# 2005 Annual Air Quality Report

## Air Quality Division

Michigan Department of Environmental Quality

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MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

# MICHIGAN'S 2005 ANNUAL AIR QUALITY REPORT

AIR QUALITY DIVISION
P.O. BOX 30260
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**Cover Photo:** An American bald eagle soaring in Michigan's Upper Peninsula at Van Riper State Park (October 2005). Photo courtesy of Sheila Blais, AQD.

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# EXECUTIVE SUMMARY

The federal Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to the public and the environment. These standards define the maximum permissible concentration of criteria pollutants in the air. Other hazardous air pollutants (HAPs) that can affect human health or the environment are called "air toxics."[1]

One or more NAAQS have been established for the six criteria pollutants that are monitored by the Michigan Department of Environmental Quality's (MDEQ's) Air Quality Division (AQD). These criteria pollutants are carbon monoxide (CO), lead (Pb), nitrogen dioxide ($NO_2$), ozone ($O_3$), particulate matter (PM) less than or equal to ($\leq$) 10 or 2.5 microns in diameter ($PM_{10}$ and $PM_{2.5}$, respectively), and sulfur dioxide ($SO_2$). The purpose of this report is to provide a summary of the 2005 air quality data, along with air quality trends in Michigan.[2] In addition, this report:

- Describes the NAAQS and how compliance is determined,
- Assesses the trends of the six criteria pollutants,
- Identifies the types of ambient air quality monitoring that's conducted throughout Michigan,
- Describes the air toxic monitoring program,
- Discusses special projects such as the Air Quality Index (AQI), *Ozone Action!*, EnviroFlash program, etc.,[3] and
- Provides a modeling and meteorological summary of data.

**Ozone and $PM_{2.5}$:**

The focus in 2005 was on Michigan's 8-hour $O_3$ and $PM_{2.5}$ nonattainment areas. In 2004, EPA announced nonattainment designations for these two criteria pollutants. A nonattainment designation means that an area does not meet the NAAQS for that pollutant or that the area contributes towards the nonattainment designation of a surrounding area and a timeframe is given to bring that area into attainment. Michigan made requests to EPA for nonattainment reconsiderations for both 8-hour $O_3$ and $PM_{2.5}$.

For nonattainment areas, States are required to develop state implementation plans (SIPs) consisting of legally enforceable measures designed to reduce that criteria pollutant's levels below the NAAQS within the specified timeframe. The states must then provide EPA with an evaluation of a number of potential control measures to be implemented along with an implementation schedule. Unfortunately, EPA did not release its proposed implementation rules for either of these pollutants until December 2005, thereby making the SIP process difficult.

Detailed background information on Michigan's air quality endeavors can be reviewed on-line by accessing the AQD's *About the Air* newsletter. This newsletter is produced on a bi-monthly basis and is available electronically from the AQD's website at http://www.michigan.gov/deqair under "Air Publications." Current air quality activities and other information are also available on the AQD's website. Information on $O_3$ is provided in **Chapter 2.4** and $PM_{2.5}$ is in **Chapter 2.5** of this report.

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

[2] On-line information about criteria pollutants and air toxics along with this and previous annual air quality reports are available via the AQD's website at http://www.michigan.gov/deqair under "Spotlight."

[3] AQI readings and real time air monitoring information for $O_3$, $SO_2$, $NO_2$, CO, and $PM_{2.5}$, along with information on the new Enviroflash program are also available on the AQD's website under "Featured Online Services."

## HAPs – Mercury

Another important issue addressed in 2005 was regarding mercury emissions. Mercury has been identified as a significant environmental pollutant for decades and is a persistent, bioaccumulative neurotoxin. Air emissions of mercury contribute to the global cycling of mercury as well as local deposition. A portion of deposited mercury can be converted to methylmercury in aquatic systems. Studies have indicated an increased risk to a developing fetus upon exposure to methylmercury via maternal fish consumption.

For Michigan, the largest industrial source of mercury air emissions is coal-fired power plants. To address this issue, the MDEQ and Michigan Public Service Commission staff, representative from utilities, and representatives from environmental, scientific, and public policy groups convened a workgroup to look at ways to reduce and phase-out mercury emissions from coal-fired power plants, along with the reduction of nitrogen oxides ($NO_X$ - a precursor to both $PM_{2.5}$ and $O_3$), $SO_2$ (a precursor to the formation of $PM_{2.5}$ and $NO_X$), and carbon dioxide ($CO_2$). The Workgroup's report with recommendations was finalized in 2005.[4] This and other mercury issues are available on the AQD's website under "SPOTLIGHT" then "Mercury. Information is also provided in **Chapter 3** of this report.

## Federal Rules and Requirements

The EPA finalized a suite of inter-related rules to address $O_3$ and $PM_{2.5}$, non-road diesel emissions, and power plant emissions of $SO_2$, $NO_X$, and mercury. Three rules specifically address the transport of pollution across state borders (the Clean Air Interstate Rule [CAIR], Clean Air Mercury Rule [CAMR], and Clean Air Non-road Diesel Rule). Both CAIR and CAMR are also aimed at reducing air pollutant emissions from power plants. Reducing non-road emissions is a critical part of the effort by federal, state, local, and tribal governments to reduce the adverse health impacts of air pollution.

Following EPA's release of the final CAIR and CAMR, numerous challenges from states, environmental groups, and power companies were filed requesting EPA to reconsider certain parts of these final rules. EPA opened up comment periods to address only four specific issues on CAIR[5] and 10 aspects of CAMR.[6] These actions did not delay implementation of the rules.

On December 20, 2005, EPA first published proposed amendments to its national air quality monitoring requirements and PM NAAQS. Michigan has provided comments on these proposals which are available from the AQD's website.[7]

## Summary

For the criteria pollutants CO, Pb, $NO_2$ and $SO_2$, all of Michigan has continued to stay in attainment with levels well below their NAAQS. For $O_3$ and $PM_{2.5}$, Michigan does have some nonattainment areas but for both pollutants, levels have continued to decline.

The main contributing factors to Michigan's $O_3$ and $PM_{2.5}$ levels are on-road and non-road emission sources ($O_3$: 33% and 30%, respectively; $PM_{2.5}$: 18% and 32%, respectively). In addition, area sources also contribute 37% of $PM_{2.5}$ emissions. Therefore, with the new federal Clean Air Rules, along with Michigan's continued reduction efforts, both of these criteria pollutants levels should continue to decline.

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[4] Michigan's Mercury Electric Utility Workgroup report is available on the AQD's website at http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-mercury-report.pdf.

[5] Information related to CAIR's regulatory actions can be found on EPA's website at http://www.epa.gov/cair/rule.html.

[6] For Information on all EPA's CAMR regulatory actions visit http://www.epa.gov/air/mercuryrule/rule.htm.

[7] EPA's proposed amendments to the National Air Quality Monitoring Regulations and proposed PM NAAQS are available at www.epa.gov/air/particlepollution/actions.html. Michigan's comments can be found at http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-monitoring-comments-4-17-06.pdf and http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-pm-naaqs-comments-4-17-06.pdf, respectively.

# CHAPTER 1: CHAPTER SUMMARIES AND BACKGROUND INFORMATION

Included in this chapter is a summary of the information contained in each of the chapters of this report, along with background information about air quality standards and Michigan's ambient air monitoring program.

## CHAPTER 1.1: CHAPTER SUMMARIES:

- **Chapter 1** contains background information on the development of the NAAQS and how compliance with these standards is determined; an overview of Michigan's air sampling network (MASN) that shows the locations where ambient air monitoring was conducted in 2005; a description of the metropolitan statistical areas (MSAs) and how these areas, along with the national, state, local and special purpose monitoring stations are used when designating attainment/nonattainment areas for NAAQS; and the variety of monitoring techniques and requirements used to ensure quality assurance of the data.
- **Chapter 2** provides an in-depth analysis of air quality trends in Michigan for each of the criteria pollutants for which NAAQS have been established. Provided are brief descriptions of the chemical and physical properties of the six criteria pollutants, as well as their health and environmental effects, common sources, national and Michigan source trends, and NAAQS. Monitoring, attainment status, and long-term trends by location are also given.
- **Chapter 3** discusses Michigan's air toxics monitoring program. "Air Toxics" include chemicals such as metals, mercury, and organic pollutants. The organic pollutants classification is further divided into sub-categories that include VOCs, carbonyl compounds, semi-volatile organic compounds, along with polycyclic aromatic hydrocarbons (PAHs) / polynuclear aromatic hydrocarbons, pesticides, polychlorinated biphenyls, and polycyclic organic matter. **Chapter 3** also provides the health effects, the importance of monitoring for air toxics, the locations of air toxics monitors, and information on the development of a comprehensive air toxics monitoring strategy.
- **Chapter 4** summarizes special air quality projects and provides their websites. These projects include the Web Monitoring and Mapping, AQI, *Ozone Action!*, the EnviroFlash program, EPA's Ozone Mapping, and real time $PM_{2.5}$ concentrations.
- **Chapter 5** contains information about modeling and meteorology. It includes ambient background determinations for New Source Review applications, a climatological summary, 2005 temperature and precipitation data, and a discussion of meteorological monitoring in Michigan.
- **Chapter 6** lists the references utilized in the creation of this report.

In addition, there are seven appendices that contain the following detailed information:

- **Appendix A** contains Quick Look Reports that provide a statistical summary of the six ambient criteria pollutants monitored in Michigan;
- **Appendix B** provides the assessment summary (Precision and Accuracy Report) on the AQD's network monitors for the criteria air pollutants;
- **Appendix C** provides tabular air toxics summaries;
- **Appendix D** shows 1-hour ozone exceedances recorded over the last decade (10 years);
- **Appendix E** contains a list of acronyms and their meanings;
- **Appendix F** is an errata sheet that contains corrections for errors found in previous Annual Air Quality Reports;
- **Appendix G** shows the AQD's organizational chart; and
- **Appendix H** has the AQD district office map.

# CHAPTER 1.2: BACKGROUND INFORMATION:

## NAAQS:

Under Section 109 of the CAA, the EPA establishes NAAQS for each pollutant for which air quality criteria have been issued and sets standards where "the attainment and maintenance are requisite to protect public health" with "an adequate margin of safety." Every five years EPA is required to review the scientific information and the standards for each criteria pollutant and obtain advice from the Clean Air Scientific Advisory Committee (CASAC) on each review. Once a standard is set, then EPA must determine the best means of implementing that standard. In December 2005, EPA proposed implementation rules for the 1997 $PM_{2.5}$ standard. Currently, NAAQS have been established for CO, Pb, $NO_2$, $O_3$, $PM_{10}$ and $PM_{2.5}$, and $SO_2$. Information on each of the criteria pollutant standards are summarized, by pollutant, in **Chapter 2**.

There are two types of NAAQS, primary and secondary.

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. In selecting the margin of safety for the primary standard, the EPA considers such factors as the nature and severity of the health effects involved and the size of the sensitive population at risk.

Air quality conditions described by the secondary standard may be the same as the primary standard or they can be more stringent. Secondary standards are chosen to protect public welfare (personal comfort and well-being) and the environment by limiting economic damage and visibility and climatic factors, as well as the harmful effects on soil, water, crops, vegetation, wildlife, and buildings.

The NAAQS have various averaging times to address health impacts. Short averaging times, such as the 1-hour maximum level of 35 parts per million (ppm) used for CO, reflect the potential for acute (short-term, immediate) effects. The long-term averaging times, such as the annual mean concentrations for $PM_{10}$, $SO_2$, and $NO_2$, are designed to protect against chronic (long-term) effects.

The following **Table 1-1** lists the primary and secondary NAAQS used, averaging time, and concentration level for each criteria pollutant. The concentrations are listed as ppm, microgram per cubic meter ($\mu g/m^3$), and/or milligram per cubic meter ($mg/m^3$).

### TABLE 1-1: NAAQS IN EFFECT DURING 2005 FOR THE CRITERIA POLLUTANTS

| CRITERIA POLLUTANT | PRIMARY (HEALTH RELATED) | | SECONDARY (WELFARE RELATED) | |
|---|---|---|---|---|
| | TYPE OF AVERAGE | STANDARD LEVEL CONCENTRATION | TYPE OF AVERAGE | STANDARD LEVEL CONCENTRATION |
| **CO** | 8-hour | 9 ppm (10 $mg/m^3$) | No Secondary Standard | |
| | 1-hour | 35 ppm (40 $mg/m^3$) | | |
| **Pb** | Maximum Quarterly Average | 1.5 $\mu g/m^3$ | Same as Primary Standard | |
| **$NO_2$** | Annual Arithmetic Mean | 0.053 ppm (100 $\mu g/m^3$) | Same as Primary Standard | |
| **$O_3$** | Maximum Daily 1-Hr Average | 0.12 ppm (235 $\mu g/m^3$) | Same as Primary Standard | |
| | 4th Highest 8-Hr Daily Maximum | 0.085 ppm (157 $\mu g/m^3$) | | |
| **$PM_{10}$** | Annual Arithmetic Mean | 50 $\mu g/m^3$ | Same as Primary Standard | |
| | 24-hour | 150 $\mu g/m^3$ | | |
| **$PM_{2.5}$** | Annual Arithmetic Mean | 15 $\mu g/m^3$ | Same as Primary Standard | |
| | 98th percentile 24-hour | 65 $\mu g/m^3$ | | |
| **$SO_2$** | Annual Arithmetic Mean | 0.03 ppm (80 $\mu g/m^3$) | 3-hour | 0.5 ppm (1300 $\mu g/m^3$) |
| | 24-hour | 0.14 ppm (365 $\mu g/m^3$) | | |

## DETERMINING COMPLIANCE WITH THE NAAQS:

To demonstrate compliance with the NAAQS, EPA has defined specific criteria for each pollutant, which is summarized in **Table 1-2**.

### TABLE 1-2: CRITERIA FOR THE DETERMINATION OF COMPLIANCE WITH THE NAAQS

| POLLUTANT | CRITERIA FOR COMPLIANCE |
|---|---|
| **CO** | Compliance with the CO standard is met when the 35 ppm 1-hour average standard and/or the 9 ppm 8-hour average standard is not exceeded more than once per year. An 8-hour average is considered valid if at least 75% for the hourly averages are available. In the event that 6 or 7-hourly averages are available, the 8-hour average is estimated on the basis of the average concentration for that time period. |
| **Pb** | Daily values are collected for three consecutive months (by calendar quarter), averaged, and then compared to the 1.5 $\mu g/m^3$ standard. |
| **$NO_2$** | Compliance is met when the annual arithmetic mean concentration does not exceed the 0.053 ppm standard, and is based on hourly data that are 75% complete for each calendar quarter. |
| **$O_3$ 1-hour** | The standard is met when the three-year average of the expected number of days where the 1-hour average of 0.12 ppm is exceeded per calendar year is equal to or less than one. |
| **$O_3$ 8-hour** | The primary and secondary standards are met when the three-year average of the 4th highest daily maximum 8-hr average concentration is less than or equal to 0.085 ppm. |
| **$PM_{10}$** | The annual primary and secondary standards are met when the annual arithmetic mean concentration is less than or equal to 50 $\mu g/m^3$. The 24-hour primary and secondary standards are met when the expected number of days per calendar year above 150 $\mu g/m^3$ is equal or less than one. |
| **$PM_{2.5}$** | The annual and secondary standards are met when the annual arithmetic mean concentration is less than or equal to 15 $\mu g/m^3$. The 24-hour primary and secondary standards are met when the three-year average of the 98$^{th}$ percentile 24-hour concentration is less than or equal to 65 $\mu g/m^3$. |
| **$SO_2$** | To determine compliance, the annual average concentration shall not exceed 0.03 ppm, the 24-hour average concentration shall not exceed 0.14 ppm more than once per calendar year, and the three-hour average concentration shall not exceed 0.5 ppm more than once per calendar year. The respective averages shall be based upon hourly data that is at least 75% complete. |

## MICHIGAN AIR SAMPLING NETWORK (MASN):

The MASN is designed to meet the network design set forth by the EPA to measure air quality throughout the state. The Michigan network is operated by the MDEQ's AQD, along with other governmental agencies. For instance, the Sault Ste. Marie monitors 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 Seney National Wildlife Refuge is operated by the U.S. Fish and Wildlife Service. However, the AQD verifies, analyzes, and collates all the data collected by the MASN[8]

[8] Data collected and reported must meet minimum quality assurance requirements established by EPA and the AQD as outlined in 40 CFR Part 58 (http://www.access.gpo.gov/nara/cfr/waisidx_03/40cfr58_03.html).

In addition, as part of the EPA's Section 105 grant, the AQD provides an annual review of the MASN monitoring data collected from the previous year and provides recommended changes. These recommendations are based on each monitor's exceedance history, changes in population distribution, and modifications to federal monitoring requirements under the CAA. Any changes made in 2005 due to the 2004 annual review's recommendation will be discussed in **Chapter 2**. **Figure 1-1** shows all the locations in Michigan where ambient air monitoring was conducted in 2005.

## FIGURE 1-1: 2005 MASN MAP

A more detailed map of the Southeast Michigan monitoring sites is shown in **Figure 1-2**.

## FIGURE 1-2: SOUTHEAST MASN MAP

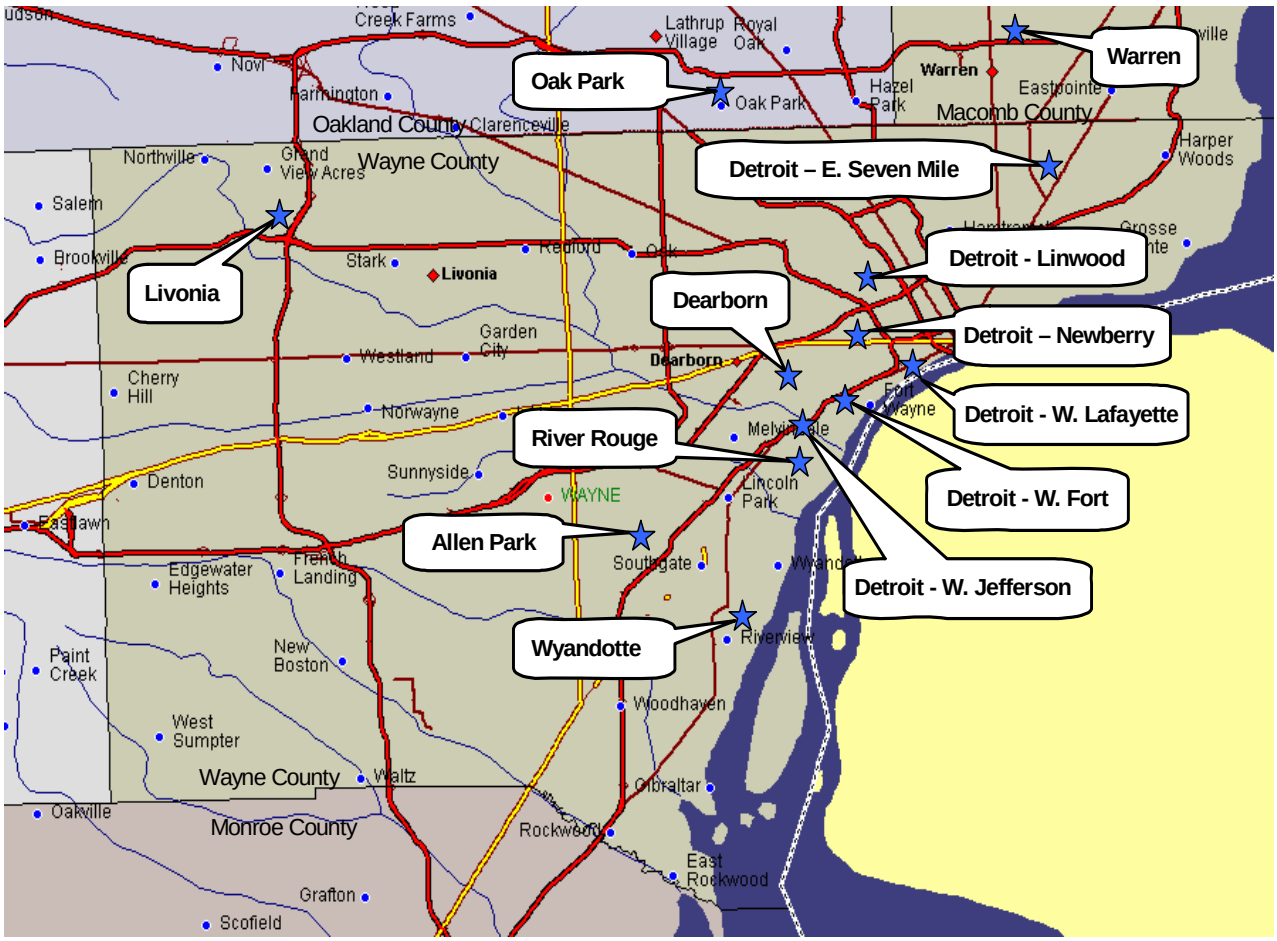



**Table 1-3** identifies the types of monitoring conducted at each monitoring site and includes the site's Aerometric Information Retrieval System (AIRS) identification number. Since the concentration of a given air contaminant at a particular time and place is highly dependent on meteorological conditions, wind speed and direction instruments, barometric pressure, solar radiation, and relative humidity are also monitored at some of these locations. **Table 1-4** lists the MDEQ monitoring stations and the type of meteorological data collected at these sites.

## TABLE 1-3: MASN STATIONS AND MONITORING CONDUCTED IN 2005

| AIRS ID | SITE NAME | Carbon Monoxide | Lead | Nitrogen Dioxide | Ozone | Particulate Matter ($PM_{10}$) | Particulate Matter ($PM_{2.5}$) | Sulfur Dioxide | Volatile Organic Compounds | Carbonyl Aldehydes / Ketone | Trace Metals | Meteorological Parameters |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | √ | | | √ | | | √ | | | | |
| 261050007 | Scottville | | | | √ | | | | | | | √ |
| 261130001 | Houghton Lake | | √ | | √ | | √■* | | √ | √ | √ | √ |
| 261150005 | Luna Pier | | | | | | √* | | | | | |
| 261210039 | Muskegon – Green Creek | | | | √ | | | | | | | √ |
| 261210040 | Muskegon – Apple Ave | | | | | | √ | | | | | |
| 261250001 | Oak Park | √ | | | √ | | √ | | | | | √ |
| 261390005 | Jenison | | | | √ | | √ | | | | | √ |
| 261450018 | Saginaw | | | | | | √■ | | | | | √ |
| 261470005 | Port Huron | | | | √ | | √■ | √ | | | | √ |
| 261530001 | +++Seney Nat'l Wildlife Refuge | √ | | | √ | | √■ | √ | | | | √ |
| 261610005 | Ann Arbor | | | | | | √ | | | | | |
| 261610008 | Ypsilanti | | √ | | √ | | √■* | | √ | √ | √ | √ |
| 261630001 | Allen Park | √ | √ | | √ | √ | √■* | | | | √ | √ |
| 261630005 | River Rouge | | √ | | | | | | | √ | √ | √ |
| 261630015 | Detroit – W. Fort | | √ | | | √ | √ | √ | √ | √ | √ | √ |
| 261630016 | Detroit – Linwood | √ | | √ | √ | | √ | √ | | | | |
| 261630019 | Detroit – E. Seven Mile | | √ | √ | √ | | √ | √ | √[1] | √[1] | √ | √ |
| 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 U.S. Fish & Wildlife
[1]VOCs and carbonyls only collected in June, July, and August of 2005.

## TABLE 1-4: 2005 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 | | | √ | √ | √ | √ | √ | √ |
| 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 | | | √ | √ | √ | √ | √ | |
| 261050007 | Scottville | | | √ | √ | √ | | | |
| 261130001 | Houghton Lake | | | √ | √ | √ | | | √ |
| 261210039 | Muskegon – Green Creek | | | √ | √ | √ | | | |
| 261250001 | Oak Park | | | √ | √ | √ | | | √ |
| 261390005 | Jenison | | | √ | √ | √ | | | |
| 261450018 | Saginaw | | | √ | √ | √ | | | √ |
| 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 | √ | √ | | | √ | | | |

## 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). These areas are established by the U.S. Office of Management and Budget (OMB). [9]

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.

[9] Census data may be obtained from the U.S. Census Bureau at: http://www.census.gov/

The two largest CSAs are in Southeast Michigan and West Michigan. For West Michigan, the MSA delineations are especially appropriate for application in the $O_3$ transport impacted counties. The following **Tables 1-5** to **Table 1-8** shows all of Michigan's CSA's broken down to include their MSA and MiSA and their respective counties:

### TABLE 1-5: DETROIT-WARREN-FLINT CSA

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

### TABLE 1-6: GRAND RAPIDS-MUSKEGON-HOLLAND CSA

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

### TABLE 1-7: LANSING-EAST LANSING-OWOSSO CSA

| | |
|---|---|
| Lansing-East Lansing MSA<br>Clinton, Eaton, & Ingham Co. | Owosso MiSA<br>Shiawassee Co. |

### TABLE 1-8: SAGINAW-BAY CITY-SAGINAW TWP. NORTH CSA

| | |
|---|---|
| Bay City MSA<br>Bay Co. | Saginaw-Saginaw Twp. North MSA<br>Saginaw Co. |

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

### TABLE 1-9: MICHIGAN'S MSAS

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

### TABLE 1-10: MICHIGAN'S MISAS

| | | | | |
|---|---|---|---|---|
| Alma MiSA<br>Gratiot Co. | Alpena MiSA<br>Alpena Co. | Big Rapids MiSA<br>Mecosta Co. | Cadillac MiSA<br>Missaukee & Wexford Co. | Coldwater MiSA<br>Branch Co. |
| Escanaba MiSA<br>Delta Co. | Houghton MiSA<br>Houghton & Keweenaw Co. | Iron Mountain (MI-WI) MiSA<br>Dickinson Co. (MI) | Marinette WI-MI MiSA<br>Menominee Co. (MI) | Marquette MiSA<br>Marquette Co. |
| Midland MiSA<br>Midland Co. | Mount Pleasant MiSA<br>Isabella Co. | Sault Ste. Marie MiSA<br>Chippewa Co. | Sturgis MiSA<br>St. Joseph Co. | Traverse City MiSA<br>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 that assists in determining nonattainment/attainment status in these MSAs consist of State and Local Air Monitoring Stations (SLAMS), National Air Monitoring Stations (NAMS), and Special Purpose Monitoring (SPM) stations. These types of stations are described as follows:

**SLAMS** allow state or local government to develop networks tailored for their immediate monitoring needs. SLAMS data is used primarily for nonattainment decisions and analyses at specific geographical areas. At least one SLAMS is required for each criteria pollutant, except for lead, and must meet monitoring requirements of the CAA.

**NAMS** were established to ensure a long-term national network for ambient monitoring and to provide a systematic, consistent database for air quality comparisons and trends analysis. NAMS must be selected from the SLAMS network with emphasis given to urban and multisource areas. For urban areas requiring more than one NAMS, a category "a" NAMS is established to measure peak concentrations in major downtown urban traffic areas, and a category "b" NAMS must be located in a highly-populated area to assess population exposure.

**SPM** stations provide special studies needed by the state and local agencies to support their SIPs and other types of monitoring, i.e. industrial, tribal, etc. that are included in the states monitoring network. These SPMs are not permanent and can be moved to accommodate changing needs and priorities. The MDEQ also uses SPM for sites where the siting may not meet specifications, the monitoring methodology may not be the federal reference method, the intent is for a short-term duration, or the data generated is for a special study and not to be used for attainment designations. However, data from SPMs are reported to EPA.

## MONITORING TECHNIQUES:

Air pollutants are generally monitored near the breathing zone as specified by a variety of EPA reference or equivalent methods. Gaseous monitors are used for $O_3$, CO, $SO_2$, and $NO_2$; filter based monitors are used for PM (TSP, $PM_{10}$, $PM_{2.5}$) and Pb. The AQD adheres to the quality assurance requirements of the EPA for gaseous and particulate air pollutant monitors as specified in Title 40 of the CFR, Part 58. The EPA has recently released a document titled, "List of Designated Reference and Equivalent Methods."[10] Explanations of these methods are found in 40 CFR Part 58 - Ambient Air Quality Surveillance and are discussed in **Chapter 2**.[11]

The AQD follows a quality system to ensure that the monitoring data that is collected and reported is valid and accurate. In following the quality system, quality assurance project plans are developed and implemented as well as standard operating procedures. 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 insuring accurate data. Additional information on the AQD's precision and accuracy procedures along with their 2005 measurement reports are available in **Appendix B**. Additional listings of documents pertaining to 40 CFR Part 58, including siting requirements, attainment determination, laboratory methods for air toxics, and quality assurance/quality control are at http://www.epa.gov/ttnamti1/ and http://www.access.gpo.gov/nara/cfr/waisidx_03/40cfr58_03.html.

[10] List Of Designated Reference and Equivalent Methods is at http://www.epa.gov/ttn/amtic/criteria.html.
[11] A complete copy of the 40 CFR Part 58 - Ambient Air Quality Surveillance is available at http://www.access.gpo.gov/nara/cfr/waisidx_03/40cfr58_03.html

# CHAPTER 2: CRITERIA POLLUTANTS MONITORED IN MICHIGAN

Each year, air quality trends are plotted using measurements from monitors located across the country. This chapter provides those trends for Michigan's ambient air quality monitors and other information for the criteria pollutants - CO, Pb, $NO_2$, $O_3$, $PM_{10}$ and $PM_{2.5}$, and $SO_2$.

Michigan air quality trends are based on actual statewide monitored readings which are also listed in EPA's Air Quality Subsystem (AQS) Quick Look Report Data for 2005 (see **Appendix A: Criteria Pollutant Summary for 2005**).

This chapter is broken down by sub chapters for each of the criteria pollutants and includes:

- an introduction that describes the pollutant,
- its health effects,
- national source trends,
- Michigan source trends,
- NAAQS,
- Michigan's monitoring requirements,
- attainment/nonattainment status for Michigan, and
- Michigan's monitoring trends that include figures, broken down by location, of those monitoring sites used in Michigan from 1996-2005.

The following is a breakdown of the criteria pollutant subsections:

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

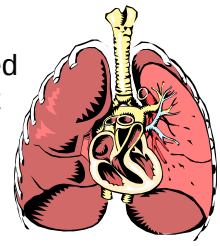
# CHAPTER 2.1: CARBON MONOXIDE TRENDS

## INTRODUCTION:

Carbon monoxide (CO) is a colorless, odorless, and poisonous gas that is created when fuel doesn't burn completely. CO is prevalent in many American cities, especially those with heavy traffic congestion. In cities, as much as 95% of all CO emissions may come from automobile exhaust. EPA estimates that motor vehicle exhaust contributes about 60% of all CO emissions nationwide with non-road vehicles accounting for the remaining CO emissions from transportation sources. Other sources of CO emissions include industrial processes, non-transportation fuel combustion, and natural sources such as wildfires (**1**).

Unlike many other air pollutants, CO levels in the outside air typically peak during colder months. One reason is because cars need more fuel to start at cold temperatures, and some emission control devices (such as oxygen sensors and catalytic converters) operate less efficiently when they are cold. Also, during the winter inversion conditions (where air pollutants are trapped near the ground beneath a layer of warm air) are more frequent. Primary sources of CO exposure are the exhaust from idling automobiles, unvented gas or kerosene space heaters, gas ranges with continuous pilot flame ignition, and cigarette smoke. Indoor air CO exposure levels in excess of 50 ppm can occur during startup and idling of motor vehicles in attached residential garages and the use of unvented gas or kerosene space heaters (**1**).

## CO EFFECTS:



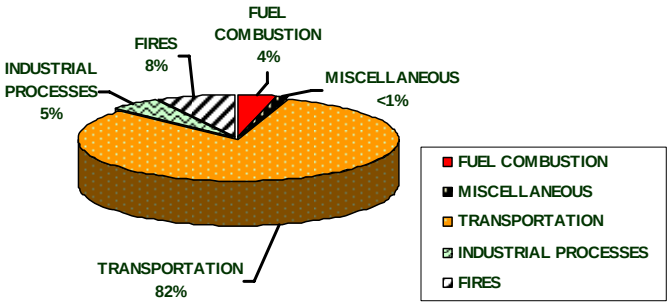
CO enters the bloodstream through the lungs where it displaces oxygen delivered to the body's organs and tissues. For those who suffer from cardiovascular (heart and respiratory) disease, especially those with angina and peripheral vascular disease, the health effects are more severe because their circulatory systems are already compromised and less efficient at carrying oxygen. But high CO pollution levels also affect healthy people (**1**).

At elevated levels, CO can cause visual impairment, interfere with mental acuity by reducing learning ability and manual dexterity, and can decrease work performance in completion of complex tasks (**1**). The severity of the reduced mental acuity effect is related to the duration of exposure and the concentration of CO.

## NATIONAL SOURCE TRENDS:

According to EPA, as shown in **Figure 2.1-1**, transportation, composed of on-road and non-road sources, accounted for 82% of the nation's total CO emissions in 2002.[12] For on-road sources, the focus of CO controls as well as CO monitoring has been on traffic-oriented sites in urban areas where the main source of CO is motor vehicle exhaust.

**Figure 2.1-1: EPA's 2002 National CO Emissions by Source Category**



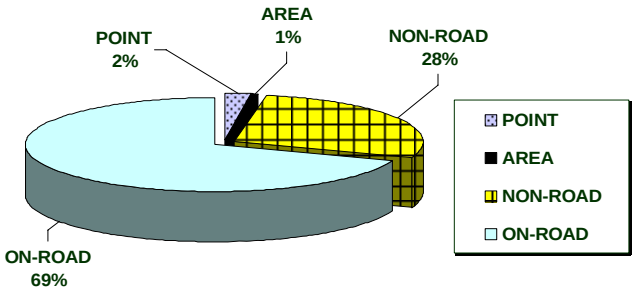

[12] Information is from EPA's Air Trends website at http://www.epa.gov/airtrends/carbon.html.

## MICHIGAN SOURCE TRENDS:

As shown in **Figure 2.1-2**, Michigan's on-road motor vehicle sources account for 69% of the state's CO emissions (EPA 2002 emissions inventory data). On-road sources include diesel, heavy and light-duty gas trucks and vehicles, and motorcycles.

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.

**Figure 2.1-2: Percentage of CO Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)**




CO emissions from Michigan's industries (point sources) account for only 2%. For the Detroit-Ann Arbor area, fossil fuel combustion from electrical utility, industrial, commercial, and residential sources, as well as iron, steel manufacturing, and foundries were the leading point sources of CO (**2, 3**).

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.[13] Currently, a review of monitoring network regulations is being conducted by EPA's Office of Air Quality Planning and Standards which may minimize the size of CO networks nationwide.

## NAAQS FOR CO:

**PRIMARY NAAQS**: 8-hour average not to exceed 9 ppm more than once/year.
1-hour average not to exceed 35 ppm more than once/year.

**SECONDARY NAAQS**: None.

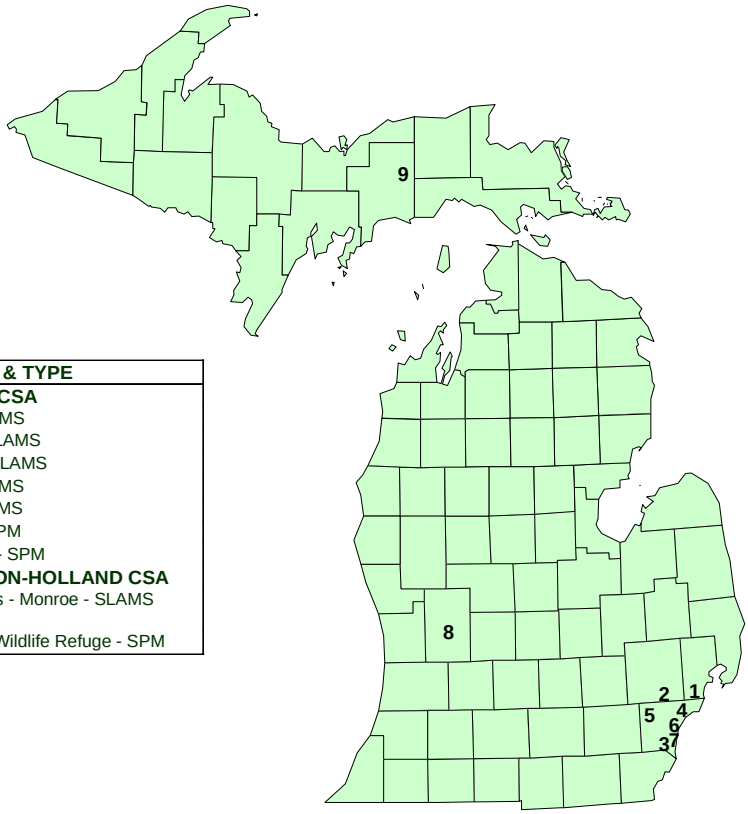
An 8-hour standard of 9 ppm (10 mg/m$^3$) and a 1-hour standard of 35 ppm (40 mg/m$^3$) are the two primary standards for CO, which are not to be exceeded more than once each year (**4**). There is no secondary standard for CO. The 8-hour standard is considered to be the more controlling form as there has not been an exceedance of the 1-hour standard in the United States (U.S.) since 1990 (**1**). At present, all Michigan areas are in attainment with both the 1-hour and 8-hour CO standards.

## CO MONITORING IN MICHIGAN:

Since Detroit is the only urban area having a population greater than 500,000, there is currently only one CO NAMS (type "b") in Michigan, located at the MDEQ's Linwood monitoring station. The Detroit-Warren-Livonia MSA has four CO monitors operating as part of the SLAMS monitoring network (Warren, Oak Park, Allen Park, and Livonia) to assess environmental impact from transportation, to support the new source review (NSR) modeling efforts, and to retain monitors per Michigan's state implementation plan (SIP) (**5**). In 2005, two SPM monitors were also added in the Detroit area (Newberry and W. Lafayette) to assess localized impacts and a SPM site was located in Seney (Schoolcraft County) to supply background levels for NSR modeling. A SLAMS monitoring station was also located in the Grand Rapids-Wyoming MSA that monitors population exposure to CO. **Figure 2.1-3** shows all nine CO monitors operating during 2005.

[13] Information on Nationwide Air Quality Trends is available at: http://www.epa.gov/airtrends/carbon.html.

## FIGURE 2.1-3: CO MONITORS ACTIVE IN 2005




**MONITOR ID & TYPE**

**DETROIT-WARREN-FLINT CSA**
1. 260991003 – Warren - SLAMS
2. 261250001 – Oak Park - SLAMS
3. 261630001 – Allen Park - SLAMS
4. 261630016 – Linwood - NAMS
5. 261630025 – Livonia - SLAMS
6. 261630038 – Newberry - SPM
7. 261630039 – W. Lafayette - SPM

**GRAND RAPIDS-MUSKEGON-HOLLAND CSA**
8. 260810020 – Grand Rapids - Monroe - SLAMS

**SCHOOLCRAFT COUNTY**
9. 261530001 – Seney Nat'l Wildlife Refuge - SPM

## ATTAINMENT/NONATTAINMENT STATUS OF CO IN MICHIGAN:

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 (**6**).

## CO TRENDS BY LOCATION:

**Figure 2.1-4** provides the maximum 2nd highest 1-hour CO level trends for Michigan from 1996-2005 which shows that there have not been any exceedances of the 1-hour CO standards.

**Figure 2.1-4: CO Levels in MI from 1996-2005 (2nd Highest 1-Hr Maximum Values)**

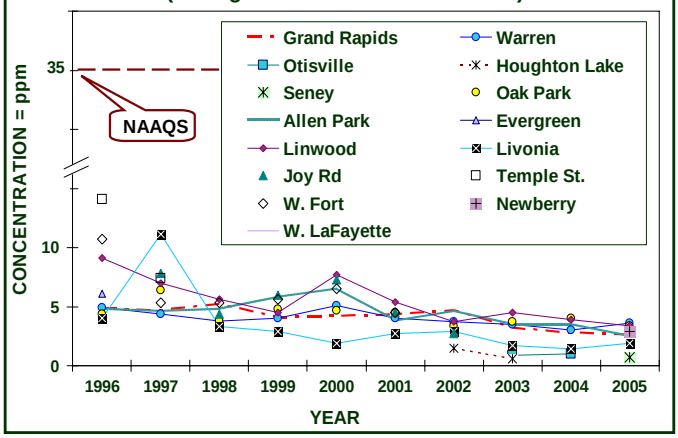



**Figure 2.1-5: CO Levels in MI from 1996-2005 (2nd Highest 8-Hr Maximum Values)**

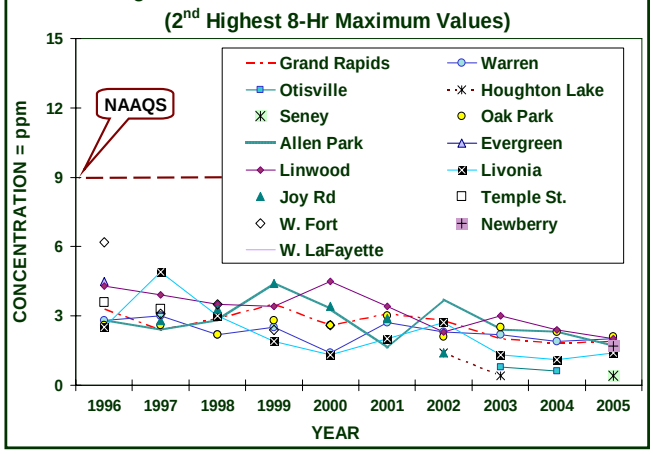



**Figure 2.1-5** provides the 2nd highest 8-hour CO maximum values for Michigan's CO sites. All sites in Michigan have shown a steady decline and there have not been any exceedances of the 8-hour CO standard.

# CHAPTER 2.2: LEAD TRENDS

## INTRODUCTION:

In the past, automobiles were the major source of lead (Pb) emissions to the atmosphere. Because of the phase-out of leaded gasoline, Pb emissions and concentrations decreased sharply during the 1980s and early 1990s, and since 1996, motor vehicle gasoline may not exceed 0.05 g (grams) per gallon (**7**). The change in gasoline formulations has had a marked impact on Pb emissions from motor vehicles. The average air quality concentration for Pb currently is 94% lower than in 1983 (**1**).

Industrial and combustion sources are now the dominant Pb emission sources, especially metallurgical processes such as smelting/refining of Pb, copper, and zinc, and the production of iron, steel, gray iron, brass, and bronze (**1**). The highest air concentrations of Pb are usually found in the vicinity of smelters and battery manufacturers (Pb acid batteries, Pb oxide/pigments, Pb glass, portland cement, and solder production are also industrial Pb emission sources). For combustion sources, Pb is an impurity found in coal, oil, and waste oil, as well as municipal solid waste and sewage sludge incineration, and may be released to the atmosphere during their combustion.

## Pb EFFECTS:

Exposure to Pb occurs through the inhalation or ingestion of lead in food, water, soil, or dust particles. Pb is accumulated in the body, primarily in the blood, bones, and soft tissues. The half-life of Pb in bone tissue is 25 years and about 25 to 50 days in soft tissues and blood. Anemia has been associated with chronic exposure at blood Pb concentrations of 50-60 micrograms per deciliter (μg/dl) in adults, and in children at 40-70 μg/dl (**8**).

Pb can also adversely affect the kidneys, liver, nervous system, and other organs. Recent studies show that neurobehavioral changes may result from Pb exposure during the child's first years of life and that Pb may be a factor in high blood pressure and subsequent heart disease.[14] Excessive Pb exposure has been associated with lower IQ scores and neurological impairment, such as seizures, mental retardation, and behavioral disorders (**1**). Even at low doses, Pb exposure is associated with changes in fundamental enzymatic, metabolic, and homeostatic mechanisms in the human body. Additionally, even low levels of Pb exposure may cause central nervous system damage in fetuses and children.

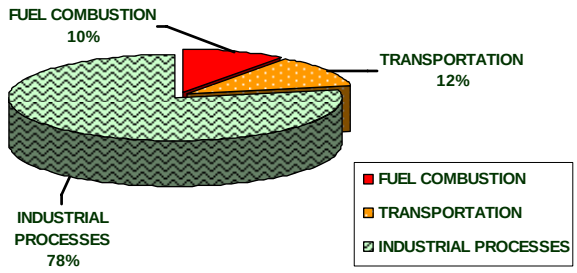
Airborne Pb can also have adverse impacts on the environment. At concentrations of 2-10 $\mu g/m^3$, Pb can inhibit plant growth, effect plant species diversity, and affect the microbial ecology of bacteria and fungi of soils. Reduced decomposition, nitrification, and a reduction in the number of invertebrates have been associated with Pb exposure. Wild and domestic grazing animals may ingest Pb that has deposited on plant or soil surfaces or that has been absorbed by plants through leaves or roots. Animals, however, do not appear to be more susceptible or more sensitive to adverse effects from Pb than are humans. Therefore, the secondary standard for Pb is identical to the primary standard.

[14] Information was obtained from the EPA's Air Trends website at http://www.epa.gov/airtrends/lead2.html.

## NATIONAL SOURCE TRENDS:

Nationwide, smelters and battery plants are now the major sources of Pb (**1**). **Figure 2.2-1** shows that nationally, industrial processes account for 78% of Pb emissions (EPA's 2002 National Pb Emissions by Source Category).[15] Transportation and fuel combustion make up the remainder of the nations Pb emissions.

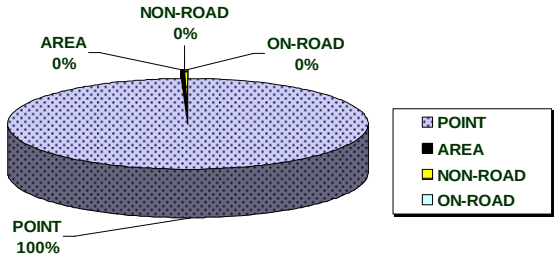
**Figure 2.2-1 EPA's 2002 National Pb Emissions by Source Category**




## MICHIGAN SOURCE TRENDS:

Michigan Pb emissions have also significantly decreased over the past 25 years. Much of this reduction can be attributed to the removal of alkylated Pb from automotive gasoline. **Figure 2.2-2** shows that non-road and on-road sources no longer contribute quantifiable Pb emissions in Michigan. Following the national trend, point sources such as non-ferrous smelters and battery plants now contribute 100% of Michigan's overall Pb emissions. However, there are no large sources of Pb in Michigan and the average ambient Pb levels are less than one tenth of the Pb NAAQS.

**Figure 2.2-2: Percentage of Pb Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)**




## NAAQS FOR Pb:

**PRIMARY NAAQS**: Maximum quarterly average not to exceed 1.5 $\mu g/m^3$.

**SECONDARY NAAQS**: Same as primary standard.

The NAAQS for Pb specifies that the average of all the Pb samples collected during a calendar quarter may not exceed 1.5 $\mu g/m^3$ (**9**). In 1997, with the phase-out of alkylated Pb additives in motor fuels, EPA's ambient air monitoring philosophy changed from a mobile source-oriented to an industrial source-oriented monitoring strategy (**1**). No point source-oriented monitoring is being conducted in the state as there are no large sources of Pb in Michigan. Michigan continues to observe concentrations well below the NAAQS.

## Pb MONITORING IN MICHIGAN:

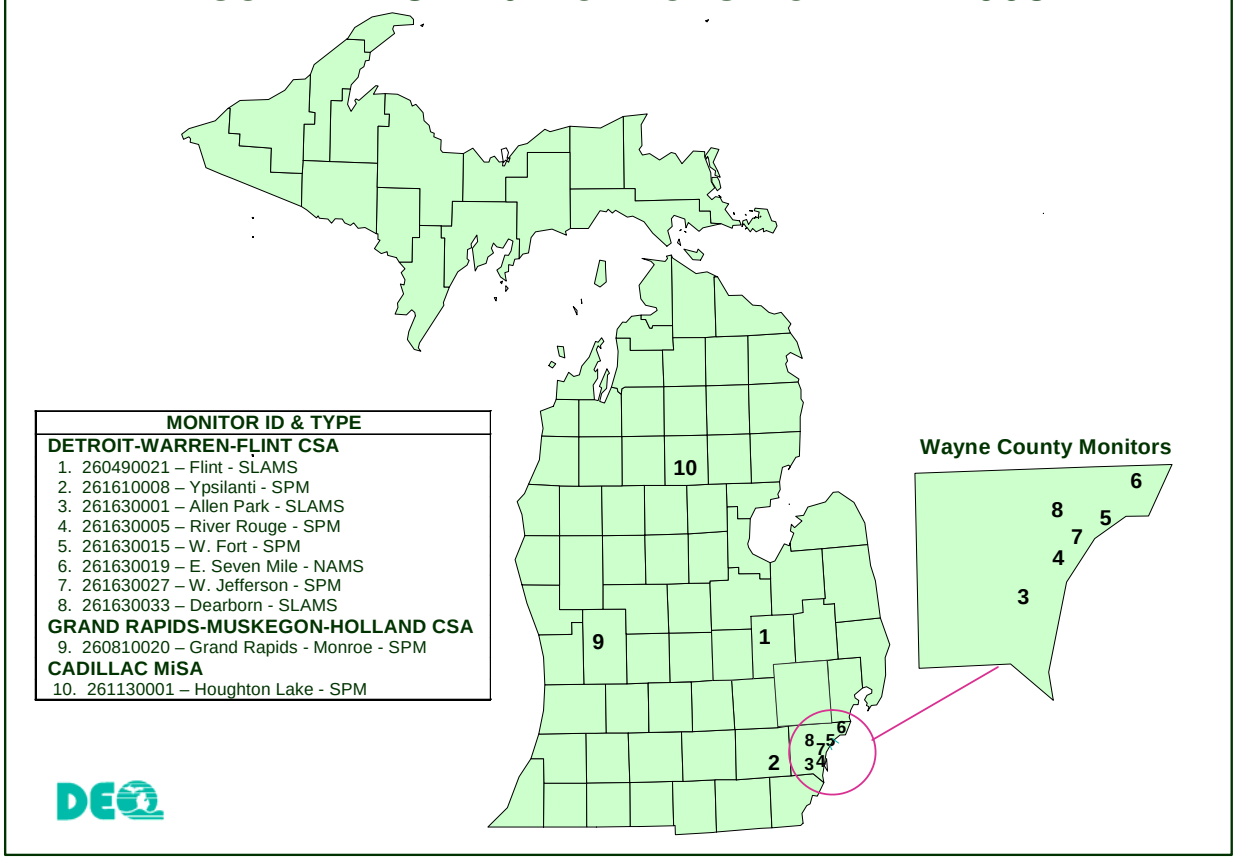
The January 20, 1999 monitoring requirements for Pb state that a single NAMS site must be located in one of the two cities with the greatest population in each region (**9**). In Region V, the Chicago-Gary-Kenosha CMSA and the Detroit-Warren-Flint CSA have the largest populations with Chicago chosen to house the required NAMS. However, Detroit's E. Seven Mile (261630019) monitoring site also has a NAMS monitor that operates as a trace metals site for toxics monitoring. Although the change in the federal regulations allows 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 MITAMP sites include Flint, Ypsilanti, Allen Park, River Rouge, Detroit (W. Fort), Grand Rapids (Monroe), and Houghton Lake. These MITAMP sites provide ambient Pb measurements collected for a 24-hour period every six to twelve days.

[15] Additional information is available on EPA's Air Trends website at http://www.epa.gov/airtrends/lead2.html.

The Dearborn site has been designated as a NATTS and as such, must determine trace metal concentrations from $PM_{10}$ filters (more information on NATTS is available in **Chapter 3: Toxic Air Pollutants in Michigan**). MDEQ is continuing to measure trace metals from TSP (total suspended particles) to maintain continuity with our historical database and to provide a full suite of trace metal measurements by various size fractions ($PM_{2.5}$, $PM_{10}$, TSP) at the NATTS site.

Due to the Detroit Air Toxics Initiative (DATI), the Detroit's W. Jefferson monitoring site (261630027) is being utilized for TSP, PAH's, mercury, and toxics (see **Chapter 3: Toxic Air Pollutants in Michigan** for more information). **Figure 2.2-3** shows a total of 10 Pb monitoring sites operated in Michigan during 2005.

## FIGURE 2.2-3: Pb MONITORS ACTIVE IN 2005




## ATTAINMENT/NONATTAINMENT STATUS OF Pb IN MICHIGAN:

Michigan is in attainment for Pb. All monitoring locations have met the Pb NAAQS with atmospheric ambient levels remaining consistently low.

## Pb TRENDS BY LOCATION:

Pb levels in Michigan have remained at less than one-tenth of the NAAQS over the past decade with a statewide Pb average below 0.02 $\mu g/m^3$. Historically, Michigan's ambient Pb levels have been less than the national average.

The following **Figures 2.2-4** and **2.2-5** show all the Pb monitoring sites in Michigan. NOTE: Due to the very low Pb levels, these figures have been enlarged and the scale divided to show the actual Pb levels.

For the years 1996-2005, **Figure 2.2-4** shows those sites in Southeast Michigan that are located within the Detroit-Warren-Flint CSA. As shown, Pb levels have remained far below the Pb NAAQS.

**Figure 2.2-5** (below) includes the remainder of Michigan's monitoring sites also for the years 1996-2005. These sites, located in the Grand Rapids-Muskegon-Holland CSA and Northern Michigan, also have maintained Pb levels below the NAAQS.

**Figure 2.2-4: Pb Levels in MI's Detroit-Warren-Flint CSA from 1996-2005 (Maximum Quarterly Values)**

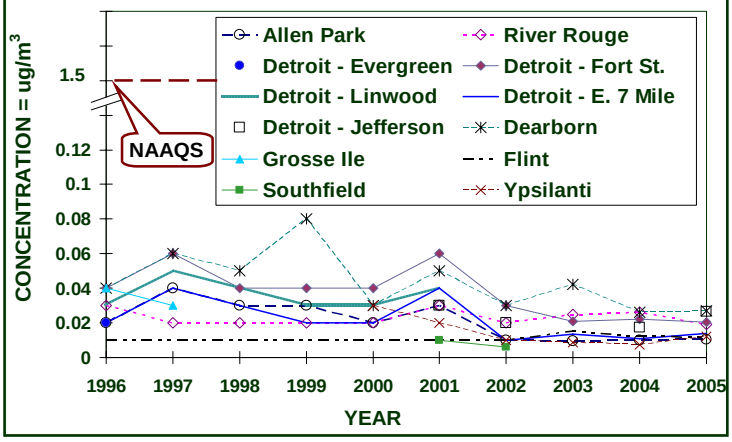
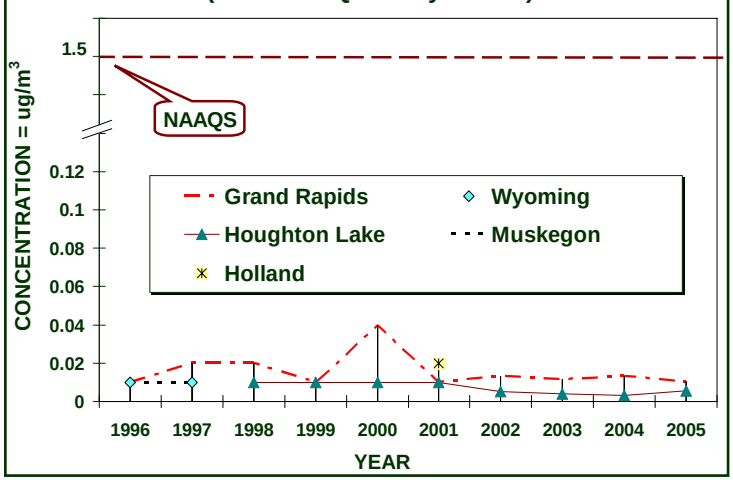



**Figure 2.2-5: Pb Levels in Grand Rapids-Muskegon-Holland CSA and Northern MI from 1996-2005 (Maximum Quarterly Values)**



# CHAPTER 2.3: NITROGEN DIOXIDE TRENDS

## INTRODUCTION:

Nitrogen dioxide ($NO_2$) is a reddish-brown, highly reactive gas that is formed in the ambient air through the oxidation of nitric oxide (NO). Upon dilution it becomes yellow or invisible. At high concentrations it has a pungent odor and at lower levels its odor is similar to bleach. $NO_2$ and $SO_2$ (sulfur dioxide) can react with other substances in the atmosphere to form acidic products that are deposited in rain (acid rain), fog, snow, or as PM. Nitrate particles and $NO_2$ can block the transmission of light, thus causing visibility impairment in urban areas (**1**).

$NO_X$ is the term used to describe the sum of NO, $NO_2$, and other oxides of nitrogen. A variety of $NO_X$ compounds and their transformation products occur both naturally and as a result of human activities. Natural sources of $NO_X$ are lightning, biological and abiological processes in soil, and stratospheric intrusion. Ammonia and other nitrogen compounds produced naturally are important in the cycling of nitrogen through the ecosystem. Man-made (anthropogenic) emissions of $NO_X$ account for a large majority of all nitrogen inputs to the environment. The major sources of anthropogenic $NO_X$ emissions are high-temperature combustion processes, such as those occurring in automobiles and power plants. According to the EPA, most $NO_X$ from combustion sources (about 95%) are emitted as NO; the remainder are largely $NO_2$. Because NO is readily converted to $NO_2$ in the environment, the estimates reported by EPA assume oxides of nitrogen are emitted in the $NO_2$ form. Home heaters and gas stoves also produce substantial amounts of $NO_2$ in indoor settings (**1**).

## $NO_2$ EFFECTS:

$NO_2$ is a component of $NO_X$ and is a matter of public health concern. Exposure to $NO_2$ occurs through the respiratory system. $NO_2$ irritates the lungs and asthmatics are more sensitive to its effects than the general population. Short-term $NO_2$ exposures (i.e., less than 3 hours) at or near the ambient $NO_2$ concentrations include cough and changes in airway responsiveness and pulmonary function in individuals with preexisting respiratory illnesses, as well as increases in respiratory illnesses in children 5 to 12 years old. 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 $NO_2$ (**1**).

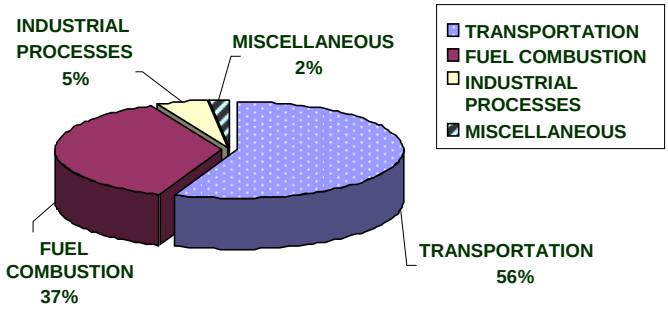
One of the most troubling health effects associated with atmospheric $NO_X$ is that it can lead to the formation of ozone ($O_3$) and nitrogen-bearing particles (e.g., nitrates and nitric acid). As discussed in the $O_3$ and PM chapters, exposure to both PM and $O_3$ is associated with adverse health effects.

Deposition of nitrogen can lead to fertilization, eutrophication, or acidification of terrestrial, wetland, and aquatic systems. These effects can alter competition between existing species, leading to changes in the number and type of species within a community. For example, eutrophic conditions in aquatic systems can produce explosive algae growth leading to a depletion of oxygen in the water and/or an increase in levels of toxins harmful to fish and other aquatic life (**1**).

## NATIONAL SOURCE TRENDS:

Since 1983, national monitored levels of $NO_2$ have decreased and those areas that once violated the $NO_2$ NAAQS now meet that standard (**1**). EPA's **Figure 2.3-1** shows that transportation (56%) and fuel combustion (37%) make up the majority of the national $NO_2$ emissions.

**Figure 2.3-1: EPA's 2002 National $NO_2$ Emissions by Source Category**

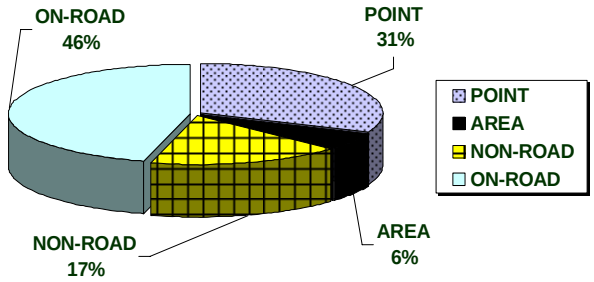



According to the EPA, the highest annual mean $NO_2$ concentrations are typically found in urban areas, with significantly lower annual mean concentrations recorded at rural sites. Interestingly, as the nation has experienced these significant decreases in $NO_2$ concentrations, $NO_X$ emissions are increasing. One possible explanation is that most of the nation's $NO_2$ monitoring sites are mobile-source-oriented sites in urban areas, and the 20-year decline in ambient $NO_2$ levels closely tracks the 19% reduction in emissions from gasoline-powered vehicles over the same time period (**1**).

## MICHIGAN SOURCE TRENDS:

For Michigan, ambient $NO_2$ levels have always been well below the NAAQS (less than half). **Figure 2.3-2** shows that on-road (46%) and point sources (31%) make up most of Michigan's total $NO_X$ emissions (utilizing EPA 2002 Emissions Inventory). Point sources include industrial, commercial, institutional, and residential fossil fuel combustion.

**Figure 2.3-2: Percentage of $NO_X$ Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)**




## NAAQS FOR $NO_2$:

**PRIMARY NAAQS**: Annual arithmetic mean not to exceed 0.053 ppm.

**SECONDARY NAAQS**: Same as primary standard.

The annual arithmetic average of all of the hourly $NO_2$ samples collected during a year may not exceed 0.053 ppm.

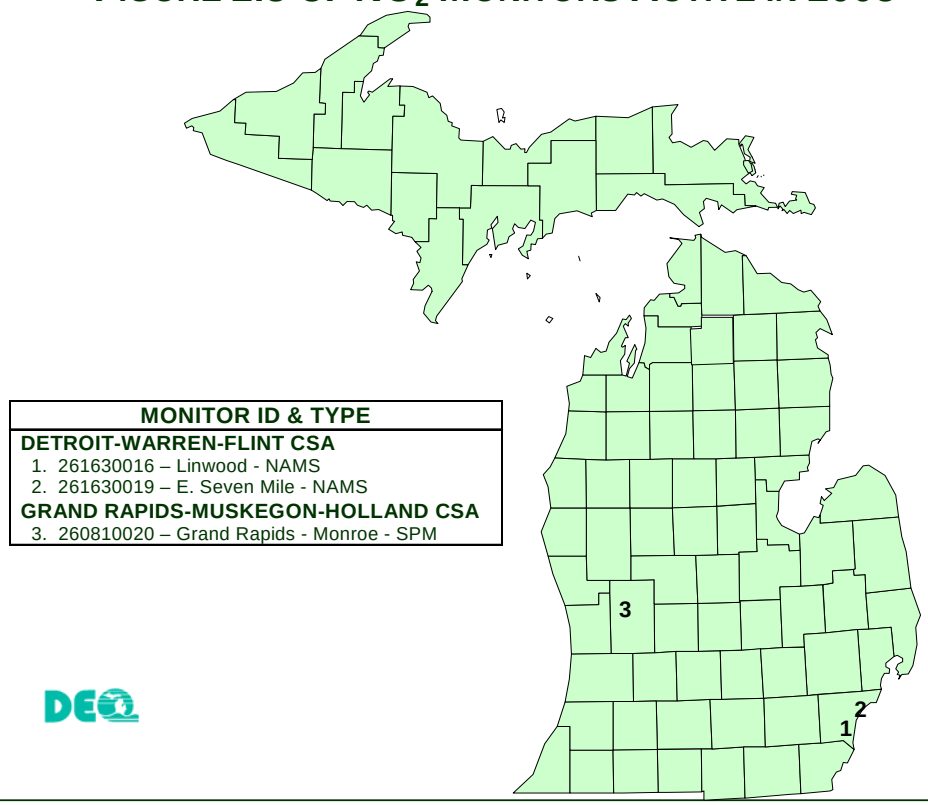
## $NO_2$ MONITORING IN MICHIGAN:

$NO_2$ NAMS are required in urban areas with population totals greater than 1,000,000. Previously, Detroit was the only urban area in Michigan meeting this population requirement and two NAMS sites were established. Now, according to the 2000 census, the Grand Rapids-Muskegon-Holland CSA has surpassed the 1,000,000 level. It is likely that the national network redesign efforts will continue to retain this requirement, so a NAMS $NO_2$ monitor may soon be required in the Grand Rapids-Muskegon-Holland CSA. Currently, a $NO_2$ monitor is operating at the Grand Rapids (Monroe) site (260810020) but has not been designated as a NAMS site.

