INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
We Protect Hoosiers and Our Environment.

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Governor

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October 20, 2009

Mr. Bharat Mathur
Acting Regional Administrator
U.S. Environmental Protection Agency
Region 5
77 West Jackson Boulevard
Chicago, IL 60604-3950

Re: Request for Redesignation Petition and Maintenance Plan for Fine Particle Attainment in the Central Indiana Nonattainment Area

Dear Mr. Mathur:

The Indiana Department of Environmental Management (IDEM) submits a Redesignation Petition and Maintenance Plan for the Central Indiana Area, consisting of Hamilton, Hendricks, Johnson, Marion, and Morgan counties, which were designated as nonattainment of the annual standard for fine particles on April 5, 2005. IDEM conducted a public hearing concerning the Redesignation Petition and Maintenance Plan on September 14, 2009 and the public comment period concluded on September 18, 2009.

This submittal documents the public review process, including a detailed summary of and response to substantive comments.

The attached document consists of the following:

Redesignation Petition and Maintenance Plan

- A formal request that the Central Indiana Area be redesignated to attainment and reclassified as maintenance. It contains and meets the requirements set forth in Section 107 of the Clean Air Act and in U.S. EPA Redesignation Guidance.
- A maintenance year of 2020 is established and 2015 is analyzed as an interim year.
- The appendices of the document contain historic air quality trend data, projected emission inventory data and thorough documentation of the mobile emissions analysis.
- A summary of, and response to, substantive written comments.

Motor Vehicle Emissions Budgets

- Contained in the Redesignation Petition is a new Motor Vehicle Emissions Budget for 2010 and 2020. The Indianapolis Area Metropolitan Planning Organization's travel demand model and MOBILE6 were used to determine emissions for the annual fine particle nonattainment area.
- A conservative margin of safety was applied to the 2010 and 2020 projected emissions.
- The travel demand model was updated with the best available assumptions.
- Vehicle registration data gathered from the Indiana Bureau of Motor Vehicles were used to replace the MOBILE6 default vehicle age distribution.

IDEM requests that the U.S. EPA proceed with review and approval of this submittal. If you have any questions or need additional information, please contact Scott Deloney, Chief, Air Programs Branch, at (317) 233-5694.

Sincerely,

Daniel Murray
Assistant Commissioner
Office of Air Quality

DM/sad/skr
Attachments

Cc: John Summerhays, U.S. EPA Region 5 (w/ enclosures)
Matt Rau, U.S. EPA Region 5 (w/ enclosures)
John Mooney, U.S. EPA Region 5 (no enclosures)
Cheryl Newton, U.S. EPA Region 5 (no enclosures)
Pat Morris, U.S. EPA Region 5 (no enclosures)
Scott Deloney, IDEM (no enclosures)
Christine Pedersen, IDEM (no enclosures)
Sarah Raymond, IDEM (w/ enclosures)
Phillip Roth, Indianapolis MPO (no enclosures)
Jerrold Bridges, MCCOG (no enclosures)

REQUEST FOR REDESIGNATION AND MAINTENANCE PLAN UNDER THE ANNUAL NATIONAL AMBIENT AIR QUALITY STANDARD FOR FINE PARTICLES

Central Indiana Area

Prepared By:
The Indiana Department of Environmental Management

October 2009

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TABLE OF CONTENTS

FIGURES

CHARTS

TABLES

GRAPHS

APPENDICES

REQUEST FOR REDESIGNATION AND MAINTENANCE PLAN UNDER THE ANNUAL NATIONAL AMBIENT AIR QUALITY STANDARD FOR FINE PARTICLES

CENTRAL INDIANA AREA

1.0 INTRODUCTION

This document supports Indiana's request that Hamilton, Hendricks, Johnson, Marion, and Morgan counties (Central Indiana Area), be redesignated from nonattainment to attainment of the 1997 annual standard for fine particles. The Central Indiana Area has recorded three years of quality assured ambient air quality monitoring data for the years 2006 through 2008, demonstrating attainment with the annual standard for fine particles, and is eligible for redesignation.

Section 107 of the Clean Air Act (CAA) establishes specific requirements to be met in order for an area to be considered for redesignation, including:

(a) A determination that the area has attained the annual standard for fine particles.
(b) An approved State Implementation Plan (SIP) for the area under Section 110(k).
(c) A determination that the improvement in air quality is due to permanent and enforceable reductions in emissions resulting from implementation of the SIP and other federal requirements.
(d) A fully approved maintenance plan under Section 175A.
(e) A determination that all Section 110 and Part D requirements have been met.

A maintenance plan provides for the continued attainment of the air quality standard by an area for a period of ten years after the United States Environmental Protection Agency (U.S. EPA) has formally redesignated the area to attainment. The plan also provides assurances that even if there is a subsequent exceedance of the air quality standard, then measures in the maintenance plan will prevent any future occurrences through contingency measures that would be triggered.

This document addresses each of these requirements, and provides additional information to support continued compliance with the annual standard for fine particles.

1.1 Background

The CAA requires states with areas designated nonattainment of the applicable National Ambient Air Quality Standard (NAAQS) for particulate matter to develop SIPs to expeditiously attain and maintain the standard. In 1997, U.S. EPA set daily and annual air quality standards for fine particles ($PM_{2.5}$), as shown in Table 1.1. The standards were legally challenged and upheld by the U.S. Supreme Court in February of 2001. In 1999, Indiana began monitoring for fine particles concentrations. The U.S. EPA designated areas in Indiana under the fine particles standards on December 17, 2004, as attainment, nonattainment or unclassifiable, with an effective date of April 5, 2005.

Table 1.1
National Ambient Air Quality Standards for Fine Particles

	Annual	24-Hour
1997 Fine Particles Standards ($PM_{2.5}$)	**15 µg/m^3** Annual arithmetic mean, averaged over three years	**65 µg/m^3** 24-hour average, 98th percentile, averaged over three years
2006 Fine Particles Standards ($PM_{2.5}$)	**15 µg/m^3** Annual arithmetic mean, averaged over three years	**35 µg/m^3** 24-hour average, 98th percentile, averaged over three years

Note: The Central Indiana Area meets the 1997 and 2006 24-hour NAAQS for fine particles. Since this area is solely designated nonattainment under the 1997 annual standard for fine particles, this document only addresses the annual standard.

On April 5, 2005, based on 2001 through 2003 monitoring data, U.S. EPA designated the Central Indiana Area as nonattainment of the annual standard for fine particles. The nonattainment areas are subject to CAA Part D, Title 1, Section 172 Subpart 1 requirements, including the development of a plan to reduce nitrogen oxides (NO_x), sulfur dioxide (SO_2) and direct $PM_{2.5}$ emissions, and demonstrate that the area will meet the annual standard for fine particles by April 5, 2010. There were no monitors in Indiana that violated the 1997 24-hour standard for fine particles and no monitors in Indiana currently violate the 2006 24-hour standard for fine particles. As a result, the Central Indiana Area was designated nonattainment solely under the 1997 annual standard. Therefore, this document pertains only to the 1997 annual standard for fine particles.

The Central Indiana Area, as defined in Section 1.2, has not previously been subject to nonattainment area rulemakings for fine particles. However, Marion County was subject to nonattainment area rulemakings under the 1-hour ozone standard. The 1-hour ozone standard was revoked on June 15, 2005. Boone, Hamilton, Hancock, Hendricks, Johnson, Madison, Marion, Morgan, and Shelby counties in Central Indiana had also been subject to nonattainment area rulemakings under the 8-hour ozone standard and all counties in Central Indiana were redesignated to attainment and classified as maintenance under the 8-hour ozone standard on October 19, 2007.

1.2 Geographical Description

The Central Indiana Area nonattainment area for annual fine particles includes Hamilton, Hendricks, Johnson, Marion and Morgan counties and contains such cities as Beech Grove, Carmel, Franklin, Greenwood, Indianapolis, Lawrence, Martinsville and Noblesville and such towns as Avon, Brownsburg, Fishers, Mooresville, Plainfield and Speedway. This area is depicted in Figure 3.1.

1.3 Status of Air Quality

Monitoring data for fine particles for the three years, 2006 through 2008, demonstrates that air quality has met the annual NAAQS for fine particles in the Central Indiana Area. This fact, accompanied by the permanent and enforceable reductions in emission levels discussed in Section 4.0, justifies a redesignation to attainment for the subject area based on Section 107(d)(3)(E) of the CAA.

2.0 REQUIREMENTS FOR REDESIGNATION

2.1 General

Section 110 and Part D of the CAA list a number of requirements that must be met by nonattainment areas prior to consideration for redesignation to attainment. In addition, U.S. EPA has published detailed guidance in a document entitled *Procedures for Processing Requests to Redesignate Areas to Attainment*, issued September 4, 1992, to Regional Air Directors. This document is hereafter referred to as "Redesignation Guidance". This Request for Redesignation and Maintenance Plan is based on the Redesignation Guidance, supplemented with additional guidance received from staff of the Criteria Pollutant Section of U.S. EPA Region V. The specific requirements for redesignation are listed below.

2.2 Fine Particles Monitoring

1) A demonstration that the annual standard for fine particles, as published in 40 CFR 50.13, has been attained. Fine particles monitoring data must show that violations of the annual ambient standard are no longer occurring.

2) Ambient monitoring data quality assured in accordance with 40 CFR 58.15, recorded in the U.S. EPA Air Quality System (AQS) database and available for public view.

3) A showing that the three-year average of annual values, based on data from all monitoring sites in the area or its affected downwind environs, do not exceed 15.0 micrograms per cubic meter ($\mu g/m^3$). This showing must rely on three complete, consecutive calendar years of quality assured data.

4) A commitment that, once redesignated, the State will continue to operate an appropriate monitoring network to verify the maintenance of the attainment status.

2.3 Emission Inventory

1) A comprehensive emission inventory of direct $PM_{2.5}$ and the precursors of fine particles completed for the base year (2006 in this case).

2) A projection of the emission inventory to a year at least ten years following redesignation.

3) A demonstration that the projected level of emissions is sufficient to maintain the annual standard for fine particles.

4) A demonstration that improvement in air quality between the year violations occurred and the year attainment was achieved is based on permanent and enforceable emission reductions and not on temporary adverse economic conditions or unusually favorable meteorology.

5) Provisions for future annual updates of the inventory to enable tracking of the emission levels, including an annual emission statement from major sources.

2.4 Modeling Demonstration

While no modeling is required for redesignating nonattainment areas, the Indiana Department of Environmental Management (IDEM) has evaluated the results of federal control-case modeling to demonstrate that compliance with the standard will be maintained.

2.5 Controls and Regulations

1) A U.S. EPA approved SIP control strategy that includes Reasonably Available Control Technology (RACT) requirements for existing stationary sources covered by Control Technology Guidelines (CTG) and non-CTG RACT for all major sources.

2) Evidence that control measures required in past SIP revisions have been fully implemented.

3) Acceptable provisions to provide for new source review.

4) Assurances that existing controls will remain in effect after redesignation, unless the State demonstrates through photochemical modeling that the standard can be maintained without one or more controls.

5) If appropriate, a commitment to adopt a requirement that all transportation plans conform with, and are consistent with, the SIP.

2.6 Corrective Actions for Potential Future Violations of the Fine Particles Standard

1) A commitment to submit a revised plan eight years after redesignation.

2) A commitment to expeditiously enact and implement additional contingency control measures in response to exceeding specified predetermined levels (triggers) or in the event that future violations of the ambient standard occur.

3) A list of potential contingency measures that would be implemented in such an event.

4) A list of NO_x, SO_2 and direct $PM_{2.5}$ sources potentially subject to future controls.

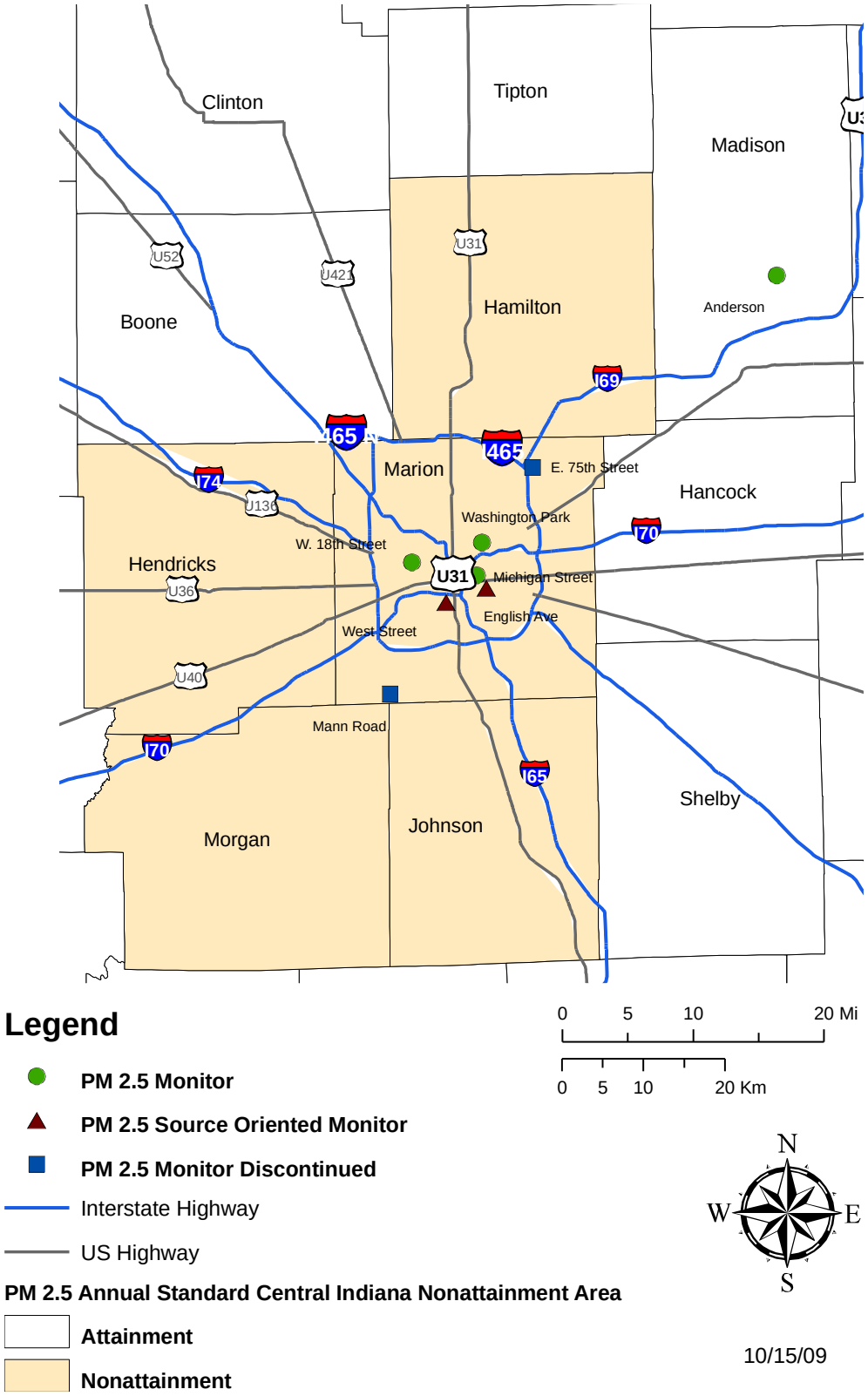
3.0 FINE PARTICLES MONITORING

3.1 Fine Particles Monitoring Network

There are currently four Federal Reference Method monitors measuring fine particles concentrations for the Central Indiana Area. Three of the monitors are located in Marion County at Washington Park, W. 18th Street and E. Michigan Street. The fourth monitor is located in Anderson in Madison County. The four monitors are operated by IDEM's Office of Air Quality (OAQ). A listing of the monitor readings from 2006 through 2008, are shown in Table 3.1 and Appendix A and were retrieved from U.S. EPA's Air Quality System (AQS) database. The locations of the monitoring sites for the Central Indiana Area are shown in Figure 3.1.

