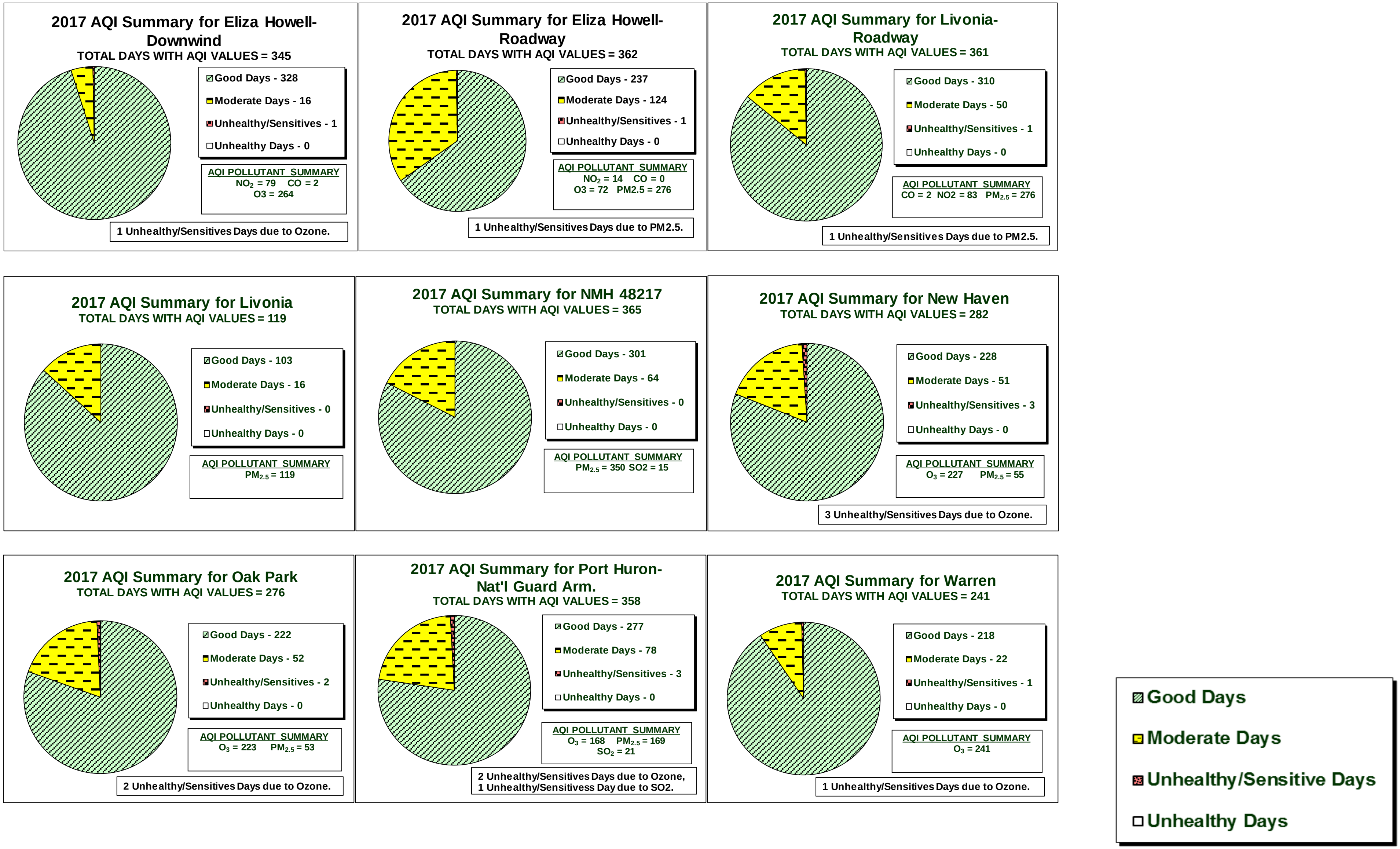
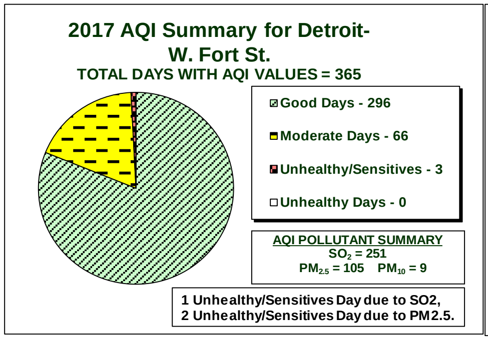
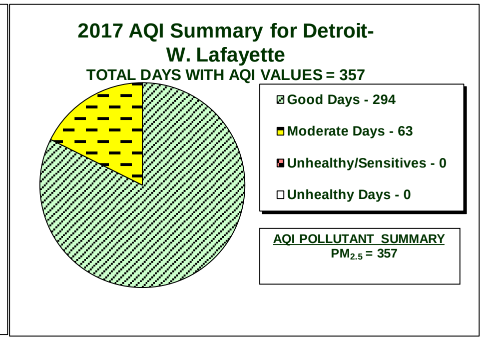


