DRAFT

Michigan Department of Environmental Quality
Air Quality Division

STATE IMPLEMENTATION PLAN SUBMITTAL

FOR

FINE PARTICULATE MATTER ($PM_{2.5}$)

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1. Executive Summary

Michigan's fine particulate matter ($PM_{2.5}$) nonattainment area is composed of seven counties in Southeast Michigan: Wayne, Oakland, Macomb, Washtenaw, St. Clair, Monroe, and Livingston. However, early analysis of monitoring data showed that half of the monitors in the region were showing attainment of the standard.

The focus of this State Implementation Plant (SIP) is on bringing all of the monitors showing nonattainment of the standard into compliance as early as possible, but no later than 2010. Quite early in the planning process, the Michigan Department of Environmental Quality (MDEQ), Southeast Michigan Council of Governments (SEMCOG) and Lake Michigan Area Directors Consortium (LADCO) initiated numerous studies and technical evaluations on the nature of the $PM_{2.5}$ violations in Southeast Michigan. The following points summarize the rationale and content of this SIP submittal, which resulted from these analyses.

- At the time of designation, six of the 12 monitors in the region were showing violations of the standard. These six monitors were concentrated in only two of the nonattainment area's seven counties.
- The air quality at the monitors showing nonattainment of the standard is dominated by ammonium sulfate, ammonium nitrate, and organic carbon (OC). The Dearborn monitor also contains a high soil component composed mostly of iron. Regional background monitors indicate high background levels of sulfates and nitrates, but the organic carbon and soil is mostly from local contributions.
- Early analysis indicated there were unique characteristics associated with the areas experiencing the highest concentrations of $PM_{2.5}$. These areas were also at the heart of previous total suspended particulates (TSP) and particulate matter less than 10 micrometers in diameter (PM_{10}) nonattainment areas.
- There is a statistically significant downward trend in $PM_{2.5}$ concentrations throughout the region. This is consistent with changes in the emissions inventory resulting from national controls.
- The downward trend is greatest at monitors in industrial locations.
- Consistent with CAA and regulatory provisions to attain as early as possible, four of the original monitors showing nonattainment are now in compliance.
- The two remaining monitors are measuring much lower levels than at the time of designation.
- The SIP control strategy focuses on additional emission reductions in the vicinity of these two monitors. This is consistent with previous particulate matter SIPs, which resulted in attainment.
- The weight of evidence (WOE) accumulated through inventory analysis, modeling, and monitoring data shows that the region will be in attainment by 2010 as a result of these local controls and the continued phase-in of several multi-state and national control programs.

Local reductions will be achieved through controls at two steel mills, an oil refinery, and the retrofitting of switchyard locomotives and school buses. To provide for additional improvements in air quality, voluntary measures to control emissions of fugitive dust in the southwest Detroit/southeast Dearborn area are being pursued.

2. Background and Overview of the $PM_{2.5}$ Rule

2.1 General Background/History of the $PM_{2.5}$ Rule

The United States Environmental Protection Agency (EPA) promulgated the national ambient air quality standards (NAAQS) for $PM_{2.5}$ in July 1997. Since the EPA lacked sufficient air quality data to make designations for the newly promulgated standards, the EPA extended the time period for making designations once three years of air quality data were collected by EPA-approved air quality monitors. The first monitors were put in place in 1998; however, a number of additional monitors did not come online until 1999, and therefore could not collect three complete years of data until the 2000-2002 time period.

After the EPA promulgated the $PM_{2.5}$ standard, several industry organizations and state governments challenged the EPA's action in the U.S. Court of Appeals for the District of Columbia Circuit (the D.C. Circuit). On May 14, 1999, the D.C. Circuit held that the Clean Air Act (CAA), as applied by the EPA in setting the 1997 standards for particulate matter (PM) and ozone, was unconstitutional as an improper delegation of legislative authority to the EPA. The ruling did not question the science or decision-making process used to establish the standards. The Court remanded the $PM_{2.5}$ standards to the EPA but did not vacate them. In June 1999, the Department of Justice (DOJ) and the EPA petitioned the D.C. Court for a rehearing and the D.C. Court denied the petition.

The DOJ and the EPA then filed a petition with the United States Supreme Court in December 1999 to appeal the decision of the D.C. Circuit. The Supreme Court held that the EPA's approach to setting the NAAQS was in accordance with the CAA and did not constitute an unconstitutional delegation of authority. The Supreme Court also affirmed that the CAA requires the EPA to set standards at levels necessary to protect the public health and welfare, without considering the economic costs of implementing the standards. The Supreme Court remanded several other issues back to the D.C. Circuit, including the issue of whether the EPA acted arbitrarily and capriciously in establishing the specific levels of the standards.

The D.C. Circuit heard arguments in this remanded case in December 2001, and issued its decision on March 26, 2002. The D.C. Circuit rejected the claim that the Agency had acted arbitrarily and capriciously in setting the levels of the standards. This last decision by the D.C. Circuit gave EPA a clear path to move forward with implementation of the $PM_{2.5}$ standards.

2.2 Michigan Nonattainment Areas

With the court’s support and sufficient data, the EPA could now move forward with nonattainment designations. States were directed to submit their recommendations for designations of attainment and nonattainment. The MDEQ recommended that only Wayne and Monroe Counties be designated as nonattainment for $PM_{2.5}$ and that each county be designated as a separate nonattainment area.

In June 2004, the EPA proposed a seven-county $PM_{2.5}$ nonattainment area for Southeast Michigan including Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne Counties (Figure 2.1). The MDEQ submitted a letter in September 2004, again requesting two nonattainment areas of only Wayne and Monroe Counties instead of seven counties.

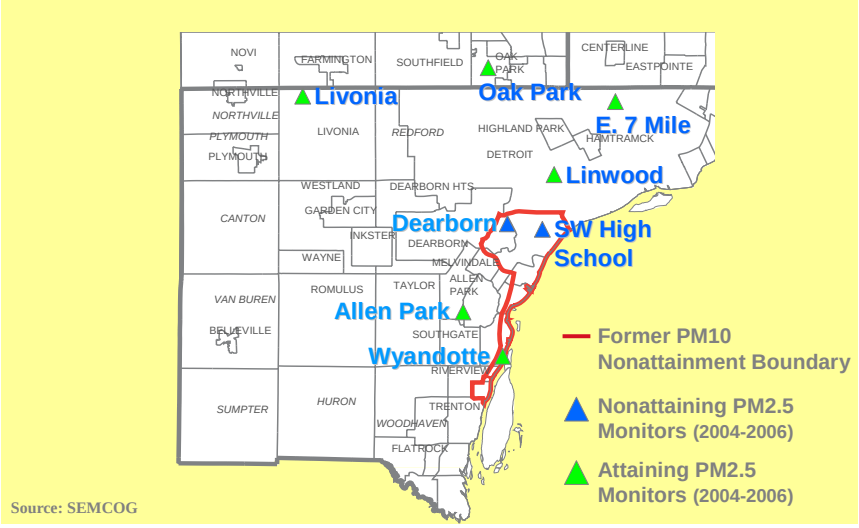
Figure 2.1: PM2.5 Nonattainment Area showing the location of PM2.5 monitors

Violating Monitor	PM2.5 Concentration
Dearborn	17.2 µg/m³
Southwestern High School (SWHS)	15.8 µg/m³

In that letter, the MDEQ stated that the seven-county nonattainment area in Southeast Michigan was arbitrary based on current and historical monitoring data for particulate matter. The monitors showing violation of the standard in Wayne County are located in an area with a history of particulate matter problems, associated with local industrial sources. Figure 2.2 shows the location of these monitors relative to the former PM_{10} nonattainment area. As the map illustrates, the areas are nearly identical. The primary source of the former PM_{10} problem was determined to be a few local industrial sources. Emissions from these sources were reduced and the region came into compliance in 1996[1].

[1] These emission reductions probably also helped lower $PM_{2.5}$ concentrations in the area. However, no long-term $PM_{2.5}$ monitoring data exist to determine the degree of improvement.

Figure 2.2: Former PM10 Nonattainment Area with Overlay of PM2.5 Monitors Wayne County

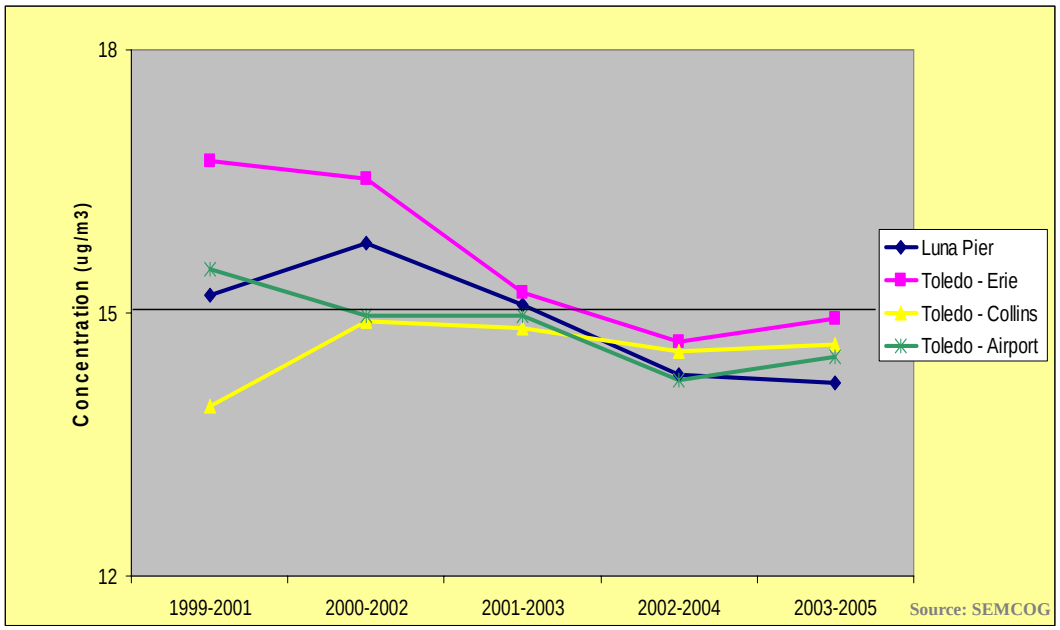


The MDEQ also asserted that most the monitors in the seven-county area were measuring attainment, making a widespread nonattainment designation inappropriate from a regulatory perspective and misleading from a public health perspective. Furthermore, several monitors measuring attainment in the seven-county area are downwind of the monitors showing violations of the standard (i.e., all counties north of Wayne and Monroe Counties). Adding controls in these downwind counties would not address the nonattainment in Wayne and Monroe counties.