IDEM's OAQ also operates two monitors in the Central Indiana Area (West Street and English Avenue in Marion County) that are considered source oriented monitors. While these monitors are not used to determine attainment with the annual standard for fine particles, the monitoring locations are included as supporting material. Two monitors (Mann Road and E. 75th Street in Marion County) in the Central Indiana Area were discontinued at the end of 2007.

Figure 3.1
Central Indiana Nonattainment Area



3.2 Ambient Fine Particles Monitoring Data

The following information summarizes U.S. EPA's "Guideline on Data Handling Conventions for the fine particles NAAQS," U.S. EPA-454/R-99-008, April 1999. Three complete years of fine particles monitoring data are required to demonstrate attainment at a monitoring site. The annual ambient air quality standard for fine particles is met at an ambient air quality monitoring site when the three-year average of the annual average of fine particles concentrations (or the design value) is less than or equal to 15.0 $\mu g/m^3$. When this occurs, the site is said to be in attainment. While calculating design values, three significant digits must be carried in the computations, with final values rounded to the nearest 0.1 $\mu g/m^3$. Decimals 0.05 or greater are rounded up, and those less than 0.05 are rounded down, so that 15.049 $\mu g/m^3$ is the largest concentration that is less than or equal to 15.0 $\mu g/m^3$. Values at or below 15.0 $\mu g/m^3$meet the standard. Values equal to or greater than 15.1 $\mu g/m^3$ exceed the standard.

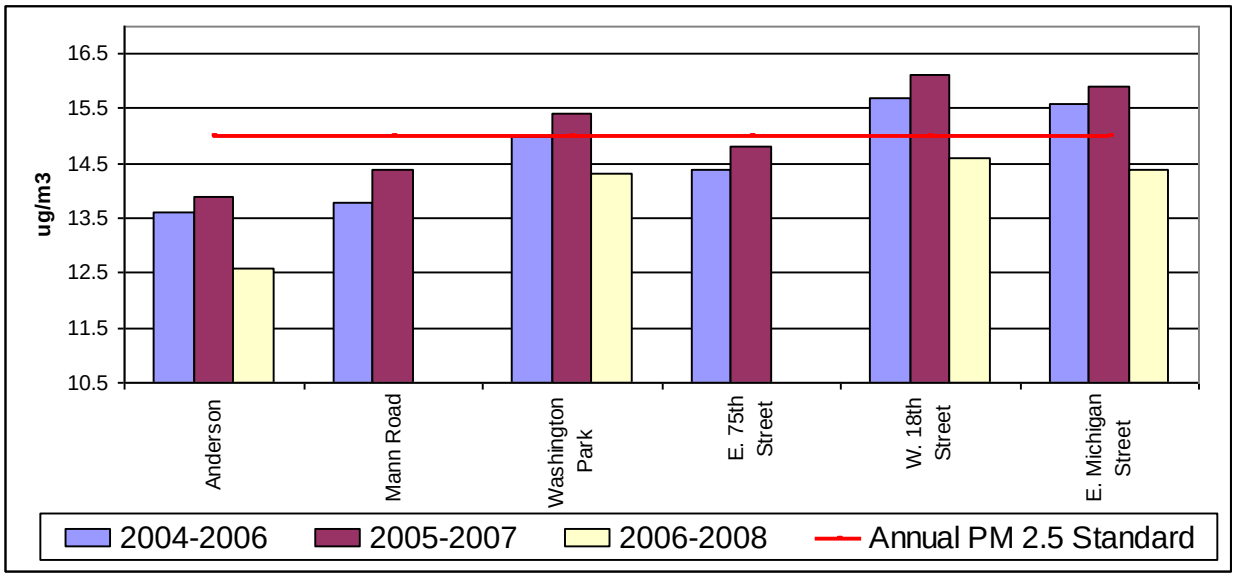
Data handling procedures are applied on an individual basis at each monitor in the area. An individual site's three-year average of the annual average fine particles concentration is also called the site's *design value*. An area is in compliance with the annual NAAQS for fine particles only if all monitoring sites meet the NAAQS. The air quality design value for the area is the highest design value among all sites in the area. Table 3.1 outlines the annual fine particles values by site and the 2006 through 2008 design values for the four active fine particles monitoring sites in the Central Indiana Area. Refer to Appendix A for the complete monitoring data summary from 2000 to 2008 for all of the Central Indiana monitors which includes the four active fine particles monitoring sites, the two source oriented monitoring sites and two discontinued monitoring sites in the Central Indiana Area.

Table 3.1
Monitoring Data for the Central Indiana Area
(Annual Average and 2006-2008 Design Values)

SITE ID	COUNTY	SITE NAME	YEAR	Annual Average $\mu g/m^3$	2006-2008 Average $\mu g/m^3$
18-095-0009	Madison	Anderson	2006	12.06	
18-095-0009	Madison	Anderson	2007	13.57	
18-095-0009	Madison	Anderson	2008	12.13	**12.6**
18-097-0078	Marion	Washington Park	2006	14.14	
18-097-0078	Marion	Washington Park	2007	15.66	
18-097-0078	Marion	Washington Park	2008	13.02	**14.3**
18-097-0081	Marion	W 18th Street	2006	14.12	
18-097-0081	Marion	W 18th Street	2007	16.07	
18-097-0081	Marion	W 18th Street	2008	13.75	**14.6**
18-097-0083	Marion	E. Michigan Street	2006	14.15	
18-097-0083	Marion	E. Michigan Street	2007	15.93	
18-097-0083	Marion	E. Michigan Street	2008	13.17	**14.4**

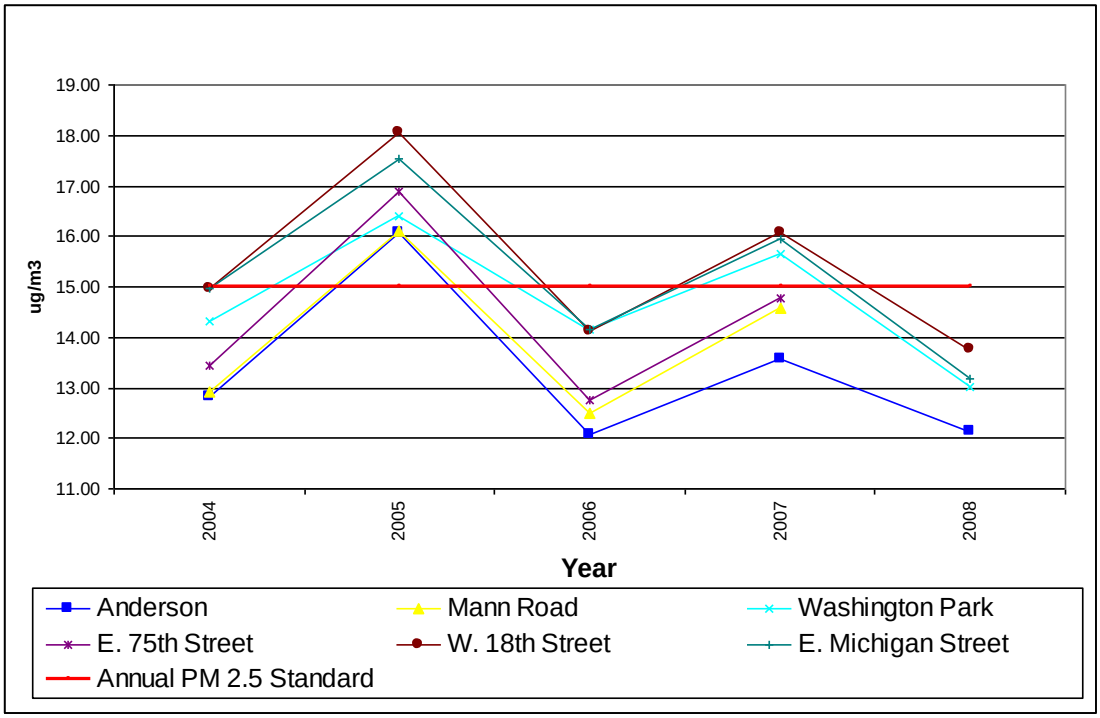
Graph 3.1 visually demonstrates the 2004 through 2008 design values for the Central Indiana nonattainment area.

Graph 3.1
Design Values for the Central Indiana Area for Fine Particles, 2004 through 2008



Note: The Mann Road and E. 75th Street monitors were discontinued December 31, 2007

Graph 3.2
Central Indiana Annual Fine Particles Trends, 2004 through 2008



Note: The Mann Road and E. 75th Street monitors were discontinued December 31, 2007

The design values for the Central Indiana Area demonstrate that the annual NAAQS for fine

particles has been attained.

Graph 3.1 shows the trend in design values for the region, while Graph 3.2 shows the trend for annual fine particles. A comprehensive list of the four fine particles monitoring sites' design values over this period is outlined in Appendix A. The area's design values have recently trended downward, as emissions have declined due to programs such as the Acid Rain program and cleaner automobiles and fuels both regionally and locally. U.S. EPA's rule to control nitrogen oxides from specific source categories (40 CFR Parts 51, 72, 75 and 96, published on October 17, 1998 and referred to as the "NO_x SIP Call") has significantly reduced emissions from large electric generating units (EGUs), industrial boilers, and cement kilns. Indiana's NO_x SIP Call Rule was adopted into the Indiana Administrative Code on June 6, 2001 at 326 IAC 10-3 and 326 ICA 10-4. The elevated particulate matter values for 2005 are considered an abnormal occurrence. An analysis of meteorological conditions and monitoring values is included in Section 7.0 and supports the conclusion that attainment of the standard as of 2008 is not the result of unusually favorable meteorological conditions. It is expected that this downward trend will continue as the above programs continue and the U.S. EPA Clean Air Interstate Rule and/or Replacement Rule is implemented.

3.3 Quality Assurance

IDEM has quality assured all data shown in Appendix A in accordance with 40 CFR 58.10 and the Indiana Quality Assurance Manual. IDEM has recorded the data in the AQS database and, thus, the data is available to the public.

3.4 Continued Monitoring

Indiana commits to continue monitoring concentrations of fine particles at the sites indicated in Table 3.1 and Appendix A. IDEM will consult with U.S. EPA Region V staff prior to making changes to the existing monitoring network through the annual network review should changes become necessary in the future. IDEM will continue to quality assure the monitoring data to meet the requirements of 40 CFR 58. IDEM will enter all data into AQS on a timely basis in accordance with federal guidelines.

4.0 EMISSION INVENTORY

U.S. EPA's Redesignation Guidance and Implementation Rule requires the submittal of a comprehensive inventory of precursor emissions for fine particles (SO_2, direct $PM_{2.5}$ and NO_x) representative of the year when the area achieves attainment of the annual NAAQS for fine particles (base year). Indiana is using 2006 as the base year. The 2006 data was grown from the 2005 emissions inventory which represents the most complete inventory available at this time. Indiana must also demonstrate that the improvement in air quality between the year that violations occurred and the year that attainment was achieved is based on permanent and enforceable emission reductions. Other requirements related to the emissions inventory include: a projection of the emission inventory to a year at least ten years following redesignation; a demonstration that the projected level of emissions is sufficient to maintain the annual standard

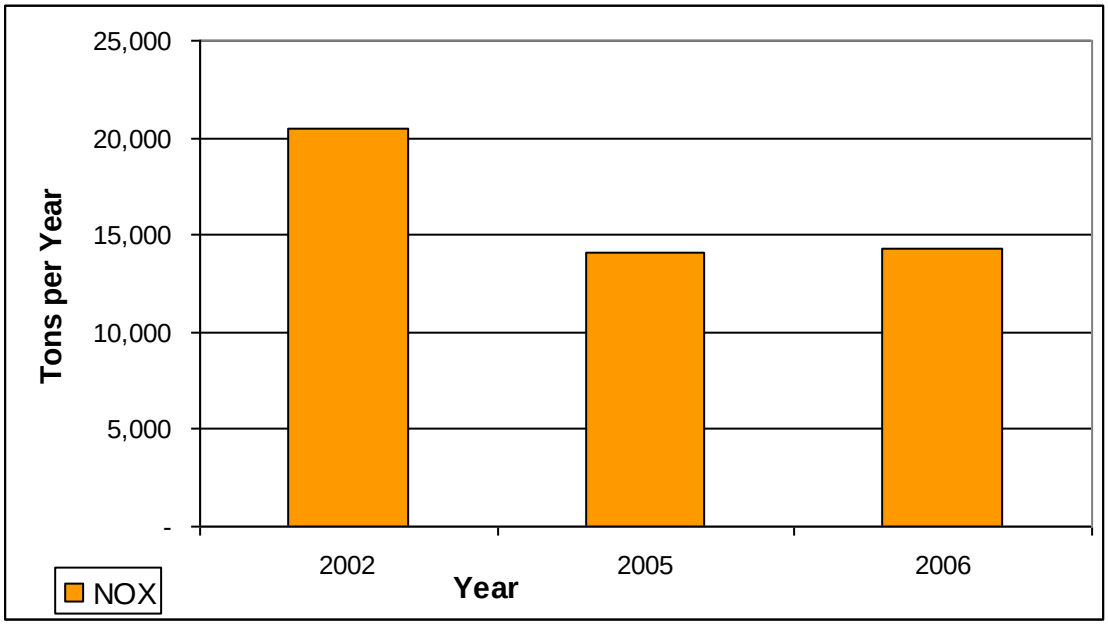
for fine particles; and, a commitment to provide future updates of the inventory to enable tracking of emission levels during the ten year maintenance period. Consistent with the federal implementation rule for fine particles, Indiana does not consider volatile organic compounds (VOCs) or ammonia to be significant contributors to fine particles. The following subsections address each of these requirements.

