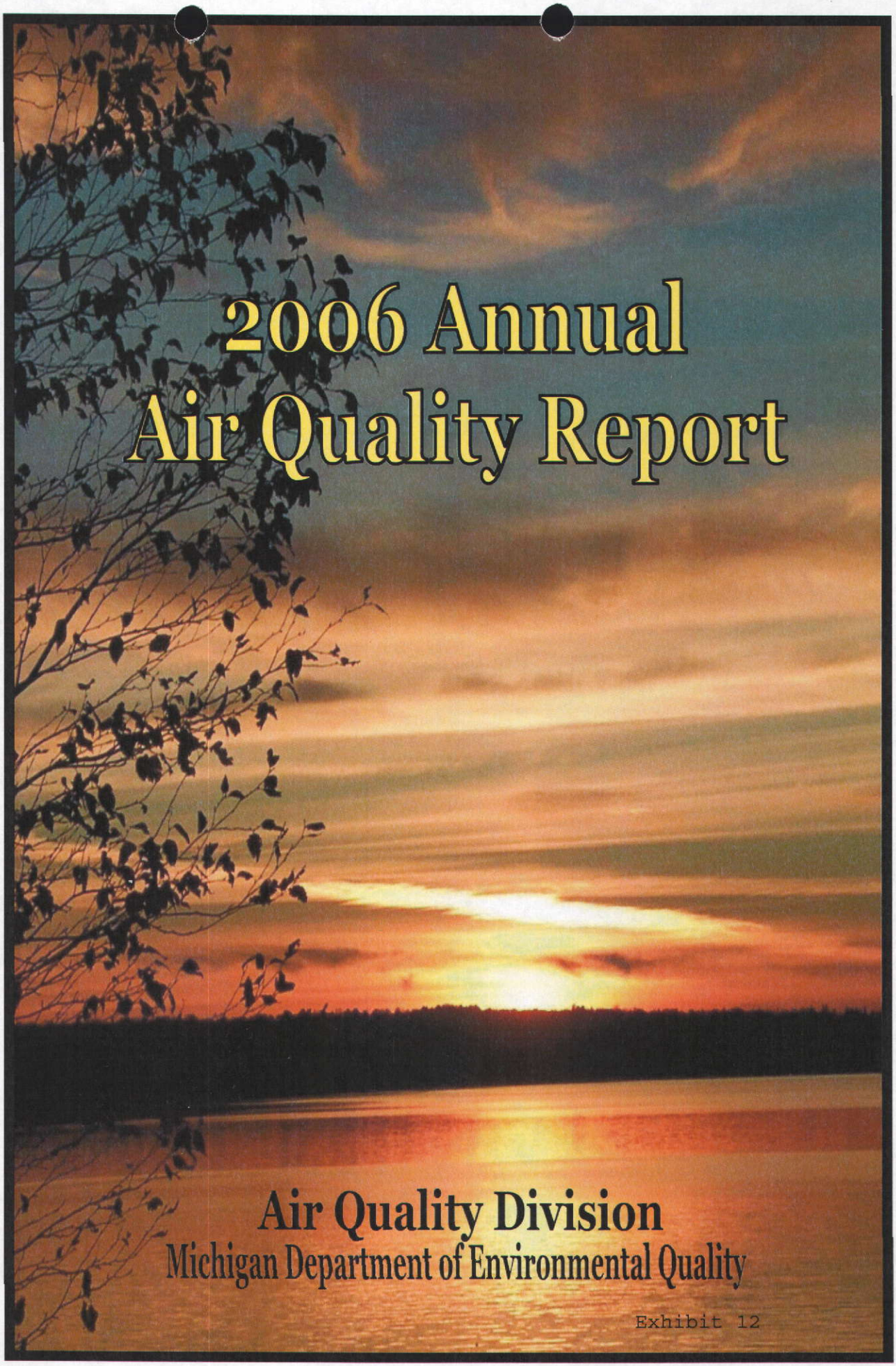
12


Michigan
2006 Annual
Air Quality Report
Air Quality Division
Michigan Department of Environmental Quality
DEQ
Exhibit 12

JENNIFER M. GRANHOLM, GOVERNOR

DEQ

STEVEN E. CHESTER, DIRECTOR

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

PROTECTING MICHIGAN'S ENVIRONMENT, ENSURING MICHIGAN'S FUTURE

Environmental Assistance Center 800-662-9278

2006 ANNUAL AIR QUALITY REPORT

AIR QUALITY DIVISION
P.O. BOX 30260
LANSING, MI 48909

November 2007

AQD homepage: http://www.michigan.gov/deqair

MICHIGAN AIR SAMPLING NETWORK:

The Michigan Air Sampling Network (MASN) is operated by the MDEQ's AQD, along with other governmental agencies. For instance, the monitors in and around Sault Ste. Marie are managed by the Inter-Tribal Council of MI, Inc.; the O_3 monitor in Leelanau County (Peshawbestown) is owned and managed by the Grand Traverse Band of Ottawa and Chippewa Indians; and the new Manistee County site (added in 2006) is handled by the Little River Band of Ottawa Indians.[5] **Figure 1-1** shows the 2006 MASN monitoring sites.

FIGURE 1-1: 2006 MASN MAP

The MASN consists of federal reference method (FRM) monitors that enable continuous monitoring for the gaseous pollutants (O_3, CO, NO_2, and SO_2), PM monitors that measure PM concentrations over a 24-hour time period, and high volume samplers for Pb. In addition, continuous $PM_{2.5}$ and PM_{10} monitors are used to provide real time hourly data (that supplement the FRM monitor data), and $PM_{2.5}$ chemical speciation monitors determine the chemical composition of $PM_{2.5}$ and help characterize background levels. The MASN data is also used to provide timely reporting to the MDEQ's new air quality reporting webpage **MIair** (discussed in **Chapter 4**). The types of monitoring conducted in 2006 and the MASN locations are shown in **Table 1-4**.

[5] In 2006, the AQD took over the operation of the Seney National Wildlife Refuge, which had previously been handled by the U.S. Fish and Wildlife Service.

Table 1-4: MASN Stations and Monitoring Conducted in 2006

AIRS ID	SITE NAME	CO	Pb	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	VOC	Carbonyl Aldehydes / Ketone	Trace Metals
260050003	Holland				√		√■*				
260170014	Bay City						√■				
260190003	Benzonia				√						
260210014	Coloma				√		√				
260270003	Cassopolis				√						
260330901	+Sault Ste. Marie – Easterday						√*			√	√
260330902	+Sault Ste. Marie – Marquette Ave.						√				
260330903	Bay Mills						√				
260370001	Rose Lake				√						
260430002	Channing						√				
260490021	Flint		√		√	√	√■	√			√
260492001	Otisville				√						
260630007	Harbor Beach				√						
260650012	Lansing				√		√■				
260710001	Crystal Falls						√				
260770008	Kalamazoo				√		√■*				
260810007	Grand Rapids – Wealthy					√					
260810020	Grand Rapids – Monroe	√	√	√	√	√	√■*	√	√	√	√
260810022	Evans				√						
260890001	++Peshawbestown				√						
260910007	Tecumseh				√						
260990009	New Haven				√		√				
260991003	Warren	√			√			√			
261010922	+++Manistee				√		√				
261050007	Scottville				√						
261130001	Houghton Lake		√		√		√■*		√	√	√
261150005	Luna Pier						√*				
261210039	Muskegon – Green Creek				√						
261210040	Muskegon – Apple Ave						√				
261250001	Oak Park	√			√		√				
261390005	Jenison				√		√				
261470005	Port Huron				√		√■	√			
261530001	Seney Nat'l Wildlife Refuge				√		■				
261610008	Ypsilanti		√		√		√■*		√	√	√
261630001	Allen Park	√	√		√	√	√■*				√
261630005	River Rouge		√								
261630015	Detroit – W. Fort		√		√	√	√	√	√	√	√
261630016	Detroit – Linwood	√		√	√		√	√			
261630019	Detroit – E. Seven Mile		√	√	√		√	√			√
261630025	Livonia	√					√				
261630027	Detroit – W. Jefferson		√								√
261630033	Dearborn		√			√■	√■*		√	√	√
261630036	Wyandotte						√				
261630038	Detroit – Newberry						√■				
261630039	Detroit – W. Lafayette	√					√■				

√ data collected
* $PM_{2.5}$ chemical speciation monitor
■ TEOM monitor

+Managed by Inter-Tribal Council
++Managed by Grand Traverse Band of Ottawa & Chippewa Indians
+++Managed by Little River Band of Ottawa Indians

Since the concentration of a given air contaminant at a particular time and place is highly dependent on meteorological conditions, wind speed and direction instruments, barometric pressure, solar radiation, and relative humidity are also monitored at some of these locations. **Table 1-5** lists those MASN locations and the type of meteorological data collected in 2006.