The EPA wanted to include counties that significantly contribute to nonattainment areas. However, the MDEQ noted that with the EPA's CAIR rule and Nitrogen oxides (NOx) SIP call, the majority of transport of $PM_{2.5}$ precursors is already addressed. In addition, this state is not prohibited from adopting controls beyond the nonattainment boundary if needed for reaching attainment. Therefore nothing is gained by the inclusion of counties where monitors record attainment levels of $PM_{2.5}$.

The Luna Pier monitor, located in the Southeastern corner of Monroe County, is one mile north of the Ohio border. In the February 2004, $PM_{2.5}$ nonattainment designation recommendation to the EPA, the MDEQ asserted strongly that Monroe County should be designated as separate nonattainment area from Wayne County because $PM_{2.5}$ levels at the Luna Pier monitor tracked far more closely with those in Toledo, Ohio (Figure 2.3).

Figure 2.3: 3-Year Average PM2.5 Levels Toledo and Luna Pier



Trend data showed that levels at the Luna Pier site had been decreasing in recent years and would likely measure attainment by 2004. Levels at the site have continued to track those in Toledo, and monitors in both areas have measured attainment of the standard since 2004. In 2005, EPA redesignated the Toledo area as attainment; but Luna Pier is still considered nonattainment because it was grouped with the Detroit nonattainment area.

The EPA made final nonattainment designations in April 2005. Disregarding the MDEQ's recommendations, the EPA designated a seven-county area in Southeast Michigan as not attaining the $PM_{2.5}$ standard. As of 2006, the only monitors that currently record $PM_{2.5}$ concentrations above the standard are in the industrialized section of Detroit in Wayne County.

3. General Planning Provisions

Pursuant to the requirements of 40 CFR 51, Appendix W, Michigan submits this SIP to meet the requirements of the EPA's Fine Particulate rules, which were adopted to comply with CAA requirements.

The MDEQ has authority to submit this SIP under Part 55, Air Pollution Control, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451).

The MDEQ provided public notice of the opportunity to comment on the SIP on February 4, 2008. On February 4, 2008, MDEQ also provided notice of the opportunity for a public hearing if requested on March 11, 2008. Public comments were addressed and are summarized in Appendix B <will be added later>.

4. State Implementation Plan Approval and Compliance with CAA Section 110 and Part D Requirements.

Section 110 of the CAA delineates general SIP requirements and Part D contains requirements applicable to Subpart 1 nonattainment areas. The language in Michigan's current rules refers to "particulate matter," which would apply to any size fraction of particulate matter (e.g., PM_{10} or $PM_{2.5}$). This provision in Michigan's current law is adequate for the current SIP submittal and any future changes to the particulate matter standards. Michigan meets all the requirements of Section 110(a) SIP elements.

Programs for emissions limitations, permitting, emissions inventories and statements, ambient monitoring, Reasonably Available Control Technology (RACT), Reasonably Available Control Measures (RACM) and contingency measures are included in the Michigan SIP.

Subpart 110(a)(2)(D) requires that SIPS contain certain measures to prevent sources in a state from significantly contributing to air quality problems in another state. Michigan has met the requirements of the federal Clean Air Interstate Rule (CAIR) to reduce NOx and sulfur dioxide (SO_2) emissions contributing to downwind states. Michigan's rules to implement the CAIR have been conditionally approved in a rule (Volume 42, Number 244, December 20, 2007).

Michigan administers a New Source Review (NSR) permitting program for major and modified sources of PM in nonattainment areas under Michigan's permit program. Permits to install cannot be issued unless the applicant can demonstrate that increased emissions from the new or modified source will not result in a violation of the NAAQS.

5. Local Planning

The SIP was developed in close consultation with SEMCOG and its air quality task force and technical advisory group. SEMCOG is the Metropolitan Planning Organization for Southeast Michigan and the lead local air quality planning agency under the CAA.

In the early 1990s, SEMCOG formed the Southeast Michigan Ozone Study (SEMOS), an air quality technical advisory group to help understand the cause of air quality problems in the region and the sources that contribute to them. While the group's name implies that its focus is ozone, its mission is much broader. The group has been instrumental in the procurement and analysis of air quality data used in ozone, carbon monoxide, and $PM_{2.5}$ SIP development. SEMOS members are a diverse group of analysts, modelers, and scientists from both industry and government. While it includes many local stakeholders, representatives from the MDEQ, the EPA, LADCO, and Canadian national and provincial environmental agencies also participate.

While SEMOS deals with the complex, technical aspects of air quality, SEMCOG's Air Quality Task Force addresses the local policy-related issues. The Task Force, which was originally formed in the 1990s to address the ozone and carbon monoxide NAAQS, was reconvened in 2003 to help evaluate strategies for bringing Southeast Michigan into attainment of the new 8-hour ozone standard and continues its activity in addressing $PM_{2.5}$. The Task Force is comprised of state and local policy makers, industry representatives, and other community stakeholders.

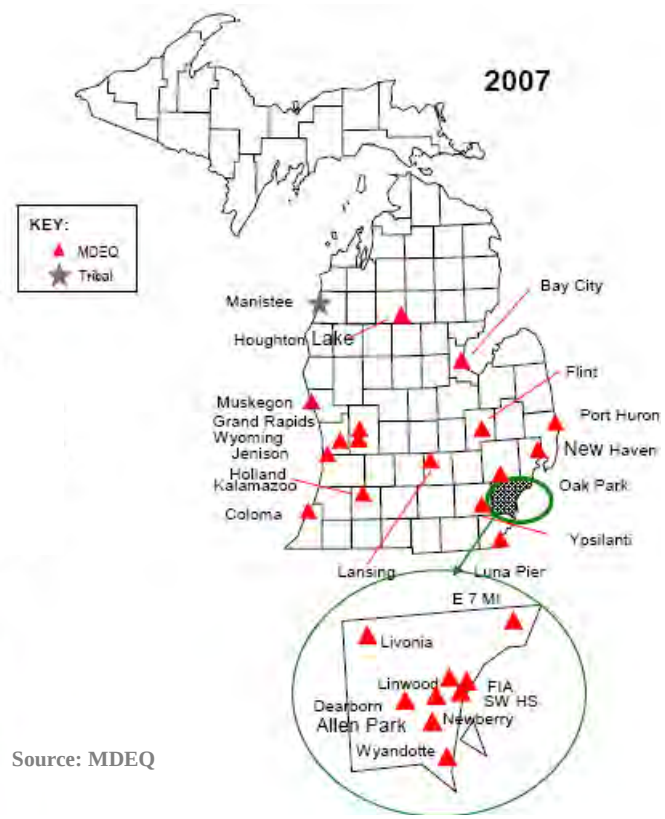
This SIP utilizes data that was gathered and analyzed by SEMOS and evaluated by the Air Quality Task Force. By coordinating with local, state and regional members, Michigan has worked to ensure that its strategy provides reasonable reductions to mitigate impacts of sources on affected $PM_{2.5}$ nonattainment areas.

6. Monitoring

Section 110(a)(2)(B) of the federal CAA requires a monitoring strategy for measuring, characterizing, and reporting $PM_{2.5}$. The MDEQ maintains a comprehensive network of $PM_{2.5}$ air quality monitors throughout Michigan with the primary objective being to determine compliance with the $PM_{2.5}$ NAAQS. The MDEQ submits network reviews[2] to the EPA Region V annually to ensure that its air monitoring operations comply with all applicable federal requirements.

Due to state and federal budget cuts, the MDEQ has reduced its monitoring network since the PM2.5 designations were made. However, no reductions in the PM2.5 FRM network in the designated nonattainment area were made. The PM2.5 monitoring network is shown in Figure 6.1.

Figure 6.1: Michigan's 2007 $PM_{2.5}$ Federal Reference Method (FRM) monitoring network.



Source: MDEQ

[2] See http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-Monitoring-Network-Review-final-9-6-07.pdf for Michigan's 2006 network review.

7. Emissions Inventory

Rule 40 CFR 51.1002 (c) requires pollutants contributing to fine particles to be part of a state's SIP. Michigan believes that primary particles (OC, crustal material and elemental carbon), SO_2 and NOx are the main components of $PM_{2.5,}$ and they are included in our analyses. Volatile organic compounds (VOCs) and ammonia (NH3) are included in the emissions inventory (and modeling inventories), however, they are not a part of Michigan's current attainment strategy for $PM_{2.5}$. VOCs' contribution to $PM_{2.5}$ are still being investigated, and therefore control measures for these compounds will not be included in this SIP (although controls for VOCs have been implemented for ozone nonattainment). Ammonia emission estimates and atmospheric chemistry are very uncertain; therefore, Michigan is not including ammonia controls in this SIP revision.

Rule 40 CFR part 51.1008(a) requires Michigan to submit to the EPA statewide emission inventories for direct $PM_{2.5}$ emissions and emissions of $PM_{2.5}$ precursors. Michigan must also submit any additional emission inventory information needed to support an attainment demonstration and Reasonable Further Progress (RFP) plan necessary to ensure expeditious attainment of the standard. The 2005 base year inventory for Michigan has been submitted to the EPA pursuant to 40 CFR Part 51, Subpart A – Emission Inventory Reporting Requirements.

As specified in the applicable EPA guidance, the emissions inventory for Michigan includes primary $PM_{2.5}$, SO_2, NOx, VOCs, and ammonia.