4.1 Emission Trends

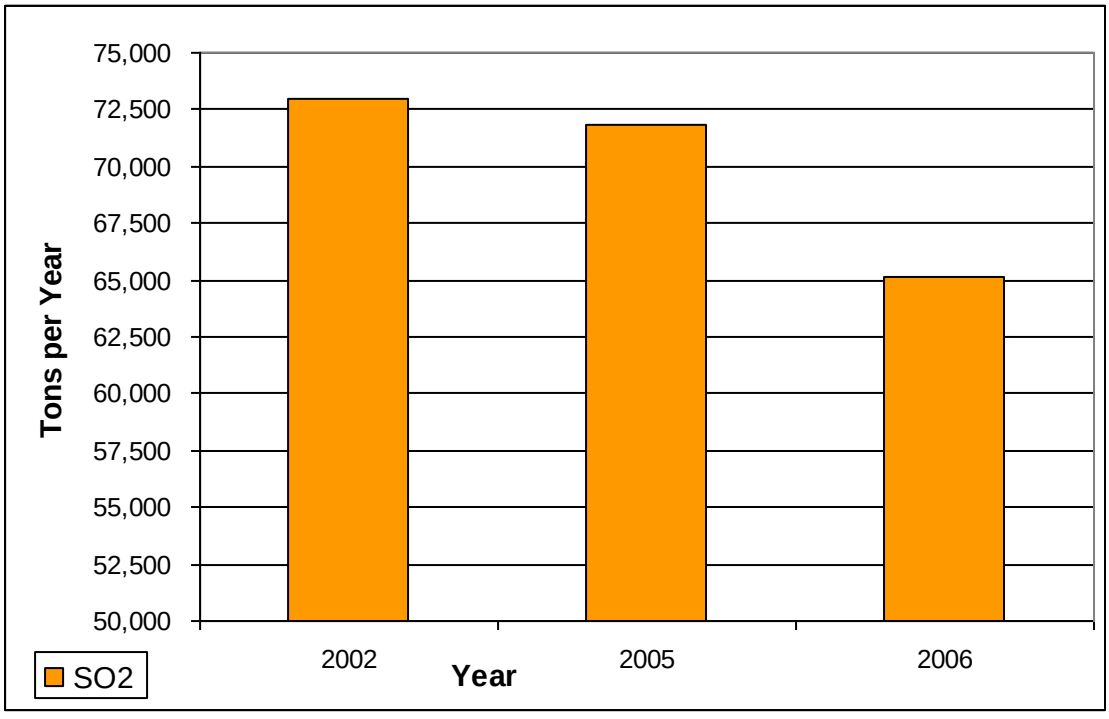
Point Sources

Graphs 4.1, 4.2 and 4.3 show the trend in point source emissions of NO_x, SO_2 and direct $PM_{2.5}$, respectively, that generally correspond to the years of monitored values used in this report. The point source data are taken from Indiana's annual emissions reporting program. The Central Indiana Area had a 29.84% reduction in NO_x point source emissions, and a 10.73% reduction in SO_2 point source emissions. The large decrease in SO_2 point source emissions from 2005 to 2006 is due to the shut down of the Citizens Gas and Coke plant in Indianapolis. An increase in direct $PM_{2.5}$ point source emissions is noted, but this increase in direct $PM_{2.5}$ emissions from 2002 to 2006 is due to previously unreported emissions from companies that did not submit their direct $PM_{2.5}$ emissions data in 2002 but did submit direct $PM_{2.5}$ data in the 2005 emissions inventory, from which the 2006 data is grown. Though a large increase in direct $PM_{2.5}$ point source emissions is depicted, the total anthropogenic direct $PM_{2.5}$ emissions have decreased by 44.34% within this period. See Graph 4.6 depicting the trend of $PM_{2.5}$ emissions from all anthropogenic sources. Regional NO_x emission reductions affect fine particles levels in the Central Indiana Area far more than NO_x emission reductions within the area itself. As Graph 4.7 illustrates, Central Indiana NO_x emissions from EGUs have decreased substantially during this time period as well. Graphs and data tables of emissions from each source category are available in Appendix C.

Graph 4.1
Central Indiana Area NO_x Point Source Emission Trends, 2002, 2005 and 2006

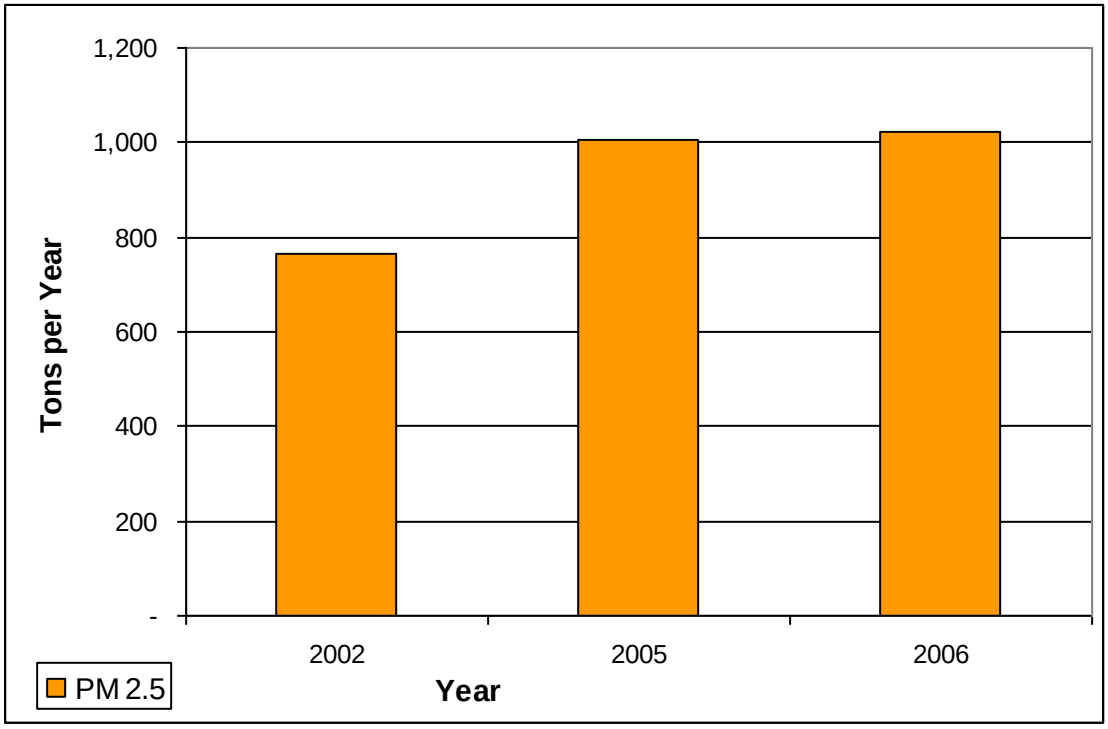


Graph 4.2
Central Indiana Area SO_2 Point Source Emission Trends, 2002, 2005 and 2006



Graph 4.3

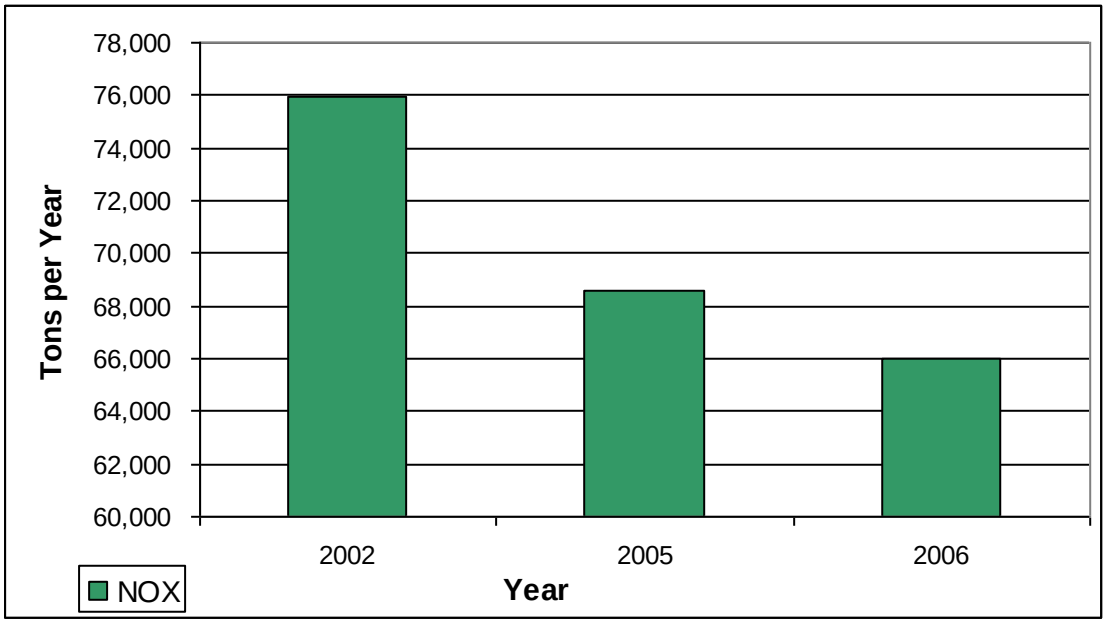
Central Indiana Area Direct $PM_{2.5}$ Point Source Emission Trends, 2002, 2005 and 2006



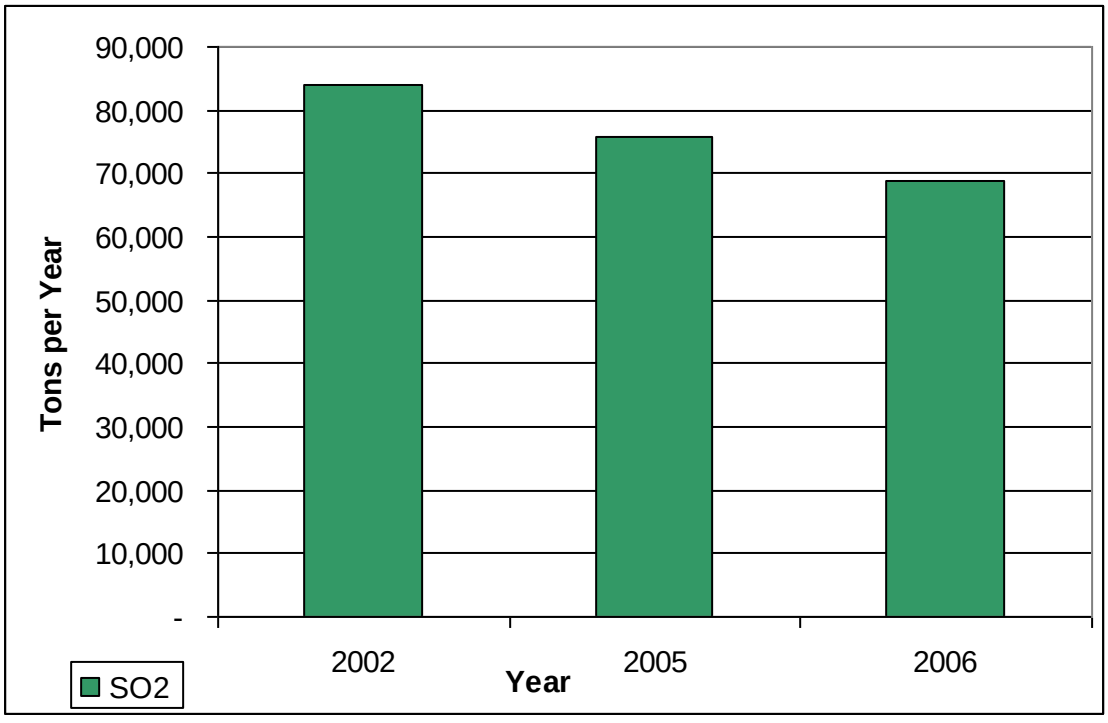
All Anthropogenic Sources

Periodic inventories, which include emissions from all sectors (mobile, area, nonroad and point source), were prepared for 2002 and 2005. The 2006 data was grown from the 2005 emission inventory. Graphs 4.4, 4.5 and 4.6 show the trends for the total emissions for all anthropogenic source categories in these years, for NO_x, SO_2 and direct $PM_{2.5}$, which also roughly follow the years of monitored trends discussed in Section 3.0. There is a downward trend in NO_x, SO_2 and direct $PM_{2.5}$ emissions from 2002 to 2005 and 2006. The decrease in NO_x can be largely attributed to those EGUs located within and surrounding the Central Indiana Area that have reduced their NO_x emissions as a result of the NO_x SIP Call. Graphs and data tables of emissions from each source category are available in Appendix C.

Graph 4.4
NO_x Emission Trends, All Sources in the Central Indiana Area, 2002, 2005 and 2006

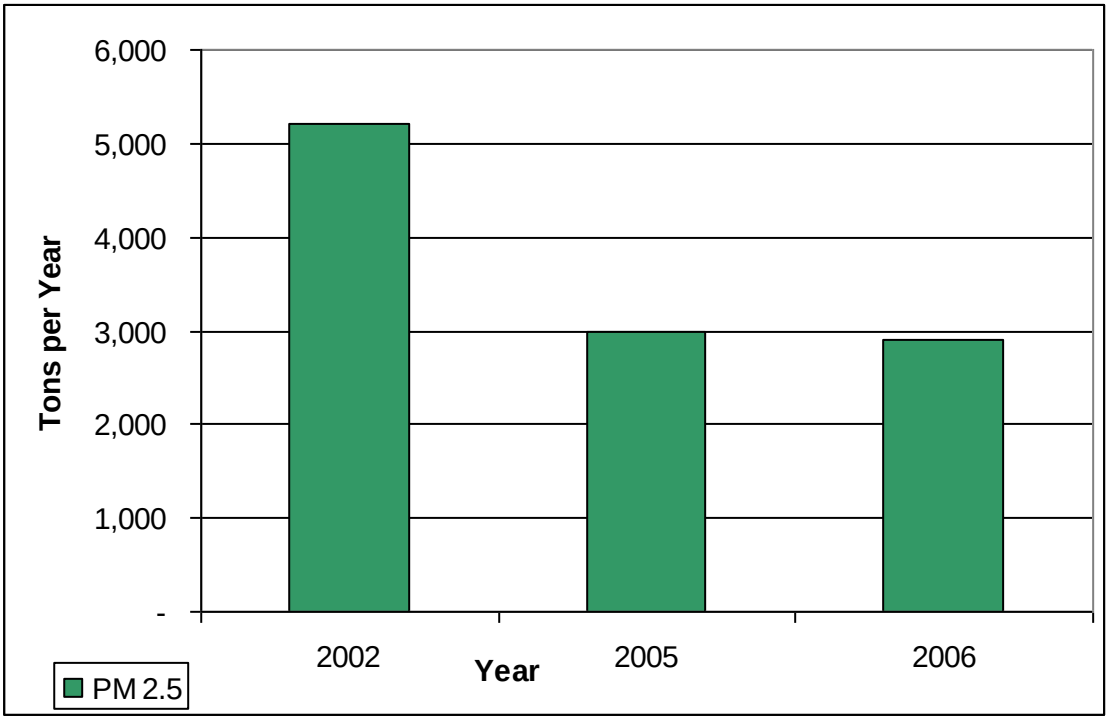


Graph 4.5
SO_2 Emission Trends, All Sources in the Central Indiana Area, 2002, 2005 and 2006



Graph 4.6

Direct $PM_{2.5}$ Emission Trends, All Sources in Central Indiana Area, 2002,2005 and 2006



EGU Sources

Graphs 4.7 and 4.8 depict the trends in NO_x and SO_2 emissions from Central Indiana EGUs for the years 1999 to 2008. There are four EGUs located in Central Indiana: Indiana Municipal Power Plant-Anderson (Madison County), Cinergy-Noblesville (Hamilton County), Indianapolis Power and Light-Harding Street (Marion County) and Indianapolis Power and Light-Eagle Valley (Morgan County). Both NO_x and SO_2 emissions are decreasing substantially in response to national programs affecting all EGUs such as the Acid Rain program and the NO_x SIP Call. Other sectors of the inventory also impact the formation of fine particles, but large regional sources such as EGUs have a substantial impact on the formation of fine particles.

These data were taken from U.S. EPA's Clean Air Markets database[1]. Data are available sooner for these units than other point sources in the inventory because of the NO_x SIP Call budget and trading requirements. Information from 2003 is significant because some EGUs started operation of their NO_x SIP Call controls in order to generate Early Reduction Credits for their future year NO_x budgets. The first season of the NO_x SIP Call budget period began May 31, 2004.