Table 1-5: 2006 Meteorological Data Collected at the MASN Stations

AIRS ID	SITE NAME	Wind Speed	Wind Direction	Resultant Speed	Resultant Direction	Temperature	Relative Humidity	Solar Radiation	Barometric Pressure
260050003	Holland			√	√	√	√	√	√
260170014	Bay City			√	√	√			
260210014	Coloma			√	√	√			
260270003	Cassopolis			√	√	√			
260490021	Flint			√	√	√			√
260492001	Otisville			√	√	√			
260630007	Harbor Beach			√	√	√			
260650012	Lansing			√	√	√			√
260770008	Kalamazoo			√	√	√			
260810020	Grand Rapids - Monroe			√	√	√			√
260810022	Evans			√	√	√			
260890001	Peshawbestown			√	√	√			
260910007	Tecumseh			√	√	√			√
260990009	New Haven			√	√	√	√	√	
261010922	Manistee			√	√	√		√	√
261050007	Scottville			√	√	√			
261130001	Houghton Lake			√	√	√			√
261210039	Muskegon – Green Creek			√	√	√			
261250001	Oak Park			√	√	√			√
261390005	Jenison			√	√	√			
261470005	Port Huron			√	√	√			
261530001	Seney Nat'l Wildlife Refuge			√	√	√	√	√	√
261610008	Ypsilanti			√	√	√			√
261630001	Allen Park	√	√			√	√		√
261630005	River Rouge			√	√	√			
261630015	Detroit - W. Fort			√	√	√	√		√
261630019	Detroit - E. Seven Mile	√	√			√	√		√
261630025	Livonia			√	√	√	√		√
261630033	Dearborn	√	√			√	√		√
261630038	Newberry			√	√	√			
261630039	W. Lafayette			√	√	√			

The MASN is designed to meet EPA's national ambient air quality monitoring requirements and is used to measure and determine what areas are meeting the NAAQS for the six criteria pollutants.[6] It is important to note that effective December 18, 2006, the EPA amended its air monitoring requirements by reshaping existing monitoring networks to ensure that monitors are concentrated in areas that are not meeting the NAAQS and allow those areas that have maintained levels well below the NAAQS to eliminate unneeded monitors (with EPA approval). In addition, the amended requirements include more co-located monitors to provide real-time air quality measurements (see **Chapter 4**).

[6] Information on the MASN can be found at http://www.michigan.gov/deqair under the heading "Air Monitoring."

The amended air monitoring requirements will also add about 75 National Core (NCORE) monitoring stations around the country beginning in 2011. NCORE sites will be multi-pollutant in nature, utilizing existing and new technologies to provide a comprehensive assessment of air quality throughout the nation and enhance the understanding of how pollution travels. While the exact locations for the NCORE monitoring stations have not yet been identified, Michigan is required to operate two or three NCORE sites. The amended requirements also contain a number of technical changes that include improvements in monitoring technologies.[7] Information on the effects of the 2006 amended monitoring requirements is discussed by criteria pollutant in **Chapter 2**.

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

METROPOLITAN STATISTICAL AREAS:

Michigan is divided into geographical planning units called Metropolitan Statistical Areas or MSAs, Micropolitan Statistical Areas (MiSAs), and Combined Statistical Areas (CSAs).[8] Both MSAs and MiSAs are defined in terms of whole counties. If specified criteria are met, adjacent MSAs and MiSAs, in various combinations, may become the components of complementary areas called CSAs. CSAs can be characterized as representing larger regions that reflect broader social and economic interactions, such as wholesaling, commodity distribution, and weekend recreation activities, and are likely to be of considerable interest to regional authorities and the private sector.

The two largest CSAs are in Southeast Michigan and West Michigan. The following **Tables 1-6** through **1-9** show all of Michigan's CSAs broken down to include the MSA/MiSA and their counties:

Table 1-6: Detroit-Warren-Flint CSA

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

Table 1-7: Grand Rapids-Muskegon-Holland CSA

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

Table 1-8: Lansing-East Lansing-Owosso CSA

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

Table 1-9: Saginaw-Bay City-Saginaw Twp. North CSA

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

[7] Complete information about the national air monitoring network is available at http://www.epa.gov/ttn/amtic/.
[8] These areas are established by the U.S. Office of Management and Budget.

Those MSAs and MiSAs that are not part of any CSA are shown in **Tables 1-10** and **1-11**:

Table 1-10: Additional Michigan MSAs

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

Table 1-11: Other Michigan MiSAs

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

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

AQD MONITORING TECHNIQUES:

The AQD follows a quality system to ensure that the monitoring data that is collected and reported is valid and accurate. Precision (the repeatability of a measurement) and accuracy (the closeness of the measurement to a true value) are the two primary components of the quality system for ensuring accurate data. Additional information on the AQD's precision and accuracy procedures along with their 2006 measurement reports are available in **Appendix B**.

CHAPTER 2: CRITERIA POLLUTANTS MONITORED IN MICHIGAN

Chapter 2 provides information on each of the six criteria pollutants that include state source information, Michigan's monitoring requirements for 2006, attainment/nonattainment status, monitoring site locations, and air quality trends from 1997-2006 broken down by location.[9] The criteria pollutant subsections found in **Chapter 2** include:

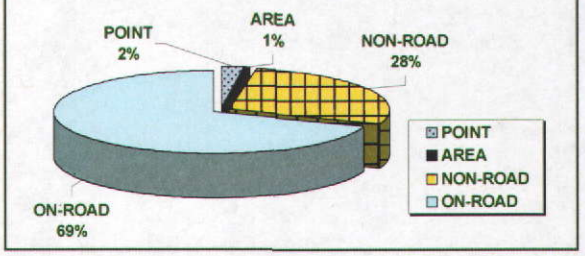
- **Chapter 2.1**: Carbon Monoxide (CO)
- **Chapter 2.2**: Lead (Pb)
- **Chapter 2.3**: Nitrogen Dioxide (NO_2)
- **Chapter 2.4**: Ozone (O_3)
- **Chapter 2.5**: Particulate Matter (PM_{10}, $PM_{2.5}$, and $PM_{2.5}$ Chemical Speciation)
- **Chapter 2.6**: Sulfur Dioxide (SO_2)

The actual 2006 data for each criteria pollutant is available in **Appendix A**.

CHAPTER 2.1: CARBON MONOXIDE (CO)

Utilizing the EPA's 2002 emissions inventory (EI) data, **Figure 2.1-1** shows that Michigan's on-road motor vehicle sources account for 69% of the state's CO emissions. On-road sources include diesel, heavy/light-duty gas trucks and vehicles, and motorcycles.

Figure 2.1-1: Percentage of CO Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)



Michigan's non-road sources contribute 28% of the CO emissions. These sources include aircraft, marine vessels, non-road two and four stroke engines, railroads, and others.

CO emissions from Michigan's industries (point sources) account for only 2%. For the Detroit-Ann Arbor area, combustion from coal-fired power plants, industrial, commercial, and residential sources, as well as iron, steel manufacturing, and foundries were the leading point sources of CO (**1, 2**).

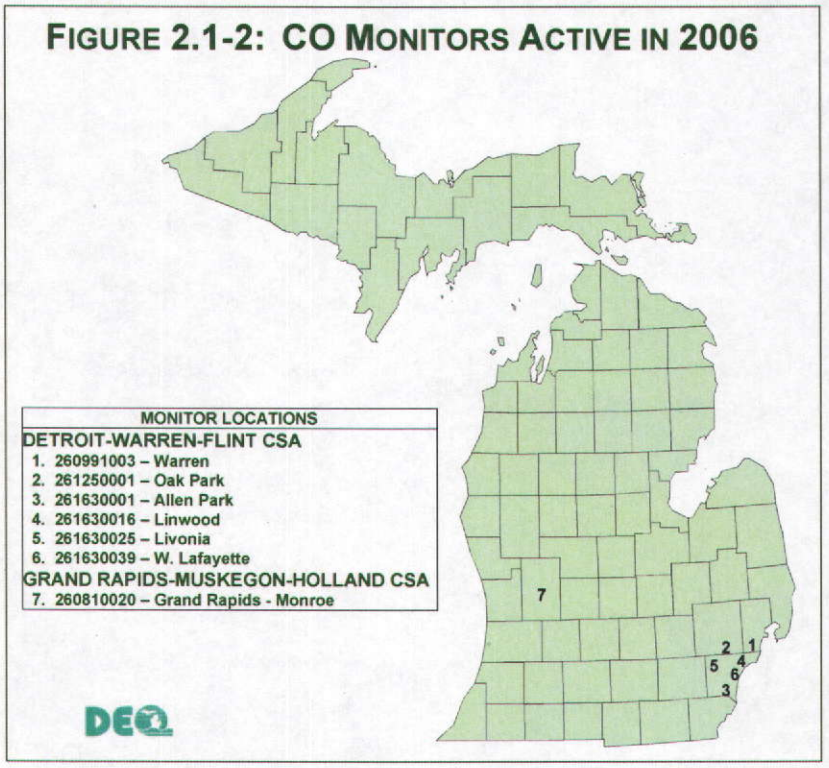
Michigan's CO emission totals are estimated to be 20% less than what the emissions were in 1990 and historically, Michigan has had better air quality when compared to nationwide trend site averages.[10] As of August 30, 1999, all areas in Michigan have been designated as attainment for CO and no monitoring needs to be performed for attainment purposes. Starting in 2007, under the 2006 amended air quality monitoring regulations, CO monitoring will no longer be required. However, trace CO monitoring will be required at the new NCORE stations.