A description of the methodology used to prepare the inventory appears in Appendix C. Mobile estimates for the nonattainment counties were prepared by SEMCOG and appear in Appendix D. Mobile emissions for other counties were prepared by the Midwest Regional Planning Organization's (MRPO) contractor using traffic and vehicle information provided by the Michigan Department of Transportation. LADCO is the MRPO. A summary of the emissions inventory is shown in Table 7.1. The State will update this inventory on a periodic basis, every three years.

In addition, emissions were projected to 2009 to support the attainment demonstration. The base year and 2009 modeling inventories were prepared by LADCO. The future year projections take into account existing control measures and measures that are known to be on the way (e.g., CAIR measures). This inventory is referred to as the LADCO Base-M inventory. Procedures used to prepare these inventory products can be found in the "Regional Air Quality Analyses for Ozone, $PM_{2.5}$, and Regional Haze: Technical Support Document," prepared by LADCO. LADCO has produced numerous summary reports with state and county total emissions and has posted them on their Internet site at:

http://www.ladco.org/tech/emis/basem/baseM_reports.htm

Table 7.1. Summary of Michigan's nonattainment area 2005 base year annual emissions per county per pollutant in tons per year (tpy) for area sources (area), nonelectric generating unit point sources (nonegu_pt), on-road mobile (on-road), off-road mobile (nonroad), electric generating unit point sources (egu_point), marine, air and rail (mar air rail), and ammonia sources (nh3).

pollutant	County name	Livingston	Macomb	Monroe	Oakland	St_Clair	Washtenaw	Wayne
	County ID	93	99	115	125	147	161	163
NH3	area	3.32	13.42	2.88	24.91	3.29	6.71	32.01
	nonegu_pt	0.15	16.24	79.41	19.73	10.33	4.48	132.61
	On-road	200.70	645.87	205.50	1319.26	171.71	388.25	1859.10
	nonroad	1.30	4.42	1.44	7.24	1.71	2.66	8.48
	egu_point			2.59		11.78		1.80
	mar air rail	0.05	0.27	0.57	0.44	0.34	0.12	1.46
	nh3	280.31	224.20	638.69	84.74	273.56	738.07	113.69
NOx	area	647.95	2498.84	606.83	4535.97	563.69	1056.74	6039.67
	nonegu_pt	654.19	720.91	3774.97	1096.91	1978.16	1050.26	9408.81
	On-road	5417.90	14121.20	5454.40	31088.00	3812.60	9962.20	43981.40
	nonroad	1288.10	5054.00	1404.71	7153.48	1519.17	2999.65	9410.39
	egu_point	5.91	134.42	38483.26	71.97	19690.31	1.45	11369.40
	mar air rail	83.97	589.24	958.21	822.22	557.31	203.64	4166.30
	nh3							
PM_{25}-PRIM	area	1424.61	468.79	1176.54	761.34	341.99	245.58	920.34
	nonegu_pt	7.35	113.13	668.31	124.44	112.50	86.86	1342.36
	On-road	89.47	265.44	91.00	559.86	71.06	170.02	792.05
	nonroad	120.62	339.65	121.96	614.54	108.58	2632.17	644.00
	egu_point	0.10	12.83	597.66	8.86	142.13	0.02	352.76
	mar air rail	2.55	13.91	29.11	23.91	18.30	6.02	99.30
	nh3							
VOC	area	4338.29	11807.62	3663.62	17387.40	2671.18	5406.23	24887.81
	nonegu_pt	176.95	2271.05	3555.73	2487.15	1379.00	388.83	6319.64
	On-road	1696.90	5784.70	1742.60	11918.00	1550.90	3349.70	16931.10
	nonroad	1927.32	4910.60	1893.76	9862.11	2166.18	2632.17	8396.96
	egu_point	0.19	39.67	300.92	8.54	285.49	0.00	175.34
	mar air rail	23.38	114.92	61.48	93.30	43.26	19.96	460.03
	nh3							
SO_2	area	226.78	930.59	181.05	1187.41	238.80	325.00	1540.36
	nonegu_pt	13.70	48.26	7733.15	274.99	1752.75	20.75	6396.53
	On-road	71.32	221.44	72.83	458.48	59.06	136.90	647.06
	nonroad	139.72	426.07	139.75	683.20	125.05	342.20	883.35
	egu_point	0.07	4.32	120386.70	3.43	66576.72	0.28	40780.46
	mar air rail	7.53	38.28	82.64	64.67	72.99	16.93	398.38
	nh3							

8. Transportation Conformity Budget

Transportation conformity is required by Section 176(c) of the CAA. The EPA's conformity rule requires that transportation plans, programs, and projects conform to SIPs and establishes the criteria and procedures for determining whether or not they do. Conformity to a SIP means that transportation activities will not produce new air quality violations, worsen existing violations or delay timely attainment of the NAAQS.

Estimates of on-road motor vehicle emissions are projected for the attainment year to assess emission trends and to ensure continued compliance with the $PM_{2.5}$ NAAQS. On-road emissions include those from cars, buses and trucks driven on public roadways. These estimates are considered a ceiling or "budget" for emissions and are used to determine whether transportation plans and projects conform to the SIP. Estimated on-road mobile emissions of primary $PM_{2.5}$ and NOx must not exceed the emission budget contained in the attainment plan. The emissions estimates for this sector reflect appropriate and up-to-date assumptions about vehicles miles traveled, socioeconomic variables, fuels used, weather inputs, and other planning assumptions. The methodology used to estimate mobile emissions in the nonattainment counties appear in Appendix D. The transportation emission budget for conformity is provided in Table 8.1.

Table 8.1: Transportation Conformity Budget for Southeast Michigan (in tons per year)

Scenario	**Emissions**	
	Primary $PM_{2.5}$	***NOx***
2002	2,767	151,390
2005	2,039	113,838
2009	1,465	75,486

Source: SEMCOG, *Southeast Michigan On-Road Mobile Source Emissions Inventory for the $PM_{2.5}$ State Implementation Plan,* January 2008.

9. Weight of Evidence (WOE)

Rule 40 CFR part 51.1007(a) requires Michigan to submit an attainment demonstration showing that the area will attain the annual and 24-hour standards as expeditiously as practicable. The demonstration must include: 1) inventory data (see also section 7), 2) emission reduction analyses, and 3) modeling results on which the State bases its attainment date.

The WOE approach used in this SIP includes a variety of data sources to make the demonstration that the Southeast Michigan $PM_{2.5}$ nonattainment area will attain the standard by 2010. The MDEQ believes that this approach is the most scientifically defensible approach because it relies on not one method, such as modeling, but multiple sources of information. This approach provides a more robust demonstration in light of the many uncertainties that remain regarding the relatively new $PM_{2.5}$ annual standard.

The data sources used in this demonstration include monitoring data, emissions inventory data, photochemical and dispersion modeling, and trends analysis. Taken together, this information provides adequate proof that the areas with the highest levels of $PM_{2.5}$ in the state, namely the Dearborn/Southwest High School (SWHS) monitoring areas, have been seeing substantial reductions in $PM_{2.5}$ levels over the last several years. It shows that regional controls of NOx and SO_2 are reducing $PM_{2.5}$ in these areas, and throughout the state, and will continue to do so in the next several years. The information further shows that significant amounts of $PM_{2.5}$ likely come predominantly from local upwind industrial sources, and that control of these sources, primarily the nearby steel mill, will bring the area into attainment of the annual $PM_{2.5}$ standard by 2010.

9.1 Fine Particulate Matter

In 1997, the EPA developed new NAAQS for fine particulate matter. The EPA designated the entire Southeast Michigan area (seven counties) as nonattainment. The three-year average concentrations for 2001-2003 showed six monitors were showing violations of the annual $PM_{2.5}$ standard. Five of these monitors were in Eastern Wayne County and the sixth was the Luna Pier monitor in Southern Monroe County (see Figure 2.1).

Air quality in Southeast Michigan is improving based on 2004-2006 data, currently only two monitors are showing violations of the NAAQS standard. The two monitors not meeting the annual standard (Dearborn and SWHS) are located in an area with a history of particulate matter problems associated with local industrial sources. Since the area successfully attained the PM_{10} standard after the application of local controls, the MDEQ believes that the most effective attainment strategy is to focus on local emission reductions from sources in this area while national programs will control secondary regional pollutants.

Fine particulate matter is a complicated mixture of ammonium sulfate, ammonium nitrate, organic carbon, elemental carbon, soil (or crustal material) and other particles. Some $PM_{2.5}$, particularly in urban areas, is anthropogenic (man-made) in origin and some is biogenic (plant-made) in origin. $PM_{2.5}$ is composed of primary (directly emitted) and secondary (formed in the atmosphere) particles. Our understanding of how much $PM_{2.5}$ is primary versus secondary, and how fast secondary formation takes place is limited. Current speciation analyses of ambient monitoring data indicate that $PM_{2.5}$ concentrations result from both primary emissions (e.g., crustal matter, elemental carbon, and much of organic carbon), and secondary formation (e.g., ammonium sulfate, ammonium nitrate, and some organic carbon).

As discussed above, $PM_{2.5}$ is composed of many different components that can come from a wide variety of sources. Few monitoring site in Southeast Michigan have speciation monitors. Lack of speciated $PM_{2.5}$ data at most locations, especially those monitors that were showing violations of the standard (Linwood, SWHS, and Wyandotte), makes identification of specific local source contributors in these areas very difficult. One must make assumptions based on source proximity to neighboring monitors that do have detailed data available. However, as will be discussed throughout this WOE, the data from Allen Park and Dearborn monitors that are only five miles apart, may have significantly different species composition and source apportionments, particularly with regard to organic carbon and crustal material. This implies that very localized emissions are impacting the monitors, particularly at Dearborn.

In addition to the complexity of the $PM_{2.5}$ mixture, quantification of $PM_{2.5}$ emissions is still evolving. Techniques for measuring these emissions are still being evaluated and debated by the EPA. Much of the current inventory cannot be measured directly. Instead estimates are made through other methods such as factoring total PM emissions (which includes total suspended solids and PM_{10}), or use of activity levels and emission factors. This adds to the complexity of determining local source contributions.