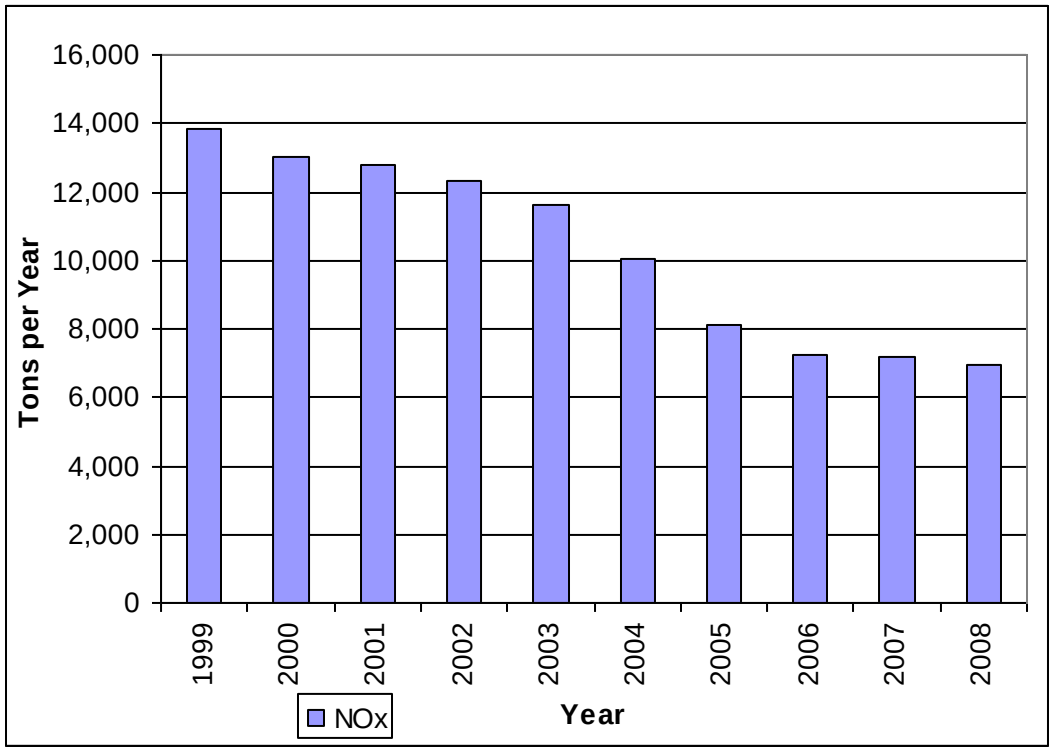
As part of the NO_x SIP Call, the states were required to adopt into their rules a budget for all large EGUs. Indiana's budget is referenced in 326 IAC 10-4. The budget represents a statewide cap on NO_x emissions. Although each unit is allocated emissions based upon historic heat input, utilities can meet this budget by over-controlling certain units or purchasing credits from the

[1] http://www.epa.gov/airmarkets

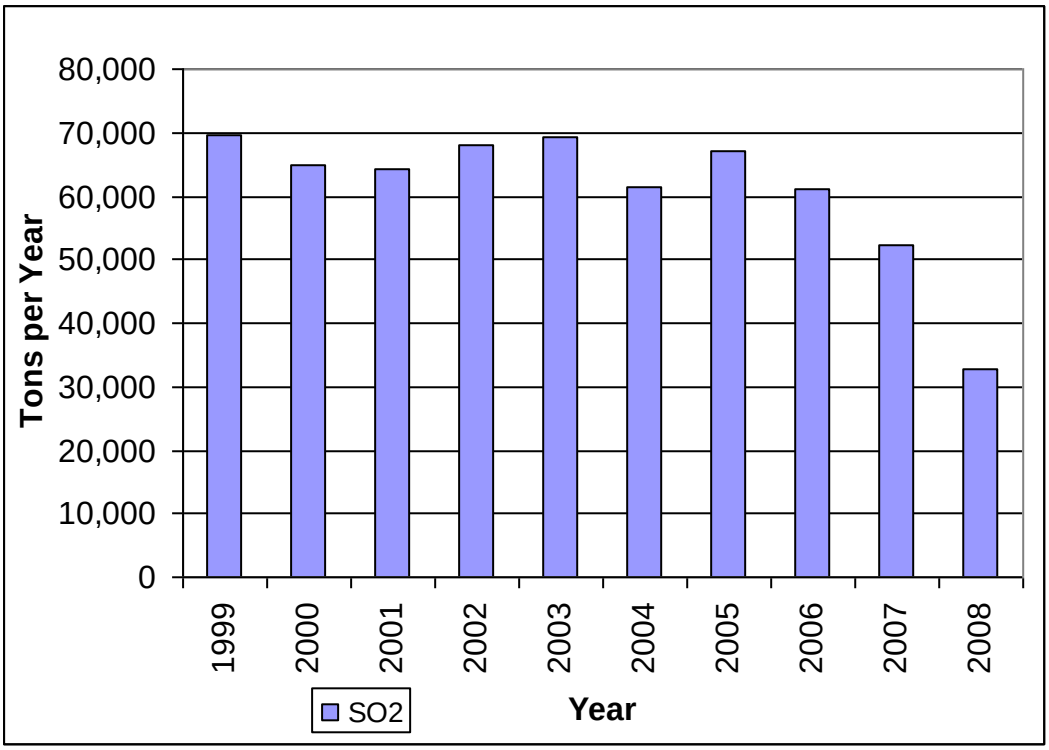
market to account for overages at other units. To summarize, NO_x emissions have dramatically decreased over the years represented on these graphs.

These emissions, capped by the state rule, are expected to remain near these levels throughout the maintenance period covered by this request. The state cap for the NOx SIP Call remained in place through 2008, at which time the Clean Air Interstate Rule (CAIR) program superseded it. CAIR, issued in March 2005, adopted by the Indiana Air Pollution Control Board on November 1, 2006 and to be implemented by 2010, will reduce regional EGU NOx emissions statewide by approximately another 17% by 2015. The D.C. Circuit court's vacatur of CAIR in July of 2008 and subsequent remand without vacatur of CAIR in December of 2008 directs U.S. EPA to revise the CAIR rule in the future. The future version of CAIR (Replacement Rule) will result in similar or greater emission reductions than assumed within the emission inventories and modeling (based on what the rule would address in response to the court's opinion).

Graph 4.7
NO_x Emissions from Electric Generating Units, Central Indiana Area, 1999 to 2008

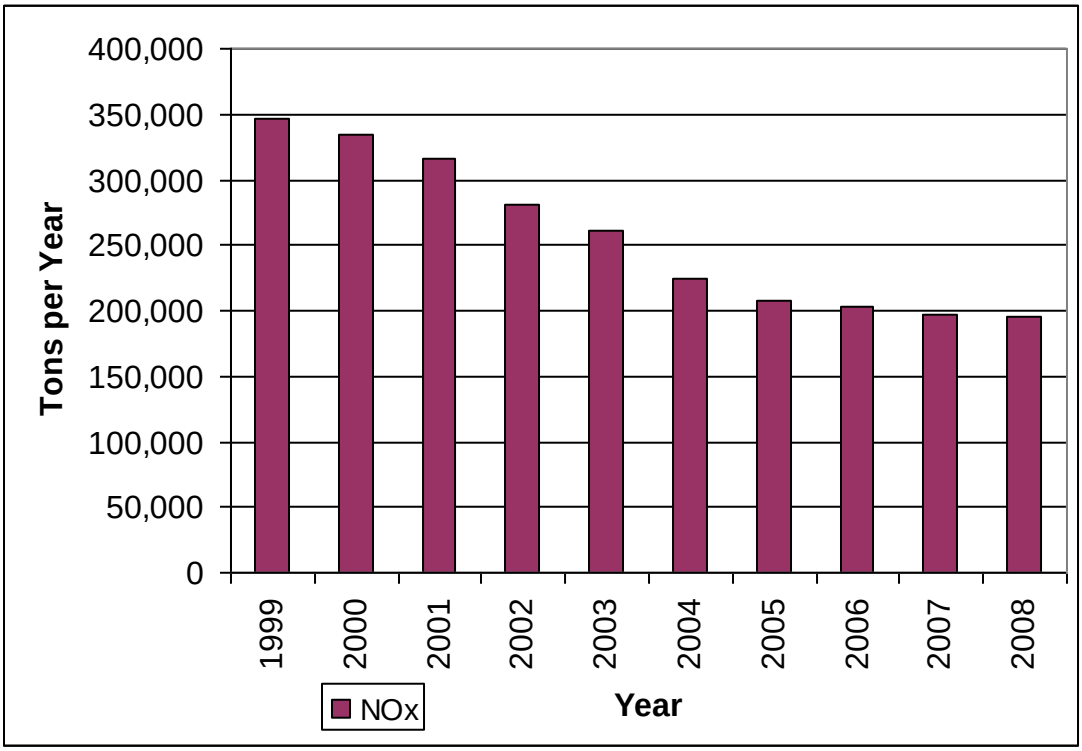


Graph 4.8
SO_2 Emissions from Electric Generating Units, Central Indiana Area, 1999 to 2008

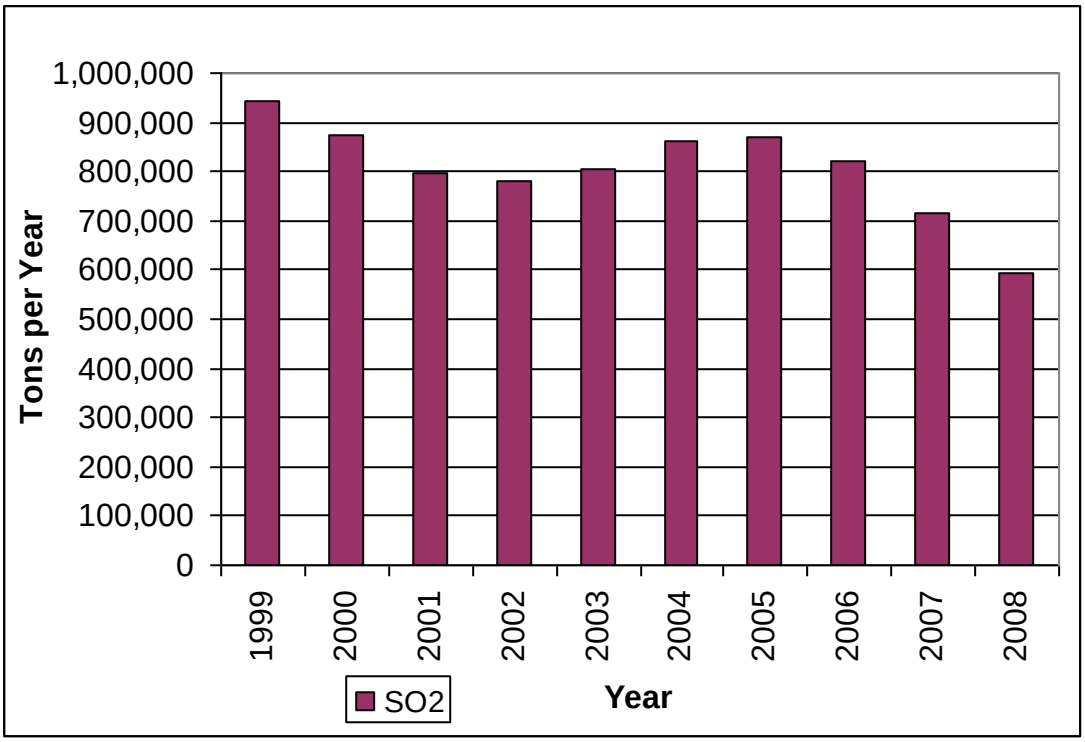


Although there are minor fluctuations in the SO_2 emissions over time, as shown in Graph 4.8 and 4.10, there are moderate reductions to date. Indiana does expect to see significant reductions in SO_2 emissions from CAIR and BART (Best Available Retrofit Technology), once implemented. Additional NOx control technologies have been installed on various emission units at the Indianapolis Power & Light Company (IPL)-Harding Street Generating Station located in Marion County and the IPL-Eagle Valley Generating Station, located in Morgan County, since the 2001-2003 monitoring period. These control technologies include Selective Non-Catalytic Reduction, Selective Catalytic Reduction, Neural Net Controls, Low NOx Burners, and Separated Overfire Air. The SO_2 data from 2008 reflects the installation of a flue gas desulphurization system at the IPL-Harding Street Generating Station that became operational in 2007. As IPL indicates, many control technologies have been installed voluntarily and are not required to be operated. Most of the major sources within the area are subject to the NO_x SIP Call, CAIR or RACT requirements. Appendix B shows detailed emissions for the point source emissions, and Appendix D shows detailed emissions for the EGUs.

Graph 4.9
Indiana Statewide NO_x Emissions from Electric Generating Units, 1999 to 2008



Graph 4.10
Indiana Statewide SO_2 Emissions from Electric Generating Units, 1999 to 2008



4.2 Base Year Inventory

IDEM prepared a comprehensive inventory for the Central Indiana Area, including area, mobile, nonroad and point sources for direct $PM_{2.5}$ and precursors of fine particles (NO_x and SO_2) for 2005 (the year with the most complete emissions inventory available at this time). The 2006 data was grown from the 2005 emission inventory to represent a base year for maintenance purposes. The 2007 implementation rule for the annual fine particles standard states that NO_x, SO_2 and direct $PM_{2.5}$ are the regulated precursors of fine particles. VOCs are not required to be addressed unless the State or EPA makes a technical demonstration that emissions of VOCs from sources in the State significantly contribute to $PM_{2.5}$ concentrations in a given nonattainment area. U.S. EPA and Indiana do not recognize VOCs as a significant contributor to fine particles formation in the State of Indiana. Indiana's 2006 base year inventory was determined by the following:

- Area sources were grown from the Indiana 2002 periodic inventory submitted to U.S. EPA.
- Mobile source emissions were calculated from MOBILE6 produced emission factors and data extracted from the region's travel-demand model. These emissions were then interpolated as needed to determine 2006 base year values.
- Point source information was compiled from IDEM's annual emissions statement database.
- Biogenic emissions are not included in these summaries.
- Nonroad emissions were grown from the 2002 National Emissions Inventory (NEI). To address concerns about the accuracy of some of the categories in U.S. EPA's nonroad emissions model, the Lake Michigan Air Directors' Consortium (LADCO) (Midwest Regional Planning Organization), contracted with two companies to review the base data and make recommendations. One of the contractors also estimated emissions for two nonroad categories not included in U.S. EPA's nonroad model. Emissions were estimated for commercial marine vessels and railroads. Recreational motorboat population and spatial surrogates (used to assign emissions to each) were significantly updated. The populations for the construction equipment category were reviewed and updated based upon surveys completed in the Midwest and the temporal allocation for agricultural sources was also updated. A new nonroad estimation model was provided by U.S. EPA for the 2002 analysis.

Appendix C contains data tables and graphs of all these emissions.