CO MONITORING IN MICHIGAN:

For 2006, as shown in **Figure 2.1-2**, there were a total of seven CO monitors in operation, with six located in Southeast Michigan and one in West Michigan.[11]

[9] The air quality trends are based on actual statewide monitored readings which are also listed in EPA's Air Quality Subsystem Quick Look Report Data.
[10] Information on Nationwide Air Quality Trends is available at: http://www.epa.gov/airtrends/carbon.html.
[11] The two previously established sites at Newberry and Seney were shut down on March 31, 2006.

FIGURE 2.1-2: CO MONITORS ACTIVE IN 2006



CO TRENDS BY LOCATION:

Figure 2.1-3 provides the maximum 2nd highest 1-hour CO level trends for Michigan from 1997-2006, which demonstrates that there have not been any exceedances of the 1-hour CO NAAQS.

Figure 2.1-3: CO Levels in MI from 1997-2006
(2nd Highest 1-Hr Maximum Values)

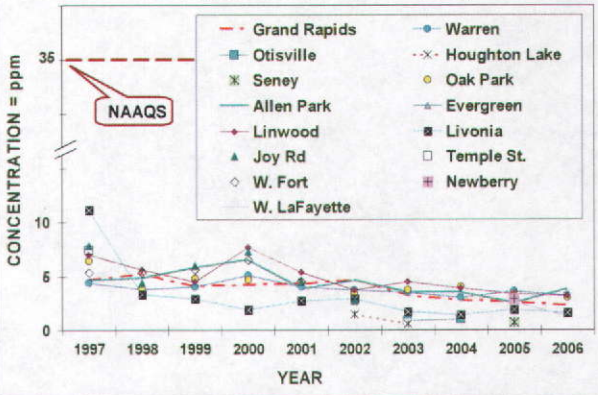


Figure 2.1-4: CO Levels in MI from 1997-2006
(2nd Highest 8-Hr Maximum Values)

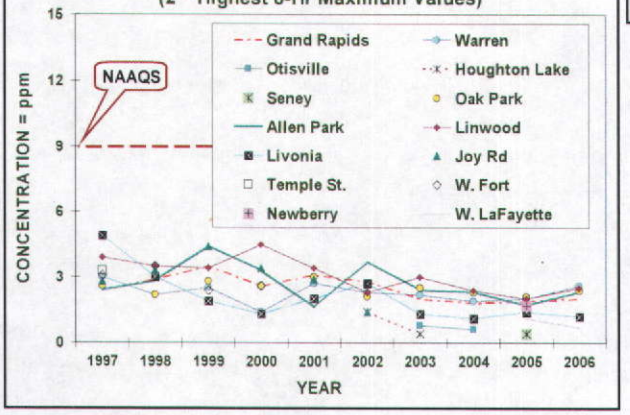
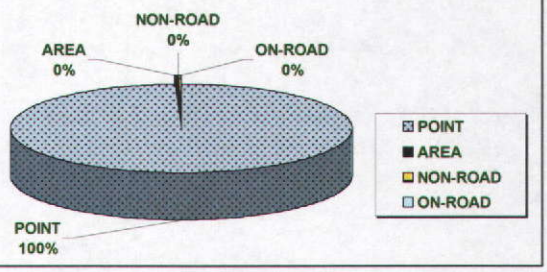


Figure 2.1-4 provides the 2nd highest 8-hour CO maximum values for Michigan's CO sites. In 2006, five of the seven CO monitoring sites (two in West Michigan and three in Southeast Michigan) had slightly elevated CO levels from the previous year. However, the values continue to remain well below the standard and Michigan has not experienced any exceedances of the 8-hour CO NAAQS.

CHAPTER 2.2: LEAD (PB)

Michigan Pb emissions have significantly decreased over the past 25 years and ambient Pb levels have been far below the Pb NAAQS. Much of this reduction can be attributed to the removal of alkylated Pb from automotive gasoline. **Figure 2.2-1** shows that point sources such as non-ferrous smelters and battery plants contribute almost all of Michigan's overall Pb emissions. However, since there are no large Pb point sources in Michigan and with the state in attainment for Pb, point source monitoring is not conducted. Michigan does monitor for Pb under its toxics monitoring program.

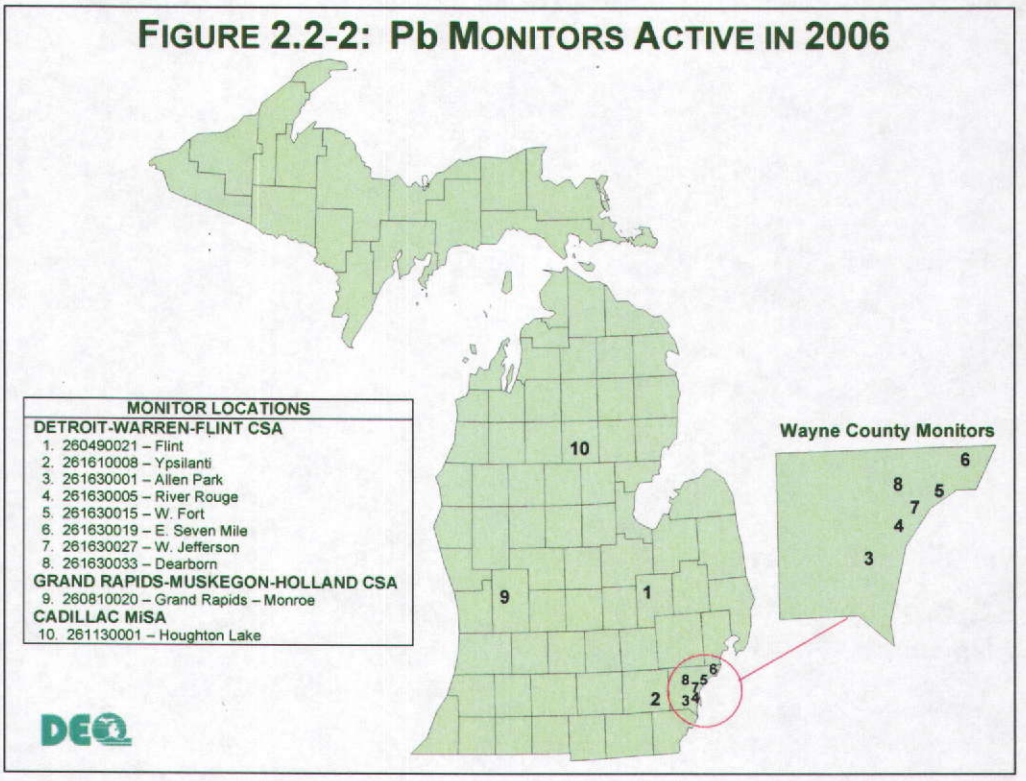
Figure 2.2-1: Percentage of Pb Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)



PB MONITORING IN MICHIGAN:

Although the 1999 monitoring regulations allow the discontinuance of many monitors, Michigan has continued Pb monitoring, along with other trace metals, as part of the Michigan Toxics Air Monitoring Program (MITAMP), the National Air Toxics Trend Sites (NATTS), and the Detroit Air Toxics Initiative (DATI) (discussed in **Chapter 3**). The MITAMP sites include Flint, Grand Rapids (Monroe), Ypsilanti, Allen Park, River Rouge, Detroit's W. Fort and E. Seven Mile, and Houghton Lake (a background site). As part of the NATTS program, the Dearborn site, must determine trace metal concentrations from PM_{10} filter. For the DATI program, Detroit's W. Jefferson monitoring site is being utilized for TSP, polynuclear aromatic hydrocarbons (PAHs), mercury, and toxics. The ten Michigan monitoring sites for Pb in 2006 are shown in **Figure 2.2-2**.