Figure C1, continued: AQI Summaries for Detroit-Warren-Dearborn-MSA





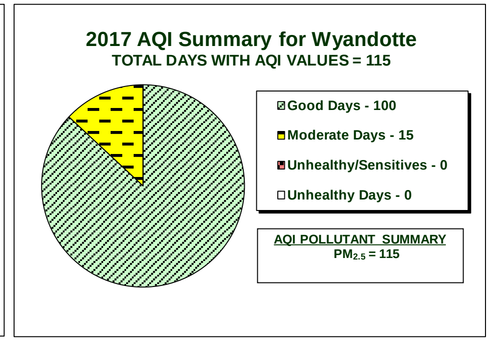
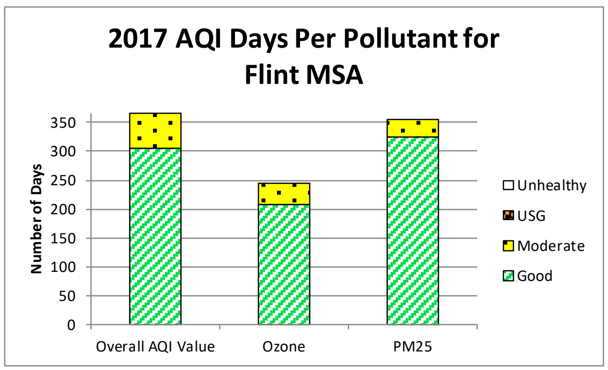
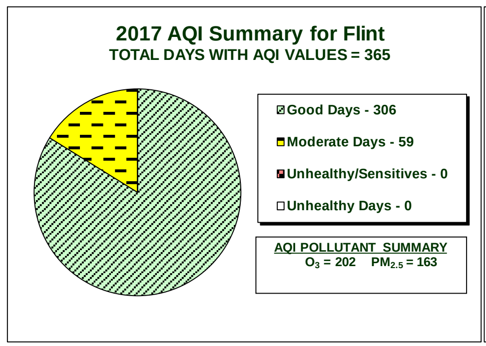


Figure C2: AQI Summaries for Flint MSA





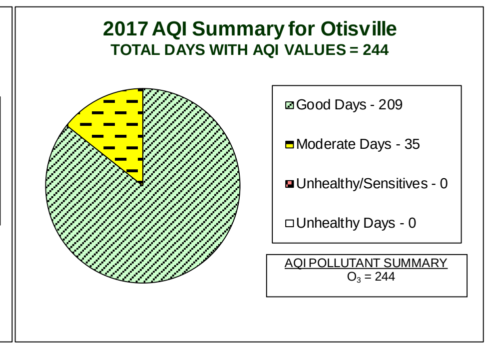
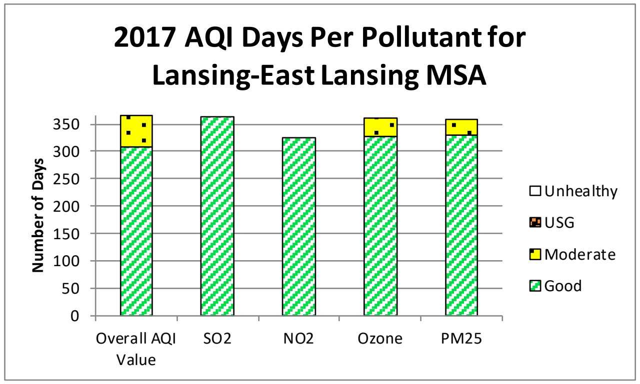
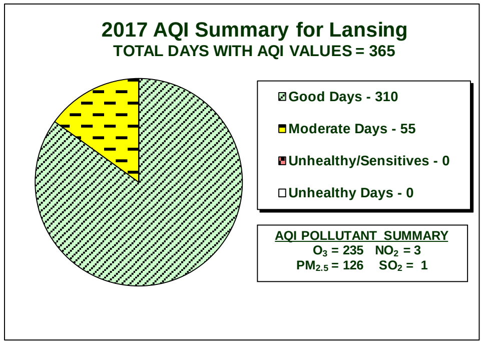