4.3 Emission Projections

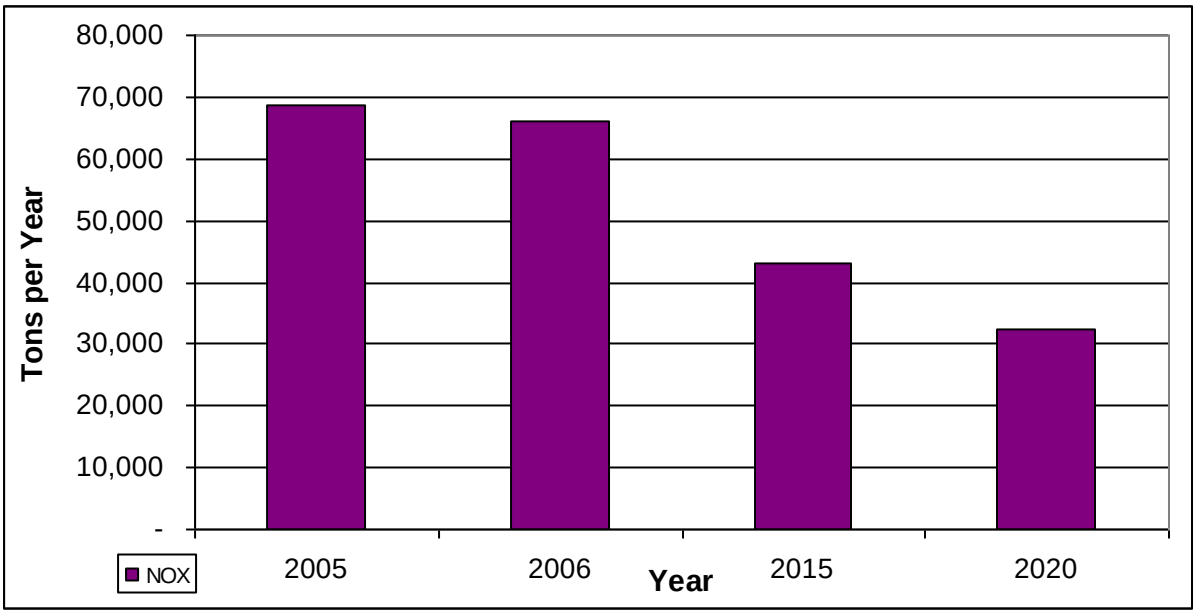
In consultation with the U.S. EPA and other stakeholders, IDEM selected the year 2020 as the maintenance year for this redesignation request. This document contains projected emission inventories for 2015 and 2020[2] for the Central Indiana Area. These emission projections were prepared by IDEM, with assistance from LADCO and the Indianapolis Metropolitan Planning Organization. The detailed inventory information for the Central Indiana Area for 2015 and

[2] EGU emission projections for the year 2020 are based on 2018 emission estimates.

2020 is in Appendix E. Emission trends are an important gauge for continued compliance with the annual standard for fine particles. Therefore, IDEM performed an initial comparison of the inventories for the base year (2006-grown from the 2005 emission inventory), interim year (2015), and maintenance year (2020) inventories for the Central Indiana Area, which are summarized below.

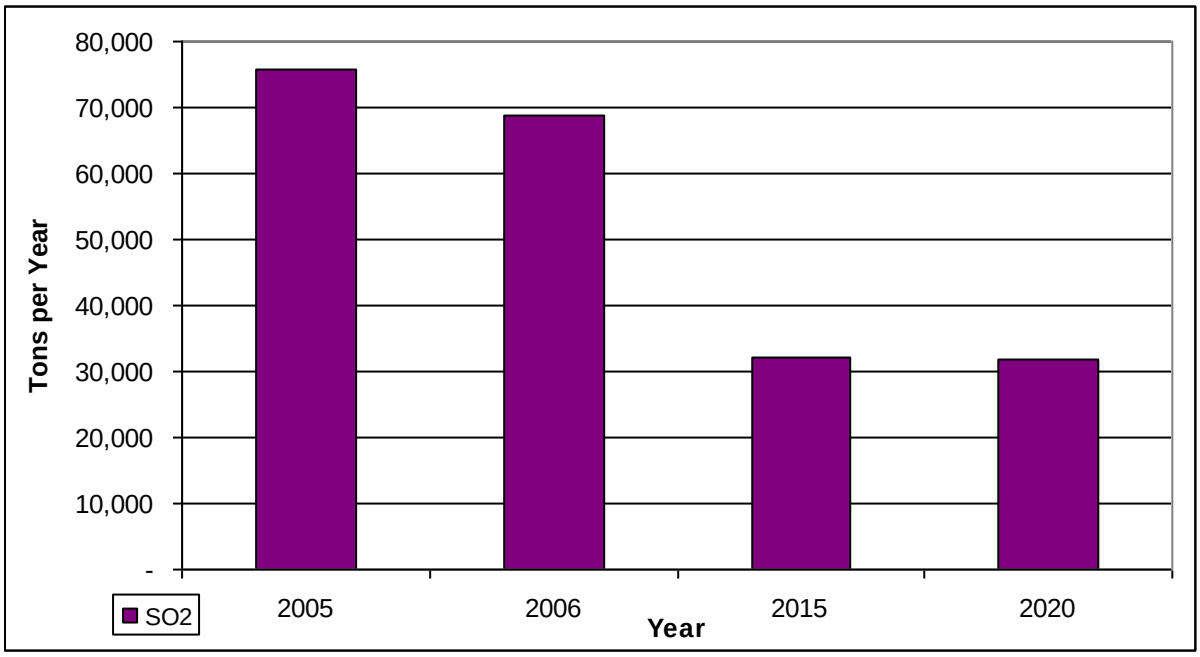
Graphs 4.11, 4.12 and 4.13 visually compare 2006 (base year-grown from the 2005 emission inventory) NO_x, SO_2 and direct $PM_{2.5}$ estimated emissions with the 2015 and 2020[3] projected emissions for the Central Indiana Area. Mobile source emission inventories are further described in Section 5.0. In addition to LADCO's estimates, point source emissions were projected based upon the statewide EGU NO_x budgets from the Indiana NO_x rule. It should be noted that EGU emission estimates for 2015 and 2020 (i.e. 2018) were projected utilizing the Department of Energy Information's Annual Energy Outlook Supplemental tables. These tables were generated for the reference case of the Annual Energy Outlook 2007 (AEO 2007) using the National Energy Modeling System.

Graph 4.11
Comparison of 2005 and 2006 Estimated and 2015 and 2020[3] Projected NO_x Emissions for the Central Indiana Area

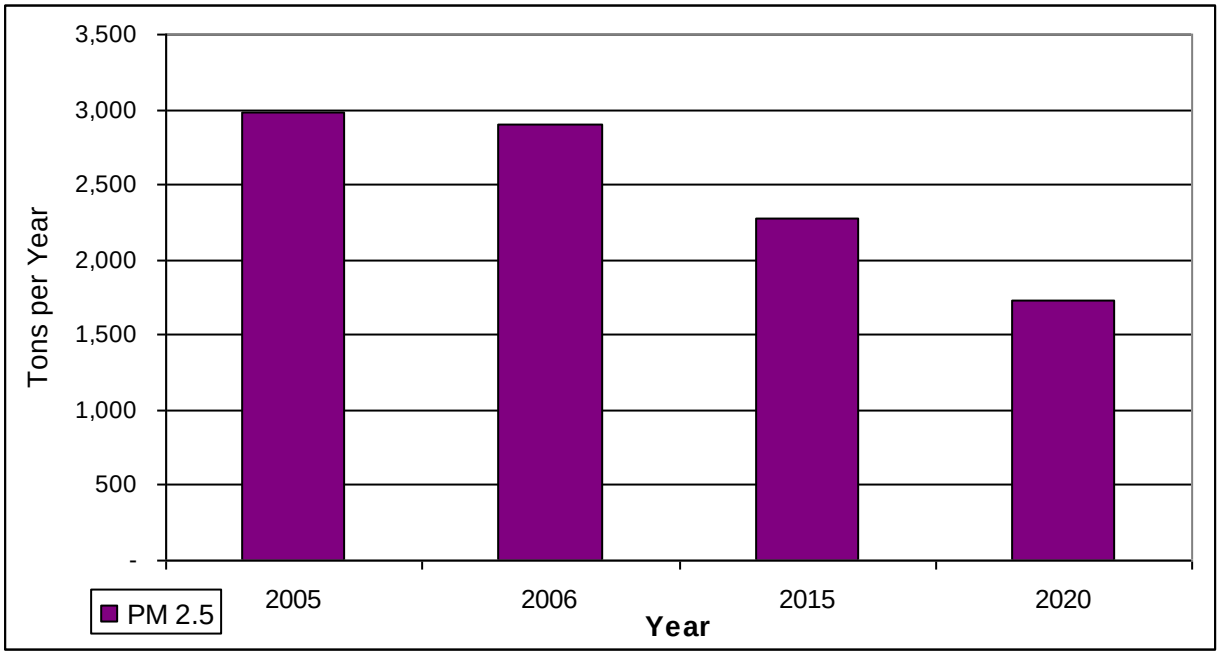


[3] EGU emission projections for the year 2020 are based on 2018 emission estimates.

Graph 4.12
Comparison of 2005 and 2006 Estimated and 2015 and 2020[4] Projected SO_2 Emissions for the Central Indiana Area



Graph 4.13
Comparison of 2005 and 2006 Estimated and 2015 and 2020[4] Projected Direct $PM_{2.5}$ Emissions for the Central Indiana Area



Graph 4.14

[4] EGU emission projections for the year 2020 are based on 2018 emission estimates.

Comparison of 2005 Estimated and 2015 and 2020[5] Projected SO_2, NO_x and Direct $PM_{2.5}$ Emission Trends for the Central Indiana Area

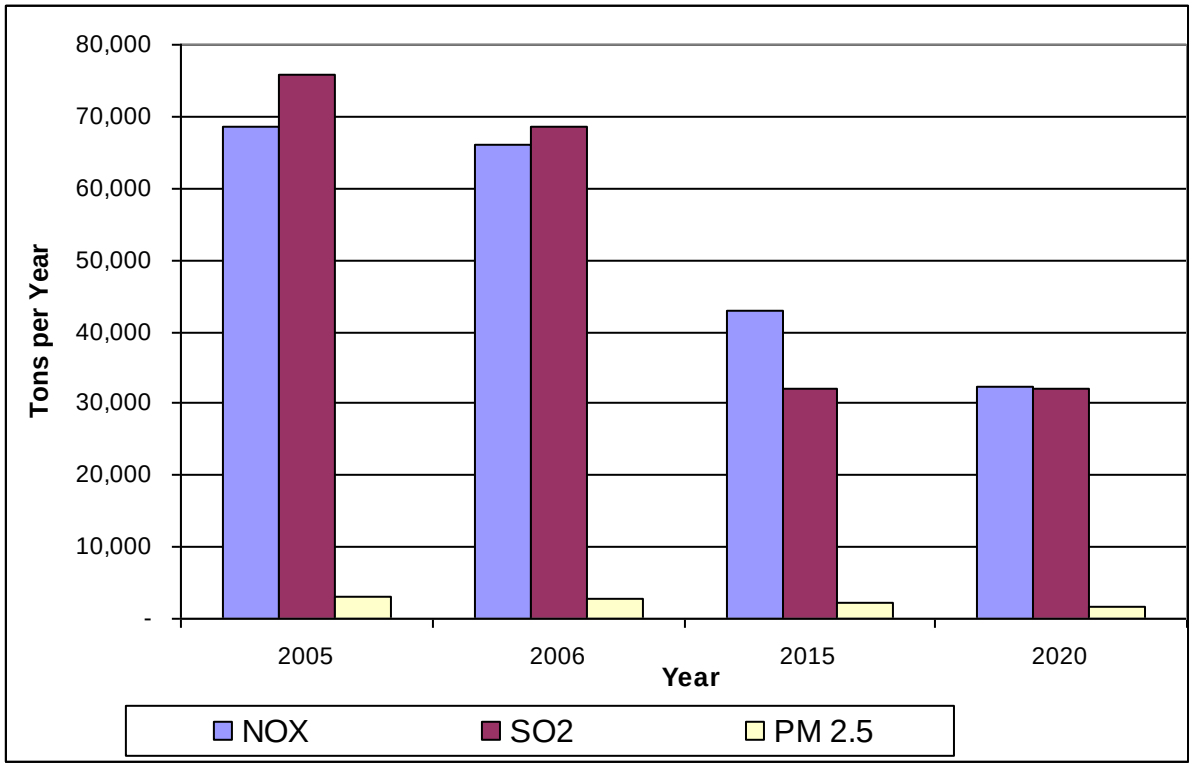


Table 4.1
Comparison of 2006 Estimated and 2020[5] Projected Emission Estimates Central Indiana Area (Annual-Tons)

	2006	2020	Change	% Change
NO_x	66,032.06	32,340.01	-33,692.05	51.02% decrease
SO_2	68,690.10	31,962.83	-36,727.27	53.46% decrease
Direct $PM_{2.5}$	2,903.64	1,736.16	-1,167.48	40.20% decrease

NO_x emissions within the Central Indiana Area are projected to decline by 51.02% between 2006 and 2020[5]. Emission reduction benefits from U.S. EPA rules covering the NO_x SIP Call, Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements, Heavy-Duty Highway Engine Rule, and Nonroad Diesel Engine Rule are factored into the changes. Further, due to implementation of the NO_x SIP Call across the eastern United States, NO_x and fine particles levels entering Central Indiana Area will also be decreased. Since CAIR is a regional cap and trade program, it cannot be predicted at this time what effect this will have on EGU units located in the Central Indiana Area or other upwind counties. Therefore, potential reductions are **not** included in Graph 4.14 or Table 4.1. SO_2 emissions within the Central Indiana Area are

[5] EGU emission projections for the year 2020 are based on 2018 emission estimates.

projected to decline by 53.46% between 2006 and 2020[6]. Direct $PM_{2.5}$ emissions from 2006 to 2020[6] are projected to decline by 40.20% within the Central Indiana Area, see Table 4.1.

4.4 Demonstration of Maintenance

Ambient air quality data from all the monitoring sites indicate that air quality in the Central Indiana Area met the annual standard for fine particles for the three-year period ending in 2008. U.S. EPA's Redesignation Guidance (Page 9) states, "A state may generally demonstrate maintenance of the NAAQS by either showing that future emissions of a pollutant or its precursors will not exceed the level of the attainment inventory, or by modeling to show that the future mix of sources and emissions rates will not cause a violation of the NAAQS**."** Emissions projections outlined in Section 4.0 of this document clearly illustrate that regional NO_x, SO_2 and direct $PM_{2.5}$ emissions will continue to decline leading to local reductions between 2006 (base year-grown from the 2005 emission inventory) and 2020[6] (maintenance plan horizon). Section 7.0 further discusses the implications of these emission trends and provides an analysis to support these conclusions. Therefore, air quality should meet the annual NAAQS for fine particles through the projected years of 2015 and 2020.

In Indiana, major point sources in all counties are required to submit air emissions information once every three years, or annually, if the SO_2 or NO_x potential to emit is greater than 2**,**500 tons per year in accordance with the Emission Reporting Rule, 326 IAC 2-6. IDEM prepares a new periodic inventory for all precursor emission sectors every three years. These precursor emission inventories will be prepared for 2008, 2011, 2014 and 2017, as necessary, to comply with the inventory reporting requirements established in the CAA. Emissions information will be compared to the 2006 base year and the 2020[6] projected maintenance year inventories to assess emission trends, as necessary, to assure continued compliance with the annual standard for fine particles.

4.5 Permanent and Enforceable Emission Reductions

Permanent and enforceable reductions of SO_2, direct $PM_{2.5}$ and NO_x have contributed to the attainment of the annual standard for fine particles. Some of these reductions were due to the implementation of the NO_x SIP Call, and some were due to the application of tighter federal standards on motor vehicles and fuels.

Section 6.0 identifies the emission control measures specific to the Central Indiana Area, as well as the implementation status of each measure.

4.6 Provisions for Future Updates

[6] EGU emission projections for the year 2020 are based on 2018 emission estimates.

As required by Section 175A(b) of the CAA, Indiana commits to submit to the Administrator, eight years after redesignation, an additional revision of this SIP. The revision will contain Indiana's plan for maintaining the national primary fine particles air quality standard for ten years beyond the first ten-year period after redesignation.