For the Detroit CSA there are currently two NAMS sites. The Linwood site measures neighborhood scale air masses for determining photochemical production of $NO_2$ in an area with the largest emissions of $NO_X$. The E. Seven Mile site is a downwind urban scale site that measures $NO_2$ produced from the reaction of $O_3$ with $NO_X$.

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. **Figure 2.3-3** shows the locations of Michigan's three $NO_2$ monitors operating during 2005. NOTE: $NO_X$ and other nitrogen compounds measurements are also being collected at the Holland site as part of the Photochemical Assessment Monitoring Stations (PAMS) network. However, this monitor cannot be used to obtain $NO_2$ levels and is not included in **Figure 2.3-3**.

**FIGURE 2.3-3: $NO_2$ MONITORS ACTIVE IN 2005**



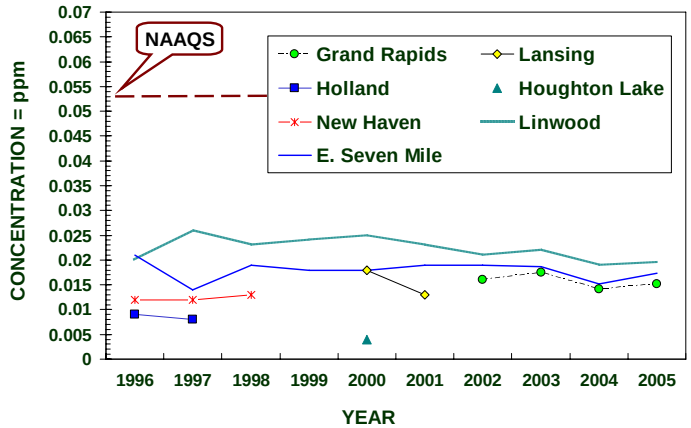

## ATTAINMENT/NONATTAINMENT STATUS OF $NO_2$ IN MICHIGAN:

Since March 3, 1978, all areas in Michigan have been in attainment for $NO_2$.

## $NO_2$ TRENDS BY LOCATION:

As shown in **Figure 2.3-4**, 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 2.3-4: $NO_2$ Levels in MI from 1996-2005 (Annual Arithmetic Mean)**

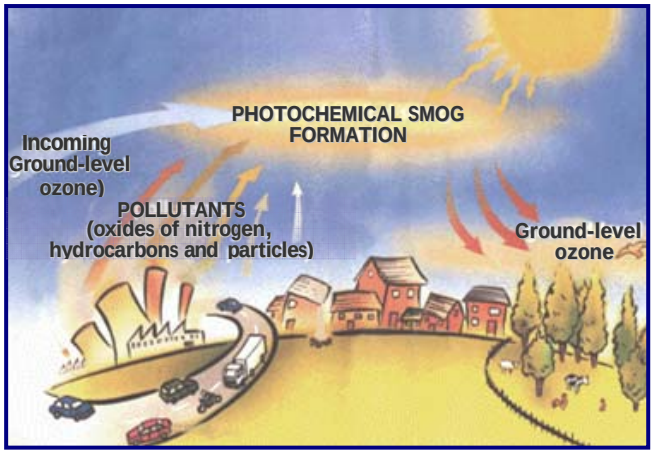


# CHAPTER 2.4: OZONE TRENDS

## INTRODUCTION:

Ozone ($O_3$) has the same chemical structure whether it occurs miles above the earth or at ground level. Therefore, depending on its location in the atmosphere, $O_3$ is considered either good or bad. Good $O_3$ occurs naturally in the stratosphere approximately 10 to 30 miles above the earth's surface and forms a layer that protects life on earth from the sun's harmful rays. The common phrase, "hole in the ozone layer," refers to a decrease in $O_3$ in this layer. Various refrigerants contain chlorofluorocarbons or hydrochlorofluorocarbons which, once released, migrate into the upper atmosphere where a complex series of chemical reactions occur destroying $O_3$ molecules and thinning the protective $O_3$ layer.[16]

In the earth's lower atmosphere, ground-level $O_3$ is considered bad. Ground-level $O_3$ is created by photochemical reactions involving $NO_X$ and VOCs in the presence of sunlight. These reactions usually occur during the hot summer months as ultraviolet radiation from the sun initiates a sequence of photolytical reactions. Major sources of $NO_X$ and VOCs are engine exhaust, emissions from industrial facilities, combustion from electric utilities, gasoline vapors, chemical solvents, and biogenic emissions from natural sources (**10**).




Ground level $O_3$ can also be transported hundreds of miles under favorable meteorological conditions. As a result, the long-range transport of air pollutants impacts the air quality of regions downwind from the actual area of formation. For Michigan, transported $O_3$ and $O_3$ precursors from Gary-Chicago-Milwaukee and other upwind source areas affect the monitor levels in Michigan.

## $O_3$ EFFECTS:

Individuals most susceptible to the effects of $O_3$ exposure include individuals with a pre-existing or chronic respiratory disease, children who are active outdoors, and adults who actively exercise or work outdoors (**1**). Human exposure to elevated $O_3$ can irritate a person's airways, reduce lung function, aggravate asthma and chronic lung diseases like emphysema and bronchitis, and inflame and damage the cells lining the lungs. Other effects associated with $O_3$ exposure are increased respiratory related hospital admissions with symptoms such as chest pain, shortness of breath, throat irritation, and cough. Ozone 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. Vegetation and forest ecosystem changes that occur include: agricultural crop and forest yield reductions; foliar injury; diminished resistance to pest and pathogens; greater susceptibility of injury from other environmental agents; reduced survivability of tree seedlings; and decreased population number in those species that are sensitive to $O_3$ (**1**). In addition, $O_3$ is a key ingredient of urban smog.[17]

[16] Detailed explanation of chemical reactions and mechanisms involved in the formation of $O_3$ and other photochemical oxidants can be found on the EPA website at http://www.epa.gov/airtrends/strat.html.

[17] Additional information about $O_3$ and its effects are available at http://www.epa.gov/airnow and http://www.epa.gov/air/urbanair/ozone/hlth.html.

## NATIONAL SOURCE TRENDS:

Part of the nation's commitment to clean, healthy air deals with reducing levels of $O_3$. In 1979, a 1-hour standard for $O_3$ was set. Over the past several years, a more restrictive health-based 8-hour $O_3$ standard has been phased in. The new average-based $O_3$ standard (attained when the 3-year average of the 4th highest 8-hour value is at or below 0.085 ppm) is more representative of the air quality people breathe.

EPA has noted that over the past 20 years, $O_3$ levels (1-hour and 8-hour) have improved considerably nationwide. EPA states that year-to-year changes in ambient $O_3$ trends are influenced by meteorological conditions, population growth, and changes in emissions levels of $O_3$ precursors (i.e. VOCs and $NO_X$) resulting from ongoing control measures (**1, 10**). In addition, it is important to note that there have been changes in network design, siting criteria, spatial coverage, and monitoring instrument calibration procedures during the past two decades (**1**).

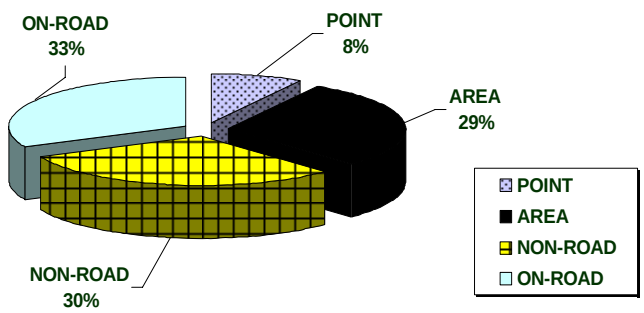
VOC emissions from man-made sources have decreased 25% over the past 10 years nationally, with the two major sources being industrial processes (47%) and transportation sources (45%). $NO_X$ emissions decreased nationwide approximately 12% over the past 10 years (**10**).

## MICHIGAN SOURCE TRENDS:

**Figure 2.4-1** shows by percentage the sources of VOC emissions in Michigan. These source types 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 2.4-1: Percentage Of VOC Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)**




For Michigan, on-road and non-road sources still account for a large percentage of VOC emissions.

## NAAQS FOR $O_3$:

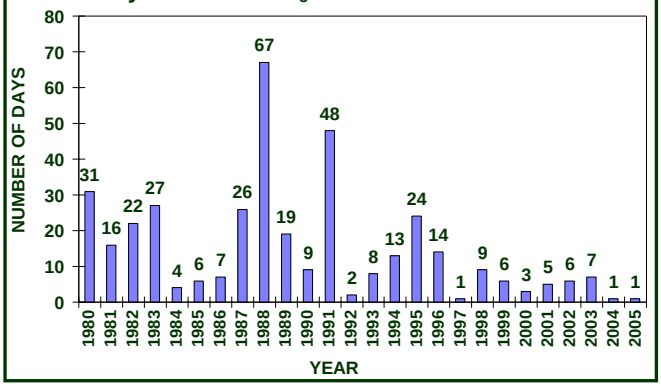
| | |
|---|---|
| **PRIMARY NAAQS (1-hour):** | Maximum daily 1-hour average concentration limit of 0.12 ppm with the average number of expected exceedances per year not to exceed one over a three year period. |
| **SECONDARY NAAQS (1-hour):** | Same as the primary NAAQS (1 hour). |
| **PRIMARY NAAQS (8-hour):** | 4th highest daily maximum 8-hour average, averaged over three years, not to exceed 0.085 ppm. |
| **SECONDARY NAAQS (8-hour):** | Same as primary 8-hour standard. |

## ATTAINMENT/NONATTAINMENT STATUS OF 1-HOUR $O_3$ STANDARD IN MICHIGAN:

All Michigan counties are now designated as attainment for the 1-hour $O_3$ standard. **Figure 2.4-2** shows Michigan's number of exceedance days from 1980-2005. Exceedance days are measured using the highest 1-hour $O_3$ concentration level (0.125 ppm or higher) reported during a 24-hour period (midnight to midnight). **Appendix D** provides a tabular summary of the 1-hour $O_3$ exceedances from 1996 to 2005 for all $O_3$ monitors in Michigan.

NOTE: See **Appendix F: Errata Sheet** for a correction to the 2003 and 2004 Annual Air Quality Reports.

**Figure 2.4-2: Observed Number of Exceedance Days of the 1-Hr $O_3$ Standard from 1980-2005**




## ATTAINMENT/NONATTAINMENT STATUS OF 8-HOUR $O_3$ STANDARDS IN MICHIGAN:

In 1997, EPA issued the average-based 8-hour ozone standard (attained when the 3-year average of the 4th highest value is below 0.085 ppm). In 2004, utilizing 2001-2003 monitoring data, EPA designated 25 counties in Michigan as nonattainment for the 8-hour $O_3$ NAAQS (**Figure 2.4-3**).[18] A nonattainment designation indicates that the area does not meet the national health-based standard, or contributes to violations of the standard in another area.

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

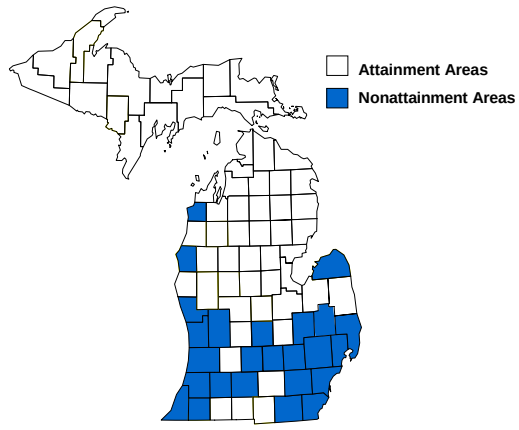
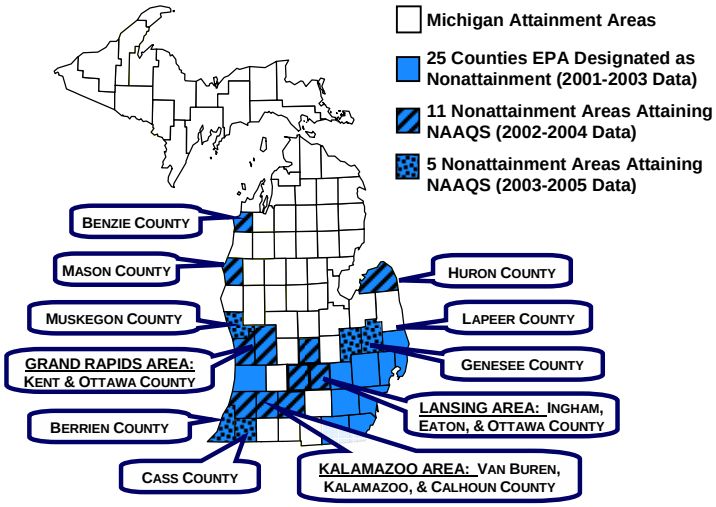



**Figure 2.4-4: 8-Hour Ozone Nonattainment Areas Meeting NAAQS**
**(Utilizing Three Year Averaged Monitoring Data)**




Upon review of the $O_3$ data collected for the periods of 2002-2004 and 2003-2005, a total of 16 (11 and 5, respectively) of the 25 original nonattainment counties are now meeting the 8-hour $O_3$ NAAQS (**Figure 2.4-4**). The AQD has requested redesignation of these 16 counties.[19]

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 1996-2005.

[18] Information on $O_3$ designations is available on the EPA's website at http://www.epa.gov/ozonedesignations/.
[19] Michigan's redesignation request actions are 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, respectively.

## TABLE 2.4-1: THREE-YEAR AVERAGE OF THE 4TH HIGHEST 8-HR $O_3$ VALUES FROM 1996-2005

| AIRS ID | SITE NAME | VALUES | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 260050003 | Holland | 4th Highest 8-hr Value ppm | 0.090 | 0.095 | 0.097 | 0.091 | 0.080 | 0.092 | 0.105 | 0.095 | 0.079 | 0.094 |
| | | Three-year Average ppm | 0.097 | 0.098 | 0.094 | 0.094 | 0.089 | 0.087 | 0.092 | 0.097 | 0.093 | **0.089** |
| | | Rounded to 0.01 ppm | 0.10 | 0.10 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.10 | 0.10 | 0.09 |
| 260190003 | Frankfort/ Benzonia | 4th Highest 8-hr Value ppm | 0.085 | 0.078 | 0.090 | 0.097 | 0.081 | 0.091 | 0.086 | 0.089 | 0.075 | 0.086 |
| | | Three-year Average ppm | 0.089 | 0.087 | 0.084 | 0.088 | 0.089 | 0.089 | 0.086 | 0.088 | 0.083 | 0.083 |
| | | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.08 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.08 | 0.08 |
| 260210014 | Coloma | 4th Highest 8-hr Value ppm | 0.098 | 0.099 | 0.093 | 0.096 | 0.077 | 0.088 | 0.098 | 0.089 | 0.073 | 0.090 |
| | | Three-year Average ppm | 0.094 | 0.098 | 0.096 | 0.096 | 0.088 | 0.087 | 0.087 | 0.091 | 0.086 | 0.084 |
| | | Rounded to 0.01 ppm | 0.09 | 0.10 | 0.10 | 0.10 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.08 |
| 260270003 | Cassopolis | 4th Highest 8-hr Value ppm | 0.095 | 0.090 | 0.091 | 0.095 | 0.079 | 0.088 | 0.103 | 0.089 | 0.077 | 0.086 |
| | | Three-year Average ppm | 0.094 | 0.094 | 0.092 | 0.092 | 0.088 | 0.087 | 0.090 | 0.093 | 0.089 | 0.084 |
| | | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.08 |
| 260370001 | Rose Lake | 4th Highest 8-hr Value ppm | 0.068 | 0.078 | 0.078 | 0.087 | 0.074 | 0.087 | 0.085 | 0.086 | 0.070 | 0.078 |
| | | Three-year Average ppm | 0.074 | 0.074 | 0.074 | 0.081 | 0.079 | 0.082 | 0.082 | 0.086 | 0.080 | 0.078 |
| | | Rounded to 0.01 ppm | 0.07 | 0.07 | 0.07 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 | 0.08 |
| 260490021 | Flint | 4th Highest 8-hr Value ppm | 0.089 | 0.076 | 0.089 | 0.089 | 0.072 | 0.091 | 0.088 | 0.087 | 0.075 | 0.079 |
| | | Three-year Average ppm | 0.082 | 0.082 | 0.084 | 0.084 | 0.083 | 0.084 | 0.083 | 0.088 | 0.083 | 0.080 |
| | | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 | 0.08 |
| 260492001 | Otisville | 4th Highest 8-hr Value ppm | 0.084 | 0.079 | 0.089 | 0.095 | 0.074 | 0.091 | 0.089 | 0.091 | 0.077 | 0.080 |
| | | Three-year Average ppm | 0.078 | 0.080 | 0.084 | 0.087 | 0.086 | 0.086 | 0.084 | 0.090 | 0.085 | 0.082 |
| | | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 | 0.08 | 0.09 | 0.09 | 0.08 |
| 260630007 | Harbor Beach | 4th Highest 8-hr Value ppm | 0.084 | 0.075 | 0.087 | 0.090 | 0.072 | 0.088 | 0.087 | 0.086 | 0.068 | 0.077 |
| | | Three-year Average ppm | 0.083 | 0.080 | 0.082 | 0.084 | 0.083 | 0.083 | 0.082 | 0.087 | 0.080 | 0.077 |
| | | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 | 0.08 |
| 260650012 | Lansing | 4th Highest 8-hr Value ppm | 0.085 | 0.076 | 0.081 | 0.089 | 0.077 | 0.083 | 0.088 | 0.085 | 0.068 | 0.082 |
| | | Three-year Average ppm | 0.084 | 0.083 | 0.080 | 0.082 | 0.082 | 0.083 | 0.082 | 0.085 | 0.080 | 0.078 |
| | | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 | 0.08 |
| 260770905<br>260770008 | Kalamazoo<br>Kalamazoo[1] | 4th Highest 8-hr Value ppm | 0.085 | 0.082 | 0.087 | 0.091 | 0.070 | 0.085 | 0.090 | 0.085 | 0.068 | 0.081 |
| | | Three-year Average ppm | 0.085 | 0.086 | 0.084 | 0.086 | 0.082 | 0.082 | 0.081 | 0.086 | 0.081 | 0.078 |
| | | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.08 | 0.09 | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 | 0.08 |

## TABLE 2.4-1: THREE-YEAR AVERAGE OF THE 4TH HIGHEST 8-HR $O_3$ VALUES FROM 1996-2005 (CONTINUED)

| AIRS ID | SITE NAME | VALUES | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 260810020 | Grand Rapids (Monroe) | 4th Highest 8-hr Value ppm | 0.087 | 0.077 | 0.079 | 0.085 | 0.068 | 0.083 | 0.087 | 0.085 | 0.068 | 0.083 |
| | | Three-year Average ppm | 0.088 | 0.086 | 0.081 | 0.080 | 0.077 | 0.078 | 0.079 | 0.085 | 0.080 | 0.078 |
| | | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 | 0.08 |
| 260812001<br>260810022 | Parnell<br>Evans | 4th Highest 8-hr Value ppm | 0.086 | 0.079 | 0.087 | 0.094 | 0.073 | 0.085 | 0.088 | 0.093 | 0.072 | 0.083 |
| | | Three-year Average ppm | 0.089 | 0.087 | 0.084 | 0.086 | 0.084 | 0.084 | 0.082 | 0.088 | 0.084 | 0.082 |
| | | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.08 | 0.09 | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 | 0.08 |
| 260890001 | Peshawbestown | 4th Highest 8-hr Value ppm | | | | | | | | 0.079 | 0.070 | 0.080 |
| | | Three-year Average ppm | | | | | | | | | | 0.076 |
| | | Rounded to 0.01 ppm | | | | | | | | | | 0.08 |
| 260910007 | Tecumseh | 4th Highest 8-hr Value ppm | 0.085 | 0.076 | 0.086 | 0.083 | 0.082 | 0.086 | 0.089 | 0.088 | 0.074 | 0.082 |
| | | Three-year Average ppm | 0.086 | 0.083 | 0.082 | 0.081 | 0.083 | 0.083 | 0.085 | 0.087 | 0.083 | 0.081 |
| | | Rounded to 0.01 ppm | 0.09 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.08 | 0.08 |
| 260990009 | New Haven | 4th Highest 8-hr Value ppm | 0.091 | 0.090 | 0.098 | 0.096 | 0.075 | 0.095 | 0.095 | 0.102 | 0.081 | 0.088 |
| | | Three-year Average ppm | 0.093 | 0.091 | 0.093 | 0.095 | 0.090 | 0.089 | 0.088 | 0.097 | 0.092 | **0.090** |
| | | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.10 | 0.09 | 0.09 |
| 260991003 | Warren | 4th Highest 8-hr Value ppm | 0.090 | 0.081 | 0.090 | 0.090 | 0.077 | 0.094 | 0.092 | 0.101 | 0.071 | 0.089 |
| | | Three-year Average ppm | 0.089 | 0.087 | 0.087 | 0.087 | 0.085 | 0.087 | 0.087 | 0.095 | 0.088 | **0.087** |
| | | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.10 | 0.09 | 0.09 |
| 261050006<br>261050007 | Ludington[2]<br>Scottville | 4th Highest 8-hr Value ppm | 0.093 | 0.086 | 0.087 | 0.101 | 0.081 | 0.093 | 0.089 | 0.087 | 0.071 | 0.085 |
| | | Three-year Average ppm | 0.096 | 0.096 | 0.088 | 0.091 | 0.089 | 0.091 | 0.087 | 0.089 | 0.082 | 0.081 |
| | | Rounded to 0.01 ppm | 0.10 | 0.10 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.08 | 0.08 |
| 261130001 | Houghton Lake | 4th Highest 8-hr Value ppm | | | 0.079 | 0.091 | 0.073 | 0.084 | 0.077 | 0.082 | 0.071 | 0.074 |
| | | Three-year Average ppm | | | | | 0.081 | 0.082 | 0.078 | 0.081 | 0.076 | 0.075 |
| | | Rounded to 0.01 ppm | | | | | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |
| 261210039 | Muskegon | 4th Highest 8-hr Value ppm | 0.097 | 0.084 | 0.092 | 0.103 | 0.078 | 0.095 | 0.096 | 0.094 | 0.070 | 0.090 |
| | | Three-year Average ppm | 0.101 | 0.099 | 0.091 | 0.093 | 0.091 | 0.092 | 0.089 | 0.095 | 0.086 | 0.084 |
| | | Rounded to 0.01 ppm | 0.10 | 0.10 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.10 | 0.09 | 0.08 |
| 261250001 | Oak Park | 4th Highest 8-hr Value ppm | 0.074 | 0.076 | 0.089 | 0.088 | 0.075 | 0.090 | 0.093 | 0.090 | 0.075 | 0.078 |
| | | Three-year Average ppm | 0.081 | 0.078 | 0.079 | 0.084 | 0.084 | 0.084 | 0.086 | 0.091 | 0.086 | 0.081 |
| | | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 | 0.08 |

## TABLE 2.4-1: THREE-YEAR AVERAGE OF THE 4TH HIGHEST 8-HR $O_3$ VALUES FROM 1996-2005 (CONTINUED)

| AIRS ID | SITE NAME | VALUES | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 261390005 | Jenison | 4th Highest 8-hr Value ppm | 0.084 | 0.079 | 0.085 | 0.091 | 0.077 | 0.086 | 0.093 | 0.090 | 0.069 | 0.086 |
| | | Three-year Average ppm | 0.084 | 0.082 | 0.082 | 0.085 | 0.084 | 0.084 | 0.085 | 0.089 | 0.084 | 0.081 |
| | | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 | 0.08 | 0.09 | 0.09 | 0.08 | 0.08 |
| 261470005 | Port Huron | 4th Highest 8-hr Value ppm | 0.086 | 0.079 | 0.091 | 0.091 | 0.080 | 0.084 | 0.100 | 0.086 | 0.074 | 0.088 |
| | | Three-year Average ppm | 0.088 | 0.086 | 0.085 | 0.087 | 0.087 | 0.085 | 0.088 | 0.090 | 0.086 | 0.082 |
| | | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.08 |
| 261530001 | Seney Nat'l Wildlife Refuge | 4th Highest 8-hr Value ppm | | | | | | | 0.083 | 0.076 | 0.074 | 0.085 |
| | | Three-year Average ppm | | | | | | | | | 0.077 | 0.078 |
| | | Rounded to 0.01 ppm | | | | | | | | | 0.08 | 0.08 |
| 261610005<br>261610007<br>261610008 | Ann Arbor<br>Ann Arbor[3]<br>Ypsilanti | 4th Highest 8-hr Value ppm | 0.088 | 0.074 | 0.084 | 0.092 | 0.078 | 0.092 | 0.091 | 0.091 | 0.071 | 0.083 |
| | | Three-year Average ppm | 0.083 | 0.082 | 0.082 | 0.083 | 0.084 | 0.087 | 0.087 | 0.091 | 0.084 | 0.081 |
| | | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 | 0.08 | 0.08 |
| 261630001 | Allen Park | 4th Highest 8-hr Value ppm | 0.082 | 0.075 | 0.079 | 0.087 | 0.067 | 0.080 | 0.088 | 0.085 | 0.065 | 0.077 |
| | | Three-year Average ppm | 0.078 | 0.078 | 0.078 | 0.080 | 0.077 | 0.078 | 0.078 | 0.084 | 0.079 | 0.075 |
| | | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |
| 261630016 | Linwood | 4th Highest 8-hr Value ppm | 0.079 | 0.079 | 0.086 | 0.084 | 0.077 | 0.087 | 0.092 | 0.084 | 0.066 | 0.079 |
| | | Three-year Average ppm | 0.082 | 0.078 | 0.081 | 0.083 | 0.082 | 0.082 | 0.085 | 0.087 | 0.080 | 0.076 |
| | | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.08 | 0.08 |
| 261630019 | E. Seven Mile | 4th Highest 8-hr Value ppm | 0.086 | 0.088 | 0.093 | 0.092 | 0.080 | 0.092 | 0.083 | 0.098 | 0.066 | 0.080 |
| | | Three-year Average ppm | 0.090 | 0.088 | 0.089 | 0.091 | 0.088 | 0.088 | 0.085 | 0.091 | 0.082 | 0.081 |
| | | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.08 | 0.08 |

Footnotes:

1. Kalamazoo site monitor operation responsibility was assumed by MDEQ on 10/96, and site ID number changed.
2. Ludington site monitor was closed in 10/97 due to loss of site access, and relocated to Scottville.
3. Ann Arbor site monitor was relocated elsewhere in Ann Arbor and later moved to Ypsilanti due to site access difficulty.

## $O_3$ MONITORING IN MICHIGAN:

The $O_3$ monitoring season is from April 1 through September 30. In addition to attainment designation applications, monitoring is also conducted to assess urban air quality, population exposure, and provide real time mapping (WEBMONMAP) and Air Quality Index (AQI) calculations (WEBMONMAP and the AQI is discussed in **Chapter 4**). These monitoring networks often extend beyond the vicinity where most precursor emissions occur because of the time it takes for $O_3$ to form from the reaction of $NO_X$ and VOC emissions. Upwind and background sites are situated according to the predominant morning upwind direction from a metropolitan area (**11**).

In western Michigan, high $O_3$ concentrations are attributed to regional $O_3$ transport across or along the Lake Michigan shoreline from other major urban areas. These monitoring sites are useful for quantifying the effectiveness of control strategies at upwind sites (**11**).

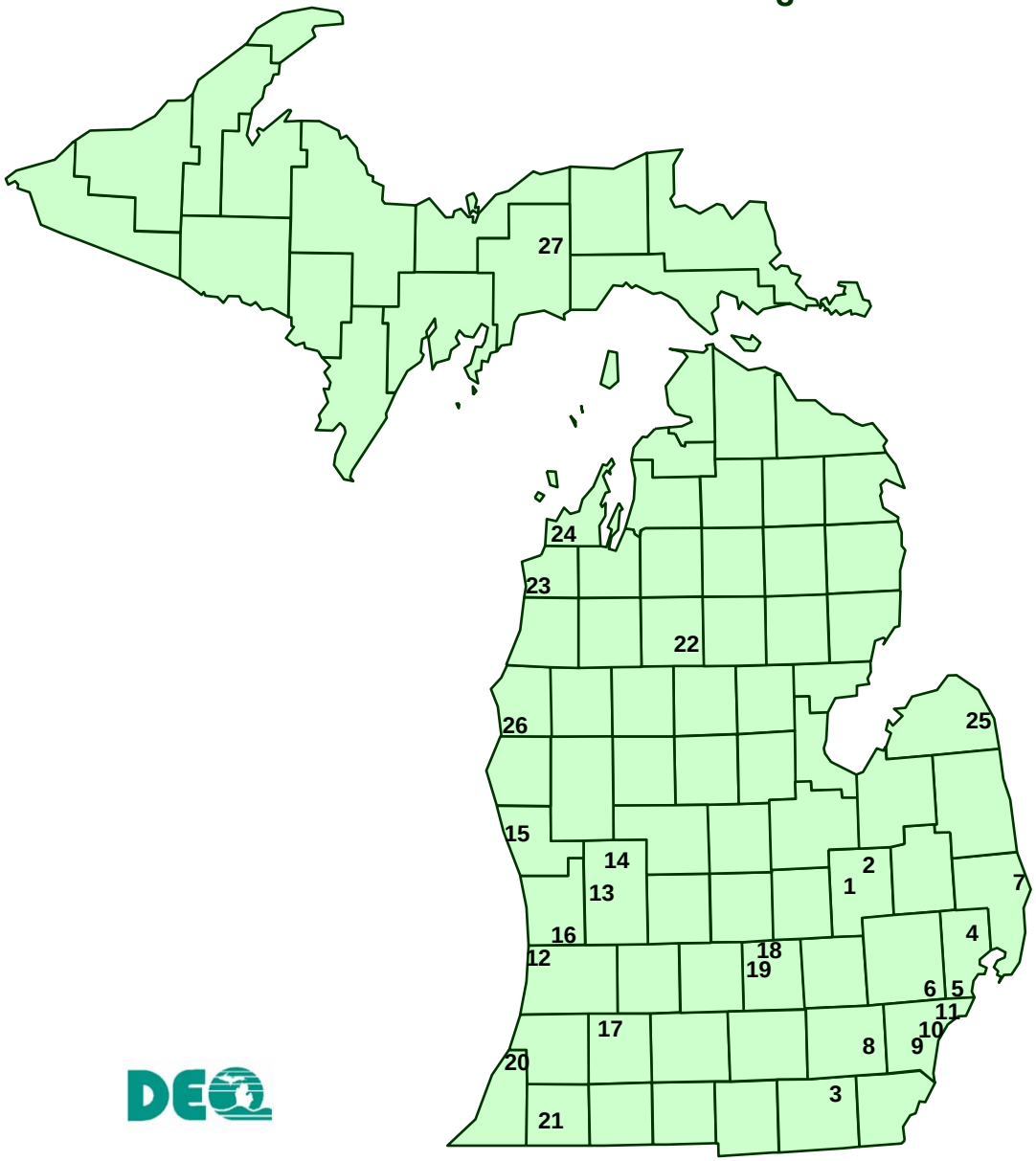
For eastern Michigan, regional $O_3$ transport is also experienced at the Port Huron monitor located downwind of the Detroit urban area. Further north and downwind of the Port Huron site is the Harbor Beach monitor which provides additional monitoring of regional $O_3$ transport into Michigan's "thumb" area. The Tecumseh monitor measures $O_3$ coming into Ann Arbor and into the Detroit metropolitan area.

Southeast Michigan monitors are located to provide an indication of population exposure at the neighborhood scale and urban scale air masses. $O_3$ is also measured at a neighborhood scale in Flint, Lansing, and Grand Rapids (Monroe). For urban scale air masses, the maximum $O_3$ concentrations are measured in Otisville, Rose Lake, Evans, Warren, and New Haven as they are situated downwind of urban areas (Flint, Lansing - E. Lansing, Grand Rapids, and Detroit, respectively). The Cassopolis monitor is a downwind site for the South Bend area.

For Central Michigan, the monitor near Houghton Lake provides background concentrations in a remote rural environment.

**Figure 2.4-5** shows the locations and types of all 27 $O_3$ air quality monitors active in Michigan during 2005.

# FIGURE 2.4-5: $O_3$ MONITORS ACTIVE IN 2005




**MONITOR ID & TYPE**

**DETROIT-WARREN-FLINT CSA**

**ANN ARBOR MSA**

1. 260910007 – Tecumseh - SLAMS
2. 261610008 – Ypsilanti - SLAMS (proposed NAMS)

**DETROIT-WARREN-LIVONIA MSA**

3. 260990009 – New Haven - SLAMS
4. 260991003 – Warren - NAMS
5. 261250001 – Oak Park - SLAMS (proposed NAMS)
6. 261470005 – Port Huron - SLAMS
7. 261630001 – Allen Park - SLAMS
8. 261630016 – Linwood - NAMS
9. 261630019 – E. Seven Mile - SLAMS

**FLINT MSA**

10. 260490021 – Flint - NAMS
11. 260492001 – Otisville – NAMS

**GRAND RAPIDS-MUSKEGON-HOLLAND CSA**

12. 260050003 – Holland - SLAMS
13. 260810020 – Grand Rapids – Monroe - NAMS
14. 260810022 – Evans - SLAMS (proposed NAMS)
15. 261210039 – Muskegon – Green Creek - SLAMS
16. 261390005 – Jenison – SLAMS

**KALAMAZOO-PORTAGE MSA**

17. 260770008 - Kalamazoo - SLAMS

**LANSING-E. LANSING MSA**

18. 260370001 – Rose Lake. - NAMS
19. 260650012 – Lansing – NAMS

**NILES-BENTON HARBOR MSA**

20. 260210014 – Coloma - SLAMS

**SOUTH BEND-MISHAWAKA (IN-MI) MSA**

21. 260270003 – Cassopolis - NAMS

**CADILLAC MISA**

22. 261130001 – Houghton Lake - SPM

**TRAVERSE CITY MISA**

23. 260190003 – Frankfort/Benzonia – SLAMS
24. 260890001 – Peshawbestown - TRIBAL

**HURON COUNTY**

25. 260630007 – Harbor Beach - SLAMS

**MASON COUNTY**

26. 261050007 – Scottville - SLAMS

**SCHOOLCRAFT COUNTY**

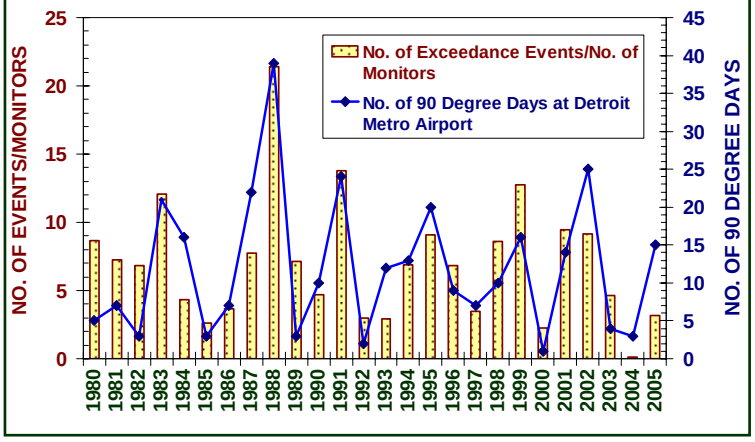
27. 261530001 – Seney Nat'l Wildlife Refuge – SLAMS

## 8-HOUR $O_3$ TRENDS BY LOCATION:

**Figure 2.4-6** compares 8-hour $O_3$ readings ≥ 0.085 ppm with the number of 90°F days (≥ 90°F) measured at the Detroit Metropolitan Airport. The total number of statewide 8-hour readings above 0.085 ppm 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.

NOTE: An error was found in the 2004 Annual Air Quality report regarding **Figure 2.4-6**. See **Appendix F: Errata Sheet** for more information.

**Figure 2.4-6: 8-Hour $O_3$ Levels Events Exceeding the NAAQS from 1980-2005**




This comparison shows the influence of temperature with respect to elevated $O_3$ levels. Over the past 22 years, a typical summer would have 12 1/2 days with the maximum daily temperature exceeding 90°F. Over the time period from 1980 through 2005, the highest number of 90°F days occurred in 1988 (39 days), while the lowest number occurred in 2000 (one day). For 2005, there were fifteen 90°F days.

In 2005, 10 of the 27 $O_3$ monitoring sites registered readings at or above the 0.085 ppm (4$^{th}$ highest value). However, when all the sites had their three-year averages calculated, there were only three (out of the 10) sites that were above the 8-hour $O_3$ NAAQS. Of these three sites, one was located in West Michigan (Holland - 0.089 ppm) and the other two were in Southeast Michigan (New Haven – 0.09 ppm and Warren – 0.087 ppm). It's important to note that these three sites are influenced by regional $O_3$ transport from other major urban areas. Warren and New Haven are situated downwind of Detroit and the Holland monitor receives regional $O_3$ transport across or along Lake Michigan shoreline from other major urban areas.

The following **Figures 2.4-7** through **2.4-11**, show the 4$^{th}$ highest 8-hour $O_3$ value trends for every monitoring site in Michigan over the last ten years (see **Table 2.4-1** for reference). These figures are broken down to enable readers to view specific parts of Michigan to see how $O_3$ has affected their area of interest. For example, the Detroit-Warren-Flint CSA is split into two figures, **Figure 2.4-7** (Detroit-Warren-Livonia MSA) and **Figure 2.4-8** (Ann Arbor and Flint MSAs).

For 2005, **Figure 2.4-7** shows that out of the seven monitors in the Detroit-Warren-Livonia MSA, only Warren, New Haven, and Port Huron had $O_3$ concentration above 0.085 ppm (0.089, 0.088, and 0.088 ppm, respectively) but when averaged over the 2003-2005 three-year period, as stated above, only Warren (0.087 ppm) and New Haven (0.09 ppm) have continued to exceed the $O_3$ NAAQS. All the remaining sites in this MSA had three-year averages below the $O_3$ NAAQS.

**Figure 2.4-7: $O_3$ Levels in MI's Detroit-Warren-Livonia MSA from 1996-2005 (4th Highest 8-Hour $O_3$ Values)**

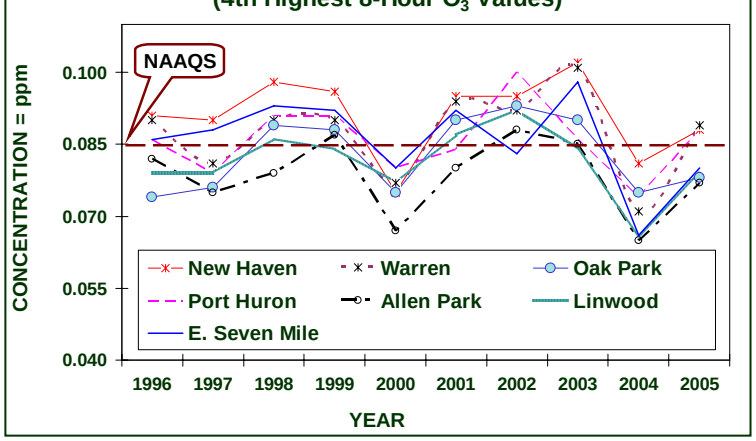


**Figure 2.4-8** shows that for 2005, all the monitoring sites in the Ann Arbor and Flint MSAs had levels below the $O_3$ standard. In addition, when these levels were averaged over the 2003-2005 period, all sites remained below the $O_3$ NAAQS.

For the western portion of Michigan, **Figure 2.4-9** (below) shows the monitoring sites in the Grand Rapids-Muskegon-Holland CSA. In 2005, three monitors (Holland, Muskegon, and Jenison) had levels above the 8-hour $O_3$ concentration of 0.085 ppm (0.094, 0.090, and 0.086 ppm, respectively).

**Figure 2.4-8: $O_3$ Levels in MI's Ann Arbor MSA and Flint MSA from 1996-2005 (4th Highest 8-Hour $O_3$ Values)**

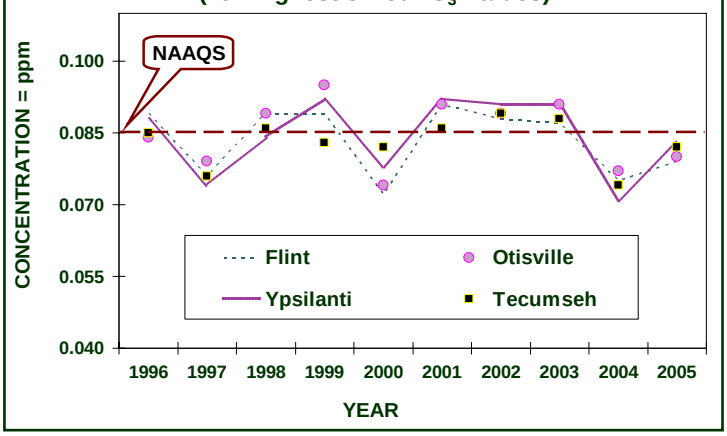
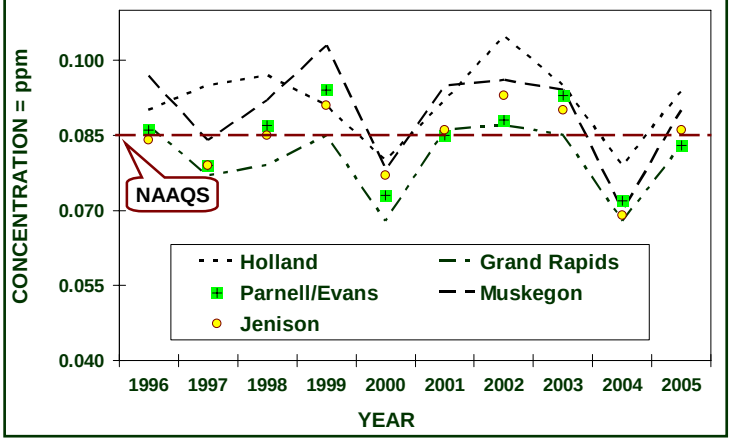



**Figure 2.4-9: $O_3$ Levels in MI's Grand Rapids-Muskegon-Holland CSA from 1996-2005 (4th Highest 8-Hour $O_3$ Values)**

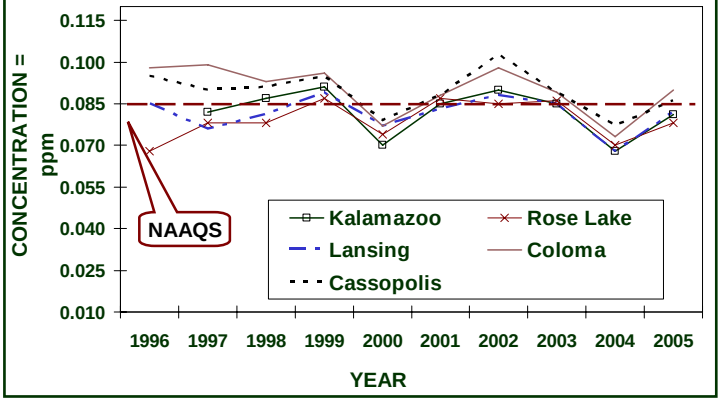



However, only Holland exceeded the 2003-2005 three-year average $O_3$ NAAQS at 0.089 ppm.

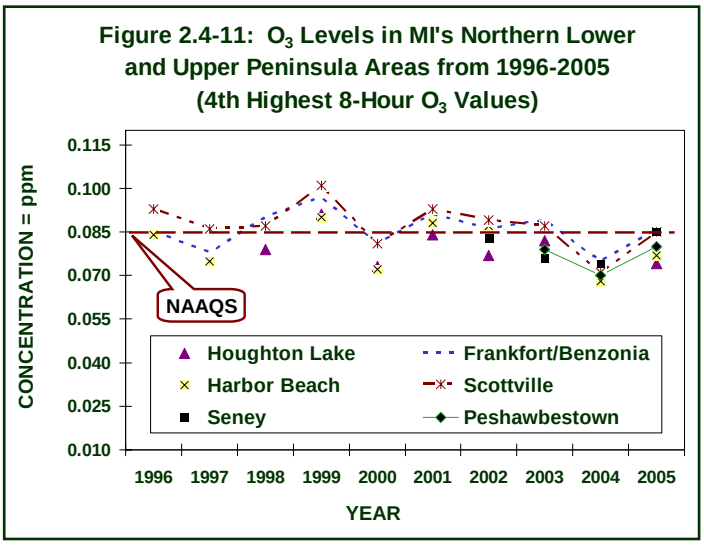
**Figure 2.4-10** (below) contains those sites located in Michigan's Kalamazoo-Portage MSA (Kalamazoo), Lansing-E. Lansing-Owosso CSA (Rose Lake and Lansing), Niles-Benton Harbor MSA (Coloma) and the South Bend-Mishawaka (Indiana-MI) MSA (Cassopolis).[20] As shown, only Coloma and Cassopolis had levels above the 8-hour $O_3$ concentration of 0.085 ppm (0.090 ppm and 0.086 ppm, respectively).

However, for the Coloma and Cassopolis monitoring sites, when the 2003-2005 three-year data is averaged, they both are below the 8-hour $O_3$ NAAQS. Therefore, all the sites in these four MSA's are in compliance with the $O_3$ standard.

**Figure 2.4-10: $O_3$ Levels in MI's Kalamazoo, Lansing, Benton Harbor, & South Bend (IN-MI) MSAs from 1996-2005 (4th Highest 8-Hour $O_3$ Values)**




[20] NOTE: The Cassopolis monitor is a downwind site of South Bend, Indiana.




For the remainder of those sites located in Northern Michigan's Lower Peninsula and the Upper Peninsula, **Figure 2.4-11** shows the concentrations for those monitors in the Cadillac MiSA (Houghton Lake), Harbor Beach, Seney, Traverse City MiSA (Frankfort/Benzonia and Peshawbestown), and Scottville. Of these sites, the Frankfort/Benzonia (0.086 ppm), Seney (0.085 ppm), and Scottville (0.085 ppm) stations had $O_3$ levels at or above 0.085 ppm. After the 2003-2005 three-year averages are calculated, all these sites were below the 8-hour $O_3$ NAAQS.

In summary, when the monitoring data for each of Michigan's $O_3$ monitoring sites are averaged over the 2003-2005 three-year period, there were a total of 24 sites out of 27 that either met or were below the 8-hour $O_3$ NAAQS. This is a substantial difference from 2003 (utilizing 2001-2003 monitoring data) when only four sites met the 8-hour $O_3$ NAAQS. In 2004, 18 sites had met the standard.

Ambient $O_3$ values in Michigan (including daily maximum values), *Ozone Action!* Day's hourly values, lists of exceedances, and other valuable information are available on the AQD's website at http://www.michigan.gov/deqair under "Ozone Action." More information on Michigan's *Ozone Action!* is also discussed in **Chapter 4: Special Projects**.

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

## INTRODUCTION:

Particulate matter or PM is a general term used for a mixture of solid particles and liquid droplets found in the air. Some particles are large enough to be seen as dust or dirt (coarse PM) where others are so small they can only be detected with an electron microscope (fine PM) (**1, 12**).

PM can be emitted directly (primary) or may form in the atmosphere (secondary). PM in the atmosphere is further categorized according to size. Generally, coarse PM or $PM_{10}$ (particles less than 10 microns [μm] in diameter which is equal to about 1/7$^{th}$ the diameter of a human hair) is composed largely of primary particles. Primary particles can originate from power plants, various manufacturing processes, wood stoves and fireplaces, agriculture and forestry practices, fugitive dust sources (road dust and wind blown soil), and forest fires. Fine PM or $PM_{2.5}$ (particles less than 2.5 μm in diameter) can come directly from primary particle emissions or through secondary reactions (**1**). Examples of secondary particulate reactions include sulfates formed from $SO_2$ (sulfur dioxide) emissions from power plants, motor vehicles (especially diesel trucks and buses), and industrial facilities, and nitrates formed from $NO_X$ emissions from power plants, automobiles, and other types of combustion sources (**1**).

Particles with diameters of less than 50 μm are classified as total suspended particulates or TSP. Particles that are greater than 50 μm in diameter do not remain in the atmosphere for appreciable lengths of time and present a smaller health risk because they are too large to be inhaled. Most man-made particulate emissions fall into the size range classified as TSP.

## PM EFFECTS:

Exposure to PM affects breathing and the cellular defenses of the lungs, aggravates existing respiratory and cardiovascular ailments, and has been linked with heart and lung disease. Various health problems have been associated with long-term (e.g., multi-year) exposures as well as daily and shorter term (e.g., 1-hour) exposures to PM. Particles of concern can include both fine and coarse-fraction particles with particle size being the major factor that determines which particles will enter the lungs and how deeply the particles will penetrate. $PM_{2.5}$ has been more clearly linked to the most serious health effects (**1**). People with heart or lung disease, the elderly, and children are at highest risk from exposure to particles.

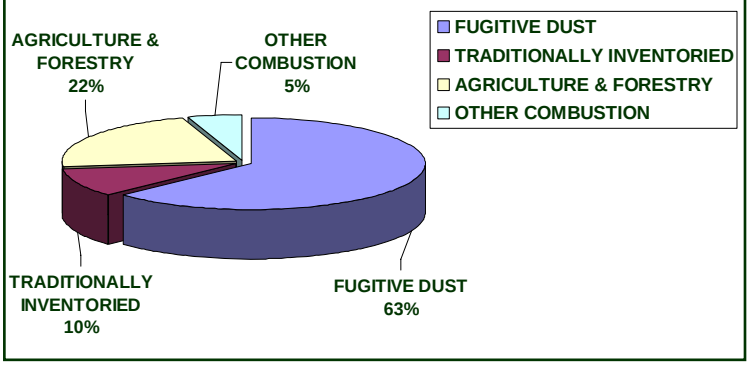
In addition to health problems, PM is the major cause of reduced visibility in many parts of the U.S. with $PM_{2.5}$ considered to be one of the primary visibility-reducing components of urban and regional haze. Airborne particles can also impact vegetation ecosystems and can cause damage to paints, building materials and/or surfaces (**1**). Deposition of acid aerosols and salts may increase corrosion of metals and impact plant tissue by corroding leaf surfaces and interfering with plant metabolism (**1**).[21]

[21] More information about PM and its effects are at: http://www.epa.gov/ttn/oarpg/naaqsfin/pmhealth.html; http://www.epa.gov/oar/particlepollution; and http://www.epa.gov/airtrends/pm.html.

## $PM_{10}$ NATIONAL SOURCE TRENDS:

**Figure 2.5-1** is from the EPA's 2003 National Air Quality and Emissions Trends Report and shows national direct $PM_{10}$ emissions by source category for 2002.[22]

Figure 2.5-1: EPA's 2002 National $PM_{10}$ Emissions by Source Category

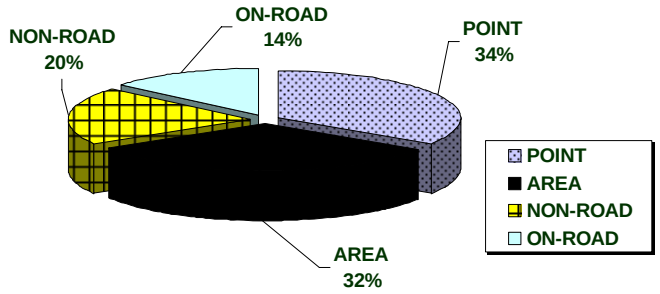



Nationally, 85% of direct $PM_{10}$ emissions are from area and non-industrial sources (i.e., natural sources) such as agriculture and forestry, wildfires and managed burning, and fugitive dust from paved and unpaved roads (**1**). Traditionally inventoried $PM_{10}$ emissions include fuel combustion, industrial processes, and transportation.

## MICHIGAN $PM_{10}$ SOURCE TRENDS:

Utilizing EPA's 2002 emissions inventory data, **Figure 2.5-2** shows Michigan's percentage of emissions by source category. It's important to note that these percentages have changed since the 1999 emissions inventory data. For instance, in the 1999 data, point sources contributed 43% of $PM_{10}$ emissions. The 2002 data shows that point sources now only contribute 34% of $PM_{10}$ emissions in Michigan, a decrease of 9%. There was also a 11% decrease in Michigan's on-road and off-road $PM_{10}$ emissions combined between the 1999 and 2002 emissions inventory data (45% and 34%, respectively). However, Michigan's area source contributions had a substantial increase in percentages from the 2002 emissions inventory (32%) to the 1999 emissions inventory (12%). **Table 2.5-1** lists the different types of point and area sources that contribute $PM_{10}$ in Michigan.

Figure 2.5-2: Percentage of $PM_{10}$ Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)




### TABLE 2.5-1: $PM_{10}$ 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 |

[22] For more National Air Quality Trends, visit EPA's website at: http://www.epa.gov/airtrends.

Additional decreases in Michigan's point sources (metal processing) are expected due to EPA's Final Rule To Reduce Toxic Air Emissions From Taconite Iron Ore Processing Facilities. Michigan has two Taconite Ore Processing facilities that separate and concentrate iron ore from taconite and produce taconite pellets, which are approximately 60% iron. On August 25, 2003, through the participation from representatives of Michigan and Minnesota's ore processing facilities and other affected industry, the EPA issued this final rule establishing PM emission limits from four processes: ore crushing and handling, ore drying, pellet handling, and indurating (hardening) furnaces. Emissions from the indurating furnaces account for over 90% of all toxic air pollutants emitted from a taconite iron ore processing facility. The PM emission limits are a surrogate for the air toxic emissions targeted by this rule as PM emissions are more easily measured.

The EPA also issued a number of other air toxic pollution measures, known as maximum achievable control technology (MACT) standards that should help reduce PM emissions from some of Michigan's area sources and other point sources.[23]

## $PM_{2.5}$ NATIONAL SOURCE TRENDS:

According to the EPA's National Air Quality and Emissions Trends Report, 2003 Special Studies Edition, $PM_{2.5}$ emitted directly from man-made sources decreased 17% between 1993 and 2002.[24] As stated in EPA's Particle Pollution Report: Current Understanding of Air Quality and Emissions through 2003, regional pollution in the eastern U.S. contributes more than half of total $PM_{2.5}$ concentrations. These regional concentrations come from emission sources such as power plants, natural sources, and urban pollution which can be transported hundreds of miles. The major chemical components that make up urban $PM_{2.5}$ are sulfates (largely due to $SO_2$ emissions from coal-fired power plants [**1**]), carbon (producing the largest local emission contributions), and nitrates.

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, focuses 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.[25] The following **Table 2.5-2**, from EPA's Particle Pollution Report, lists the major emission control programs since 1995 that have or will reduce PM.

[23] More information on these MACTs is available at http://www.epa.gov/ttn/atw/mactfnl.html.
[24] It should be noted that EPA did not account for secondary particles formed when emissions of $NO_X$, $SO_2$, ammonia, and other gases reacted in the atmosphere (**1**).
[25] The final CAIR information is available at http://www.epa.gov/air/interstateairquality/.

## Table 2.5-2: Selection of Emission Control Programs Contributing to PM Emission Reductions 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).

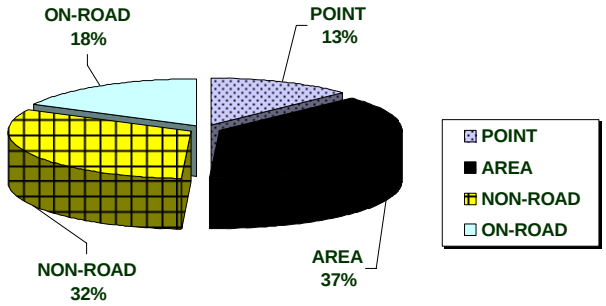
[d] Includes a variety of source categories such as Boilers and Process heaters, Pulp and Paper, Petroleum Refineries, various minerals and ores, and others. While these standards are for hazardous air pollutants (HAPs) such as metals, measures to reduce HAPs in many cases also reduce PM emissions.

[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.

## MICHIGAN $PM_{2.5}$ SOURCE TRENDS:

EPA's 2002 emissions inventory data (**Figure 2.5-3)** shows that area sources (37%) produce the majority of $PM_{2.5}$ emissions in Michigan. However, non-road and on-road (18%) sources combined produce 50% of Michigan's $PM_{2.5}$ emissions. This has changed dramatically from EPA's 1999 emissions inventory data when non-road sources (59%) and on-road sources (39%) accounted for 98% of Michigan's overall $PM_{2.5}$ emissions.

**Figure 2.5-3: Percentage Of $PM_{2.5}$ Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)**




With road sources producing the majority of Michigan's $PM_{2.5}$ emissions, it is important to note that the EPA estimates that the Clean Air Non-road Diesel Rule, signed July 7, 2005, decreases exhaust emissions from these types of engines by more than 90%.[26]

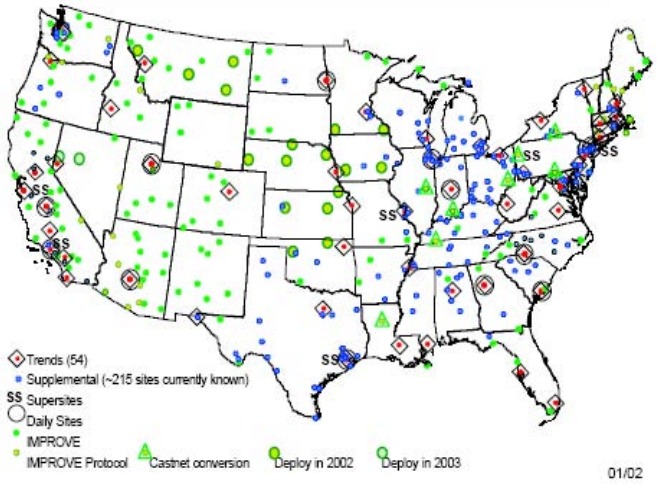
[26] Diesel Fuel Program information is at http://www.epa.gov/otaq/regs/fuels/diesel/diesel.htm#dfr-concurrent.

## $PM_{2.5}$ CHEMICAL SPECIATION:

To gather data on the chemical makeup of $PM_{2.5}$, EPA established a Speciation Trends Network (STN) (**Figure 2.5-4**) consisting of approximately 54 sites in 43 states (**13**). The STN is intended to complement the other components of the $PM_{2.5}$ network by providing: [27]

- Annual and seasonal spatial characterization of aerosols;
- Air quality trends analysis and tracking the progress of control programs;
- Integration of the chemical speciation data set with the data collected from the Interagency Monitoring of Protected Visual Environments (IMPROVE) network; and
- Development of emission control strategies.

**FIGURE 2.5-4: CURRENT/PLANNED $PM_{2.5}$ SPECIATION NETWORKS**




These chemical speciation sites are used to determine trends in concentration levels of selected ions, metals, carbon species, and organic compounds in $PM_{2.5}$. The STN samplers are placed at various NAMS and SLAMS across the nation. Approximately 20 of the monitoring sites have been placed at existing PAMS.[28] The placement of the remaining trends sites were coordinated by EPA and the state and local agencies with locations primarily in or near larger MSAs (**14**). Activities include annual and seasonal characterization of aerosols, air quality trends analysis in relation to the development of control programs, and the evaluation of the monitoring data in the development of emission control strategies (**14**). EPA does not rule out the possibility that objectives, requirements, and methods for speciation sampling may need to be adjusted in the future.[29]

## NAAQS FOR PARTICULATE MATTER:

In 1971, a NAAQS was established for TSP. Michigan still uses TSP monitoring to determine the concentration of airborne metal particulates. The PM standard was revised from TSP to $PM_{10}$ on July 1, 1987. Research demonstrated smaller size particles present a greater health risk.

**PRIMARY $PM_{10}$ NAAQS**: Annual arithmetic mean not to exceed 50 $\mu g/m^3$

24-hour concentration limit of 150 $\mu g/m^3$. Average number of expected exceedances per year not to exceed one over the most recent three-year period.

**SECONDARY $PM_{10}$ NAAQS**: Same as primary standard.

[27] STN data will not be used for attainment or nonattainment decisions.
[28] PAMS collect and report detailed data for VOCs, $NO_X$, $O_3$ and meteorological parameters. Information on PAMS is available at http://www.epa.gov/oar/oaqps/pams/.
[29] More $PM_{2.5}$ speciation information is available at http://www.epa.gov/ttn/amtic/pmspec.html.

On July 18, 1997, the $PM_{10}$ standard was revised and a new standard was added for $PM_{2.5}$ (**15**). The final form of the $PM_{2.5}$ standard consists of an annual as well as a 24-hour average. Compliance with both the 24-hour and annual standards is based on data averaged over a three-year period.

| | |
|---|---|
| **PRIMARY $PM_{2.5}$ NAAQS**: | Annual arithmetic mean not to exceed 15 $\mu g/m^3$ (based on a three-year average)<br>98th percentile of 24-hour concentration not to exceed 65 $\mu g/m^3$ (based on a three-year average). |
| **SECONDARY $PM_{2.5}$ NAAQS**: | Same as primary standard. |

On December 20, 2005, EPA proposed revisions to the PM NAAQS. EPA states that these proposed revisions, published in the January 17, 2006 Federal Register (FR), would strengthen a $PM_{2.5}$ standard important for both health and visibility, and would improve and refocus the coarse particle standards on those particles that are associated with public health concerns.[30] The proposed revisions address two categories of particle pollution:

- *fine particles* ($PM_{2.5}$), which are 2.5 micrometers in diameter and smaller; and
- *inhalable coarse particles* ($PM_{10-2.5}$), which are smaller than 10 micrometers in diameter but larger than $PM_{2.5}$.

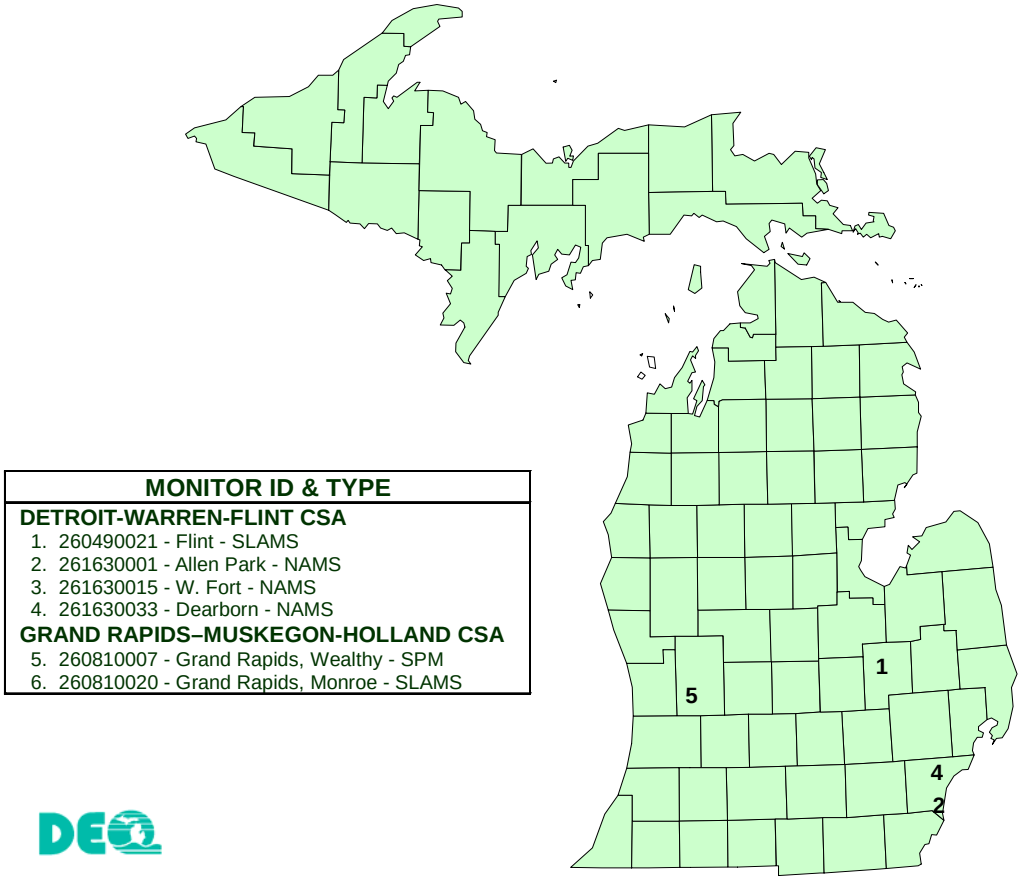
Simultaneously, EPA proposed amendments to its national air quality monitoring requirements, including those for monitoring particle pollution. The proposed changes include the design of a network to monitor $PM_{10-2.5}$.[31]

## MONITORING FOR $PM_{10}$ IN MICHIGAN:

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 2.5-5** identifies the locations of the six $PM_{10}$ monitoring stations that were operating in Michigan during 2005. These monitors are located in Michigan's largest populated urban areas with 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.