9.2 Emissions

Significant emission reductions in the Midwest are expected from national controls including CAIR and additional motor vehicle reductions (Tier 2, the Diesel Rule and low-sulfur fuel requirements). The EPA's Mobile6 model predicts that VOC, NOx and $PM_{2.5}$ emissions from on-road mobile sources alone will be reduced by more than 50 percent between 2002 and 2010 in Southeast Michigan (see Figure 1 in Appendix A). National stationary source controls, including CAIR and the NOx SIP call, are expected to reduce point source NOx emissions by 40 percent and SO_2 emissions by 15 percent between 2002 and 2009. These controls will result in approximately a 1 – 2 $\mu g/m^3$ reduction in $PM_{2.5}$ mass concentrations by 2009 (see Table 1 in Appendix A). These reductions already take into account expected economic growth and increases in travel. This is compelling evidence that areas in Southeast Michigan that are currently attaining the standard will remain in compliance.

While these reductions are already having a significant, positive impact in Southeast Michigan and will continue to do so in the future, we cannot assume that they will result in attainment at Dearborn and SWHS, the two monitoring sites that are still exceeding the annual standard. Additional reductions in the vicinity of these sites are needed.

These two monitors are located in the industrialized core of Detroit, which contains a complex array of emission sources (see Figures 2 and 3 in Appendix A). Both of these monitors are within three miles of two steel mills; an oil refinery; three power generating plants; an auto manufacturer; a wastewater treatment plant; lime, cement, slag, asphalt plants, and several other industrial facilities. All available data show that emission reductions resulting from planned steel mill controls will be very effective in bringing the remaining monitors showing violations of the standard, and therefore the entire nonattainment area, into attainment.

Significant local $PM_{2.5}$ reductions will be achieved from controls that are currently being phased in at the Severstal and U.S Steel facilities as well as the Marathon oil refinery. All three of these facilities are less than three miles from the two monitors measuring the highest $PM_{2.5}$ concentrations in the region: Dearborn and SWHS. Based on a recent EPA study (RTI 2006) as well as permit application data, the MDEQ estimates these controls will provide a combined primary PM emission reduction of 336 tpy (166 tpy from controls at Severstal, see Table 2 in Appendix A, 76 tpy from U.S. Steel baghouse replacement, and 94 tpy from Marathon through NSR settlement, see Table 3 in Appendix A).

A number of other industrial facilities in the area surrounding the Dearborn, SWHS, and Wyandotte monitors have either closed or scaled back their operations since 2002 (see Table 4 in Appendix A). These changes may be contributing to the more rapid decrease in $PM_{2.5}$ levels observed at industrial monitoring sites (see Figure 4 in Appendix A).

In addition to the on-road mobile emission reductions previously mentioned, significant reductions are expected from off-road mobile sources. The exact contribution of mobile sources at Dearborn is not yet known. However, the site is in close proximity to several rail yards, one of which is immediately upwind of the monitor. There are as many as 40 switch yard locomotives operating within 2.5 miles of the site and most operate 24 hours per day, seven days per week. Some of these rail operations are also in the vicinity of the SWHS monitor.

Over the next two years, 28 of the switch engines in this area will be retrofitted with anti-idling equipment. These retrofits are being funded through a $1.5 million federal Supplemental Environmental Project. Based on data from a similar project in Chicago (USEPA 2004), this initiative is expected to reduce NOx emissions by 67 tons/year and PM by 2 tons/year. In addition, four switch engine locomotives at the CSX rail yard immediately adjacent to the Dearborn monitoring site will be rebuilt with smaller engines over the next two years, resulting in an annual emissions reduction of 66 tons of NOx and 1.8 tons of diesel PM. This project is being funding through the federal Congestion Mitigation Air Quality (CMAQ) program.

While the emissions reduction expected from retrofitting diesel switch engine locomotives is relatively small compared to those at the large stationary sources, they are expected to have some impact because of their low level of discharge and close proximity to the Dearborn monitor. In fact, modeling predicts the benefit of this control measure will be over 50 times greater at Dearborn than at SWHS or Wyandotte (see Table 5 in Appendix A).

One other potential source of $PM_{2.5}$ in the area may be due to fugitive dust from a significant number of storage piles, unpaved lots, and parcels of barren land in the vicinity of the Dearborn and SWHS monitors (see Figure 5 in Appendix A). While most emissions from these sources are larger than 2.5 microns, their collective impact is cause for concern. As part of a previous particulate SIP, a number of facilities in the area have fugitive dust plans. However, many others do not. A voluntary program to reduce fugitive dust from some of these sources through the use of native vegetation is currently being pursued.

Other possible sources of local emissions are small point sources in the area that are exempt from the MDEQ's emissions inventory reporting because of lower emissions. Identification and study of these sources may occur in the future if funding becomes available.

The MDEQ also analyzed the impacts of other NOx and SO_2 emission reductions throughout the nonattainment area to evaluate the need for broad-based controls such as RACT. MDEQ performed a special photochemical model run of the seven-county nonattainment area with a 50 percent reduction in NOx and SO_2 for <u>all</u> source types. This provided a screening analysis of the impacts of a beyond-RACT control scenario. It was thought that if the run showed significant improvements in $PM_{2.5}$ annual levels, then more source-selective runs would be done. However, the modeling resulted in less than ¼ ug/m^3 reduction at all of the monitors in the area (see Table 6 in Appendix A), demonstrating that localized emission reductions should be the focus of efforts to bring the area into attainment. The application of RACT-type control measures throughout the seven-county nonattainment area would be an ineffective and unproductive strategy for reducing emissions and bringing the nonattaining areas into compliance with the annual standard.

9.3 Monitoring

For the purpose of weight of evidence, monitoring data clearly supports the MDEQ assessment that attainment of the annual $PM_{2.5}$ standard will be achieved by 2010. $PM_{2.5}$ levels in the nonattainment area have been on a downward path for a number of years, and this trend is expected to continue.

The latest three-year average concentrations (2004-2006) show that only two of the original six monitors showing violations are still exceeding the standard: Dearborn and SWHS. Since 2000-2002, $PM_{2.5}$ concentrations at all sites in the region have steadily declined. The three-year average concentration dropped 1.6 µg/m^3 (on average) between the 2000-2002 and 2004-2006 time periods. The largest and fastest

decreases have occurred at the sites with the highest concentrations in the industrial core: Dearborn (2.69 µg/m^3), SWHS (2.16 µg/m^3), and Wyandotte (3.04 µg/m^3), (see Table 7 in Appendix A).

Despite a rise in 2005 $PM_{2.5}$ concentrations in Southeast Michigan and indeed the entire Midwestern United States as a whole (possibly due, in part, to higher summer sulfate concentrations caused by an increase in Midwest power plant SO_2 emissions), there has been a strong downward trend in Southeast Michigan's $PM_{2.5}$ concentrations over the last six years (see Figure 4 in Appendix A). In fact, every monitor in Southeast Michigan recorded its lowest annual average $PM_{2.5}$ concentration in 2006 (see Table 8 in Appendix A). Concentrations in the first three quarters in 2007 have also been low, continuing the downward trend in Southeast Michigan (Table 8 in Appendix A). As a result, the latest three-year annual average (2004-2006) shows three additional monitors - Allen Park, Linwood and Wyandotte - are now measuring PM2.5 levels that meet the standard.

Examination of trends in $PM_{2.5}$ chemical species between 2002 and 2006 shows downward trends for sulfates, nitrates, and OC at Dearborn, Allen Park, and Luna Pier. The downward trend for OC is statistically significant at all threes sites, with the greatest decrease occurring at Dearborn (-0.54 ug/m^3/year, see Table 9 in Appendix A). A separate analysis of OC levels by wind direction indicates that the decrease at Dearborn is occurring at a faster rate than at Allen Park. This provides corroborating evidence that local sources are significantly impacting OC at Dearborn (see Table 10 in Appendix A). A faster decrease of OC at Dearborn compared to Allen Park is also shown in Figure 6 in Appendix A. It indicates that OC concentrations are becoming more similar to Allen Park and the difference between the sites has decreased by about 1 ug/m^3 in the past 5 years.

$PM_{2.5}$ in Southeast Michigan is comprised largely of sulfates, nitrates, and OC with small contributions from elemental carbon and crustal material (or soil, see Figure 7 in Appendix A). Various analyses of both local and regional monitoring data all indicate that Southeast Michigan's nonattainment problem is caused by a combination of regional transport and local emissions from sources in the vicinity of the monitors showing violations of the standard. A LADCO analysis of rural background concentrations versus urban excess in the Midwest shows the majority of $PM_{2.5}$ measured in our region is coming from outside Southeast Michigan (see Figure 8 in Appendix A). This is true for all components of $PM_{2.5}$ except OC and soil, which has a higher local contribution (see Figure 9 in Appendix A).

However, the regional background alone is not high enough to cause a violation of the standard, and all $PM_{2.5}$ monitors in the Southeast Michigan nonattainment area that are less impacted by local sources are meeting the standard (see Figure 4 in Appendix A).

Counties to the north of Wayne County do not contribute to $PM_{2.5}$ nonattainment at the monitors showing violation of the standard. Analysis shows that the vast majority of the urban excess at these monitors on days when winds are from the northeast, north or northwest, comes from within Wayne County. Little increase is attributable to Oakland

and Macomb counties. And in all cases, average concentrations at the monitors showing violation of the standards are well below the standard when winds are from these directions (see Figures 10 and 11 in Appendix A).

Within Southeast Michigan, crustal matter is significantly higher at the Dearborn monitor, even though this monitor is less than three miles from several others (see Figure 12 in Appendix A). The "crustal" component is largely composed of iron (see Figure 13 in Appendix A). A wind rose for the iron component of $PM_{2.5}$ at Dearborn points directly to the southwest (see Figure 14 in Appendix A). Conversely, the iron wind rose for Allen Park, while measuring much lower levels, points to the northeast. The Allen Park monitor is approximately five miles southwest of Dearborn. Additional wind direction analysis shows that, when winds are from the southwest, average crustal concentrations at Dearborn are over 2.5 $\mu g/m^3$ higher than those at Allen Park and are sometimes as much as 6 $\mu g/m^3$ higher (see Figure 15 in Appendix A). This clearly indicates a significant local iron source directly between these two sites and closer to the Dearborn monitor.