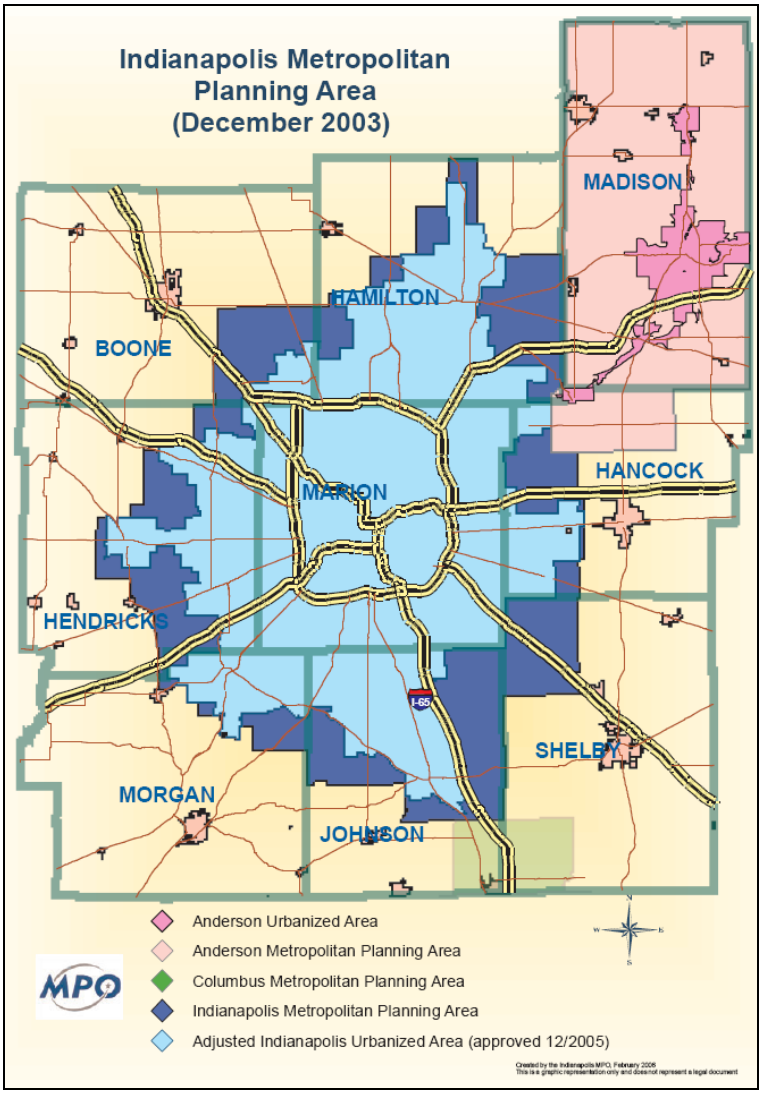
5.0 TRANSPORTATION CONFORMITY BUDGETS

5.1 On-Road Emissions Estimates

The Indianapolis Department of Metropolitan Development (DMD), the Madison County Council of Governments (MCCOG) and the Columbus Area Metropolitan Planning Organization are the Metropolitan Planning Organizations (MPOs), whose planning areas intersect the five county Central Indiana Area. In addition, significant portions of the nonattainment area are not under the jurisdiction of any MPO. These planning areas and the current $PM_{2.5}$ nonattainment area are illustrated in Figure 5.1.

An interagency consultation group consisting of representatives from the three MPOs, the Indiana Department of Transportation, IDEM, the Federal Highway Administration and local transit and environmental quality providers jointly determines regional significance. Primary responsibility for modeling emissions falls under the purview of DMD, which runs the MOBILE6 model to arrive at emission rates, and its regional travel model to develop estimates of vehicle miles traveled (VMT) for all areas, except for the MCCOG planning area, which administers its own travel model. DMD then compiles all results into a regional emissions analysis, which all MPOs then adopt following a public involvement period.

Figure 5.1
Central Indiana MPO Jurisdictions



These models simulate the traffic in the area and are used to predict what the traffic would be like in future years given growth expectations. The models are used mostly to identify where travel capacity will be needed and to determine the infrastructure requirements necessary to meet that need. They are also used to support the calculation of mobile source emissions. The travel demand forecast model is used to predict the total daily VMT and the U.S. EPA software program, MOBILE6, is used to calculate the emissions per mile. The product of these two outputs, once combined, is the estimated total amount of pollution emitted by the on-road vehicles for the area analyzed.

5.2 Overview

Broadly described, MOBILE6 is used to determine "emission factors", which are the average emissions per mile (grams/mile) for $PM_{2.5}$ and $PM_{2.5}$ precursors, including NO_x and SO_2. There are numerous variables that can affect the emission factors. The vehicle-fleet (vehicles on the road) age and the vehicle types have a major effect on the emission factors. The facility-type on which the vehicles are traveling (MOBILE6 facility-types are Freeway, Arterial, Local and Ramp) and the vehicle speeds also affect the emission factor values. Meteorological factors such as air temperature and humidity affect the emission factors. These data are estimated using the *best available data* to create emission factors for $PM_{2.5}$ precursors including NO_x and SO_2. After emission factors are determined, they must be multiplied by the VMT to determine the quantity of vehicle-related emissions. This information derives from the travel demand model.

It should be noted that each year analyzed will have different emission factors, volumes, speeds and likely some additional modeling done. MOBILE6 input and output files can be found in Appendix F.

5.3 Analysis Years

The travel demand model contains road networks that are time specific. The Central Indiana MPOs have modeled the years 2002, 2010 and 2020. Information, including emissions, has been interpolated from 2002 and 2010 for the year 2006. This Redesignation Petition provides emission inventory estimates for 2006, 2010, 2015 and 2020 to meet the requirements specified by the CAA and U.S. EPA. The emissions estimates outlined in Section 4.0 of this document reference the mobile source emissions data contained in Table 5.1.

5.4 Emission Estimates

Table 5.1 outlines onroad emissions estimates for the entire nonattainment area for the years 2006, 2010 and 2020.

Table 5.1 - Emission Estimates for On-Road Mobile Sources

	2006	**2010**	**2020**
VMT (miles/day)	48,394,097.00	49,885,362.00	57,422,782.00
$PM_{2.5}$ (tons/year)	416.63	351.75	228.75
NO_x (tons/year)	22,734.38	18,767.25	8,118.00

5.5 Motor Vehicle Emission Budget

Table 5.2 contains the motor vehicle emissions budgets for the entire nonattainment area for the years 2010 and 2020.

Table 5.2 – Motor Vehicle Emission Budgets in Tons Per Year

Year	2010	2020
$PM_{2.5}$	369.34	251.63
NO_x	19,705.61	8,929.80

Consistent with the federal implementation rule for fine particles, Indiana does not consider mobile source SO_2 to be a significant contributor to fine particles for this nonattainment area, as mobile source SO_2 constitutes less than 1.2 % of the area's total anthropogenic emissions.

These budgets include the emissions estimates calculated for 2010 and 2020. The emission estimates are derived from the MPO's travel demand models and MOBILE6, as described above. Through the interagency consultation process, it was determined that an interim budget for the year 2010, in addition to the budget for the year 2020, would be appropriate. A reasonable margin of safety has been applied to the 2010 and 2020 budgets in the amount of 5% and 10% respectively. Margins of safety are used to accommodate the wide array of assumptions that are factored into the calculation process. Since assumptions change over time, it is necessary to have a margin of safety that will accommodate the impact of refined assumptions in the process. The resulting 2010 and 2020 budgets for total $PM_{2.5}$ and NO_x emissions remain well below the 2006 base year emissions referenced in Table 5.1.

All methodologies, latest planning assumptions and margins of safety were determined to be appropriate through the interagency consultation process.

6.0 CONTROL MEASURES AND REGULATIONS

This section provides specific information on the control measures that have been or will be implemented in the Central Indiana Area, including CAA requirements and additional state or local measures implemented beyond CAA requirements.

6.1 Reasonably Available Control Technology (RACT)

As required by Section 172 of the CAA, Indiana in the mid-1990s promulgated rules requiring RACT for emissions of VOCs. There were no specific rules required by the CAA, such as RACT for existing sources, beyond statewide rules. Statewide RACT rules have applied to all new sources locating in Indiana since that time. The Indiana rules are found in 326 IAC 8. The following is a listing of applicable rules:

326 IAC 8-1-6 BACT for Non-Specific Sources

326 IAC 8-2	Surface Coating Emission Limitations
326 IAC 8-3	Solvent Degreasing Operations
326 IAC 8-4	Petroleum Sources
326 IAC 8-5	Miscellaneous Operation
326 IAC 8-6	Organic Solvent Emission Limitations

Since the Central Indiana Area attained the annual standard for fine particles prior to an Attainment SIP or RACT SIP being due, and since the implementation rule for fine particles stipulates that states are only required to draft and implement RACT rules for the precursor emission reductions necessary to attain the standard, no further RACT rules are required for this area. These Indiana rules are Clean Air Act requirements already in the State Implementation Plan and provide secondary benefits for $PM_{2.5}$.

6.2 Implementation of Past SIP Revisions

The area was only recently designated nonattainment for the annual standard for fine particles and the area has now attained the standard well in advance of its attainment deadline of 2010. As a result, Indiana is no longer required to develop and submit an Attainment SIP or RACT SIP for this area under the annual NAAQS for fine particles.

6.3 Nitrogen Oxides (NO_x) Rule

The U.S. EPA NO_x SIP Call required twenty-two states to adopt rules that would result in significant emission reductions from large EGUs, industrial boilers and cement kilns in the eastern United States. Indiana adopted this rule in 2001. Beginning in 2004, this rule accounts for a reduction of approximately thirty-one percent (31%) of all NO_x emissions statewide compared to previous uncontrolled years.

Twenty-one other states have also adopted these rules. The result is that significant reductions have occurred regionally and within the Central Indiana Area because of the number of affected units within the region. From Graphs 4.7 and 4.9, it can be seen that emissions covered by this program have been trending downward since 1999. Table 6.1, compiled from data taken from the U.S. EPA Clean Air Markets Web site, quantifies the gradual NO_x reductions that have occurred in Indiana as a result of Title IV (Acid Rain) of the CAA and the NO_x SIP Call Rule. The NOx SIP Call cap will stay in place through 2008, at which time the caps in the CAIR program will supersede it. Since CAIR is a regional cap and trade program, it cannot be predicted at this time what effect this will have on EGU units located in the Central Indiana Area or other upwind counties.

Further, U.S. EPA published Phase II of the NO_x SIP Call that establishes a budget for large (emissions of greater than 1 ton per day) stationary internal combustion engines. In Indiana, the rule decreases emissions statewide from natural gas compressor stations by 4,263 tons during the ozone season. The Indiana Phase II NOx SIP Call Rule became effective February 26, 2006 and implementation began in 2007.

Table 6.1
Trends in EGU NO_x Emissions Statewide in Indiana

Year	NO_x Emissions (tons /year)
1999	347,216.5
2000	334,522.1
2001	315,419.7
2002	281,146.1
2003	260,980.0
2004	224,311.3
2005	207,981.6
2006	202,728.0
2007	196,553.1
2008	196,134.5
Budget 2009-2014	108,935
Budget 2015 and later	90,779

6.4 Measures Beyond Clean Air Act SIP Requirements

Reductions in fine particles precursor emissions have occurred, or are anticipated to occur, as a result of local and federal programs. These additional control measures include:

Tier 2 Vehicles Standards[7]

Federal Tier 2 motor vehicle standards require all passenger vehicles in a manufacturer's fleet, including light-duty trucks and sport utility vehicles (SUVs), to meet an average standard of 0.07 grams of NO_x per mile. Implementation began in 2004 and was completed in 2007. The Tier 2 standards also cover passenger vehicles over 8,500 pounds gross vehicle weight rating (larger pickup trucks and SUVs), which are not covered by the current Tier 1 standards. For these vehicles, the standards were phased in beginning in 2008, with full compliance in 2009. The new standards require vehicles to be 77% to 95% cleaner than those on the road prior to the program. The Tier 2 standards also reduced the sulfur content of gasoline to 30 ppm beginning in January 2006. Most gasoline sold in Indiana prior to January 2006 had a sulfur content of about 500 ppm. Sulfur occurs naturally in gasoline, but interferes with the operation of catalytic converters on vehicles resulting in higher NO_x emissions. Lower sulfur gasoline is necessary to achieve the Tier 2 vehicle emissions standards.

Heavy-Duty Gasoline and Diesel Highway Vehicle Standards[8]

New U.S. EPA standards designed to reduce NO_x and VOC emissions from heavy-duty gasoline and diesel highway vehicles took effect in 2004. A second phase of standards and testing procedures, that began in 2007, reduced particulate matter from heavy-duty highway engines and also reduced highway diesel fuel sulfur content to 15 ppm since the sulfur can damage emissions control devices. The total program is expected to achieve a 90% reduction in direct particulate matter emissions and a 95% reduction in NO_x emissions for these new engines using low sulfur diesel, compared to existing engines

[7] http://www.epa.gov/fedrgstr/EPA-AIR/2000/February/Day-10/a19a.htm
[8] http://www.epa.gov/fedrgstr/EPA-AIR/1997/October/Day-21/a27494.htm

using higher sulfur content diesel. There will also be SO_2 reductions from these rules. The U.S. EPA has not quantified the expected reductions.

Large Nonroad Diesel Engine Standards[9]

In May 2004, U.S. EPA promulgated new rules for large nonroad diesel engines, such as those used in construction, agricultural and industrial equipment, to be phased in between 2008 and 2014. The nonroad diesel rules also reduce the allowable sulfur in nonroad diesel fuel by over 99%. Nonroad diesel fuel currently averages approximately 3,400 parts per million (ppm) sulfur. This rule limits nonroad diesel sulfur content to 500 ppm in 2006 and 15 ppm in 2010. The combined engine and fuel rules will reduce NO_x and PM emissions from large nonroad diesel engines by over 90%, compared to current nonroad engines using higher sulfur content diesel.

Nonroad Spark-Ignition Engines and Recreational Engines Standards

This new standard, effective in July 2003, regulates NO_x, VOCs and carbon monoxide (CO) for groups of previously unregulated nonroad engines. The new standard applies to all new engines sold in the United States and imported after the standards went into effect. The standard applies to large spark-ignition engines (forklifts and airport ground service equipment), recreational vehicles (off-highway motorcycles and all-terrain vehicles) and recreational marine diesel engines. The regulation varies based upon the type of engine and vehicle.

The large spark-ignition engines contribute to ozone formation and ambient CO and PM levels in urban areas. Tier 1 of this standard was implemented in 2004 and Tier 2 started in 2007. Like the large spark-ignition engines, recreational vehicles contribute to ozone and fine particles formation and ambient CO and PM levels. For model year 2006 off-highway motorcycles and all-terrain vehicles, at least 50% of a manufacture's fleet was required to meet the new exhaust emissions standard and 100% of the fleet was required to meet the standards in 2007. Recreational marine diesel engines over 37 kilowatts are used in yachts, cruisers and other types of pleasure craft. Recreational marine engines contribute to ozone formation and PM levels, especially surrounding marinas.

When all of the nonroad spark-ignition engines and recreational engine standards are fully implemented, an overall 72% reduction in VOC, 80% reduction in NO_x and 56% reduction in CO emissions are expected by 2020.

Clean Air Interstate Rule (CAIR)

On May 12, 2005, the U.S. EPA promulgated the "Rule to Reduce Interstate Transport of Fine Particulate Matter and Ozone (Clean Air Interstate Rule); Revisions to Acid Rain Program; Revisions to the NO_x SIP Call"; Final Rule. This rule established the requirement for states to adopt rules limiting the emissions of NO_x and SO_2 and provided a model rule for the states to use in developing their rules to meet federal requirements. The purpose of CAIR is to reduce interstate transport of precursors to fine particles and ozone.