[30] Information on the revised particulate standards are available at http://www.epa.gov/airlinks/airlinks4.html.
[31] Current information on both proposals can be found at http://www.epa.gov/air/particles/actions.html.

## FIGURE 2.5-5: $PM_{10}$ MONITORS ACTIVE IN 2005




**MONITOR ID & TYPE**

**DETROIT-WARREN-FLINT CSA**

1. 260490021 - Flint - SLAMS
2. 261630001 - Allen Park - NAMS
3. 261630015 - W. Fort - NAMS
4. 261630033 - Dearborn - NAMS

**GRAND RAPIDS–MUSKEGON-HOLLAND CSA**

5. 260810007 - Grand Rapids, Wealthy - SPM
6. 260810020 - Grand Rapids, Monroe - SLAMS

## ATTAINMENT/NONATTAINMENT STATUS OF $PM_{10}$ IN MICHIGAN:

All areas of Michigan are in attainment with the $PM_{10}$ NAAQS since October 4, 1996.

## $PM_{10}$ TRENDS BY LOCATION:

**Figures 2.5-6** through **2.5-8** are broken down by locations and identify the trends in the 24-hour $PM_{10}$ values in Michigan over the past decade.

**Figure 2.5-6** shows the annual arithmetic means for the Detroit-Warren-Flint CSA from 1996-2005. For 2005, 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 (39.7 µg/m$^3$) in the state.

**Figure 2.5-6: $PM_{10}$ Levels in MI's Detroit-Warren-Flint CSA from 1996-2005 (Annual Arithmetic Means)**

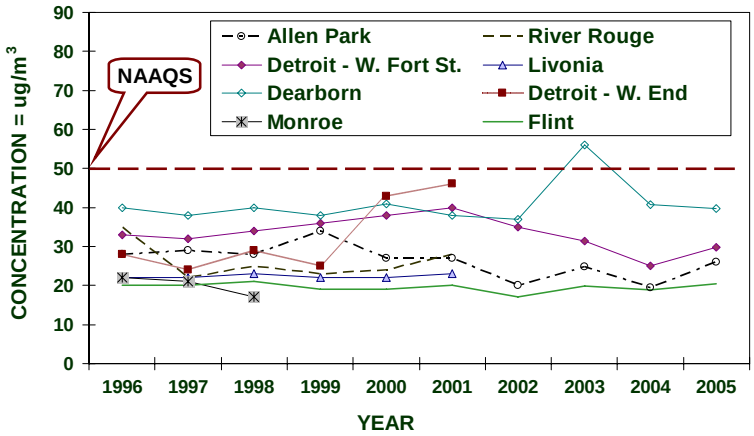
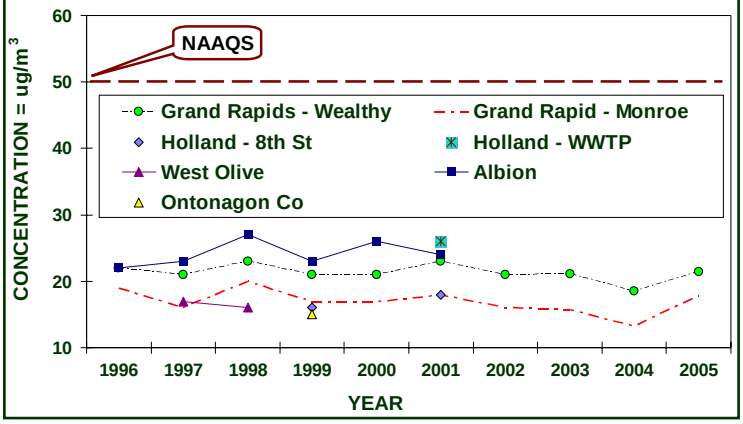


**Figure 2.5-7** shows the annual arithmetic means for the Grand Rapids-Muskegon-Holland CSA and includes the Ontonagon County monitoring site. For 2005, there are only two sites monitoring for $PM_{10}$. Both of these sites were in the Grand Rapids area and they continue to show annual mean $PM_{10}$ levels below the $PM_{10}$ NAAQS. For the decade, all the monitoring sites in western Michigan have maintained a level well below the $PM_{10}$ NAAQS.

**Figure 2.5-7: $PM_{10}$ Levels in the Grand Rapids-Muskegon-Holland CSA & North MI from 1996-2005 (Annual Arithmetic Means)**




## Exceedances of the $PM_{10}$ Standard

**Table 2.5-3** shows that from 1996 to 2005, there were a total of five exceedances of the 24-hour $PM_{10}$ standard. Each occurred at the Dearborn monitoring station. NOTE: The two events in 2003 were inadvertently omitted from the 2003 and 2004 Annual Air Quality Reports and are included here (see **Appendix F: Errata Sheet**). Both the two exceedance events in 2003 and the one in 2004 happened during construction activities near the Dearborn monitor. However, only the 2004 exceedance was considered an "exceptional event" under federal criteria and this concentration was not used for attainment/nonattainment purposes. The following is a description of the 2004 exceptional event:

- On June 8, 2004, there was one exceedance of the 24-hour $PM_{10}$ standard at 242 $\mu g/m^3$ due to construction at the nearby soccer field and running track. During this construction, a large dirt storage pile was placed within 100 feet of the Dearborn monitoring station. These particulate emissions were uncontrolled. Wind gusts reached greater than 28 mph and no precipitation was observed during the period of June 3rd through the 8th. On June 9, 2004, a thunderstorm came through the area providing moisture to the pile and created a hard crust, thereby mitigating further particulate emissions.

### TABLE 2.5-3: VALUES EXCEEDING THE $PM_{10}$ 24-HOUR NAAQS (150 $\mu G/M^3$) FROM 1996 TO 2005

| Year | Total Number of Exceedances Per Year | Site (s) | Date | 24-Hour Value $\mu g/m^3$ |
|---|---|---|---|---|
| 1996 | 1 | 26-163-0033 | 9/5/96 | 158 |
| 1997 | 0 | None | | |
| 1998 | 0 | None | | |
| 1999 | 1 | 26-163-0033 | 10/25/99 | 156 |
| 2000 | 0 | None | | |
| 2001 | 0 | None | | |
| 2002 | 0 | None | | |
| 2003 | 2 | 26-163-0033 | 4/15/03 | 191 |
| | | | 7/26/03 | 157 |
| 2004 | 1 | 26-163-0033 | 6/8/04 | 242 |
| 2005 | 0 | None | | |

## 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 locations for the Michigan monitoring sites were selected using the EPA siting criteria for community-oriented, regional transport, and regional background sites (**16, 17**). These 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:** The R&P sequential $PM_{2.5}$ FRM monitors are deployed at all of Michigan's $PM_{2.5}$ monitoring sites to characterize background or regional $PM_{2.5}$ transport collectively from upwind sources.

**$PM_{2.5}$ FRM MONITOR**

In 2005, four sites were added to Michigan's $PM_{2.5}$ FRM monitoring network bringing the total to 31 (see **Figure 2.5-8**). Two monitoring sites, Detroit's W. Lafayette and Newberry, were established as part of a new monitoring project to investigate PM levels in an area of Detroit heavily impacted by mobile source emissions. In October 2005, FRM monitors were added to the Channing and Crystal Falls area in Michigan's Upper Peninsula for a short-term study to determine the impact of outdoor wood boilers on air quality. Monitoring at these two sites will continue until April 2006.

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 (**16, 18, 19**). Co-located $PM_{10}$ and $PM_{2.5}$ sites include Flint, Grand Rapids (Monroe), Dearborn, and Detroit's Allen Park and W. Fort St.. Siting criteria along with population distribution, emissions from stationary sources, the locations of existing $O_3$ and $PM_{10}$ sites, and Michigan geography determine the final design of the Michigan $PM_{2.5}$ monitoring network.

**TEOM MONITOR**

**Continuous $PM_{2.5}$ Monitoring:** Short-term measurements of $PM_{2.5}$ or $PM_{10}$ are updated on an hourly basis using R&P 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 (Detroit's Allen Park and Grand Rapids - Monroe) (**18**).

In 2005, TEOM monitors were added to Detroit's W. Lafayette and Newberry monitoring sites bringing Michigan's total to 14 continuous $PM_{2.5}$ monitors. The remaining TEOM monitors are located at Bay City, Dearborn, Flint, Holland, Houghton Lake, Kalamazoo, Lansing, Port Huron, Saginaw, and Ypsilanti.

**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 filters over a 24-hour period on either a once every three or once every six day schedule. Samples are collected on three types of filters: teflon, nylon, and quartz. Each filter is analyzed by a different method to determine various components of $PM_{2.5}$ (**20**).

**MET-ONE SASS MONITOR**

For 2005, there were a total of nine chemical speciation monitoring sites. The primary objectives of these sites were to provide data that will be used to determine air quality and to support the development of attainment strategies. In the Detroit-Warren-Flint CSA the Allen Park, Dearborn, Luna Pier, and Ypsilanti monitors will be used in the creation of attainment strategies for Southeast Michigan. The Luna Pier speciation monitor is being used to characterize $PM_{2.5}$ arising from transport. The Ypsilanti speciation monitor supplies urban upwind data and also provides additional air quality data for Washtenaw County Health Department and other researchers in their investigation of the elevated asthma levels in the area.

For West Michigan, even though the counties were designated as attainment, there are two monitoring sites gathering speciation data. The monitor in Grand Rapids, a large population center, will be valuable in comparing the differences in chemical composition across large metropolitan areas and the Holland site addresses transport from Chicago and more rural concentrations of speciated $PM_{2.5}$.

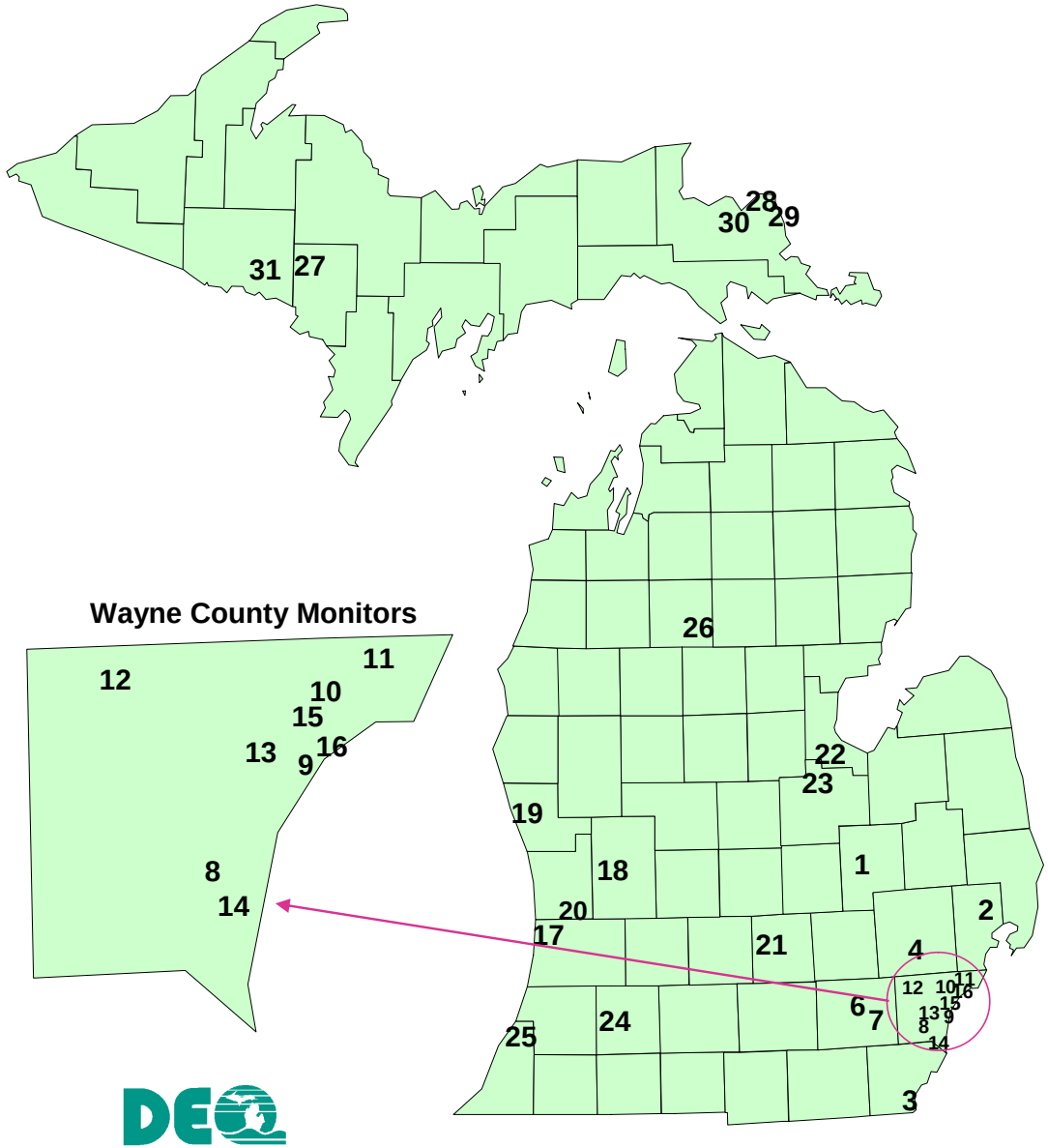
With Kalamazoo having the highest PM levels outside of the Detroit area, the speciation monitoring data will be helpful in maintaining attainment for this location.

Speciated monitors are used to gather background information for regional visibility modeling at Houghton Lake. Speciated $PM_{2.5}$ measurements are also being carried out by the Inter-Tribal Council at the Sault Ste. Marie – Easterday site for Michigan's Upper Peninsula.

In addition, Michigan has expanded its $PM_{2.5}$ monitoring by placing both TEOM and SASS monitors at the following seven locations: Allen Park, Dearborn, Grand Rapids, Holland, Houghton Lake, Kalamazoo, and Ypsilanti.

The following **Figure 2.5-8** shows all of Michigan's 31 $PM_{2.5}$ monitoring stations operating in 2005 and denotes which sites also have TEOM and/or SASS monitors in operation.

# FIGURE 2.5-8: $PM_{2.5}$ MONITORS ACTIVE IN 2005




**MONITOR ID & TYPE**

**DETROIT-WARREN-FLINT CSA**
1. 260490021 – Flint – SLAMS* (TEOM)
2. 260990009 – New Haven – SLAMS
3. 261150005 – Luna Pier – SLAMS (SASS)
4. 261250001 – Oak Park – SLAMS*
5. 261470005 – Port Huron – SLAMS (TEOM)
6. 261610005 – Ann Arbor – SLAMS*
7. 261610008 – Ypsilanti - SLAMS* (TEOM/SASS)
8. 261630001 – Allen Park – SLAMS* (TEOM/SASS)
9. 261630015 – W. Fort - SLAMS
10. 261630016 – Linwood – SLAMS*
11. 261630019 – E. Seven Mile – SLAMS
12. 261630025 – Livonia – SLAMS*
13. 261630033 – Dearborn – SLAMS (TEOM/SASS)
14. 261630036 – Wyandotte – SLAMS*
15. 261630038 – Newberry – SPM (TEOM)
16. 261630039 – W. Lafayette – SPM (TEOM)

**GRAND RAPIDS-MUSKEGON-HOLLAND CSA**
17. 260050003 – Holland – SLAMS (TEOM/SASS)
18. 260810020 – Grand Rapids – SLAMS* (TEOM/SASS)
19. 261210040 – Muskegon - SLAMS
20. 261390005 – Jenison - SLAMS

**LANSING-E. LANSING-OWOSSO CSA**
21. 260650012 – Lansing – SLAMS* (TEOM)

**SAGINAW-BAYCITY-SAGINAW TWP. NORTH CSA**
22. 260170014 – Bay City – SLAMS (TEOM)
23. 261450018 – Saginaw – SLAMS (TEOM)

**KALAMAZOO-PORTAGE MSA**
24. 260770008 – Kalamazoo - SLAMS (TEOM/SASS)

**NILES-BENTON HARBOR MSA**
25. 260210014 – Coloma - SLAMS

**CADILLAC MiSA**
26. 261130001 – Houghton Lake – SPM (TEOM/SASS)

**IRON MOUNTAIN (MI-WI) MiSA**
27. 260430002 – Channing - SPM

**SAULT STE. MARIE MiSA**
28. 260330901 – Sault Ste Marie, Easterday – TRIBAL (SASS)
29. 260330902 – Sault Ste Marie, Marquette – TRIBAL
30. 260330903 – Bay Mills - TRIBAL

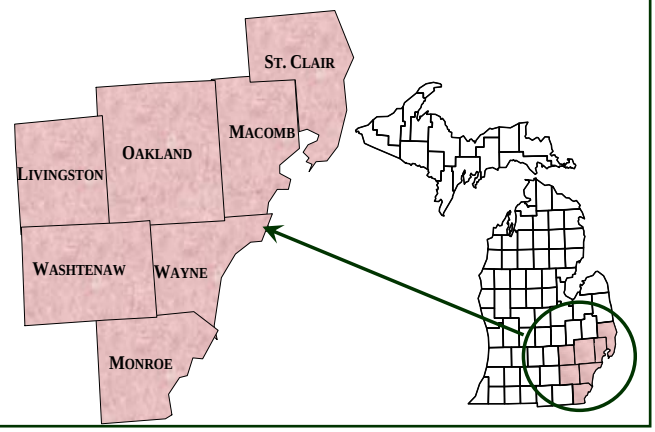
**IRON COUNTY**
31. 260710001 – Crystal Falls - SPM

*Pending approval for NAMS designation

## ATTAINMENT/NONATTAINMENT STATUS OF $PM_{2.5}$ IN MICHIGAN:

EPA promulgated the $PM_{2.5}$ NAAQS on July 18, 1997. In the January 5, 2005 FR, EPA announced their $PM_{2.5}$ designations, effective April 5, 2005, utilizing the 2001-2003 three-year annual average data.[32] **Figure 2.5-9** shows the seven Southeast Michigan counties designated as nonattainment for $PM_{2.5}$: Monroe, Wayne, St. Clair, Oakland, Macomb, Livingston, and Washtenaw. As stated in the FR notice, States were allowed to submit 2004 $PM_{2.5}$ quality-assured monitoring data, calculate the 2002-2004 three-year annual average, and request changes in attainment status if this data and supporting rationale showed an area should instead be designated attainment.

**FIGURE 2.5-9: EPA'S $PM_{2.5}$ NONATTAINMENT AREA DESIGNATIONS FOR MICHIGAN (BASED ON THE 2001-2003 THREE-YR ANNUAL AVERAGES DATA)**




On February 22, 2005, MDEQ submitted documentation demonstrating that monitors in the counties surrounding Wayne County (Livingston, Oakland, Macomb, Monroe, St. Clair, and Washtenaw Counties) are not violating the standard and that Wayne County is the only county showing nonattainment. The MDEQ submittal also included information supporting the conclusion that air pollution emissions in the surrounding six counties do not cause the nonattainment levels in Wayne County. However, EPA denied Michigan's request for reconsideration as they believe the surrounding counties contribute to the overall air quality violations at the Wayne County monitors.[33]

States with counties designated as nonattainment for $PM_{2.5}$ are required to develop control strategies to bring the areas into attainment by 2010. The state attainment plans and regulations must be submitted to EPA by January 2008. In the November 1, 2005 FR, EPA announced its proposed $PM_{2.5}$ Implementation Rule that describes the planning requirements for state, local, and tribal governments when developing their plans to meet the $PM_{2.5}$ NAAQS. The proposed rule addresses:

- Attainment Demonstrations and Modeling: Data period for attainment determinations, criteria for attainment date extensions, use of a classification/nonclassification system, modeling criteria.
- Reasonably Available Control Technology (RACT): Criteria, thresholds, and implementation deadlines; substituting CAIR requirements for EGU RACT.
- Reasonably Available Control Measures and Reasonable Further Progress: Criteria for meeting these requirements.
- New Source Review in Attainment and Nonattainment Areas: Identifies pollutants to be controlled ($PM_{2.5}$ direct emissions, $SO_2$, $NO_X$, and VOCs), threshold levels, and offset ratios.
- Transportation Conformity, Emission Test Methods, and Emission Inventories: Proposed requirements.

Michigan has several concerns and provided comments to this proposed rule on January 31, 2006. It's important to note that the MDEQ is working with a coalition of stakeholders, including the Southeast Michigan Ozone and $PM_{2.5}$ Task Force, and the Lake Michigan Air Director's Consortium, to effectively address $PM_{2.5}$. Studies are underway to determine source contribution of PM.

The following **Table 2.5-4** provides the 1999-2005 annual mean $PM_{2.5}$ concentrations by individual monitoring stations.

[32] Information on all of EPA's $PM_{2.5}$ designations is available at http://www.epa.gov/pmdesignations/.
[33] Michigan's submittal is at http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-mi-pm2-5-ltr-2-22-05.pdf.

Stations labeled #2 provide a precision estimate of the overall measurement and operate on a one in six sampling schedule. All other samplers (except Holland, Grand Rapids #1, Allen Park #1, and Linwood), sample on a one in three day schedule. The differences in the average concentrations and maximum levels are the result from these differences in sampling frequency.

## TABLE 2.5-4: ANNUAL MEAN $PM_{2.5}$ CONCENTRATIONS BY INDIVIDUAL MONITORING STATION FROM 1999-2005 (ANNUAL MEAN, ROUNDED)[34]

| AIRS ID – Station Name | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2003-2005 Mean |
|---|---|---|---|---|---|---|---|---|
| 260050003 - Holland | 12.1 | 11.7 | 12.8 | 12.4 | 12.38 | 11.21 | 12.39 | 12.0 |
| 260070005 - Alpena | | 7.6 | 9.8 | 9.1 | | | | ** |
| 260170014 - Bay City | | 10.1 | 11.5 | 11.3 | 10.89 | 9.85 | 12.44 | 11.1 |
| 260210014 - Coloma | 12.3 | 12.1 | 13.2 | 12.5 | 12.46 | 10.23 | 13.05 | 11.9 |
| 260330901 - Sault Ste. Marie #1 | | | 8.2 | 7.6 | 8.64 | 7.16 | 8.16 | 8.0 |
| 260330901 - Sault Ste. Marie #2 | | | 7.9 | 8.2 | 9.45* | 6.28 | 9.29* | 8.3 |
| 260330902 - Sault Ste. Marie | | | 7.9 | 7.8 | 8.09 | 6.74 | 7.94 | 7.6 |
| 260330903 – Bay Mills | | | | | | | 4.31* | ** |
| 260430002 - Channing | | | | | | | 6.11* | ** |
| 260490021 - Flint | 12.0 | 13.0 | 13.1 | 12.5 | 12.01 | 10.49 | 12.89 | 11.8 |
| 260550003 - Traverse City | | 8.6 | 9.3 | 8.0 | | | | ** |
| 260650012 - Lansing #1 | 12.6 | 13.1 | 14.0 | 13.50 | 13.01 | 11.06 | 13.54 | 12.5 |
| 260650012 - Lansing #2 | 12.9 | 13.6 | 13.3 | 12.4 | 14.08* | 6.20* | | ** |
| 260710001 – Crystal Falls | | | | | | | 3.97* | ** |
| 260770008 - Kalamazoo #1 | 14.9 | **15.1** | **15.6** | 14.8 | 13.92 | 11.33 | 13.83 | 13.0 |
| 260770008 - Kalamazoo #2 | 14.7 | 14.7 | 14.6 | 15.0 | 14.27* | 11.09 | 14.64* | 13.3 |
| 260810020 - Grand Rapids #1 | 13.8 | 13.8 | 14.4 | 13.3 | 13.51 | 12.00 | 13.72 | 13.1 |
| 260810020 - Grand Rapids #2 | 13.9 | 13.8 | 14.2 | 13.2 | 14.00 | 11.26 | **15.37** | 13.5 |
| 260990009 - New Haven | 12.7 | 13.4 | 13.6 | 13.4 | 12.8 | 11.96 | 14.37 | 13.1 |
| 261130001 - Houghton Lake | | | | | 7.96 | 7.29 | 9.38 | 8.2 |
| 261150005 - Luna Pier | | **15.2** | **15.3** | **16.3** | 13.73 | 12.98 | **15.70** | 14.2 |
| 261210040 - Muskegon #1 | 12.2 | 11.9 | 12.6 | 12.4 | 11.87 | 10.16 | 13.07 | 11.7 |
| 261210040 - Muskegon #2 | 14.5 | 11.0 | | | | | | ** |
| 261250001 - Oak Park | 14.2 | **15.4** | 14.7 | 15.0 | 14.58 | 12.76 | **15.46** | 14.3 |
| 261250010 - Southfield | | | 17.1 | 17.6 | | | | ** |
| 261390005 - Jenison | 12.9 | 13.2 | 13.8 | 13.6 | 12.69 | 11.33 | 13.99 | 12.7 |
| 261450018 - Saginaw #1 | 9.8 | 10.5 | 11.5 | 10.8 | 10.62 | 9.51 | 11.72* | 10.6 |
| 261450018 - Saginaw #2 | 10.4 | 9.8 | 10.3 | | | | | ** |
| 261470005 - Port Huron #1 | 13.2 | 14.4 | 14.0 | 13.8 | 14.16 | 12.10 | **15.09** | 13.8 |
| 261470005 - Port Huron #2 | | | 13.2 | 13.0 | **15.67*** | | | ** |
| 261530001 - Seney Nat'l Wildlife | | | 7.5 | 6.0 | 3.73* | | | ** |
| 261610005 - Ann Arbor | 12.8 | 13.2 | 13.5 | 13.6 | 13.06* | 10.67 | 13.20 | 12.3 |
| 261610008 - Ypsilanti #1 | 14.2 | 14.3 | 14.5 | 14.9 | 14.64 | 12.87 | **15.61** | 14.4 |
| 261610008 - Ypsilanti #2 | | | 13.8 | 13.0 | **15.12** | 11.09 | **16.70** | 14.3 |
| 261630001 - Allen Park #1 | **16.7** | **15.6** | **17.3** | **15.9** | **15.2** | 14.24 | **15.94** | **15.1** |
| 261630001 - Allen Park #2 | **19.6** | **16.0** | **16.2** | 13.9 | **17.51*** | 12.32 | **17.66** | **15.8** |
| 261630015 - Detroit - W. Fort t. | **17.7** | **18.1** | **18.3** | **17.4** | **16.63** | **15.39** | **17.21** | **16.4** |
| 261630016 - Detroit - Linwood | **17.1** | **15.5** | **15.8** | **15.6** | **15.82** | 13.69 | **16.01** | **15.2** |
| 261630019 - Detroit - E Seven Mile | | 14.5 | 14.5 | **15.6** | 14.63 | 13.23 | **16.48** | 14.8 |
| 261630025 - Livonia | 13.1 | 14.6 | 14.6 | 14.4 | 14.14 | 12.57 | 14.94 | 13.9 |
| 261630033 - Dearborn | **17.0** | **20.1** | **19.6** | **19.8** | **19.11** | **16.83** | **18.55** | **18.2** |
| 261630036 - Wyandotte | **16.3** | **17.6** | **18.2** | **16.3** | **16.26** | 13.66 | **16.41** | **15.5** |
| 261630038 - Detroit - Newberry | | | | | | | **16.41*** | ** |
| 261630039 - Detroit - W. Lafayette | | | | | | | **16.22*** | ** |

*The mean does not satisfy summary criteria.
**The $PM_{2.5}$ NAAQS cannot be calculated as there is not three years worth of data or monitoring ended prior to 2005.
NOTE: The 2003 value for Houghton Lake has been corrected. See **Appendix F: Errata Sheet**.

[34] The annual $PM_{2.5}$ NAAQS is met when the three-year average is less than or equal to 15.0 $\mu g/m^3$. For comparing calculated values to the standard, the average annual means is rounded to the nearest 0.1 $\mu g/m^3$.

**Table 2.5-5** is a detailed assessment of the 24-hour 98$^{TH}$ percentile $PM_{2.5}$ concentrations for 1999-2005 showing Michigan's levels are consistently below the 65 $\mu g/m^3$ standard (three-year average).

## TABLE 2.5-5: 24-HOUR 98$^{TH}$ PERCENTILE $PM_{2.5}$ CONCENTRATIONS BY INDIVIDUAL MONITORING STATION FROM 1999-2005 (98$^{TH}$ PERCENTILE, ROUNDED)[35]

| AIRS ID – Station Name | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2003-2005 Mean |
|---|---|---|---|---|---|---|---|---|
| 260050003 - Holland | 36.5 | 35.7 | 42.1 | 36.7 | 35.6 | 30.3 | 36.1 | 34.0 |
| 260070005 - Alpena | | 25.4 | 35.1 | 27.3 | | | | * |
| 260170014 - Bay City | | 27.7 | 34.2 | 32.0 | 26.7 | 28.0 | 40.5 | 31.7 |
| 260210014 - Coloma | 35.4 | 29.7 | 32.3 | 30.6 | 34.1 | 29.0 | 33.8 | 32.3 |
| 260330901 - Sault Ste. Marie #1 | | | 27.9 | 22.1 | 26.3 | 22.3 | 25.1 | 24.6 |
| 260330901 - Sault Ste. Marie #2 | | | 25.4 | 21.4 | 38.3 | 15.4 | 28.3 | 27.3 |
| 260330902 - Sault Ste. Marie | | | 28.0 | 27.0 | 25.4 | 23.2 | 25.1 | 24.6 |
| 260330903 - Bay Mills | | | | | | | 11.1 | * |
| 260430002 - Channing | | | | | | | 18.4 | * |
| 260490021 - Flint | 32.8 | 32.2 | 38.0 | 30.8 | 32.2 | 27.9 | 35.9 | 32.0 |
| 260550003 - Traverse City | | 27.2 | 32.7 | 23.3 | | | | * |
| 260650012 - Lansing #1 | 34.6 | 37.2 | 37.2 | 32.8 | 29.0 | 29.4 | 38.1 | 32.2 |
| 260650012 - Lansing #2 | 36.8 | 35.3 | 40.4 | 30.1 | 28.9 | 6.2 | | * |
| 260710001 - Crystal Falls | | | | | | | 13.9 | * |
| 260770008 - Kalamazoo #1 | 38.0 | 35.5 | 40.0 | 32.3 | 36.9 | 27.3 | 33.3 | 32.5 |
| 260770008 - Kalamazoo #2 | 38.7 | 36.5 | 36.0 | 32.0 | 35.7 | 28.9 | 31.5 | 32.0 |
| 260810020 - Grand Rapids #1 | 38.8 | 40.5 | 43.5 | 35.1 | 35.0 | 31.8 | 44.7 | 37.2 |
| 260810020 - Grand Rapids #2 | 39.3 | 28.1 | 39.4 | 32.4 | 29.6 | 30.5 | 45.6 | 35.2 |
| 260990009 - New Haven | 31.9 | 33.2 | 42.0 | 35.6 | 31.8 | 31.9 | 41.5 | 35.1 |
| 261130001 - Houghton Lake | | | | | 23.6 | 21.0 | 30.8 | 25.1 |
| 261150005 - Luna Pier | | 37.2 | 39.2 | 42.7 | 34.7 | 35.0 | 49.3 | 39.7 |
| 261210040 - Muskegon #1 | 38.1 | 35.0 | 34.9 | 29.8 | 36.3 | 32.7 | 41.0 | 36.7 |
| 261210040 - Muskegon #2 | 39.1 | 23.5 | | | | | | * |
| 261250001 - Oak Park | 42.8 | 40.7 | 39.4 | 38.4 | 36.6 | 32.5 | 52.2 | 40.4 |
| 261250010 - Southfield | | | 44.2 | 31.4 | | | | * |
| 261390005 - Jenison | 38.7 | 33.7 | 35.0 | 36.8 | 31.0 | 30.9 | 42.3 | 34.7 |
| 261450018 - Saginaw #1 | 31.0 | 27.5 | 34.6 | 26.0 | 26.8 | 27.4 | 37.8 | 30.7 |
| 261450018 - Saginaw #2 | 34.3 | 28.4 | 10.3 | | | | | * |
| 261470005 - Port Huron #1 | 44.5 | 33.1 | 40.5 | 35.3 | 37.2 | 32.2 | 47.6 | 39.0 |
| 261470005 - Port Huron #2 | | | 35.9 | 37.7 | 38.0 | | | * |
| 261530001 - Seney Nat'l Wildlife | | | 26.0 | 18.0 | 15.8 | | | * |
| 261610005 - Ann Arbor | 38.2 | 33.1 | 38.5 | 31.3 | 33.3 | 28.4 | 39.1 | 33.6 |
| 261610008 - Ypsilanti #1 | 40.6 | 30.3 | 39.7 | 30.9 | 38.8 | 31.5 | 52.1 | 40.8 |
| 261610008 - Ypsilanti #2 | | | 39.0 | 32.6 | 32.5 | 31.2 | 54.6 | 39.4 |
| 261630001 - Allen Park #1 | 49.0 | 41.8 | 48.3 | 39.6 | 40.5 | 36.9 | 43.0 | 40.1 |
| 261630001 - Allen Park #2 | 44.1 | 34.6 | 40.1 | 30.9 | 39.2 | 33.8 | 58.0 | 43.7 |
| 261630015 - Detroit - W. Fort St. | 50.2 | 44.5 | 42.9 | 38.2 | 33.6 | 36.0 | 49.7 | 39.8 |
| 261630016 - Detroit - Linwood | 51.7 | 44.0 | 46.0 | 42.7 | 46.2 | 38.3 | 51.8 | 45.4 |
| 261630019 - Detroit - E Seven Mile | | 42.0 | 42.0 | 34.4 | 37.1 | 35.0 | 52.3 | 41.5 |
| 261630025 - Livonia | 38.4 | 35.9 | 44.7 | 32.7 | 38.1 | 32.2 | 40.2 | 36.8 |
| 261630033 - Dearborn | 45.1 | 45.1 | 43.2 | 45.7 | 42.8 | 39.4 | 50.2 | 44.1 |
| 261630036 - Wyandotte | 45.0 | 42.7 | 46.6 | 34.1 | 34.8 | 32.3 | 46.7 | 37.9 |
| 261630038 - Detroit - Newberry | | | | | | | 57.5 | * |
| 261630039 - Detroit - W. Lafayette | | | | | | | 43.9 | * |

*The 2003-2005 mean cannot be calculated as there is not three years worth of data or monitoring ended prior to 2005.

The following **Figures 2.5-10** through **2.5-14** shows the annual mean $PM_{2.5}$ trend for each monitoring site in Michigan for the years monitoring was conducted.

[35] The 98$^{TH}$ percentile value was obtained from the EPA AQS. For the purpose of comparing calculated values, the three-year 24-hour average is rounded to the nearest 0.1 $\mu g/m^3$.

For clarity purposes, the Detroit-Warren-Flint CSA has been broken down into two graphs. **Figure-2.5-10** shows Wayne County's nine monitoring sites (part of the Detroit-Warren-Flint CSA) annual mean trends from 1999-2005. In 2005, eight of the nine monitoring sites had yearly readings above the $PM_{2.5}$ standard with Livonia the only site below at 14.9 µg/m$^3$. After the three-year annual means are calculated, the following five sites did not meet the $PM_{2.5}$ NAAQS: Allen Park (15.1 µg/m$^3$), W. Fort (16.4 µg/m$^3$), Dearborn (18.2 µg/m$^3$), Linwood (15.2 µg/m$^3$), and Wyandotte (15.5 µg/m$^3$). Historically (since 1999), the Dearborn and W. Fort monitoring sites have continually been above the $PM_{2.5}$ NAAQS with Dearborn having the highest readings in the state.

**Figure 2.5-10: Detroit-Warren-Flint CSA - (Wayne County Only) Annual Arithmetic Means for $PM_{2.5}$ from 1999-2005**

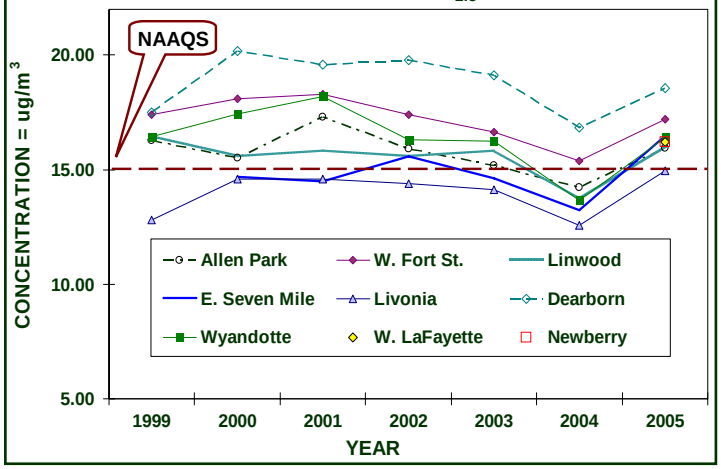



**Figure 2.5-11** contains the remainder of those sites in the Detroit-Warren-Flint CSA's (without Wayne County). For 2005, Ypsilanti (15.6 µg/m$^3$) and Luna Pier (15.7 µg/m$^3$) were the only sites that had yearly readings above the $PM_{2.5}$ standard. However, after the three year annual mean is averaged these sites remained below the $PM_{2.5}$ NAAQS.

In summary, for the entire Detroit-Warren-Flint CSA, only Wayne County had three-year annual mean values above the $PM_{2.5}$ NAAQS. This trend was the same in 2004 reiterating Michigan's position that only Wayne County should be designated as nonattainment.

**Figure 2.5-11: Detroit-Warren-Flint CSA (without Wayne County) Annual Arithmetic Means for $PM_{2.5}$ from 1999-2005**

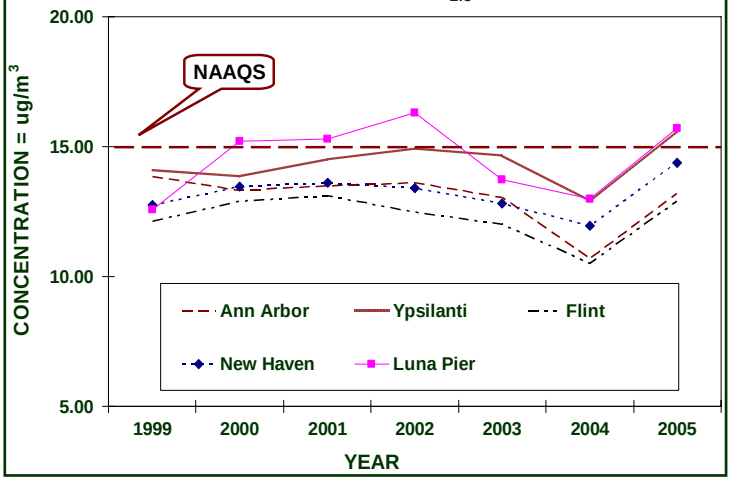



**Figure 2.5-12** combines the $PM_{2.5}$ monitoring sites in the Grand Rapids-Muskegon-Holland CSA, Kalamazoo, and Coloma for a view of West Michigan.

All sites in Western Michigan have been below the $PM_{2.5}$ NAAQS since 2002. In 2000 and 2001, the Kalamazoo monitor was the only West Michigan monitor to have readings above the standard at 15.1 µg/m$^3$ and 15.6 µg/m$^3$, respectively.

**Figure 2.5-12: West MI - Grand Rapids-Muskegon-Holland CSA, Kalamazoo & Benton Harbor MSAs Annual Arithmetic Means for $PM_{2.5}$ from 1999-2005**

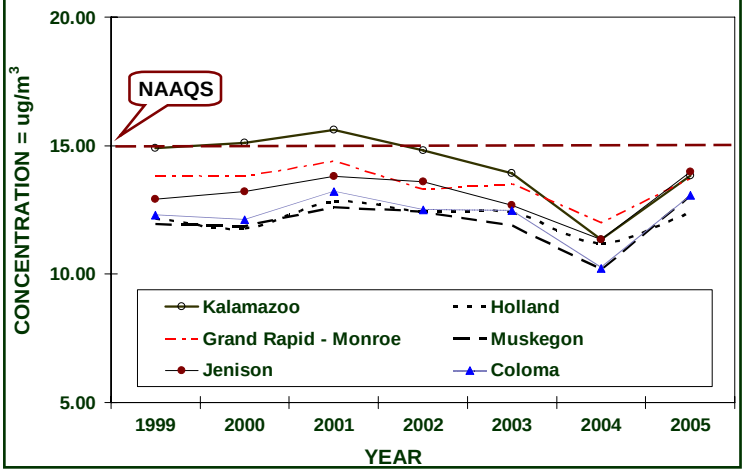


**Figure 2.5-13** shows the remaining monitoring sites operational in Michigan's Lower Peninsula (Lansing-E. Lansing-Owosso CSA, Saginaw-Bay City-Saginaw Twp. North CSA, Traverse City MiSA, and Houghton Lake located in the Cadillac MiSA). All these sites have remained below the $PM_{2.5}$ NAAQS.

**Figure 2.5-14** (below) contains those sites in Michigan's Upper Peninsula. All sites had levels below the $PM_{2.5}$ NAAQS. However, three-year annual averages are not available for these sites as they have not been in operation long enough.

**Figure 2.5-13: Lansing-E. Lansing CSA, Saginaw-Bay City CSA, Traverse City MiSA, & Cadillac MiSA Annual Arithmetic Means for $PM_{2.5}$ from 1999-2005**

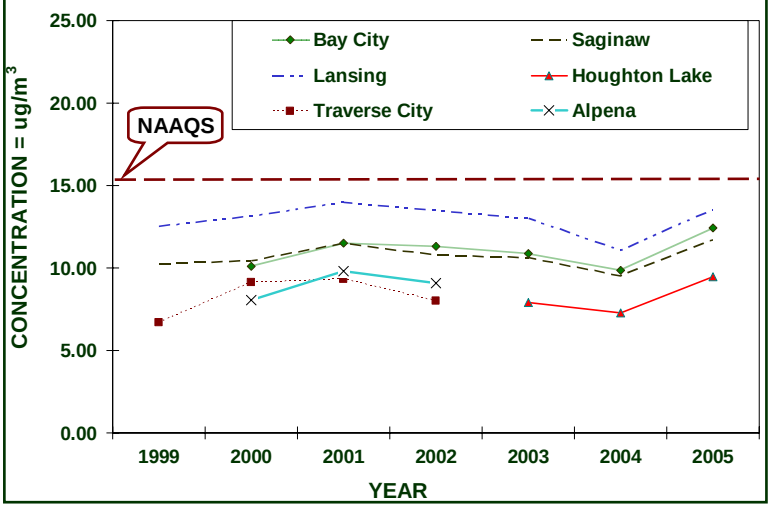
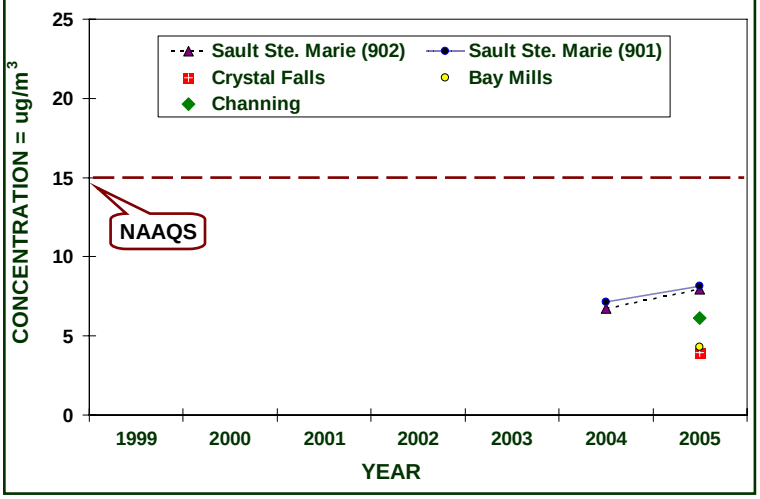



**Figure 2.5-14: Sault Ste. Marie MiSA, Iron Mountain (MI-WI) MiSA, and Iron County Sites Annual Arithmetic Means for $PM_{2.5}$ from 1999-2005**




NOTE: With on-road and non-road sources producing 50% of Michigan's $PM_{2.5}$ emissions, it is important to acknowledge that there are several federal measures that will reduce vehicle emissions nationwide.

Beginning in 2004, requirements to reduce emissions from on-road sources were phased-in. This measure, part of the Tier 2 Vehicle and Gasoline Sulfur Program, reduces the level of sulfur in gasoline and sets the standards for tailpipe emissions for all on-road passenger vehicles, regardless of whether they run on gasoline, diesel fuel, or alternative fuels.[36]

To address non-road sources, the new Clean Air Non-Road Diesel Rule reduces future diesel engines by integrating engine and fuel controls as a total system.[37] In order to meet these emission standards, engine manufacturers will produce new engines with advanced emission-control technologies. In addition, because the emission-control devices can be damaged by sulfur, this rule also decreases the allowable level of sulfur in non-road diesel fuel.

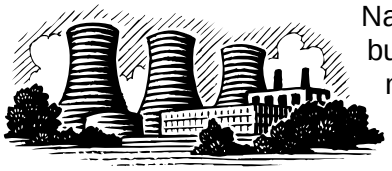
There are also several federal measures that will help reduce point source emissions of $NO_X$, a secondary source of $PM_{2.5}$. The first is the recently implemented $NO_X$ SIP Call that requires $NO_X$ reductions from power plants in 19 eastern states including Michigan. Other federal measures are included in the EPA's Clean Air Rules of 2004, such as CAIR, finalized in 2005, that requires $NO_X$ reductions from power plants across the region that will also result in lower $PM_{2.5}$ levels.

[36] The Tier 2 Vehicle and Gasoline Sulfur Program is available at http://www.epa.gov/tier2/.
[37] Information on the Clean Air Non-Road Diesel Rule is available at http://www.epa.gov/nonroad-diesel/2004fr.htm.

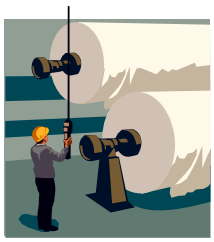
# CHAPTER 2.6: SULFUR DIOXIDE TRENDS

## INTRODUCTION:

Sulfur dioxide ($SO_2$) is a colorless gas formed by the burning of sulfur-containing material and is odorless at typical ambient concentrations. It can react with other atmospheric chemicals to form sulfuric acid. When a sulfur-bearing fuel is combusted, the sulfur is oxidized to form $SO_2$ and then it reacts with other pollutants to form aerosols. In liquid form, it is found in clouds, fog, rain, aerosol particles, and in surface films on these particles. $SO_2$ reacts with ammonia in the atmosphere to form ammonium sulfate, a common fine particulate material ($PM_{2.5}$) found in the Midwest. Other sulfate-containing chemical species prevalent in fine particles include ammonium bisulfate.

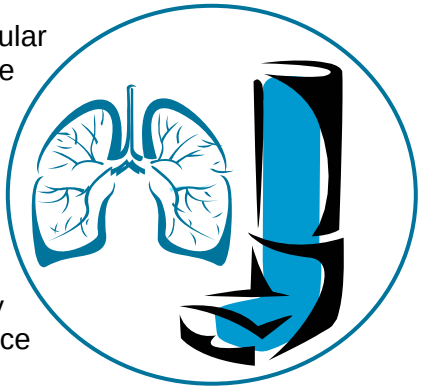


Nationwide, the largest source of $SO_2$ comes from coal-burning power plants. State regulations require that most of the coal burned in Michigan contain low amounts of sulfur. $SO_2$ also is emitted from smelters, petroleum refineries, pulp and paper mills, transportation sources, and steel mills. Other sources include residential, commercial, and industrial space heating.



## $SO_2$ EFFECTS:

Exposure to elevated levels of $SO_2$ aggravates existing cardiovascular and pulmonary disease. Asthmatics, children, and the elderly are especially sensitive to its effects. Asthmatic individuals receiving short-term exposures during moderate exertion may experience reduced lung function and symptoms such as wheezing, chest tightness, or shortness of breath (**1**). Depending upon the concentration, $SO_2$ may also cause symptoms in people who do not have asthma. Where $SO_2$ is emitted, PM is also often emitted. $SO_2$ and PM may exert a synergistic toxic effect. Together, they may cause respiratory illness, alteration in the body's defense and clearance mechanisms, and aggravation of existing cardiovascular disease (**1**).

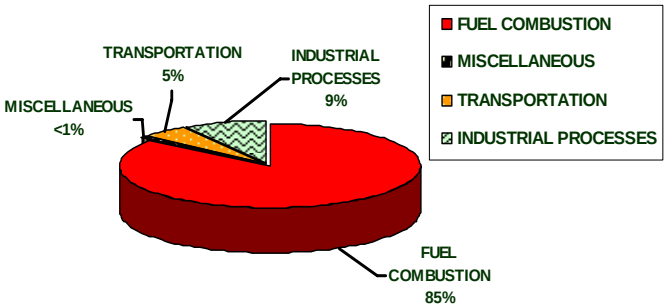


$SO_2$ and $NO_X$ together are the major precursors to acid rain, which is associated with the acidification of soils, lakes, and streams and accelerated corrosion of buildings and monuments. $SO_2$ is also a major precursor to $PM_{2.5}$, which is a significant health concern, and a main contributor to poor visibility.

## NATIONAL SOURCE TRENDS:

According to the EPA, coal-burning power plants have consistently been the largest contributor of $SO_2$ emissions, producing about 63% of all $SO_2$ emissions (**1**). The highest $SO_2$ emission density is located in the eastern U.S., in large metropolitan areas, and in those areas with coal-burning plants. Emissions from these power plants account for most of the fuel combustion category in EPA's **Figure 2.6-1**.[38]

**Figure 2.6-1: EPA's 2002 National $SO_2$ Emissions by Source Category**



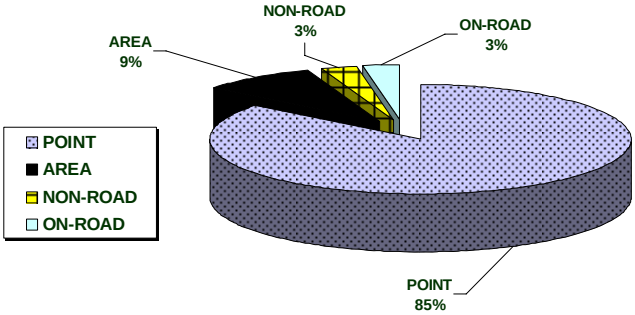

[38] Figure 2.6-1 is from EPA Air Trends information located at http://www.epa.gov/airtrends/sulfur2.html.

## MICHIGAN SOURCE TRENDS:

**Figure 2.6-2**, shows 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 2.6-2: Percentage of $SO_2$ Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)**




Michigan's $SO_2$ levels have consistently been well below the NAAQS with Michigan being in attainment for $SO_2$ since 1982.

## NAAQS FOR $SO_2$:

| | |
|---|---|
| **PRIMARY NAAQS**: | Annual Arithmetic Mean not to exceed 0.030 ppm (80 $\mu g/m^3$). 24-hour concentration limit not to exceed 0.14 ppm (365 $\mu g/m^3$) more than once/year. |
| **SECONDARY NAAQS**: | 3-hour concentrations not to exceed 0.50 ppm (1300 $\mu g/m^3$) more than once/year. |

Note: In May of 1996, the EPA made a technical change that expressed the NAAQS for $SO_2$ in terms of ppm rather than $\mu g/m^3$. The actual levels of the standard were not changed (**21**).

## $SO_2$ MONITORING IN MICHIGAN:

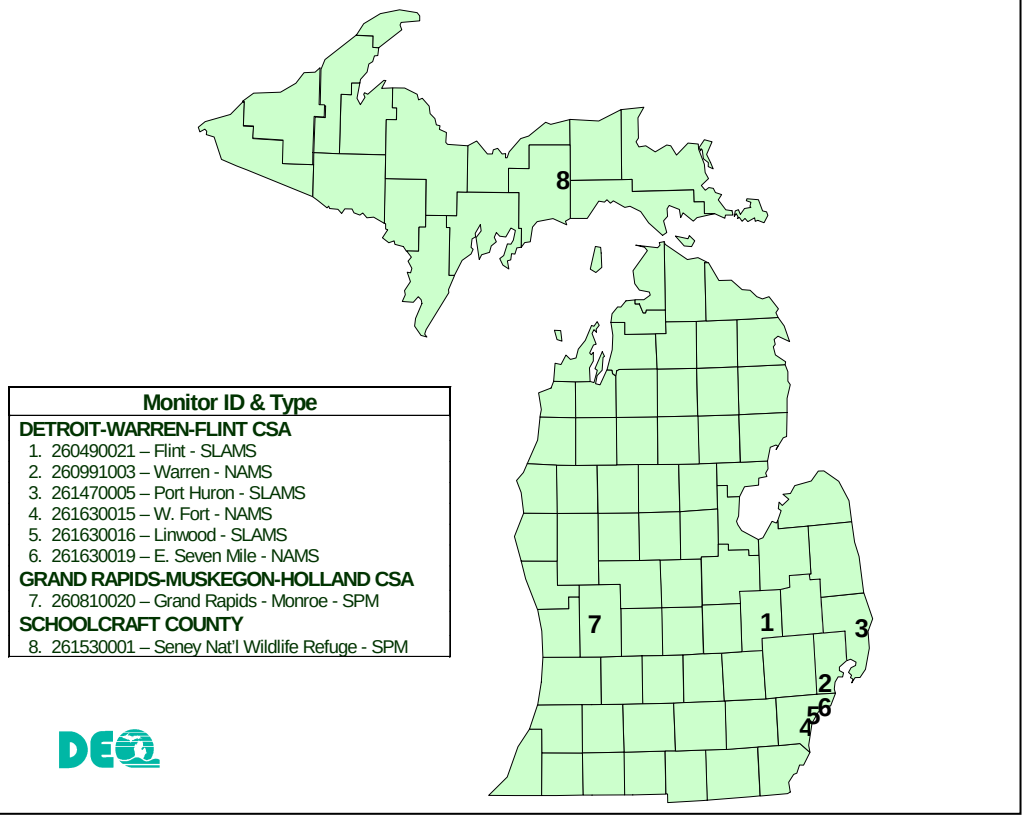
The EPA requires that only two to four NAMS in the Detroit urban area because there is a low probability of exceeding the $SO_2$ NAAQS. Michigan currently has three NAMS in Detroit measuring for neighborhood scale trends, W. Fort (situated so that maximum $SO_2$ levels are being monitored), E. Seven Mile, and Warren. In addition, recent drafts of the monitoring regulations may allow a reduction to only a single NAMS $SO_2$ monitor being placed in the Detroit-Warren-Flint CSA in the future.

An additional monitoring station is located at Port Huron to measure maximum $SO_2$ concentrations of neighborhood or middle scale air parcels. In addition, if the monitoring requirements for $SO_2$ NAMS monitors are changed to require a site in all CSAs with population totals exceeding one million people, the designation of the SPM monitor at Grand Rapids' Monroe would be changed to a NAMS description. **Figure 2.6-3** (on the following page) shows the locations of Michigan's eight $SO_2$ monitoring stations that were operational in 2005.

## ATTAINMENT/NONATTAINMENT STATUS OF $SO_2$ IN MICHIGAN:

On October 20, 1982, the last remaining $SO_2$ nonattainment area in Michigan was redesignated to attainment (**22**). Michigan has continued to maintain attainment status since that date.

## Figure 2.6-3: $SO_2$ Monitors Active in 2005




## $SO_2$ TRENDS BY LOCATION:

Average $SO_2$ levels monitored in the state have consistently been well below the annual 0.030 ppm NAAQS. **Figure 2.6-4** shows those sites in the Detroit-Warren-Flint CSA.

**Figure 2.6-4: $SO_2$ Levels for Detroit-Warren-Flint CSA from 1996-2005 (Annual Arithmetic Mean)**

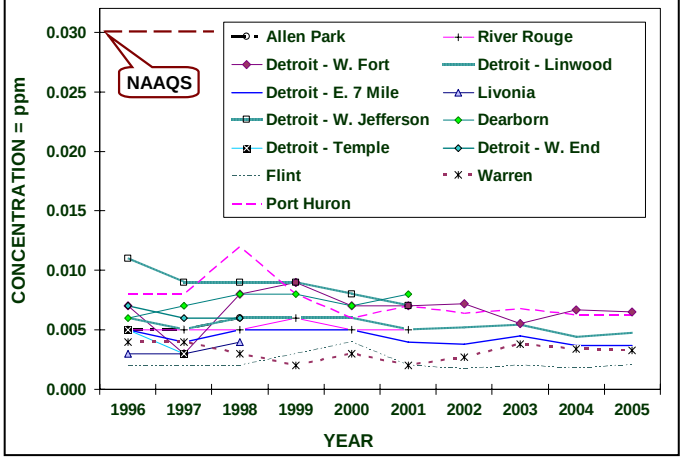



**Figure 2.6-5: $SO_2$ Levels for Grand Rapids-Muskegon-Holland CSA, Cadillac MiSA, and MI's Upper Peninsula from 1996-2005 (Annual Arithmetic Mean)**

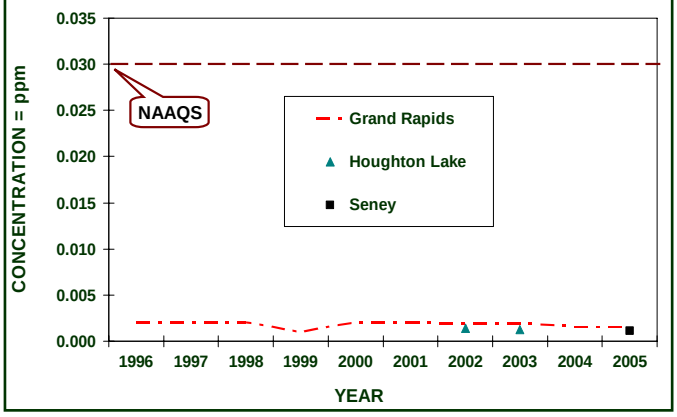



**Figure 2.6-5** contains the remaining $SO_2$ sites for Michigan's Grand Rapids-Muskegon-Holland CSA, Cadillac MiSA (Houghton Lake), and Seney (Upper Peninsula).

Trends for 24-hour maximum levels have followed a pattern similar to that of the annual mean.

# CHAPTER 3: TOXIC AIR POLLUTANTS

## INTRODUCTION:

The previous chapters of this report addressed the six criteria pollutants that have NAAQS. In addition to those pollutants, a wide variety of substances are classified as toxic air pollutants, or air toxics. The exact compounds and substances included in this category are determined by the various state and federal regulations that address these materials. For example, under the CAA, the EPA specifically addresses a group of 187 hazardous air pollutants (HAPs). In Michigan, under the state'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 goes on to list 41 substances which are *not* TACs, indicating that all others *are* TACs.

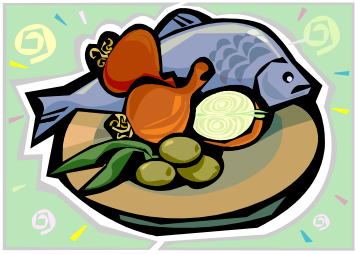
In general, air toxics can be categorized as metals, organic substances, and other substances. Examples of metals include aluminum, arsenic, beryllium, barium, cadmium, chromium, cobalt, copper, iron, mercury, manganese, molybdenum, nickel, lead, vanadium, and zinc. The organic toxics classification can be divided into sub-categories that include VOCs, carbonyl compounds (aldehydes and ketones), semi-volatile compounds (SVOCs), PAHs/polynuclear aromatic hydrocarbons (PNAs), pesticides, polychlorinated biphenyls (PCBs), and polycyclic organic matter. The other substances include asbestos, dioxin, and radionuclides such as radon.

With such a large, diverse group of substances that may be considered air toxics, regulatory agencies have developed shorter lists for the purpose of addressing particular concerns. For example, some initiatives have targeted those substances that are persistent and/or bioaccumulative (discussed further in this section), and the EPA has developed an Integrated Urban Air Toxics Strategy with a focus on 33 substances (the Urban HAPs List). The 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).

The MDEQ's AQD and the EPA made significant efforts to develop monitoring strategies for air toxics, to determine where (and for what substances) future monitoring efforts should be focused to best address data needs and objectives. The AQD drafted The Development of an Air Toxics Monitoring Strategy for Michigan to provide a network characterizing ambient levels of air toxics, including atmospheric deposition.[39]

## HEALTH EFFECTS OF AIR TOXICS:

Air toxics have a wide range of potential health effects. Examples include: the aggravation of asthma; irritation to the eyes, nose, and throat; carcinogenicity; developmental toxicity; nervous system effects; and various other effects on internal organs. Some substances have one "critical" effect, while others may have several. Some effects appear with a short period of exposure, while others may appear after long-term exposure or after a long period of time has passed since the exposure ended; and, most toxic effects are not unique to one substance. Also, some effects may be of concern only after the substance has settled (deposited) to the ground, followed by exposure through an oral pathway such as the eating of fish or produce. Further complicating the assessment of air toxics concerns is the broad range of susceptibility that various people may have.



[39] The report "The Development of an Air Toxics Monitoring Strategy" is available on the AQD's website at http://www.michigan.gov/deqair, Air Toxics, Information.

The evaluation of the significance of air toxics levels is hindered by several additional factors. Unlike the six criteria pollutants, there are no health-protective NAAQS for the air toxics. Instead, air quality assessments utilize various short-term and long-term screening levels estimated to be safe considering the critical effects of concern for specific substances. This is made more difficult by the lack of complete toxicity information for many substances. For some air toxics, the analytical detection limits are too high to consistently measure the amount present; and in some cases, the risk assessment-based "safe" levels are below the detection limits. Another problem is that there are data gaps regarding the potential for interactive toxic effects for co-exposure to multiple substances present in emissions and in ambient air. All these factors make it difficult to accurately assess the potential health concerns of air toxics.

## NATIONAL EFFORTS AND DATA ANALYSIS:

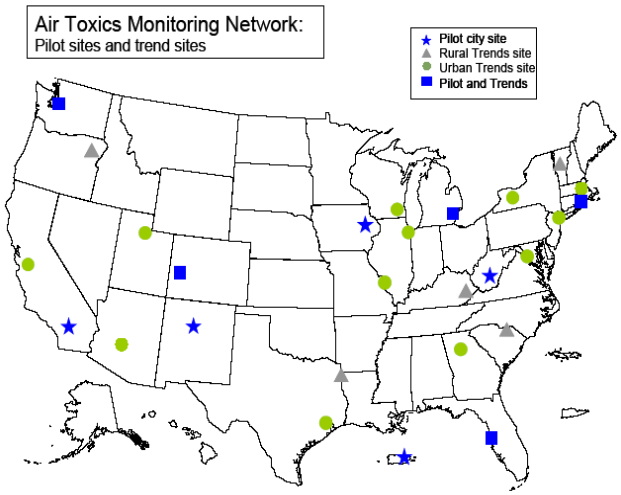
**NATA:** Recently, EPA released the results of the National-Scale Air Toxics Assessment (NATA) for the 1999 air toxics emissions. This follows a similar study of 1996 emissions which was released in 2000. The purpose of the NATA study is to identify and prioritize air toxics, emission source types and locations which are of greatest potential concern in terms of contributing to population risk. The NATA 1999 study includes 177 air toxics. The assessment follows four steps:

1. Compiling a national emissions inventory of air toxics emissions from outdoor sources including large sources such as waste incinerators and factories, and smaller sources such as dry cleaners, small manufacturers, and wildfires. Also included are emissions from highway and non-road mobile sources, such as cars, trucks and boats.
2. Estimating ambient concentrations of air toxics across the U.S.
3. Estimating population exposures across the contiguous U.S.
4. Characterizing potential public health risk due to inhalation of air toxics including both cancer and non-cancer effects.