FIGURE 2.2-2: Pb MONITORS ACTIVE IN 2006



It is important to note that the 2006 amended monitoring requirements also de-emphasize Pb monitoring and under the NCORE network, there will only be ten sites nationally that will be required to measure Pb. However, since operation of the Dearborn NATTS site is funded through a different grant source, monitoring of Pb and other trace metals, both as TSP and PM_{10} will continue to help maintain continuity with Michigan's historical database and to provide a full suite of trace metal measurements by various size fractions ($PM_{2.5}$, PM_{10}, TSP). Pb measurements as $PM_{2.5}$ are also made throughout the $PM_{2.5}$ speciation network (discussed in **Chapter 2.5**). If EPA adopts a more stringent form of the NAAQS or if budget concerns arise, Michigan's Pb monitoring network may need to be modified.

PB TRENDS BY LOCATION:

Pb levels in Michigan have remained far below the NAAQS over the past decade. Due to the very low Pb levels, **Figures 2.2-3** and **2.2-4** have been enlarged and the scale divided to show the actual Pb levels.

For the years 1997-2006, **Figure 2.2-3** shows those sites in Southeast Michigan that are located within the Detroit-Warren-Flint CSA. **NOTE**: The spike at Detroit's Fort Street in 2006 was investigated and confirmed as accurate, although no known reason was found.

Figure 2.2-3: Pb Levels in MI's Detroit-Warren-Flint CSA from 1997-2006 (Maximum Quarterly Values)

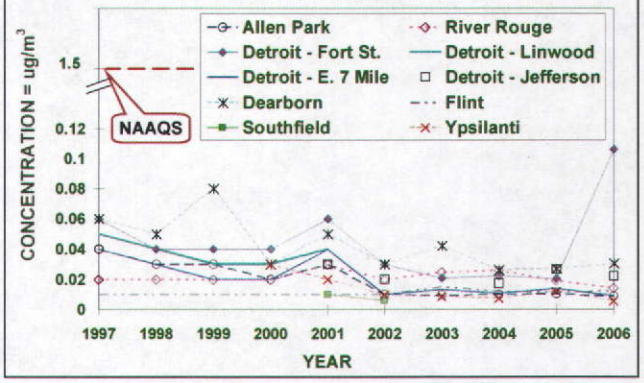


Figure 2.2-4: Pb Levels in Grand Rapids-Muskegon-Holland CSA and Northern MI from 1997-2006 (Maximum Quarterly Values)

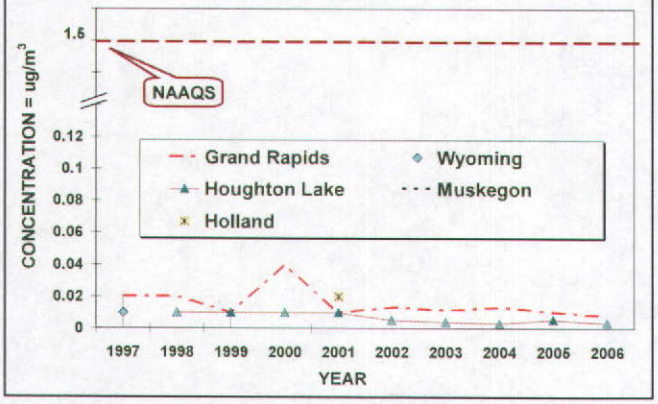
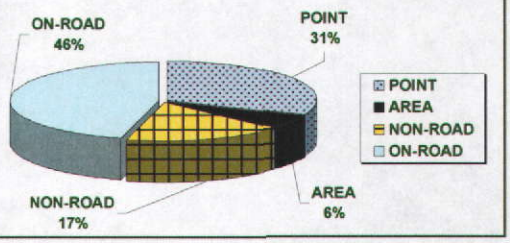


Figure 2.2-4 includes the remainder of Michigan's monitoring sites located in the Grand Rapids-Muskegon-Holland CSA and Northern Michigan for the years 1997-2006.

CHAPTER 2.3: NITROGEN DIOXIDE (NO_2)

Michigan ambient NO_2 levels have always been well below the NAAQS. **Figure 2.3-1** shows that on-road (46%) and point sources (31%) make up most of Michigan's total NO_X emissions. Point sources include industrial, commercial, institutional, and residential fossil fuel combustion. Since March 3, 1978, all areas in Michigan have been in attainment for NO_2.

Figure 2.3-1: Percentage of NO_X Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)



NO_2 MONITORING IN MICHIGAN:

Even though there are no nonattainment areas for NO_2 in Michigan and monitoring for attainment purposes is not required, monitors continue to operate to support photochemical model validation work. For 2006, **Figure 2.3-2** shows that there were three NO_2 monitors in operation - two were located in the Detroit CSA and one in the Grand Rapids-Muskegon-Holland CSA (Grand Rapids-Monroe site). For the Detroit CSA, the Linwood monitor measures neighborhood scale air masses used for determining photo-chemical production of NO_2 in an area with the largest emissions of NO_X, and the E. Seven Mile monitor is a downwind urban scale site that measures NO_2 produced from the reaction of O_3 with NO_X.

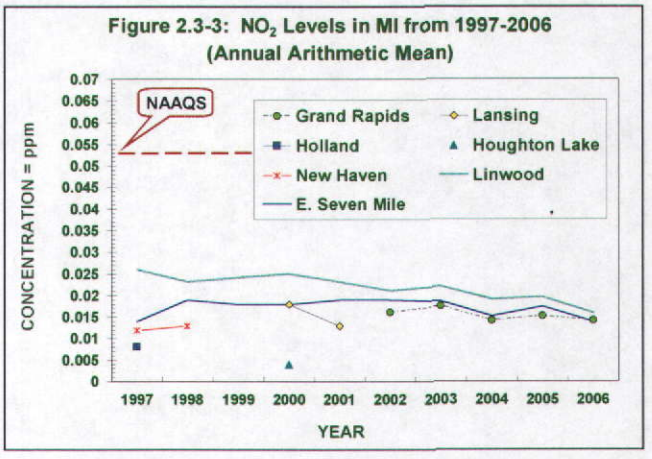
FIGURE 2.3-2: NO_2 MONITORS ACTIVE IN 2006

It is important to note that the revised 2006 air quality monitoring regulations no longer require NO_2 monitoring. Under the new NCORE requirements, trace monitoring will be necessary and Michigan will establish trace monitors at Grand Rapids and Allen Park before January 2008.

NO_2 TRENDS BY LOCATION:

As shown in **Figure 2.3-3**, all monitoring sites have shown an annual NO_2 concentration at less than half of the 0.053 ppm NAAQS. There has never been an exceedance of the NO_2 standard in Michigan.

Figure 2.3-3: NO_2 Levels in MI from 1997-2006 (Annual Arithmetic Mean)

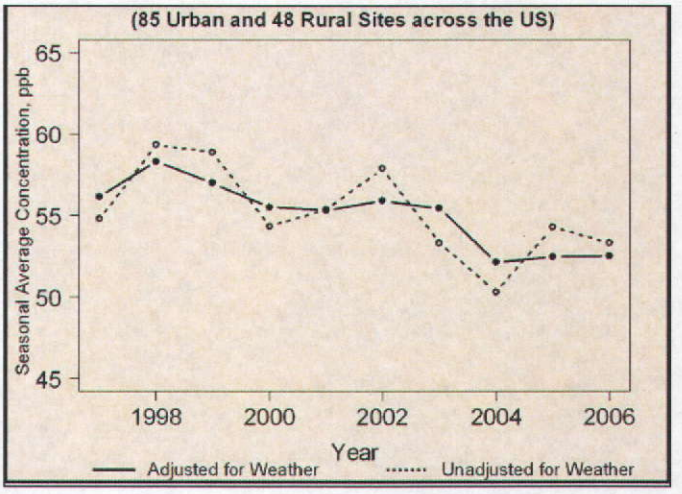


CHAPTER 2.4: OZONE (O_3)

Ground-level O_3 is not emitted directly from any source, but is created by photochemical reactions involving NO_X and VOCs (O_3 precursors) in the presence of sunlight. EPA states that nationwide, O_3 levels (1-hour and 8-hour) have improved considerably. National programs that have cut VOC and NO_X emissions from vehicles, industrial facilities, and electric utilities, along with the reformulation of fuels, and other consumer/commercial products (i.e., paints and chemical solvents that contain VOC) have helped to reduce the levels of O_3. EPA notes that variations in weather conditions also play an important role in determining O_3 levels.[12]

In **Figure 2.4-1**, EPA used 8-hour O_3 concentrations from 85 urban and 48 rural sites across the U.S.[13] Typical weather conditions were determined by averaging conditions (e.g., temperature, humidity, etc.) for the summers (May-September) of 1997 through 2006. The dotted line shows the trend in observed values at monitoring sites, while the solid line illustrates the underlying O_3 trend after removing the effects of weather. The solid line represents O_3 levels anticipated under typical weather conditions and serves as a more accurate O_3 trend for assessing changes in emissions. EPA states that for Michigan, on average, O_3 levels declined 10% between 1997 and 2006. These improvements are in response to both state and regional reductions in NO_X and VOC emissions.