[9] http://www.epa.gov/fedrgstr/EPA-AIR/1998/October/Day-23/a24836.htm

CAIR applies to: (1) any stationary, fossil-fuel-fired boiler or stationary, fossil-fuel-fired combustion turbine, a generator with nameplate capacity of more than 25MWe [megawatt electrical] producing electricity for sale; and (2) for a unit that qualifies as a cogeneration unit during the 12-month period starting on the date that the unit first produces electricity and continues to qualify as a cogeneration unit, a cogeneration unit serving at any time a generator with a nameplate capacity of more than 25 MWe and supplying in any calendar year more than one-third of the unit's potential electric output capacity or 219,000 MWh (megawatt hours), whichever is greater to any utility power distribution system for sale.

This rule provides annual state caps for NO_x and SO_2 in two phases, with the Phase I caps for NO_x and SO_2 starting in 2009 and 2010, respectively. Phase II caps become effective in 2015. The U.S. EPA is allowing the caps to be met through a cap and trade program if a state chooses to participate in the program.

In response to U.S. EPA's rulemaking, IDEM adopted a state rule in 2006 based on the model federal rule. IDEM's rule includes an annual and seasonal NO_x trading program, and an annual SO_2 trading program. This rule requires compliance effective January 1, 2009.

On March 10, 2005, the U.S. EPA finalized the Clean Air Interstate Rule (CAIR). SO_2 emissions from power plants in the 28 eastern states and the District of Columbia covered by CAIR will be cut by 4.3 million tons by 2009 and reduced by an additional 5.4 million tons in 2015. NO_x emissions will be cut by 1.7 million tons by 2009 and reduced by an additional 1.3 million tons in 2015. The D.C. Circuit court's vacatur of CAIR in July of 2008 and subsequent remand without vacatur of CAIR in December of 2008 directs U.S. EPA to revise the CAIR rule in the future. The future version of CAIR (Replacement Rule) will result in similar or greater emission reductions than assumed within the emission inventories and modeling (based on what the rule would address in response to the court's opinion).

Together, these rules will substantially reduce local and regional sources of fine particles precursors. The modeling analyses discussed in Section 7.0 include these rules and show the reductions in annual fine particles concentrations expected to result from the implementation of these rules.

6.5 Controls to Remain in Effect

Indiana commits to maintain the control measures listed above after redesignation, or submit to U.S. EPA, as a SIP revision, any changes to its rules or emission limits applicable to SO_2, NO_x or direct $PM_{2.5}$ sources as required for maintenance of the annual standard for fine particles in the Central Indiana Area.

Indiana, through IDEM's Office of Air Quality and its Compliance and Enforcement Branch, has the legal authority and necessary resources to actively enforce any violations of its rules or

permit provisions. After redesignation, it intends to continue enforcing all rules that relate to the emission of fine particles and fine particles precursors in the Central Indiana Area.

6.6 New Source Review Provisions

Indiana has a long standing and fully implemented New Source Review (NSR) program that is outlined in rule at 326 IAC 2. The rule includes provisions for the Prevention of Significant Deterioration (PSD) permitting program in 326 IAC 2-2. Indiana's PSD program was conditionally approved on March 3, 2003 (68 FR 9892) and received final approval on May 20, 2004 (69 FR 29071) by U.S. EPA as part of the SIP.

Any facility that is not listed in the 2005 emission inventory, or for which credit through the shutdown or curtailment was taken in demonstrating attainment, will not be allowed to construct, reopen, modify or reconstruct without meeting all applicable permit rule requirements. The review process will be identical to that used for new sources. Once the area is redesignated, OAQ will implement NSR through the PSD program, which requires an air quality analysis to evaluate whether the new source will threaten the NAAQS.

7.0 MODELING AND METEOROLOGY

Although U.S. EPA's redesignation guidance does not require modeling for fine particles nonattainment areas seeking redesignation, extensive modeling has been performed covering the Central Indiana region to determine the effect of emission control strategies on fine particles levels. Future year modeled annual fine particles concentrations are expected to be reduced by 8% to 24% from baseline design values.

7.1 Summary of Modeling Results to Support Rulemakings

U.S. EPA Modeling for Clean Air Interstate Rule (CAIR), 2005

Indiana will reduce SO_2 emissions from the implementation of CAIR in 2009 by 222,000 tons from the 2009 emissions projections without CAIR, and by 2015, SO_2 emissions will be reduced by an additional 178,000 tons from the 2015 emissions projections without CAIR. Indiana will reduce NO_x emissions from the implementation of CAIR in 2009 by 113,000 tons from the 2009 emissions projections without CAIR, and by 2015, NO_x emissions will be reduced by 149,000 tons from the 2015 emissions projections without CAIR. The D.C. Circuit court's vacatur of CAIR in July of 2008 and subsequent remand without vacatur of CAIR in December of 2008 directs U.S. EPA to revise the CAIR rule in the future. The future-year emission reduction projections listed above will change. The future version of CAIR (Replacement Rule) will result in similar or greater emission reductions than assumed within the emission inventories and modeling (based on what the rule would address in response to the court's opinion). However, the large NO_x and SO_2 emission reductions demonstrate the photochemical model's response to those reductions on modeled concentrations.

U.S. EPA performed modeling to support the emission reductions associated with CAIR. U.S.

EPA used the Community Multiscale Air Quality Model (CMAQ) applied to the 2001 meteorology, as processed by the Mesoscale Model (MM5). Emissions input into CMAQ included SO_2, NO_x, VOC, ammonia and direct $PM_{2.5}$ for 2001. The modeling was based on the annual fine particles design values calculated from 1999 through 2003. Future year modeling was conducted, which included Marion and Madison counties, and the future year design values for 2010 and 2015 were evaluated for attainment of the annual NAAQS for fine particles as shown in Table 7.1. Fine particles concentrations are accounted for by modeling both the base future year emissions and the emissions reductions associated with CAIR. U.S. EPA found model performance met suggested benchmark performance goals within the range or better than other comparable modeling applications.

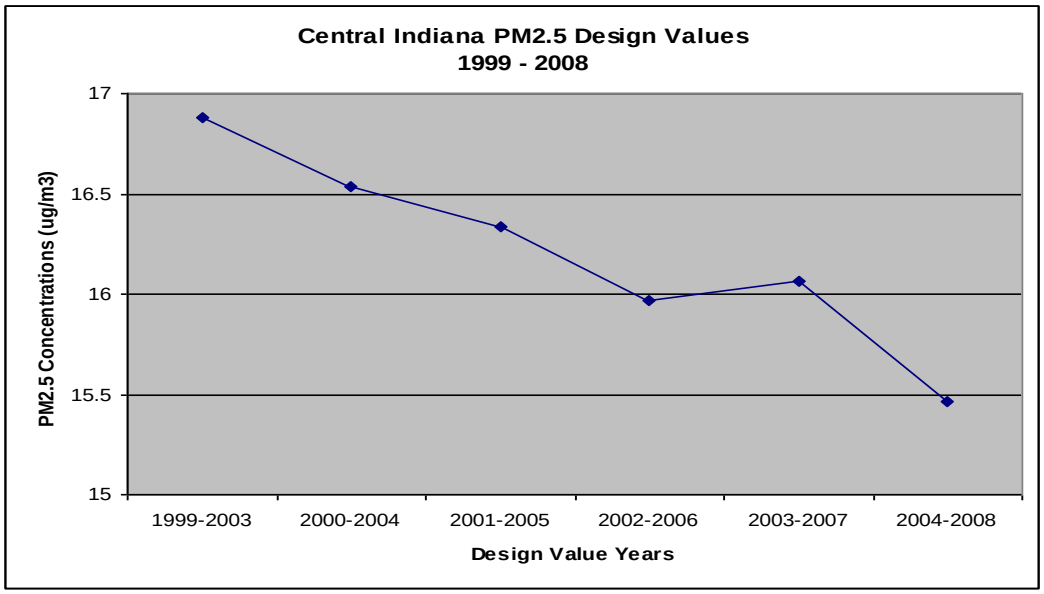
Table 7.1
Modeling Results from U.S. EPA for the Clean Air Interstate Rule

County	MSA/CMSA	Design Value 1999-2003	Future Design Value 2010 Base	Future Design Value 2010 with CAIR	Future Design Value 2015 without CAIR	Future Design Value 2015 with CAIR
		($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)
Marion Co.	Indianapolis, IN	16.9	16.8	15.5	16.8	15.4
Madison Co.	Indianapolis, IN	14.8	14.5	13.3	14.3	13.0

Modeling results show that the base future year modeling without CAIR accounts for approximately 0.1 to 0.3 $\mu g/m^3$ decreases in concentrations for 2010 and approximately 0.1 to 0.5 $\mu g/m^3$ decreases in concentrations for 2015. The future year modeling showed that emissions reductions associated with CAIR would account for approximately 1.4 to 1.5 $\mu g/m^3$ decreases in concentrations for 2010 and approximately 1.5 to 1.8 $\mu g/m^3$ decreases by 2015. Therefore, impacts from CAIR equate to modeled concentration decreases of 1.4 $\mu g/m^3$ by 2010 and 1.5 $\mu g/m^3$ by 2015 in Marion County.

While results of U.S. EPA's CAIR modeling show modeled concentrations above the standard, it should be noted that the base year design value used by U.S. EPA was taken from 1999-2003 and is higher than current design values in the area. From Graph 7.1, the 1999-2003 design value can be compared to the maximum 2004-2008 design value within Marion County. The resulting decrease of the design value is 1.4 $\mu g/m^3$. Therefore, U.S. EPA's CAIR modeling, using current 2004-2008 design values, would show lower modeled concentrations below the annual fine particles standard of 15.0 $\mu g/m^3$.

Graph 7.1
Modeling Results from U.S. EPA for the Clean Air Interstate Rule



Results of the U.S. EPA CAIR modeling show that Marion County will approach the annual fine particles NAAQS in 2010 with modeled impacts reduced by 8 % to 14%. With further reductions projected in CAIR for 2015, all design values decrease by 9% to 15% and attain the annual NAAQS for fine particles. If using current design values as a baseline, U.S. EPA's CAIR modeling shows Marion County would attain the current annual fine particles standard.

LADCO Modeling for Clean Air Interstate Rule

LADCO conducted modeling to determine the impact of CAIR in the Midwest. LADCO's modeling used the Comprehensive Air Quality Model with extensions (CAMx) applied to the year 2005 meteorology, as processed by the MM5. Emissions input into CAMx included SO_2, NO_x, VOC, ammonia and direct $PM_{2.5}$ for 2005. The modeling was based on 2003 through 2007 design values. Future year modeling for 2009, 2012, and 2018 was conducted and the future year design values were determined, as shown in Table 7.2.

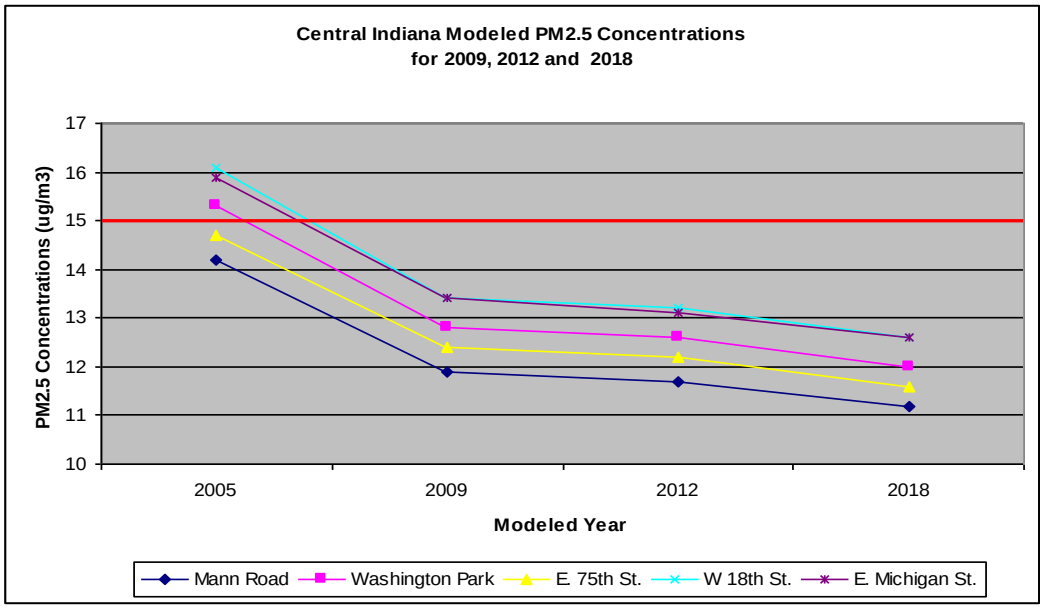
Table 7.2
LADCO's Round 5 Modeling Results for the Clean Air Interstate Rule

				Base-case	Base-case	Base-case

Monitor ID	Monitor Name	County	Design Value 2003-2007	with CAIR - 2009	with CAIR - 2012	with CAIR – 2018
			(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)
18-097-0042	Mann Road	Marion	14.2	11.9	11.7	11.2
18-097-0078	Washington Park	Marion	15.3	12.8	12.6	12.0
18-097-0079	E. 75th St.	Marion	14.7	12.4	12.2	11.6
18-097-0081	W. 18th St.	Marion	16.1	13.4	13.2	12.6
18-097-0083	E. Michigan St.	Marion	15.9	13.4	13.1	12.6

Results of the LADCO CAIR modeling show that Marion County will attain the annual NAAQS for fine particles of 15 µg/m^3 by 2009. As shown in Table 7.2, future year modeled annual fine particles concentrations for 2009 will be 16% to 17% lower than baseline annual fine particles design values, 17% to 18% lower in 2012 and 21% to 22% lower in 2018 and will continue to decrease, thereafter. A graphical representation is shown in Graph 7.2. The Mann Road and E. 75th Street monitors were closed at the end of 2007. However, at the time the modeling was conducted, the Mann Road and E. 75th Street monitors were still in operation.

Graph 7.2
Modeling Results for Marion County $PM_{2.5}$ Monitors for 2009, 2012 and 2018



7.2 LADCO's Round 5 Speciated Modeled Attainment Test Results

The Speciated Modeled Attainment Test (SMAT) is the attainment test for annual fine particles. To determine the future year annual fine particles concentrations, speciated data is calculated. The different species that were modeled and are associated with fine particles include sulfates, nitrates, organic carbon, elemental carbon, ammonium, particle bound water, "other" primary inorganic fine particles and passively collected mass. The SMAT results from LADCO's Round 5 modeling are listed below. Percent ranges of the model results from the five fine particles monitors in Central Indiana were broken down into these speciated constituents of fine particles emissions. The percent change from the observed speciated data in 2005 to the future year

modeled results for 2009 are listed in Table 7.3.

Table 7.3
LADCO's Round 5 SMAT Modeling Results for Central Indiana
(Percent decrease from observed to modeled concentrations)

Species of $PM_{2.5}$	2009
Sulfates	23% - 26%
Nitrates	0% - 6%
Organic Carbon	0% - 3%
Elemental Carbon	17%
Ammonium	16% - 19%
Particle Bound Water	19% - 24%

The results show that sulfate, ammonium, elemental carbon and particle bound water concentration decreases are projected to be at least 16% in the year 2009. Lesser nitrate reductions are projected to occur, up to 6%, with organic carbon reductions occurring up to 3%. LADCO modeling shows good performance for sulfates and elemental carbon predicted baseline concentrations, slight over-prediction for nitrate concentrations and under-predictions of organic carbon concentrations. Overall, model performance is adequate for SIP planning and gives a good idea of the effects of emissions reductions from national emission control measures on Central Indiana.