The NATA is intended to provide state, local, tribal agencies, and others with a better understanding of the risks from inhalation exposure to toxic air pollutants from outdoor sources. The 1999 study is available at: http://www.epa.gov/ttn/atw/nata1999/. EPA intends to continue updating the NATA study every three years.

**NATTS:** In 2003, using the air toxics monitoring data generated from studies of pilot city sites, EPA funded 13 National Air Toxics Trend Stations (NATTS) as a preliminary step toward establishing a national air toxics monitoring network. In 2004, the NATTS was expanded to 22 stations (Tampa is participating with a monitoring site in two counties) including some of the original pilot cities, such as Providence, Detroit, Tampa, Seattle, and Grand Junction (**Figure 3-1**).

**FIGURE 3-1: MAP OF 22 NATIONAL AIR TOXICS TREND STATIONS**




The central goal of the NATTS network is to detect trends in high-risk air toxics such as benzene, formaldehyde, chromium, and 1,3-butadiene. The EPA requires that the NATTS sites measure VOCs, carbonyls, and trace metals on a once every 6 day sampling schedule (Michigan's Dearborn site also measures trace metals as both TSP and $PM_{2.5}$ along with the required $PM_{10}$ metals).

**Other National Studies:** In addition to funding air monitoring projects, EPA also contracted various data analysis activities on a national level. In Michigan, two sets of data analysis activities were completed in 2004 for the Lake Michigan Air Directors Consortium (LADCO). These reports, the Sonoma Technology Inc. (STI) Air Toxics Data Analysis and the Battelle Air Toxics Data Analysis analyzed data from the pilot projects.[40] The following briefly describes these two monitoring projects:

- The STI project consisted of the analysis of air toxics monitoring data and evaluation of air toxics modeling. Both facets of the project build upon previous and ongoing analyses and evaluations. The objectives of the STI project were to provide a comprehensive "look" at all of the existing air toxics data—both the historical archive and the pilot city database. This "look" will provide a broad national assessment of air toxics data, along with guidance and tools that will enable agencies collecting air toxics data to look at and use their data. In addition, the preparation of limited model-to-monitor comparisons with EPA's ongoing modeling work was included.
- The main goal of the Battelle analysis was to apportion and quantify the environmental sources (spatial and temporal) of ambient air toxics monitoring variability, to gain an understanding of how environmental sources of variability influence air toxics concentrations, and to determine specific recommendations for the design of a national air toxics monitoring network. As additional investigations, the effects of below method detection limit (MDL) data on the partitioning of air toxics monitoring variability, and the effects of other explanatory factors (e.g., meteorological variables) on pollutant concentrations were examined.

## MICHIGAN MONITORING EFFORTS AND DATA ANALYSIS:

Data on the ambient levels of air toxics are needed to assess potential exposure levels. For Michigan, air toxics monitoring efforts are separated into three types on the basis of the objectives of the studies:

1. The MITAMP has the purpose of determining the ambient air levels and long-term trends of air toxics in urban areas and a background site.
2. There are special studies of persistent and bioaccumulative toxics (PBTs) with the purpose of characterizing the ambient air levels or deposition rates of these specific substances of concern.
3. Source specific monitoring is performed for the purpose of determining the source impact caused by emissions of relatively short lists of specific air toxics from certain facilities. (**NOTE**: Source specific monitoring information and data is not provided in this report.)

### MITAMP:

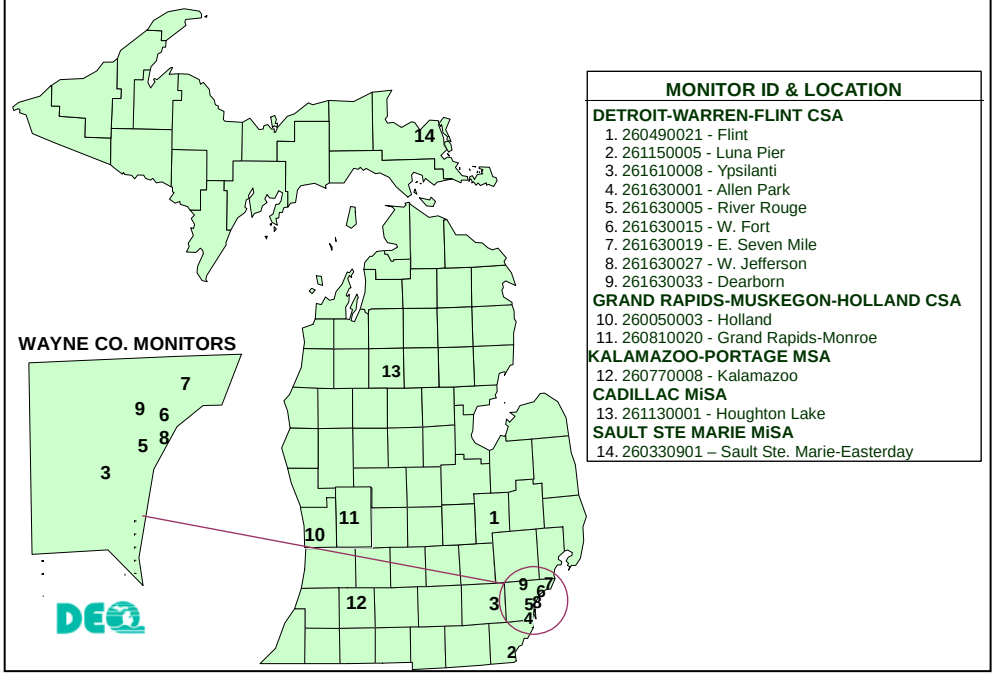
The Michigan Toxics Air Monitoring Program or MITAMP was established in January 1990 preceding the 1987-1988 EPA "Urban Toxics Air Monitoring Program." Since the MITAMP's inception, more than 50 toxic organic compounds and up to 15 trace metals have been routinely monitored at various urban locations throughout the state.[41]

Carbonyl sampling (aldehydes and ketones) under the MITAMP began in June 1995 (**23**). To collect MITAMP data, the AQD operates monitors using sampling techniques specifically designed for pollutants of interest. High-volume sampler filters are used to collect metals, evacuated steel canisters are used to sample for VOCs, and carbonyl cartridges are used for aldehydes and ketones. On a non-routine basis, samplers using polyurethane foam and other sorbents are used to collect SVOCs, PCBs, etc.

[40] The STI and Battelle reports are available on the LADCO website at http://www.ladco.org/toxics.html.
[41] Some of the MITAMP sites only measure trace metals and some measure only carbonyls and metals.

**Figure 3-2** shows the 14 MITAMP stations where air toxics were measured in 2005. Nine of the MITAMP sites are located in the Detroit-Warren-Flint CSA, with six sites operating in Wayne County. The monitor in Flint collects data for toxic metals; the monitor located at W. Fort is the MDEQ's long-term trend toxics site; and the Dearborn site (which measures all air toxics that are monitored in the state) is one of the 22 NATTS. Other Michigan sites for monitoring air toxics include Grand Rapids, Kalamazoo, Ypsilanti, Sault Ste. Marie (Easterday) and a "background" site near Houghton Lake. The Houghton Lake site was selected to provide data for a relatively unimpacted site (away from large urban areas or high vehicle emissions) as a basis for comparison to urban data. The following **Table 3-1** shows the type of monitoring conducted at the MITAMP stations.

## FIGURE 3-2: MITAMP MONITORS ACTIVE IN 2005




## TABLE 3-1: MITAMP MONITORS ACTIVE IN 2005 AND TOXICS MEASURED

| AIRS ID – SITE NAME | VOCS | CARBONYLS | METALS TSP | METALS $PM_{10}$ | SPECIATED $PM_{2.5}$ | SVOCS |
|---|---|---|---|---|---|---|
| 260050003 - Holland | | | | | √ | |
| 260330901 - Sault Ste. Marie-Easterday | | | | | √ | √ |
| 260490021 - Flint | | | √ | | | |
| 260770008 - Kalamazoo | | | | | √ | |
| 260810020 - Grand Rapids-Monroe | √ | √ | √ | | √ | |
| 261130001 - Houghton Lake | √ | √ | √ | | √ | |
| 261150005 - Luna Pier | | | | | √ | |
| 261610008 - Ypsilanti | √ | √ | √ | | √ | |
| 261630001 - Allen Park | √ | √ | √ | | √ | |
| 261630005 - River Rouge | | √ | √ | | | |
| 261630015 - W. Fort | √ | √ | √ | | | |
| 261630019 - E. Seven Mile | √* | √* | √ | | | |
| 261630027 - W. Jefferson | √ | | √ | | | √ |
| 261630033 - Dearborn | √ | √ | √ | √ | √ | |

*VOCs and carbonyls were only collected from June through August 2005.

The summarized analytical results for trace metals, VOCS, SVOCs, and carbonyl compounds for the MITAMP stations listed above are provided in **Appendix C1**. **Appendix C2** has the summaries of speciated $PM_{2.5}$ analytical results. The history of Michigan's air monitoring sites (non-industrial only) operational from 1987 to 2005 and the categories of air toxics monitored at those sites are shown in the following **Table 3-2**.

## TABLE 3-2: HISTORY OF AIR MONITORING SITES COLLECTING TOXICS DATA IN MICHIGAN (NON-INDUSTRIAL SITES ONLY)

| COUNTY | LOCATION | AIRS ID | YEARS OPERATED | | | | | | | | | | | | | | | | | | | EVER MONITORED* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 00 | 01 | 02 | 03 | 04 | 05 | VOCs | Carbonyls | Metals-TSP | Metals-$PM_{10}$ | Speciated $PM_{2.5}$ | SVOCs |
| Allegan | South Haven | 260050002 | | | | | | x | x | x | | | | x | x | | | | | | | | | | x | | x |
| Allegan | Holland | 260050003 | | | | | | | | x | x | x | x | x | x | x | x | x | x | x | x | | | | | x | |
| Cheboygan | Pellston | 260310001 | | | | | | x | x | x | | | | | | | | | | | | | | | x | | |
| Chippewa | Brimley | 260330033 | | | | | x | | | | | | | | | | | | | | | | | x | | | |
| Chippewa | Lake Superior St. Univ. | 260330901 | | | | | | | | | | | | | | | | | x | x | x | | | | | x | x |
| Genesee | Flint | 260490011 | | x | x | x | x | | | | | | | | | | | | | | | | | x | | | |
| Genesee | Flint, Whaley Park | 260490021 | | | | | | | | | x | x | x | x | x | x | x | x | x | x | x | | | x | | x | |
| Grand Traverse | Traverse City | 260550002 | | | | | x | | | | | | | | | | | | | | | | | x | | | |
| Huron | Bay Port | 260630003 | | | | x | x | | | | | | | | | | | | | | | | | x | | | |
| Ingham | Lansing | 260650013 | x | x | | | | | | | | | | | | | | | | | | x | | x | | | |
| Ingham | Lansing | 260651001 | | x | x | x | x | | | | | | | | | | | | | | | | | x | | | |
| Kalamazoo | Kalamazoo | 260770002 | | x | x | x | x | x | | | | | | | | | | | | | | | | x | | | |
| Kalamazoo | Portage | 260770004 | | | | x | x | x | x | | | | | | | | | | | | | x | | x | | | |
| Kalamazoo | Fairgrounds | 260770008 | | | | | | | | | | | x | x | | | | | | x | x | | | | | x | |
| Kent | Grand Rapids | 260810010 | | x | x | x | x | | | x | x | x | x | x | | | | | | | | | | x | | | |
| Kent | Grand Rapids | 260810020 | | | | | | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | x | |
| Kent | Grand Rapids | 260810021 | | | | | | | | | x | x | x | x | x | x | x | x | x | x | | x | x | x | | | |
| Kent | Wyoming | 260812002 | | x | x | x | x | | | | x | x | x | x | | | | | | | | | | x | | | |
| Menominee | Menominee | 261090002 | | | | | | | x | | | | | | | | | | | | | | | x | | | |
| Midland | Midland | 261110007 | x | x | x | x | x | x | | | | | | | | | | | | | | x | | x | | | x |
| Missaukee | Houghton Lake | 261130001 | | | | | | | | | | | | x | x | x | x | x | x | x | x | x | x | x | | x | |
| Monroe | Luna Pier | 261150005 | | | | | | | | | | | | | | | x | x | x | x | x | | | | | x | |
| Muskegon | Muskegon | 261210023 | | x | x | x | x | | | | x | x | x | | | | | | | | | | | x | | | |
| Oakland | Southfield | 261250010 | | | | | | | | | | | | | | | x | x | | | | x | x | x | | x | x |
| Saginaw | Saginaw | 261450002 | | x | x | x | x | | | | | | | | | | | | | | | | | x | | | |
| Saint Clair | Port Huron Nat'l Guard | 261470005 | x | x | x | x | x | | | | | | | | | | | | | | | x | | x | | x | |
| Sanilac | Deckerville | 261510002 | | | | | | x | x | x | | | | | | | | | | | | | | | x | | |
| Washtenaw | Ann Arbor | 261610002 | | x | x | x | x | | | | | | | | | | | | | | | | | x | | | |
| Washtenaw | Dexter | 261618001 | | | | | | x | x | x | | | | | | | | | | | | | | | x | | |
| Washtenaw | Ypsilanti | 261610008 | | | | | | | | | | | | | | x | x | x | x | x | x | x | x | x | | x | |
| Wayne | Allen Park | 261630001 | | | | | | | | | | | | | | | x | x | x | x | x | x | x | x | | x | x |
| Wayne | Dearborn | 261630002 | x | x | | | | | | | | | | | | | | | | | | x | | x | | | x |
| Wayne | Dearborn, Wyoming St. | 261630033 | | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Wayne | Detroit, Evergreen | 261630014 | | | x | x | x | | | | | | | | | | | | | | | | | x | | | |
| Wayne | Detroit, W. Fort | 261630015 | | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | x | x |
| Wayne | Detroit, W Jefferson | 261630027 | | | | | | | | | | | | | | | x | x | | x | x | x | x | x | | | x |
| Wayne | Detroit, Linwood | 261630016 | | | x | x | x | x | x | x | x | x | x | x | x | x | | | | | | | | x | | | |
| Wayne | Detroit, E Seven Mile | 261630019 | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | x | x |
| Wayne | River Rouge | 261630005 | | | | | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | | x |
| Wayne | Weston Trailer | 261630032 | x | x | | | | | | | | | | | | | | | | | | x | | x | | | x |

*Note: Includes all years of operation, not just 2005.

Air toxics monitoring in Michigan has shown that air toxics levels are generally higher in large urban areas, such as Detroit, than in small cities or rural areas. As previously discussed, the EPA's NATA 1996 and NATA 1999 reports have evaluated the emissions of air toxics in the U.S. and estimated the air levels and health risks that they pose. Those studies found that large cities such as Detroit have a relatively high number of emission sources (vehicles and industries), higher ambient air levels, and greater health risks than small cities and rural areas.

The following are summaries of some recent and on-going studies that have been conducted to evaluate air toxics in the Detroit area:

**DATI:** The Detroit Air Toxics Initiative (DATI) is a project initiated by the AQD, and funded by a grant from the EPA's Fiscal Year 2003 Community Assistance and Risk Reduction Initiative. This project includes two components, one to assess the health risks from exposure to air toxics in the Detroit area, and the other to fund projects to help reduce identified risks. The risk assessment performed for the DATI focused primarily on air toxics monitoring data from the Detroit Air Toxics Pilot Project, an intensive one-year study in the Detroit area that ran from April 2001 through April 2002. A total of 224 air toxics were monitored at the following seven sites in the Detroit area: Allen Park, Dearborn, W. Jefferson, W. Fort Street, Southfield, River Rouge, and northeast Detroit (E. Seven Mile). In addition, monitoring was also done at Ypsilanti and Houghton Lake (background site) for comparison. Unfortunately, pump failure and subsequent indoor air contamination seriously compromised the quality of the VOC data at Houghton Lake and Ypsilanti. Therefore, all VOC data have been deleted from April 23, 2001 through March 25, 2005 for the Houghton Lake site and from October 8, 2001 through March 25, 2005 for the Ypsilanti site. Corrective actions have been identified and implemented to prevent this type of incident in the future.

The AQD finalized the DATI Risk Assessment Report, along with a Technical Summary and Public Summary of that report in 2005.[42] Potential risk reduction efforts are being evaluated, with assistance from the DATI Stakeholder Group. In addition, the AQD is continuing to monitor air toxics in the Detroit area in response to the DATI findings. This monitoring will determine whether the levels of air toxics have changed since the DATI monitoring in 2001 and 2002 or remain at levels of concern.

**DEARS:** In 2004, the AQD and EPA's National Exposure Research Laboratory and National Health and Environmental Effects Research Laboratory began conducting the Detroit Exposure Aerosol Research Study (DEARS). DEARS is a three-year field monitoring study that is designed to measure exposure and describe exposure relationships for air toxics, PM components, PM from specific sources, and criteria pollutants in Detroit. The study includes monitors at the Allen Park site, indoor/outdoor monitors at participant's houses, and personal exposure monitors.[43] Some of the DEARS objectives are to:

- Determine the associations between concentrations measured at central site monitors and outdoor residential and indoor residential and personal exposures.
- Identify the human activity factors that influence personal exposures to selected pollutants.
- Investigate and apply source apportionment models to evaluate the contribution of specific ambient sources to residential concentrations and personal exposures to PM constituents and air toxics.
- Determine the associations between ambient concentrations of criteria gases ($O_3$, $NO_2$, and $SO_2$) and personal exposures for these gases.

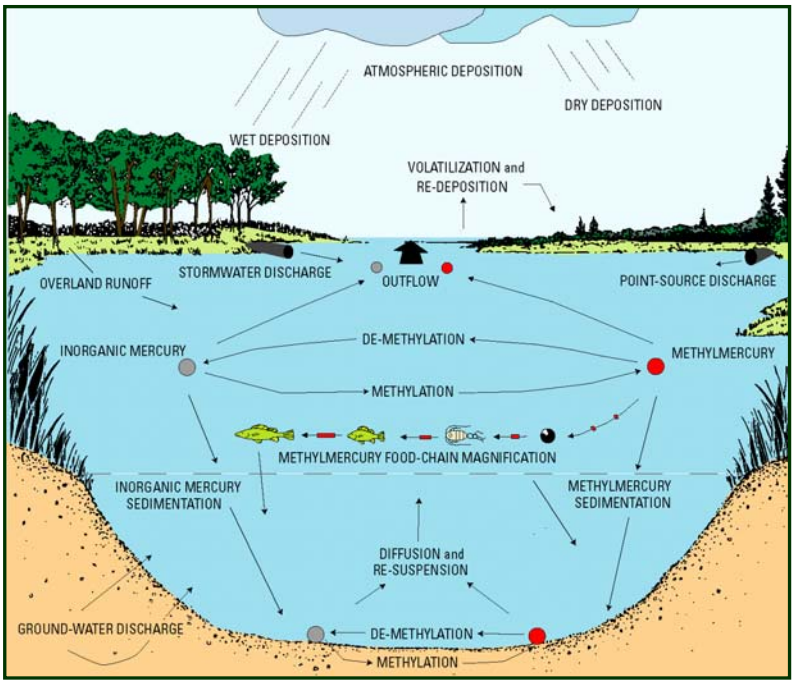
[42] The DATI reports are available on the MDEQ AQD's website at http://www.michigan.gov/deqair.
[43] DEARS information is available at http://www.epa.gov/dears/.

## Persistent, Bioaccumulative Toxics (PBTs):

Many toxic air pollutants are of concern because they may pose health risks to people breathing air contaminated with these pollutants. A subset of these pollutants, known as PBTs, may not occur at levels high enough in the ambient air to cause concern from direct inhalation, but may pose a health risk through indirect exposure to persistent air pollutants that have been deposited. Such indirect exposures can occur from various routes, such as ingesting contaminated water, soil, meat, dairy products, or fish. Examples of effects that can result from sufficiently high levels or duration of exposure to PBTs include cancer, developmental and reproductive toxicity, and other effects in humans and wildlife.

PBTs enter the environment through a variety of sources including atmospheric deposition (**Figure 3-3**). Atmospheric deposition has been shown to be the most significant source of PBTs to remote inland lakes and to some of the Great Lakes (**24, 25, 26**). Typically, atmospheric deposition of PBTs to the environment occurs via three processes, including:

**FIGURE 3-3: ATMOSPHERIC DEPOSITION**

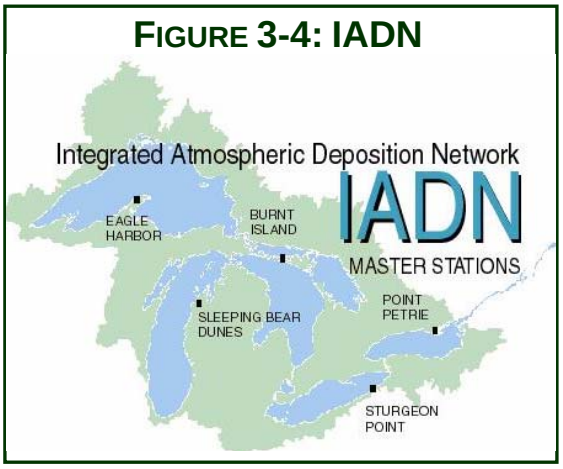



- *Wet Deposition* refers to gases and particles carried in precipitation (rain, snow, fog, and sleet) that are deposited on land and water surfaces.
- *Dry Deposition* refers to pollutants bound to PM that are deposited on water and land surfaces in the absence of precipitation.
- *Gas Absorption or Exchange* refers to pollutants in a gaseous state that cross the air-water interface, and are absorbed in the water column by gas transfer.

Deposition is one of the crucial elements largely responsible for contamination of lakes and streams by some types of pollutants, including mercury and PCBs. Additionally, deposition of certain pollutants like dioxin can contribute to elevated levels in soils, crops, and meat/dairy products. The following discusses EPA's Integrated Atmospheric Deposition Network (IADN) within the Great Lakes Basin.

**IADN:** The EPA and Canada have established a limited monitoring network within the Great Lakes Basin in response to the 1990 CAA and the 1987 amended Great Lakes Water Quality Agreement - Annex 15. The IADN (**Figure 3-4**) was mandated to assess the extent of atmospheric deposition of HAPs to the Great Lakes. Two sites were established in Michigan as part of this network with one located in Sleeping Bear Dunes on the Lake Michigan shoreline and the other is at Eagle Harbor on the Lake Superior shoreline in the Keweenaw Peninsula.

**FIGURE 3-4: IADN**



At the IADN sites, precipitation and air samples are collected and analyzed for trace metals including Pb, arsenic and cadmium, as well as PCBs, PAHs, and pesticides including lindane, dieldrin, dichlorodiphenyltrichloroethane (DDT), and endosulfan. This data has been summarized in several published articles (**27, 28**).

The IADN serves as an important tool in establishing background concentrations of PBTs and in assessing atmospheric deposition temporal trends for the PBTs listed above. Due to resource constraints, sampling and analysis for mercury and dioxins/furans have not been conducted routinely at the IADN sites.

Although MDEQ does not have funding to support an extensive monitoring network for PBTs, a few short-term studies have been conducted to better understand the levels of PBTs, specifically addressing mercury in the atmosphere and to assess loadings. The following is a brief summary of these on-going studies:

- For Michigan, the largest industrial source of mercury air emissions is coal-fired power plants. The MDEQ was directed from Governor Granholm to pursue the reduction and phase-out of mercury emissions from coal-fired power plants, along with reductions of $NO_X$ (a precursor to both $PM_{2.5}$ and $O_3$), $SO_2$ (a precursor to the formation of $PM_{2.5}$ and $NO_X$), and carbon dioxide ($CO_2$).

  The AQD initiated the creation of the Michigan Mercury Electric Utility Workgroup for Mercury Emissions from Coal-Fired Power Plants in 2003. This workgroup consisted of MDEQ and Michigan Public Service Commission staff; representative from utilities potentially impacted by the workgroup recommendations; and representatives from environmental, scientific, and public policy groups. The workgroup's report along with their recommendations was finalized on June 21, 2005.[44] This report also includes detailed information on:

  - background, sources, and uses of mercury;
  - its impacts to health, environment, and recreation;
  - Michigan's monitoring efforts and regulatory programs;
  - mercury emissions, deposition and modeling, including a mercury emissions inventory;
  - federal and other states/regional regulations;[45]
  - energy choices and policy development;
  - along with controls, costs, methodologies and other issues associated with mercury reduction programs from coal-fired utilities.

  On April 17, 2006, Governor Granholm announced that the MDEQ will develop a regulation that requires Michigan's coal-fired electric utilities to reduce their mercury emissions by 90% by 2015. The governor asked that the rule take into account both technological and cost-based considerations. Additionally, the rule should not allow trading, but that it could include a utility system-wide approach as long as it would not result in "hot spot" mercury emissions that would place Michigan residents at risk.

- In 2000, the MDEQ, the Minnesota Pollution Control Agency, and the Wisconsin Department of Natural Resources applied for and received a grant from EPA's Great Lakes National Geographic Initiative to identify and quantify sources of mercury to the atmosphere within the three Great Lakes' states. MDEQ's AQD was responsible for administering the funds which included the design and building of a mobile mercury laboratory, housed in a climate-controlled trailer, complete with a generator, two Tekran 2537A mercury vapor analyzers, meteorological

[44] The Michigan's Mercury Electric Utility Workgroup Final Report on Mercury Emissions from Coal-Fired Power Plants is available at http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-mercury-report.pdf.

[45] In 2005, EPA addressed mercury emissions with the Clean Air Mercury Rule (CAMR), which established an emissions cap and a schedule to reduce mercury emissions from coal-fired power plants.

monitoring equipment, data loggers, and a computer for data compilation and analysis (**29**). This "Tekran" mercury trailer was then shared and continues to be shared on a rotation basis among the three states for quantifying mercury emissions from:

TEKRAN MERCURY TRAILER

- manufacturing facilities (thermometers, chlor-alkali),
- scrap metal yards and shredders,
- mercury recyclers (fluorescent bulbs, smelters, and other materials),
- solid waste processing facilities,
- medical waste autoclaves,
- land-applied wastes (sewage sludge, wood ash, coal ash),
- taconite tailings basins,
- control soils, and
- parking lots.

In addition, the funding also allowed the purchase and sharing of two portable Lumex RA 915+ mercury vapor analyzers. The three states assist local health departments in providing use of the Lumex to facilitate quantification of mercury concentrations in homes or businesses where mercury was spilled. The final grant report titled, Identification of Atmospheric Mercury Sources in the Great Lakes States Through an Ambient Monitoring Program was finalized in November 2003.[46]

The mercury monitoring equipment continues to be used in Michigan. In 2005, the monitoring equipment was used to assess the fugitive elemental mercury emissions from steel mills, an aluminum smelter, a dental amalgam manufacturer, a fluorescent bulb crusher, and a metal shredder. A final report documenting this work is currently being drafted and will be posted on AQD's website by summer of 2006.

- The AQD, partnering with the University of Michigan (U of M), were awarded grants from the Michigan Great Lakes Protection Fund and the EPA's Great Lake Atmospheric Deposition (GLAD) program administered by the Great Lakes Commission to develop a mercury monitoring network. The project began in the fall of 2001. Because Michigan lacks long-term mercury data from urban areas, sites were established in three urban areas of Grand Rapids, Flint, and Detroit. In addition, the recording of long-term event-based mercury deposition continued at three rural sites in Michigan (Dexter, Pellston, and Eagle Harbor) (**30**).

  Preliminary data demonstrated the influence of local sources emitting mercury and the importance of speciated mercury monitoring to assess man-made source contributions to wet (e.g., rain) deposition of mercury. To allow trend analysis, the AQD and U of M received additional funding to extend this project through fall 2005.

  Recently, the U of M principle investigator received additional funding from the EPA's GLAD program to continue the project through the fall of 2007. This funding will support continued speciated monitoring of deposited atmospheric mercury using hybrid receptor modeling and compare the results with those of the models used by EPA.

While PBT air monitoring and atmospheric deposition studies have been conducted in the past several years, they were for a limited time frame and for a limited set of pollutants. These somewhat fragmented studies demonstrate the need for implementation of a comprehensive, continuous atmospheric deposition network within the state and region.

[46] The final grant report is available on the AQD's website at http://www.deq.state.mi.us/documents/deq-aqd-toxics-Hgfinalreport.pdf.

# CHAPTER 4: SPECIAL PROJECTS

## AQD'S WEB MONITORING AND MAPPING:

In 2005, the MDEQ provided real-time air quality information via its WEBMONMAP (Web Monitoring and Mapping) website. WEBMONMAP is designed to report raw hourly air pollution data collected at MDEQ air monitoring sites and display it graphically over the base maps in an array of time series plots. The air pollution data is downloaded directly from the air monitoring stations.[47]

Unfortunately, due to MDEQ's server hardware and software updates, incompatibilities have developed with this version of WEBMONMAP. As a result, MDEQ will be developing a new website in mid-2006 to display its air monitoring data.

## AIR QUALITY INDEX:

The AQI is a tool that is used by the MDEQ and the EPA to report daily air quality data. The tool uses a relative scale of 0 to 500 to provide a measure of air quality. The higher the AQI value, the greater the level of air pollution and potential for health concerns, in terms of acute health effects over time periods of 24 hours or less.

In **Table 4-1**, each air pollutant concentration is related to an index value and the AQI is the highest of the corresponding index values for the monitored air pollutants. The AQI index has limitations in that it does not provide an indication of chronic air pollution exposure over months or years, nor does it reflect additive, synergistic, or antagonistic health effects that may result from exposure from two or more air pollutants.

### TABLE 4-1: THE AQI (EFFECTIVE 10/4/99)

| | | MAXIMUM POLLUTANT CONCENTRATION PER AQI CATEGORY | | | | | | |
|---|---|---|---|---|---|---|---|---|
| AQI VALUE | AQI DESCRIPTOR | $PM_{2.5}$ (24 hr) $\mu g/m^3$ | $PM_{10}$ (24 hr) $\mu g/m^3$ | $SO_2$ (24 hr) ppm | $O_3$ (8 hr) ppm | $O_3$ (1 hr) ppm | CO (8 hr) ppm | $NO_2$ (1 hr) ppm |
| 500 | | 500.4 | 604 | 1.004 | | 0.604 | 50 | 2.04 |
| 400 | Hazardous (AQI > 301) | 350.4 | 504 | 0.804 | | 0.504 | 40 | 1.64 |
| 300 | Very Unhealthy (AQI 201-300) | 250.4 | 424 | 0.604 | 0.374 | 0.404 | 30 | 1.24 |
| 200 | Unhealthy (AQI 151-200) | 150.4 | 354 | 0.304 | 0.124 | 0.204 | 15 | 0.64 |
| 150 | Unhealthy for sensitive groups (AQI 101-150) | 65.4 | 254 | 0.224 | 0.104 | 0.164 | 12 | |
| 100 | Moderate (AQI 51-100) | 40.4 | 154 | 0.144 | 0.084 | 0.124 | 9 | |
| 50 | Good (AQI 0-50) | 15.4 | 54 | 0.034 | 0.064 | | 4 | |
| 0 | | 0 | 0 | 0 | 0 | 0 | 0 | |

The EPA has assigned a specific color to each AQI category. **Table 4-2** identifies the AQI colors and the associated health statements by individual air pollutant. These color codes are used to display AQI values and level of health concern.

[47] Air pollution data uploads could be delayed if a telephone line or modem is disabled at one of the stations.

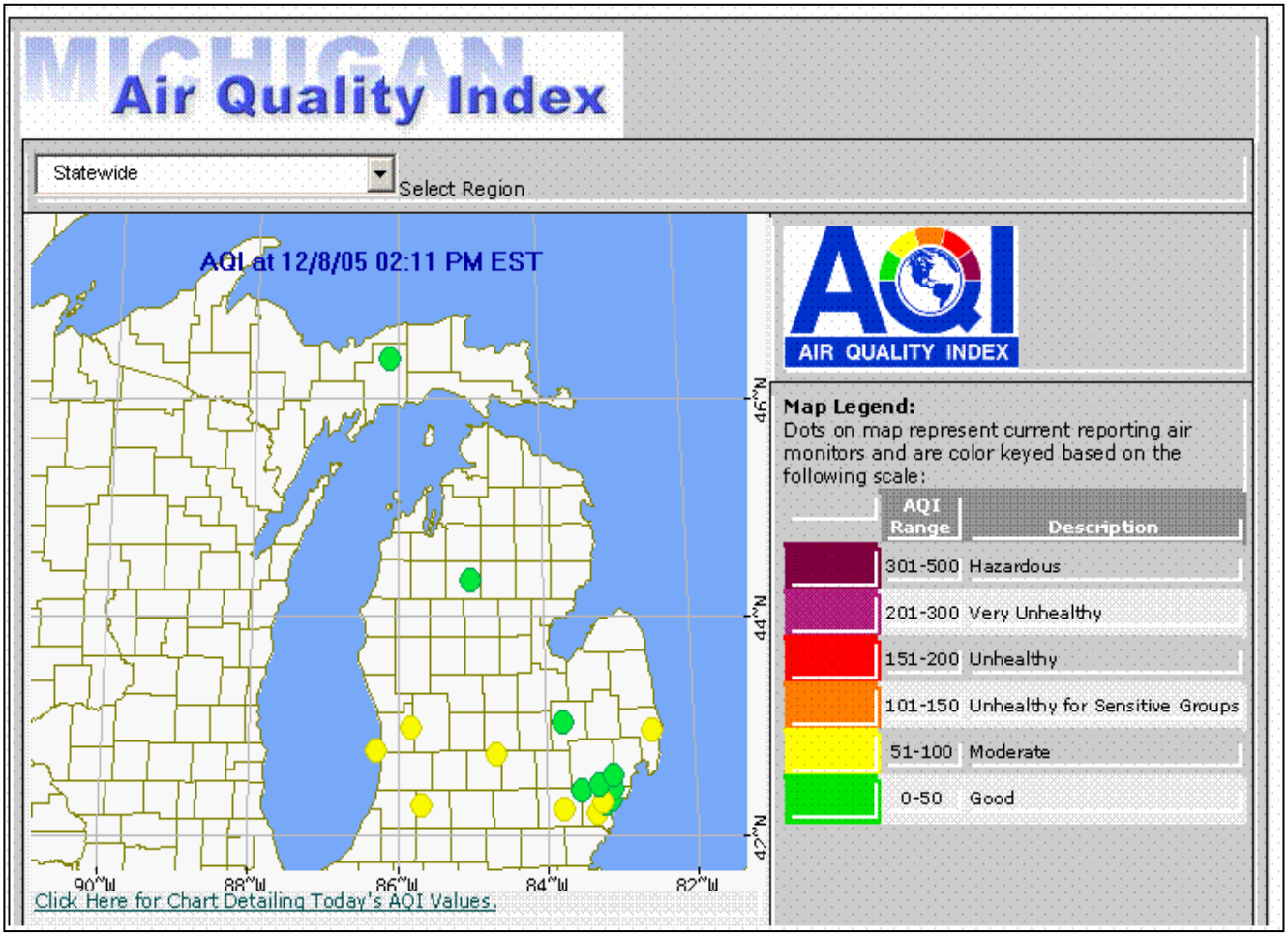
## TABLE 4-2: THE AQI COLORS AND HEALTH STATEMENTS

| AQI COLOR, CATEGORY & VALUE | PARTICULATE MATTER ($\mu g/m^3$) 24-Hour | OZONE (ppm) 8-Hour / 1-Hour | CARBON MONOXIDE (ppm) 8-hour | SULFUR DIOXIDE (ppm) 24-hour | NITROGEN DIOXIDE (ppm) 1-hour |
|---|---|---|---|---|---|
| **GREEN:** Good 1-50 | **None** | **None** | **None** | **None** | **None** |
| **YELLOW:** Moderate 51-100 | Unusually sensitive people should consider reducing prolonged or heavy exertion | Unusually sensitive people should consider reducing prolonged or heavy exertion | **None** | **None** | **None** |
| **ORANGE:** Unhealthy For Sensitive Groups 101-150 | People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion. | Active children and adults, and people with lung disease such as asthma, should reduce prolonged or heavy outdoor exertion. | People with cardiovascular disease, such as angina, should limit heavy exertion and avoid sources of CO, such as heavy traffic. | People with asthma should consider limiting outdoor exertion. | **None** |
| **RED:** Unhealthy 151-200 | People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should limit prolonged exertion. | Active children and adults, and people with lung disease such as asthma, should avoid prolonged or heavy exertion. Everyone else, especially children, should reduce prolonged outdoor exertion. | People with cardiovascular disease, such as angina, should limit moderate exertion and avoid sources of CO, such as heavy traffic. | Children, asthmatics, and people with heart or lung disease should limit outdoor exertion. | **None** |
| **PURPLE:** Very Unhealthy 201-300 | People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion. | Active children and adults, and people with respiratory disease such as asthma, should avoid all outdoor exertion. Everyone else, especially children should limit outdoor exertion. | People with cardiovascular disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic. | Children, asthmatics, and people with heart or lung disease should avoid outdoor exertion. Everyone else should limit outdoor exertion. | Children and people with respiratory disease, such as asthma, should limit heavy outdoor exertion. |
| **MAROON:** Hazardous 301-500 | Everyone should avoid any outdoor exertion; people with heart or lung disease, older adults, and children should remain indoors. | Everyone should avoid all outdoor exertion. | People with cardiovascular disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic. Everyone else should limit heavy exertion. | Children, asthmatics, and people with heart or lung disease should remain indoors. Everyone else should avoid outdoor exertion. | Children and people with respiratory disease, such as asthma, should limit moderate or heavy outdoor exertion. |

Air quality in Michigan generally falls in the “good” or “moderate” range. Rarely does the state record unhealthy air quality but occasionally, an area will fall into the “unhealthy for sensitive groups” range. Michigan has never recorded an AQI above 300.

The following **Figure 4-1** provides an example map displaying AQI values as color-coded dots for each monitor site throughout the state.

## FIGURE 4-1: AIR QUALITY INDEX




AQI values are made available to the public and local news agencies (newspapers, television, and radio) on a daily basis and are also updated daily on the MDEQ's website at http://www.michigan.gov/deqair, under "Air Quality Index." AQI values are presented in tabular form and plotted on a state map with color-coded dots that signify the AQI value (as shown above). It is important to note that not all pollutants are measured at each site. In fact, some sites only obtain AQI measurements for that portion of the year corresponding to the $O_3$ season, therefore, the number of days for each site may not be equivalent to 365 days per year.

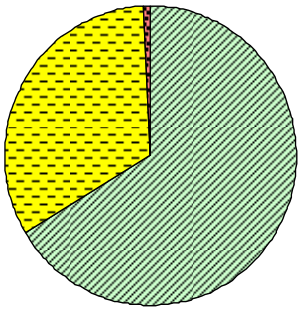
The following pie charts were created to show the AQI values for each of Michigan's 2005 monitoring sites and include the total number of days measurements were taken along with the pollutant distribution of the AQI values for those measurements. The following **Figures 4-2** through **4-4** are grouped by CSA. The remaining sites (not part of a CSA) are divided by whether they are located in Michigan's Lower Peninsula or Upper Peninsula (**Figures 4-5** and **4-6**, respectively):

- **Figure 4-2** – AQI Summaries for Detroit-Warren-Flint CSA
- **Figure 4-3** – AQI Summaries for Lansing-East Lansing-Owosso CSA
- **Figure 4-4** – AQI Summaries for Grand Rapids-Muskegon-Holland CSA
- **Figure 4-5** – AQI Summaries for Saginaw-Bay City-Saginaw Twp. North CSA
- **Figure 4-6** – Michigan's Lower Peninsula Area AQI Summaries (not included in any CSA)
- **Figure 4-7** – Michigan's Upper Peninsula Area AQI Summaries

# FIGURE 4-2: AQI SUMMARIES FOR DETROIT-WARREN-FLINT CSA

## ANN ARBOR MSA

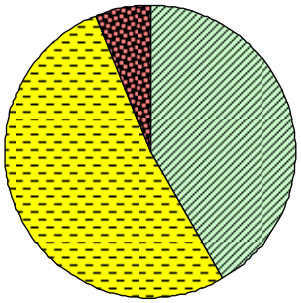
### 2005 AQI Summary for Ann Arbor
TOTAL DAYS WITH AQI VALUES = 110



- Good Days - 73
- Moderate Days - 36
- Unhealthy/Sensitives - 1
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 110 $PM_{10}$ = 0

### 2005 AQI Summary for Ypsilanti
TOTAL DAYS WITH AQI VALUES = 360

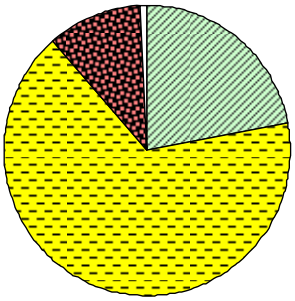


- Good Days - 150
- Moderate Days - 188
- Unhealthy/Sensitives - 22
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 17 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 343 $PM_{10}$ = 0

## DETROIT-WARREN-LIVONIA MSA

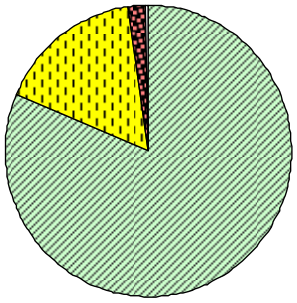
### 2005 AQI Summary for Allen Park
TOTAL DAYS WITH AQI VALUES = 365



- Good Days - 80
- Moderate Days - 244
- Unhealthy/Sensitives - 38
- Unhealthy Days - 3

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 3 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 361 $PM_{10}$ = 1

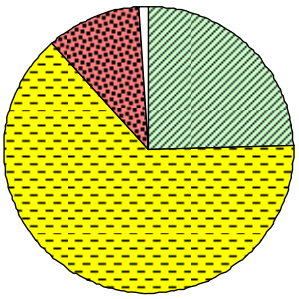
### 2005 AQI Summary for E. Seven Mile
TOTAL DAYS WITH AQI VALUES = 347



- Good Days - 282
- Moderate Days - 57
- Unhealthy/Sensitives - 7
- Unhealthy Days - 1

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 150 $SO_2$ = 107
$NO_2$ = 0 $PM_{2.5}$ = 90 $PM_{10}$ = 0

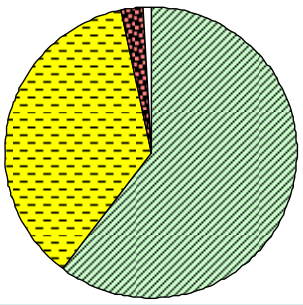
### 2005 AQI Summary for Dearborn
TOTAL DAYS WITH AQI VALUES = 354



- Good Days - 86
- Moderate Days - 226
- Unhealthy/Sensitives - 37
- Unhealthy Days - 5

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 344 $PM_{10}$ = 10

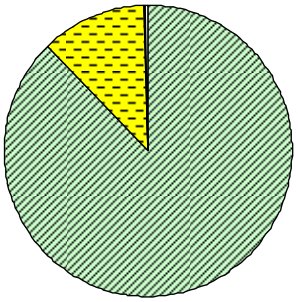
### 2005 AQI Summary for Linwood
TOTAL DAYS WITH AQI VALUES = 365



- Good Days - 220
- Moderate Days - 133
- Unhealthy/Sensitives - 9
- Unhealthy Days - 3

AQI POLLUTANT SUMMARY
CO = 5 $O_3$ = 83 $SO_2$ = 5
$NO_2$ = 0 $PM_{2.5}$ = 272 $PM_{10}$ = 0

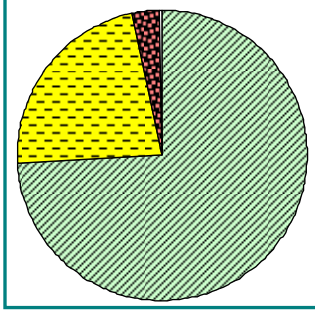
### 2005 AQI Summary for Livonia
TOTAL DAYS WITH AQI VALUES = 363



- Good Days - 319
- Moderate Days - 42
- Unhealthy/Sensitives - 1
- Unhealthy Days - 1

AQI POLLUTANT SUMMARY
CO = 249 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 114 $PM_{10}$ = 0

### 2005 AQI Summary for New Haven
TOTAL DAYS WITH AQI VALUES = 244



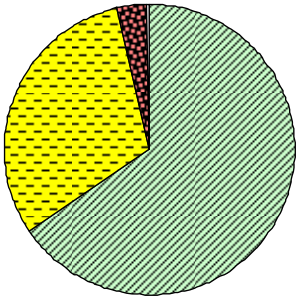
- Good Days - 181
- Moderate Days - 55
- Unhealthy/Sensitives - 7
- Unhealthy Days - 1

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 160 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 84 $PM_{10}$ = 0

# FIGURE 4-2: AQI SUMMARIES FOR DETROIT-WARREN-FLINT CSA (CONTINUED)

## DETROIT-WARREN-LIVONIA MSA (CONTINUED)

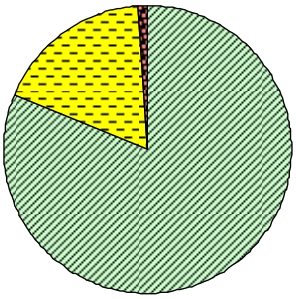
### 2005 AQI Summary for Newberry
TOTAL DAYS WITH AQI VALUES = 253



- Good Days - 166
- Moderate Days - 78
- Unhealthy/Sensitives - 8
- Unhealthy Days - 1

AQI POLLUTANT SUMMARY
CO = 24 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 229 $PM_{10}$ = 0

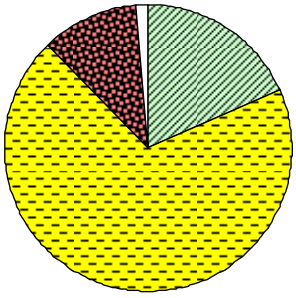
### 2005 AQI Summary for Oak Park
TOTAL DAYS WITH AQI VALUES = 356



- Good Days - 289
- Moderate Days - 63
- Unhealthy/Sensitives - 4
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 117 $O_3$ = 146 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 93 $PM_{10}$ = 0

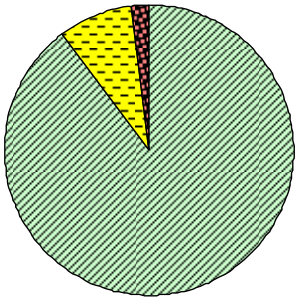
### 2005 AQI Summary for Port Huron
TOTAL DAYS WITH AQI VALUES = 365



- Good Days - 67
- Moderate Days - 253
- Unhealthy/Sensitives - 40
- Unhealthy Days - 5

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 7 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 358 $PM_{10}$ = 0

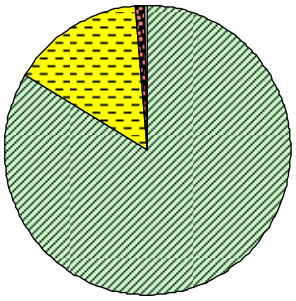
### 2005 AQI Summary for Warren
TOTAL DAYS WITH AQI VALUES = 365



- Good Days - 327
- Moderate Days - 31
- Unhealthy/Sensitives - 7
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 131 $O_3$ = 181 $SO_2$ = 53
$NO_2$ = 0 $PM_{2.5}$ = 0 $PM_{10}$ = 0

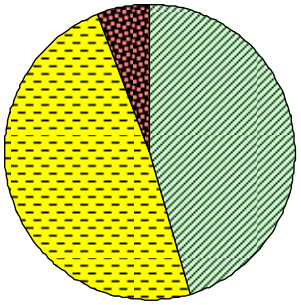
### 2005 AQI Summary for W. Fort Street
TOTAL DAYS WITH AQI VALUES = 345



- Good Days - 288
- Moderate Days - 52
- Unhealthy/Sensitives - 4
- Unhealthy Days - 1

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 51 $SO_2$ = 181
$NO_2$ = 0 $PM_{2.5}$ = 108 $PM_{10}$ = 5

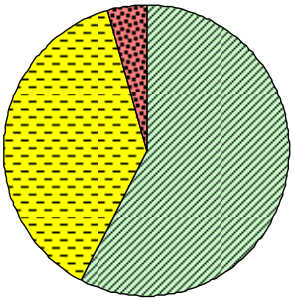
### 2005 AQI Summary for W. Lafayette
TOTAL DAYS WITH AQI VALUES = 123



- Good Days - 56
- Moderate Days - 60
- Unhealthy/Sensitives - 7
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 8 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 115 $PM_{10}$ = 0

### 2005 AQI Summary for Wyandotte
TOTAL DAYS WITH AQI VALUES = 113



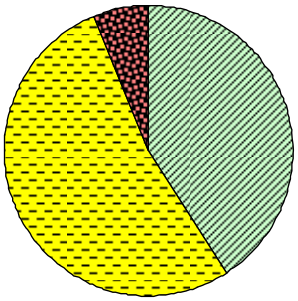
- Good Days - 65
- Moderate Days - 43
- Unhealthy/Sensitives - 5
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 113 $PM_{10}$ = 0

## FIGURE 4-2: AQI SUMMARIES FOR DETROIT-WARREN-FLINT CSA (CONTINUED)

### FLINT MSA

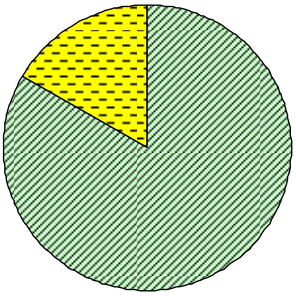
**2005 AQI Summary for Flint**
TOTAL DAYS WITH AQI VALUES = 365



- Good Days - 149
- Moderate Days - 194
- Unhealthy/Sensitives - 22
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 5 $SO_2$ = 26
$NO_2$ = 0 $PM_{2.5}$ = 334 $PM_{10}$ = 0

**2005 AQI Summary for Otisville**
TOTAL DAYS WITH AQI VALUES = 184

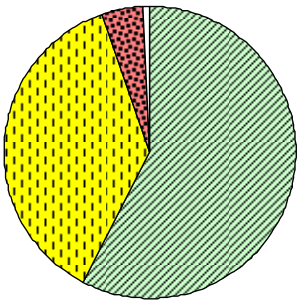


- Good Days - 153
- Moderate Days - 31
- Unhealthy/Sensitives - 0
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 184 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 0 $PM_{10}$ = 0

### MONROE MSA

**2005 AQI Summary for Luna Pier**
TOTAL DAYS WITH AQI VALUES = 115

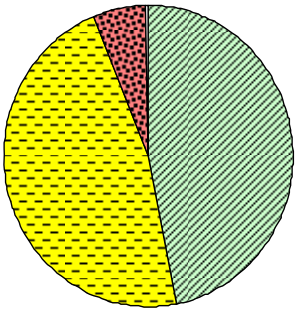


- Good Days - 66
- Moderate Days - 43
- Unhealthy/Sensitives - 5
- Unhealthy Days - 1

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 115 $PM_{10}$ = 0

## FIGURE 4-3: AQI SUMMARIES FOR LANSING-E. LANSING-OWOSSO CSA

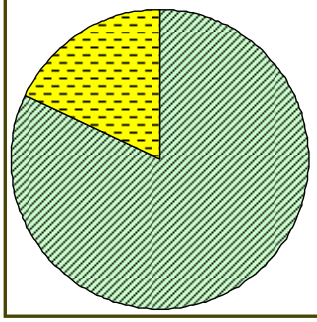
**2005 AQI Summary for Lansing**
TOTAL DAYS WITH AQI VALUES = 362



- Good Days - 170
- Moderate Days - 170
- Unhealthy/Sensitives - 21
- Unhealthy Days -1

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 42 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 320 $PM_{10}$ = 0

**2005 AQI Summary for Rose Lake**
TOTAL DAYS WITH AQI VALUES = 184



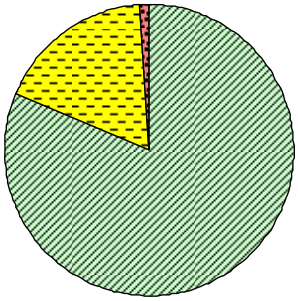
- Good Days - 151
- Moderate Days - 33
- Unhealthy/Sensitives - 0
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 184 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 0 $PM_{10}$ = 0

# FIGURE 4-4: AQI SUMMARIES FOR GRAND RAPIDS-MUSKEGON-HOLLAND CSA

## 2005 AQI Summary for Evans

TOTAL DAYS WITH AQI VALUES = 184



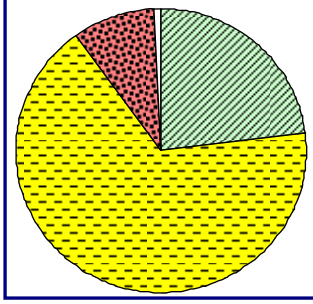
- Good Days - 150
- Moderate Days - 32
- Unhealthy/Sensitives - 2
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY

CO = 0 $O_3$ = 184 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 0 $PM_{10}$ = 0

## 2005 AQI Summary for Grand Rapids (Monroe Street)

TOTAL DAYS WITH AQI VALUES = 365



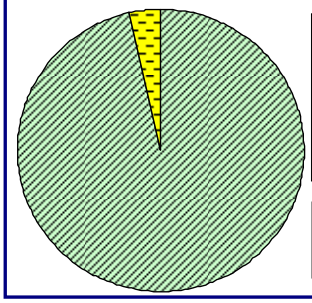
- Good Days - 84
- Moderate Days - 245
- Unhealthy/Sensitives - 33
- Unhealthy Days - 3

AQI POLLUTANT SUMMARY

CO = 0 $O_3$ = 13 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 352 $PM_{10}$ = 0

## 2005 AQI Summary for Grand Rapids (Wealthy Street)

TOTAL DAYS WITH AQI VALUES = 57



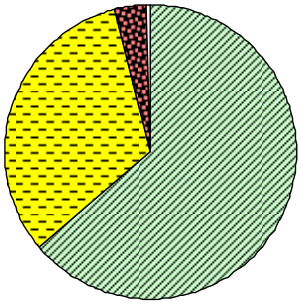
- Good Days - 55
- Moderate Days - 2
- Unhealthy/Sensitives - 0
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY

CO = 0 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 0 $PM_{10}$ = 57

## 2005 AQI Summary for Holland

TOTAL DAYS WITH AQI VALUES = 365



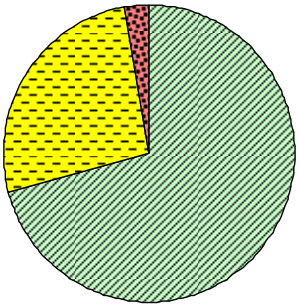
- Good Days - 233
- Moderate Days - 118
- Unhealthy/Sensitives - 12
- Unhealthy Days - 2

AQI POLLUTANT SUMMARY

CO = 0 $O_3$ = 122 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 243 $PM_{10}$ = 0

## 2005 AQI Summary for Jenison

TOTAL DAYS WITH AQI VALUES = 242



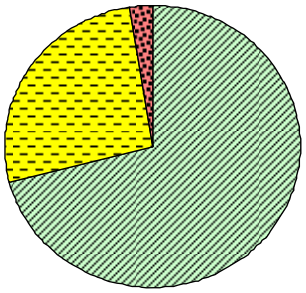
- Good Days - 171
- Moderate Days - 64
- Unhealthy/Sensitives - 7
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY

CO = 0 $O_3$ = 162 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 80 $PM_{10}$ = 0

## 2005 AQI Summary for Muskegon (Apple Avenue)

TOTAL DAYS WITH AQI VALUES = 116



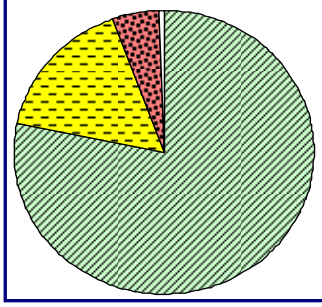
- Good Days - 82
- Moderate Days - 31
- Unhealthy/Sensitives - 3
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY

CO = 0 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 116 $PM_{10}$ = 0

## 2005 AQI Summary for Muskegon (Green Creek Road)

TOTAL DAYS WITH AQI VALUES = 179



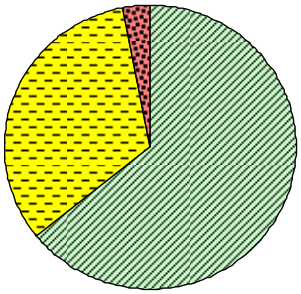
- Good Days - 140
- Moderate Days - 29
- Unhealthy/Sensitives - 9
- Unhealthy Days - 1

AQI POLLUTANT SUMMARY

CO = 0 $O_3$ = 179 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 0 $PM_{10}$ = 0

## FIGURE 4-5: AQI SUMMARIES FOR SAGINAW-BAY CITY-SAGINAW TWP. N. CSA

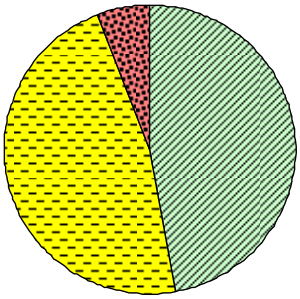
### 2005 AQI Summary for Bay City
TOTAL DAYS WITH AQI VALUES = 137



- Good Days - 88
- Moderate Days - 45
- Unhealthy/Sensitives - 4
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 137 $PM_{10}$ = 0

### 2005 AQI Summary for Saginaw
TOTAL DAYS WITH AQI VALUES = 309

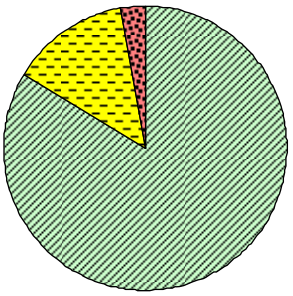


- Good Days - 146
- Moderate Days - 145
- Unhealthy/Sensitives - 18
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 309 $PM_{10}$ = 0

## FIGURE 4-6: MICHIGAN'S LOWER PENINSULA AREA AQI SUMMARIES

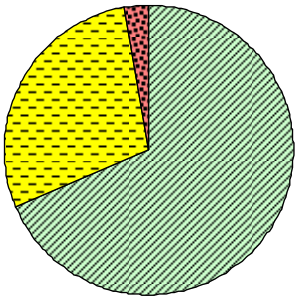
### 2005 AQI Summary for Benzonia
TOTAL DAYS WITH AQI VALUES = 182



- Good Days - 152
- Moderate Days - 25
- Unhealthy/Sensitives - 5
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 182 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 0 $PM_{10}$ = 0

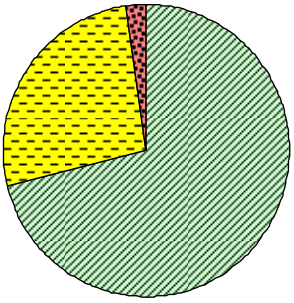
### 2005 AQI Summary for Cassopolis
TOTAL DAYS WITH AQI VALUES = 184



- Good Days - 126
- Moderate Days - 53
- Unhealthy/Sensitives - 5
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 184 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 0 $PM_{10}$ = 0

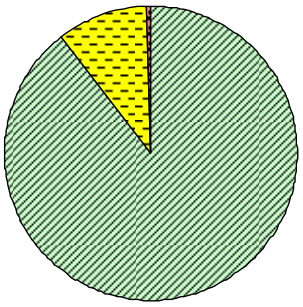
### 2005 AQI Summary for Coloma
TOTAL DAYS WITH AQI VALUES = 242



- Good Days - 172
- Moderate Days - 65
- Unhealthy/Sensitives - 5
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 164 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 78 $PM_{10}$ = 0

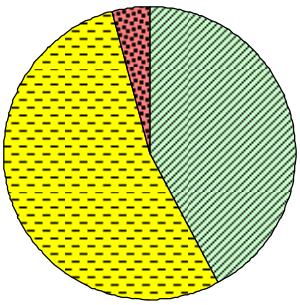
### 2005 AQI Summary for Harbor Beach
TOTAL DAYS WITH AQI VALUES = 181



- Good Days - 162
- Moderate Days - 18
- Unhealthy/Sensitives - 1
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 181 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 0 $PM_{10}$ = 0

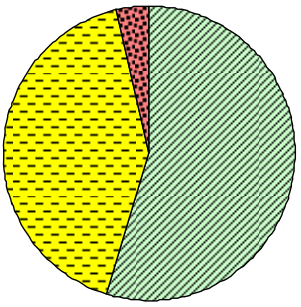
### 2005 AQI Summary for Houghton Lake
TOTAL DAYS WITH AQI VALUES = 365



- Good Days - 154
- Moderate Days - 196
- Unhealthy/Sensitives - 15
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 15 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 350 $PM_{10}$ = 0

### 2005 AQI Summary for Kalamazoo
TOTAL DAYS WITH AQI VALUES = 362

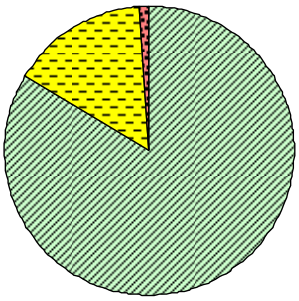


- Good Days - 198
- Moderate Days - 151
- Unhealthy/Sensitives - 13
- Unhealthy Days -0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 70 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 292 $PM_{10}$ = 0

## FIGURE 4-6: MI'S LOWER PENINSULA AREA AQI SUMMARIES (CONTINUED)

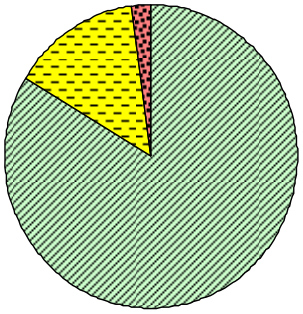
### 2005 Peshawbestown AQI Summary
TOTAL DAYS WITH AQI VALUES = 183



- Good Days - 153
- Moderate Days - 28
- Unhealthy/Sensitives - 2
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 183 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 0 $PM_{10}$ = 0

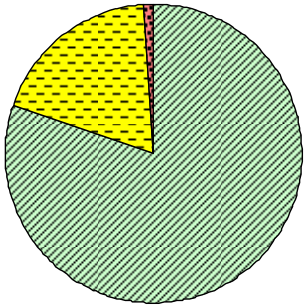
### 2005 AQI Summary for Scottville
TOTAL DAYS WITH AQI VALUES = 182



- Good Days - 152
- Moderate Days - 26
- Unhealthy/Sensitives - 4
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 182 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 0 $PM_{10}$ = 0

### 2005 AQI Summary for Tecumseh
TOTAL DAYS WITH AQI VALUES = 184

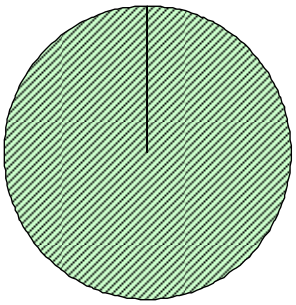


- Good Days - 148
- Moderate Days - 34
- Unhealthy/Sensitives - 2
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 184 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 0 $PM_{10}$ = 0

## FIGURE 4-7: MICHIGAN'S UPPER PENINSULA AREA AQI SUMMARIES

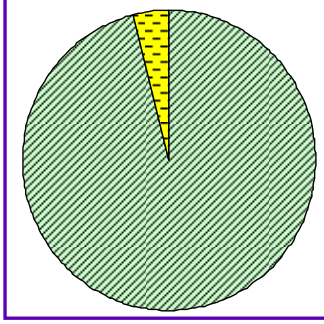
### 2005 AQI Summary for Bay Mills
TOTAL DAYS WITH AQI VALUES = 15



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

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 15 $PM_{10}$ = 0

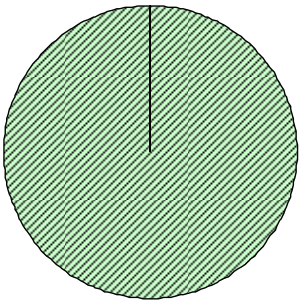
### 2005 AQI Summary for Channing
TOTAL DAYS WITH AQI VALUES = 25



- Good Days - 24
- Moderate Days - 1
- Unhealthy/Sensitives - 0
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 25 $PM_{10}$ = 0

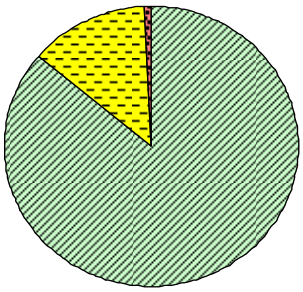
### 2005 AQI Summary for Crystal Falls
TOTAL DAYS WITH AQI VALUES = 25



- Good Days - 25
- Moderate Days - 0
- Unhealthy/Sensitives - 0
- Unhealthy Days -0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 25 $PM_{10}$ = 0

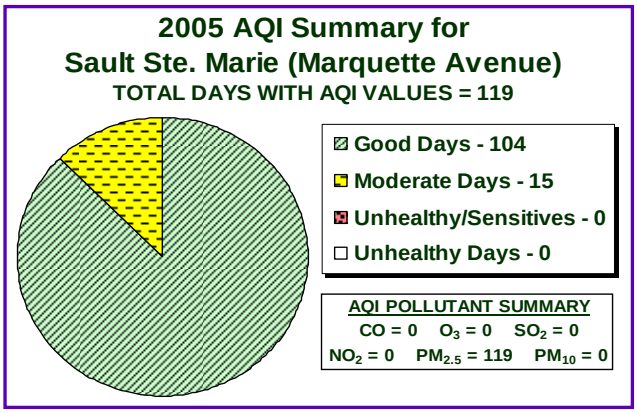
### 2005 AQI Summary for Sault Ste. Marie (Easterday)
TOTAL DAYS WITH AQI VALUES = 123

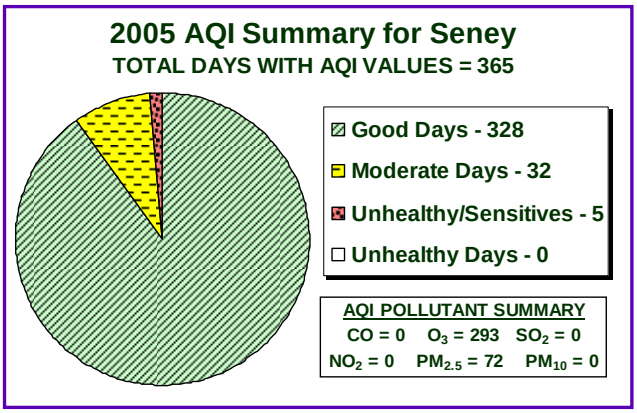


- Good Days - 106
- Moderate Days - 16
- Unhealthy/Sensitives - 1
- Unhealthy Days - 0

AQI POLLUTANT SUMMARY
CO = 0 $O_3$ = 0 $SO_2$ = 0
$NO_2$ = 0 $PM_{2.5}$ = 123 $PM_{10}$ = 0

## FIGURE 4-7: MI'S UPPER PENINSULA AREA AQI SUMMARIES (CONTINUED)




## MICHIGAN'S *OZONE ACTION!*:

*Ozone Action!* days are declared in Southeast and West Michigan when meteorological conditions are conducive for elevated ground-level $O_3$ to occur. When 8-hour $O_3$ levels are expected to exceed the AQI health indicator of 0.085 ppm, an *Ozone Action!* day may be called. On *Ozone Action!* days, business, industry, government, and the public are encouraged to take voluntary action to reduce emissions that lead to the formation of $O_3$. Clean air choices include:

- avoiding the refueling of vehicles or choosing to refuel during the evening hours;
- omitting unnecessary travel;
- selecting alternative transportation options such as carpools, taking the bus, walking or biking;
- deferring the use of gasoline-powered lawn and recreation equipment (particularly inefficient two-stroke engines);
- reducing energy use; and
- modifying use of household solvents and cleaners.