Figure 2.4-1: EPA's National 8-Hour O_3 Air Quality Trends from 1997-2006

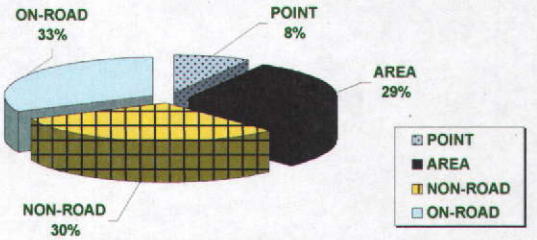


According to EPA's 2002 EI data (**Figure 2.4-2**), Michigan's on-road and non-road sources still account for a large percentage of VOC emissions. Michigan's VOC emission sources include:

- motor vehicles;
- storage, transport, processing, and marketing of petroleum products;
- combustions of fuels; and
- industrial processes such as production/use of organic chemicals, paints, polymers, resins, surface coatings, plastic product manufacturing, coke production/byproducts, and degreasing.

VOCs can also include the terpenes and isoprenes naturally emitted from vegetation.

Figure 2.4-2: Percentage Of VOC Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)



[12] Information was obtained from EPA's website, Trends in Ozone Adjusted for Weather Conditions available at http://www.epa.gov/airtrends/weather.html.

[13] EPA Reference: Cox, William M. and Shao-Hang Chu. (1996). "Assessment of Interannual Ozone Variation in Urban Areas from a Climatological Perspective." Atmospheric Environment, 30.14, 2615-2625.

Under the 8-hour O_3 NAAQS, EPA designated 25 counties in Michigan as nonattainment on June 15, 2004 (**Figure 2.4-3**). Following implementation of the 8-hour O_3 standards, EPA revoked the 1-hour standard on July 15, 2005.

In 2006, the MDEQ successfully petitioned EPA to change the status for 16 of the 25 designated nonattainment counties to attainment.[14] EPA's final rule approving Michigan's redesignation requests for the counties of Benzie, Berrien, Calhoun, Cass, Clinton, Eaton, Genesee, Huron, Ingham, Kalamazoo, Kent, Lapeer, Mason, Muskegon, Ottawa, and Van Buren was published in the May 16, 2007 Federal Register.[15] **Figure 2.4-4** shows the nine counties in Michigan that remain in nonattainment.

The following **Table 2.4-1** shows the three-year averages of the 4th highest 8-hour O_3 values for all of Michigan's monitoring sites from 1997-2006. It is important to point out that the three-year averages for the 2004-2006 monitoring period show that all sites, except Holland (Allegan County), were meeting the O_3 NAAQS.

NOTE: In 2006, the AQD added O_3 monitors at a new site in Manistee and at Detroit's West Fort site. Because there is only one year's worth of data, only the 2006 values are noted in **Table 2.4-1** for these two sites.

Figure 2.4-3: EPA's Designated 8-hour Ozone Attainment/Nonattainment Areas for Michigan
(Utilizing 2001-2003 Monitoring Data)

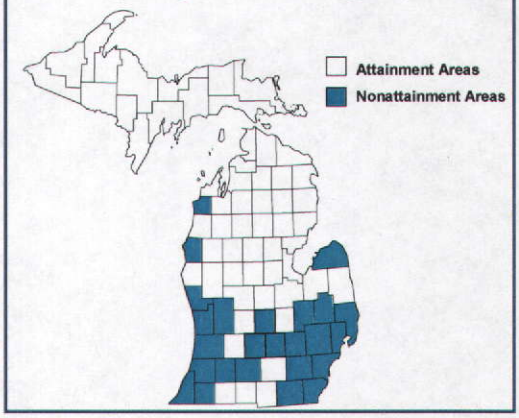
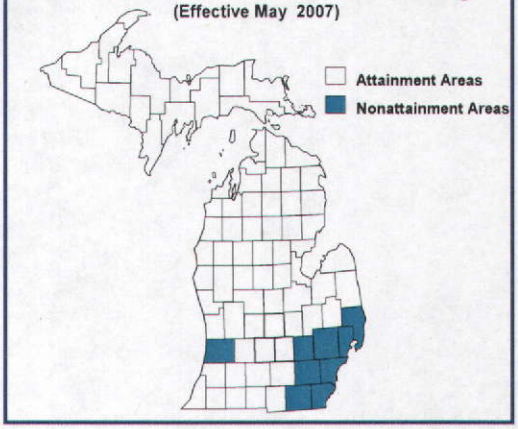


Figure 2.4-4: EPA's Designated 8-hour Ozone Attainment/Nonattainment Areas for Michigan
(Effective May 2007)



[14] Michigan's redesignation request actions are located at http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-ozone-11countyredesignation-march06.pdf and http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-ozone-5-county-redesignation-5-30-06.pdf.

[15] The May 16, 2007 Federal Register notice is available at http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-ozone-redesignations-5-07.pdf

CHAPTER 2.5: PARTICULATE MATTER (PM_{10}, $PM_{2.5}$, $PM_{2.5}$ CHEMICAL SPECIATION, AND TSP)

PM is categorized according to the size and health impact of the particles. Particle size is the major factor that determines which particles will enter the lungs and how deeply they will penetrate. $PM_{2.5}$ are much smaller "fine particles" equal to or less than 2.5 µm in diameter and cause the most serious health effects. At the end of 2006, there were two important federal regulation revisions that will affect how monitoring for PM will be conducted in the future. Although the impact of these revisions will not affect the 2006 monitoring data presented in this report, it is important to discuss.

On October 17, 2006, EPA amended the ambient air monitoring requirements impacting how $PM_{2.5}$ will be measured. Under the 2006 amended regulations, the $PM_{2.5}$ monitoring network requires every-day sampling for those areas that approach the 24-hour $PM_{2.5}$ standard, while others will operate on every third or sixth day cycles.[18] As with the O_3 monitoring network, MSA boundaries have been modified and population totals tied to measurements of ambient air quality have increased. Also, any monitors with a design value (using the most recent three years worth of data) which is greater than or equal to 85% of the $PM_{2.5}$ NAAQS, will require more monitors in those MSAs. Another important aspect of the regulations is that the proposed NCORE sites will add measurement of "inhalable coarse particles," (i.e. $PM_{10-2.5}$) with some monitors providing continuous mass concentration monitoring and others 24-hour filter-based sampling to enable development of $PM_{10-2.5}$ methods for chemical speciation.[19]

Effective December 18, 2006, EPA also revised the 1997 PM NAAQS which establishes a more stringent 24-hour $PM_{2.5}$ annual standard and revokes the PM_{10} annual standard.[20] Under the newly revised 24-hour $PM_{2.5}$ NAAQS, Michigan must provide to EPA by December 18, 2007 (based on 2004-2006 monitoring data), its recommendations on which areas in the state should be designated as attainment and nonattainment. EPA will notify states by August 2008 on their designation determinations with an effective date of December 2008. Following final designations, states with nonattainment areas are required to submit SIPs within three years (April 2011) and must show attainment by 2013.

It is important to note that many national programs have been put in place to reduce levels of PM. These programs control directly emitted PM and/or the emissions that contribute to PM formation, such as SO_2, NO_X, and VOCs. For example, EPA's Clean Air Interstate Rule (CAIR), finalized in 2005, focus on those states whose SO_2 and NO_X emissions significantly contribute to the $PM_{2.5}$ and O_3 pollution problems in other downwind states. The NO_X SIP Call, which began in 2004, reduces NO_X and regional transport of ground-level O_3 pollution for those states in the eastern U.S. (such as Michigan). Based on EPA's modeling of year 2015 results from the NO_X SIP call and other federally implemented programs that reduce NO_X and SO_2 (e.g., CAIR, etc.), it is expected that all Michigan counties, except for Wayne County (which is also out of compliance for the annual $PM_{2.5}$ standard), will attain compliance.[21] The following **Table 2.5-1** is from EPA's Particle Pollution Report: Current Understanding of Air Quality and Emissions through 2003 and lists the major emission control programs since 1995 that have or will reduce PM.[22]

[18] Effective January 1, 2007, the required changes have been made to Michigan's $PM_{2.5}$ monitoring network.
[19] In the original draft revision of the 1997 PM NAAQS, EPA had proposed implementing a new "inhalable coarse particle" category but decided that further research was needed. Therefore, this new method of measurement ($PM_{10-2.5}$) was established under the 2006 revised air monitoring regulations.
[20] EPA's October 16, 2006 federal register notice for the new PM NAAQS is available at http://www.epa.gov/fedrgstr/EPA-AIR/2006/October/Day-17/a8477.pdf.
[21] Additional information on PM is available on the AQD's website at http://www.michigan.gov/deqair under "Assessment and Planning," "Attainment/Nonattainment Information," then "Particulate Matter."
[22] The Particle Pollution Report is available at http://www.epa.gov/air/airtrends/aqtrnd04/pm.html.