Additional evidence of a local emissions source is seen in total $PM_{2.5}$ as well. The increase in $PM_{2.5}$ is highest from the southwest and west wind directions when nearby monitors are subtracted from the Dearborn $PM_{2.5}$ concentration. This would indicate that there is a large local source between the Dearborn and the "background" monitors (Allen Park, Luna Pier & Ypsilanti) (see Figure 16 in Appendix A). The Severstal steel facility lies in exactly this position (see Figure 17 in Appendix A). As part of a consent order and permit with the MDEQ, this facility is in the process of installing new baghouses on its blast furnaces and basic oxygen furnace, as well as other control equipment. These changes are expected to reduce primary $PM_{2.5}$ emissions at this facility by 166 tpy (see Table 2 in Appendix A for additional details).

In addition to crustal material, OC is significantly higher at the Dearborn monitor (1.5-2.0$\mu g/m^3$ higher), even though this monitor is less than three miles from several others (see Figure 12 in Appendix A). The Dearborn wind rose for OC indicates a more even distribution than iron, but still shows noticeably higher concentrations when the wind is from the west, southwest or south (see Figure 14 in Appendix A). However, the specific sources(s) of this excess OC have yet to be identified.

Currently, we are unable to explain the observed decrease in excess OC unique to Dearborn. If this reduction is permanent, future analysis focused on explaining this urban excess will be difficult.

9.4 Organic Carbon: More Study Needed

Determining the source of local organic carbon emissions is difficult. Results of source apportionment studies conducted to date are not definitive due to data limitations. However, the data do indicate a significant local industrial component at Dearborn that exceeds that seen at Allen Park and other sites in Southeast Michigan. Mobile sources also appear to significantly contribute to the OC mass (see Figure 18 in Appendix A). Further analysis is needed to identify the source(s) of organic carbon excess at

Dearborn and determine how it can be controlled. To this end, the MDEQ, with support from SEMCOG, has initiated continuous monitoring for OC at Dearborn. LADCO is sponsoring additional measurement-based source apportionment studies, as well.

To help understand the OC fraction, six recent source apportionment studies (based on the positive matrix factorization {PMF} statistical analysis method) were examined (Kenski 2007, see Figure 19 in Appendix A). Several common findings are:

- At Dearborn, the source apportionment studies indicate that local industrial sources, including steel manufacturing but also other metal industries, likely contribute 2.5-3.5 ug/m^3 to annual average $PM_{2.5}$.
- Dearborn also experiences higher mobile source impacts than Allen Park (1.3 to 1.7 ug/m^3 greater), and much of the increase is from diesel sources.
- Secondary sulfate and nitrate levels do not differ much between Allen Park and Dearborn, evidence that these levels are not being influenced by local sources. However, some of the industrial source fingerprints did include sulfate mass, which indicates that local sources of sulfate are present and need further evaluation.

Chemical mass balance (CMB) analyses on high $PM_{2.5}$ days at Dearborn show varied patterns, suggesting that varying mixtures of sources are impacting this site on any given day. Plumes from industrial sources as well as emissions from smoking vehicles appear evident in these episodes (see Figure 20 in Appendix A). However, the observed contribution from smoking vehicles is not unique to Dearborn. The same patterns are evident at Allen Park and other sites in Southeast Michigan, as well as sites in other parts of the Midwest where this analysis has been done. Thus, smoking vehicles do not appear to explain the $PM_{2.5}$ excess being measured at Dearborn (STI 2006).

Additional studies that have been conducted in Detroit to help assess the sources of $PM_{2.5}$, particularly for OC, are still being analyzed. However, preliminary results of one study done by an advanced mobile laboratory from Canada (CRUISER) showed some peaks in OC from high vehicle traffic areas, trains, and a sausage smoking factory (see Figure 21 in Appendix A). In addition, upwind/ downwind analysis of one of the Detroit steel mills showed a large difference in $PM_{2.5}$, particulate sulfate, black carbon and several precursors, as well as a small (0.8 ug/m^3) increase in organic carbon (see Table 11 in Appendix A). Although this was only one sampling event taken in a short time period, it does indicate that this steel mill may have a significant amount of particulate emissions, but may only be a moderate source of particulate OC.

Another preliminary analysis by LADCO used nonparametric regression and kernel density estimates to regress continuous monitor concentrations to wind speed and wind direction data to map locations of relatively high OC and black carbon sources. This study was done at Dearborn and Allen Park as well as Newberry and FIA (or Lafayette Street), two of Michigan's new monitoring sites, because they have the necessary black carbon continuous monitors. Newberry also has an OC continuous monitor. A highly

industrialized area near Zug Island was indicated for high black carbon emissions in a combined analysis of all four sites (see Figure 22 in Appendix A). The FIA site showed high black carbon emissions from the Ambassador Bridge (Figure 22 in Appendix A). The analysis at Newberry indicates that an intermodal freight terminal in the area emits high concentrations of both OC and black carbon (see Figure 23 in Appendix A). Thus trains, trucks and cars may be an important source of these pollutants.

Overall, there are still many unanswered questions with OC and more needs to be done to identify the source(s) of organic carbon excess at Dearborn, how they have changed over time, and if necessary, how they can be controlled in the future.

9.5 Modeling

For the purpose of weight of evidence, photochemical and dispersion modeling support the MDEQ assessment that attainment of the annual $PM_{2.5}$ standard will be achieved by 2010 at the monitors currently exceeding the standard, and that monitors that are meeting the standard will remain in attainment of the annual standard. The most recent combination of photochemical and local scale modeling shows attainment of the standard at the highest monitor (Dearborn) by 2009.

9.5.1 Photochemical Modeling

Extensive photochemical modeling (CAMx) has been conducted by LADCO to address $PM_{2.5}$, as well as ozone and haze in Michigan. A comprehensive Technical Support Document (TSD) describes the modeling parameters, the testing of the model itself, and the predicted reductions in these pollutants in future years. An electronic version of the document is available at www.ladco.org. Section 3 of the TSD describes the model and inputs, and Section 4 provides the modeled future year $PM_{2.5}$ levels for the state.

Table xx (see also Table 1 in Appendix A) in the TSD shows the modeled $PM_{2.5}$ levels at several monitors in Wayne County, Michigan. The two highest monitors, Dearborn (261630033) and SWHS (261630015), have 2009 values of 15.7 ug/m^3 and 14.2 ug/m^3, respectively, in the Round 5 modeling. Of the two modeling scenarios, Round 5 is a more recent version than Round 4, with Round 5 using a base year of 2005 and Round 4 using a 2002 base year. Other upgrades to the model and inventory were also made in the Round 5 modeling.

The Round 5 modeling demonstrated that all monitors with the exception of the Dearborn monitor show attainment by the 2010 attainment date. The Dearborn monitor is further evaluated using local scale modeling described below, which shows that the local scale emission reductions at Severstal Steel will bring the Dearborn monitor values below 15 ug/m^3 by the 2010 attainment date.

9.5.2 Local Scale Dispersion Modeling

As a complement to LADCO's photochemical modeling, the MDEQ conducted local scale dispersion modeling to determine the impacts of localized emission reductions at large industrial facilities in the vicinity of the air monitors showing violations of the standard. This modeling showed approximately 0.8 ug/m^3 reduction in $PM_{2.5}$ at the Dearborn monitor as a result of the controls required at Severstal. Additional reductions are attributed primarily to the locomotive controls, and controls installed at Marathon and U.S. Steel.

The local scale modeling is a key to determining impacts of local controls on the nearby monitors that is not accounted for in the CAMx modeling. Predicted impacts from regional grid models such as CAMx cannot account for reductions in close proximity to the monitors because they typically use 36km or 12km grid resolution for SIP attainment demonstrations. Emission reductions from a local area/point source within each grid are "spread out" over the entire grid. Thus, grid models provide useful information concerning regional contributions, but fail to adequately address neighborhood scale interactions.

For areas like the Dearborn monitor location, where local source primary emissions may contribute a sizable portion of the total $PM_{2.5}$ (i.e., 10 to 30 percent of the total annual average), use of a Gaussian dispersion model may work well for determining local primary impacts within a small area. Such modeling techniques have become known as local scale, or "hotspot," modeling. Similar to regional scale photochemical grid modeling analyses, the EPA recommends that hotspot dispersion modeling results be used in a relative manner rather than the absolute manner employed in NSR analyses. Therefore, that is the approach followed by the MDEQ in this WOE demonstration.

The process to determine neighborhood scale impacts follows the principles suggested in Section 5.3.2 of the EPA's Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze dated April 2007. Similar guidance has been discussed in various regional workshops sponsored by the Midwest Regional Planning Organization (LADCO).

As indicated by Section 5.3.2, there is no single, simple method for quantifying the local contribution to a specific location. In fact, the local component will likely include contributions from more than one source. When applying the model to changes in primary $PM_{2.5}$, the recommended approach is to identify the individual components of $PM_{2.5}$. This approach is necessary so that the non-primary components of $PM_{2.5}$ (i.e., nitrates, sulfates, etc.) can be removed and only the primary portions can be considered. For purposes of this analysis, only the speciated primary components identified as "soil" and "mixed industrials" were considered. These components should contain most of the metals expected from the steel industry plus fugitive emissions associated with large industrial areas.

The guidance further recommends that the analysis be done on a quarterly basis. This evaluation deviates from that approach because most of the referenced material was provided on an annual basis. This deviation is not expected to significantly alter the results of this analysis.