**Table 4-3** shows that during 2005, there were five *Ozone Action!* Days called for Southeast Michigan and 11 for West Michigan.

### TABLE 4-3: 2005 *OZONE ACTION!* DAY INFORMATION

| | SEMCOG (Southeast) | WMCAC (West) |
|---|---|---|
| August | None Declared | Tuesday, 9th |
| | None Declared | Monday, 8th |
| | None Declared | Wednesday, 3rd |
| | None Declared | Tuesday, 2nd |
| subtotal | 0 | 4 |
| July | Tuesday, 12th | Tuesday, 12th |
| | Monday, 11th | Monday, 11th |
| subtotal | 2 | 2 |
| June | Monday, 27th | Monday, 27th |
| | None Declared | Friday, 24th |
| | Friday, 10th | Friday, 10th |
| | Thursday, 9th | Thursday, 9th |
| | None Declared | Wednesday, 8th |
| subtotal | 3 | 5 |
| **total:** | 5 | 11 |

As part of the notification and education process for Michigan's *Ozone Action!* days, the AQD's website lists *Ozone Action!* day information and provides current and extended forecasts. Maximum daily $O_3$ concentrations are displayed as both 1-hour and 8-hour values by geographical location on a near real time basis. $O_3$ values for both averaging times are also available for the previous week along with web links that provide:

- Exceedances of the 1-hour $O_3$ standard,
- Highest 8-hour $O_3$ values by year,
- Three-year average of the 4$^{TH}$ highest 8-hour $O_3$ values,
- Attainment maps,
- Monitor locations by pollutant.

Additionally, historical summaries of *Ozone Action!* days for western and southeastern Michigan (shown in **Figure 4-8**), meteorological data, *Ozone Action!* partners, and other *Ozone Action!* information is available at http://www.michigan.gov/deqair, under "*Ozone Action!*" (http://www.deq.state.mi.us/aqi/o3.asp).

## FIGURE 4-8: 2005 SUMMARY OF THE HIGHEST 8-HOUR $O_3$ CONCENTRATIONS FOR ALL OF MICHIGAN'S MONITORING SITES

The four highest values in ppb are listed. All values at and above 85 ppb are included to illustrate frequency of occurrence. *Max. Allowable* is the maximum 4$^{th}$ highest value that can occur in 2005 without violating the 8-hour $O_3$ standard. **NOTE:** Monitoring sites in violation of the 8-hour $O_3$ standard include Holland, New Haven, and Warren. All other Michigan monitoring sites are meeting the standard.

| 261630001 Allen Park Max Allowable 104 ppb | | 260270003 Cassopolis Max Allowable 88 ppb | | 260210014 Coloma Max Allowable 92 ppb | | 261630019 East Seven Mile Max Allowable 90 ppb | | 260810022 Evans Max Allowable 89 ppb | | 260490021 Flint Max Allowable 92 ppb | | 260190003 Frankfort Max Allowable 90 ppb | | 260810020 Grand Rapids Max Allowable 101 ppb | | 260630007 Harbor Beach Max Allowable 100 ppb | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date |
| 92 | 6/27/05 | 91 | 6/27/05 | 96 | 6/24/05 | 88 | 7/21/05 | 94 | 6/24/05 | 85 | 8/26/05 | 96 | 6/23/05 | 91 | 6/24/05 | 86 | 8/8/05 |
| 78 | 7/10/05 | 88 | 7/10/05 | 93 | 6/27/05 | 83 | 7/4/05 | 85 | 6/28/05 | 81 | 5/9/05 | 94 | 6/24/05 | 88 | 6/28/05 | 84 | 6/27/05 |
| 78 | 8/26/05 | 87 | 7/11/05 | 92 | 9/12/05 | 80 | 7/11/05 | 84 | 6/9/05 | 80 | 4/18/05 | 88 | 7/10/05 | 86 | 6/27/05 | 77 | 5/9/05 |
| 77 | 6/24/05 | 86 | 6/30/05 | 90 | 6/30/05 | 80 | 8/8/05 | 83 | 8/7/05 | 79 | 5/8/05 | 88 | 6/27/05 | 83 | 8/2/05 | 77 | 6/10/05 |
| | | 85 | 6/29/05 | 87 | 7/24/05 | | | | | | | 88 | 7/11/05 | | | | |

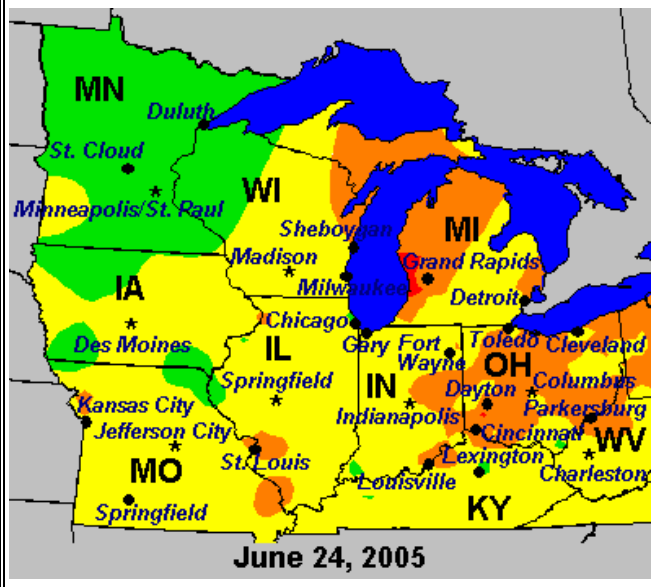
| 260050003 Holland Max Allowable 80 ppb | | 261130001 Houghton Lake Max Allowable 101 ppb | | 261390005 Jenison Max Allowable 95 ppb | | 260770008 Kalamazoo Max Allowable 101 ppb | | 260650012 Lansing Max Allowable 101 ppb | | 261630016 Linwood Max Allowable 104 ppb | | 261210039 Muskegon Max Allowable 90 ppb | | 260990009 New Haven Max Allowable 71 ppb | | 261250001 Oak Park Max Allowable 89 ppb | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date |
| 113 | 6/24/05 | 86 | 6/24/05 | 98 | 6/24/05 | 91 | 6/29/05 | 95 | 7/11/05 | 85 | 7/10/05 | 113 | 6/24/05 | 100 | 6/24/05 | 83 | 8/8/05 |
| 107 | 6/28/05 | 77 | 5/8/05 | 98 | 6/28/05 | 88 | 7/11/05 | 85 | 6/27/05 | 83 | 6/27/05 | 92 | 7/11/05 | 90 | 7/11/05 | 82 | 7/11/05 |
| 95 | 9/12/05 | 76 | 4/19/05 | 91 | 6/27/05 | 86 | 4/18/05 | 85 | 7/12/05 | 81 | 6/24/05 | 91 | 6/27/05 | 90 | 7/20/05 | 79 | 6/24/05 |
| 94 | 6/27/05 | 74 | 4/18/05 | 86 | 7/10/05 | 86 | 6/27/05 | 82 | 6/29/05 | 79 | 7/11/05 | 90 | 6/30/05 | 88 | 6/27/05 | 78 | 6/27/05 |
| 94 | 6/30/05 | | | 85 | 8/2/05 | | | | | | | 89 | 6/23/05 | 86 | 7/4/05 | | |
| 94 | 7/10/05 | | | | | | | | | | | 89 | 7/10/05 | 85 | 6/10/05 | | |
| 94 | 8/9/05 | | | | | | | | | | | 89 | 8/9/05 | | | | |
| 88 | 8/2/05 | | | | | | | | | | | 89 | 9/11/05 | | | | |
| 88 | 8/7/05 | | | | | | | | | | | 88 | 9/12/05 | | | | |
| 86 | 9/11/05 | | | | | | | | | | | 87 | 6/28/05 | | | | |
| 85 | 7/31/05 | | | | | | | | | | | | | | | | |

| 260492001 Otisville Max Allowable 88 ppb | | 260890001 Pashawbestown Max Allowable 105 ppb | | 261470005 Port Huron Max Allowable 94 ppb | | 260370001 Rose Lake Max Allowable 98 ppb | | 261050007 Scottville Max Allowable 98 ppb | | 261530001 Seney Max Allowable 104 ppb | | 260910007 Tecumseh Max Allowable 92 ppb | | 260991003 Warren Max Allowable 82 ppb | | 261610008 Ypsilanti Max Allowable 92 ppb | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date | Value, ppb | Date |
| 82 | 5/9/05 | 94 | 6/24/05 | 107 | 6/24/05 | 83 | 6/29/05 | 100 | 6/23/05 | 97 | 6/23/05 | 97 | 6/27/05 | 103 | 6/27/05 | 96 | 9/1/05 |
| 81 | 4/18/05 | 90 | 6/23/05 | 90 | 6/10/05 | 80 | 6/27/05 | 95 | 6/24/05 | 95 | 8/3/05 | 89 | 6/26/05 | 102 | 6/24/05 | 91 | 6/27/05 |
| 81 | 5/8/05 | 81 | 9/13/05 | 89 | 8/3/05 | 79 | 7/12/05 | 85 | 6/27/05 | 91 | 9/12/05 | 83 | 7/11/05 | 99 | 7/4/05 | 84 | 6/26/05 |
| 80 | 8/8/05 | 80 | 9/11/05 | 88 | 6/8/05 | 78 | 7/11/05 | 85 | 7/10/05 | 84 | 6/27/05 | 82 | 7/12/05 | 89 | 6/25/05 | 83 | 7/11/05 |
| | | | | 88 | 7/4/05 | | | | | | | | | 88 | 7/11/05 | | |
| | | | | | | | | | | | | | | 87 | 7/10/05 | | |
| | | | | | | | | | | | | | | 86 | 6/21/05 | | |

## EPA'S $O_3$ MAPPING:

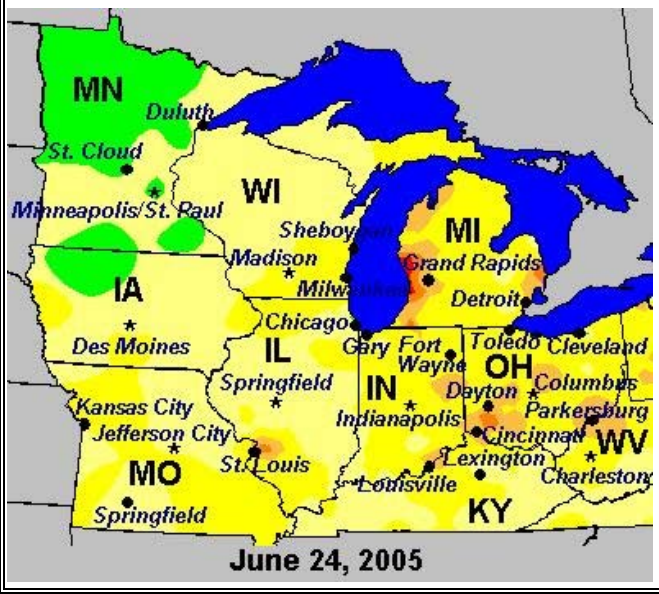
Michigan supplies data to EPA as part of a cooperative effort between EPA, states, and local air pollution control agencies to provide near real time information on ground level $O_3$ concentrations. EPA uses this $O_3$ data to produce maps that display $O_3$ concentrations covering the Midwest, New England, Mid-Atlantic, Southeastern, South Central, and Pacific Coastal regions of the country. In addition, an animation of the levels is provided of current and previous day's $O_3$ showing $O_3$ formation and transport with time. There are also web links that provide the previous and/or historical 1-hour and 8-hour peak $O_3$ values as shown in **Figure 4-9**. The EPA AIRNOW website is different from the AQD daily $O_3$ concentration website in that the geographical scale is much broader and data maps are generated over a less frequent time interval basis. EPA's AIRNOW website is available at: http://www.epa.gov/airnow/.

### FIGURE 4-9: AIRNOW MIDWEST 8-HOUR AND 1-HOUR $O_3$ MAPS




**8-Hr Peak AQI - Ozone**

- Good
- Moderate
- Unhealthy for Sensitive Groups
- Unhealthy
- Very Unhealthy
- Data not available




**1-Hr Average Peak Concentration**

- 0-60 ppb
- 61-79 ppb
- 80-99 ppb
- 100-110 ppb
- 111-124 ppb
- 125+ ppb
- Data not available

**EnviroFlash** is an EPA pilot project designed to transmit air quality information electronically, via computer e-mail or mobile text messaging, on $PM_{2.5}$ and $O_3$ ground level pollution in select cities across the nation. In 2005, **EnviroFlash** was expanded to over 100 cities across the nation. The ultimate goal is to develop a nationwide notification system that provides current local environmental information.

Currently air quality forecasts and "near" real-time AQI data are available for the public when they access the AQD website and via EPA's AIRNow. **EnviroFlash** is an additional service that notifies the subscriber about air quality forecasts (at self-selected health levels) and about "*Ozone Action!* days. People with small children, family members with asthma (or other health problems), or those that will have increased respiration due to working or exercising strenuously may want to be notified when the air is predicted to be "unhealthy for sensitive groups." This "heads-up" information allows these individuals the ability to adjust their daily activities when poor air conditions are anticipated. People enrolled in **EnviroFlash** get only the information they choose to receive sent directly to their computer e-mail or mobile phone with text messaging.

For Michigan, the MDEQ provides real-time air quality forecasts and/or *Ozone Action*! notifications electronically to people living or working in Detroit, Ann Arbor, Flint Saginaw, Kalamazoo, Muskegon, Grand Rapids, Holland, Lansing, and Traverse City (see **Figure 4-10**). Providing this information will help residents make informed decisions on planning their daily activities and in making those clean air choices that improve where we all live, work, and play. Clean air choices include taking "*Action!*" to reduce air pollution levels by driving less, using energy efficient products, and by opting not to burn as combustion generates air pollution.

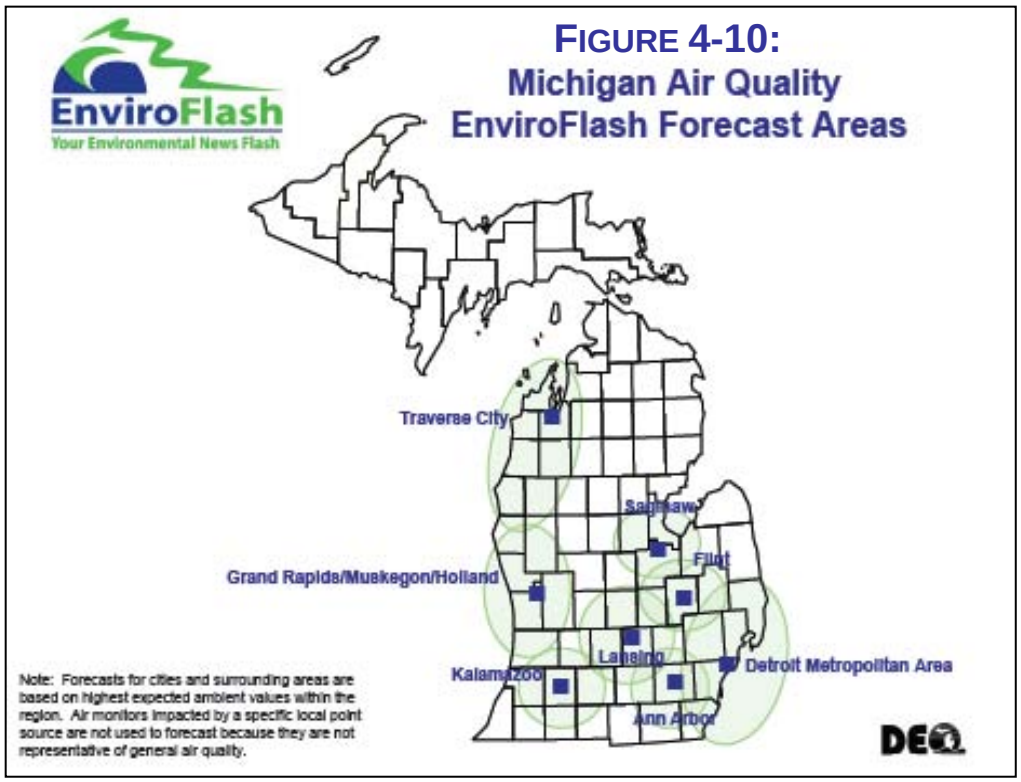



**FIGURE 4-10: Michigan Air Quality EnviroFlash Forecast Areas**

Future plans hope to include a feature to communicate emergency air issues as well as information on other environmental topics (such as water quality or beach closings). To sign-up for **EnviroFlash** notices and to view more details about this program visit the AQD's website at: www.michigan.gov/deqair.

# CHAPTER 5: MODELING AND METEOROLOGICAL INFORMATION

## AMBIENT BACKGROUND DETERMINATIONS:

Ambient background estimates are needed in order to carry out modeling analyses in NSR (New Source Review) applications. These backgrounds are added with modeled impacts to demonstrate that new and modified facilities will not cause a violation of the NAAQS. **Table 5-1** lists default ambient background values by Air Quality Control Region (AQCR) for the latest available years of data.

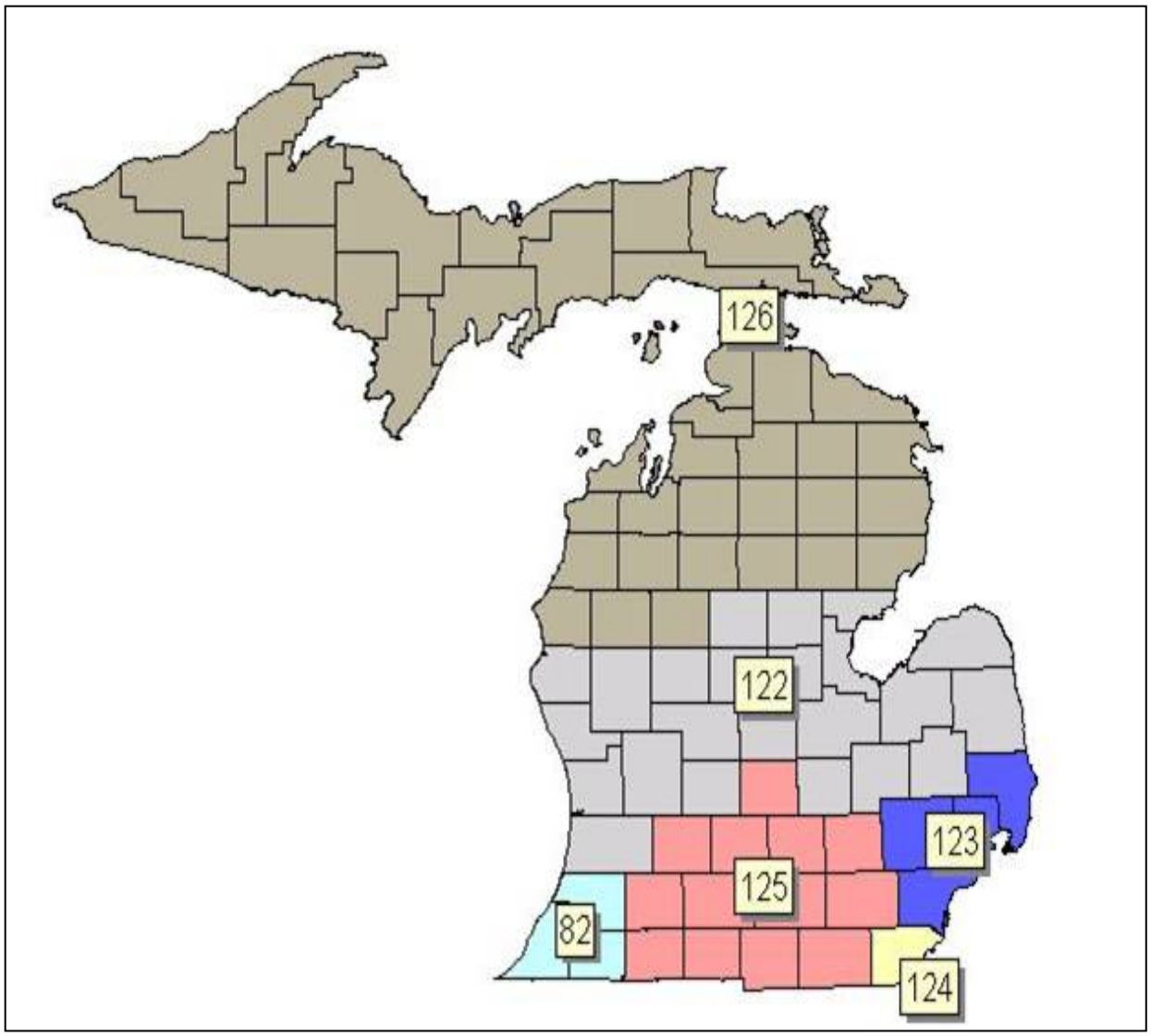
### TABLE 5-1: DEFAULT AMBIENT BACKGROUND VALUES BY AQCR (µG/M$^3$)*

| POLLUTANT | AVERAGING TIME | REGION 82 | REGION 122 | REGION 123 | REGION 124 | REGION 125 | REGION 126 |
|---|---|---|---|---|---|---|---|
| $SO_2$ | 3 Hour (1) | 83 | 56 | 253 | 154 | 154 | 45 |
| | 24 Hour (1) | 43 | 29 | 69 | 75 | 75 | 13 |
| | Annual (2) | 11 | 5 | 13 | 19 | 19 | 3 |
| $PM_{10}$ | 24 Hour (3) | 66 | 45 | 73 | 67 | 67 | 48 |
| | Annual (2) | 31 | 20 | 31 | 22 | 22 | 22 |
| CO | 1 Hour (1) | 3712 | 3248 | 5220 | 4060 | 4060 | 812 |
| | 8 Hour (1) | 2320 | 2204 | 3480 | 2784 | 2784 | 464 |
| NO2 | Annual (2) | 27 | 34 | 42 | 42 | 42 | 12 |
| Pb | Quarterly (4) | 0.01 | 0.01 | 0.03 | 0.01 | 0.01 | 0.01 |

*Depending upon the specific location, values could change
(1) High second high values observed.
(2) Highest of the three highest annual concentrations observed.
(3) Fourth highest 24-hour concentration observed.
(4) Highest quarterly concentration observed.

The following **Figure 5-1** shows the locations of the AQCRs with the counties within each region specified below. Please note that these background values are generalized and that certain NSR applications may demand more site specific values. If more site specific information is desired, please contact the AQD's Strategy Development Unit at 517-373-7023.

## FIGURE 5-1: AQCR AND COUNTIES FOR NSR AMBIENT BACKGROUNDS




**Region 82 Counties:** Berrien, Cass, and Van Buren.

**Region 122 Counties:** Allegan, Arenac, Bay, Clare, Genesee, Gladwin, Gratiot, Huron, Ionia, Isabella, Kent, Lapeer, Mecosta, Midland, Montcalm, Muskegon, Newaygo, Oceana, Ottawa, Saginaw, Sanilac, Shiawassee, and Tuscola.

**Region 123 Counties:** Macomb, Oakland, St. Clair, and Wayne.

**Region 124 County:** Monroe.

**Region 125 Counties:** Barry, Branch, Calhoun, Clinton, Eaton, Hillsdale, Ingham, Jackson, Kalamazoo, Lenawee, Livingston, St. Joseph, and Washtenaw.

**Region 126 Counties:** Alcona, Alger, Alpena, Antrim, Baraga, Benzie, Charlevoix, Cheboygan, Chippewa, Crawford, Delta, Dickinson, Emmet, Gogebic, Grand Traverse, Houghton, Iosco, Iron, Kalkaska, Keweenaw, Lake, Leelanau, Luce, Mackinac, Manistee, Marquette, Mason, Menominee, Missaukee, Montmorency, Ogemaw, Ontonagon, Osceola, Oscoda, Otsego, Presque Isle, Roscommon, Schoolcraft, and Wexford.

## CLIMATOLOGICAL INFORMATION:

Michigan owes much of its climate to its mid-latitude location. Stretching from about 41.5 degrees ($^o$) to 47.5$^o$ north latitude, Michigan's weather varies dramatically depending upon the seasonal position of the polar jet stream. In the winter, the polar jet passes to the south of Michigan, exposing the state to cold arctic air masses. In the summer, when the polar jet is to the north of the state, Michigan experiences warm weather thanks to air masses originating in the Gulf of Mexico. However, the Great Lakes also have a profound impact upon Michigan's weather. "Lake-effects" are usually greatest within approximately thirty miles of the lakeshore, but can extend further inland. In the summer, air above the Great Lakes is transported onshore as a cool breeze. In the fall these waters, cooling slower than the surrounding land, can help warm the lakeshore, increasing the number of frost-free growing days. As winter's first cold winds blow across the warm, open lakes, clouds often form to produce intense, localized snowfalls. In the spring, when moisture-laden air passes over a cold lake surface, it may cool enough to cause broad fog banks to form along shoreline areas.

The Great Lakes also help in reducing air pollution in Michigan by raising atmospheric humidity. First, the moisture that the Great Lakes add to the air condenses on small pollutant particles to form cloud droplets. The cloud droplets grow until they are heavy enough to fall out as rain or snow. Second, as the rain and snow fall, they collide with larger pollutant particles, stripping them from the air. Third, high relative humidity reduces the amount of moisture evaporating from the soil, keeping dust from being re-entrained into the air. In addition, lake-effect clouds reflect incoming solar rays to keep summer temperatures cooler and to keep heat from the earth's surface in the winter from escaping to space, keeping winter nights warmer. As a result, less fossil fuel needs to be burned to produce energy for cooling and heating, respectively.

## 2005 TEMPERATURE AND PRECIPITATION DATA FOR MICHIGAN:

The following **Figures 5-2** through **5-4** (average daily temperatures) and **Figures 5-5** through **5-7** (total monthly precipitation amounts) show total amounts as compared to their climatic norms for sites in the Upper Peninsula, and the northern and southern Lower Peninsula. These figures were constructed by averaging data from several National Weather Service (NWS) 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 2005.

Figure 5-2: Southern Lower Peninsula
2005 Observed Average Daily Temperatures vs.
Normal Average Daily Temperatures

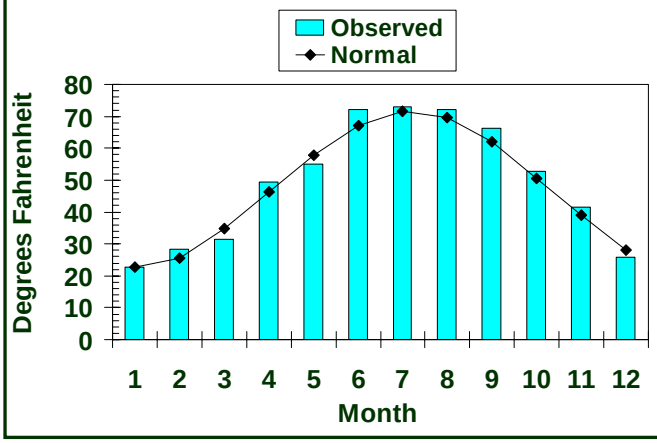



Figure 5-3: Northern Lower Peninsula
2005 Observed Average Daily Temperatures vs.
Normal Average Daily Temperatures

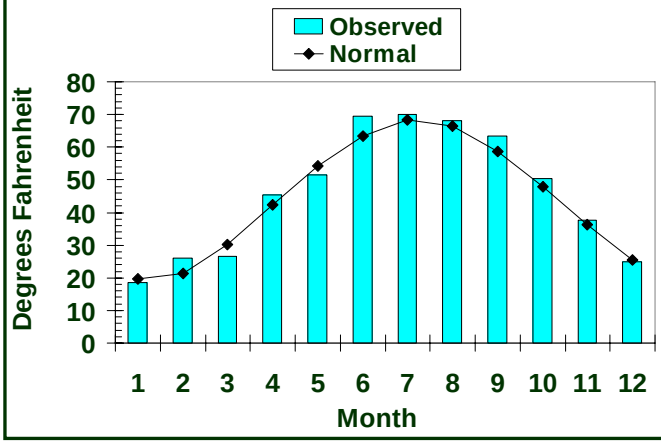



Figure 5-4: Upper Peninsula
2005 Observed Average Daily Temperatures vs.
Normal Average Daily Temperatures

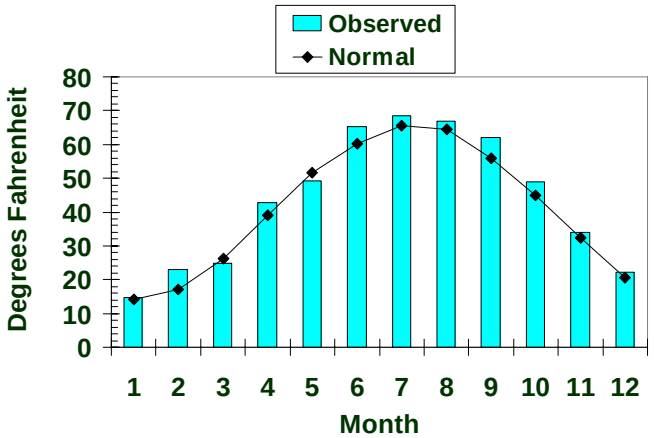



Figure 5-5: Southern Lower Peninsula
2005 Observed Monthly Precipitation vs.
Normal Monthly Precipitation

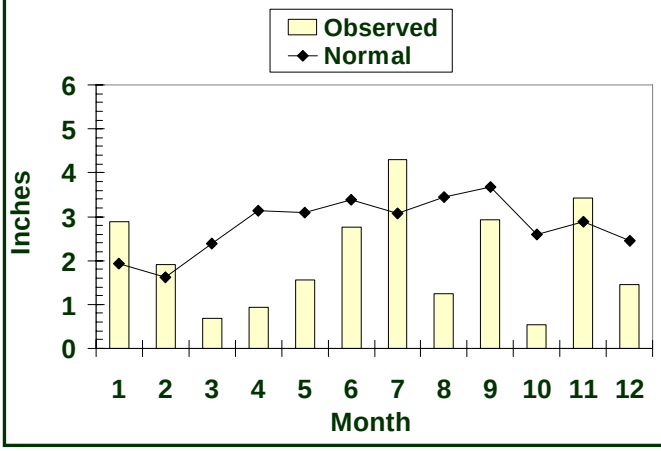



Figure 5-6: Northern Lower Peninsula
2005 Observed Monthly Precipitation vs.
Normal Monthly Precipitation

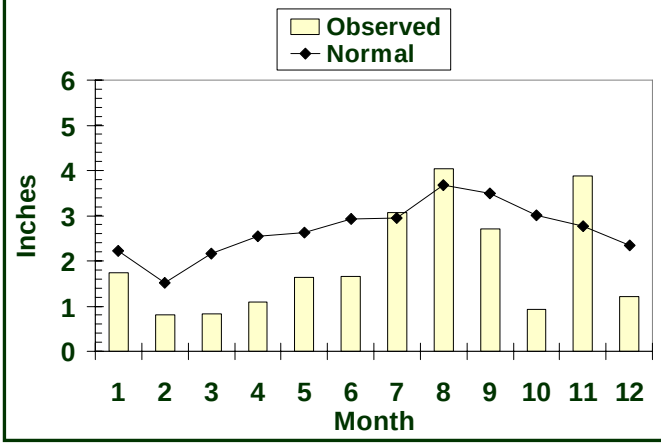
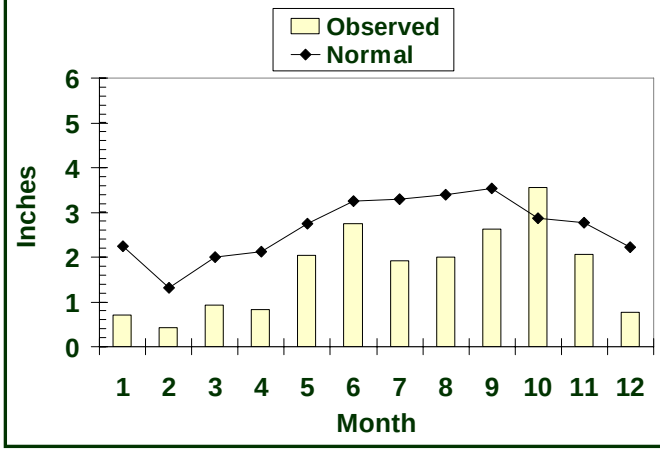



Figure 5-7: Upper Peninsula
2005 Observed Monthly Precipitation vs.
Normal Monthly Precipitation



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# APPENDIX A: CRITERIA POLLUTANT SUMMARY FOR 2005

**Appendix A** utilizes EPA's 2005 AQS Quick Look Report Data to present a summary of ambient air quality data collected for the criteria pollutants at monitoring locations throughout Michigan. Concentrations of non-gaseous pollutants are generally given in $\mu g/m^3$ and in ppm for gaseous pollutants. The following define some of the terms listed in the **Appendix A** reports.

**Site I.D.**: The AQS site ID is the EPA's code number for these sites and has replaced the MASN number. Prior to 1989, each site was labeled with a five-digit MASN code number.

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

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

**# OBS**: For Pb, TSP, $PM_{2.5}$, and $PM_{10}$, the # OBS (number of observations) refers to the number of valid 24-hour values gathered.

For continuous monitors (CO, $NO_2$, $O_3$, $PM_{2.5}$ TEOM, and $SO_2$,), # OBS refers to the total valid hourly averages obtained from the analyzer.

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

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

# CRITERIA POLLUTANT SUMMARY FOR 2005

## CO Measured in ppm

| Site ID | POC | City | County | Year | # OBS | 1-hr Highest Value | 1-hr 2nd Highest Value | # > 35 | 8-hr Highest Value | 8-hr 2nd Highest Value | # > 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260810020 | 1 | Grand Rapids | Kent | 2005 | 8630 | 2.8 | 2.6 | 0 | 2.0 | 1.9 | 0 |
| 260991003 | 1 | Warren | Macomb | 2005 | 8426 | 4.8 | 3.6 | 0 | 2.5 | 2.0 | 0 |
| 261250001 | 1 | Oak Park | Oakland | 2005 | 8192 | 3.7 | 3.4 | 0 | 2.2 | 2.1 | 0 |
| 261530001 | 1 | Seney | Schoolcraft | 2005 | 8320 | 0.8 | 0.7 | 0 | 0.7 | 0.4 | 0 |
| 261630001 | 1 | Allen Park | Wayne | 2005 | 8616 | 2.5 | 2.5 | 0 | 1.8 | 1.7 | 0 |
| 261630016 | 1 | Detroit - Linwood | Wayne | 2005 | 8416 | 3.7 | 3.4 | 0 | 2.6 | 2.0 | 0 |
| 261630025 | 1 | Livonia | Wayne | 2005 | 8287 | 2.1 | 1.9 | 0 | 1.7 | 1.4 | 0 |
| 261630038 | 1 | Detroit - Newberry | Wayne | 2005 | 4616 | 2.9 | 2.9 | 0 | 1.8 | 1.7 | 0 |
| 261630039 | 1 | Detroit - W. Lafayette | Wayne | 2005 | 2599 | 2.8 | 2.6 | 0 | 1.8 | 1.1 | 0 |

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

| Site ID | POC | City | County | Year | # OBS | Qtr 1 Arith Mean | Qtr 2 Arith Mean | Qtr 3 Arith Mean | Qtr 4 Arith Mean | # Means > 1.5 | Highest Value | 2nd Highest Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 260490021 | 4 | Flint | Genesee | 2005 | 59 | .00706 | .01024 | .01105 | .01169 | 0 | .05680 | .02533 |
| 260810020 | 1 | Grand Rapids | Kent | 2005 | 31 | .00675* | .00846* | .01016* | .00547* | 0 | .01551 | .01455 |
| 261130001 | 1 | Houghton Lake | Missaukee | 2005 | 60 | .00285 | .00383 | .00562 | .00270 | 0 | .02291 | .00820 |
| 261610008 | 1 | Ypsilanti | Washtenaw | 2005 | 25 | .00938* | .00662* | .01223* | .00618* | 0 | .02226 | .02104 |
| 261630001 | 2 | Allen Park | Wayne | 2005 | 59 | .01067 | .00988 | .00968 | .00698 | 0 | .02497 | .02206 |
| 261630005 | 1 | River Rouge | Wayne | 2005 | 61 | .01730 | .01706 | .01912 | .01565 | 0 | .07066 | .04713 |
| 261630015 | 4 | Detroit - W. Fort | Wayne | 2005 | 61 | .01810 | .02038 | .02038 | .01781 | 0 | .04577 | .04468 |
| 261630019 | 1 | Detroit - E. Seven Mile | Wayne | 2005 | 56 | .00990 | .01131 | .01385 | .01092 | 0 | .02538 | .02536 |
| 261630027 | 1 | Detroit – W. Jefferson | Wayne | 2005 | 58 | .02573 | .02672 | .02524 | .02468 | 0 | .11704 | .05160 |
| 261630033 | 2 | Dearborn | Wayne | 2005 | 56 | .01845 | .02690 | .02297 | .02068 | 0 | .11812 | .04669 |

*Indicates the mean does not satisfy summary criteria

## $NO_2$ Measured in ppm

| Site ID | POC | City | County | Year | # OBS | 1-Hr Highest Value | 1-Hr 2nd Highest Value | Annual Arith Mean |
|---|---|---|---|---|---|---|---|---|
| 260810020 | 1 | Grand Rapids | Kent | 2005 | 7963 | .075 | .067 | .0151 |
| 261630016 | 1 | Detroit - Linwood | Wayne | 2005 | 8353 | .073 | .073 | .0196 |
| 261630019 | 2 | Detroit - E. Seven Mile | Wayne | 2005 | 7474 | .084 | .072 | .0173 |

## $O_3$ (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 | 2005 | 181 | 183 | .128 | .123 | .111 | .107 | 1 | 1.0 | 0 |
| 260190003 | 1 | Benzonia | Benzie | 2005 | 180 | 183 | .104 | .100 | .098 | .098 | 0 | 0.0 | 0 |
| 260210014 | 1 | Coloma | Berrien | 2005 | 180 | 183 | .106 | .106 | .104 | .101 | 0 | 0.0 | 3 |
| 260270003 | 2 | Cassopolis | Cass | 2005 | 183 | 183 | .102 | .097 | .093 | .092 | 0 | 0.0 | 0 |
| 260370001 | 2 | Rose Lake | Clinton | 2005 | 183 | 183 | .095 | .089 | .088 | .087 | 0 | 0.0 | 0 |
| 260490021 | 1 | Flint | Genesee | 2005 | 142 | 183 | .100 | .087 | .086 | .086 | 0 | 0.0 | 1 |
| 260492001 | 1 | Otisville | Genesee | 2005 | 160 | 183 | .092 | .092 | .090 | .089 | 0 | 0.0 | 3 |
| 260630007 | 1 | Harbor Beach | Huron | 2005 | 177 | 183 | .103 | .094 | .091 | .090 | 0 | 0.0 | 0 |
| 260650012 | 2 | Lansing | Ingham | 2005 | 179 | 183 | .109 | .093 | .093 | .091 | 0 | 0.0 | 0 |
| 260770008 | 1 | Kalamazoo | Kalamazoo | 2005 | 182 | 183 | .095 | .092 | .092 | .089 | 0 | 0.0 | 1 |
| 260810020 | 1 | Grand Rapids | Kent | 2005 | 181 | 183 | .107 | .102 | .094 | .089 | 0 | 0.0 | 2 |
| 260810022 | 1 | Evans | Kent | 2005 | 181 | 183 | .098 | .097 | .096 | .095 | 0 | 0.0 | 2 |
| 260890001 | 1 | Peshawbestown | Leelanau | 2005 | 175 | 183 | .101 | .100 | .094 | .093 | 0 | 0.0 | 2 |
| 260910007 | 1 | Tecumseh | Lenawee | 2005 | 182 | 183 | .106 | .101 | .098 | .096 | 0 | 0.0 | 1 |
| 260990009 | 1 | New Haven | Macomb | 2005 | 183 | 183 | .110 | .109 | .104 | .103 | 0 | 0.0 | 0 |
| 260991003 | 1 | Warren | Macomb | 2005 | 170 | 183 | .118 | .116 | .110 | .110 | 0 | 0.0 | 2 |
| 261050007 | 1 | Scottville | Mason | 2005 | 175 | 183 | .112 | .110 | .099 | .096 | 0 | 0.0 | 1 |
| 261130001 | 1 | Houghton Lake | Missaukee | 2005 | 179 | 183 | .092 | .081 | .079 | .077 | 0 | 0.0 | 2 |
| 261210039 | 1 | Muskegon | Muskegon | 2005 | 177 | 183 | .128 | .108 | .106 | .106 | 1 | 1.0 | 0 |
| 261250001 | 2 | Oak Park | Oakland | 2005 | 174 | 183 | .095 | .095 | .094 | .089 | 0 | 0.0 | 1 |
| 261390005 | 1 | Jenison | Ottawa | 2005 | 182 | 183 | .111 | .108 | .100 | .096 | 0 | 0.0 | 1 |
| 261470005 | 1 | Port Huron | St .Clair | 2005 | 183 | 183 | .118 | .105 | .104 | .101 | 0 | 0.0 | 0 |
| 261530001 | 1 | Seney | Schoolcraft | 2005 | 166 | 183 | .110 | .105 | .105 | .096 | 0 | 0.0 | 0 |
| 261610008 | 1 | Ypsilanti | Washtenaw | 2005 | 176 | 183 | .100 | .099 | .097 | .093 | 0 | 0.0 | 0 |
| 261630001 | 2 | Allen Park | Wayne | 2005 | 163 | 183 | .101 | .092 | .092 | .090 | 0 | 0.0 | 5 |
| 261630016 | 1 | Detroit -Linwood | Wayne | 2005 | 163 | 183 | .095 | .095 | .094 | .093 | 0 | 0.0 | 1 |
| 261630019 | 2 | Detroit - E. Seven Mile | Wayne | 2005 | 157 | 183 | .102 | .100 | .097 | .095 | 0 | 0.0 | 7 |

## $O_3$ (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 >/= 0.085 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260050003 | 1 | Holland | Allegan | 2005 | 98 | 180 | .113 | .107 | .095 | .094 | 11 |
| 260190003 | 1 | Benzonia | Benzie | 2005 | 98 | 180 | .096 | .094 | .088 | .086 | 5 |
| 260210014 | 1 | Coloma | Berrien | 2005 | 98 | 180 | .096 | .093 | .092 | .090 | 5 |
| 260270003 | 2 | Cassopolis | Cass | 2005 | 100 | 183 | .091 | .088 | .087 | .086 | 5 |
| 260370001 | 2 | Rose Lake | Clinton | 2005 | 100 | 183 | .083 | .080 | .079 | .078 | 0 |
| 260490021 | 1 | Flint | Genesee | 2005 | 75 | 137 | .085 | .081 | .080 | .079 | 1 |
| 260492001 | 1 | Otisville | Genesee | 2005 | 87 | 160 | .082 | .081 | .081 | .080 | 0 |
| 260630007 | 1 | Harbor Beach | Huron | 2005 | 97 | 177 | .086 | .084 | .077 | .077 | 1 |
| 260650012 | 2 | Lansing | Ingham | 2005 | 98 | 179 | .095 | .085 | .085 | .082 | 3 |
| 260770008 | 1 | Kalamazoo | Kalamazoo | 2005 | 98 | 180 | .088 | .085 | .083 | .081 | 2 |

## $O_3$ (8-Hour) Measured in ppm (Continued)

| Site ID | POC | City | County | Year | % OBS | Valid Days Measured | Highest Value | 2nd Highest Value | 3rd Highest Value | 4th Highest Value | Day Max >/= 0.085 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260810020 | 1 | Grand Rapids | Kent | 2005 | 99 | 181 | .091 | .088 | .086 | .083 | 3 |
| 260810022 | 1 | Evans | Kent | 2005 | 98 | 180 | .094 | .085 | .084 | .083 | 2 |
| 260890001 | 1 | Peshawbestown | Leelanau | 2005 | 95 | 174 | .094 | .090 | .081 | .080 | 2 |
| 260910007 | 1 | Tecumseh | Lenawee | 2005 | 99 | 182 | .097 | .089 | .083 | .082 | 2 |
| 260990009 | 1 | New Haven | Macomb | 2005 | 100 | 183 | .100 | .090 | .090 | .088 | 6 |
| 260991003 | 1 | Warren | Macomb | 2005 | 93 | 170 | .103 | .102 | .099 | .089 | 7 |
| 261050007 | 1 | Scottville | Mason | 2005 | 95 | 174 | .100 | .095 | .085 | .085 | 4 |
| 261130001 | 1 | Houghton Lake | Missaukee | 2005 | 97 | 178 | .086 | .077 | .076 | .074 | 1 |
| 261210039 | 1 | Muskegon | Muskegon | 2005 | 96 | 176 | .113 | .092 | .091 | .090 | 10 |
| 261250001 | 2 | Oak Park | Oakland | 2005 | 94 | 172 | .083 | .082 | .079 | .078 | 0 |
| 261390005 | 1 | Jenison | Ottawa | 2005 | 99 | 181 | .098 | .098 | .091 | .086 | 5 |
| 261470005 | 1 | Port Huron | St .Clair | 2005 | 100 | 183 | .107 | .090 | .089 | .088 | 5 |
| 261530001 | 1 | Seney | Schoolcraft | 2005 | 90 | 165 | .098 | .096 | .093 | .085 | 4 |
| 261610008 | 1 | Ypsilanti | Washtenaw | 2005 | 96 | 176 | .096 | .091 | .084 | .083 | 2 |
| 261630001 | 2 | Allen Park | Wayne | 2005 | 89 | 163 | .092 | .078 | .078 | .077 | 1 |
| 261630016 | 1 | Detroit - Linwood | Wayne | 2005 | 87 | 160 | .085 | .083 | .081 | .079 | 1 |
| 261630019 | 2 | Detroit - E. Seven Mile | Wayne | 2005 | 75 | 137 | .088 | .083 | .080 | .080 | 1 |

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

| Site ID | POC | Monitor | City | County | Year | # OBS | Highest Value | 2nd Highest Value | 3rd Highest Value | 4th Highest Value | 98% | Wtd. Arith. Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 260050003 | 1 | FRM | Holland | Allegan | 2005 | 361 | 46.9 | 46.4 | 43.0 | 43.0 | 36.1 | 12.39 |
| 260050003 | 5 [b] | SASS | Holland | Allegan | 2005 | 60 | 53.8 | 53.6 | 40.3 | 39.1 | 53.6 | 14.70 |
| 260170014 | 1 | FRM | Bay City | Bay | 2005 | 117 | 44.9 | 41.9 | 40.5 | 37.5 | 40.5 | 12.44 |
| 260210014 | 1 | FRM | Coloma | Berrien | 2005 | 118 | 46.1 | 35.0 | 33.8 | 32.9 | 33.8 | 13.05 |
| 260330901 | 1 | FRM | Sault Ste. Marie | Chippewa | 2005 | 118 | 33.2 | 28.3 | 25.1 | 23.4 | 25.1 | 8.16 |
| 260330901 | 2 [a] | FRM | Sault Ste. Marie | Chippewa | 2005 | 42 | 28.3 | 23.7 | 20.6 | 19.5 | 28.3 | 9.29* |
| 260330901 | 5 [b] | SASS | Sault Ste. Marie | Chippewa | 2005 | 84 | 45.5 | 29.2 | 29.1 | 26.5 | 29.2 | 9.49 |
| 260330902 | 1 | FRM | Sault Ste. Marie | Chippewa | 2005 | 119 | 30.0 | 28.5 | 25.1 | 22.7 | 25.1 | 7.94 |
| 260330903 | 1 | FRM | Bay Mills | Chippewa | 2005 | 15 | 11.1 | 9.4 | 9.0 | 6.0 | 11.1 | 4.31* |
| 260430002 | 1 | FRM | Channing | Dickinson | 2005 | 25 | 18.4 | 13.4 | 12.5 | 10.9 | 18.4 | 6.11* |
| 260490021 | 1 | FRM | Flint | Genesee | 2005 | 119 | 54.3 | 38.7 | 35.9 | 35.5 | 35.9 | 12.89 |
| 260650012 | 1 | FRM | Lansing | Ingham | 2005 | 120 | 52.8 | 42.6 | 38.1 | 36.4 | 38.1 | 13.54 |
| 260710001 | 1 | FRM | Crystal Falls | Iron | 2005 | 25 | 13.9 | 9.8 | 7.6 | 7.5 | 13.9 | 3.97* |
| 260770008 | 1 | FRM | Kalamazoo | Kalamazoo | 2005 | 116 | 44.4 | 39.0 | 33.3 | 31.7 | 33.3 | 13.83 |
| 260770008 | 2 [a] | FRM | Kalamazoo | Kalamazoo | 2005 | 51 | 39.3 | 31.5 | 31.0 | 30.6 | 31.5 | 14.64* |
| 260770008 | 5 [b] | SASS | Kalamazoo | Kalamazoo | 2005 | 61 | 46.5 | 38.1 | 34.2 | 34.1 | 38.1 | 16.42 |
| 260810020 | 1 | FRM | Grand Rapids | Kent | 2005 | 356 | 75.3 | 65.4 | 57.9 | 49.4 | 44.7 | 13.72 |
| 260810020 | 2 [a] | FRM | Grand Rapids | Kent | 2005 | 60 | 52.3 | 45.6 | 37.6 | 36.2 | 45.6 | 15.37 |
| 260810020 | 5 [b] | SASS | Grand Rapids | Kent | 2005 | 59 | 57.2 | 47.6 | 42.4 | 39.6 | 47.6 | 16.86 |
| 260990009 | 1 | FRM | New Haven | Macomb | 2005 | 120 | 79.2 | 57.0 | 41.5 | 39.3 | 41.5 | 14.37 |

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

| Site ID | POC | Monitor | City | County | Year | # OBS | Highest Value | 2nd Highest Value | 3rd Highest Value | 4th Highest Value | 98% | Wtd. Arith. Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 261130001 | 1 | FRM | Houghton Lake | Missaukee | 2005 | 109 | 33.3 | 32.1 | 30.8 | 29.3 | 30.8 | 9.45 |
| 261130001 | 5[b] | SASS | Houghton Lake | Missaukee | 2005 | 58 | 41.3 | 31.8 | 26.1 | 25.0 | 31.8 | 10.67* |
| 261150005 | 1 | FRM | Luna Pier | Monroe | 2005 | 112 | 73.1 | 52.1 | 49.3 | 44.9 | 49.3 | 15.70 |
| 261150005 | 5[b] | SASS | Luna Pier | Monroe | 2005 | 57 | 59.6 | 51.2 | 45.1 | 38.9 | 51.2 | 17.15 |
| 261210040 | 1 | FRM | Muskegon | Muskegon | 2005 | 116 | 48.7 | 46.2 | 41.0 | 37.2 | 41.0 | 13.07 |
| 261250001 | 1 | FRM | Oak Park | Oakland | 2005 | 118 | 56.1 | 53.5 | 52.2 | 43.8 | 52.2 | 15.46 |
| 261390005 | 1 | FRM | Jenison | Ottawa | 2005 | 117 | 47.9 | 43.6 | 42.3 | 38.3 | 42.3 | 13.99 |
| 261450018 | 1 | FRM | Saginaw | Saginaw | 2005 | 114 | 45.2 | 38.9 | 37.8 | 36.8 | 37.8 | 11.72* |
| 261470005 | 1 | FRM | Port Huron | St. Clair | 2005 | 111 | 68.8 | 47.9 | 47.6 | 41.3 | 47.6 | 15.09 |
| 261610005 | 1 | FRM | Ann Arbor | Washtenaw | 2005 | 110 | 60.3 | 39.9 | 39.1 | 34.8 | 39.1 | 13.20 |
| 261610008 | 1 | FRM | Ypsilanti | Washtenaw | 2005 | 114 | 58.0 | 53.7 | 52.1 | 40.1 | 52.1 | 15.61 |
| 261610008 | 2[a] | FRM | Ypsilanti | Washtenaw | 2005 | 59 | 55.1 | 54.6 | 40.5 | 33.8 | 54.6 | 16.70 |
| 261610008 | 5[b] | SASS | Ypsilanti | Washtenaw | 2005 | 60 | 58.7 | 50.8 | 39.2 | 34.3 | 50.8 | 16.62 |
| 261630001 | 1 | FRM | Allen Park | Wayne | 2005 | 349 | 81.6 | 73.8 | 58.5 | 57.8 | 43.0 | 15.94 |
| 261630001 | 2[a] | FRM | Allen Park | Wayne | 2005 | 59 | 58.1 | 58.0 | 42.7 | 36.8 | 58.0 | 17.66 |
| 261630001 | 5[b] | SASS | Allen Park | Wayne | 2005 | 113 | 58.5 | 52.2 | 51.8 | 43.6 | 51.8 | 16.86 |
| 261630015 | 1 | FRM | Detroit - W. Fort | Wayne | 2005 | 114 | 69.7 | 56.5 | 49.7 | 44.2 | 49.7 | 17.21 |
| 261630016 | 1 | FRM | Detroit - Linwood | Wayne | 2005 | 338 | 79.0 | 75.8 | 75.0 | 56.9 | 51.8 | 16.01 |
| 261630019 | 1 | FRM | Detroit - E. Seven Mile | Wayne | 2005 | 117 | 68.0 | 54.5 | 52.3 | 49.4 | 52.3 | 16.48 |
| 261630025 | 1 | FRM | Livonia | Wayne | 2005 | 114 | 67.4 | 52.7 | 40.2 | 37.5 | 40.2 | 14.94 |
| 261630033 | 1 | FRM | Dearborn | Wayne | 2005 | 115 | 71.5 | 61.1 | 50.2 | 44.8 | 50.2 | 18.55 |
| 261630033 | 5[b] | SASS | Dearborn | Wayne | 2005 | 55 | 59.0 | 52.2 | 36.6 | 35.5 | 52.2 | 19.70 |
| 261630036 | 1 | FRM | Wyandotte | Wayne | 2005 | 113 | 53.5 | 52.6 | 46.7 | 44.7 | 46.7 | 16.41 |
| 261630038 | 1 | FRM | Detroit - Newberry. | Wayne | 2005 | 75 | 66.3 | 57.5 | 52.8 | 36.9 | 57.5 | 16.41* |
| 261630039 | 1 | FRM | Detroit – W. Lafayette | Wayne | 2005 | 35 | 43.9 | 31.3 | 27.7 | 25.2 | 43.9 | 16.22* |

*Indicates the mean does not satisfy summary criteria [a] POC 2 FRM: used primarily for precision purposes. [b] POC 5: SASS - used primarily for determining particulate species.

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

| Site ID | POC | Monitor | City | County | Year | # OBS | # Req. | % OBS | Highest Value | 2nd Highest Value | 3rd Highest Value | 4th Highest Value | Wtd Arith Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 260490021 | 1 | GRAV | Flint | Genesee | 2005 | 59 | 61 | 97 | 72 | 67 | 52 | 43 | 20.5 |
| 260810007 | 1 | GRAV | Grand Rapids | Kent | 2005 | 57 | 61 | 93 | 66 | 57 | 51 | 50 | 21.4 |
| 260810020 | 1 | GRAV | Grand Rapids | Kent | 2005 | 61 | 61 | 100 | 71 | 58 | 45 | 44 | 17.8 |
| 261630001 | 1 | GRAV | Allen Park | Wayne | 2005 | 59 | 61 | 97 | 85 | 71 | 65 | 55 | 26.1 |
| 261630015 | 1 | GRAV | Detroit - W. Fort | Wayne | 2005 | 59 | 61 | 97 | 79 | 73 | 70 | 69 | 29.8 |
| 261630033 | 1 | GRAV | Dearborn | Wayne | 2005 | 55 | 61 | 90 | 95 | 87 | 84 | 79 | 39.7 |

*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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260050003 | 3 | TEOM | Holland | Allegan | 2005 | 7640 | 72 | 68 | 68 | 68 | 12.08 |
| 260170014 | 3 | TEOM | Bay City | Bay | 2005 | 729 | 55 | 54 | 53 | 52 | 16.96* |
| 260490021 | 3 | TEOM | Flint | Genesee | 2005 | 7826 | 159 | 148 | 106 | 103 | 21.00 |
| 260650012 | 3 | TEOM | Lansing | Ingham | 2005 | 8139 | 468 | 266 | 145 | 89 | 19.66 |
| 260770008 | 3 | TEOM | Kalamazoo | Kalamazoo | 2005 | 7303 | 112 | 89 | 87 | 82 | 17.80 |
| 260810020 | 3 | TEOM | Grand Rapids | Kent | 2005 | 7969 | 85 | 84 | 84 | 83 | 25.05 |
| 261130001 | 3 | TEOM | Houghton Lake | Missaukee | 2005 | 8639 | 90 | 88 | 88 | 87 | 19.36 |
| 261450018 | 3 | TEOM | Saginaw | Saginaw | 2005 | 7022 | 97 | 96 | 95 | 94 | 18.96 |
| 261470005 | 3 | TEOM | Port Huron | St. Clair | 2005 | 8710 | 128 | 128 | 126 | 124 | 25.71 |
| 261530001 | 3 | TEOM | Seney | Schoolcraft | 2005 | 8244 | 66 | 62 | 61 | 61 | 7.20 |
| 261610008 | 3 | TEOM | Ypsilanti | Washtenaw | 2005 | 8544 | 189 | 93 | 92 | 92 | 19.64 |
| 261630001 | 3 | TEOM | Allen Park | Wayne | 2005 | 8304 | 163 | 153 | 148 | 122 | 25.09 |
| 261630033 | 3 | TEOM | Dearborn | Wayne | 2005 | 8298 | 413 | 316 | 200 | 140 | 25.63 |
| 261630038 | 3 | TEOM | Detroit – Newberry | Wayne | 2005 | 5269 | 162 | 132 | 129 | 86 | 14.83 |
| 261630039 | 3 | TEOM | Detroit – W. Lafayette | Wayne | 2005 | 2463 | 73 | 70 | 68 | 68 | 20.44 |
| 261630039 | 4 | TEOM | Detroit – W. Lafayette | Wayne | 2005 | 2661 | 169 | 120 | 74 | 67 | 13.28 |

*Indicates the mean does not satisfy the criteria

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

| Site ID | POC | Monitor | City | County | Year | # OBS | Highest Value | 2nd Highest Value | 3rd Highest Value | 4th Highest Value | Wtd. Arith. Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 261630033 | 3 | TEOM | Dearborn | Wayne | 2005 | 8152 | 499 | 499 | 431 | 357 | 34.6 |

## $SO_2$ Measured in ppm

| Site ID | POC | City | County | Year | # OBS | 24-hr Highest Value | 24-hr 2nd Highest Value | OBS > 0.14 | 3-hr Highest Value | 3-hr 2nd Highest Value | OBS > 0.5 | 1-hr Highest Value | 1-hr 2nd Highest Value | Arith Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 260490021 | 1 | Flint | Genesee | 2005 | 8602 | .016 | .013 | 0 | .036 | .025 | 0 | .048 | .042 | .0021 |
| 260810020 | 1 | Grand Rapids | Kent | 2005 | 8367 | .014 | .010 | 0 | .020 | .019 | 0 | .026 | .025 | .0016 |
| 260991003 | 1 | Warren | Macomb | 2005 | 8150 | .019 | .018 | 0 | .082 | .069 | 0 | .171 | .123 | .0033 |
| 261470005 | 1 | Port Huron | St Clair | 2005 | 8716 | .046 | .045 | 0 | .122 | .117 | 0 | .201 | .171 | .0062 |
| 261530001 | 1 | Seney | Schoolcraft | 2005 | 7958 | .007 | .005 | 0 | .012 | .011 | 0 | .027 | .017 | .0011 |
| 261630015 | 1 | Detroit - W. Fort | Wayne | 2005 | 8193 | .060 | .043 | 0 | .117 | .107 | 0 | .145 | .143 | .0065 |
| 261630016 | 2 | Detroit - Linwood | Wayne | 2005 | 8044 | .026 | .025 | 0 | .102 | .095 | 0 | .176 | .122 | .0047 |
| 261630019 | 1 | Detroit - E. Seven Mile | Wayne | 2005 | 7917 | .022 | .020 | 0 | .062 | .054 | 0 | .091 | .074 | .0037 |

# APPENDIX B: PRECISION AND ACCURACY REPORT FOR 2005

**Appendix B** provides the quality assurance assessment summary for precision and accuracy of the AQD's Air Monitoring Unit (AMU) network monitors for the criteria air pollutants. The AMU follows a quality system where quality assurance project plans are developed and implemented as well as standard operating procedures to ensure that the monitoring data that is collected and reported is accurate and defendable. Precision (repeatability of a measurement) and accuracy (closeness of the measurement to a true value) are the two primary components of the quality system[48].