Figure C3: AQI Summaries for Lansing-East Lansing-MSA





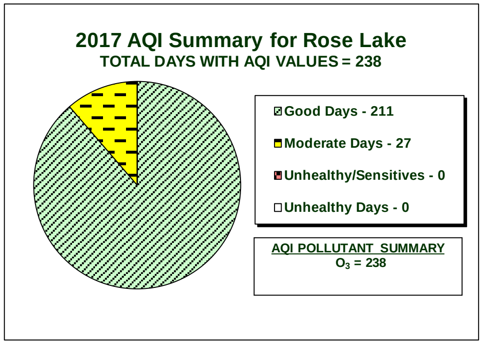
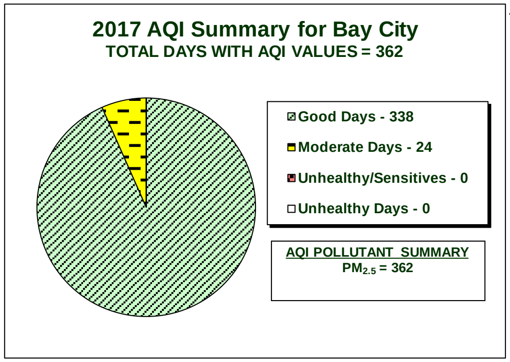


Figure C4: AQI Summary for Saginaw-Midland-Bay City-MSA



*Note: This site does not have AQI per pollutant graphs since only one pollutant is monitored in one location in these areas.

Figure C5: AQI Summaries for Grand Rapids-Wyoming MSA

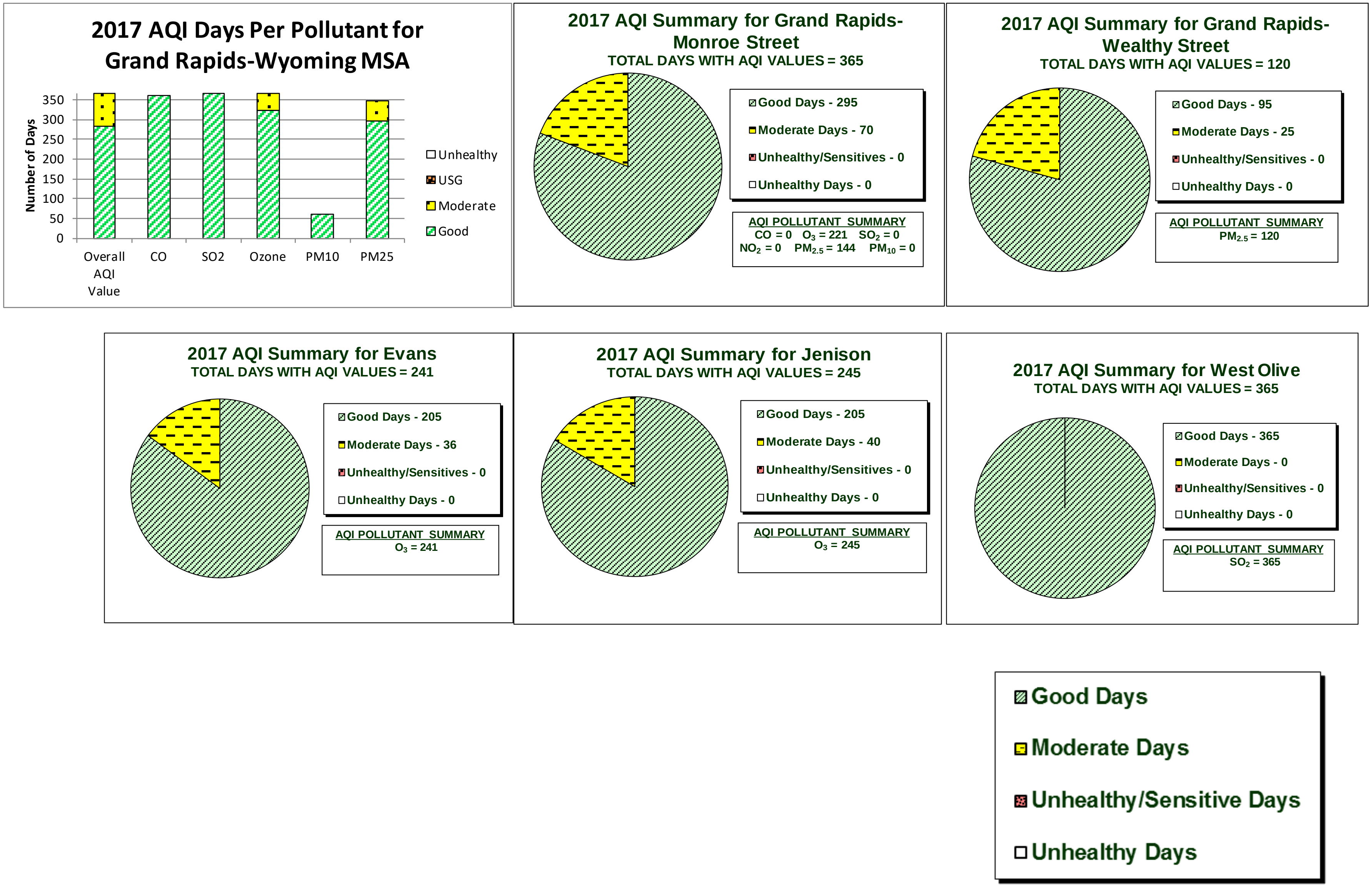
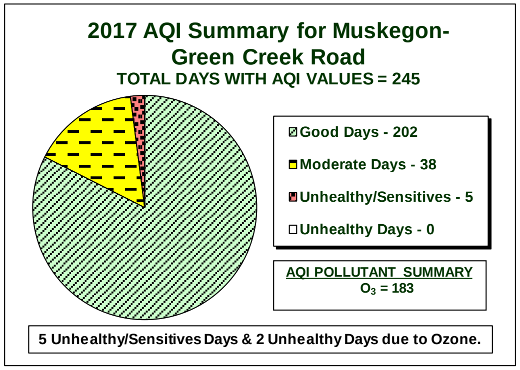
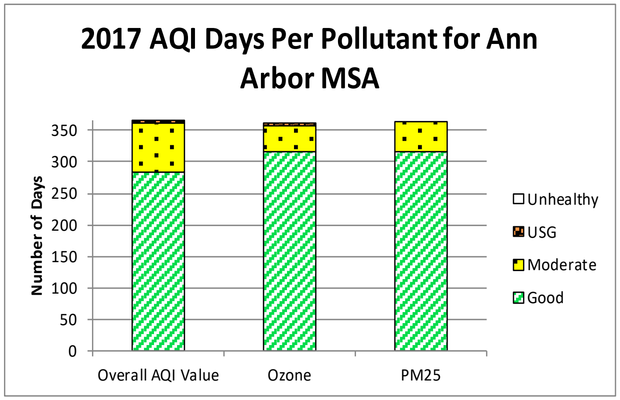