The guidance recommends using a relative approach to determine the reductions from planned control strategies rather than absolute model results. This is different from the usual application of results from Gaussian models for regulatory permitting. This is, however, consistent with regional modeling of $PM_{2.5}$, thus is more appropriate for this purpose. The relative reduction factor derived from the 2002 base modeling and the anticipated 2009 emissions was applied to the specified primary component of $PM_{2.5}$ for anticipated reductions.

a. Process for determining impacts of localized emissions reductions

The methodology used to predict the impacts of required local SIP controls on future $PM_{2.5}$ levels is summarized as follows:

1) Estimate the amount of observed (monitored) $PM_{2.5}$ at the Dearborn monitor that is local in origin.
2) Model base year $PM_{2.5}$ emissions (PM_{10} if $PM_{2.5}$ emissions data unavailable) from local point sources to determine the impact on the Dearborn monitor.
3) Calculate the amount of observed $PM_{2.5}$ at the Dearborn monitor that comes from Severstal.
4) Model future year (2009) $PM_{2.5}$ emissions from Severstal to determine impact on the Dearborn monitor.
5) Calculate the relative reduction factor for 2009 emission reductions at Severstal.
6) Calculate the predicted $PM_{2.5}$ reduction at the Dearborn monitor in 2009 as a result of SIP controls at Severstal.

1) Local impacts

To confidently apply a dispersion model in an attainment test, it is first important to determine the local component of the monitored primary $PM_{2.5}$. For this analysis, it is important to identify the local contributions from as small an area as possible to ease identification of the likely contributing sources.

For purposes of this WOE demonstration, three monitoring sites in the area of Southeast Michigan with the highest $PM_{2.5}$ levels were reviewed: Dearborn, SWHS, and Allen Park.

Dearborn monitor

The Dearborn monitor consistently records the highest values of $PM_{2.5}$ in Southeast Michigan, making it the primary monitor of concern. The 2000-2004 weighted average (i.e., the average of the three 3-year averages from those years) is 19.3 ug/m^3. As seen in Figure 24 in Appendix A, the monitor resides several hundred meters northeast of the

Severstal steel mill. This is the direction of the climatic prevailing wind direction (Figure 25 in Appendix A). Between the steel mill and the monitor lies a major rail switching yard that has approximately 19 to 30 trains per day being operated within the yard. Approximately 16 engines will be idling in the rail yard at any given time. The Ford Motor Company Rouge Complex is located just north of the Severstal facility. Another steel company, U.S. Steel, is located on Zug Island, approximately three miles southeast of the monitor. Additionally, a major gasoline refinery, Marathon, is located approximately two miles south of the monitor. Figure 26 in Appendix A shows the relationship of the monitor to these influencing facilities. $PM_{2.5}$ filters collected at the Dearborn monitor are analyzed for particle speciation. This monitor has the highest $PM_{2.5}$ levels in the nonattainment area and is key to demonstrating attainment. It will become the primary point of reference in this WOE demonstration.

SWHS monitor

The SWHS monitor is 2.2 miles east of the Dearborn monitor and approximately one mile north of the U.S. Steel facility on Zug Island (Figure 26 in Appendix A). With the predominant southwest winds (Figure 25 in Appendix A), this location is also vulnerable to emissions from U.S. Steel, Severstal, and Marathon. The 2000-2004 weighted average is 17.3 ug/m^3. Speciated $PM_{2.5}$ data is not available from the SWHS site.

Allen Park monitor

The Allen Park Monitor is located approximately five miles southwest of the Dearborn monitor (Figure 26 in Appendix A). Due to the prevailing winds (Figure 25 in Appendix A), the Allen Park monitor is located upwind of the majority of facilities that likely impact the Dearborn and SWHS monitors during southwest winds episodes. The 2000-2004 weighted average is 15.8 ug/m^3. Due to the upwind nature of the Allen Park monitor location, this monitor can provide more of a regional aspect of Southeast Michigan as compared to the Dearborn and SWHS monitors, which receive a large local component of primary $PM_{2.5}$. Filters collected at the Allen Park monitor are analyzed for particle speciation.

Dearborn vs. Allen Park monitor analysis

Comparison of the particle speciation at Allen Park and Dearborn monitors provides helpful information on the local sources impacting the Dearborn monitor. Several reports analyzing the Dearborn and Allen Park filters have been funded through LADCO. Data from the reports were heavily relied upon for this portion of the WOE demonstration. This section of the WOE relied primarily on source apportionment analysis of the two monitors by STI (2006) and Clarkson University. These reports, in their entirety, are available at the LADCO web site: http://www.ladco.org/reports.html. It should be noted that additional reports are also available from LADCO. Some of these reports contain additional analysis through 2006. However, since the modeling data provided in this WOE centers around the base year of 2002, monitor data from that time period was used.

Based on the differences between the 2000-2004 weighted average contribution at Dearborn (19.3 ug/m^3) and Allen Park (15.8 ug/m^3), first conclusions suggest a maximum of 3.5 ug/m^3 of $PM_{2.5}$ impacting Dearborn are from local sources. This

conclusion is supported by the STI (2006) report "Data Analysis and Source Apportionment of $PM_{2.5}$ in Selected Midwestern Cities," November 2007, which states that "…the Allen Park site does not seem to be influenced by sources in the Dearborn area…" (page 3-10).

It is possible that the 3.5 ug/m^3 value is an overestimation of local impacts because there are likely sources that impact both monitors. A comparison of the results from the following reports provides a more realistic estimate of local contribution to the Dearborn site. The difference between the combined soil and mixed industry at Allen Park (2.23 ug/m^3) and Dearborn (4.55 ug/m^3) is 2.32 ug/m^3 in the Clarkson report (see Table 10.1). The difference between the combined soil and mixed industry at Allen Park (1.98 ug/m^3) and Dearborn (4.36 ug/m^3) is 2.38 ug/m^3 in the STI (2006) report (see Table 10.1).

Table 10.1: Comparison of Clarkson and STI source apportionment results.

	Clarkson Report			**STI Report**	
	Allen Park (2001-2003)	**Dearborn (2002-2003)**		**Allen Park (2002-2004)**	**Dearborn (2002-2005)**
Sulfate	5.10	8.00		4.51	4.49
Nitrate	3.40	3.98		4.16	4.26
Soil	0.98	2.23		0.63	0.88
Aged Sea and Road Salt	0.46	0.46			
Spark-ignition Vehicles	3.70	4.07		3.53	3.96
Diesel Vehicles	0.84	1.13		2.37	1.06
Biomass Burning	0.37				0.31
Mixed Industrial	1.25	2.32		1.35	3.48
Local Primary Particulate					
Soil + Industrial	2.23	4.55		1.98	4.36
Dearborn - Allen Park	**2.32**			**2.38**	

The local contribution of primary $PM_{2.5}$ in the range of 2.30 ug/m^3 to the Dearborn monitor is further supported by additional analysis by LADCO, documented in a report titled, "Data Analysis to Support Local Area Modeling" (Kenski, 2007). In Figure 4, approximately 3.25 ug/m^3 is associated with the Dearborn monitor while approximately 0.95 ug/m^3 is associated with Allen Park monitor. Subtracting the Allen Park concentration as area background would leave at the Dearborn monitor 2.30 ug/m^3 as local contribution, which is similar to the Clarkson and STI results. It is likely that this is an underestimation since some of the sources contributing to Dearborn also contribute to a small degree to Allen Park.

For purposes of this WOE demonstration, a concentration of 2.30 ug/m^3 of primary fine particulate will be considered as nearby local contribution to the Dearborn site (Table 12 in Appendix A).

2.) Model base year local source emissions

The EPA AERMOD Gaussian Dispersion model was used to predict impacts at the monitors of concern. Table 13 in Appendix A provides the significant sources used in the AERMOD model to predict impacts from neighborhood scale emissions (see Figures 2 and 3 in Appendix A). Most of the sources were treated as a single individual point source using a weighted, representative stack. Due to the proximity of the Severstal facility, detailed refined modeling used all individual point and volume sources as defined during previous New Source Review permitting. Actual $PM_{2.5}$ 2002 emissions from Severstal (479.3 tpy) were identified by the MDEQ at each detailed emission point. Emissions used from the other sources were PM_{10} emissions as provided by the facility 2002 Michigan Air Emissions Reports (MAERs). The total modeled impact at the Dearborn monitor is 4.66 ug/m^3, with 3.44 ug/m^3 coming from Severstal. Emissions from these sources have not changed significantly in the last several years.

3.) Calculation of the amount of Severstal $PM_{2.5}$ impacting the Dearborn monitor

To determine the Severstal impact on the Dearborn monitor, a Relative Factor was derived based on the modeled values from the local sources. The Severstal impact (3.44 ug/m^3) was divided by the overall predicted impact from all local sources (4.66 ug/m^3) for a Relative Factor of 0.738. Applying this factor to the previously determined local primary $PM_{2.5}$ contribution to the Dearborn monitor of 2.30 ug/m^3 yields a value of 1.70 ug/m^3 contributed by Severstal to the Dearborn monitor.

4.) Modeled impact of 2009 Severstal emissions on the Dearborn monitor

The AERMOD model was run using the 2009 Severstal projected emissions. The emission total is reduced by 166 tons of $PM_{2.5}$ from the 2002 level because of the various controls that the company is installing. The inventory list is summarized in Table 2 of the Appendix A. The 2009 impact was predicted to be 1.59 ug/m^3.

5.) Calculation of the Relative Reduction Factor

The 2009 impact was predicted to be 1.59 ug/m^3 as compared to the 2002 base case impact of 3.44 ug/m^3. This provides a Relative Reduction Factor of 0.462 (i.e., 1.59 / 3.44 = 0.462).

6.) Calculation of the reduction in ug/m^3 at Dearborn in '09 because of Severstal controls

The reduction in observed values at the Dearborn monitor in 2009 resulting from reductions at Severstal is calculated by multiplying the relative reduction factor of 0.462 by the predicted Severstal contribution of 1.70 ug/m^3 in 2002. Therefore the expected reduction by 2009 will be 0.78 ug/m^3 based only on Severstal reductions. Table 10.2 summarizes these figures. It should be noted that this is a conservative prediction because other emission reductions in the area from U.S. Steel, Marathon, locomotive retrofits, and other sources have not been accounted for in this calculation and will further contribute to reductions at the Dearborn monitor.

b. Modeled local control strategies

The LADCO analysis (Figure 13 in Appendix A) provided evidence that iron accounts for approximately 1.4 ug/m^3 of primary particulate to the Dearborn monitor. Iron is associated primarily with steel production, and most can be attributed to Severstal. Table 13 in Appendix A indicates that U.S. Steel contributes only slightly to Dearborn compared to Severstal. As such, based on the annual emissions, prevailing winds, and close proximity, it can be reasonably assumed that Severstal contributes the majority of excess $PM_{2.5}$ which is not seen at other area monitors. As provided in the previous section, the assumption that Severstal contributes 1.70 ug/m^3 to the Dearborn monitor is likely an underestimation, as conservative assumptions are applied at each step of this analysis.