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

### PRECISION MEASUREMENTS

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

**PARTICULATE MONITORS:** The particulate monitors also have precision criteria in Title 40 CFR 58, but the evaluation of precision is achieved through co-located sampling. Co-located sampling is conducted by placing two monitors in the same location, sampling for the same duration, and on the same day. The closeness of the measurements to each other is how precision is evaluated.

### ACCURACY MEASUREMENTS

**GASEOUS MONITORS:** Accuracy is evaluated for gaseous monitors by the site operator conducting the two week calibration checks and the quarterly multi-point calibration gas checks. Accuracy for gaseous monitors is also evaluated by a yearly independent audit where three levels of audit gas are used to challenge the gaseous monitors. Quality Assurance Team Members conduct audits using dedicated audit equipment and gases. The assessment summary in this appendix reports the results of the accuracy calculations for Level 1, 2, and 3 of the calibration gas.

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

To insure the accuracy of AMU's monitoring equipment, all flow measurement devises, flow orifices, thermometers, and met equipment (measuring wind speed and wind direction at the sites) are recertified once a year using a certified standard. In addition, once a year the EPA laboratory certifies two of AMU's ozone generators which are then used as Reference Method instruments for AMU staff to certify the remaining ozone generators and monitors. Each ozone generator is recertified every 90 days and is independently audited at least once a year. The other gaseous pollutant monitors are calibrated every four weeks using EPA certified Protocol 1 cylinder gases for calibration and are independently audited once a year.

The MDEQ's Environmental Laboratory also conducts internal quality control tests for Pb and other metals. For the multi-metals ambient air sampling that is conducted, the MDEQ Lab analyzes several levels of metals standards. The accuracy calculations for Pb in this appendix are indicated by Level 1 and Level 2.

[48] Audits for the Sault Ste. Marie tribal sites and Seney federal IMPROVE site is not included in this report.

# 2005 DATA ASSESSMENT SUMMARY FOR THE FOLLOWING CRITERIA AIR POLLUTANTS

## CO:

| YEAR Quarter | PRECISION | | | | ACCURACY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | # of Analyzers | # of Checks | Probability Limits Lower | Probability Limits Upper | # of Audits | Level 1 Lower | Level 1 Upper | Level 2 Lower | Level 2 Upper | Level 3 Lower | Level 3 Upper |
| **2005** | **7** | **204** | **-6** | **+5** | **10** | **-8** | **+9** | **-5** | **+8** | **-5** | **+9** |
| 1st | 7 | 48 | -6 | +5 | 2 | -7 | -3 | -1 | -1 | -3 | -1 |
| 2nd | 7 | 53 | -7 | +6 | 5 | -2 | +6 | -2 | +8 | -1 | +9 |
| 3rd | 7 | 52 | -5 | +4 | 2 | -16 | +16 | -12 | +14 | -9 | +11 |
| 4th | 7 | 51 | -4 | +5 | 1 | +4 | * | +3 | * | +5 | * |

* insufficient number of analyzers to calculate accuracy.

## Pb:

| YEAR Quarter | PRECISION | | | | | | ACCURACY | | | LAB ACCURACY | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | # of Co-located Samples | # of Co-located Sites | # of Samples < Limit | Probability Limits Lower | Probability Limits Upper | # of Valid Co-located Data Pair | # of Audits | Level 2 Lower | Level 2 Upper | # of Audits | Level 1 Lower | Level 1 Upper | Level 2 Lower | Level 2 Upper |
| **2005** | **51** | **1** | **51** | ***** | ***** | **0** | **13** | **-6** | **+8** | **24** | **-3** | **+10** | **-8** | **+8** |
| 1st | 13 | 1 | 13 | * | * | 0 | 2 | -1 | +6 | 6 | -5 | +14 | -3 | +10 |
| 2nd | 12 | 1 | 12 | * | * | 0 | 3 | -8 | +8 | 6 | -1 | +8 | -7 | +4 |
| 3rd | 12 | 1 | 12 | * | * | 0 | 6 | -8 | +6 | 6 | -3 | +12 | -10 | +11 |
| 4th | 14 | 1 | 14 | * | * | 0 | 2 | -5 | +12 | 6 | -3 | +5 | -8 | +3 |

* measurements less than EPA's limit; cannot estimate precision

## $NO_2$:

| YEAR Quarter | PRECISION | | | | ACCURACY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | # of Analyzers | # of Checks | Probability Limits Lower | Probability Limits Upper | # of Audits | Level 1 Lower | Level 1 Upper | Level 2 Lower | Level 2 Upper | Level 3 Lower | Level 3 Upper |
| **2005** | **3** | **77** | **-5** | **+7** | **4** | **-20** | **+1** | **-10** | **-1** | **-8** | **+1** |
| 1st | 3 | 19 | -4 | +8 | 1 | -13 | * | -6 | * | -3 | * |
| 2nd | 3 | 21 | -7 | +7 | 1 | -1 | * | -2 | * | -1 | * |
| 3rd | 3 | 19 | -4 | +6 | 0 | * | * | * | * | * | * |
| 4th | 3 | 18 | -5 | +9 | 2 | -13 | -9 | -7 | -6 | -7 | -3 |

* insufficient number of checks to calculate accuracy.

## $O_3$:

| YEAR | PRECISION | | | | ACCURACY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quarter | # of Analyzers | # of Checks | Probability Limits Lower | Probability Limits Upper | # of Audits | Level 1 Lower | Level 1 Upper | Level 2 Lower | Level 2 Upper | Level 3 Lower | Level 3 Upper |
| **2005** | **27** | **386** | **-3** | **+4** | **28** | **-3** | **+5** | **-3** | **+5** | **-3** | **+5** |
| 1st | No data due to ozone season | | | | | | | | | | |
| 2nd | 27 | 195 | -3 | +4 | 14 | -2 | +5 | -2 | +5 | -2 | +5 |
| 3rd | 27 | 191 | -3 | +4 | 14 | -4 | +4 | -4 | +4 | -4 | +4 |
| 4th | No data due to ozone season | | | | | | | | | | |

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

## $PM_{10}$:

| YEAR | PRECISION | | | | | | ACCURACY | | |
|---|---|---|---|---|---|---|---|---|---|
| Quarter | # of Co-located Samples | # of Co-located Sites | # of Samples < Limit | 95% Probability Limits Lower | 95% Probability Limits Upper | # of Valid Co-located Data Pairs | # of Audits | Probability Lower | Probability Upper |
| **2005** | **105** | **2** | **41** | **-17** | **+24** | **64** | **9** | **-8** | **+8** |
| 1st | 25 | 2 | 14 | -28 | +18 | 11 | 2 | -10 | +9 |
| 2nd | 25 | 2 | 5 | -17 | +25 | 20 | 2 | -7 | +1 |
| 3rd | 27 | 2 | 9 | -14 | +35 | 18 | 2 | -8 | +5 |
| 4th | 28 | 2 | 13 | -8 | +12 | 15 | 3 | -7 | +12 |

## $PM_{2.5}$:

| YEAR | PRECISION | | | | | | ACCURACY | | |
|---|---|---|---|---|---|---|---|---|---|
| Quarter | # of Co-located Samples | # of Co-located Sites | # of Samples < Limit | 95% Probability Limits Lower | 95% Probability Limits Upper | # of Valid Co-located Data Pairs | # of Audits | Probability Lower | Probability Upper |
| **2005** | **266** | **6** | **62** | **-7** | **+8** | **204** | **130** | **-2** | **+2** |
| 1st | 68 | 5 | 13 | -6 | +8 | 55 | 32 | -2 | +2 |
| 2nd | 67 | 5 | 17 | -6 | +6 | 50 | 33 | -3 | +3 |
| 3rd | 77 | 6 | 13 | -8 | +9 | 64 | 33 | -2 | +2 |
| 4th | 54 | 4 | 19 | -7 | +6 | 35 | 32 | -3 | +2 |

## $SO_2$:

| YEAR | PRECISION | | | | ACCURACY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quarter | # of Analyzers | # of Checks | Probability Limits Lower | Probability Limits Upper | # of Audits | Level 1 Lower | Level 1 Upper | Level 2 Lower | Level 2 Upper | Level 3 Lower | Level 3 Upper |
| **2005** | **8** | **203** | **-5** | **+5** | **9** | **-16** | **+15** | **-10** | **+16** | **-8** | **+16** |
| 1st | 8 | 48 | -4 | +6 | 2 | -15 | -1 | -7 | -1 | -3 | -0 |
| 2nd | 8 | 53 | -6 | +5 | 4 | -14 | +15 | -8 | +17 | -7 | +17 |
| 3rd | 8 | 53 | -5 | +4 | 1 | +3 | * | +3 | * | +5 | * |
| 4th | 8 | 49 | -5 | +3 | 2 | -22 | +30 | -16 | +28 | -13 | +25 |

* insufficient number of checks to calculate accuracy.

# APPENDIX C: 2005 AIR TOXICS MONITORING SUMMARY FOR METALS, VOCS, CARBONYL COMPOUNDS, & SPECIATED $PM_{2.5}$

**Appendix C** provides summary statistics of ambient air concentrations of various substances monitored in Michigan during 2005. At each monitoring site, air samples were taken over a 24-hour period (midnight to midnight); a calendar day. These air samples are called "observations" and represent the average air concentration during that 24-hour period. The frequency of observation varies by site and chemical substance, but was typically done once every 6 or 12 days. For some substances the sampled air concentration was lower than the laboratory's analytical MDL. Air concentrations that are lower than the MDL are given the value of "non-detect." Each substance analyzed has its own MDL, which varies from laboratory to laboratory and from year to year. The cited MDLs represent the detection limits that are routinely attained. In the calculation of the minimum and maximum annual averages (also called "means"), zero (0.0 $\mu g/m^3$) or the MDL, respectively, are substituted for non-detected air contaminant levels. The 2005 data in this appendix are divided into two sections:

**Appendix C-1** summarizes the air concentrations of various metals (TSP), VOCs, and carbonyls; and **Appendix C-2** summarizes the air concentrations of various metals found in speciated $PM_{2.5}$.

**Table C-1** shows the monitoring stations and what was monitored at each station.

**Table C-1: Monitoring Station and Type of Monitoring Conducted**

| SITE NAME | AIRS ID | APPENDIX C-1 | | | | APPENDIX C-2 |
|---|---|---|---|---|---|---|
| | | VOC | Carbonyl | Metals TSP | Metals $PM_{10}$ | Speciated $PM_{2.5}$ |
| Allen Park | 261630001 | | | √ | | √ |
| Dearborn | 261630033 | √ | √ | √ | √ | √ |
| Detroit - E. Seven Mile | 261630019 | √ | √ | √ | | |
| Detroit - W. Fort | 261630015 | √ | √ | √ | | |
| Detroit - W. Jefferson | 261630027 | √ | | √ | | |
| Flint | 260490021 | | | √ | | |
| Grand Rapids - Monroe | 260810020 | | | | | √ |
| Holland | 260050003 | | | | | √ |
| Houghton Lake | 261130001 | √ | √ | √ | | √ |
| Kalamazoo | 260770008 | | | | | √ |
| Sault Ste. Marie - Easterday | 260330901 | | | | | √ |
| Luna Pier | 261150005 | | | | | √ |
| River Rouge | 261630005 | | √ | √ | | |
| Ypsilanti | 261610008 | √ | √ | √ | | √ |

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

**MDL:** Analytical MDL in units of $\mu g/m^3$
**# Obs:** Number of Observations (number of daily air samples taken during the year)
**Num > MDL:** Number of daily samples above the MDL
**Max1:** highest daily air concentration during 2005
**Max2:** second highest daily air concentration during 2005
**Max3:** third highest daily air concentration during 2005
**Min Mean:** average air concentration, assuming daily samples below MDL were equal to 0.0 $\mu g/m^3$.
**Max Mean:** average air concentration, assuming daily samples below MDL were equal to MDL.
**AIRS ID:** Aerometric Information Retrieval System identification number used by EPA and MDEQ to identify each monitoring site.

# APPENDIX C1: AIR TOXICS SUMMARY FOR METALS, VOCS, & CARBONYL COMPOUNDS

| ALLEN PARK | | | AIRS ID: 261630001 | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **# Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Arsenic (TSP) | 59 | 59 | 0.0000648 | 0.0104 | 0.00706 | 0.00502 | 0.00175 | 0.00175 |
| Barium (TSP) | 60 | 60 | 0.000533 | 0.189 | 0.159 | 0.156 | 0.117 | 0.117 |
| Beryllium (TSP) | 60 | 60 | 0.0000664 | 0.0000486 | 0.0000467 | 0.0000435 | 0.0000216 | 0.0000216 |
| Cadmium (TSP) | 59 | 59 | 0.0000648 | 0.00217 | 0.00084 | 0.00071 | 0.000321 | 0.000321 |
| Chromium (TSP) | 59 | 59 | 0.000232 | 0.0234 | 0.0125 | 0.00807 | 0.00534 | 0.00534 |
| Cobalt (TSP) | 59 | 59 | 0.0000622 | 0.00058 | 0.00052 | 0.000505 | 0.00024 | 0.00024 |
| Copper (TSP) | 60 | 60 | 0.000754 | 0.537 | 0.513 | 0.466 | 0.242 | 0.242 |
| Iron (TSP) | 60 | 60 | 0.000457 | 1.78 | 1.6 | 1.43 | 0.707 | 0.707 |
| Lead (TSP) | 59 | 59 | 0.000102 | 0.025 | 0.0221 | 0.0206 | 0.00922 | 0.00922 |
| Manganese (TSP) | 60 | 60 | 0.000189 | 0.104 | 0.0825 | 0.066 | 0.0284 | 0.0284 |
| Molybdenum (TSP) | 59 | 59 | 0.0000863 | 0.00229 | 0.00209 | 0.00198 | 0.00106 | 0.00106 |
| Nickel (TSP) | 59 | 59 | 0.000194 | 0.0223 | 0.00717 | 0.00702 | 0.00271 | 0.00271 |
| Vanadium (TSP) | 59 | 59 | 0.0000885 | 0.0231 | 0.0136 | 0.0134 | 0.0034 | 0.0034 |
| Zinc (TSP) | 60 | 60 | 0.000259 | 0.178 | 0.157 | 0.152 | 0.071 | 0.071 |
| 2,5-dimethylbenzaldehyde | 19 | 1 | 0.0116 | 0.0712 | 0 | 0 | 0.00375 | 0.0147 |
| Acetaldehyde | 19 | 19 | 0.0218 | 4.63 | 2.29 | 2.22 | 1.56 | 1.56 |
| Acetone | 19 | 19 | 0.0166 | 6.84 | 4.8 | 4.2 | 2.83 | 2.83 |
| Benzaldehyde | 19 | 19 | 0.013 | 0.295 | 0.169 | 0.156 | 0.109 | 0.109 |
| Crotonaldehyde | 19 | 17 | 0.0115 | 0.149 | 0.106 | 0.0889 | 0.06 | 0.0613 |
| Formaldehyde | 19 | 19 | 0.0173 | 5.37 | 4.54 | 2.74 | 2.08 | 2.08 |
| Hexanaldehyde | 19 | 19 | 0.00819 | 0.164 | 0.16 | 0.143 | 0.0949 | 0.0949 |
| Isovaleraldehyde | 19 | 4 | 0.0106 | 0.127 | 0.0317 | 0.0317 | 0.0111 | 0.0195 |
| Propionaldehyde | 19 | 19 | 0.0119 | 3.56 | 0.672 | 0.449 | 0.431 | 0.431 |
| Valeraldehyde | 19 | 18 | 0.0106 | 0.197 | 0.18 | 0.155 | 0.0836 | 0.0842 |
| 1,1,1-Trichloroethane | 30 | 17 | 0.229 | 0.273 | 0.273 | 0.218 | 0.102 | 0.22 |
| 1,1,2,2-Tetrachloroethane | 30 | 0 | 0.321 | 0 | 0 | 0 | 0 | 0.321 |
| 1,1,2-Trichloroethane | 30 | 0 | 0.351 | 0 | 0 | 0 | 0 | 0.351 |
| 1,1-Dichloroethane | 30 | 0 | 0.17 | 0 | 0 | 0 | 0 | 0.17 |
| 1,1-Dichloroethene | 30 | 0 | 0.186 | 0 | 0 | 0 | 0 | 0.186 |
| 1,2,4-Trichlorobenzene | 30 | 2 | 1.26 | 0.223 | 0.148 | 0 | 0.0124 | 1.2 |
| 1,2,4-Trimethylbenzene | 30 | 22 | 0.293 | 6.1 | 4.28 | 2.21 | 1.07 | 1.15 |
| 1,2-Dibromoethane | 30 | 0 | 0.345 | 0 | 0 | 0 | 0 | 0.345 |
| 1,2-Dichlorobenzene | 30 | 1 | 0.275 | 0.0601 | 0 | 0 | 0.002 | 0.264 |
| 1,2-Dichloroethane | 30 | 0 | 0.209 | 0 | 0 | 0 | 0 | 0.209 |
| 1,2-Dichloropropane | 30 | 0 | 0.273 | 0 | 0 | 0 | 0 | 0.273 |
| 1,3,5-Trimethylbenzene | 30 | 19 | 0.183 | 1.77 | 1.23 | 0.688 | 0.326 | 0.397 |
| 1,3-Butadiene | 30 | 17 | 0.126 | 0.974 | 0.929 | 0.398 | 0.17 | 0.227 |
| 1,3-Dichlorobenzene | 30 | 1 | 0.374 | 0.0601 | 0 | 0 | 0.002 | 0.367 |
| 1,4-Dichlorobenzene | 30 | 11 | 0.358 | 0.541 | 0.361 | 0.12 | 0.0641 | 0.293 |
| 2-Chloro-1,3-Butadiene | 30 | 0 | 0.163 | 0 | 0 | 0 | 0 | 0.163 |
| Acetonitrile | 30 | 7 | 0.173 | 472 | 113 | 50.7 | 22 | 22.1 |
| Acrylonitrile | 30 | 0 | 0.151 | 0 | 0 | 0 | 0 | 0.151 |
| Benzene | 30 | 30 | 0.135 | 8.5 | 8.37 | 3.58 | 2.21 | 2.21 |
| Bromodichloromethane | 30 | 0 | 0.248 | 0 | 0 | 0 | 0 | 0.248 |
| Bromoform | 30 | 0 | 0.51 | 0 | 0 | 0 | 0 | 0.51 |
| Bromomethane | 30 | 7 | 0.194 | 0.117 | 0.0777 | 0.0777 | 0.0156 | 0.164 |
| Carbon Tetrachloride | 30 | 28 | 0.344 | 0.818 | 0.818 | 0.818 | 0.6 | 0.625 |
| Chlorobenzene | 30 | 0 | 0.159 | 0 | 0 | 0 | 0 | 0.159 |
| Chloroethane | 30 | 8 | 0.228 | 0.132 | 0.106 | 0.106 | 0.0211 | 0.21 |
| Chloroform | 30 | 14 | 0.181 | 0.83 | 0.781 | 0.537 | 0.185 | 0.288 |
| Chloromethane | 30 | 30 | 0.109 | 1.76 | 1.69 | 1.59 | 1.34 | 1.34 |
| Chloromethyl Benzene | 30 | 0 | 0.233 | 0 | 0 | 0 | 0 | 0.233 |
| cis-1,2-Dichloroethene | 30 | 0 | 0.198 | 0 | 0 | 0 | 0 | 0.198 |
| cis-1,3-Dichloropropene | 30 | 0 | 0.194 | 0 | 0 | 0 | 0 | 0.194 |
| Dibromochloromethane | 30 | 0 | 0.488 | 0 | 0 | 0 | 0 | 0.488 |
| Dichlorodiflouromethane | 30 | 30 | 0.124 | 4.15 | 4.06 | 4.01 | 3.34 | 3.34 |
| Ethylbenzene | 30 | 30 | 0.151 | 3.87 | 2.87 | 1.91 | 0.926 | 0.926 |
| Halocarbon 114 | 30 | 15 | 0.176 | 0.14 | 0.14 | 0.14 | 0.0677 | 0.173 |
| Hexachloro-1,3-Butadiene | 30 | 4 | 2.19 | 0.213 | 0.107 | 0.107 | 0.0178 | 1.74 |

| ALLEN PARK | | | AIRS ID: 261630001 | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| m/p -Xylene | 30 | 30 | 0.194 | 11.3 | 8.29 | 5.52 | 2.54 | 2.54 |
| Methyl Ethyl Ketone | 30 | 2 | 0.348 | 1.5 | 1.03 | 0 | 0.0843 | 0.403 |
| Methyl Isobutyl Ketone | 30 | 1 | 0.296 | 0.205 | 0 | 0 | 0.00683 | 0.296 |
| Methyl Tert-Butyl Ether | 30 | 0 | 0.241 | 0 | 0 | 0 | 0 | 0.241 |
| Methylene Chloride | 30 | 21 | 0.241 | 1.08 | 0.868 | 0.799 | 0.342 | 0.42 |
| o-xylene | 30 | 29 | 0.16 | 4.95 | 3.73 | 2.21 | 1.06 | 1.06 |
| Styrene | 30 | 17 | 0.157 | 0.682 | 0.469 | 0.383 | 0.143 | 0.217 |
| Tetrachloroethene | 30 | 30 | 0.289 | 100 | 95.6 | 77.3 | 18.4 | 18.4 |
| Toluene | 30 | 30 | 0.16 | 26.2 | 23.2 | 10.1 | 5.65 | 5.65 |
| trans-1,2-Dichloroethene | 30 | 0 | 0.187 | 0 | 0 | 0 | 0 | 0.187 |
| trans-1,3-Dichloropropene | 30 | 0 | 0.214 | 0 | 0 | 0 | 0 | 0.214 |
| Trichloroethene | 30 | 7 | 0.255 | 0.484 | 0.215 | 0.161 | 0.043 | 0.244 |
| Trichloroflouromethane | 30 | 30 | 0.197 | 2.13 | 2.13 | 2.02 | 1.71 | 1.71 |
| Vinyl Chloride | 30 | 0 | 0.102 | 0 | 0 | 0 | 0 | 0.102 |

| DEARBORN | | | AIRS ID: 261630033 | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Arsenic (TSP) | 56 | 56 | 0.0000605 | 0.00489 | 0.00488 | 0.00382 | 0.00197 | 0.00197 |
| Arsenic ($PM_{10}$) | 55 | 55 | 0.0000686 | 0.00632 | 0.00589 | 0.00396 | 0.00202 | 0.00202 |
| Barium (TSP) | 56 | 56 | 0.000531 | 0.133 | 0.122 | 0.121 | 0.0953 | 0.0953 |
| Barium ($PM_{10}$) | 55 | 55 | 0.000138 | 0.0556 | 0.0487 | 0.0409 | 0.023 | 0.023 |
| Beryllium (TSP) | 56 | 56 | 0.0000628 | 0.000424 | 0.00038 | 0.000307 | 0.000115 | 0.000115 |
| Beryllium ($PM_{10}$) | 55 | 54 | 0.000104 | 0.000238 | 0.00012 | 0.000118 | 0.0000451 | 0.0000456 |
| Cadmium (TSP) | 56 | 56 | 0.0000607 | 0.00181 | 0.00158 | 0.00141 | 0.000648 | 0.000648 |
| Cadmium ($PM_{10}$) | 55 | 55 | 0.0000689 | 0.00283 | 0.00253 | 0.00169 | 0.000741 | 0.000741 |
| Chromium (TSP) | 56 | 56 | 0.000219 | 0.0159 | 0.0136 | 0.0134 | 0.00724 | 0.00724 |
| Chromium ($PM_{10}$) | 55 | 55 | 0.000252 | 0.0119 | 0.00758 | 0.00673 | 0.00414 | 0.00414 |
| Cobalt (TSP) | 56 | 56 | 0.0000582 | 0.00117 | 0.00097 | 0.00093 | 0.00043 | 0.00043 |
| Cobalt ($PM_{10}$) | 55 | 55 | 0.0000663 | 0.00102 | 0.000869 | 0.00082 | 0.000374 | 0.000374 |
| Copper (TSP) | 56 | 56 | 0.000731 | 0.784 | 0.39 | 0.364 | 0.19 | 0.19 |
| Copper ($PM_{10}$) | 55 | 55 | 0.000761 | 0.378 | 0.103 | 0.089 | 0.0507 | 0.0507 |
| Iron (TSP) | 56 | 56 | 0.000447 | 5.22 | 4.84 | 4.55 | 2.03 | 2.03 |
| Iron ($PM_{10}$) | 55 | 55 | 0.000543 | 3.35 | 2.66 | 2.41 | 1.15 | 1.15 |
| Lead (TSP) | 56 | 56 | 0.0000961 | 0.118 | 0.0467 | 0.0446 | 0.0223 | 0.0223 |
| Lead ($PM_{10}$) | 55 | 55 | 0.00011 | 0.132 | 0.0397 | 0.0383 | 0.0198 | 0.0198 |
| Manganese (TSP) | 56 | 56 | 0.000181 | 0.631 | 0.542 | 0.329 | 0.144 | 0.144 |
| Manganese ($PM_{10}$) | 55 | 55 | 0.000245 | 0.216 | 0.174 | 0.171 | 0.0697 | 0.0697 |
| Molybdenum (TSP) | 56 | 56 | 0.0000807 | 0.0128 | 0.00733 | 0.00298 | 0.00165 | 0.00165 |
| Molybdenum ($PM_{10}$) | 55 | 55 | 0.0000917 | 0.0139 | 0.00721 | 0.00304 | 0.00157 | 0.00157 |
| Nickel (TSP) | 56 | 56 | 0.000189 | 0.0321 | 0.0161 | 0.0099 | 0.00426 | 0.00426 |
| Nickel ($PM_{10}$) | 55 | 55 | 0.000226 | 0.0345 | 0.0141 | 0.01 | 0.00412 | 0.00412 |
| Vanadium (TSP) | 56 | 56 | 0.000083 | 0.0325 | 0.0133 | 0.0101 | 0.00564 | 0.00564 |
| Vanadium ($PM_{10}$) | 55 | 55 | 0.0000947 | 0.043 | 0.0111 | 0.0103 | 0.00432 | 0.00432 |
| Zinc (TSP) | 56 | 56 | 0.000258 | 0.798 | 0.755 | 0.752 | 0.249 | 0.249 |
| Zinc ($PM_{10}$) | 55 | 55 | 0.0000673 | 0.556 | 0.531 | 0.51 | 0.192 | 0.192 |
| 2,5-dimethylbenzaldehyde | 9 | 0 | 0.0518 | 0 | 0 | 0 | 0 | 0.0518 |
| Acetaldehyde | 9 | 9 | 0.0229 | 2.95 | 2.88 | 2.2 | 1.92 | 1.92 |
| Acetone | 9 | 9 | 0.0738 | 5.09 | 4.26 | 3.65 | 3.02 | 3.02 |
| Benzaldehyde | 9 | 0 | 0.0211 | 0 | 0 | 0 | 0 | 0.0211 |
| Crotonaldehyde | 9 | 0 | 0.0123 | 0 | 0 | 0 | 0 | 0.0123 |
| Formaldehyde | 9 | 9 | 0.0246 | 11.1 | 11 | 7.52 | 5.3 | 5.3 |
| Hexanaldehyde | 9 | 0 | 0.0405 | 0 | 0 | 0 | 0 | 0.0405 |
| Isovaleraldehyde | 9 | 0 | 0.0255 | 0 | 0 | 0 | 0 | 0.0255 |
| m,p-Tolualdehyde | 9 | 0 | 0.0387 | 0 | 0 | 0 | 0 | 0.0387 |
| n-Butyraldehyde | 9 | 3 | 0.0132 | 0.779 | 0.581 | 0.484 | 0.205 | 0.214 |
| o-Tolualdehyde | 9 | 0 | 0.0324 | 0 | 0 | 0 | 0 | 0.0324 |
| Propionaldehyde | 9 | 5 | 0.0378 | 0.478 | 0.437 | 0.432 | 0.224 | 0.241 |
| Valeraldehyde | 9 | 0 | 0.0387 | 0 | 0 | 0 | 0 | 0.0387 |
| 1,1,1-Trichloroethane | 39 | 1 | 1.12 | 0.109 | 0 | 0 | 0.00279 | 1.12 |
| 1,1,2,2-Tetrachloroethane | 39 | 0 | 1.41 | 0 | 0 | 0 | 0 | 1.41 |

| DEARBORN | AIRS ID: 261630033 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| 1,1,2-Trichloroethane | 39 | 0 | 1.18 | 0 | 0 | 0 | 0 | 1.18 |
| 1,1-Dichloroethane | 39 | 0 | 0.842 | 0 | 0 | 0 | 0 | 0.842 |
| 1,1-Dichloroethene | 39 | 0 | 0.838 | 0 | 0 | 0 | 0 | 0.838 |
| 1,2,4-Trichlorobenzene | 39 | 0 | 1.89 | 0 | 0 | 0 | 0 | 1.89 |
| 1,2,4-Trimethylbenzene | 39 | 21 | 1.02 | 2.36 | 1.72 | 1.4 | 0.507 | 1.05 |
| 1,2-Dibromoethane | 39 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| 1,2-Dichlorobenzene | 39 | 0 | 1.24 | 0 | 0 | 0 | 0 | 1.24 |
| 1,2-Dichloroethane | 39 | 0 | 0.856 | 0 | 0 | 0 | 0 | 0.856 |
| 1,2-Dichloropropane | 39 | 0 | 1.01 | 0 | 0 | 0 | 0 | 1.01 |
| 1,3,5-Trimethylbenzene | 39 | 9 | 0.989 | 0.787 | 0.639 | 0.4 | 0.0897 | 1 |
| 1,3-Butadiene | 39 | 6 | 0.465 | 0.35 | 0.31 | 0.22 | 0.035 | 0.439 |
| 1,3-Dichlorobenzene | 39 | 0 | 1.3 | 0 | 0 | 0 | 0 | 1.3 |
| 1,4-Dichlorobenzene | 39 | 2 | 1.28 | 0.41 | 0.18 | 0 | 0.0151 | 1.24 |
| 2,2,4-Trimethylpentane | 25 | 20 | 1.4 | 1 | 0.99 | 0.92 | 0.48 | 0.76 |
| 2-Chloro-1,3-Butadiene | 39 | 0 | 0.768 | 0 | 0 | 0 | 0 | 0.768 |
| Acetonitrile | 38 | 23 | 1.45 | 43 | 34 | 33.6 | 6.84 | 7.08 |
| Acrylonitrile | 39 | 3 | 0.765 | 0.58 | 0.54 | 0.43 | 0.0397 | 0.723 |
| Benzene | 39 | 38 | 0.659 | 4.6 | 3.39 | 2.3 | 1.38 | 1.41 |
| Bromodichloromethane | 39 | 0 | 1.38 | 0 | 0 | 0 | 0 | 1.38 |
| Bromoform | 39 | 0 | 2.17 | 0 | 0 | 0 | 0 | 2.17 |
| Bromomethane | 39 | 1 | 0.78 | 1.2 | 0 | 0 | 0.0308 | 0.782 |
| Carbon Tetrachloride | 39 | 31 | 1.32 | 0.944 | 0.818 | 0.7 | 0.464 | 0.846 |
| Chlorobenzene | 39 | 1 | 0.94 | 0.184 | 0 | 0 | 0.00472 | 0.94 |
| Chloroethane | 39 | 1 | 0.592 | 0.158 | 0 | 0 | 0.00405 | 0.589 |
| Chloroform | 39 | 21 | 0.967 | 1.76 | 1.5 | 1.37 | 0.391 | 0.759 |
| Chloromethane | 39 | 39 | 0.427 | 2.46 | 2.3 | 1.9 | 1.41 | 1.41 |
| Chloromethyl Benzene | 39 | 0 | 1.05 | 0 | 0 | 0 | 0 | 1.05 |
| cis-1,2-Dichloroethene | 39 | 0 | 0.852 | 0 | 0 | 0 | 0 | 0.852 |
| cis-1,3-Dichloropropene | 39 | 0 | 0.915 | 0 | 0 | 0 | 0 | 0.915 |
| Dibromochloromethane | 39 | 0 | 1.82 | 0 | 0 | 0 | 0 | 1.82 |
| Dichlorodiflouromethane | 39 | 39 | 0.992 | 4.3 | 4.25 | 4.15 | 2.99 | 2.99 |
| Ethylbenzene | 39 | 25 | 0.896 | 1.95 | 1.1 | 1.09 | 0.397 | 0.835 |
| Halocarbon 113 | 25 | 5 | 2.26 | 0.96 | 0.93 | 0.7 | 0.152 | 1.95 |
| Halocarbon 114 | 39 | 8 | 1.4 | 4.3 | 3.9 | 3.7 | 0.523 | 1.6 |
| Hexachloro-1,3-Butadiene | 39 | 0 | 2.62 | 0 | 0 | 0 | 0 | 2.62 |
| m/p -Xylene | 39 | 37 | 0.911 | 5.04 | 3.3 | 2.91 | 1.41 | 1.48 |
| Methyl Ethyl Ketone | 39 | 25 | 9.34 | 7.9 | 3.1 | 2.8 | 1.15 | 2.72 |
| Methyl Isobutyl Ketone | 39 | 3 | 2.68 | 0.97 | 0.88 | 0.75 | 0.0667 | 2.44 |
| Methyl Tert-Butyl Ether | 39 | 0 | 1.24 | 0 | 0 | 0 | 0 | 1.24 |
| Methylene Chloride | 39 | 12 | 0.741 | 5 | 3.3 | 2.4 | 0.383 | 0.964 |
| n-Hexane | 25 | 24 | 3.46 | 3.8 | 2.4 | 2.2 | 1.08 | 1.22 |
| o-xylene | 39 | 31 | 0.896 | 2.21 | 1.35 | 1 | 0.488 | 0.755 |
| Styrene | 39 | 11 | 0.866 | 0.724 | 0.639 | 0.511 | 0.102 | 0.863 |
| Tetrachloroethene | 39 | 28 | 1.4 | 9.97 | 9.5 | 9.29 | 2.47 | 2.95 |
| Toluene | 39 | 39 | 0.773 | 13.3 | 6.03 | 5.2 | 2.91 | 2.91 |
| trans-1,2-Dichloroethene | 39 | 0 | 0.838 | 0 | 0 | 0 | 0 | 0.838 |
| trans-1,3-Dichloropropene | 39 | 0 | 0.915 | 0 | 0 | 0 | 0 | 0.915 |
| Trichloroethene | 39 | 0 | 1.12 | 0 | 0 | 0 | 0 | 1.12 |
| Trichloroflouromethane | 39 | 39 | 1.14 | 16 | 3.2 | 2.53 | 2.19 | 2.19 |
| Vinyl Chloride | 39 | 0 | 0.519 | 0 | 0 | 0 | 0 | 0.519 |

| DETROIT - E. Seven Mile | AIRS ID: 261630019 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Arsenic (TSP) | 56 | 56 | 0.0000629 | 0.0122 | 0.00739 | 0.00601 | 0.00187 | 0.00187 |
| Barium (TSP) | 56 | 56 | 0.00056 | 0.157 | 0.149 | 0.133 | 0.107 | 0.107 |
| Beryllium (TSP) | 56 | 56 | 0.0000664 | 0.000206 | 0.000131 | 0.000126 | 0.0000372 | 0.0000372 |
| Cadmium (TSP) | 56 | 56 | 0.0000631 | 0.00199 | 0.00125 | 0.00109 | 0.000441 | 0.000441 |
| Chromium (TSP) | 56 | 56 | 0.00023 | 0.0092 | 0.00696 | 0.00683 | 0.00458 | 0.00458 |
| Cobalt (TSP) | 56 | 56 | 0.0000607 | 0.00101 | 0.000866 | 0.0008 | 0.000328 | 0.000328 |
| Copper (TSP) | 56 | 56 | 0.000812 | 0.369 | 0.306 | 0.282 | 0.0936 | 0.0936 |

| DETROIT - E. Seven Mile | AIRS ID: 261630019 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Iron (TSP) | 57 | 57 | 0.000547 | 2.5 | 1.79 | 1.54 | 0.669 | 0.669 |
| Lead (TSP) | 56 | 56 | 0.000101 | 0.0254 | 0.0254 | 0.0241 | 0.0114 | 0.0114 |
| Manganese (TSP) | 56 | 56 | 0.000196 | 0.106 | 0.0888 | 0.0873 | 0.0292 | 0.0292 |
| Molybdenum (TSP) | 56 | 56 | 0.000084 | 0.00249 | 0.00219 | 0.00209 | 0.00105 | 0.00105 |
| Nickel (TSP) | 56 | 56 | 0.000206 | 0.0125 | 0.00743 | 0.00604 | 0.00291 | 0.00291 |
| Vanadium (TSP) | 56 | 56 | 0.0000867 | 0.045 | 0.0203 | 0.0159 | 0.00436 | 0.00436 |
| Zinc (TSP) | 56 | 56 | 0.000272 | 1.08 | 0.257 | 0.218 | 0.119 | 0.119 |

| DETROIT - W. Fort | AIRS ID: 261630015 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Arsenic (TSP) | 61 | 61 | 0.0000642 | 0.0152 | 0.00679 | 0.00531 | 0.00227 | 0.00227 |
| Barium (TSP) | 61 | 61 | 0.000551 | 0.172 | 0.158 | 0.154 | 0.115 | 0.115 |
| Beryllium (TSP) | 61 | 61 | 0.0000676 | 0.000286 | 0.000228 | 0.000199 | 0.0000792 | 0.0000792 |
| Cadmium (TSP) | 61 | 61 | 0.0000643 | 0.0112 | 0.00366 | 0.00207 | 0.00102 | 0.00102 |
| Chromium (TSP) | 61 | 61 | 0.000233 | 0.353 | 0.157 | 0.0794 | 0.018 | 0.018 |
| Cobalt (TSP) | 61 | 61 | 0.0000618 | 0.00422 | 0.00345 | 0.00238 | 0.000621 | 0.000621 |
| Copper (TSP) | 61 | 61 | 0.000798 | 1.3 | 0.687 | 0.57 | 0.272 | 0.272 |
| Iron (TSP) | 61 | 61 | 0.000478 | 9.99 | 6.96 | 6.63 | 2.1 | 2.1 |
| Lead (TSP) | 61 | 61 | 0.000102 | 0.0458 | 0.0447 | 0.0446 | 0.0191 | 0.0191 |
| Manganese (TSP) | 61 | 61 | 0.000196 | 3.61 | 0.82 | 0.457 | 0.163 | 0.163 |
| Molybdenum (TSP) | 61 | 61 | 0.0000857 | 0.00549 | 0.00389 | 0.00297 | 0.00164 | 0.00164 |
| Nickel (TSP) | 61 | 61 | 0.000203 | 0.527 | 0.219 | 0.105 | 0.0207 | 0.0207 |
| Vanadium (TSP) | 61 | 60 | 0.0000882 | 0.0507 | 0.0142 | 0.0139 | 0.00597 | 0.00597 |
| Zinc (TSP) | 61 | 61 | 0.000268 | 0.393 | 0.377 | 0.272 | 0.128 | 0.128 |
| 2,5-dimethylbenzaldehyde | 10 | 0 | 0.119 | 0 | 0 | 0 | 0 | 0.119 |
| Acetaldehyde | 10 | 10 | 0.0523 | 4.37 | 2.21 | 2.01 | 1.72 | 1.72 |
| Acetone | 10 | 10 | 0.169 | 9.07 | 6.25 | 5.31 | 4.26 | 4.26 |
| Benzaldehyde | 10 | 0 | 0.0484 | 0 | 0 | 0 | 0 | 0.0484 |
| Crotonaldehyde | 10 | 0 | 0.0282 | 0 | 0 | 0 | 0 | 0.0282 |
| Formaldehyde | 10 | 10 | 0.0563 | 3.9 | 2.07 | 1.72 | 1.62 | 1.62 |
| Hexanaldehyde | 10 | 0 | 0.0927 | 0 | 0 | 0 | 0 | 0.0927 |
| Isovaleraldehyde | 10 | 0 | 0.0585 | 0 | 0 | 0 | 0 | 0.0585 |
| m,p-Tolualdehyde | 10 | 0 | 0.0886 | 0 | 0 | 0 | 0 | 0.0886 |
| n-Butyraldehyde | 10 | 1 | 0.0302 | 0.858 | 0 | 0 | 0.0858 | 0.113 |
| o-Tolualdehyde | 10 | 0 | 0.0746 | 0 | 0 | 0 | 0 | 0.0746 |
| Propionaldehyde | 10 | 0 | 0.0867 | 0 | 0 | 0 | 0 | 0.0867 |
| Valeraldehyde | 10 | 0 | 0.0886 | 0 | 0 | 0 | 0 | 0.0886 |
| 1,1,1-Trichloroethane | 25 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| 1,1,2,2-Tetrachloroethane | 25 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| 1,1,2-Trichloroethane | 25 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| 1,1-Dichloroethane | 25 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,1-Dichloroethene | 25 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,2,4-Trichlorobenzene | 25 | 0 | 2.2 | 0 | 0 | 0 | 0 | 2.2 |
| 1,2,4-Trimethylbenzene | 25 | 10 | 1.43 | 1.2 | 1.1 | 0.82 | 0.288 | 1.15 |
| 1,2-Dibromoethane | 25 | 0 | 2.28 | 0 | 0 | 0 | 0 | 2.28 |
| 1,2-Dichlorobenzene | 25 | 0 | 1.79 | 0 | 0 | 0 | 0 | 1.79 |
| 1,2-Dichloroethane | 25 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,2-Dichloropropane | 25 | 0 | 1.39 | 0 | 0 | 0 | 0 | 1.39 |
| 1,3,5-Trimethylbenzene | 25 | 1 | 1.43 | 0.39 | 0 | 0 | 0.0156 | 1.39 |
| 1,3-Butadiene | 25 | 4 | 0.65 | 0.28 | 0.22 | 0.21 | 0.0348 | 0.581 |
| 1,3-Dichlorobenzene | 25 | 0 | 1.79 | 0 | 0 | 0 | 0 | 1.79 |
| 1,4-Dichlorobenzene | 25 | 0 | 1.79 | 0 | 0 | 0 | 0 | 1.79 |
| 2,2,4-Trimethylpentane | 25 | 20 | 1.4 | 0.99 | 0.87 | 0.73 | 0.414 | 0.694 |
| 2-Chloro-1,3-Butadiene | 25 | 0 | 1.1 | 0 | 0 | 0 | 0 | 1.1 |
| Acetonitrile | 25 | 22 | 1.63 | 5.3 | 5 | 3.7 | 1.51 | 1.7 |
| Acrylonitrile | 25 | 0 | 1.09 | 0 | 0 | 0 | 0 | 1.09 |
| Benzene | 25 | 24 | 0.939 | 7 | 5.5 | 3.5 | 1.77 | 1.81 |
| Bromodichloromethane | 25 | 0 | 1.99 | 0 | 0 | 0 | 0 | 1.99 |
| Bromoform | 25 | 0 | 3.03 | 0 | 0 | 0 | 0 | 3.03 |
| Bromomethane | 25 | 0 | 1.11 | 0 | 0 | 0 | 0 | 1.11 |

| DETROIT - W. Fort | AIRS ID: 261630015 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Carbon Tetrachloride | 25 | 16 | 1.84 | 0.7 | 0.68 | 0.67 | 0.372 | 1.03 |
| Chlorobenzene | 25 | 0 | 1.36 | 0 | 0 | 0 | 0 | 1.36 |
| Chloroethane | 25 | 2 | 0.775 | 0.29 | 0.24 | 0 | 0.0212 | 0.734 |
| Chloroform | 25 | 0 | 1.4 | 0 | 0 | 0 | 0 | 1.4 |
| Chloromethane | 25 | 25 | 0.608 | 1.7 | 1.6 | 1.6 | 1.26 | 1.26 |
| Chloromethyl Benzene | 25 | 0 | 1.5 | 0 | 0 | 0 | 0 | 1.5 |
| cis-1,2-Dichloroethene | 25 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| cis-1,3-Dichloropropene | 25 | 0 | 1.3 | 0 | 0 | 0 | 0 | 1.3 |
| Dibromochloromethane | 25 | 0 | 2.5 | 0 | 0 | 0 | 0 | 2.5 |
| Dichlorodiflouromethane | 25 | 25 | 1.46 | 3.7 | 3.5 | 3.3 | 2.79 | 2.79 |
| Ethylbenzene | 25 | 11 | 1.3 | 0.89 | 0.69 | 0.64 | 0.205 | 0.933 |
| Halocarbon 113 | 25 | 5 | 2.26 | 1.2 | 1 | 0.81 | 0.177 | 1.98 |
| Halocarbon 114 | 25 | 6 | 2.06 | 4 | 3.6 | 3.5 | 0.84 | 2.42 |
| Hexachloro-1,3-Butadiene | 25 | 0 | 3.12 | 0 | 0 | 0 | 0 | 3.12 |
| m/p -Xylene | 25 | 22 | 1.3 | 2.2 | 1.7 | 1.5 | 0.89 | 1.05 |
| Methyl Ethyl Ketone | 25 | 21 | 14.3 | 5.7 | 3.4 | 3.1 | 1.63 | 3.91 |
| Methyl Isobutyl Ketone | 25 | 1 | 4 | 0.63 | 0 | 0 | 0.0252 | 3.87 |
| Methyl Tert-Butyl Ether | 25 | 0 | 1.79 | 0 | 0 | 0 | 0 | 1.79 |
| Methylene Chloride | 25 | 4 | 1 | 13 | 3.9 | 1.1 | 0.758 | 1.6 |
| n-Hexane | 25 | 25 | 3.46 | 4.7 | 4.2 | 3.8 | 1.38 | 1.38 |
| o-xylene | 25 | 12 | 1.3 | 0.92 | 0.68 | 0.67 | 0.235 | 0.911 |
| Styrene | 25 | 0 | 1.26 | 0 | 0 | 0 | 0 | 1.26 |
| Tetrachloroethene | 25 | 2 | 2 | 3 | 0.43 | 0 | 0.137 | 1.98 |
| Toluene | 25 | 25 | 1.1 | 4.6 | 4.6 | 4.2 | 2.54 | 2.54 |
| trans-1,2-Dichloroethene | 25 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| trans-1,3-Dichloropropene | 25 | 0 | 1.3 | 0 | 0 | 0 | 0 | 1.3 |
| Trichloroethene | 25 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| Trichloroflouromethane | 25 | 25 | 1.66 | 2.3 | 2.2 | 2.2 | 1.63 | 1.63 |
| Vinyl Chloride | 25 | 0 | 0.752 | 0 | 0 | 0 | 0 | 0.752 |

| DETROIT – W. Jefferson | AIRS ID: 261630027 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Arsenic (TSP) | 58 | 58 | 0.0000619 | 0.00874 | 0.00535 | 0.00516 | 0.00248 | 0.00248 |
| Barium (TSP) | 58 | 58 | 0.000539 | 0.18 | 0.169 | 0.146 | 0.115 | 0.115 |
| Beryllium (TSP) | 58 | 57 | 0.0000658 | 0.00137 | 0.000966 | 0.000646 | 0.00023 | 0.000231 |
| Cadmium (TSP) | 58 | 58 | 0.000062 | 0.00293 | 0.00256 | 0.00253 | 0.000863 | 0.000863 |
| Chromium (TSP) | 58 | 58 | 0.000226 | 0.0207 | 0.0182 | 0.0166 | 0.00944 | 0.00944 |
| Cobalt (TSP) | 58 | 58 | 0.0000596 | 0.00153 | 0.00131 | 0.00123 | 0.000543 | 0.000543 |
| Copper (TSP) | 58 | 58 | 0.000776 | 1.13 | 0.965 | 0.675 | 0.272 | 0.272 |
| Iron (TSP) | 58 | 58 | 0.000464 | 7.44 | 6.84 | 6.75 | 2.55 | 2.55 |
| Lead (TSP) | 58 | 58 | 0.0000988 | 0.117 | 0.0516 | 0.0498 | 0.0256 | 0.0256 |
| Manganese (TSP) | 58 | 58 | 0.000378 | 0.896 | 0.661 | 0.558 | 0.175 | 0.175 |
| Molybdenum (TSP) | 58 | 58 | 0.0000825 | 0.00405 | 0.00371 | 0.00354 | 0.00174 | 0.00174 |
| Nickel (TSP) | 58 | 58 | 0.0002 | 0.0137 | 0.0116 | 0.0105 | 0.00502 | 0.00502 |
| Vanadium (TSP) | 58 | 58 | 0.0000851 | 0.0468 | 0.022 | 0.0202 | 0.0085 | 0.0085 |
| Zinc (TSP) | 58 | 58 | 0.000262 | 0.507 | 0.417 | 0.311 | 0.152 | 0.152 |
| 1,1,1-Trichloroethane | 43 | 21 | 0.241 | 0.218 | 0.218 | 0.218 | 0.0787 | 0.225 |
| 1,1,2,2-Tetrachloroethane | 43 | 0 | 0.335 | 0 | 0 | 0 | 0 | 0.335 |
| 1,1,2-Trichloroethane | 43 | 0 | 0.37 | 0 | 0 | 0 | 0 | 0.37 |
| 1,1-Dichloroethane | 43 | 0 | 0.179 | 0 | 0 | 0 | 0 | 0.179 |
| 1,1-Dichloroethene | 43 | 0 | 0.193 | 0 | 0 | 0 | 0 | 0.193 |
| 1,2,4-Trichlorobenzene | 43 | 2 | 1.3 | 0.148 | 0.148 | 0 | 0.00688 | 1.26 |
| 1,2,4-Trimethylbenzene | 43 | 34 | 0.302 | 2.46 | 2.36 | 2.21 | 0.701 | 0.769 |
| 1,2-Dibromoethane | 43 | 0 | 0.358 | 0 | 0 | 0 | 0 | 0.358 |
| 1,2-Dichlorobenzene | 43 | 0 | 0.274 | 0 | 0 | 0 | 0 | 0.274 |
| 1,2-Dichloroethane | 43 | 1 | 0.22 | 0.162 | 0 | 0 | 0.00377 | 0.218 |
| 1,2-Dichloropropane | 43 | 0 | 0.288 | 0 | 0 | 0 | 0 | 0.288 |
| 1,3,5-Trimethylbenzene | 43 | 29 | 0.19 | 0.885 | 0.737 | 0.639 | 0.229 | 0.297 |
| 1,3-Butadiene | 43 | 23 | 0.131 | 0.354 | 0.354 | 0.31 | 0.0978 | 0.163 |
| 1,3-Dichlorobenzene | 43 | 2 | 0.389 | 0.0601 | 0.0601 | 0 | 0.0028 | 0.38 |

| DETROIT – W. Jefferson | | | AIRS ID: 261630027 | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| 1,4-Dichlorobenzene | 43 | 14 | 0.369 | 1.8 | 0.361 | 0.18 | 0.0768 | 0.329 |
| 2-Chloro-1,3-Butadiene | 43 | 0 | 0.169 | 0 | 0 | 0 | 0 | 0.169 |
| Acetonitrile | 43 | 0 | 0.184 | 0 | 0 | 0 | 0 | 0.184 |
| Acrylonitrile | 43 | 0 | 0.158 | 0 | 0 | 0 | 0 | 0.158 |
| Benzene | 43 | 43 | 0.141 | 47.9 | 42.8 | 26.5 | 8.18 | 8.18 |
| Bromodichloromethane | 43 | 0 | 0.258 | 0 | 0 | 0 | 0 | 0.258 |
| Bromoform | 43 | 0 | 0.538 | 0 | 0 | 0 | 0 | 0.538 |
| Bromomethane | 43 | 12 | 0.199 | 0.272 | 0.117 | 0.117 | 0.0226 | 0.167 |
| Carbon Tetrachloride | 43 | 41 | 0.357 | 1.01 | 1.01 | 0.944 | 0.635 | 0.661 |
| Chlorobenzene | 43 | 3 | 0.167 | 0.0921 | 0.0921 | 0.046 | 0.00535 | 0.166 |
| Chloroethane | 43 | 11 | 0.239 | 0.237 | 0.132 | 0.106 | 0.0252 | 0.222 |
| Chloroform | 43 | 14 | 0.188 | 7.03 | 0.342 | 0.293 | 0.219 | 0.353 |
| Chloromethane | 43 | 43 | 0.11 | 2.4 | 2.17 | 1.92 | 1.37 | 1.37 |
| Chloromethyl Benzene | 43 | 0 | 0.241 | 0 | 0 | 0 | 0 | 0.241 |
| cis-1,2-Dichloroethene | 43 | 0 | 0.207 | 0 | 0 | 0 | 0 | 0.207 |
| cis-1,3-Dichloropropene | 43 | 0 | 0.201 | 0 | 0 | 0 | 0 | 0.201 |
| Dibromochloromethane | 43 | 0 | 0.512 | 0 | 0 | 0 | 0 | 0.512 |
| Dichlorodiflouromethane | 43 | 43 | 0.129 | 5.39 | 5.09 | 4.01 | 3.26 | 3.26 |
| Ethylbenzene | 43 | 41 | 0.158 | 2.26 | 1.95 | 1.82 | 0.663 | 0.676 |
| Halocarbon 114 | 43 | 20 | 0.183 | 0.14 | 0.14 | 0.14 | 0.0619 | 0.179 |
| Hexachloro-1,3-Butadiene | 43 | 2 | 2.17 | 0.107 | 0.107 | 0 | 0.00498 | 2.01 |
| m/p -Xylene | 43 | 43 | 0.202 | 4.99 | 4.73 | 4.17 | 1.74 | 1.74 |
| Methyl Ethyl Ketone | 43 | 10 | 0.37 | 5.31 | 3.01 | 2.51 | 0.438 | 0.738 |
| Methyl Isobutyl Ketone | 43 | 4 | 0.307 | 0.369 | 0.328 | 0.246 | 0.0277 | 0.307 |
| Methyl Tert-Butyl Ether | 43 | 0 | 0.249 | 0 | 0 | 0 | 0 | 0.249 |
| Methylene Chloride | 43 | 34 | 0.252 | 1.6 | 1.6 | 1.01 | 0.449 | 0.513 |
| o-xylene | 43 | 40 | 0.167 | 2.17 | 2.08 | 2.08 | 0.711 | 0.727 |
| Styrene | 43 | 26 | 0.164 | 1.28 | 0.809 | 0.469 | 0.17 | 0.241 |
| Tetrachloroethene | 43 | 26 | 0.3 | 5.15 | 2.85 | 1.15 | 0.427 | 0.569 |
| Toluene | 43 | 43 | 0.167 | 35.4 | 14.2 | 13.9 | 5.33 | 5.33 |
| trans-1,2-Dichloroethene | 43 | 0 | 0.193 | 0 | 0 | 0 | 0 | 0.193 |
| trans-1,3-Dichloropropene | 43 | 0 | 0.222 | 0 | 0 | 0 | 0 | 0.222 |
| Trichloroethene | 43 | 8 | 0.263 | 0.322 | 0.161 | 0.161 | 0.0262 | 0.246 |
| Trichloroflouromethane | 43 | 43 | 0.204 | 6.69 | 4.55 | 3.37 | 2.22 | 2.22 |
| Vinyl Chloride | 43 | 0 | 0.104 | 0 | 0 | 0 | 0 | 0.104 |
| Acenaphthene | 42 | 42 | 0.0000000421 | 0.086 | 0.0506 | 0.0354 | 0.0107 | 0.0107 |
| Acenaphthylene | 42 | 42 | 0.000000271 | 0.0418 | 0.0221 | 0.0123 | 0.0034 | 0.0034 |
| Anthracene | 42 | 38 | 0.000000161 | 0.0125 | 0.012 | 0.0101 | 0.00265 | 0.00265 |
| Benzo(a)anthracene | 42 | 42 | 0.000000084 | 0.00539 | 0.00364 | 0.00242 | 0.000648 | 0.000648 |
| Benzo(a)pyrene | 42 | 40 | 0.000000157 | 0.00627 | 0.0021 | 0.00154 | 0.00051 | 0.00051 |
| Benzo(b)fluoranthene | 42 | 42 | 0.0000000686 | 0.00636 | 0.00394 | 0.00302 | 0.000794 | 0.000794 |
| Benzo(ghi)perylene | 42 | 41 | 0.0000000571 | 0.00425 | 0.00159 | 0.00149 | 0.000465 | 0.000465 |
| Benzo(k)fluoranthene | 42 | 42 | 0.0000000626 | 0.00532 | 0.00361 | 0.00276 | 0.000701 | 0.000701 |
| Chrysene | 42 | 42 | 0.0000000421 | 0.00602 | 0.00525 | 0.00367 | 0.00102 | 0.00102 |
| Dibenzo(ah)anthracene | 42 | 16 | 0.0000000667 | 0.000809 | 0.000463 | 0.000428 | 0.0000844 | 0.0000845 |
| Fluoranthene | 42 | 42 | 0.0000000688 | 0.0352 | 0.0233 | 0.0227 | 0.00727 | 0.00727 |
| Fluorene | 42 | 42 | 0.0000000626 | 0.0704 | 0.0461 | 0.0255 | 0.0102 | 0.0102 |
| Indeno(123-cd)pyrene | 42 | 41 | 0.0000000738 | 0.00577 | 0.00211 | 0.00151 | 0.000542 | 0.000542 |
| Naphthalene | 42 | 42 | 0.0000000421 | 1.41 | 1.32 | 0.991 | 0.181 | 0.181 |
| Phenanthrene | 42 | 42 | 0.0000000533 | 0.117 | 0.102 | 0.0887 | 0.0274 | 0.0274 |
| Pyrene | 42 | 42 | 0.0000000688 | 0.0206 | 0.0137 | 0.0137 | 0.00447 | 0.00447 |

| FLINT | | | AIRS ID: 260490021 | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Arsenic (TSP) | 59 | 59 | 0.0000634 | 0.0157 | 0.00927 | 0.00569 | 0.00205 | 0.00205 |
| Barium (TSP) | 59 | 59 | 0.00051 | 0.285 | 0.175 | 0.116 | 0.0991 | 0.0991 |
| Beryllium (TSP) | 59 | 55 | 0.0000656 | 0.0000409 | 0.0000355 | 0.000031 | 0.0000134 | 0.0000147 |
| Cadmium (TSP) | 59 | 59 | 0.0000634 | 0.00076 | 0.00071 | 0.00067 | 0.000246 | 0.000246 |
| Chromium (TSP) | 59 | 59 | 0.000228 | 0.00672 | 0.00527 | 0.00502 | 0.00348 | 0.00348 |
| Cobalt (TSP) | 59 | 59 | 0.0000609 | 0.00047 | 0.0004 | 0.00039 | 0.000206 | 0.000206 |

| FLINT | AIRS ID: 260490021 | | | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **# Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Copper (TSP) | 59 | 59 | 0.000736 | 1.41 | 1.02 | 0.846 | 0.379 | 0.379 |
| Iron (TSP) | 59 | 59 | 0.000446 | 0.939 | 0.893 | 0.853 | 0.448 | 0.448 |
| Lead (TSP) | 59 | 59 | 0.0000998 | 0.0568 | 0.0253 | 0.0253 | 0.00999 | 0.00999 |
| Manganese (TSP) | 59 | 59 | 0.000186 | 0.031 | 0.028 | 0.0277 | 0.0132 | 0.0132 |
| Molybdenum (TSP) | 59 | 59 | 0.0000844 | 0.00168 | 0.0016 | 0.00146 | 0.000727 | 0.000727 |
| Nickel (TSP) | 59 | 59 | 0.000192 | 0.00398 | 0.00339 | 0.0032 | 0.00176 | 0.00176 |
| Vanadium (TSP) | 59 | 59 | 0.0000867 | 0.00729 | 0.0062 | 0.00572 | 0.00152 | 0.00152 |
| Zinc (TSP) | 59 | 59 | 0.000248 | 0.08 | 0.08 | 0.078 | 0.0467 | 0.0467 |

| GRAND RAPIDS - Monroe | AIRS ID: 260810020 | | | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **# Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Arsenic (TSP) | 31 | 31 | 0.0000709 | 0.00343 | 0.0027 | 0.00255 | 0.00126 | 0.00126 |
| Barium (TSP) | 31 | 31 | 0.000525 | 0.181 | 0.133 | 0.127 | 0.11 | 0.11 |
| Beryllium (TSP) | 31 | 30 | 0.0000723 | 0.0000274 | 0.0000256 | 0.000022 | 0.0000115 | 0.0000121 |
| Cadmium (TSP) | 31 | 31 | 0.0000708 | 0.00034 | 0.00031 | 0.000293 | 0.000185 | 0.000185 |
| Chromium (TSP) | 31 | 31 | 0.000251 | 0.00645 | 0.00624 | 0.00603 | 0.00433 | 0.00433 |
| Cobalt (TSP) | 31 | 31 | 0.0000679 | 0.000779 | 0.00039 | 0.00038 | 0.000231 | 0.000231 |
| Copper (TSP) | 31 | 31 | 0.000774 | 1.09 | 0.952 | 0.788 | 0.581 | 0.581 |
| Iron (TSP) | 31 | 31 | 0.00047 | 0.944 | 0.835 | 0.809 | 0.468 | 0.468 |
| Lead (TSP) | 31 | 31 | 0.00011 | 0.0155 | 0.0146 | 0.0132 | 0.00769 | 0.00769 |
| Manganese (TSP) | 31 | 31 | 0.0002 | 0.0287 | 0.028 | 0.027 | 0.0145 | 0.0145 |
| Molybdenum (TSP) | 31 | 31 | 0.0000944 | 0.0022 | 0.00161 | 0.00107 | 0.000794 | 0.000794 |
| Nickel (TSP) | 31 | 31 | 0.000201 | 0.00438 | 0.00334 | 0.00331 | 0.00182 | 0.00182 |
| Vanadium (TSP) | 31 | 31 | 0.0000964 | 0.00262 | 0.00243 | 0.00221 | 0.000859 | 0.000859 |
| Zinc (TSP) | 31 | 31 | 0.000256 | 0.086 | 0.08 | 0.0792 | 0.055 | 0.055 |
| 2,5-dimethylbenzaldehyde | 10 | 0 | 0.04 | 0 | 0 | 0 | 0 | 0.04 |
| Acetaldehyde | 10 | 10 | 0.0177 | 25.9 | 4.96 | 4.22 | 4.98 | 4.98 |
| Acetone | 10 | 10 | 0.057 | 18.3 | 7.92 | 7.79 | 6.46 | 6.46 |
| Benzaldehyde | 10 | 2 | 0.0163 | 1.54 | 0.36 | 0 | 0.19 | 0.203 |
| Crotonaldehyde | 10 | 1 | 0.00952 | 0.593 | 0 | 0 | 0.0593 | 0.0676 |
| Formaldehyde | 10 | 10 | 0.019 | 25.8 | 6.34 | 5.02 | 5.83 | 5.83 |
| Hexanaldehyde | 10 | 5 | 0.0313 | 8.03 | 0.942 | 0.766 | 1.08 | 1.09 |
| Isovaleraldehyde | 10 | 0 | 0.0197 | 0 | 0 | 0 | 0 | 0.0197 |
| m,p-Tolualdehyde | 10 | 0 | 0.0299 | 0 | 0 | 0 | 0 | 0.0299 |
| n-Butyraldehyde | 10 | 9 | 0.0102 | 1.51 | 0.959 | 0.782 | 0.58 | 0.581 |
| o-Tolualdehyde | 10 | 0 | 0.0251 | 0 | 0 | 0 | 0 | 0.0251 |
| Propionaldehyde | 10 | 9 | 0.0293 | 1.61 | 0.95 | 0.867 | 0.578 | 0.582 |
| Valeraldehyde | 10 | 3 | 0.0299 | 2.28 | 1.24 | 0.268 | 0.379 | 0.4 |
| 1,1,1-Trichloroethane | 23 | 22 | 1.6 | 3 | 1.9 | 1.9 | 1.24 | 1.31 |
| 1,1,2,2-Tetrachloroethane | 23 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| 1,1,2-Trichloroethane | 23 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| 1,1-Dichloroethane | 23 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,1-Dichloroethene | 23 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,2,4-Trichlorobenzene | 23 | 1 | 2.2 | 2.2 | 0 | 0 | 0.0957 | 2.2 |
| 1,2,4-Trimethylbenzene | 23 | 12 | 1.44 | 1.6 | 1.6 | 1.4 | 0.512 | 1.21 |
| 1,2-Dibromoethane | 23 | 0 | 2.29 | 0 | 0 | 0 | 0 | 2.29 |
| 1,2-Dichlorobenzene | 23 | 0 | 1.8 | 0 | 0 | 0 | 0 | 1.8 |
| 1,2-Dichloroethane | 23 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,2-Dichloropropane | 23 | 0 | 1.4 | 0 | 0 | 0 | 0 | 1.4 |
| 1,3,5-Trimethylbenzene | 23 | 1 | 1.44 | 0.43 | 0 | 0 | 0.0187 | 1.4 |
| 1,3-Butadiene | 23 | 6 | 0.651 | 0.4 | 0.33 | 0.28 | 0.073 | 0.554 |
| 1,3-Dichlorobenzene | 23 | 0 | 1.8 | 0 | 0 | 0 | 0 | 1.8 |
| 1,4-Dichlorobenzene | 23 | 0 | 1.8 | 0 | 0 | 0 | 0 | 1.8 |
| 2,2,4-Trimethylpentane | 23 | 22 | 1.4 | 1.5 | 0.98 | 0.96 | 0.585 | 0.646 |
| 2-Chloro-1,3-Butadiene | 23 | 0 | 1.1 | 0 | 0 | 0 | 0 | 1.1 |
| Acetonitrile | 23 | 20 | 1.64 | 2.3 | 2.3 | 2 | 1.2 | 1.42 |
| Acrylonitrile | 23 | 1 | 1.1 | 0.66 | 0 | 0 | 0.0287 | 1.08 |
| Benzene | 23 | 22 | 0.94 | 2.3 | 1.9 | 1.7 | 1.1 | 1.14 |
| Bromodichloromethane | 23 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| Bromoform | 23 | 0 | 3.04 | 0 | 0 | 0 | 0 | 3.04 |