Table 2.5-1: Select PM Emission Control Programs from 1995-2015

Program	Sector	Direct PM[a] Reductions	PM Precursors SO_2 Reductions	PM Precursors NO_x Reductions	PM Precursors VOC Reductions	Implementation Date
Clean Air Nonroad Diesel Rule	Mobile sources	X	X	X		2004-2015
Clean Air Interstate Rule (proposed December 2003)	Electric Utilities	X	X	X		2010-2015
Acid Rain Program	Electric Utilities		X	X		1995-2010
NO_x SIP Call	Electric Utilities		X	X		2004
Regional Haze Rule/ Best Available Retrofit Technology	Electric Utilities[b]	X	X	X		2013-2015
$PM_{2.5}$ Implementation[c]	Stationary/Area/ Mobile sources	X	X	X	X	2008-2015
PM_{10} SIPs (e.g., San Joaquin Valley)	Stationary/Area/ Mobile sources	X	X	X	X	Ongoing
Maximum Achievable Control Technology (MACT) Standards[d]	Stationary/Area	X			X	1996-2003
Various Mobile Source Programs[e]		X	X	X	X	Ongoing

[a] Includes elemental and organic carbon, metals, and other direct emissions of PM.

[b] Also applies to industrial boiler and the other source categories also covered under Prevention of Significant Deterioration (PSD).

[c] Includes Reasonably Available Control Technology (RACT) and Reasonably Available Control Measures (RACM).

[d] Includes a variety of source categories such as Boilers and Process heaters, Pulp and Paper, Petroleum Refineries, various minerals and ores, and others. While these standards are for hazardous air pollutants (HAPs) such as metals, measures to reduce HAPs in many cases also reduce PM emissions.

[e] Includes such programs as onroad diesel and gasoline engines, nonroad gasoline engines, Low Sulfur Diesel and Gasoline Fuel Limits for onroad and offroad engines, Motorcycles, Land-based recreational vehicles, and Marine diesel engines.

PM_{10}:

Figure 2.5-1 shows Michigan's percentage of emissions by source category. Michigan's on-road and off-road PM_{10} emissions combined contribute 34%, point sources 34%, and area sources 32%. For area source contributions, Michigan had a substantial increase in percentages from the 2002 emissions inventory (32%) to the 1999 emissions inventory (12%). **Table 2.5-2** lists the different types of point and area sources that contribute PM_{10} in Michigan.

Figure 2.5-1: Percentage of PM_{10} Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)

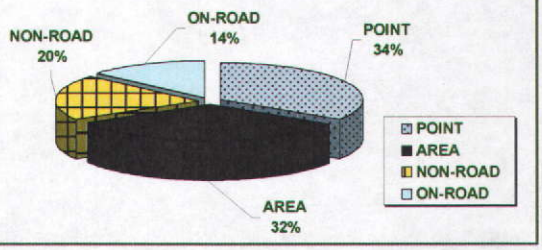
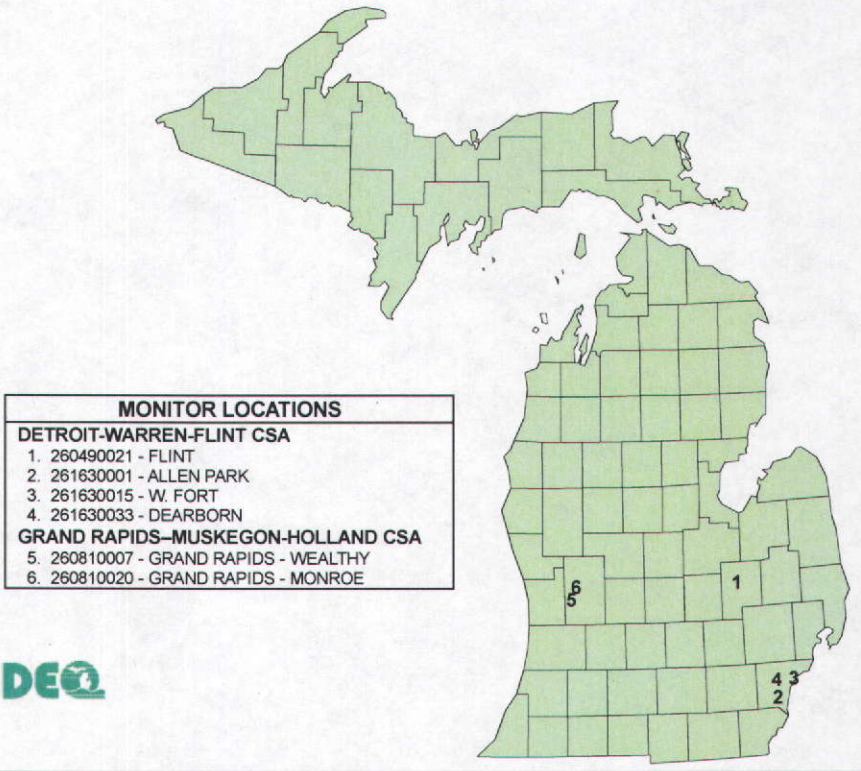


Table 2.5-2: PM_{10} Point and Area Source Types in Michigan

POINT SOURCES	AREA SOURCES
fossil fuel combustion (i.e., coal burning)	fossil fuel combustion; other combustion (i.e., residential fireplaces/wood stoves); incineration; and open burning
chemical and allied product manufacturing	oil and gas production
metals processing	agriculture, food, and mineral products
petroleum, petroleum products, and related industries	wood, pulp and paper, and publishing products; misc. industrial processes
other industrial processes	agriculture and forestry

Since October 4, 1996, all areas in Michigan have been in attainment with the PM_{10} NAAQS. Due to the recent focus upon $PM_{2.5}$ and because of the relatively low level of PM_{10} measured over recent years, Michigan's PM_{10} network is maintained at a minimum level. The map in **Figure 2.5-2** identifies the locations of the six PM_{10} monitoring stations that were operating in Michigan during 2006. These monitors are located in the state's largest populated urban areas -- three in the Detroit area, one in Flint, and two in Grand Rapids. To better characterize the nature of PM in Michigan, many of the existing PM_{10} monitors are co-located with $PM_{2.5}$ monitors in population-oriented areas.

FIGURE 2.5-2: PM_{10} MONITORS ACTIVE IN 2006



PM_{10} TRENDS BY LOCATION:

Figure 2.5-3 shows the annual arithmetic means for the Detroit-Warren-Flint CSA from 1997-2006. For 2006, all monitoring sites in the Detroit area had readings below the PM_{10} standard with the Dearborn continuing to have the highest maximum annual mean (31.5 $\mu g/m^3$) in the state.

Figure 2.5-3: PM_{10} Levels in MI's Detroit-Warren-Flint CSA from 1997-2006 (Annual Arithmetic Means)

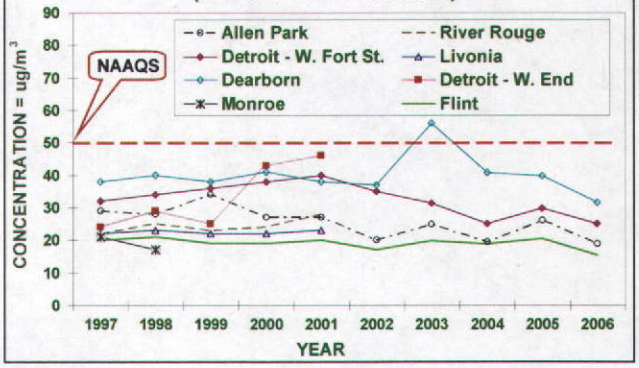


Figure 2.5-4: PM_{10} Levels in the Grand Rapids-Muskegon-Holland CSA & North MI from 1997-2006 (Annual Arithmetic Means)

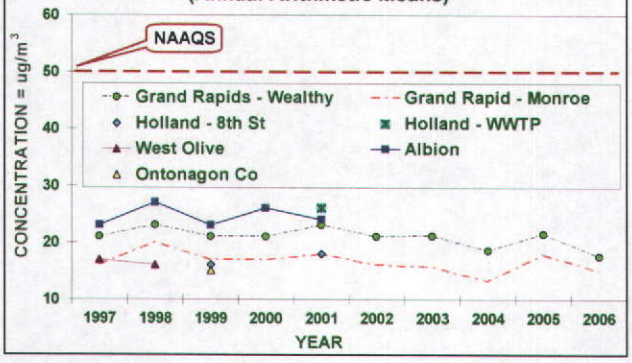
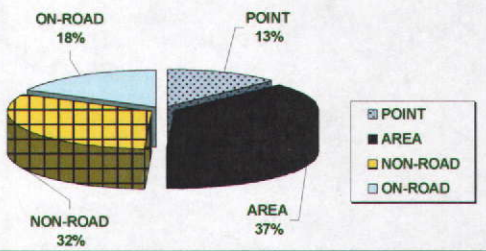


Figure 2.5-4 shows the annual arithmetic means for the Grand Rapids-Muskegon-Holland CSA and Northern Michigan from 1997-2006. In 2006, the two PM_{10} monitoring sites located in the Grand Rapids area continue to show a decline in the annual mean levels. For the decade, all the monitoring sites in western Michigan have maintained a level well below the PM_{10} NAAQS.