Table 2 in Appendix A lists 2002 emissions from the permit application inventory and 2009 projected emissions. As shown by the total emissions reductions, Severstal will reduce emissions by installing new particulate controls on two blast furnace, the basic oxygen furnace and several other smaller operations in the facility. The sum of the reductions will be 166 tons per year. These reductions were not taken into account during the regional modeling performed with CAMx. Thus, double-counting should not be an issue.

The AERMOD model was run using the 2009 Severstal projected emissions. The new **2009 Impact** was predicted to be 1.59 ug/m^3 as compared to the **2002 Base Case** impact of 3.44 ug/m^3. This provides a Relative Reduction Factor (**RRF**) of 0.462 (i.e., 1.59 / 3.44 = 0.464). Applied to the monitored **2002 Contribution** by Severstal (1.70 ug/m^3), the expected Severstal reduction by 2009 will be 0.78 ug/m^3. Table 10.2 summarizes these figures. This reduction in primary particulate from Severstal, in conjunction with the regional 2009 prediction of total $PM_{2.5}$ particulate (15.7 ug/m^3), indicates that Dearborn will be in attainment by 2009 even before considering other reductions of neighborhood scale emissions.

Table 10.2: Severstal's 2009 contribution to the Dearborn monitor

2002 Base Case: AERMOD Severstal Contribution to Dearborn	3.44	ug/m3
AERMOD Total: AERMOD Neighborhood Scale Contribution to Dearborn	4.66	ug/m3
Relative Factor: Severstal Relative Factor *(2002 Base Case / AERMOD Total)*	0.738	
Total: MONITORED Neighborhood Scale Contribution to Dearborn Monitor	2.30	ug/m3
2002 Contribution: Severstal's 2002 Contribution to the Dearborn Monitor *(Total x Relative Factor)*	1.70	ug/m3
2009 Impact: AERMOD Severstal Contribution to Dearborn	1.59	ug/m3
RRF: Relative Reduction Factor *(2009 Impact / 2002 Base Case)*	0.462	
2009 Severstal Reduction to Dearborn Impact *(RRF x 2002 Contribution)*	**0.78**	**ug/m3**

c. AERMOD dispersion model validation

The hotspot dispersion modeling results can be evaluated to address model performance. Similar to grid modeling, the dispersion model results should be compared to ambient data to ensure the model is working well.

As discussed in the previous section, combined soil (including metals) and mixed industrial impacts at the Dearborn monitor were concluded to be 4.55 ug/m^3 per the Clarkson report and 4.36 ug/m^3 per the STI report. Table 13 in Appendix A provides overall combined impacts and individual contribution for each source near the Dearborn monitor based on the AERMOD modeling. The combined near source industrial emissions were predicted to yield an impact of 4.66 ug/m^3 at the Dearborn monitor. This close comparison to the Clarkson and STI values suggests that the emissions estimates and dispersion model are doing a reasonable job addressing the local component of primary $PM_{2.5}$ from nearby industrial sources.

The model further gives a combined impact from these sources of 0.50 ug/m^3 at the predominantly upwind Allen Park monitor. This minimal impact is expected because of the location of the monitor in relation to the sources. This also follows the STI assumption that "…the Allen Park site does not seem to be influenced by sources in the Dearborn area…" (page 3-10).

The AERMOD modeled impact at the SWHS monitor (2.35 ug/m^3) from the same sources is less than the modeled impact at Dearborn (4.66 ug/m^3) for the same emission sources. This is expected because of the larger distance between the sources and SWHS. The Dearborn minus SWHS modeled difference, 2.31 ug/m^3 (4.66 ug/m^3 -

2.35 ug/m^3) is similar to the monitored 2000-2004 weighted average difference of 2.0 ug/m^3 (19.3 ug/m^3 - 17.3 ug/m^3).

In all cases, some AERMOD overprediction is expected because all source emissions, except Severstal, assumed PM_{10} emissions will be higher than $PM_{2.5}$ emissions. Table 12 in Appendix A provides a summary of the Dearborn minus the Allen Park industrial particulate differences.

9.5.3 Combined Modeling Results

The impacts of future year emission reductions, taking into account future year growth as well, is demonstrated by combining the regional scale photochemical modeling with the local scale modeling. To avoid double counting of emission reductions, the modeled local source emission reductions are not accounted for in the regional modeling inventory. The future year predicted $PM_{2.5}$ levels as determined by the regional modeling is included in Table x in Section 4 of the LADCO TSD (see also Table 1 in Appendix A). The values for the two monitors that are showing violations of the standard in Michigan, in micrograms per cubic meter, are as follows:

Monitor	2009 (regional)	2009 (local)	2009 predicted level
Dearborn	15.7	0.8 reduction from Severstal	14.9
SWHS	14.2	Not calculated	Less than 14.2 expected

The predicted $PM_{2.5}$ impact at the Dearborn monitor in 2009 resulting from primary $PM_{2.5}$ emission reductions at Severstal is a reduction of 0.8 ug/m^3. This equals 14.9 when subtracted from 15.7. The $PM_{2.5}$ standard is 15, thus the combined modeling shows that the Dearborn monitor can be expected to meet the $PM_{2.5}$ standard by 2009.

10. Attainment Strategy

Similar to the attainment strategy for ozone, the approach for fine particulate should be multifaceted. There are four components to the attainment strategy for $PM_{2.5}$:

1. Implementation of national controls;
2. Implementation of local controls;
3. Voluntary measures, and;
4. Areas of continued study.

This multifaceted strategy is based on lessons learned from our technical analyses as reflected in the WOE demonstration. No single program can be relied upon for attainment and our limitations in predicting the future through the use of air pollution models, travel models and economic models are recognized in this multifaceted attainment strategy.

Acknowledging that some activities that will contribute to air quality improvement and attainment do not necessarily lend themselves to regulatory action and that controls in certain parts of the nonattainment area will contribute very little toward attainment, the strategy targets local controls in a portion of eastern Wayne County. This is consistent with the location of violating monitors and with earlier successful strategies in attaining previous particulate matter standards.

10.1 Implementation of National Controls

a) Mobile Sources

Mobile sources are recognized as a significant contributor to $PM_{2.5}$ levels in both attainment and nonattainment areas. The focus on reducing emissions cost-effectively in the eastern portion of Wayne County is somewhat incompatible with specialized vehicular emission reduction programs. More importantly, the contribution of mobile sources to $PM_{2.5}$ levels will be reduced throughout the region and nation as a result of several new federal requirements. These requirements affect both vehicle design as well as fuel specifications. We estimate the following programs will reduce $PM_{2.5}$ mobile source emissions by over 51 percent between 2002 and the attainment year, 2010.

Tier 2 emission standards: We expect significant reductions in mobile source emissions from implementation of the Tier 2 program. The Tier 2 program requires manufacturers to produce vehicles that emit much lower levels of pollution than earlier generations. Because this is a national program, these reductions from “on-board” controls will be occurring in Southeast Michigan as well as in upwind areas. Consequently, transport into the region will be reduced.

Diesel Rule: Similarly, the EPA estimates its new Diesel Rule will result in a 97 percent reduction in emissions from heavy-duty diesel trucks. As with gasoline vehicles, these reductions will occur throughout the entire country.

Low sulfur gasoline and diesel fuel: Beginning in 2004, refineries began phasing in a new sulfur levels for gasoline due to new federal standards for fuel. This standard requires the average sulfur level to be no greater that 30 parts per million (ppm). This represents a 14-fold reduction in Southeast Michigan where average levels in 2002 were 430 ppm. Also beginning in 2006, a new requirement for ultra low sulfur diesel fuel (15 ppm) will begin phasing in. As with gasoline, this represents an enormous decrease from the 380 ppm average measured in 2002.[3] These sulfur reductions are a key contributor to the large-scale vehicular emission reductions shown in Figure 1 of Appendix A.

Although these low sulfur fuel programs are federal requirements, the Michigan Department of Agriculture (MDA) is committed to testing for compliance with these standards. The MDA will update its existing programs and regulations to include a provision for the enforcement of these standards.

Implementation of this program and enforcement of this program is primarily the responsibility of the EPA. Using a combination of its enforcement authority under the Clean Air Act and its program for certifying manufacturer compliance with vehicle emissions standards, the EPA is a key partner in implementing this facet of the control strategy.

b) Stationary Sources

Clean Air Interstate Rule: In 2005, the EPA finalized a rule to address long-range transport of $PM_{2.5}$, commonly referred to as the CAIR rule. This rule will result in major reductions of sulfates and nitrates, two of the most significant contributors to $PM_{2.5}$ at monitors showing violations of the standards and throughout the nonattainment area. The MDEQ has primary responsibility for ensuring that required emission reductions are implemented. The MDEQ is committed to ensuring these reductions occur as scheduled in the national rule.

10.2 Implementation of Local Controls

a) Severstal steel production facility

Two enforceable programs have already been put in place to secure emission reductions that are a key component of the $PM_{2.5}$ attainment strategy. One is a recently approved consent order between Severstal and the MDEQ. The other is a recently approved permit that is subject to the consent order. These programs require emission reductions from the following sources:

[3] Alliance of Automobile Manufacturers. 2002 North American summer and winter fuel surveys.

- Basic Oxygen Furnace (BOF): Install baghouse
- Blast furnace C: Install baghouse
- Blast furnace B: Install baghouse or shutdown by June 2008
- Torch cutting: No longer permitted on site
- Scarfing operations: Reduce opacity
- Torpedo cars: Reduce smoking

The combined impact of these controls is expected to reduce annual primary $PM_{2.5}$ emissions by 166 tpy, and will be especially critical in reducing the excess iron identified in our technical analysis (See Tables 2 and 3 in Appendix A).