| GRAND RAPIDS - Monroe | AIRS ID: 260810020 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Bromomethane | 23 | 0 | 1.11 | 0 | 0 | 0 | 0 | 1.11 |
| Carbon Tetrachloride | 23 | 15 | 1.86 | 0.69 | 0.67 | 0.66 | 0.374 | 1.01 |
| Chlorobenzene | 23 | 0 | 1.38 | 0 | 0 | 0 | 0 | 1.38 |
| Chloroethane | 23 | 0 | 0.777 | 0 | 0 | 0 | 0 | 0.777 |
| Chloroform | 23 | 4 | 1.4 | 0.84 | 0.7 | 0.49 | 0.105 | 1.26 |
| Chloromethane | 23 | 23 | 0.609 | 1.8 | 1.8 | 1.7 | 1.3 | 1.3 |
| Chloromethyl Benzene | 23 | 0 | 1.5 | 0 | 0 | 0 | 0 | 1.5 |
| cis-1,2-Dichloroethene | 23 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| cis-1,3-Dichloropropene | 23 | 0 | 1.3 | 0 | 0 | 0 | 0 | 1.3 |
| Dibromochloromethane | 23 | 0 | 2.5 | 0 | 0 | 0 | 0 | 2.5 |
| Dichlorodiflouromethane | 23 | 23 | 1.48 | 3.7 | 3.5 | 3.3 | 2.81 | 2.81 |
| Ethylbenzene | 23 | 14 | 1.3 | 1.2 | 0.84 | 0.73 | 0.331 | 0.84 |
| Halocarbon 113 | 23 | 10 | 2.27 | 2.4 | 2.1 | 2.1 | 0.668 | 1.95 |
| Halocarbon 114 | 23 | 5 | 2.08 | 3.6 | 3.5 | 3.5 | 0.709 | 2.34 |
| Hexachloro-1,3-Butadiene | 23 | 0 | 3.13 | 0 | 0 | 0 | 0 | 3.13 |
| m/p -Xylene | 23 | 20 | 1.3 | 2.7 | 2.4 | 1.8 | 1.08 | 1.25 |
| Methyl Ethyl Ketone | 23 | 21 | 14.4 | 4.7 | 4.1 | 3.8 | 1.85 | 3.11 |
| Methyl Isobutyl Ketone | 23 | 4 | 4.01 | 2.5 | 1.1 | 0.98 | 0.232 | 3.54 |
| Methyl Tert-Butyl Ether | 23 | 0 | 1.8 | 0 | 0 | 0 | 0 | 1.8 |
| Methylene Chloride | 23 | 4 | 1 | 3.5 | 3.1 | 1.1 | 0.375 | 1.2 |
| n-Hexane | 23 | 22 | 3.47 | 3.9 | 2.1 | 1.9 | 1.03 | 1.18 |
| o-xylene | 23 | 17 | 1.3 | 1.3 | 1 | 0.85 | 0.44 | 0.78 |
| Styrene | 23 | 1 | 1.27 | 0.47 | 0 | 0 | 0.0204 | 1.24 |
| Tetrachloroethene | 23 | 1 | 2 | 0.48 | 0 | 0 | 0.0209 | 1.93 |
| Toluene | 23 | 23 | 1.1 | 8 | 6.7 | 6.3 | 3.28 | 3.28 |
| trans-1,2-Dichloroethene | 23 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| trans-1,3-Dichloropropene | 23 | 0 | 1.3 | 0 | 0 | 0 | 0 | 1.3 |
| Trichloroethene | 23 | 1 | 1.6 | 0.63 | 0 | 0 | 0.0274 | 1.56 |
| Trichloroflouromethane | 23 | 23 | 1.67 | 3.7 | 3.5 | 3.5 | 2.24 | 2.24 |
| Vinyl Chloride | 23 | 0 | 0.753 | 0 | 0 | 0 | 0 | 0.753 |

| HOUGHTON LAKE | AIRS ID: 261130001 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Arsenic (TSP) | 60 | 60 | 0.0000661 | 0.00223 | 0.00168 | 0.00164 | 0.000662 | 0.000662 |
| Barium (TSP) | 60 | 60 | 0.000521 | 0.13 | 0.128 | 0.12 | 0.0984 | 0.0984 |
| Beryllium (TSP) | 60 | 50 | 0.0000683 | 0.000117 | 0.000034 | 0.0000279 | 0.0000101 | 0.000013 |
| Cadmium (TSP) | 60 | 60 | 0.0000661 | 0.00064 | 0.00045 | 0.000307 | 0.000137 | 0.000137 |
| Chromium (TSP) | 60 | 60 | 0.000235 | 0.0319 | 0.0307 | 0.0101 | 0.00386 | 0.00386 |
| Cobalt (TSP) | 60 | 60 | 0.0000635 | 0.0005 | 0.00045 | 0.00039 | 0.000099 | 0.000099 |
| Copper (TSP) | 60 | 60 | 0.000746 | 2.02 | 1.72 | 1.68 | 0.562 | 0.562 |
| Iron (TSP) | 60 | 60 | 0.000453 | 0.483 | 0.321 | 0.32 | 0.131 | 0.131 |
| Lead (TSP) | 60 | 60 | 0.000103 | 0.0229 | 0.0082 | 0.00806 | 0.00375 | 0.00375 |
| Manganese (TSP) | 60 | 60 | 0.000191 | 0.066 | 0.019 | 0.018 | 0.00688 | 0.00688 |
| Molybdenum (TSP) | 60 | 60 | 0.0000881 | 0.00121 | 0.0009 | 0.000675 | 0.000316 | 0.000316 |
| Nickel (TSP) | 60 | 60 | 0.000193 | 0.0353 | 0.0289 | 0.00269 | 0.00194 | 0.00194 |
| Vanadium (TSP) | 59 | 56 | 0.0000892 | 0.00348 | 0.0024 | 0.00172 | 0.000536 | 0.000541 |
| Zinc (TSP) | 60 | 60 | 0.000253 | 0.069 | 0.0572 | 0.057 | 0.0283 | 0.0283 |
| 2,5-dimethylbenzaldehyde | 10 | 0 | 0.05 | 0 | 0 | 0 | 0 | 0.05 |
| Acetaldehyde | 10 | 10 | 0.0221 | 1.49 | 1.41 | 0.93 | 0.851 | 0.851 |
| Acetone | 10 | 10 | 0.0712 | 5.37 | 4.1 | 3.3 | 2.55 | 2.55 |
| Benzaldehyde | 10 | 0 | 0.0204 | 0 | 0 | 0 | 0 | 0.0204 |
| Crotonaldehyde | 10 | 0 | 0.0119 | 0 | 0 | 0 | 0 | 0.0119 |
| Formaldehyde | 10 | 10 | 0.0238 | 1.63 | 1.39 | 1.17 | 0.941 | 0.941 |
| Hexanaldehyde | 10 | 0 | 0.0391 | 0 | 0 | 0 | 0 | 0.0391 |
| Isovaleraldehyde | 10 | 0 | 0.0246 | 0 | 0 | 0 | 0 | 0.0246 |
| m,p-Tolualdehyde | 10 | 0 | 0.0374 | 0 | 0 | 0 | 0 | 0.0374 |
| n-Butyraldehyde | 10 | 0 | 0.0127 | 0 | 0 | 0 | 0 | 0.0127 |
| o-Tolualdehyde | 10 | 0 | 0.0314 | 0 | 0 | 0 | 0 | 0.0314 |
| Propionaldehyde | 10 | 0 | 0.0366 | 0 | 0 | 0 | 0 | 0.0366 |
| Valeraldehyde | 10 | 0 | 0.0374 | 0 | 0 | 0 | 0 | 0.0374 |
| 1,1,1-Trichloroethane | 35 | 5 | 1.39 | 0.164 | 0.164 | 0.164 | 0.0203 | 1.39 |

| HOUGHTON LAKE | AIRS ID: 261130001 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| 1,1,2,2-Tetrachloroethane | 35 | 0 | 1.75 | 0 | 0 | 0 | 0 | 1.75 |
| 1,1,2-Trichloroethane | 35 | 0 | 1.39 | 0 | 0 | 0 | 0 | 1.39 |
| 1,1-Dichloroethane | 35 | 0 | 1.04 | 0 | 0 | 0 | 0 | 1.04 |
| 1,1-Dichloroethene | 35 | 0 | 1.05 | 0 | 0 | 0 | 0 | 1.05 |
| 1,2,4-Trichlorobenzene | 35 | 0 | 2.03 | 0 | 0 | 0 | 0 | 2.03 |
| 1,2,4-Trimethylbenzene | 35 | 5 | 1.26 | 1.3 | 0.0983 | 0.0983 | 0.0484 | 1.24 |
| 1,2-Dibromoethane | 35 | 0 | 1.99 | 0 | 0 | 0 | 0 | 1.99 |
| 1,2-Dichlorobenzene | 35 | 0 | 1.59 | 0 | 0 | 0 | 0 | 1.59 |
| 1,2-Dichloroethane | 35 | 1 | 1.05 | 0.162 | 0 | 0 | 0.00463 | 1.05 |
| 1,2-Dichloropropane | 35 | 0 | 1.22 | 0 | 0 | 0 | 0 | 1.22 |
| 1,3,5-Trimethylbenzene | 35 | 3 | 1.24 | 0.51 | 0.0492 | 0.0492 | 0.0174 | 1.21 |
| 1,3-Butadiene | 35 | 5 | 0.574 | 0.0443 | 0.0443 | 0.0443 | 0.00506 | 0.563 |
| 1,3-Dichlorobenzene | 35 | 0 | 1.57 | 0 | 0 | 0 | 0 | 1.57 |
| 1,4-Dichlorobenzene | 35 | 1 | 1.59 | 0.0601 | 0 | 0 | 0.00172 | 1.58 |
| 2,2,4-Trimethylpentane | 30 | 7 | 1.4 | 0.89 | 0.5 | 0.39 | 0.087 | 1.16 |
| 2-Chloro-1,3-Butadiene | 35 | 0 | 0.958 | 0 | 0 | 0 | 0 | 0.958 |
| Acetonitrile | 35 | 22 | 1.4 | 7.17 | 4.82 | 2.5 | 1.02 | 1.53 |
| Acrylonitrile | 35 | 0 | 0.952 | 0 | 0 | 0 | 0 | 0.952 |
| Benzene | 35 | 28 | 0.814 | 1.1 | 0.639 | 0.6 | 0.335 | 0.523 |
| Bromodichloromethane | 35 | 0 | 1.74 | 0 | 0 | 0 | 0 | 1.74 |
| Bromoform | 35 | 0 | 2.62 | 0 | 0 | 0 | 0 | 2.62 |
| Bromomethane | 35 | 5 | 0.979 | 0.0777 | 0.0777 | 0.0388 | 0.00777 | 0.959 |
| Carbon Tetrachloride | 35 | 35 | 1.62 | 0.818 | 0.67 | 0.67 | 0.553 | 0.553 |
| Chlorobenzene | 35 | 0 | 1.18 | 0 | 0 | 0 | 0 | 1.18 |
| Chloroethane | 35 | 7 | 0.683 | 0.25 | 0.25 | 0.211 | 0.0279 | 0.648 |
| Chloroform | 35 | 33 | 1.22 | 2.2 | 1.7 | 1.6 | 0.771 | 0.851 |
| Chloromethane | 35 | 35 | 0.539 | 1.94 | 1.9 | 1.63 | 1.17 | 1.17 |
| Chloromethyl Benzene | 35 | 0 | 1.31 | 0 | 0 | 0 | 0 | 1.31 |
| cis-1,2-Dichloroethene | 35 | 0 | 1.04 | 0 | 0 | 0 | 0 | 1.04 |
| cis-1,3-Dichloropropene | 35 | 0 | 1.13 | 0 | 0 | 0 | 0 | 1.13 |
| Dibromochloromethane | 35 | 0 | 2.17 | 0 | 0 | 0 | 0 | 2.17 |
| Dichlorodiflouromethane | 34 | 34 | 1.25 | 4 | 3.71 | 3.31 | 2.69 | 2.69 |
| Ethylbenzene | 35 | 5 | 1.13 | 0.13 | 0.0869 | 0.0869 | 0.0136 | 1.13 |
| Halocarbon 113 | 30 | 7 | 2.26 | 0.66 | 0.64 | 0.62 | 0.144 | 1.86 |
| Halocarbon 114 | 35 | 19 | 1.77 | 3.9 | 3.6 | 3.5 | 1.37 | 2.32 |
| Hexachloro-1,3-Butadiene | 35 | 0 | 3.18 | 0 | 0 | 0 | 0 | 3.18 |
| m/p -Xylene | 35 | 7 | 1.13 | 0.35 | 0.32 | 0.217 | 0.0427 | 1.08 |
| Methyl Ethyl Ketone | 35 | 22 | 12.2 | 3.6 | 3.1 | 2.3 | 1.03 | 5.12 |
| Methyl Isobutyl Ketone | 35 | 1 | 3.47 | 2.4 | 0 | 0 | 0.0686 | 3.42 |
| Methyl Tert-Butyl Ether | 35 | 0 | 1.57 | 0 | 0 | 0 | 0 | 1.57 |
| Methylene Chloride | 35 | 11 | 0.877 | 5 | 2.2 | 2.1 | 0.416 | 1.1 |
| n-Hexane | 30 | 13 | 3.45 | 3.8 | 1.2 | 0.98 | 0.333 | 2.29 |
| o-xylene | 35 | 5 | 1.13 | 0.13 | 0.0869 | 0.0869 | 0.0136 | 1.13 |
| Styrene | 35 | 4 | 1.1 | 0.17 | 0.128 | 0.128 | 0.0146 | 1.1 |
| Tetrachloroethene | 35 | 1 | 1.73 | 0.79 | 0 | 0 | 0.0226 | 1.7 |
| Toluene | 35 | 23 | 0.954 | 1 | 0.93 | 0.87 | 0.405 | 0.782 |
| trans-1,2-Dichloroethene | 35 | 0 | 1.05 | 0 | 0 | 0 | 0 | 1.05 |
| trans-1,3-Dichloropropene | 35 | 0 | 1.14 | 0 | 0 | 0 | 0 | 1.14 |
| Trichloroethene | 35 | 0 | 1.4 | 0 | 0 | 0 | 0 | 1.4 |
| Trichloroflouromethane | 35 | 35 | 1.43 | 31 | 13 | 2.53 | 2.78 | 2.78 |
| Vinyl Chloride | 35 | 1 | 0.659 | 0.0256 | 0 | 0 | 0.000731 | 0.657 |

| RIVER ROUGE | AIRS ID: 261630005 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Arsenic (TSP) | 61 | 61 | 0.0000616 | 0.00805 | 0.00488 | 0.00395 | 0.00181 | 0.00181 |
| Barium (TSP) | 61 | 61 | 0.000543 | 0.14 | 0.137 | 0.137 | 0.0982 | 0.0982 |
| Beryllium (TSP) | 61 | 61 | 0.0000649 | 0.0000993 | 0.000089 | 0.0000831 | 0.0000392 | 0.0000392 |
| Cadmium (TSP) | 61 | 61 | 0.0000618 | 0.00247 | 0.00207 | 0.00199 | 0.000623 | 0.000623 |
| Chromium (TSP) | 61 | 61 | 0.000225 | 0.0244 | 0.0188 | 0.0154 | 0.00723 | 0.00723 |
| Cobalt (TSP) | 61 | 61 | 0.0000594 | 0.00072 | 0.0007 | 0.00066 | 0.000321 | 0.000321 |
| Copper (TSP) | 61 | 61 | 0.00077 | 2.52 | 1.99 | 1.98 | 0.727 | 0.727 |

| RIVER ROUGE | AIRS ID: 261630005 | | | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Iron (TSP) | 61 | 61 | 0.000463 | 3.79 | 3.58 | 2.98 | 1.28 | 1.28 |
| Lead (TSP) | 61 | 61 | 0.0000983 | 0.0707 | 0.0471 | 0.0445 | 0.0173 | 0.0173 |
| Manganese (TSP) | 61 | 61 | 0.000189 | 0.285 | 0.221 | 0.203 | 0.072 | 0.072 |
| Molybdenum (TSP) | 61 | 61 | 0.0000822 | 0.00262 | 0.00242 | 0.00239 | 0.00118 | 0.00118 |
| Nickel (TSP) | 61 | 61 | 0.000198 | 0.0118 | 0.00685 | 0.00678 | 0.00321 | 0.00321 |
| Vanadium (TSP) | 61 | 61 | 0.0000847 | 0.0405 | 0.0201 | 0.0158 | 0.00622 | 0.00622 |
| Zinc (TSP) | 61 | 61 | 0.000264 | 0.594 | 0.4 | 0.271 | 0.129 | 0.129 |
| 2,5-dimethylbenzaldehyde | 20 | 0 | 0.0528 | 0 | 0 | 0 | 0 | 0.0528 |
| Acetaldehyde | 20 | 20 | 0.0233 | 4.08 | 2.72 | 2.36 | 1.53 | 1.53 |
| Acetone | 20 | 20 | 0.0752 | 7.9 | 6.35 | 5.2 | 3.4 | 3.4 |
| Benzaldehyde | 20 | 0 | 0.0215 | 0 | 0 | 0 | 0 | 0.0215 |
| Crotonaldehyde | 20 | 0 | 0.0125 | 0 | 0 | 0 | 0 | 0.0125 |
| Formaldehyde | 20 | 20 | 0.0251 | 14.1 | 3.57 | 2.78 | 2.36 | 2.36 |
| Hexanaldehyde | 20 | 1 | 0.0412 | 1.68 | 0 | 0 | 0.084 | 0.123 |
| Isovaleraldehyde | 20 | 0 | 0.026 | 0 | 0 | 0 | 0 | 0.026 |
| m,p-Tolualdehyde | 20 | 0 | 0.0394 | 0 | 0 | 0 | 0 | 0.0394 |
| n-Butyraldehyde | 20 | 4 | 0.0134 | 0.546 | 0.463 | 0.416 | 0.0918 | 0.102 |
| o-Tolualdehyde | 20 | 0 | 0.0332 | 0 | 0 | 0 | 0 | 0.0332 |
| Propionaldehyde | 20 | 9 | 0.0385 | 1.06 | 0.577 | 0.48 | 0.208 | 0.23 |
| Valeraldehyde | 20 | 0 | 0.0395 | 0 | 0 | 0 | 0 | 0.0395 |

| SAULT STE. MARIE - Easterday | AIRS ID: 260330901 | | | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Acenaphthene | 38 | 38 | 0.00000007 | 0.000864 | 0.000855 | 0.00083 | 0.000371 | 0.000371 |
| Acenaphthylene | 38 | 32 | 0.000000423 | 0.00121 | 0.0011 | 0.000889 | 0.000243 | 0.000243 |
| Anthracene | 38 | 24 | 0.000000251 | 0.00102 | 0.000855 | 0.000795 | 0.000194 | 0.000194 |
| Benzo(a)anthracene | 38 | 37 | 0.000000132 | 0.000314 | 0.000278 | 0.000251 | 0.0000928 | 0.0000928 |
| Benzo(a)pyrene | 38 | 24 | 0.000000244 | 0.000404 | 0.000328 | 0.000306 | 0.0000786 | 0.0000787 |
| Benzo(b)fluoranthene | 38 | 35 | 0.000000105 | 0.00074 | 0.000556 | 0.00052 | 0.000159 | 0.000159 |
| Benzo(ghi)perylene | 38 | 30 | 0.0000000921 | 0.000538 | 0.000361 | 0.000296 | 0.000115 | 0.000115 |
| Benzo(k)fluoranthene | 38 | 34 | 0.0000000953 | 0.000583 | 0.000501 | 0.0005 | 0.000153 | 0.000153 |
| Chrysene | 38 | 38 | 0.0000000703 | 0.000852 | 0.000675 | 0.000667 | 0.000231 | 0.000231 |
| Dibenzo(ah)anthracene | 38 | 3 | 0.000000102 | 0.0000673 | 0.0000439 | 0.000037 | 0.0000039 | 0.00000399 |
| Fluoranthene | 38 | 38 | 0.000000109 | 0.00791 | 0.00673 | 0.00526 | 0.0021 | 0.0021 |
| Fluorene | 38 | 37 | 0.0000000953 | 0.00301 | 0.00202 | 0.00176 | 0.000954 | 0.000954 |
| Indeno(123-cd)pyrene | 38 | 23 | 0.000000115 | 0.000538 | 0.000389 | 0.000328 | 0.0001 | 0.0001 |
| Naphthalene | 38 | 38 | 0.00000007 | 0.00838 | 0.00656 | 0.00652 | 0.00166 | 0.00166 |
| Phenanthrene | 38 | 38 | 0.00000008 | 0.0231 | 0.0194 | 0.0169 | 0.00591 | 0.00591 |
| Pyrene | 38 | 38 | 0.000000109 | 0.00404 | 0.0033 | 0.00218 | 0.00109 | 0.00109 |

| YPSILANTI | AIRS ID: 261610008 | | | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Arsenic (TSP) | 25 | 25 | 0.0000605 | 0.00681 | 0.00469 | 0.00461 | 0.00182 | 0.00182 |
| Barium (TSP) | 24 | 24 | 0.00053 | 0.245 | 0.118 | 0.116 | 0.104 | 0.104 |
| Beryllium (TSP) | 24 | 24 | 0.0000633 | 0.000035 | 0.0000338 | 0.00003 | 0.0000149 | 0.0000149 |
| Cadmium (TSP) | 25 | 25 | 0.0000607 | 0.00091 | 0.000678 | 0.00046 | 0.000261 | 0.000261 |
| Chromium (TSP) | 25 | 25 | 0.00022 | 0.00777 | 0.00743 | 0.00741 | 0.00522 | 0.00522 |
| Cobalt (TSP) | 25 | 25 | 0.0000583 | 0.00045 | 0.00033 | 0.0003 | 0.000204 | 0.000204 |
| Copper (TSP) | 24 | 24 | 0.000748 | 0.54 | 0.451 | 0.444 | 0.253 | 0.253 |
| Iron (TSP) | 24 | 24 | 0.000452 | 0.984 | 0.756 | 0.745 | 0.454 | 0.454 |
| Lead (TSP) | 25 | 25 | 0.0000966 | 0.0223 | 0.021 | 0.0156 | 0.00888 | 0.00888 |
| Manganese (TSP) | 24 | 24 | 0.000184 | 0.0376 | 0.036 | 0.029 | 0.0161 | 0.0161 |
| Molybdenum (TSP) | 25 | 25 | 0.0000808 | 0.00262 | 0.00233 | 0.00179 | 0.00101 | 0.00101 |
| Nickel (TSP) | 25 | 25 | 0.000193 | 0.00397 | 0.00373 | 0.00311 | 0.00181 | 0.00181 |
| Vanadium (TSP) | 25 | 25 | 0.0000831 | 0.00537 | 0.00506 | 0.0048 | 0.00182 | 0.00182 |
| Zinc (TSP) | 24 | 24 | 0.000257 | 0.126 | 0.085 | 0.082 | 0.0565 | 0.0565 |
| 2,5-dimethylbenzaldehyde | 10 | 0 | 0.0541 | 0 | 0 | 0 | 0 | 0.0541 |
| Acetaldehyde | 10 | 10 | 0.0239 | 3.1 | 3.01 | 2.48 | 1.87 | 1.87 |
| Acetone | 10 | 10 | 0.0772 | 5.96 | 5.45 | 4.6 | 4.02 | 4.02 |
| Benzaldehyde | 10 | 0 | 0.0221 | 0 | 0 | 0 | 0 | 0.0221 |

| YPSILANTI | | | AIRS ID: 261610008 | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Crotonaldehyde | 10 | 0 | 0.0129 | 0 | 0 | 0 | 0 | 0.0129 |
| Formaldehyde | 10 | 10 | 0.0257 | 6.73 | 4.32 | 3.38 | 2.6 | 2.6 |
| Hexanaldehyde | 10 | 2 | 0.0423 | 2.18 | 0.783 | 0 | 0.296 | 0.33 |
| Isovaleraldehyde | 10 | 1 | 0.0267 | 0.61 | 0 | 0 | 0.061 | 0.085 |
| m,p-Tolualdehyde | 10 | 0 | 0.0405 | 0 | 0 | 0 | 0 | 0.0405 |
| n-Butyraldehyde | 10 | 5 | 0.0139 | 1.5 | 0.962 | 0.782 | 0.411 | 0.418 |
| o-Tolualdehyde | 10 | 0 | 0.034 | 0 | 0 | 0 | 0 | 0.034 |
| Propionaldehyde | 10 | 6 | 0.0396 | 1.39 | 1.29 | 0.77 | 0.504 | 0.521 |
| Valeraldehyde | 10 | 3 | 0.0405 | 3.4 | 1.06 | 0.898 | 0.536 | 0.564 |
| 1,1,1-Trichloroethane | 13 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| 1,1,2,2-Tetrachloroethane | 13 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| 1,1,2-Trichloroethane | 13 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| 1,1-Dichloroethane | 13 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,1-Dichloroethene | 13 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,2,4-Trichlorobenzene | 13 | 0 | 2.2 | 0 | 0 | 0 | 0 | 2.2 |
| 1,2,4-Trimethylbenzene | 13 | 2 | 1.42 | 1.2 | 0.83 | 0 | 0.156 | 1.36 |
| 1,2-Dibromoethane | 13 | 0 | 2.28 | 0 | 0 | 0 | 0 | 2.28 |
| 1,2-Dichlorobenzene | 13 | 0 | 1.8 | 0 | 0 | 0 | 0 | 1.8 |
| 1,2-Dichloroethane | 13 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,2-Dichloropropane | 13 | 0 | 1.4 | 0 | 0 | 0 | 0 | 1.4 |
| 1,3,5-Trimethylbenzene | 13 | 0 | 1.42 | 0 | 0 | 0 | 0 | 1.42 |
| 1,3-Butadiene | 13 | 0 | 0.651 | 0 | 0 | 0 | 0 | 0.651 |
| 1,3-Dichlorobenzene | 13 | 0 | 1.8 | 0 | 0 | 0 | 0 | 1.8 |
| 1,4-Dichlorobenzene | 13 | 0 | 1.8 | 0 | 0 | 0 | 0 | 1.8 |
| 2,2,4-Trimethylpentane | 13 | 13 | 1.4 | 0.83 | 0.7 | 0.58 | 0.425 | 0.425 |
| 2-Chloro-1,3-Butadiene | 13 | 0 | 1.1 | 0 | 0 | 0 | 0 | 1.1 |
| Acetonitrile | 13 | 9 | 1.62 | 4.1 | 2.5 | 1.3 | 1 | 1.5 |
| Acrylonitrile | 13 | 0 | 1.1 | 0 | 0 | 0 | 0 | 1.1 |
| Benzene | 13 | 11 | 0.939 | 1.4 | 1.3 | 1.1 | 0.825 | 0.97 |
| Bromodichloromethane | 13 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| Bromoform | 13 | 0 | 3.02 | 0 | 0 | 0 | 0 | 3.02 |
| Bromomethane | 13 | 0 | 1.11 | 0 | 0 | 0 | 0 | 1.11 |
| Carbon Tetrachloride | 13 | 12 | 1.85 | 0.69 | 0.64 | 0.62 | 0.505 | 0.643 |
| Chlorobenzene | 13 | 0 | 1.35 | 0 | 0 | 0 | 0 | 1.35 |
| Chloroethane | 13 | 1 | 0.775 | 0.19 | 0 | 0 | 0.0146 | 0.729 |
| Chloroform | 13 | 12 | 1.4 | 2.7 | 2.4 | 2.4 | 1.65 | 1.76 |
| Chloromethane | 13 | 13 | 0.608 | 1.8 | 1.5 | 1.5 | 1.26 | 1.26 |
| Chloromethyl Benzene | 13 | 0 | 1.5 | 0 | 0 | 0 | 0 | 1.5 |
| cis-1,2-Dichloroethene | 13 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| cis-1,3-Dichloropropene | 13 | 0 | 1.3 | 0 | 0 | 0 | 0 | 1.3 |
| Dibromochloromethane | 13 | 0 | 2.5 | 0 | 0 | 0 | 0 | 2.5 |
| Dichlorodiflouromethane | 13 | 13 | 1.45 | 3.2 | 3.1 | 2.8 | 2.59 | 2.59 |
| Ethylbenzene | 13 | 6 | 1.3 | 0.76 | 0.49 | 0.45 | 0.21 | 0.91 |
| Halocarbon 113 | 13 | 4 | 2.25 | 0.77 | 0.71 | 0.7 | 0.222 | 1.77 |
| Halocarbon 114 | 13 | 4 | 2.05 | 3.6 | 3.4 | 3.2 | 0.992 | 2.42 |
| Hexachloro-1,3-Butadiene | 13 | 0 | 3.12 | 0 | 0 | 0 | 0 | 3.12 |
| m/p -Xylene | 13 | 9 | 1.3 | 2.3 | 1.3 | 1.2 | 0.712 | 1.11 |
| Methyl Ethyl Ketone | 13 | 11 | 14.2 | 2.3 | 1.8 | 1.8 | 1.26 | 3.49 |
| Methyl Isobutyl Ketone | 13 | 3 | 4.01 | 0.84 | 0.83 | 0.78 | 0.188 | 3.27 |
| Methyl Tert-Butyl Ether | 13 | 0 | 1.8 | 0 | 0 | 0 | 0 | 1.8 |
| Methylene Chloride | 13 | 3 | 1 | 2.6 | 1 | 0.96 | 0.351 | 1.12 |
| n-Hexane | 13 | 12 | 3.45 | 1.4 | 1 | 0.98 | 0.625 | 0.894 |
| o-xylene | 13 | 6 | 1.3 | 0.81 | 0.55 | 0.53 | 0.238 | 0.938 |
| Styrene | 13 | 0 | 1.25 | 0 | 0 | 0 | 0 | 1.25 |
| Tetrachloroethene | 13 | 1 | 2 | 0.73 | 0 | 0 | 0.0562 | 1.9 |
| Toluene | 13 | 13 | 1.1 | 5.3 | 3.6 | 3.6 | 2.38 | 2.38 |
| trans-1,2-Dichloroethene | 13 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| trans-1,3-Dichloropropene | 13 | 0 | 1.3 | 0 | 0 | 0 | 0 | 1.3 |
| Trichloroethene | 13 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| Trichloroflouromethane | 13 | 13 | 1.65 | 2.4 | 2.2 | 2 | 1.65 | 1.65 |
| Vinyl Chloride | 12 | 0 | 0.752 | 0 | 0 | 0 | 0 | 0.752 |

# APPENDIX C2: AIR TOXICS SUMMARY FOR SPECIATED $PM_{2.5}$

| ALLEN PARK | | AIRS ID: 261630001 | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|
| **Chemical Name** | **# Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ LC | 113 | 113 | 0.895 | 58.5 | 52.2 | 51.8 | 16.8 | 16.8 |
| Aluminum | 113 | 43 | 0.0126 | 0.0836 | 0.0772 | 0.0696 | 0.0108 | 0.0202 |
| Ammonium Ion | 113 | 113 | 0.172 | 10 | 9.74 | 8.66 | 2.44 | 2.44 |
| Antimony | 113 | 51 | 0.0109 | 0.0629 | 0.0444 | 0.0409 | 0.00518 | 0.0108 |
| Arsenic | 113 | 90 | 0.000891 | 0.00665 | 0.00642 | 0.00615 | 0.00157 | 0.00178 |
| Barium | 113 | 66 | 0.023 | 0.206 | 0.189 | 0.135 | 0.0158 | 0.0266 |
| Bromine | 113 | 110 | 0.00078 | 0.0119 | 0.00922 | 0.00829 | 0.00326 | 0.00327 |
| Cadmium | 113 | 40 | 0.00482 | 0.0284 | 0.0181 | 0.0161 | 0.00209 | 0.00491 |
| Calcium | 113 | 113 | 0.00471 | 0.21 | 0.198 | 0.174 | 0.0581 | 0.0581 |
| Cerium | 113 | 69 | 0.0133 | 0.0741 | 0.0552 | 0.0551 | 0.00889 | 0.0157 |
| Cesium | 113 | 11 | 0.00994 | 0.0244 | 0.0236 | 0.0214 | 0.00149 | 0.00992 |
| Chlorine | 113 | 57 | 0.00671 | 0.248 | 0.159 | 0.118 | 0.0124 | 0.0169 |
| Chromium | 113 | 96 | 0.000933 | 0.0328 | 0.0319 | 0.0273 | 0.00402 | 0.00417 |
| Cobalt | 113 | 28 | 0.00078 | 0.00164 | 0.00128 | 0.0012 | 0.000114 | 0.000724 |
| Copper | 113 | 110 | 0.00104 | 0.056 | 0.0466 | 0.0435 | 0.0095 | 0.00952 |
| Elemental Carbon | 112 | 112 | 0.285 | 2.09 | 1.84 | 1.57 | 0.781 | 0.781 |
| Europium | 113 | 38 | 0.00291 | 0.0187 | 0.0129 | 0.0118 | 0.00192 | 0.00418 |
| Gallium | 113 | 66 | 0.00131 | 0.00549 | 0.00326 | 0.00245 | 0.000456 | 0.00103 |
| Gold | 113 | 48 | 0.00189 | 0.00654 | 0.0063 | 0.00466 | 0.000786 | 0.00185 |
| Hafnium | 113 | 54 | 0.00921 | 0.0164 | 0.0124 | 0.00769 | 0.00168 | 0.00649 |
| Indium | 113 | 50 | 0.00549 | 0.0228 | 0.0219 | 0.021 | 0.0032 | 0.00593 |
| Iridium | 113 | 28 | 0.00211 | 0.00851 | 0.00712 | 0.00502 | 0.00048 | 0.00202 |
| Iron | 113 | 113 | 0.00737 | 0.373 | 0.304 | 0.266 | 0.127 | 0.127 |
| Lanthanium | 113 | 55 | 0.0107 | 0.0422 | 0.0385 | 0.036 | 0.00518 | 0.0114 |
| Magnesium | 113 | 27 | 0.00917 | 0.0715 | 0.0597 | 0.0583 | 0.00482 | 0.0108 |
| Manganese | 113 | 109 | 0.000912 | 0.0146 | 0.0118 | 0.00944 | 0.00363 | 0.00366 |
| Mercury | 113 | 50 | 0.00213 | 0.0117 | 0.00861 | 0.00818 | 0.00141 | 0.00251 |
| Molybdenum | 113 | 14 | 0.00279 | 0.00595 | 0.00409 | 0.00375 | 0.000253 | 0.0027 |
| Nickel | 113 | 86 | 0.000613 | 0.00887 | 0.00802 | 0.00736 | 0.00149 | 0.00165 |
| Niobium | 113 | 26 | 0.00146 | 0.00641 | 0.00478 | 0.00455 | 0.000469 | 0.00146 |
| Organic Carbon Peak1 | 112 | 112 | 0.305 | 4.41 | 3.38 | 2.5 | 1.12 | 1.12 |
| Organic Carbon Peak2 | 112 | 112 | 0.306 | 3.2 | 2.88 | 2.42 | 1.14 | 1.14 |
| Organic Carbon Peak3 | 112 | 112 | 0.287 | 2.32 | 2.19 | 2.02 | 0.804 | 0.804 |
| Organic Carbon Peak4 | 112 | 112 | 0.298 | 3.6 | 3.44 | 2.74 | 0.989 | 0.989 |
| Organic Carbon | 112 | 112 | 0.494 | 10.8 | 8.7 | 8.19 | 4.1 | 4.1 |
| Organic Carbon Pyrolytic | 112 | 14 | 0.243 | 1.9 | 1.35 | 1 | 0.0486 | 0.259 |
| Phosphorus | 113 | 2 | 0.00618 | 0.00128 | 0.00082 | 0 | 0.0000186 | 0.00615 |
| Potassium Ion | 113 | 113 | 60 | 0.00378 | 0.563 | 0.476 | 0.19 | 0.0467 |
| Potassium | 113 | 113 | 113 | 0.00591 | 0.665 | 0.587 | 0.205 | 0.07 |
| Rubidium | 113 | 113 | 49 | 0.000755 | 0.00213 | 0.0021 | 0.00187 | 0.0003 |
| Samarium | 113 | 113 | 35 | 0.00236 | 0.0171 | 0.0102 | 0.00981 | 0.00157 |
| Scandium | 113 | 113 | 16 | 0.00336 | 0.00244 | 0.00233 | 0.00198 | 0.000162 |
| Selenium | 113 | 113 | 91 | 0.000969 | 0.0091 | 0.0084 | 0.00785 | 0.0018 |
| Silicon | 113 | 113 | 89 | 0.00885 | 0.258 | 0.24 | 0.227 | 0.0562 |
| Silver | 113 | 113 | 52 | 0.00443 | 0.0187 | 0.0146 | 0.0134 | 0.00247 |
| Sodium Ion | 113 | 113 | 108 | 0.0464 | 0.254 | 0.241 | 0.24 | 0.0709 |
| Sodium | 113 | 113 | 64 | 0.0318 | 0.238 | 0.155 | 0.133 | 0.0283 |
| Strantium | 113 | 113 | 83 | 0.000958 | 0.00873 | 0.00638 | 0.00525 | 0.00134 |
| Sulfate | 113 | 113 | 113 | 0.379 | 28.9 | 21.2 | 20.8 | 4.73 |
| Sulfur | 113 | 113 | 113 | 0.104 | 8.98 | 6.82 | 6.78 | 1.53 |
| Tantalum | 113 | 113 | 21 | 0.00514 | 0.0125 | 0.00735 | 0.00478 | 0.000551 |
| Terbium | 113 | 113 | 76 | 0.00452 | 0.0213 | 0.0194 | 0.0171 | 0.00576 |
| Tin | 113 | 113 | 63 | 0.00762 | 0.0506 | 0.046 | 0.0284 | 0.00643 |
| Titatium | 113 | 113 | 92 | 0.00176 | 0.0199 | 0.015 | 0.0145 | 0.00477 |
| Total Nitrate | 113 | 113 | 113 | 0.253 | 19.3 | 17.6 | 12.1 | 3.06 |
| Tungsten | 113 | 113 | 50 | 0.00323 | 0.00992 | 0.00828 | 0.00711 | 0.00131 |
| Vanadium | 113 | 113 | 97 | 0.00123 | 0.0146 | 0.00992 | 0.00723 | 0.00226 |
| Yttrium | 113 | 113 | 52 | 0.00105 | 0.00371 | 0.00339 | 0.00339 | 0.000626 |
| Zinc | 113 | 113 | 113 | 0.00155 | 0.0988 | 0.0804 | 0.0752 | 0.0216 |
| Zirconium | 113 | 113 | 58 | 0.00144 | 0.00595 | 0.00547 | 0.0049 | 0.00121 |

| DEARBORN | AIRS ID: 261630033 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| $PM_{2.5}$ LC | 55 | 55 | 1.03 | 59 | 52.2 | 36.6 | 19.7 | 19.7 |
| Aluminum | 55 | 28 | 0.0146 | 0.307 | 0.106 | 0.0847 | 0.0269 | 0.0357 |
| Ammonium Ion | 55 | 55 | 0.178 | 9.39 | 7.28 | 5.55 | 2.53 | 2.53 |
| Antimony | 55 | 23 | 0.0104 | 0.0652 | 0.0581 | 0.043 | 0.00717 | 0.0129 |
| Arsenic | 55 | 44 | 0.00105 | 0.00752 | 0.006 | 0.00531 | 0.00184 | 0.00207 |
| Barium | 55 | 23 | 0.0256 | 0.136 | 0.0583 | 0.0497 | 0.0144 | 0.0282 |
| Bromine | 55 | 55 | 0.000807 | 0.0115 | 0.00945 | 0.00894 | 0.00409 | 0.00409 |
| Cadmium | 55 | 21 | 0.00477 | 0.0189 | 0.0135 | 0.00964 | 0.00206 | 0.00468 |
| Calcium | 55 | 55 | 0.0122 | 0.819 | 0.812 | 0.584 | 0.165 | 0.165 |
| Cerium | 55 | 31 | 0.0146 | 0.218 | 0.112 | 0.0873 | 0.0214 | 0.0298 |
| Cesium | 55 | 8 | 0.0104 | 0.02 | 0.0186 | 0.0142 | 0.00168 | 0.00982 |
| Chlorine | 55 | 29 | 0.00945 | 0.487 | 0.314 | 0.289 | 0.0457 | 0.0504 |
| Chromium | 55 | 40 | 0.00109 | 0.0859 | 0.072 | 0.0215 | 0.00694 | 0.00722 |
| Cobalt | 55 | 13 | 0.00168 | 0.00326 | 0.00162 | 0.0014 | 0.000273 | 0.00162 |
| Copper | 55 | 54 | 0.00103 | 0.0332 | 0.0323 | 0.0244 | 0.0104 | 0.0104 |
| Elemental Carbon | 55 | 55 | 0.292 | 1.76 | 1.74 | 1.72 | 0.91 | 0.91 |
| Europium | 55 | 21 | 0.00489 | 0.196 | 0.0568 | 0.0258 | 0.0079 | 0.0116 |
| Gallium | 55 | 31 | 0.00135 | 0.00523 | 0.00257 | 0.00192 | 0.000525 | 0.00122 |
| Gold | 55 | 17 | 0.00215 | 0.00442 | 0.00325 | 0.00315 | 0.000469 | 0.00191 |
| Hafnium | 55 | 32 | 0.00907 | 0.0278 | 0.0158 | 0.0127 | 0.00349 | 0.00736 |
| Indium | 55 | 23 | 0.00533 | 0.0202 | 0.0195 | 0.0171 | 0.00316 | 0.0059 |
| Iridium | 55 | 11 | 0.00221 | 0.00593 | 0.00582 | 0.00385 | 0.000489 | 0.00221 |
| Iron | 55 | 55 | 0.0327 | 2.57 | 1.95 | 1.91 | 0.574 | 0.574 |
| Lanthanium | 55 | 32 | 0.0117 | 0.196 | 0.096 | 0.0745 | 0.0175 | 0.022 |
| Magnesium | 55 | 25 | 0.0113 | 0.129 | 0.0844 | 0.083 | 0.0176 | 0.0226 |
| Manganese | 55 | 52 | 0.00233 | 0.16 | 0.134 | 0.0982 | 0.0299 | 0.03 |
| Mercury | 55 | 23 | 0.00219 | 0.0101 | 0.00931 | 0.00896 | 0.00167 | 0.00289 |
| Molybdenum | 55 | 7 | 0.00279 | 0.00711 | 0.00501 | 0.00326 | 0.000381 | 0.00282 |
| Nickel | 55 | 42 | 0.000672 | 0.025 | 0.024 | 0.0237 | 0.00292 | 0.00306 |
| Niobium | 55 | 12 | 0.00152 | 0.00361 | 0.00349 | 0.00268 | 0.000453 | 0.00157 |
| Organic Carbon Peak1 | 55 | 55 | 0.339 | 3.41 | 3.24 | 2.94 | 1.68 | 1.68 |
| Organic Carbon Peak2 | 55 | 55 | 0.308 | 1.92 | 1.84 | 1.83 | 1.18 | 1.18 |
| Organic Carbon Peak3 | 55 | 55 | 0.289 | 1.95 | 1.58 | 1.56 | 0.871 | 0.871 |
| Organic Carbon Peak4 | 55 | 55 | 0.3 | 3.09 | 2.5 | 2.45 | 1.04 | 1.04 |
| Organic Carbon | 55 | 55 | 0.54 | 8.3 | 7.68 | 7.48 | 4.8 | 4.8 |
| Organic Carbon Pyrolytic | 55 | 12 | 0.242 | 0.574 | 0.302 | 0.224 | 0.0326 | 0.22 |
| Phosphorus | 55 | 1 | 0.00605 | 0.00291 | 0 | 0 | 0.0000529 | 0.006 |
| Potassium Ion | 55 | 40 | 0.0108 | 0.834 | 0.684 | 0.611 | 0.145 | 0.145 |
| Potassium | 55 | 55 | 0.0123 | 0.932 | 0.759 | 0.673 | 0.171 | 0.171 |
| Rubidium | 55 | 34 | 0.000785 | 0.00759 | 0.00631 | 0.00543 | 0.00109 | 0.00135 |
| Samarium | 55 | 20 | 0.0026 | 0.0407 | 0.0354 | 0.0287 | 0.00504 | 0.00682 |
| Scandium | 55 | 7 | 0.00342 | 0.0036 | 0.00291 | 0.00187 | 0.00019 | 0.00338 |
| Selenium | 55 | 48 | 0.000973 | 0.0097 | 0.00867 | 0.00745 | 0.00261 | 0.00273 |
| Silicon | 55 | 48 | 0.0134 | 0.666 | 0.383 | 0.381 | 0.121 | 0.122 |
| Silver | 55 | 26 | 0.00428 | 0.0182 | 0.0126 | 0.0124 | 0.00237 | 0.00425 |
| Sodium Ion | 55 | 53 | 0.0484 | 0.392 | 0.274 | 0.261 | 0.111 | 0.112 |
| Sodium | 55 | 35 | 0.0389 | 0.35 | 0.292 | 0.248 | 0.0747 | 0.0895 |
| Strantium | 55 | 41 | 0.00096 | 0.00715 | 0.00408 | 0.0039 | 0.00147 | 0.00169 |
| Sulfate | 55 | 55 | 0.445 | 28.9 | 24.3 | 18 | 5.66 | 5.66 |
| Sulfur | 55 | 55 | 0.122 | 9.26 | 7.42 | 5.27 | 1.77 | 1.77 |
| Tantalum | 55 | 12 | 0.00555 | 0.0112 | 0.0085 | 0.0071 | 0.00115 | 0.00499 |
| Terbium | 55 | 35 | 0.011 | 0.101 | 0.0861 | 0.0838 | 0.0188 | 0.025 |
| Tin | 55 | 27 | 0.00745 | 0.0296 | 0.0279 | 0.0263 | 0.00497 | 0.00824 |
| Titatium | 55 | 43 | 0.00189 | 0.0661 | 0.0361 | 0.0269 | 0.00854 | 0.00904 |
| Total Nitrate | 55 | 55 | 0.237 | 13.8 | 10.7 | 8.04 | 2.85 | 2.85 |
| Tungsten | 55 | 13 | 0.00338 | 0.00733 | 0.00698 | 0.00594 | 0.000927 | 0.00341 |
| Vanadium | 55 | 48 | 0.00126 | 0.0208 | 0.0171 | 0.0152 | 0.00388 | 0.00406 |
| Yttrium | 55 | 28 | 0.00108 | 0.00326 | 0.00314 | 0.00309 | 0.000686 | 0.00115 |
| Zinc | 55 | 55 | 0.00557 | 0.395 | 0.362 | 0.334 | 0.0973 | 0.0973 |
| Zirconium | 55 | 28 | 0.00147 | 0.00571 | 0.00418 | 0.00396 | 0.00115 | 0.00178 |

| GRAND RAPIDS - Monroe | AIRS ID: 260810020 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **# Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ LC | 59 | 59 | 0.895 | 57.2 | 47.6 | 42.4 | 16.7 | 16.7 |
| Aluminum | 59 | 24 | 0.0134 | 0.164 | 0.0567 | 0.0561 | 0.0129 | 0.0223 |
| Ammonium Ion | 59 | 59 | 0.157 | 8.32 | 6.84 | 6.21 | 2.22 | 2.22 |
| Antimony | 59 | 23 | 0.0108 | 0.112 | 0.0886 | 0.0607 | 0.00915 | 0.0153 |
| Arsenic | 59 | 38 | 0.000872 | 0.00781 | 0.00414 | 0.00391 | 0.00109 | 0.00151 |
| Barium | 59 | 23 | 0.0227 | 0.107 | 0.0606 | 0.0418 | 0.00738 | 0.0234 |
| Bromine | 59 | 56 | 0.00075 | 0.00715 | 0.00709 | 0.00653 | 0.00293 | 0.00295 |
| Cadmium | 59 | 24 | 0.0047 | 0.028 | 0.0198 | 0.0174 | 0.00331 | 0.00572 |
| Calcium | 59 | 59 | 0.00376 | 0.113 | 0.0994 | 0.0948 | 0.0406 | 0.0406 |
| Cerium | 59 | 31 | 0.0122 | 0.0452 | 0.0445 | 0.0336 | 0.00778 | 0.0139 |
| Cesium | 59 | 9 | 0.00992 | 0.0248 | 0.0231 | 0.0214 | 0.00182 | 0.00982 |
| Chlorine | 59 | 21 | 0.00688 | 0.157 | 0.142 | 0.0498 | 0.01 | 0.0154 |
| Chromium | 59 | 43 | 0.00273 | 0.199 | 0.0274 | 0.00519 | 0.00532 | 0.00557 |
| Cobalt | 59 | 17 | 0.000715 | 0.0019 | 0.00126 | 0.00113 | 0.000179 | 0.000708 |
| Copper | 59 | 58 | 0.00108 | 0.0385 | 0.0362 | 0.024 | 0.00823 | 0.00824 |
| Elemental Carbon | 59 | 58 | 0.275 | 1.52 | 1.25 | 1.17 | 0.608 | 0.612 |
| Europium | 59 | 17 | 0.00278 | 0.0182 | 0.0155 | 0.0119 | 0.00141 | 0.00363 |
| Gallium | 59 | 35 | 0.00128 | 0.00247 | 0.00187 | 0.00141 | 0.000401 | 0.000932 |
| Gold | 59 | 19 | 0.00189 | 0.0071 | 0.00361 | 0.00335 | 0.000502 | 0.0018 |
| Hafnium | 59 | 23 | 0.00911 | 0.0106 | 0.01 | 0.00828 | 0.0015 | 0.00706 |
| Indium | 59 | 22 | 0.00548 | 0.0253 | 0.0209 | 0.0174 | 0.00288 | 0.0059 |
| Iridium | 59 | 17 | 0.00218 | 0.00595 | 0.00501 | 0.00402 | 0.000706 | 0.00218 |
| Iron | 59 | 59 | 0.01 | 0.689 | 0.278 | 0.22 | 0.0933 | 0.0933 |
| Lanthanium | 59 | 25 | 0.00993 | 0.0586 | 0.0502 | 0.0368 | 0.00558 | 0.0104 |
| Magnesium | 59 | 21 | 0.00956 | 0.0967 | 0.0655 | 0.0586 | 0.00901 | 0.0136 |
| Manganese | 59 | 53 | 0.000913 | 0.0221 | 0.0124 | 0.0124 | 0.00405 | 0.00415 |
| Mercury | 59 | 28 | 0.00226 | 0.00677 | 0.00654 | 0.00561 | 0.00137 | 0.00243 |
| Molybdenum | 59 | 9 | 0.00281 | 0.0109 | 0.00524 | 0.00257 | 0.000414 | 0.00281 |
| Nickel | 59 | 43 | 0.00103 | 0.0546 | 0.00876 | 0.0065 | 0.0018 | 0.00197 |
| Niobium | 59 | 14 | 0.00145 | 0.00792 | 0.00374 | 0.00315 | 0.000593 | 0.00158 |
| Organic Carbon Peak1 | 59 | 59 | 0.308 | 3.69 | 2.35 | 2.07 | 1.19 | 1.19 |
| Organic Carbon Peak2 | 59 | 59 | 0.307 | 2.34 | 1.99 | 1.88 | 1.18 | 1.18 |
| Organic Carbon Peak3 | 59 | 59 | 0.286 | 1.86 | 1.57 | 1.56 | 0.798 | 0.798 |
| Organic Carbon Peak4 | 59 | 59 | 0.298 | 3.26 | 2.73 | 2.59 | 0.989 | 0.989 |
| Organic Carbon | 59 | 59 | 0.498 | 10.8 | 7.77 | 7.44 | 4.17 | 4.17 |
| Organic Carbon Pyrolytic | 59 | 8 | 0.241 | 0.995 | 0.154 | 0.0816 | 0.0223 | 0.23 |
| Phosphorus | 59 | 1 | 0.00584 | 0.00141 | 0 | 0 | 0.0000239 | 0.00583 |
| Potassium Ion | 59 | 28 | 0.00389 | 0.879 | 0.176 | 0.151 | 0.0487 | 0.049 |
| Potassium | 59 | 59 | 0.00579 | 1.02 | 0.183 | 0.145 | 0.0744 | 0.0744 |
| Rubidium | 59 | 23 | 0.00072 | 0.00209 | 0.00204 | 0.00176 | 0.000334 | 0.00074 |
| Samarium | 59 | 14 | 0.00233 | 0.0159 | 0.00979 | 0.00537 | 0.00106 | 0.00292 |
| Scandium | 59 | 5 | 0.00337 | 0.00187 | 0.00128 | 0.00082 | 0.0000831 | 0.00335 |
| Selenium | 59 | 49 | 0.00096 | 0.00517 | 0.00451 | 0.00432 | 0.00156 | 0.00172 |
| Silicon | 59 | 45 | 0.00895 | 0.214 | 0.208 | 0.167 | 0.0456 | 0.0483 |
| Silver | 59 | 21 | 0.00423 | 0.0167 | 0.0118 | 0.0116 | 0.00219 | 0.00461 |
| Sodium Ion | 59 | 51 | 0.0471 | 0.266 | 0.172 | 0.167 | 0.0536 | 0.059 |
| Sodium | 59 | 33 | 0.0343 | 0.367 | 0.167 | 0.124 | 0.0344 | 0.0481 |
| Strantium | 59 | 42 | 0.000926 | 0.0138 | 0.00328 | 0.00328 | 0.000967 | 0.00118 |
| Sulfate | 59 | 59 | 0.328 | 19 | 17.9 | 14.4 | 4.01 | 4.01 |
| Sulfur | 59 | 59 | 0.0908 | 6.54 | 6.23 | 5.14 | 1.38 | 1.38 |
| Tantalum | 59 | 11 | 0.00506 | 0.0108 | 0.00956 | 0.00652 | 0.000724 | 0.00444 |
| Terbium | 59 | 39 | 0.00386 | 0.0205 | 0.0192 | 0.016 | 0.00409 | 0.00561 |
| Tin | 59 | 24 | 0.00728 | 0.033 | 0.0283 | 0.0276 | 0.00429 | 0.00817 |
| Titatium | 59 | 46 | 0.00176 | 0.0141 | 0.0138 | 0.0122 | 0.00397 | 0.00441 |
| Total Nitrate | 59 | 59 | 0.247 | 15.2 | 14.4 | 11.6 | 2.99 | 2.99 |
| Tungsten | 59 | 24 | 0.00316 | 0.0128 | 0.0121 | 0.00653 | 0.0014 | 0.00334 |
| Vanadium | 59 | 36 | 0.00125 | 0.0063 | 0.00513 | 0.00443 | 0.00114 | 0.00165 |
| Yttrium | 59 | 30 | 0.00105 | 0.00303 | 0.00268 | 0.00248 | 0.000694 | 0.00113 |
| Zinc | 59 | 59 | 0.00145 | 0.102 | 0.0732 | 0.0713 | 0.0189 | 0.0189 |
| Zirconium | 59 | 23 | 0.0014 | 0.00618 | 0.00549 | 0.00513 | 0.000968 | 0.0017 |

| HOLLAND | AIRS ID: 260050003 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| $PM_{2.5}$ LC | 60 | 60 | 0.826 | 53.8 | 53.6 | 40.3 | 14.7 | 14.7 |
| Aluminum | 60 | 18 | 0.0131 | 0.0684 | 0.0468 | 0.031 | 0.00577 | 0.0159 |
| Ammonium Ion | 61 | 61 | 0.153 | 7.55 | 7.28 | 5.75 | 2.16 | 2.16 |
| Antimony | 60 | 27 | 0.0105 | 0.0396 | 0.0385 | 0.0315 | 0.00536 | 0.0106 |
| Arsenic | 60 | 42 | 0.000937 | 0.00353 | 0.0035 | 0.00346 | 0.00111 | 0.00148 |
| Barium | 60 | 27 | 0.023 | 0.0686 | 0.0618 | 0.0514 | 0.00913 | 0.0225 |
| Bromine | 60 | 56 | 0.000781 | 0.00673 | 0.00644 | 0.00626 | 0.00281 | 0.00286 |
| Cadmium | 60 | 22 | 0.00454 | 0.0239 | 0.0195 | 0.0159 | 0.00246 | 0.00508 |
| Calcium | 60 | 60 | 0.00318 | 0.0756 | 0.0724 | 0.0715 | 0.0278 | 0.0278 |
| Cerium | 60 | 28 | 0.0138 | 0.0565 | 0.0295 | 0.0195 | 0.00602 | 0.0145 |
| Cesium | 60 | 10 | 0.00994 | 0.0227 | 0.0225 | 0.0221 | 0.00209 | 0.00985 |
| Chlorine | 60 | 20 | 0.0067 | 0.112 | 0.0303 | 0.0202 | 0.00479 | 0.0103 |
| Chromium | 60 | 37 | 0.000833 | 0.00625 | 0.00485 | 0.00457 | 0.00115 | 0.00147 |
| Cobalt | 60 | 21 | 0.000622 | 0.00227 | 0.00093 | 0.00093 | 0.000159 | 0.000569 |
| Copper | 60 | 46 | 0.000832 | 0.0147 | 0.00742 | 0.0062 | 0.00165 | 0.00184 |
| Elemental Carbon | 61 | 61 | 0.261 | 0.856 | 0.834 | 0.757 | 0.37 | 0.37 |
| Europium | 60 | 25 | 0.00258 | 0.00723 | 0.00619 | 0.00537 | 0.0013 | 0.00312 |
| Gallium | 60 | 37 | 0.00139 | 0.00245 | 0.00241 | 0.00209 | 0.000339 | 0.000854 |
| Gold | 60 | 29 | 0.00203 | 0.00888 | 0.00687 | 0.00315 | 0.000877 | 0.00194 |
| Hafnium | 60 | 27 | 0.00874 | 0.0136 | 0.00979 | 0.00977 | 0.00189 | 0.00661 |
| Indium | 60 | 20 | 0.00532 | 0.0209 | 0.0189 | 0.0177 | 0.00237 | 0.00557 |
| Iridium | 60 | 19 | 0.00226 | 0.00935 | 0.00396 | 0.00326 | 0.000585 | 0.00209 |
| Iron | 60 | 60 | 0.00293 | 0.154 | 0.131 | 0.122 | 0.047 | 0.047 |
| Lanthanium | 60 | 22 | 0.011 | 0.0431 | 0.0259 | 0.0232 | 0.004 | 0.0106 |
| Magnesium | 60 | 9 | 0.0118 | 0.0728 | 0.0665 | 0.0585 | 0.00483 | 0.0129 |
| Manganese | 60 | 49 | 0.000848 | 0.0082 | 0.00672 | 0.00572 | 0.0018 | 0.00197 |
| Mercury | 60 | 31 | 0.00218 | 0.00618 | 0.00595 | 0.00537 | 0.00141 | 0.00238 |
| Molybdenum | 60 | 8 | 0.00285 | 0.00572 | 0.00501 | 0.00315 | 0.00033 | 0.00279 |
| Nickel | 60 | 34 | 0.000598 | 0.00689 | 0.00361 | 0.00314 | 0.00063 | 0.000893 |
| Niobium | 60 | 19 | 0.00157 | 0.00373 | 0.00314 | 0.00233 | 0.000447 | 0.00137 |
| Organic Carbon Peak1 | 61 | 61 | 0.284 | 2.1 | 1.88 | 1.67 | 0.76 | 0.76 |
| Organic Carbon Peak2 | 61 | 61 | 0.296 | 1.9 | 1.69 | 1.69 | 0.978 | 0.978 |
| Organic Carbon Peak3 | 61 | 61 | 0.278 | 1.54 | 1.45 | 1.39 | 0.652 | 0.652 |
| Organic Carbon Peak4 | 61 | 60 | 0.285 | 2.47 | 2.35 | 2.27 | 0.764 | 0.768 |
| Organic Carbon | 61 | 61 | 0.433 | 6.59 | 6.55 | 6.3 | 3.17 | 3.17 |
| Organic Carbon Pyrolytic | 61 | 12 | 0.241 | 0.47 | 0.194 | 0.142 | 0.0182 | 0.211 |
| Phosphorus | 60 | 2 | 0.00538 | 0.00794 | 0.00011 | 0 | 0.000134 | 0.00541 |
| Potassium Ion | 61 | 33 | 0.00362 | 0.481 | 0.168 | 0.15 | 0.0445 | 0.0447 |
| Potassium | 60 | 60 | 0.00514 | 0.59 | 0.143 | 0.133 | 0.0605 | 0.0605 |
| Rubidium | 60 | 34 | 0.000766 | 0.00223 | 0.00222 | 0.00198 | 0.000453 | 0.000701 |
| Samarium | 60 | 24 | 0.00219 | 0.0077 | 0.00654 | 0.00501 | 0.00113 | 0.00256 |
| Scandium | 60 | 12 | 0.00315 | 0.00222 | 0.00187 | 0.00152 | 0.000175 | 0.00308 |
| Selenium | 60 | 49 | 0.000985 | 0.00396 | 0.00361 | 0.00345 | 0.00132 | 0.0015 |
| Silicon | 60 | 40 | 0.00848 | 0.114 | 0.112 | 0.0946 | 0.028 | 0.0318 |
| Silver | 60 | 29 | 0.00416 | 0.0113 | 0.00935 | 0.0091 | 0.00194 | 0.00383 |
| Sodium Ion | 61 | 54 | 0.0477 | 0.185 | 0.12 | 0.111 | 0.0454 | 0.0484 |
| Sodium | 60 | 20 | 0.0452 | 0.376 | 0.271 | 0.249 | 0.0277 | 0.0508 |
| Strantium | 60 | 40 | 0.000937 | 0.00795 | 0.00385 | 0.00364 | 0.00107 | 0.00132 |
| Sulfate | 61 | 61 | 0.356 | 25 | 19.9 | 19.7 | 4.41 | 4.41 |
| Sulfur | 60 | 60 | 0.0947 | 8.33 | 6.62 | 5.68 | 1.44 | 1.44 |
| Tantalum | 60 | 22 | 0.00522 | 0.0141 | 0.00933 | 0.00851 | 0.00156 | 0.00449 |
| Terbium | 60 | 34 | 0.00309 | 0.0129 | 0.0121 | 0.0104 | 0.00218 | 0.00364 |
| Tin | 60 | 34 | 0.00751 | 0.032 | 0.0258 | 0.022 | 0.00651 | 0.00921 |
| Titatium | 60 | 43 | 0.00168 | 0.0171 | 0.0108 | 0.00933 | 0.00297 | 0.00349 |
| Total Nitrate | 61 | 61 | 0.23 | 14.4 | 12.6 | 11.5 | 2.72 | 2.72 |
| Tungsten | 60 | 19 | 0.00321 | 0.011 | 0.00966 | 0.00431 | 0.000811 | 0.00278 |
| Vanadium | 60 | 42 | 0.00117 | 0.00479 | 0.00362 | 0.00292 | 0.00101 | 0.0014 |
| Yttrium | 60 | 30 | 0.00108 | 0.00396 | 0.0035 | 0.00291 | 0.000709 | 0.00119 |
| Zinc | 60 | 59 | 0.0011 | 0.0735 | 0.044 | 0.0267 | 0.0123 | 0.0123 |
| Zirconium | 60 | 20 | 0.00139 | 0.00501 | 0.00468 | 0.00374 | 0.000654 | 0.00148 |