Figure C6: Muskegon MSA



*Note: This site does not have AQI per pollutant graphs since only one pollutant is monitored in one location in these areas.

Figure C7: Ann Arbor MSA



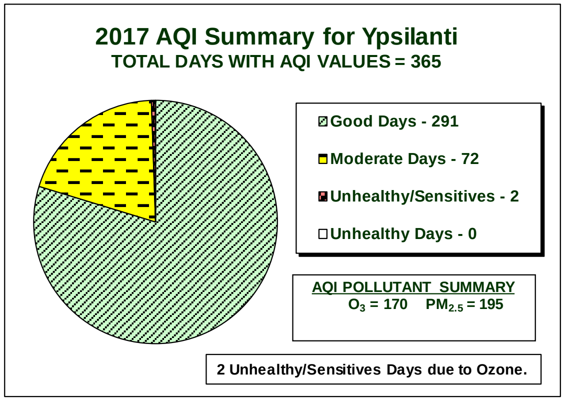
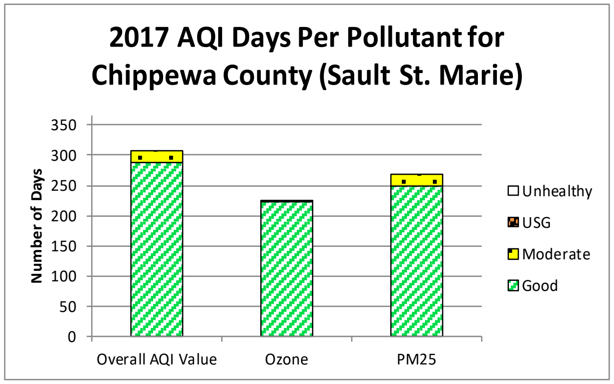
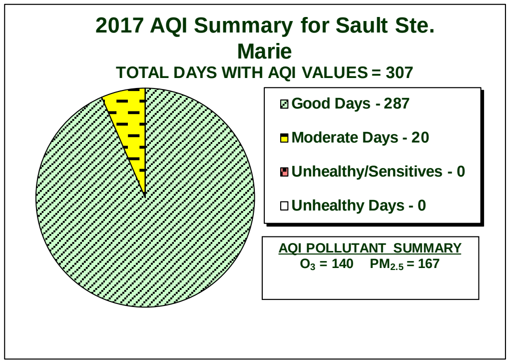
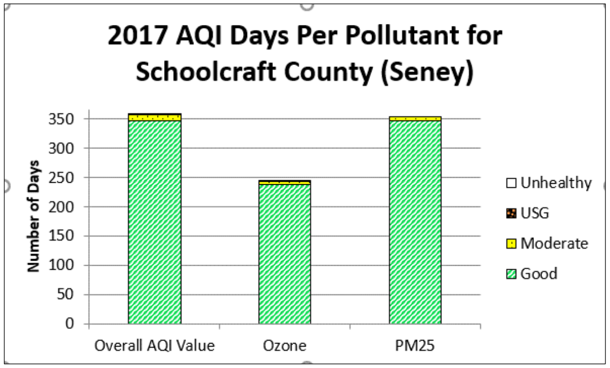