Furthermore, a Supplemental Environmental Project requires Severstal to take the following additional actions:

- School bus retrofits: The Company will spend $100,000 to retrofit approximately 100 school buses in the local area with diesel oxidation catalysts and/or engine crankcase filters. These devices will reduce the exposure of children to diesel particulate emissions as well as reduce overall $PM_{2.5}$ emissions in the area.
- Company-owned diesel equipment retrofits: The Company will spend $100,000 to retrofit some of its own on-site diesel equipment.
- Planting of trees in the area: The Company will spend $200,000 on tree planting in the area, providing both air quality and aesthetic benefits.

b. U.S. Steel

An enforceable consent order and permit between the company and the MDEQ resulted in reductions at the B blast furnace. The existing baghouse was replaced resulting in an annual primary PM emissions reduction of 76 tons (see Table 3 in Appendix A).

c. Marathon

An enforceable consent order and permit at Marathon will also result in $PM_{2.5}$ emission reductions. These reductions will result from the following specific actions that are currently being implemented:

- Fluid Catalytic Cracking Unit (FCCU): Company is adding an electrostatic precipitator (ESP) and catalyst additives.
- CO Boiler: Has been shut down.
- Crude/Vac Heater: NOx Controls.
- BT Inter Heater and BT Charge Heater: NOx reductions.

The combined impact of these controls is expected to reduce annual primary PM emissions by 94 tpy.

Marathon has also applied for a permit to install a coking unit to process heavy crude oil. The proposed permit is currently in the public comment phase of the permitting process; however, if the permit is successfully completed, the company will marginally reduce PM and its precursors. In addition, pending permit approval, Marathon is planning several other air quality actions (see Table 3 in Appendix A).

- Voluntary retrofit of school buses in the City of Detroit fleet.
- Voluntary enhanced street sweeping on public roads in the vicinity of the plant.
- Voluntary installation of air monitoring stations in and around the facility.
- Voluntary installation of particulate controls on the truck fleet that will transport petroleum coke.
- Voluntary purchase of PM_{10} offsets from closed plants to retire.

d. Reductions from plant closures and changes in operations

As discussed in the WOE, $PM_{2.5}$ levels are improving. The rate of improvement is greater at the industrial monitoring sites (Dearborn, SWHS, & Wyandotte). While local regulatory measures were not responsible for this improvement, many of these reductions are permanent and the impact on attainment and maintenance is significant.

e. Diesel Switch Engine Locomotive Retrofits

In the course of identifying possible sources for emission reductions, we also considered factors beyond the quantity of emissions. These include the nature of the emissions and proximity to the Dearborn and Southwestern High School monitors and surrounding communities. Approximately 40 switch engines operate in these areas on a fairly continuous basis with little or no emission control. As a result, retrofitting of these engines is being pursued.

10.3 Voluntary measures

a. High emitting vehicle detection

Despite the massive reductions in vehicular emissions as a result of on-board controls and cleaner fuels, a small portion of the vehicle population contributes disproportionately to the total amount of these emissions. Because of the cost, effectiveness, and time to implement a mandatory vehicle-testing program, this measure is not being pursued. Furthermore, a large number of vehicles that operate in the region are not registered in the area and are merely passing through. Thus, they would not be subject to the test.

Nonetheless, advances in technology make it feasible to sample vehicle emissions in-situ using a remote sensing device. SEMCOG recently completed a project to identify the number and characteristics of high emitters in the region. The project showed that Southeast Michigan has fewer high emitters than other parts of the country due to its

newer fleet. However, the study also showed that 10% of the fleet contributes 70% of the emissions. Thus, reducing the number of high emitters has significant emission reduction potential. The project included contacting owners of high emitting vehicles and encouraging them to voluntarily seek repairs. Roughly 40% of those contacted did seek repairs, which shows great promise for a broader voluntary program. The vast majority of those who did not seek repairs said they could not afford them. SEMCOG is pursuing follow-up activities to make the public aware of the high emitter issue with a goal of reducing the number of high polluting vehicles on the road.

b. Fugitive Dust Reduction

In the course of our technical analysis, a large number of storage piles, unpaved lots, and barren land within a three-mile radius of both the Dearborn and Southwestern High School monitors were observed (Figure 5 in Appendix A). The vast majority of emissions from these "fugitive" sources are thought to be larger than $PM_{2.5}$. Nonetheless, the sheer number of these sources and their possible aggregate impact is cause for attention. While many of these sources are already the subject of a regulatory program as the result of a previous SIP, more could be done to reduce the impact of fugitive dust in this area.

To that end, SEMCOG has teamed with Southwest Detroit Environmental Vision and a graduate class at the University of Michigan (U of M) to develop a blueprint for greening this area. During the 2007-2008 academic year, the U of M students will be researching different plant species that could have the greatest potential for reducing dust in the area; the locations where planting could be most advantageous; and, ways that such landscaping could be marketed to businesses in the community as well as other potential funding organizations.

While the precise impact of this initiative on fine particulate concentrations in the area is unknown, implementation of such a greening program will certainly improve the overall environment for the people who live and work in the area.

10.4 Tracking Progress and Continuing Evaluation

Another part of the multifaceted approach to the $PM_{2.5}$ strategy involves tracking progress toward attainment and continued evaluation of other possible contributors that should be the subject of control. This differs from the traditional approach to SIP development but is consistent with the weight of evidence on which this strategy is based. Specifically, instead of presuming that attainment will occur exactly as planned, this section includes a course of action, tracking progress, and identifying other contributors that should be subject to control. Each of these elements is discussed below.

a. **$PM_{2.5}$ Monitoring Network Enhancement –** In order to improve our understanding of the $PM_{2.5}$ nonattainment problem in Southeast Michigan, particularly with regard to individual species, enhancements to the current monitoring network are needed. Appendix E is a draft strategy for improving the

monitoring network in this region, provided MDEQ can obtain additional funding. These enhancements will not only improve our understanding of current $PM_{2.5}$ concentrations, they will also allow us to better track progress towards attainment.

b. **Organic Carbon Analysis –** While the controls listed in sections 10.1 to10.3 above will have a significant impact on $PM_{2.5}$ in Southeast Michigan, more needs to be done to understand and address the excess organic carbon component. Much time and effort has been spent analyzing available organic carbon data. However, the lack of speciated data at many monitoring locations and the relatively short history of monitoring data make it difficult to identify the source(s) of these emissions. Additional studies will be pursued to increase our understanding of this component and its contribution to Southeast Michigan's fine particulate problem.

11. RACT and RACM

Rule 40 CFR part 51.1010 requires Michigan to submit with the attainment demonstration a SIP revision demonstrating that it has adopted all RACM (including RACT for stationary sources) necessary to demonstrate attainment as expeditiously as practicable. RACM is the application of reasonable controls on sources in a nonattainment area to expedite the attainment of the area. RACT is a subset of RACM; the application of such controls specifically on stationary sources.

Michigan's $PM_{2.5}$ SIP is being developed to demonstrate through a weight of evidence approach that the nonattainment area will attain the standard by 2010 through a combination of multistate regional controls and reductions at several sources in close proximity to the areas with the highest $PM_{2.5}$ annual levels. This attainment demonstration does not include any additional controls representing RACT or RACM.

To determine whether RACT/RACM controls would be effective in bringing the violating monitors into attainment more rapidly the planned controls, the MDEQ has done photochemical screening modeling. A conservative (50 percent) reduction of NOx and SO_2 emissions for the whole state and in the seven-county nonattainment area was modeled to see what impact the reduction would have in the area. With the 50 percent reduction representing RACT and RACM controls, the resulting impacts on $PM_{2.5}$ levels was less than one microgram per cubic meter (see Tables 1 and 2 in Appendix F). A larger reduction in PM2.5 levels is needed to justify such widespread controls as reasonable.

A detailed description of the method used for the screening modeling is found in Appendix D. Tables 3 through 7 in Appendix F contain a list of the source categories and their emissions that could be considered in a RACT and RACM analysis in the seven-county nonattainment area in the event that this issue is revisited in a future SIP. These are included for informational purposes only.

From a timing standpoint, additional controls would not likely be implemented prior to the 2010 date. State administrative rules take up to a year and a half to promulgate, and any required controls would take another year or two to implement. Emission reductions from RACT or RACM would not occur until well beyond the 2010 timeframe.

12. Reasonable Further Progress (RFP) Requirements

Rule 40 CFR part 51.1009 requires a demonstration of RFP. However, if the State submits an attainment demonstration showing attainment by 2009, the State is not required to submit a separate RFP plan. Michigan plans to reach attainment by 2009, and will not submit a separate RFP plan.

13. Contingency Measures

Rule 40 CFR part 51.1012 requires that the State must submit in each attainment plan specific contingency measures to be undertaken if the area fails to make reasonable further progress, or fails to attain the $PM_{2.5}$ NAAQS by its attainment date. Michigan evaluated several contingency measures and the optional contingency measures are shown below.

$PM_{2.5}$ Contingency Plans

1) Steel Mill Operations
    a. Charging / Tapping Operations – additional PM controls
    b. Crushing operations -- require additional wets suppressions controls
    c. Slag Processing – additional PM controls
    d. Levy slag processing– upgrade wet suppression
    e. Hot Strip Mill Processing – additional NOx controls
    f. Blast Furnace Operations – additional SO_2 controls
    g. EES coke battery controls – additional SO_2 controls
2) Impact crushers located at recycle scrap yards – upgrade wet suppression
3) Charbroiling operations at restaurants - reduce smoke emissions
4) Concrete manufacturing - upgrade wet suppression
5) Asphalt plants – upgrade wet suppression and NOx controls, low sulfur fuels
6) Institutional commercial and industrial (ICI) boilers – SO_2 and NOx controls
7) Landfill flaring operations – replace flares with energy producing operations
8) Sand blasting operations – dust suppression
9) Zinc plating operations — additional controls
10) Outdoor Wood Burners – require performance standards for manufacturers

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