$PM_{2.5}$:

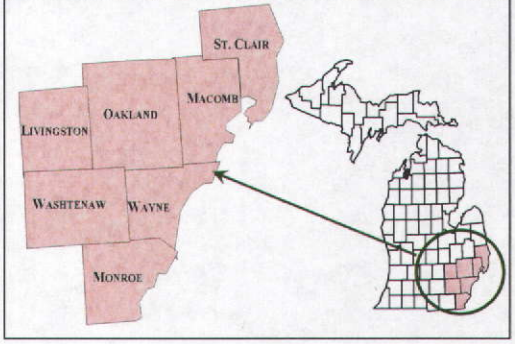
Figure 2.5-5 shows that according to EPA's 2002 EI data, Michigan area sources produce the majority of $PM_{2.5}$ emissions in the state (37%). However, when you combine non-road (32%) and on-road (18%) sources together, they produce 50% of Michigan's $PM_{2.5}$ emissions. Point sources, such as fossil fuel (coal) combustion, metal processing, incineration, etc., account for the remaining 13% of Michigan's $PM_{2.5}$ emissions.

Figure 2.5-5: Percentage Of $PM_{2.5}$ Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)



In 2005, EPA designated under the 1997 $PM_{2.5}$ NAAQS, seven Southeast Michigan counties as nonattainment (shown in **Figure 2.5-6**). By 2010, Michigan is required to develop control strategies to bring the areas into attainment. The final $PM_{2.5}$ Implementation Rule describing the requirements needed to develop these control strategies, was issued by EPA on March 29, 2007. The AQD is currently working on Michigan's SIP due to EPA by April 18, 2008 for these seven Southeast Michigan nonattainment counties. **NOTE**: The final $PM_{2.5}$ Implementation Rule addresses the 1997 PM NAAQS and is not intended, at this time, to be used for the newly revised 2006 PM NAAQS.

FIGURE 2.5-6: EPA'S $PM_{2.5}$ NONATTAINMENT AREA DESIGNATIONS FOR MICHIGAN (BASED ON THE 2001-2003 THREE-YR ANNUAL AVERAGES DATA)



COMPREHENSIVE MONITORING FOR $PM_{2.5}$ IN MICHIGAN:

The statewide particulate network consists of many components which together provide a picture of the nature of PM within the state. The concentrations of $PM_{2.5}$ measured over a 24-hour time period are determined using the federal reference method (FRM). Only data generated by FRM monitors are used for comparisons to the NAAQS. The Michigan monitoring sites are located in urban, commercial, and residential areas where people are exposed to $PM_{2.5}$.

In addition to the FRM monitors, continuous and speciated monitors are also used at some locations. Continuous monitoring is beneficial as it provides real time hourly data that supplements the $PM_{2.5}$ data collected by FRM monitors. Speciated monitoring provides a better understanding of the chemical composition of $PM_{2.5}$ material and better characterizes background levels. The following are brief descriptions of the types of monitors that make up Michigan's $PM_{2.5}$ monitoring network.

$PM_{2.5}$ FRM Monitoring Network: $PM_{2.5}$ FRM monitors are deployed at all of Michigan's 30 $PM_{2.5}$ monitoring sites to characterize background or regional $PM_{2.5}$ transport collectively from upwind sources. The two monitoring sites in Detroit's W. Lafayette and Newberry investigate PM levels in an area of Detroit heavily impacted by mobile source emissions. The FRM monitors at the Channing and Crystal Falls sites in Michigan's Upper Peninsula were established for a short-term study to determine the impact of outdoor wood boilers on air quality. In addition, five $PM_{2.5}$ FRM monitoring sites are co-located with PM_{10} monitors to allow for $PM_{2.5}$ and PM_{10} comparisons (**4, 5, 6**). Co-located PM_{10} and $PM_{2.5}$ sites include Flint, Grand Rapids (Monroe), Dearborn, and Detroit's Allen Park and W. Fort.

Continuous $PM_{2.5}$ Monitoring: 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 a core monitoring $PM_{2.5}$ site in a metropolitan area

with a population greater than one million. Both Detroit (Allen Park) and Grand Rapids (Monroe) meet this requirement (**5**).

Initially, the MDEQ operated all TEOM units with an inlet temperature of 50 degrees Celsius, but this high inlet temperature was volatilizing nitrate during the winter months. Between 2003 and 2004, filter dynamic measurement system (FDMS) inlets were added to all TEOMs. However, maintenance problems occurred during summer days with high humidity, which also interfered with data capture. As a possible solution, in 2006 the MDEQ operated all 14 TEOMS with the FDMS inlets installed only during the winter months and removed the FDMS inlets during the summer. (both data are shown in **Appendix A**). It is important to note that performance was worse in 2006 and several discontinued parts had broken. Therefore, in February 2007, all FDMS units were removed from the TEOMS.

Chemical Speciation Monitoring: Single event Met-One spiral ambient speciation samplers (SASS) are used throughout Michigan's speciation network and are placed in population-oriented stations in both urban and rural locations. $PM_{2.5}$ chemical speciation samples are collected on three types of filters: teflon, nylon, and quartz over a 24-hour period. Each filter is analyzed by a different method to determine various components of $PM_{2.5}$ (**7**). There are nine SASS monitors operating in Michigan.

The primary objectives of the chemical speciation monitoring sites are to provide data that will be used to determine air quality and to support the development of attainment strategies. Historical speciation data for Michigan indicates that $PM_{2.5}$ is made up of 30% nitrate compounds, 30% sulfate compounds, 30% organic carbon,[23] and 10% as unidentified or trace elements. In January 2007, EPA released its new SPECIATE 4.0, which includes a total of 4,080 PM speciation and total organic compound profiles of air pollution sources. These profiles are used to create speciated emissions inventories for regional haze, $PM_{2.5}$, and O_3 air quality modeling, and to estimate hazardous and toxic air pollutant emissions from the speciation emissions.