Figure C8: AQI Summary for Upper Peninsula







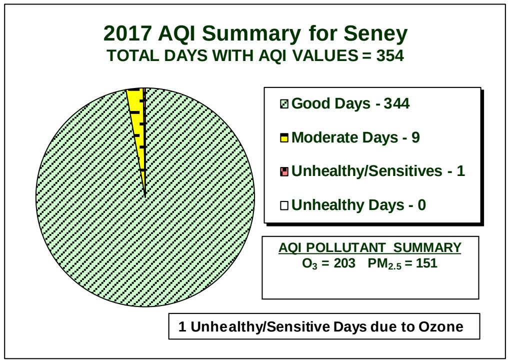
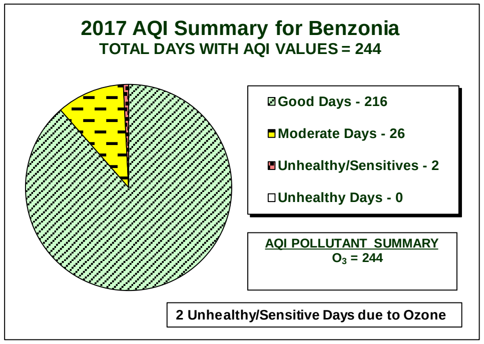
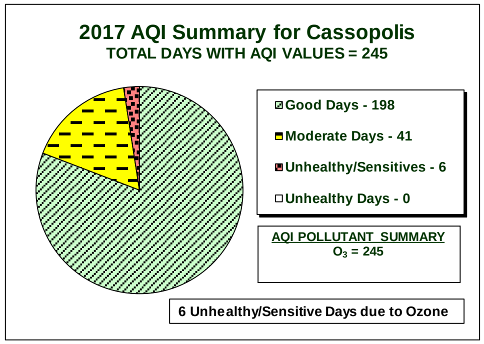
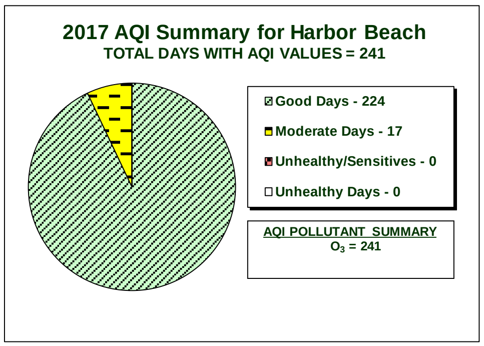
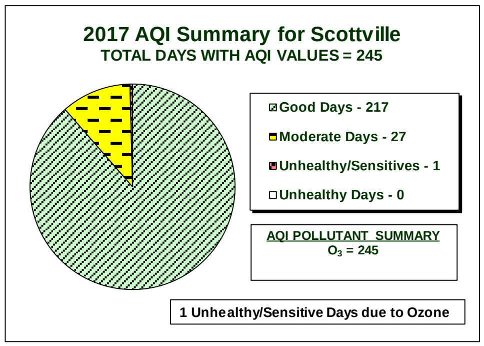


Figure C9: AQI Summaries for Michigan's Other Lower Peninsula Areas

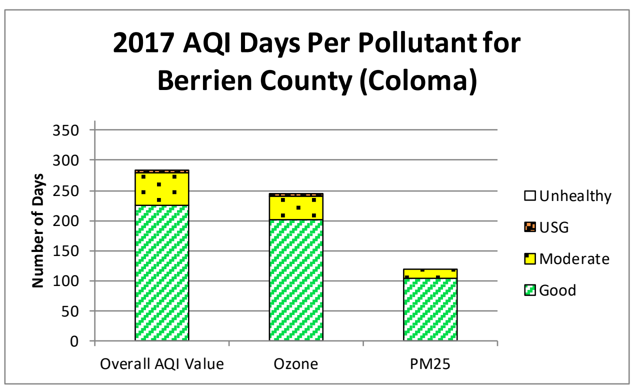








*Note: These sites do not have AQI per pollutant graphs since only one pollutant is monitored in one location in these areas.