| HOUGHTON LAKE | | AIRS ID: 261130001 | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|
| **Chemical Name** | **# Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ LC | 58 | 58 | 0.643 | 41.3 | 31.8 | 26.1 | 10.7 | 10.7 |
| Aluminum | 58 | 23 | 0.0118 | 0.0373 | 0.0342 | 0.0326 | 0.00666 | 0.0152 |
| Ammonium Ion | 58 | 57 | 0.0834 | 4.73 | 3.98 | 3.42 | 1.18 | 1.18 |
| Antimony | 58 | 23 | 0.0101 | 0.049 | 0.0246 | 0.0245 | 0.0041 | 0.00969 |
| Arsenic | 58 | 31 | 0.000924 | 0.00409 | 0.00338 | 0.00303 | 0.00079 | 0.00126 |
| Barium | 58 | 25 | 0.0202 | 0.0517 | 0.0408 | 0.0394 | 0.00678 | 0.0216 |
| Bromine | 58 | 52 | 0.000784 | 0.00547 | 0.00547 | 0.00488 | 0.00204 | 0.00212 |
| Cadmium | 58 | 19 | 0.00469 | 0.0203 | 0.0178 | 0.014 | 0.0023 | 0.00508 |
| Calcium | 58 | 57 | 0.00265 | 0.0753 | 0.0597 | 0.057 | 0.0178 | 0.0179 |
| Cerium | 58 | 20 | 0.0161 | 0.0522 | 0.0373 | 0.0367 | 0.0052 | 0.0158 |
| Cesium | 58 | 9 | 0.0108 | 0.026 | 0.0113 | 0.00878 | 0.00131 | 0.00948 |
| Chlorine | 58 | 21 | 0.00594 | 0.0479 | 0.0154 | 0.0134 | 0.00357 | 0.00827 |
| Chromium | 58 | 37 | 0.000845 | 0.0146 | 0.00421 | 0.00397 | 0.00106 | 0.00138 |
| Cobalt | 58 | 24 | 0.000606 | 0.00128 | 0.0012 | 0.00113 | 0.00021 | 0.000585 |
| Copper | 58 | 49 | 0.000838 | 0.0103 | 0.0101 | 0.0101 | 0.00307 | 0.0032 |
| Elemental Carbon | 59 | 56 | 0.252 | 0.57 | 0.535 | 0.466 | 0.181 | 0.194 |
| Europium | 58 | 15 | 0.00277 | 0.0056 | 0.00534 | 0.00501 | 0.000766 | 0.00309 |
| Gallium | 58 | 29 | 0.00146 | 0.00572 | 0.00257 | 0.00244 | 0.000529 | 0.00129 |
| Gold | 58 | 21 | 0.00203 | 0.0049 | 0.00478 | 0.0028 | 0.000583 | 0.00179 |
| Hafnium | 58 | 20 | 0.00889 | 0.0084 | 0.00351 | 0.00338 | 0.000754 | 0.00632 |
| Indium | 58 | 19 | 0.0052 | 0.0176 | 0.0111 | 0.0104 | 0.00177 | 0.00501 |
| Iridium | 58 | 22 | 0.00241 | 0.012 | 0.00595 | 0.00548 | 0.000981 | 0.00244 |
| Iron | 58 | 58 | 0.00182 | 0.0619 | 0.0548 | 0.0527 | 0.0232 | 0.0232 |
| Lanthanium | 58 | 20 | 0.0126 | 0.0756 | 0.0508 | 0.0455 | 0.00555 | 0.0129 |
| Magnesium | 58 | 17 | 0.0115 | 0.0744 | 0.0732 | 0.0557 | 0.00696 | 0.013 |
| Manganese | 58 | 38 | 0.00086 | 0.00326 | 0.00283 | 0.00275 | 0.000809 | 0.00112 |
| Mercury | 58 | 26 | 0.00216 | 0.00701 | 0.00665 | 0.00525 | 0.00107 | 0.0022 |
| Molybdenum | 58 | 10 | 0.00283 | 0.00792 | 0.00466 | 0.00443 | 0.000475 | 0.00281 |
| Nickel | 58 | 32 | 0.000602 | 0.00326 | 0.00198 | 0.00145 | 0.000404 | 0.00068 |
| Niobium | 58 | 15 | 0.00158 | 0.00637 | 0.00594 | 0.00409 | 0.00058 | 0.00161 |
| Organic Carbon Peak1 | 59 | 59 | 0.267 | 1.38 | 1 | 0.987 | 0.46 | 0.46 |
| Organic Carbon Peak2 | 59 | 59 | 0.29 | 1.79 | 1.68 | 1.56 | 0.872 | 0.872 |
| Organic Carbon Peak3 | 59 | 59 | 0.274 | 1.45 | 1.39 | 1.36 | 0.596 | 0.596 |
| Organic Carbon Peak4 | 59 | 58 | 0.274 | 1.84 | 1.82 | 1.52 | 0.564 | 0.568 |
| Organic Carbon | 59 | 59 | 0.39 | 5.33 | 5.29 | 5.19 | 2.51 | 2.51 |
| Organic Carbon Pyrolytic | 59 | 15 | 0.241 | 0.244 | 0.241 | 0.164 | 0.0177 | 0.197 |
| Phosphorus | 58 | 4 | 0.00516 | 0.00408 | 0.00291 | 0.00175 | 0.000169 | 0.00506 |
| Potassium Ion | 58 | 14 | 0.0019 | 0.299 | 0.11 | 0.0998 | 0.0201 | 0.0204 |
| Potassium | 58 | 58 | 0.00433 | 0.361 | 0.127 | 0.124 | 0.0413 | 0.0413 |
| Rubidium | 58 | 24 | 0.000786 | 0.00239 | 0.00153 | 0.00145 | 0.000337 | 0.000771 |
| Samarium | 58 | 19 | 0.0023 | 0.00723 | 0.00466 | 0.00349 | 0.000756 | 0.0024 |
| Scandium | 58 | 14 | 0.00306 | 0.00315 | 0.00209 | 0.00176 | 0.000255 | 0.00304 |
| Selenium | 58 | 40 | 0.000998 | 0.0035 | 0.00295 | 0.00291 | 0.000872 | 0.00116 |
| Silicon | 58 | 43 | 0.00731 | 0.122 | 0.104 | 0.079 | 0.0236 | 0.0262 |
| Silver | 58 | 19 | 0.00414 | 0.0169 | 0.00991 | 0.00724 | 0.00158 | 0.00403 |
| Sodium Ion | 58 | 49 | 0.0466 | 0.205 | 0.157 | 0.102 | 0.0408 | 0.0455 |
| Sodium | 58 | 24 | 0.0442 | 0.337 | 0.23 | 0.189 | 0.0316 | 0.0504 |
| Strantium | 58 | 29 | 0.000941 | 0.00845 | 0.00255 | 0.00239 | 0.000646 | 0.00107 |
| Sulfate | 58 | 58 | 0.254 | 12.9 | 12.4 | 8.38 | 2.94 | 2.94 |
| Sulfur | 58 | 58 | 0.0737 | 4.95 | 4.41 | 3.53 | 1.01 | 1.01 |
| Tantalum | 58 | 23 | 0.00558 | 0.0158 | 0.0127 | 0.0111 | 0.00199 | 0.00485 |
| Terbium | 58 | 22 | 0.0028 | 0.00609 | 0.00595 | 0.00502 | 0.00103 | 0.00291 |
| Tin | 58 | 28 | 0.00714 | 0.0329 | 0.0249 | 0.0239 | 0.00477 | 0.00807 |
| Titatium | 58 | 42 | 0.00164 | 0.00957 | 0.00711 | 0.00609 | 0.00178 | 0.00228 |
| Total Nitrate | 58 | 58 | 0.127 | 8.73 | 7.65 | 7.18 | 1.23 | 1.23 |
| Tungsten | 58 | 31 | 0.00347 | 0.0131 | 0.0099 | 0.009 | 0.0019 | 0.00338 |
| Vanadium | 58 | 36 | 0.00114 | 0.00501 | 0.00385 | 0.00361 | 0.000877 | 0.00135 |
| Yttrium | 58 | 27 | 0.00111 | 0.00397 | 0.00396 | 0.00315 | 0.000659 | 0.00117 |
| Zinc | 58 | 53 | 0.000868 | 0.0191 | 0.0165 | 0.016 | 0.00613 | 0.00619 |
| Zirconium | 58 | 21 | 0.00142 | 0.00501 | 0.00443 | 0.00442 | 0.000934 | 0.00172 |

| KALAMAZOO | AIRS ID: 260770008 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | # Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| $PM_{2.5}$ LC | 61 | 61 | 0.882 | 46.5 | 38.1 | 34.2 | 16.3 | 16.3 |
| Aluminum | 61 | 34 | 0.0121 | 0.127 | 0.116 | 0.111 | 0.0238 | 0.0302 |
| Ammonium Ion | 61 | 61 | 0.136 | 5.11 | 4.46 | 4.22 | 1.91 | 1.91 |
| Antimony | 61 | 20 | 0.0105 | 0.0327 | 0.0316 | 0.0256 | 0.00405 | 0.0105 |
| Arsenic | 61 | 44 | 0.000888 | 0.00583 | 0.00502 | 0.005 | 0.00143 | 0.00172 |
| Barium | 61 | 26 | 0.0203 | 0.202 | 0.14 | 0.112 | 0.0137 | 0.0265 |
| Bromine | 61 | 61 | 0.000763 | 0.0111 | 0.00816 | 0.00742 | 0.00331 | 0.00331 |
| Cadmium | 61 | 18 | 0.00465 | 0.0199 | 0.0128 | 0.0118 | 0.00195 | 0.00496 |
| Calcium | 61 | 61 | 0.00758 | 0.382 | 0.353 | 0.319 | 0.105 | 0.105 |
| Cerium | 61 | 28 | 0.0133 | 0.0776 | 0.0676 | 0.067 | 0.0113 | 0.0199 |
| Cesium | 61 | 6 | 0.00963 | 0.0206 | 0.0196 | 0.00442 | 0.000743 | 0.0086 |
| Chlorine | 61 | 27 | 0.0064 | 0.213 | 0.141 | 0.101 | 0.0132 | 0.0177 |
| Chromium | 61 | 44 | 0.000861 | 0.00707 | 0.00641 | 0.00626 | 0.00155 | 0.0018 |
| Cobalt | 61 | 17 | 0.000782 | 0.00203 | 0.0016 | 0.0011 | 0.000205 | 0.000766 |
| Copper | 61 | 50 | 0.000841 | 0.0196 | 0.0112 | 0.00731 | 0.00297 | 0.00312 |
| Elemental Carbon | 61 | 61 | 0.275 | 1.64 | 1.37 | 1.37 | 0.59 | 0.59 |
| Europium | 61 | 18 | 0.00283 | 0.0179 | 0.0117 | 0.00942 | 0.00176 | 0.00405 |
| Gallium | 61 | 42 | 0.00132 | 0.00583 | 0.00268 | 0.00233 | 0.000649 | 0.00114 |
| Gold | 61 | 19 | 0.00188 | 0.00547 | 0.00455 | 0.00425 | 0.000539 | 0.00177 |
| Hafnium | 61 | 25 | 0.00897 | 0.00875 | 0.00851 | 0.00622 | 0.00161 | 0.0068 |
| Indium | 61 | 17 | 0.0052 | 0.0275 | 0.0233 | 0.0126 | 0.00173 | 0.00526 |
| Iridium | 61 | 12 | 0.00209 | 0.00408 | 0.00385 | 0.0035 | 0.000381 | 0.00202 |
| Iron | 61 | 61 | 0.00744 | 0.401 | 0.354 | 0.318 | 0.131 | 0.131 |
| Lanthanium | 61 | 32 | 0.0106 | 0.0525 | 0.0511 | 0.051 | 0.0091 | 0.0148 |
| Magnesium | 61 | 26 | 0.0108 | 0.0914 | 0.0767 | 0.0678 | 0.00942 | 0.0143 |
| Manganese | 61 | 55 | 0.000926 | 0.0177 | 0.0158 | 0.0149 | 0.00454 | 0.00462 |
| Mercury | 61 | 23 | 0.00204 | 0.00734 | 0.00676 | 0.00664 | 0.0011 | 0.00232 |
| Molybdenum | 61 | 10 | 0.00281 | 0.00758 | 0.0049 | 0.00361 | 0.000449 | 0.0028 |
| Nickel | 61 | 42 | 0.000608 | 0.00369 | 0.00303 | 0.00297 | 0.000742 | 0.000936 |
| Niobium | 61 | 14 | 0.00149 | 0.00349 | 0.00291 | 0.00245 | 0.000361 | 0.00142 |
| Organic Carbon Peak1 | 61 | 61 | 0.298 | 3.1 | 2.35 | 1.99 | 1.01 | 1.01 |
| Organic Carbon Peak2 | 61 | 61 | 0.307 | 1.93 | 1.85 | 1.83 | 1.15 | 1.15 |
| Organic Carbon Peak3 | 61 | 61 | 0.285 | 1.77 | 1.62 | 1.59 | 0.785 | 0.785 |
| Organic Carbon Peak4 | 61 | 61 | 0.294 | 3.45 | 2.72 | 2.33 | 0.932 | 0.932 |
| Organic Carbon | 61 | 61 | 0.484 | 9.76 | 9.06 | 7.04 | 3.94 | 3.94 |
| Organic Carbon Pyrolytic | 61 | 13 | 0.244 | 1.8 | 0.994 | 0.405 | 0.0648 | 0.254 |
| Phosphorus | 61 | 4 | 0.00655 | 0.0169 | 0.0128 | 0.0099 | 0.000661 | 0.00681 |
| Potassium Ion | 61 | 30 | 0.00432 | 0.904 | 0.201 | 0.165 | 0.0542 | 0.0545 |
| Potassium | 61 | 61 | 0.00715 | 1.02 | 0.264 | 0.198 | 0.0935 | 0.0935 |
| Rubidium | 61 | 32 | 0.000752 | 0.00211 | 0.00148 | 0.0014 | 0.000314 | 0.00063 |
| Samarium | 61 | 25 | 0.00223 | 0.022 | 0.0123 | 0.0119 | 0.00219 | 0.00365 |
| Scandium | 61 | 5 | 0.00331 | 0.00409 | 0.00361 | 0.00117 | 0.000165 | 0.00335 |
| Selenium | 61 | 50 | 0.000966 | 0.00653 | 0.00513 | 0.00405 | 0.00129 | 0.00146 |
| Silicon | 61 | 55 | 0.0128 | 0.761 | 0.629 | 0.547 | 0.137 | 0.138 |
| Silver | 61 | 22 | 0.0043 | 0.00969 | 0.00862 | 0.00792 | 0.00166 | 0.00412 |
| Sodium Ion | 61 | 53 | 0.0471 | 0.144 | 0.141 | 0.132 | 0.0438 | 0.0478 |
| Sodium | 61 | 34 | 0.0397 | 0.319 | 0.176 | 0.117 | 0.0274 | 0.0464 |
| Strantium | 61 | 43 | 0.000944 | 0.0149 | 0.00389 | 0.0035 | 0.00114 | 0.00138 |
| Sulfate | 61 | 61 | 0.358 | 20.7 | 14.7 | 14.7 | 4.45 | 4.45 |
| Sulfur | 61 | 61 | 0.101 | 6.16 | 5.65 | 5.18 | 1.47 | 1.47 |
| Tantalum | 61 | 13 | 0.00482 | 0.0077 | 0.00701 | 0.00361 | 0.000614 | 0.00442 |
| Terbium | 61 | 33 | 0.00462 | 0.0339 | 0.0279 | 0.0229 | 0.0056 | 0.00787 |
| Tin | 61 | 33 | 0.00742 | 0.028 | 0.0263 | 0.0251 | 0.00505 | 0.00802 |
| Titatium | 61 | 47 | 0.00181 | 0.0344 | 0.0257 | 0.0219 | 0.00683 | 0.00729 |
| Total Nitrate | 61 | 61 | 0.21 | 9.82 | 9.51 | 7.31 | 2.46 | 2.46 |
| Tungsten | 61 | 29 | 0.00314 | 0.01 | 0.00793 | 0.00586 | 0.0014 | 0.00304 |
| Vanadium | 61 | 44 | 0.00121 | 0.00722 | 0.00711 | 0.00561 | 0.00171 | 0.00206 |
| Yttrium | 61 | 32 | 0.00105 | 0.00373 | 0.00293 | 0.00244 | 0.00059 | 0.00101 |
| Zinc | 61 | 61 | 0.0013 | 0.125 | 0.0779 | 0.0398 | 0.0169 | 0.0169 |
| Zirconium | 61 | 26 | 0.00139 | 0.0064 | 0.00443 | 0.00431 | 0.000996 | 0.00167 |

| SAULT STE. MARIE - Easterday | AIRS ID: 260330901 | | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|
| **Chemical Name** | **# Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ LC | 84 | 82 | 0.575 | 45.5 | 29.2 | 29.1 | 9.09 | 9.1 |
| Aluminum | 85 | 36 | 0.0121 | 0.0872 | 0.0704 | 0.0458 | 0.0101 | 0.0182 |
| Ammonium Ion | 85 | 84 | 0.0659 | 6.04 | 4.32 | 3.63 | 0.929 | 0.929 |
| Antimony | 85 | 36 | 0.0105 | 0.0477 | 0.0476 | 0.0465 | 0.00559 | 0.0112 |
| Arsenic | 85 | 53 | 0.000855 | 0.00516 | 0.00466 | 0.00352 | 0.000797 | 0.00115 |
| Barium | 85 | 26 | 0.0232 | 0.176 | 0.136 | 0.111 | 0.00994 | 0.0249 |
| Bromine | 85 | 76 | 0.000737 | 0.00588 | 0.00569 | 0.00535 | 0.00196 | 0.00206 |
| Cadmium | 85 | 31 | 0.00465 | 0.0228 | 0.0221 | 0.0151 | 0.00213 | 0.00483 |
| Calcium | 85 | 84 | 0.0036 | 0.223 | 0.155 | 0.154 | 0.0365 | 0.0366 |
| Cerium | 85 | 41 | 0.0127 | 0.0702 | 0.0577 | 0.0462 | 0.00779 | 0.0149 |
| Cesium | 85 | 11 | 0.0096 | 0.0306 | 0.024 | 0.0223 | 0.00198 | 0.00977 |
| Chlorine | 85 | 37 | 0.00633 | 0.0901 | 0.0791 | 0.0779 | 0.00782 | 0.0122 |
| Chromium | 85 | 64 | 0.000856 | 0.0134 | 0.0109 | 0.01 | 0.00193 | 0.00216 |
| Cobalt | 85 | 25 | 0.000705 | 0.00121 | 0.0011 | 0.00093 | 0.00014 | 0.00067 |
| Copper | 85 | 66 | 0.000838 | 0.0271 | 0.0112 | 0.0107 | 0.00177 | 0.00195 |
| Elemental Carbon | 85 | 84 | 0.257 | 0.666 | 0.635 | 0.627 | 0.282 | 0.284 |
| Europium | 85 | 26 | 0.00258 | 0.0101 | 0.00942 | 0.00826 | 0.00125 | 0.00331 |
| Gallium | 85 | 36 | 0.00133 | 0.00674 | 0.00373 | 0.0029 | 0.000495 | 0.00122 |
| Gold | 85 | 37 | 0.00195 | 0.00837 | 0.00501 | 0.00419 | 0.000783 | 0.00179 |
| Hafnium | 85 | 36 | 0.00878 | 0.0128 | 0.0108 | 0.00977 | 0.00163 | 0.00658 |
| Indium | 85 | 26 | 0.00525 | 0.0172 | 0.015 | 0.0127 | 0.00165 | 0.00491 |
| Iridium | 85 | 28 | 0.00224 | 0.00861 | 0.00756 | 0.0072 | 0.000699 | 0.00214 |
| Iron | 85 | 84 | 0.00469 | 0.884 | 0.372 | 0.299 | 0.0749 | 0.0749 |
| Lanthanium | 85 | 31 | 0.0102 | 0.0496 | 0.0403 | 0.0343 | 0.00482 | 0.0111 |
| Magnesium | 85 | 22 | 0.0102 | 0.0618 | 0.0601 | 0.0336 | 0.00406 | 0.0101 |
| Manganese | 85 | 68 | 0.000848 | 0.028 | 0.00699 | 0.00686 | 0.00216 | 0.00234 |
| Mercury | 85 | 41 | 0.00219 | 0.0105 | 0.00839 | 0.0072 | 0.00141 | 0.00249 |
| Molybdenum | 85 | 14 | 0.00282 | 0.00476 | 0.0036 | 0.00279 | 0.000263 | 0.00261 |
| Nickel | 85 | 69 | 0.000592 | 0.00548 | 0.00444 | 0.00378 | 0.000971 | 0.00109 |
| Niobium | 85 | 22 | 0.00149 | 0.00883 | 0.00453 | 0.00396 | 0.000554 | 0.00154 |
| Organic Carbon Peak1 | 85 | 85 | 0.277 | 1.75 | 1.52 | 1.48 | 0.658 | 0.658 |
| Organic Carbon Peak2 | 85 | 85 | 0.292 | 2.94 | 1.81 | 1.78 | 0.922 | 0.922 |
| Organic Carbon Peak3 | 85 | 85 | 0.275 | 1.97 | 1.63 | 1.48 | 0.621 | 0.621 |
| Organic Carbon Peak4 | 85 | 83 | 0.277 | 2.24 | 2.02 | 1.63 | 0.63 | 0.636 |
| Organic Carbon | 85 | 85 | 0.413 | 8.36 | 5.87 | 5.83 | 2.86 | 2.86 |
| Organic Carbon Pyrolytic | 85 | 24 | 0.242 | 1 | 0.462 | 0.201 | 0.0311 | 0.203 |
| Phosphorus | 85 | 3 | 0.00527 | 0.00793 | 0.00418 | 0.00338 | 0.000182 | 0.0053 |
| Potassium Ion | 85 | 46 | 0.00355 | 0.305 | 0.179 | 0.178 | 0.0431 | 0.0433 |
| Potassium | 85 | 84 | 0.00544 | 0.334 | 0.251 | 0.208 | 0.064 | 0.064 |
| Rubidium | 85 | 36 | 0.00073 | 0.00162 | 0.00151 | 0.0015 | 0.000345 | 0.00074 |
| Samarium | 85 | 28 | 0.00219 | 0.0127 | 0.00895 | 0.00849 | 0.00116 | 0.00271 |
| Scandium | 85 | 10 | 0.00328 | 0.00222 | 0.00186 | 0.00163 | 0.000126 | 0.00327 |
| Selenium | 85 | 55 | 0.000968 | 0.0072 | 0.00408 | 0.00256 | 0.000841 | 0.00117 |
| Silicon | 85 | 57 | 0.00788 | 0.168 | 0.167 | 0.155 | 0.0325 | 0.0354 |
| Silver | 85 | 33 | 0.00415 | 0.0123 | 0.0106 | 0.0106 | 0.00169 | 0.00403 |
| Sodium Ion | 85 | 80 | 0.0491 | 0.141 | 0.138 | 0.119 | 0.0497 | 0.0516 |
| Sodium | 85 | 42 | 0.0375 | 0.449 | 0.226 | 0.197 | 0.034 | 0.0492 |
| Strantium | 85 | 52 | 0.000911 | 0.00373 | 0.00246 | 0.00244 | 0.00069 | 0.00101 |
| Sulfate | 85 | 84 | 0.214 | 11.6 | 8.22 | 8.17 | 2.37 | 2.37 |
| Sulfur | 85 | 84 | 0.0522 | 4.04 | 2.88 | 2.72 | 0.796 | 0.796 |
| Tantalum | 85 | 20 | 0.00496 | 0.0114 | 0.00977 | 0.00653 | 0.000728 | 0.00436 |
| Terbium | 85 | 52 | 0.00367 | 0.0237 | 0.0174 | 0.0171 | 0.00341 | 0.00515 |
| Tin | 85 | 37 | 0.00722 | 0.042 | 0.0264 | 0.0237 | 0.00425 | 0.00784 |
| Titatium | 85 | 58 | 0.00169 | 0.0177 | 0.0103 | 0.0101 | 0.00255 | 0.00313 |
| Total Nitrate | 85 | 85 | 0.0981 | 9.47 | 6.9 | 3.99 | 0.8 | 0.8 |
| Tungsten | 85 | 38 | 0.00318 | 0.00861 | 0.00802 | 0.00791 | 0.00128 | 0.00287 |
| Vanadium | 85 | 60 | 0.00118 | 0.00721 | 0.0057 | 0.00511 | 0.00154 | 0.00193 |
| Yttrium | 85 | 36 | 0.00103 | 0.00344 | 0.00314 | 0.00291 | 0.000589 | 0.00111 |
| Zinc | 85 | 82 | 0.000998 | 0.0836 | 0.0461 | 0.038 | 0.0092 | 0.00923 |
| Zirconium | 85 | 40 | 0.00142 | 0.00663 | 0.00663 | 0.00513 | 0.000998 | 0.0016 |

| LUNA PIER | | AIRS ID: 261150005 | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|
| **Chemical Name** | **# Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ LC | 57 | 57 | 0.926 | 59.6 | 51.2 | 45.1 | 17.2 | 17.2 |
| Aluminum | 58 | 25 | 0.0138 | 0.123 | 0.114 | 0.104 | 0.0152 | 0.0251 |
| Ammonium Ion | 57 | 56 | 0.161 | 8.54 | 7.34 | 5.91 | 2.27 | 2.27 |
| Antimony | 58 | 20 | 0.0101 | 0.049 | 0.0244 | 0.0233 | 0.00406 | 0.0104 |
| Arsenic | 58 | 43 | 0.000897 | 0.00674 | 0.00557 | 0.00497 | 0.00145 | 0.00169 |
| Barium | 58 | 28 | 0.0255 | 0.203 | 0.132 | 0.12 | 0.0169 | 0.0312 |
| Bromine | 58 | 55 | 0.000777 | 0.00852 | 0.00691 | 0.00665 | 0.00288 | 0.00292 |
| Cadmium | 58 | 28 | 0.00485 | 0.0164 | 0.016 | 0.0125 | 0.00282 | 0.00503 |
| Calcium | 58 | 57 | 0.00408 | 0.155 | 0.141 | 0.117 | 0.0448 | 0.0448 |
| Cerium | 58 | 29 | 0.0143 | 0.0684 | 0.0675 | 0.0445 | 0.0094 | 0.0175 |
| Cesium | 58 | 7 | 0.0106 | 0.0277 | 0.0192 | 0.0117 | 0.00145 | 0.0103 |
| Chlorine | 58 | 18 | 0.0069 | 0.0995 | 0.079 | 0.0439 | 0.0068 | 0.0125 |
| Chromium | 58 | 43 | 0.000892 | 0.069 | 0.0199 | 0.00658 | 0.00285 | 0.00308 |
| Cobalt | 58 | 12 | 0.000695 | 0.00104 | 0.00082 | 0.0006 | 0.000102 | 0.000662 |
| Copper | 58 | 52 | 0.00101 | 0.0296 | 0.0275 | 0.024 | 0.00372 | 0.00381 |
| Elemental Carbon | 57 | 56 | 0.273 | 1.31 | 1.26 | 1.25 | 0.577 | 0.582 |
| Europium | 58 | 14 | 0.00286 | 0.0207 | 0.00933 | 0.00675 | 0.00127 | 0.00373 |
| Gallium | 58 | 37 | 0.00136 | 0.00327 | 0.00304 | 0.00303 | 0.000644 | 0.00115 |
| Gold | 58 | 24 | 0.00193 | 0.00711 | 0.00655 | 0.00496 | 0.000937 | 0.00194 |
| Hafnium | 58 | 28 | 0.00911 | 0.011 | 0.00665 | 0.00627 | 0.00151 | 0.0063 |
| Indium | 58 | 25 | 0.00548 | 0.0333 | 0.0167 | 0.0135 | 0.00347 | 0.0063 |
| Iridium | 58 | 12 | 0.00216 | 0.00817 | 0.00384 | 0.00374 | 0.000491 | 0.00208 |
| Iron | 58 | 58 | 0.0049 | 0.366 | 0.311 | 0.198 | 0.0835 | 0.0835 |
| Lanthanium | 58 | 27 | 0.0115 | 0.0498 | 0.0433 | 0.0246 | 0.00646 | 0.012 |
| Magnesium | 58 | 17 | 0.01 | 0.0822 | 0.0613 | 0.0198 | 0.00457 | 0.00981 |
| Manganese | 58 | 53 | 0.000866 | 0.0119 | 0.00684 | 0.00648 | 0.00249 | 0.00257 |
| Mercury | 58 | 27 | 0.0022 | 0.00804 | 0.00792 | 0.00735 | 0.00145 | 0.00256 |
| Molybdenum | 58 | 5 | 0.00281 | 0.00349 | 0.00163 | 0.00163 | 0.000144 | 0.00269 |
| Nickel | 58 | 43 | 0.000629 | 0.0261 | 0.0064 | 0.00347 | 0.0015 | 0.00166 |
| Niobium | 58 | 15 | 0.00155 | 0.00537 | 0.00442 | 0.00409 | 0.000629 | 0.00166 |
| Organic Carbon Peak1 | 57 | 57 | 0.294 | 2.65 | 2.23 | 1.95 | 0.932 | 0.932 |
| Organic Carbon Peak2 | 57 | 57 | 0.296 | 1.76 | 1.56 | 1.55 | 0.988 | 0.988 |
| Organic Carbon Peak3 | 57 | 57 | 0.281 | 1.68 | 1.62 | 1.43 | 0.71 | 0.71 |
| Organic Carbon Peak4 | 57 | 57 | 0.294 | 2.79 | 2.4 | 2.31 | 0.916 | 0.916 |
| Organic Carbon | 57 | 57 | 0.46 | 7.59 | 7.1 | 6.28 | 3.57 | 3.57 |
| Organic Carbon Pyrolytic | 57 | 10 | 0.242 | 0.442 | 0.366 | 0.213 | 0.0232 | 0.221 |
| Phosphorus | 58 | 1 | 0.00539 | 0.00058 | 0 | 0 | 0.00001 | 0.00537 |
| Potassium Ion | 57 | 28 | 0.00384 | 0.54 | 0.271 | 0.171 | 0.0463 | 0.0465 |
| Potassium | 58 | 57 | 0.00556 | 0.586 | 0.359 | 0.172 | 0.0684 | 0.0684 |
| Rubidium | 58 | 31 | 0.000759 | 0.00268 | 0.00226 | 0.0021 | 0.000391 | 0.000696 |
| Samarium | 58 | 20 | 0.00229 | 0.00897 | 0.00793 | 0.00731 | 0.00133 | 0.00298 |
| Scandium | 58 | 8 | 0.00313 | 0.00339 | 0.00291 | 0.00245 | 0.000255 | 0.00322 |
| Selenium | 58 | 52 | 0.000997 | 0.0188 | 0.0155 | 0.0144 | 0.00309 | 0.00319 |
| Silicon | 58 | 41 | 0.00894 | 0.221 | 0.209 | 0.144 | 0.0416 | 0.0449 |
| Silver | 58 | 26 | 0.00433 | 0.0135 | 0.0123 | 0.0101 | 0.00285 | 0.00488 |
| Sodium Ion | 57 | 51 | 0.0472 | 0.314 | 0.197 | 0.196 | 0.0739 | 0.0772 |
| Sodium | 58 | 33 | 0.0381 | 0.216 | 0.185 | 0.165 | 0.0372 | 0.0515 |
| Strantium | 58 | 44 | 0.000982 | 0.00768 | 0.00729 | 0.00709 | 0.00143 | 0.00167 |
| Sulfate | 57 | 57 | 0.395 | 24.9 | 20.3 | 14.6 | 4.94 | 4.94 |
| Sulfur | 58 | 57 | 0.109 | 8.42 | 7.19 | 4.99 | 1.63 | 1.63 |
| Tantalum | 58 | 11 | 0.0054 | 0.0143 | 0.0141 | 0.0138 | 0.00118 | 0.00525 |
| Terbium | 58 | 35 | 0.00375 | 0.0421 | 0.0192 | 0.0136 | 0.00406 | 0.00571 |
| Tin | 58 | 31 | 0.00752 | 0.0372 | 0.0318 | 0.0294 | 0.00632 | 0.00933 |
| Titatium | 58 | 46 | 0.00168 | 0.017 | 0.0125 | 0.0107 | 0.0036 | 0.00401 |
| Total Nitrate | 57 | 57 | 0.213 | 11.6 | 8.46 | 8.34 | 2.52 | 2.52 |
| Tungsten | 58 | 25 | 0.00328 | 0.0102 | 0.00815 | 0.00723 | 0.00135 | 0.00309 |
| Vanadium | 58 | 46 | 0.00117 | 0.0101 | 0.00897 | 0.00862 | 0.00204 | 0.00229 |
| Yttrium | 58 | 24 | 0.00106 | 0.00292 | 0.00291 | 0.0028 | 0.00048 | 0.00105 |
| Zinc | 58 | 57 | 0.00123 | 0.0514 | 0.0481 | 0.0457 | 0.0159 | 0.0159 |
| Zirconium | 58 | 25 | 0.00152 | 0.0948 | 0.00455 | 0.00431 | 0.00256 | 0.00323 |

| YPSILANTI | AIRS ID: 261610008 | | | | | Units: µg/m³ | |
|---|---|---|---|---|---|---|---|
| **Chemical Name** | **# Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ LC | 60 | 60 | 0.898 | 58.7 | 50.8 | 39.2 | 16.6 | 16.6 |
| Aluminum | 60 | 21 | 0.0125 | 0.131 | 0.0575 | 0.0482 | 0.00965 | 0.0188 |
| Ammonium Ion | 60 | 60 | 0.158 | 8.44 | 7.21 | 6.04 | 2.23 | 2.23 |
| Antimony | 60 | 25 | 0.0102 | 0.0362 | 0.0233 | 0.021 | 0.00397 | 0.00982 |
| Arsenic | 60 | 40 | 0.0009 | 0.00754 | 0.00488 | 0.00443 | 0.00141 | 0.00172 |
| Barium | 60 | 28 | 0.0218 | 0.0713 | 0.0547 | 0.0417 | 0.00786 | 0.02 |
| Bromine | 60 | 58 | 0.000819 | 0.0675 | 0.0103 | 0.00935 | 0.00452 | 0.00453 |
| Cadmium | 60 | 17 | 0.00457 | 0.0176 | 0.0142 | 0.0104 | 0.00208 | 0.00513 |
| Calcium | 60 | 59 | 0.0035 | 0.102 | 0.0893 | 0.0786 | 0.0317 | 0.0318 |
| Cerium | 60 | 25 | 0.0144 | 0.0412 | 0.0308 | 0.0293 | 0.00535 | 0.0135 |
| Cesium | 60 | 10 | 0.01 | 0.024 | 0.0151 | 0.00966 | 0.00147 | 0.00896 |
| Chlorine | 60 | 20 | 0.00768 | 0.937 | 0.7 | 0.203 | 0.0347 | 0.0398 |
| Chromium | 60 | 37 | 0.000837 | 0.0109 | 0.00585 | 0.00438 | 0.0013 | 0.00164 |
| Cobalt | 60 | 13 | 0.000669 | 0.00093 | 0.00082 | 0.0007 | 0.00011 | 0.000643 |
| Copper | 60 | 54 | 0.000901 | 0.0487 | 0.019 | 0.0181 | 0.00469 | 0.00477 |
| Elemental Carbon | 60 | 60 | 0.27 | 1.82 | 1.38 | 1.33 | 0.501 | 0.501 |
| Europium | 60 | 20 | 0.00281 | 0.0111 | 0.00806 | 0.00654 | 0.00118 | 0.00337 |
| Gallium | 60 | 33 | 0.00136 | 0.00315 | 0.00314 | 0.00294 | 0.000578 | 0.0012 |
| Gold | 60 | 21 | 0.00194 | 0.00711 | 0.00521 | 0.0049 | 0.000807 | 0.00201 |
| Hafnium | 60 | 26 | 0.00908 | 0.0142 | 0.00861 | 0.00666 | 0.0018 | 0.00699 |
| Indium | 60 | 21 | 0.00528 | 0.0164 | 0.0153 | 0.0119 | 0.00268 | 0.00586 |
| Iridium | 60 | 16 | 0.00226 | 0.00537 | 0.00338 | 0.00314 | 0.000525 | 0.00207 |
| Iron | 60 | 60 | 0.00396 | 0.303 | 0.176 | 0.147 | 0.0627 | 0.0627 |
| Lanthanium | 60 | 19 | 0.0115 | 0.0598 | 0.0367 | 0.018 | 0.00345 | 0.0108 |
| Magnesium | 60 | 16 | 0.0103 | 0.0942 | 0.061 | 0.0382 | 0.00509 | 0.0114 |
| Manganese | 60 | 49 | 0.000862 | 0.0116 | 0.00798 | 0.00729 | 0.00198 | 0.00215 |
| Mercury | 60 | 28 | 0.00213 | 0.0391 | 0.0105 | 0.0086 | 0.0024 | 0.00349 |
| Molybdenum | 60 | 10 | 0.00279 | 0.00571 | 0.00523 | 0.0049 | 0.000459 | 0.00279 |
| Nickel | 60 | 44 | 0.00062 | 0.0036 | 0.00339 | 0.00327 | 0.000804 | 0.000969 |
| Niobium | 60 | 14 | 0.00149 | 0.00502 | 0.00466 | 0.00442 | 0.000468 | 0.00148 |
| Organic Carbon Peak1 | 60 | 60 | 0.303 | 3.86 | 3.71 | 3.15 | 1.06 | 1.06 |
| Organic Carbon Peak2 | 60 | 60 | 0.302 | 2.71 | 1.79 | 1.67 | 1.08 | 1.08 |
| Organic Carbon Peak3 | 60 | 60 | 0.283 | 1.95 | 1.43 | 1.4 | 0.735 | 0.735 |
| Organic Carbon Peak4 | 60 | 59 | 0.296 | 3.54 | 3.02 | 3.02 | 0.955 | 0.959 |
| Organic Carbon | 60 | 60 | 0.481 | 11.9 | 9.73 | 8.51 | 3.9 | 3.9 |
| Organic Carbon Pyrolytic | 60 | 15 | 0.244 | 2.44 | 0.337 | 0.332 | 0.0634 | 0.243 |
| Phosphorus | 60 | 2 | 0.00589 | 0.00735 | 0.00024 | 0 | 0.000126 | 0.00589 |
| Potassium Ion | 60 | 27 | 0.00456 | 1.58 | 0.151 | 0.146 | 0.0568 | 0.0571 |
| Potassium | 60 | 60 | 0.00636 | 1.64 | 0.154 | 0.134 | 0.0798 | 0.0798 |
| Rubidium | 60 | 22 | 0.000739 | 0.0018 | 0.00173 | 0.00148 | 0.000251 | 0.000699 |
| Samarium | 60 | 14 | 0.00229 | 0.0128 | 0.00619 | 0.00385 | 0.000694 | 0.00252 |
| Scandium | 60 | 12 | 0.0031 | 0.00176 | 0.0014 | 0.0014 | 0.000156 | 0.00301 |
| Selenium | 60 | 46 | 0.000974 | 0.00565 | 0.00443 | 0.0042 | 0.00153 | 0.00176 |
| Silicon | 60 | 47 | 0.00825 | 0.167 | 0.132 | 0.126 | 0.0371 | 0.0397 |
| Silver | 60 | 26 | 0.00426 | 0.0106 | 0.00989 | 0.00922 | 0.0015 | 0.00366 |
| Sodium Ion | 60 | 56 | 0.0463 | 0.588 | 0.203 | 0.189 | 0.0637 | 0.0666 |
| Sodium | 60 | 31 | 0.0371 | 0.326 | 0.245 | 0.133 | 0.0311 | 0.0459 |
| Strantium | 60 | 39 | 0.000946 | 0.0217 | 0.00523 | 0.00443 | 0.00124 | 0.00152 |
| Sulfate | 60 | 60 | 0.366 | 29.7 | 16.4 | 14.8 | 4.55 | 4.55 |
| Sulfur | 60 | 60 | 0.108 | 10.4 | 6.38 | 5.33 | 1.61 | 1.61 |
| Tantalum | 60 | 9 | 0.00502 | 0.0183 | 0.00804 | 0.00571 | 0.00069 | 0.00492 |
| Terbium | 60 | 34 | 0.00341 | 0.0142 | 0.0116 | 0.0112 | 0.00241 | 0.00409 |
| Tin | 60 | 19 | 0.00703 | 0.0343 | 0.0237 | 0.0221 | 0.00405 | 0.0084 |
| Titatium | 60 | 43 | 0.00168 | 0.0314 | 0.00909 | 0.00863 | 0.00329 | 0.00383 |
| Total Nitrate | 60 | 60 | 0.231 | 13.8 | 11.7 | 11.1 | 2.76 | 2.76 |
| Tungsten | 60 | 18 | 0.00327 | 0.01 | 0.00768 | 0.00654 | 0.00105 | 0.00319 |
| Vanadium | 60 | 38 | 0.00117 | 0.00736 | 0.00549 | 0.00529 | 0.00113 | 0.0016 |
| Yttrium | 60 | 21 | 0.00103 | 0.00326 | 0.0028 | 0.0028 | 0.000417 | 0.001 |
| Zinc | 60 | 60 | 0.00121 | 0.0819 | 0.0543 | 0.0492 | 0.015 | 0.015 |
| Zirconium | 60 | 20 | 0.00138 | 0.00628 | 0.00535 | 0.00374 | 0.000788 | 0.00162 |

# APPENDIX D: 1-HOUR $O_3$ EXCEEDANCES FROM 1996-2005

**Appendix D** is a tabulation of 1-hour $O_3$ Exceedances from 1996 to 2005. This information is provided by **Site Location**.

Exceedances are measured as a 1-hour $O_3$ averaged concentration level of 0.125 ppm or higher during a 24-hour period (midnight to midnight), with the highest 1-hour $O_3$ level being reported.

Historical $O_3$ exceedances for years prior to 1996 can be found in earlier Annual Air Quality Reports.

## 1-HOUR $O_3$ EXCEEDANCES FROM 1996 TO 2005 - Sorted By SITE LOCATION

(Units in ppm)

| 26-147-0030 ALGONAC | 26-161-0005 ANN ARBOR | 26-019-0003 BENZONIA | 26-027-0003 CASSOPOLIS | 26-021-0014 COLOMA | 26-081-2001 EVANS | 26-133-0901 EVART |
|---|---|---|---|---|---|---|
| Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc |
| Monitoring for $O_3$ ended in 1999 | Monitoring for $O_3$ ended in 1996 | 6-28-96 0.144 | 5-19-98 0.137 | 6-13-96 0.125 | 6-28-96 0.128 | Only in service during 1996 |
| | | | 6-24-02 0.128 | 6-28-96 0.138 | 6-29-96 0.125 | |
| | | | 7-3-02 0.127 | 5-19-98 0.136 | 1999 Monitor moved to Evans (26-081-0020) | |
| | | | | 9-6-98 0.157 | | |
| | | | | 7-30-99 0.144 | | |
| | | | | 8-8-01 0.126 | | |

| 26-049-0021 FLINT | 26-081-0020 GRAND RAPIDS | 26-063-0007 HARBOR BEACH | 26-005-0003 HOLLAND | 26-143-0901 HOUGHTON LAKE | 26-139-0005 JENISON | 26-077-0906 KALAMAZOO |
|---|---|---|---|---|---|---|
| Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc |
| 5-15-98 0.130 | 6-28-96 0.135 | 6-14-01 0.153 | 6-28-96 0.154 | Only in service during 1996 | 6-28-96 0.140 | Monitoring for $O_3$ ended in 1996 |
| | 6-29-96 0.127 | | 9-6-98 0.130 | | | |
| | | | 7-30-99 0.154 | | | |
| | | | 6-9-00 0.126 | | | |
| | | | 6-23-02 0.129 | | | |
| | | | 7-20-04 0.107 | | | |
| | | | 6-24-05 0.128 | | | |

| 26-105-0006 LUDINGTON | 26-121-0039 MUSKEGON | 26-099-0009 NEW HAVEN | 26-049-2001 OTISVILLE | 26-147-0005 PORT HURON | 26-099-1003 WARREN |
|---|---|---|---|---|---|
| Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc |
| 6-27-96 0.128 | 6-28-96 0.158 | 7-12-97 0.138 | 5-15-98 0.152 | 5-22-96 0.184 | 7-6-96 0.125 |
| 6-28-96 0.160 | 7-30-99 0.154 | 7-15-98 0.129 | 6-11-99 0.131 | 5-19-98 0.128 | 6-25-03 0.125 |
| 7-30-99 0.161 | 6-9-00 0.129 | 8-21-98 0.126 | | 6-29-01 0.126 | |
| 6-9-00 0.130 | 6-22-02 0.130 | 6-12-99 0.147 | | 6-25-02 0.140 | |
| 8-1-01 0.125 | 6-23-02 0.128 | 6-27-01 0.127 | | 6-24-03 0.132 | |
| | 6-24-05 0.128 | 6-24-03 0.135 | | 6-25-03 0.143 | |
| | | 6-25-03 0.131 | | | |
| | | 7-3-03 0.131 | | | |

# APPENDIX E: AQD ACRONYMS AND DEFINITIONS

| AQD ACRONYM | DEFINITION |
|---|---|
| < | less than |
| > | greater than |
| ≥ | greater than or equal to |
| º | degree |
| % | percent |
| AIRS | Aerometric Information Retrieval System |
| AMU | Air Monitoring Unit (AQD) |
| AQA | Air Quality Analysis |
| AQCR | Air Quality Control Region |
| AQD | Air Quality Division |
| AQES | Air Quality Evaluation Section |
| AQI | Air Quality Index |
| AQS | Air Quality Subsystem |
| Btu | British thermal units |
| C | Celsius |
| CAA | Clean Air Act |
| CFR | Code of Federal Regulations |
| CMSA | Consolidated Metropolitan Statistical Area |
| CO | carbon monoxide |
| CSA | Combined Statistical Area |
| DATI | Detroit Air Toxics Initiative |
| DDE | a DDT degradation product |
| DDT | dichlorodiphenyltrichloroethane |
| EGBE | ethylene glycol monobutyl ether |
| EMSL | Environmental Monitoring and Support Laboratory |
| EPA | United States Environmental Protection Agency |
| FR | Federal Register |
| FRM | Federal Reference Method |
| g | grams |
| GLPF | Great Lakes Protection Fund |
| HAP | Hazardous Air Pollutant |
| IADN | Integrated Atmospheric Deposition Network |
| IMPROVE | Interagency Monitoring of Protected Visual Environments |
| LADCO | Lake Michigan Air Director's Consortium |
| LMOS | Lake Michigan Ozone Study |
| MACT | Maximum Achievable Control Technology |
| MASN | Michigan Air Sampling Network |
| MDEQ | Michigan Department of Environmental Quality |
| MDNR | Michigan Department of Natural Resources |
| MESB | Michigan Environmental Science Board |
| $mg/m^3$ | milligrams per cubic meter |
| MI | Michigan |
| MiSA | Micropolitan Statistical Area |
| MITAMP | Michigan Toxics Air Monitoring Program |
| MSA | Metropolitan Statistical Area |
| NAAQS | National Ambient Air Quality Standards |

| AQD ACRONYM | DEFINITION |
|---|---|
| NADP | National Atmospheric Deposition Program |
| NAMS | National Air Monitoring Stations |
| NASA | National Aeronautics and Space Administration |
| NATA | National Air Toxics Assessment |
| NATIS | National Air Toxics Trend Site |
| $NO_2$ | nitrogen dioxide |
| $NO_X$ | oxides of nitrogen |
| NSR | New Source Review |
| NWS | National Weather Service |
| $O_3$ | ozone |
| OAQPS | Office of Air Quality Planning and Standards (EPA) |
| OAR | Office of Air and Radiation (EPA) |
| OBS | Observations |
| OMB | U.S. Office of Management and Budget |
| ORD | Office of Research and Development (EPA) |
| OTAG | Ozone Transport Assessment Group |
| PAHs | polycyclic aromatic hydrocarbons |
| PAMS | Photochemical Assessment Monitoring Station |
| Pb | lead |
| PBT | Persistent, Bioaccumulative Toxics |
| PCB | polychlorinated biphenyls |
| PM | Particulate Matter |
| $PM_{10}$ | PM with an aerodynamic diameter $\geq$ 10 microns in diameter |
| $PM_{2.5}$ | PM with an aerodynamic diameter $\geq$ 2.5 microns in diameter |
| PNAs | polynuclear aromatic hydrocarbons |
| ppb | parts per billion |
| ppm | parts per million |
| RTP | Research Triangle Park |
| SASS | Spiral aerosol speciation sampler |
| SEMCOG | Southeast Michigan Council of Governments |
| SIP | State Implementation Plan |
| SLAMS | State and Local Air Monitoring Stations |
| $SO_2$ | sulfur dioxide |
| SPM | Special Purpose Monitoring |
| SPOTS | Spatially Plotted Ozone Tracking System |
| STN | Speciation Trends Network |
| SVOC | Semi-volatile compounds |
| TACs | Toxic Air Contaminants |
| TEOM | Tapered Element Oscillating Microbalance |
| TOMS | Total Ozone Mapping Spectrometer (NASA) |
| TSP | Total Suspended Particulates |
| $\mu$g/dl | micrograms per deciliter |
| $\mu g/m^3$ | micrograms per cubic meter |
| $\mu$m | micrometers |
| U.S. | United States |
| VOC | Volatile Organic Compounds |
| VMT | vehicle miles traveled |
| WEBMONMAP | Web Monitoring and Mapping |

# APPENDIX F: ERRATA SHEET

**Appendix F** is an Errata Sheet listing those corrections or missing information that were found in the previous 2003 and 2004 Annual Air Quality Report. Please note that these corrections, where necessary, have been made in the 2005 Annual Air Quality Report.

**2003 AND 2004 ANNUAL AIR QUALITY REPORT:** The following errors occurred in both reports:

**CHAPTER 2.4: OZONE TRENDS:**

**ATTAINMENT/NONATTAINMENT STATUS OF 1-HR AND 8-HR $O_3$ STANDARDS IN MICHIGAN:** On page 29 in the 2003 report and page 49 in the 2004 report, it was stated that "All of the three highest 1-hour $O_3$ concentrations reported in Michigan occurred at the Port Huron site..." This statement should have read:

> Over the past decade, the highest 1-hour $O_3$ concentrations reported in Michigan occurred at the Port Huron monitoring site in 1994 (0.178 ppm) and 1996 (0.184 ppm). During this same time span, the highest number of exceedances reported (12) occurred at the New Haven monitor. Both the Port Huron monitor and New Haven monitor are located downwind of the Detroit urban area and are influenced by regional $O_3$ transport. Since 1980, the five highest 1-hour $O_3$ readings reported in Michigan occurred at the New Haven site in 1988 (0.204 ppm), the Port Huron site in 1982 and 1996 (0.196 ppm and 0.184 ppm, respectively), and the Muskegon site in 1988 and 1989 (0.203 ppm and 0.191 ppm, respectively).

**CHAPTER 2.5: $PM_{10}$, $PM_{2.5}$, $PM_{2.5}$ CHEMICAL SPECIATION, AND TSP TRENDS:**

**$PM_{10}$ TRENDS BY LOCATION:** There were two $PM_{10}$ exceedances in 2003 that were inadvertently left out of **Table 2.5-1** (2003)/**Table 2.5-2** (2004)**: Values Exceeding the 24-hour Standard (150 µg/m$^3$) for $PM_{10}$ in Michigan** (Page 47 and 49, respectively). Both of these exceedances occurred at the Dearborn monitoring site (261630033) on April 15, 2003 (191 µg/m$^3$) and July 26, 2003 (153 µg/m$^3$).

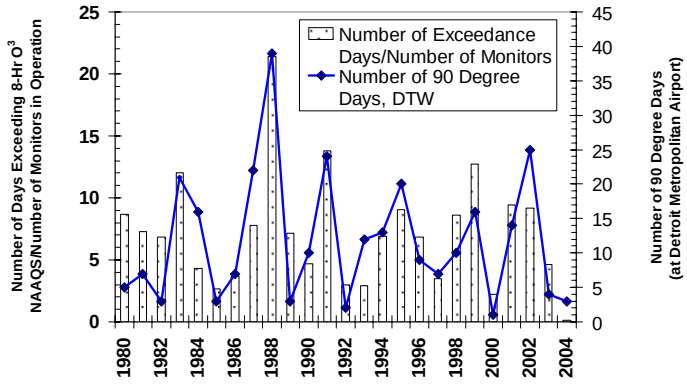
Also in this chapter under **Table 2.5-2** (2003)/**Table 2.5-3** (2004)**: Annual Mean $PM_{2.5}$ Concentrations by Individual Monitoring Station** (Page 50 and 55, respectively), the 2003 annual mean for Houghton Lake should read 7.96 µg/m$^3$.

**2004 ANNUAL AIR QUALITY REPORT:**

**CHAPTER 2.4: $O_3$ TRENDS:**

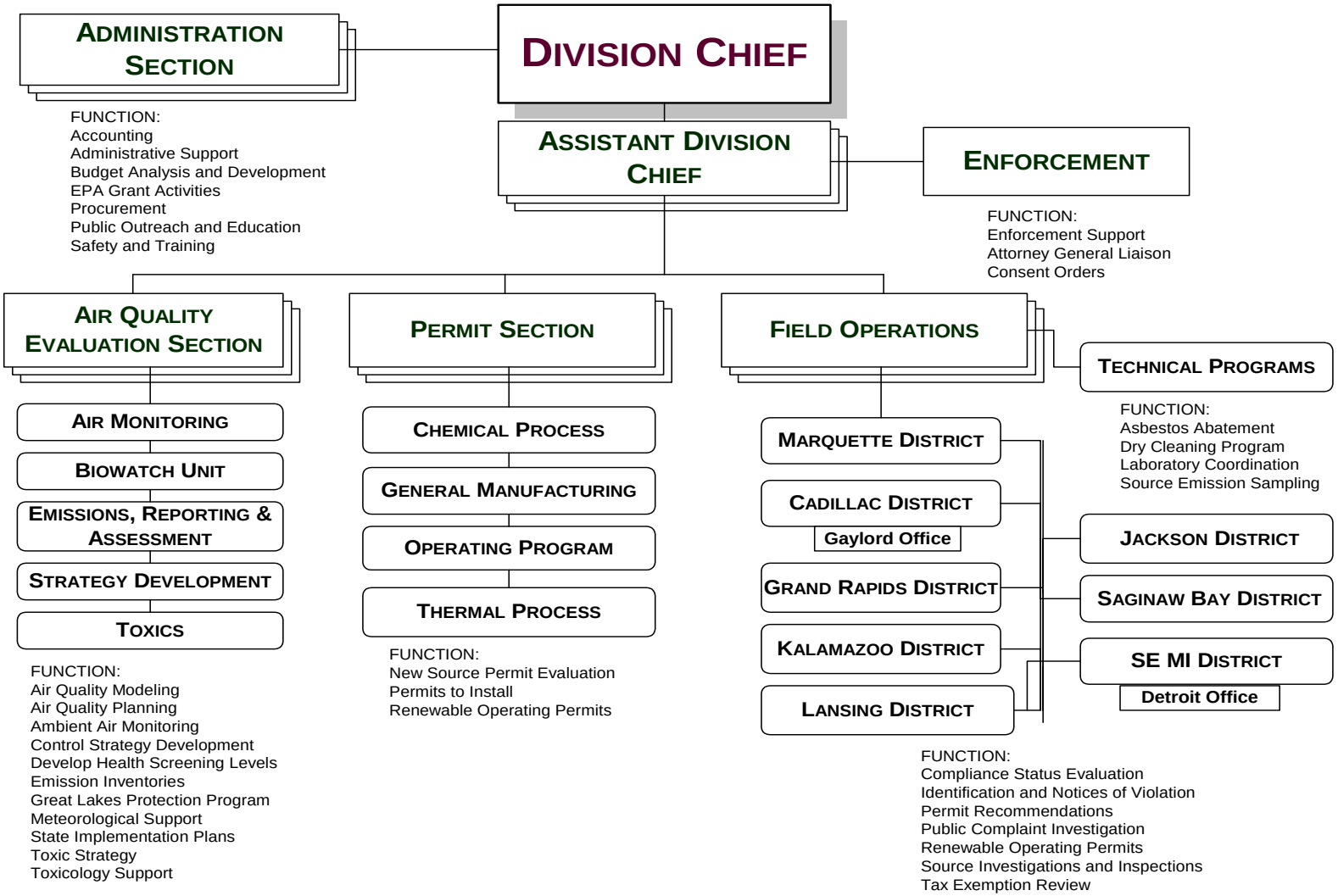
**8-HOUR $O_3$ TRENDS BY LOCATION:** On Page 39, **Figure 2.4-6** is in error as the "Number of 90 Degree Days, DTW" was graphed without the 1980 and 1981 data, skewing the results. **Figure 2.4-6** to the right is the corrected version.

**Figure 2.4-6: 8-Hr $O_3$ Levels Greater than 0.085 ppm, 1980-2004**



# APPENDIX G: AQD ORGANIZATIONAL CHART

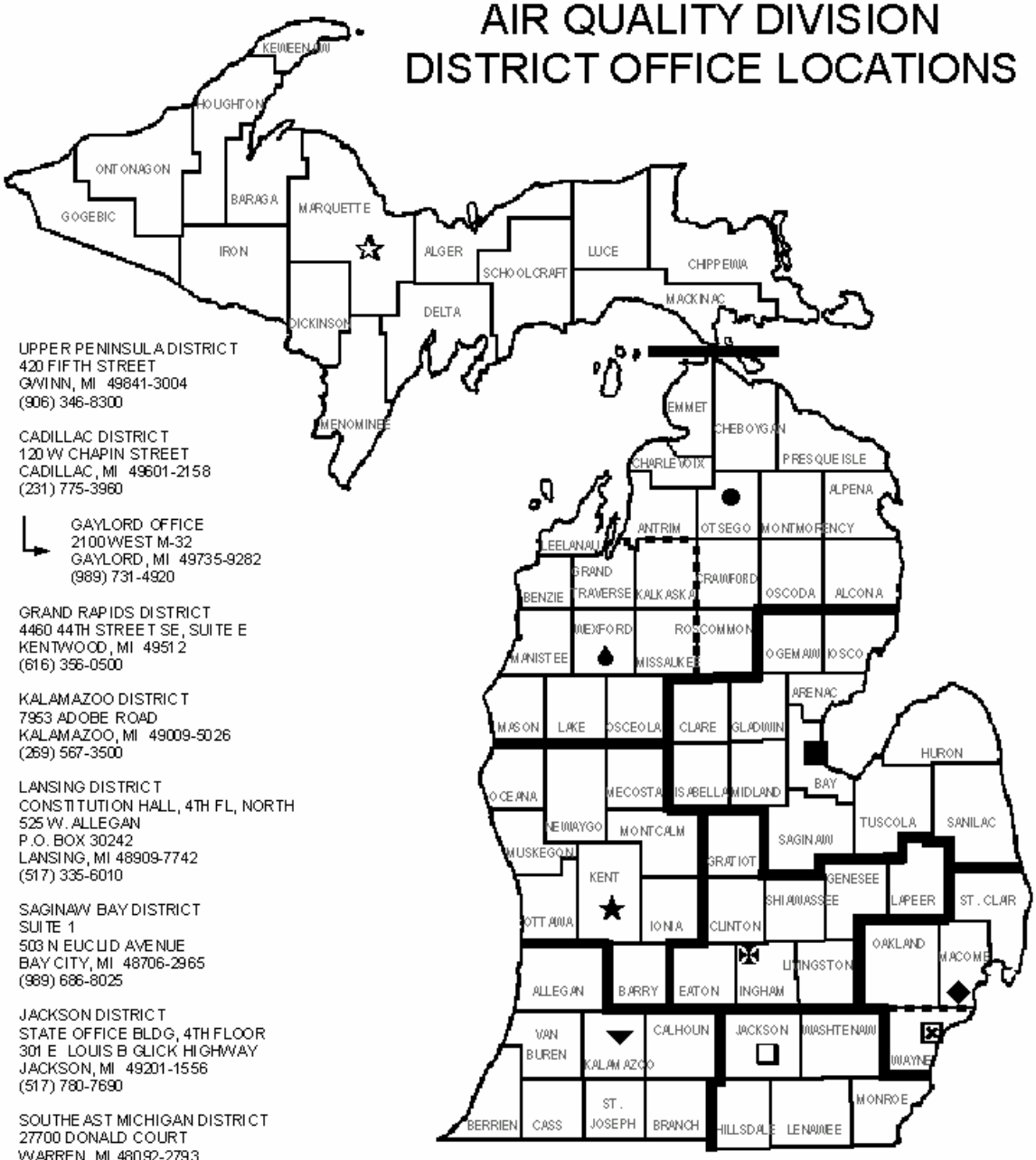
## MDEQ AIR QUALITY DIVISION



# APPENDIX H: AQD DISTRICT OFFICE LOCATIONS

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

## AIR QUALITY DIVISION DISTRICT OFFICE LOCATIONS




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

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

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

GRAND RAPIDS DISTRICT
4460 44TH STREET SE, SUITE E
KENTWOOD, MI 49512
(616) 356-0500

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

LANSING DISTRICT
CONSTITUTION HALL, 4TH FL, NORTH
525 W. ALLEGAN
P.O. BOX 30242
LANSING, MI 48909-7742
(517) 335-6010

SAGINAW BAY DISTRICT
SUITE 1
503 N EUCLID AVENUE
BAY CITY, MI 48706-2965
(989) 686-8025

JACKSON DISTRICT
STATE OFFICE BLDG, 4TH FLOOR
301 E LOUIS B GLICK HIGHWAY
JACKSON, MI 49201-1556
(517) 780-7690

SOUTHEAST MICHIGAN DISTRICT
27700 DONALD COURT
WARREN, MI 48092-2793
(586) 753-3700

DETROIT OFFICE
CADILLAC PLACE, SUITE 2-300
3058 WEST GRAND BLVD
DETROIT, MI 48202-6058
(313) 456-4700
(Wayne County sources)

**AIR QUALITY INTERNET ADDRESS:**

**www.michigan.gov/deqair**

01-03-2006