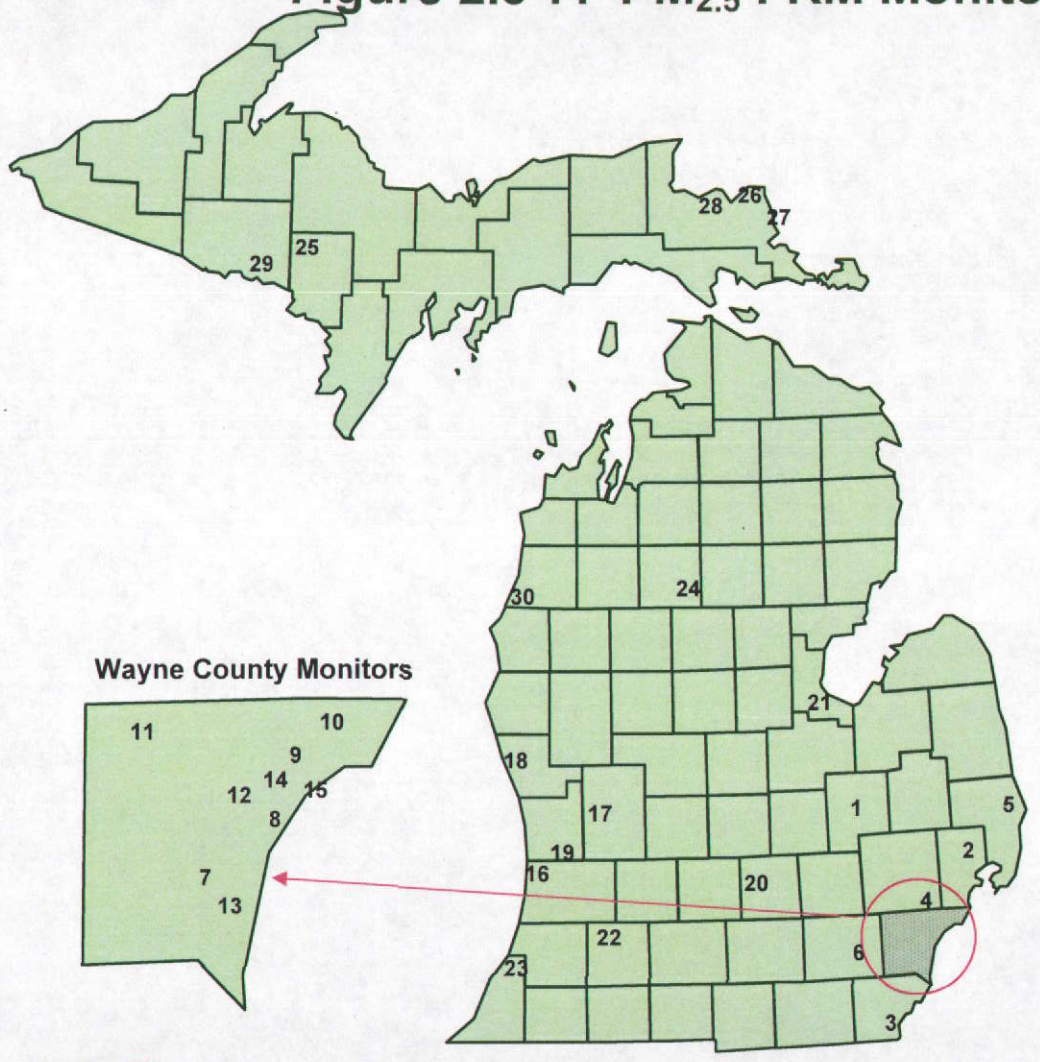
It is important to note that the 2006 amended air monitoring regulations specify speciation monitoring, but did not provide much detail except that measurements of $PM_{10-2.5}$ will be added to the NCORE sites.[24] Continued operation of the speciation trend site in Detroit (Allen Park) is required on a national level and the sampling frequency has increased to once every three days.

In 2006, the monitors in Saginaw and Ann Arbor were shut down and a Tribal site was added in Manistee County. **Figure 2.5-7** shows all of Michigan's 30 $PM_{2.5}$ FRM monitoring stations operating in 2006 and denotes which sites also have TEOM and/or SASS monitors in operation. **NOTE**: A TEOM is operating at the Seney site along with an O_3 monitor, but is not included in **Figure 2.5-7** as it does not have a $PM_{2.5}$ FRM monitor.

[23] To better understand the chemical composition of the organic carbon fraction, a number of studies have been conducted in Southeast Michigan to further investigate organic carbon. Information can be found in the Michigan 2006 Ambient Air Monitoring Network Review, available at http://www.michigan.gov/deqair.

[24] Current information on both proposals can be found at http://www.epa.gov/air/particles/actions.html.

Figure 2.5-7: $PM_{2.5}$ FRM Monitors Active in 2006



MONITOR LOCATIONS

DETROIT-WARREN-FLINT CSA
1. 260490021 – Flint (TEOM)
2. 260990009 – New Haven
3. 261150005 – Luna Pier (SASS)
4. 261250001 – Oak Park
5. 261470005 – Port Huron (TEOM)
6. 261610008 – Ypsilanti (TEOM/SASS)
7. 261630001 – Allen Park (TEOM/SASS)
8. 261630015 – W. Fort
9. 261630016 – Linwood
10. 261630019 – E. Seven Mile
11. 261630025 – Livonia
12. 261630033 – Dearborn (TEOM/SASS)
13. 261630036 – Wyandotte
14. 261630038 – Newberry (TEOM)
15. 261630039 – W. Lafayette (TEOM)

GRAND RAPIDS-MUSKEGON-HOLLAND CSA
16. 260050003 – Holland (TEOM/SASS)
17. 260810020 – Grand Rapids (TEOM/SASS)
18. 261210040 – Muskegon
19. 261390005 – Jenison

LANSING-E. LANSING-OWOSSO CSA
20. 260650012 – Lansing (TEOM)

SAGINAW-BAYCITY-SAGINAW TWP. NORTH CSA
21. 260170014 – Bay City (TEOM)

KALAMAZOO-PORTAGE MSA
22. 260770008 – Kalamazoo (TEOM/SASS)

NILES-BENTON HARBOR MSA
23. 260210014 – Coloma

CADILLAC MiSA
24. 261130001 – Houghton Lake (TEOM/SASS)

IRON MOUNTAIN (MI-WI) MiSA
25. 260430002 – Channing

SAULT STE. MARIE MiSA
26. 260330901 – Sault Ste Marie, Easterday – TRIBAL (SASS)
27. 260330902 – Sault Ste Marie, Marquette – TRIBAL
28. 260330903 – Bay Mills - TRIBAL

IRON COUNTY
29. 260710001 – Crystal Falls

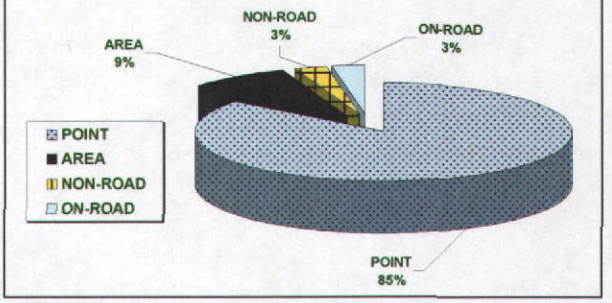
MANISTEE COUNTY
30. 261010922 – Manistee - TRIBAL

CHAPTER 2.6: SULFUR DIOXIDE (SO_2)

According to EPA's 2002 EI data, **Figure 2.6-1** illustrates that point source emissions contribute 85% of the overall SO_2 emissions in Michigan. These point sources include:

- fossil fuel (coal) combustion,
- chemical and allied product manufacturing,
- metals processing,
- petroleum and related industries,
- incineration, and
- other industrial processes.

Figure 2.6-1: Percentage of SO_2 Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)

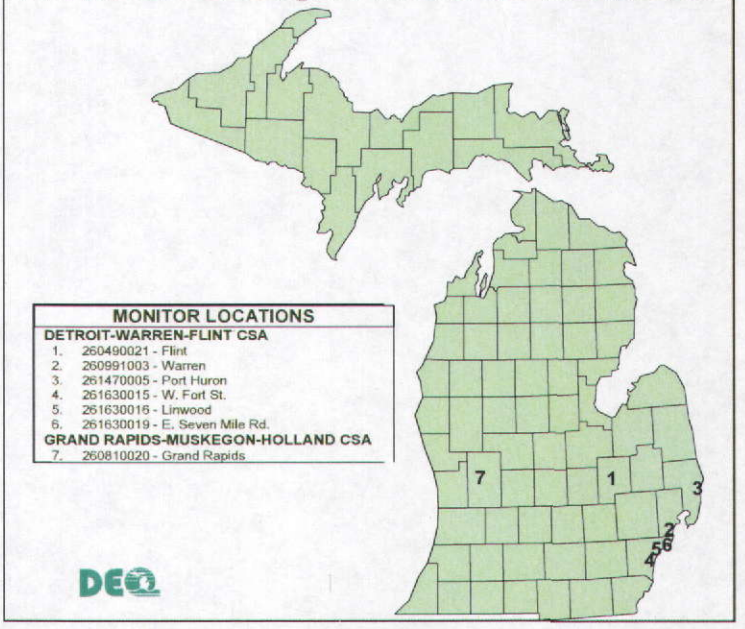


Michigan has been in attainment for SO_2 since 1982, with levels consistently well below the SO_2 NAAQS. Under the 2006 revised monitoring regulations, SO_2 monitoring is no longer required.

SO_2 MONITORING IN MICHIGAN:

For 2006, **Figure 2.6-2** shows that there were seven SO_2 monitors in operation, with the majority located in Southeast Michigan. As required under the 1997 air monitoring regulations, three monitors are located in the Detroit area measuring for neighborhood scale trends. These sites are at W. Fort (situated so that maximum SO_2 levels are being monitored), E. Seven Mile, and Warren. Additional monitors are also located at Linwood and Port Huron to measure maximum SO_2 concentrations of neighborhood or middle scale trends. The Flint monitor, though not technically located in Southeast Michigan, also measures for neighborhood scale trends. The other SO_2 site is located in Grand Rapids and it monitors neighborhood scale trends for West Michigan.

FIGURE 2.6-2: SO_2 MONITORS ACTIVE IN 2006



SO_2 TRENDS BY LOCATION:

In **Figure 2.6-3**, average SO_2 levels monitored in the state have consistently remained well below the annual 0.030 ppm NAAQS.

Figure 2.6-3: SO_2 Levels in Michigan from 1997-2006 (Annual Arithmetic Mean)