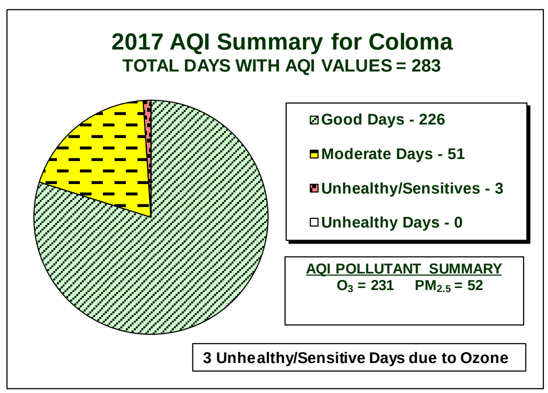
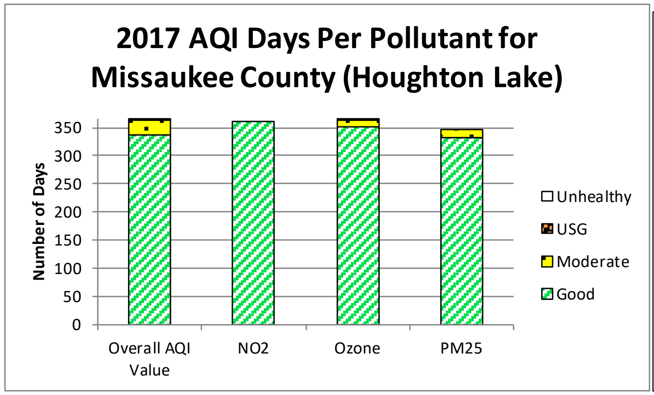
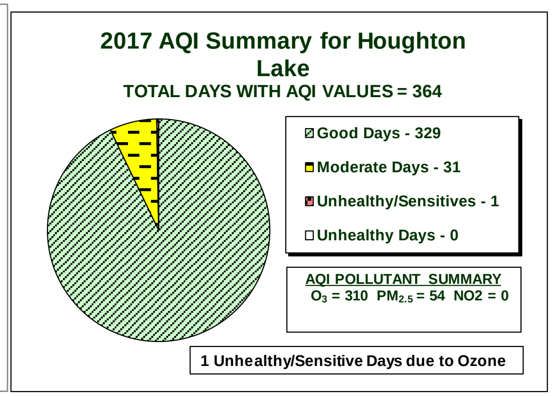
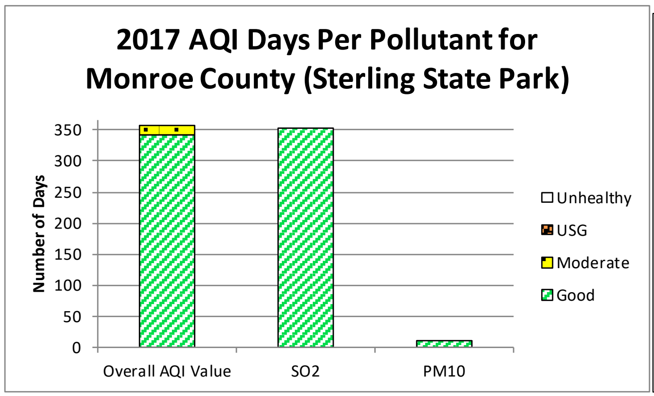
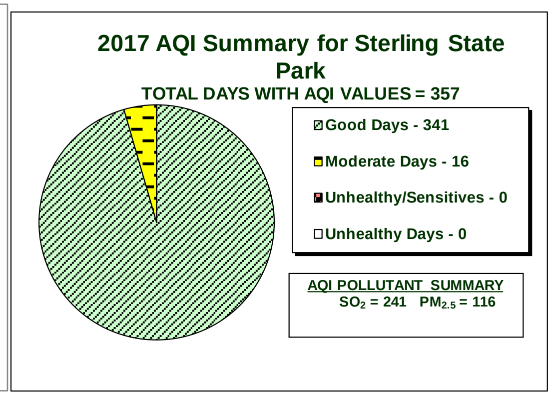


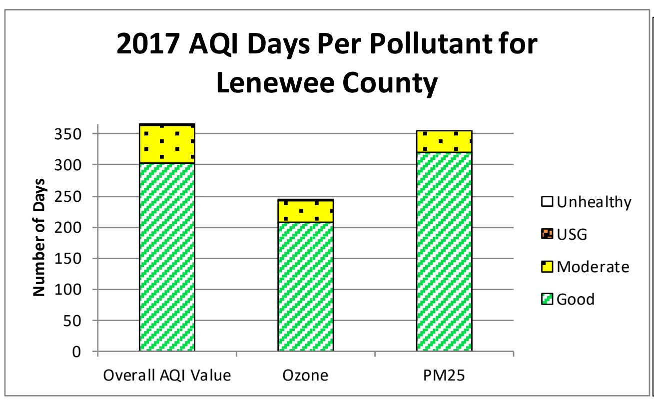
Figure C9, continued: AQI Summaries for Michigan's Other Lower Peninsula Areas











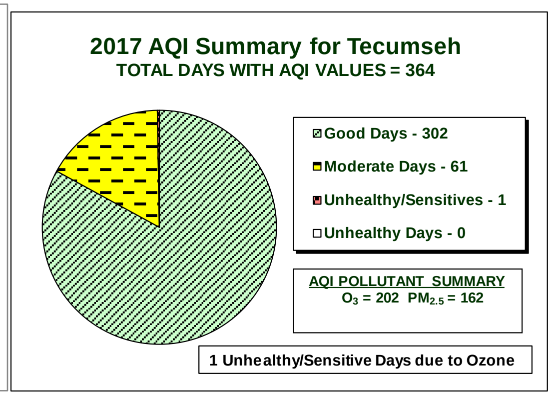
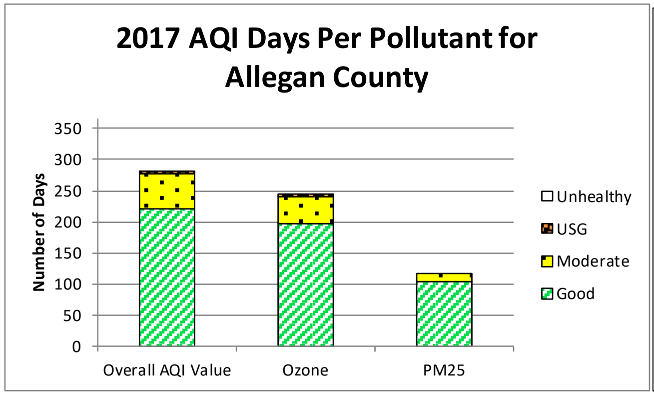
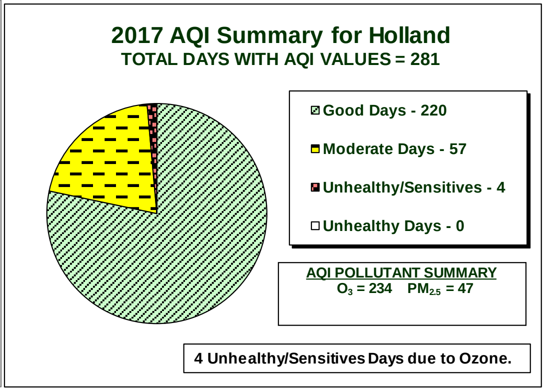
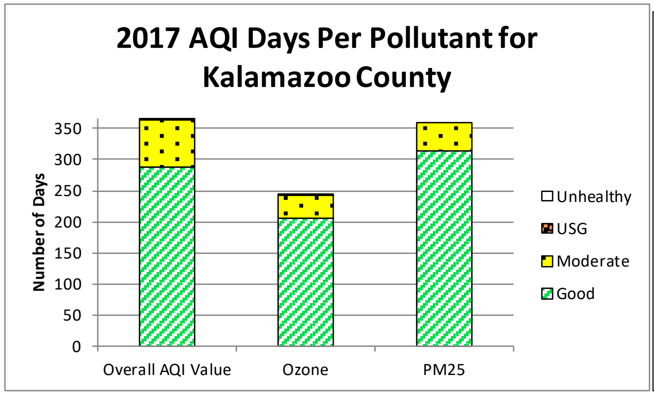
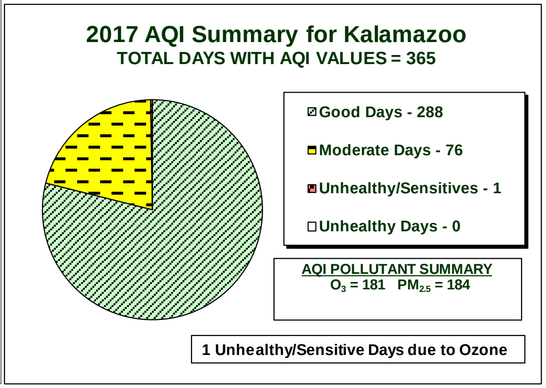


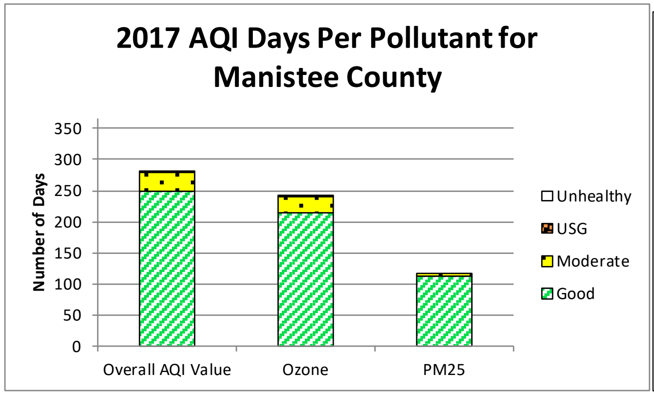
Figure C9, continued: AQI Summaries for Michigan's Other Lower Peninsula Areas

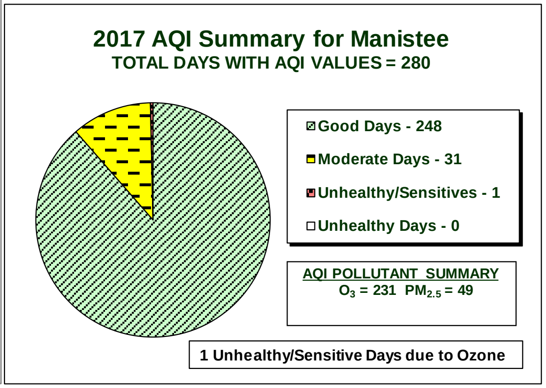












APPENDIX D: NAAQS CHANGES

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<tr><td>CO</td><td colspan="10">1-hour maximum not to exceed 35 ppm more than once in a year.
8-hour maximum not to exceed 9 ppm more than once in a year.</td></tr>
<tr><td>Lead</td><td></td><td colspan="5">Calendar quarter average of 1.5 $\mu g/m^3$ not to be exceeded</td><td colspan="4">3-month average of 0.15 $\mu g/m^3$ not to be exceeded</td></tr>
<tr><td>NO_2</td><td colspan="7">Annual average of 53 ppb or less.</td><td colspan="3">98th percentile of the 1-hour concentration averaged over 3 yrs is 100 ppb or less</td></tr>
<tr><td>SO_2</td><td colspan="7">24-Hour concentration of 0.14 ppm not exceeded more than once per year.
Annual average of 0.03 ppm or less.</td><td colspan="3">1-hour average of 99th percentile is 75 ppb or less, averaged over 3 yrs. Previous revoked</td></tr>
<tr><td>Ozone</td><td colspan="2">Total photochemical oxidants:
1-hour max of 0.08 ppm not exceeded once per yr</td><td colspan="2">1-hour maximum concentration is 0.12 ppm one or less hour per yr</td><td colspan="2">4^{th} highest daily maximum 8-hour concentration averaged over 3 yrs is 0.08 ppm or less</td><td colspan="3">4^{th} highest daily maximum 8-hour concentration averaged over 3 yrs is 0.075 ppm or less</td><td>4^{th} highest daily maximum 8-hour concentration averaged over 3 yrs is 0.070 ppm or less</td></tr>
<tr><td>TSP & PM_{10}</td><td colspan="3">TSP: 24-hour average not to exceed 260 $\mu g/m^3$ more than once per yr
Annual geometric mean of 75 $\mu g/m^3$</td><td colspan="2">PM_{10}: 24-hour average not to exceed 150 $\mu g/m^3$ more than once per yr on average over a 3-yr period
Annual mean of 50 $\mu g/m^3$ or less average over 3 yrs</td><td colspan="5">Annual average revoked
24-hour average retained</td></tr>
<tr><td>$PM_{2.5}$</td><td colspan="4"></td><td>Annual mean of 15.0 $\mu g/m^3$ or less average over 3 yrs.
98^{th} percentile of 24-hour average of 65 $\mu g/m^3$ or less averaged over 3 yrs</td><td colspan="3">Annual mean retained.
98^{th} percentile of 24-hour average of 35 $\mu g/m^3$ or less averaged over 3 yrs</td><td colspan="2">Annual mean of 12.0 $\mu g/m^3$ or less average over 3 yrs.
98^{th} percentile of 24-hour average retained</td></tr>
</table>

APPENDIX E: ACRONYMS AND THEIR DEFINITIONS

>	Greater than
<	Less than
≥	Greater than or equal to
≤	Less than or equal to
%	Percent
µg/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)
BC	Black Carbon
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAA	Clean Air Act
CBSA	Core-Based Statistical Area
Cd	Cadmium
CFR	Code of Federal Regulations
CO	Carbon monoxide
CSA	Consolidated Statistical Area
DEQ	Michigan Department of Environmental Quality
EC/OC	Elemental carbon/Organic carbon
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

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

NMH 48217......New Mount Hermon 48217 ZIP code monitoring site

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..................Polychlorinated 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
US ....United States
USEPA.............United States Environmental Protection Agency
UV ....Ultra-violet
VOC ....Volatile Organic Compounds
Vs.....................Versus

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