7.3 LADCO's Round 5 Particulate Source Apportionment Results

Particulate Source Apportionment (PSAT) modeling was conducted by LADCO. The results of the PSAT Round 5 modeling shows the regional contributions by emission sectors on each monitor that was modeled. Chart 7.1 shows the PSAT modeling results for the E. Michigan Street fine particles monitor in Marion County. Indiana was the biggest regional contributor to the E. Michigan Street fine particles monitor with Ohio, the VISTAS Regional Planning Organization (Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee, Virginia and West Virginia) and Illinois also contributing. The PSAT modeling results show the majority of Indiana's emission sector contributions come from ammonium emission sources, mobile, EGUs, off-road (including marine, aircraft and railroad), area and non-EGU sources. Other regional contributions result mainly from EGU emissions. Ammonia represents primarily the agricultural contribution.

Chart 7.1
Regional/Emission Sector PSAT Results at E. Michigan St.

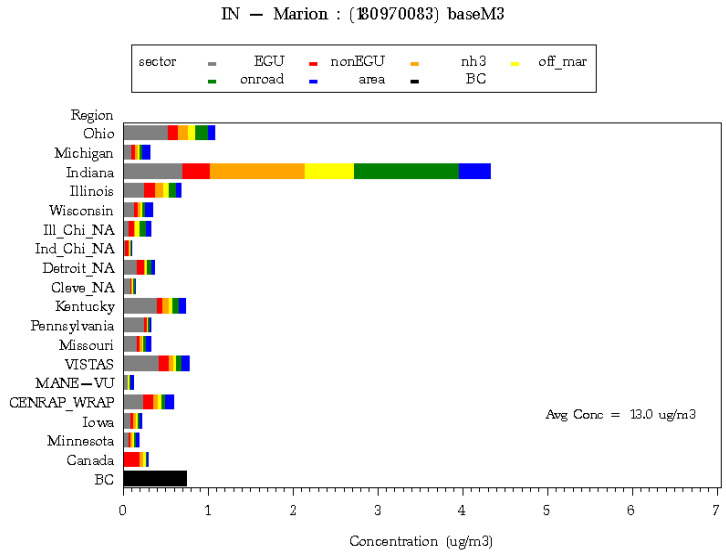
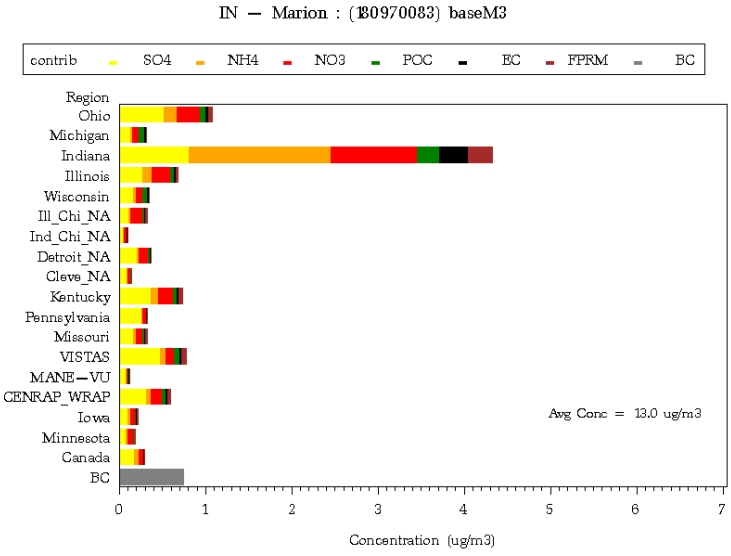


Chart 7.2 shows the modeled pollutant contributions on the E. Michigan Street fine particles monitor. The PSAT modeling results show the majority of Indiana's pollutant contributions come from ammonium, nitrate, sulfate, elemental carbon, primary fine particulates and organic carbon. Pollutant contributions from other regions consist mainly of sulfates and nitrates.

Chart 7.2
Regional/Pollutant PSAT Results at E. Michigan St. $PM_{2.5}$ Monitor



The following pie charts depict the species contributions to fine particles concentrations at the Central Indiana monitors. The pie charts include both the observed 2005 contributions and year

2009 modeled contributions for each monitor. Since the monitors are in close proximity of each other, results are fairly similar in the distribution of species concentrations among the monitors. Charts 7.3 through 7.7 cover the five fine particles monitors in the Central Indiana area that are used to determine compliance with the annual NAAQS.

Chart 7.3
Pie Charts - Species Modeled Contributions to W. 18th St. $PM_{2.5}$ Monitor
(Base Year Modeled Concentrations = 15.6 µg/m^3) (Future Year Modeled Concentrations =13.2 µg/m^3)

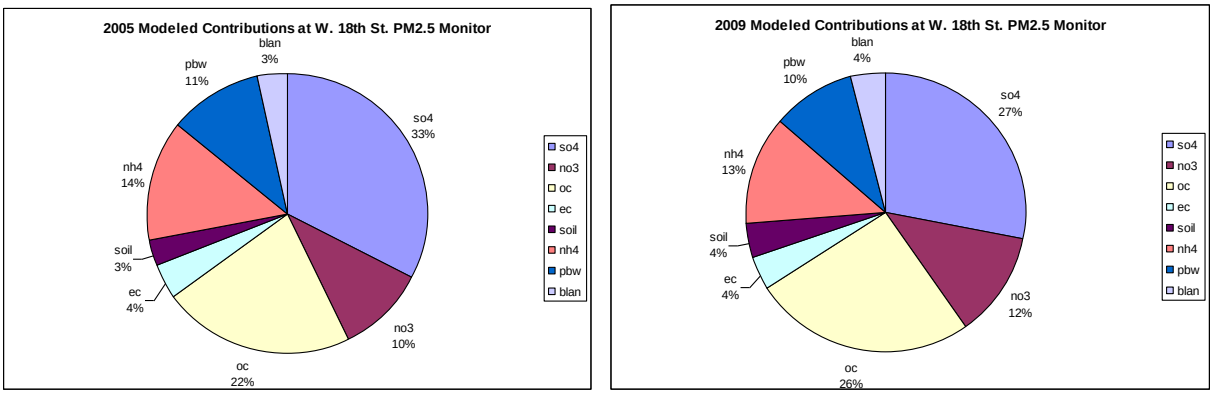


Chart 7.4
Pie Charts - Species Modeled Contributions to Washington Park $PM_{2.5}$ Monitor
(Base Year Modeled Concentrations = 14.7 µg/m^3) (Future Year Concentrations =12.6 µg/m^3)

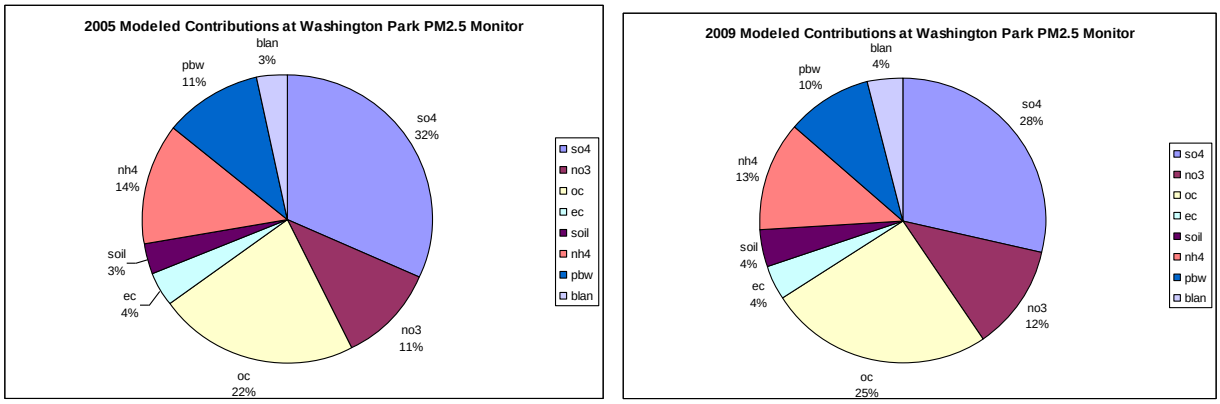
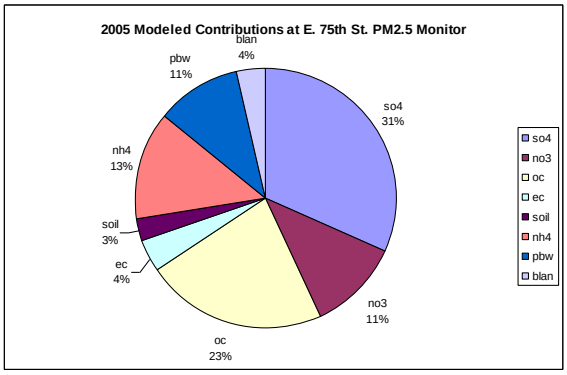


Chart 7.5
Pie Charts - Species Modeled Contributions to E. 75th St. $PM_{2.5}$ Monitor

(Base Year Modeled Concentrations = 14.2 µg/m^3) (Future Year Modeled Concentrations =12.3 µg/m^3)



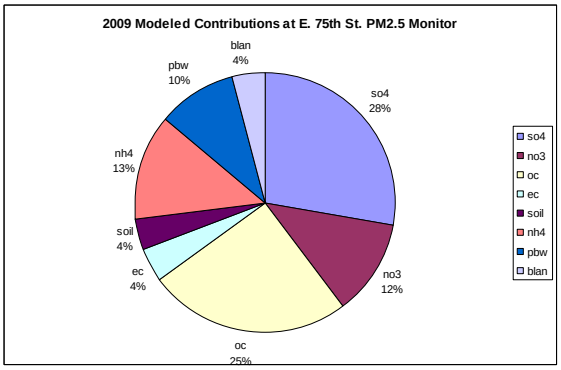
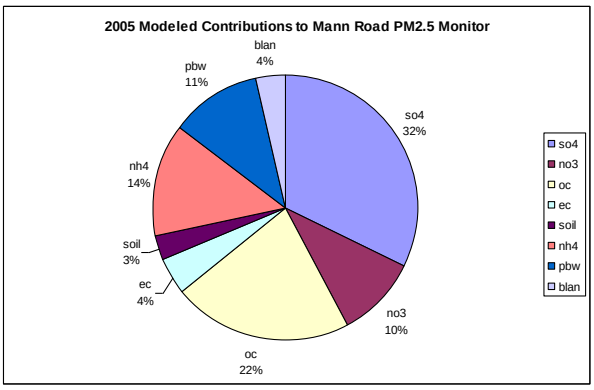


Chart 7.6
Pie Charts of the Species Modeled Contributions to Mann Road $PM_{2.5}$ Monitor
(Base Year Modeled Concentrations = 13.7 µg/m^3) (Future Year Modeled Concentrations =11.9 µg/m^3)



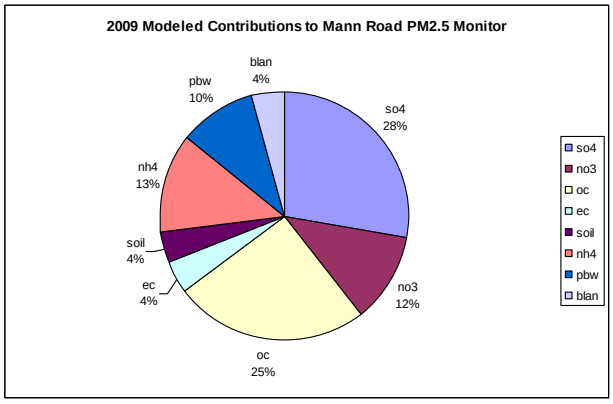
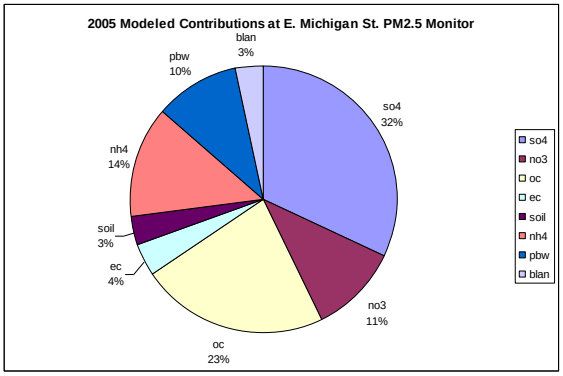
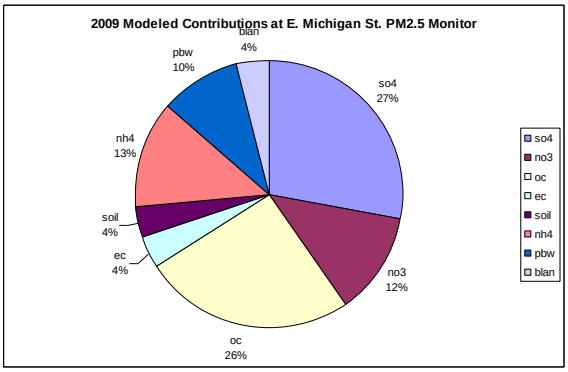


Chart 7.7
Pie Charts of the Species Modeled Contributions to E. Michigan St. $PM_{2.5}$ Monitor
(Base Year Modeled Concentrations = 15.4 µg/m^3) (Future Year Modeled Concentrations =13.2 µg/m^3)





Results of the Round 5 PSAT modeling for Marion County fine particle monitors show the highest pollutant contributors to base-case and future year fine particle concentrations are sulfate, organic carbon, ammonium and nitrate. Future year modeling shows decreases in sulfates (due to the emission reductions from CAIR) and ammonium. The future year modeling did show

slight increases in organic carbon and nitrates from the base-case modeled concentrations. Five main types of pollutants contribute to fine particles concentrations: direct $PM_{2.5}$ emissions; sulfur dioxide; nitrogen oxides; ammonia; and volatile organic compounds. However, the effect of reducing emissions of each of these pollutants varies by area, depending on the fine particles composition, emission levels, and other area-specific factors. Therefore, for the Central Indiana Area, following final U.S. EPA policies, $PM_{2.5}$ direct emissions (including organic carbon, elemental carbon and crustal material), sulfur dioxide, and nitrogen oxides must be evaluated for emission reduction measures. Neither Indiana nor U.S. EPA have determined that VOCs or ammonia contribute significantly to $PM_{2.5}$ concentrations in the area and need to have control measures evaluated.

7.4 Summary of Existing Modeling Results

U.S. EPA and LADCO modeling for future year design values have consistently shown that existing national emission control measures would bring the Central Indiana counties into attainment of the annual NAAQS for fine particles. Emission control measures to be implemented in the next several years will provide even greater assurance that air quality will continue to meet the standard into the future. Modeling support for the Clean Air Interstate Rule with and without has shown that future year design values for the Central Indiana Area will continue to attain the annual standard for fine particles with modeled future year design values below 15 $\mu g/m^3$. U.S. EPA future year modeling of national emission control strategies, based on current design values, show that the Central Indiana Area will attain the annual NAAQS for fine particles without additional national emission controls. Future national and local emission control strategies will ensure that the Central Indiana fine particles attainment area will be maintained with an increasing margin of safety over time.

7.5 Meteorological Analysis for Central Indiana

Meteorological conditions are one of the most important factors that influence development and transport of fine particles. Stagnant surface conditions during any time of the year and upper air ridging provides conducive conditions for the development and transport of fine particles. Ultimately, passage of surface cold fronts with a clean air mass change will lower fine particles readings in the Central Indiana Area.

7.6 Surface Air Conditions Present During High Fine Particles Concentration Days

Higher annual concentrations of fine particles tend to correlate with warmer temperatures and lighter wind speeds, although high fine particles episodes can occur in the summer or winter. It should be noted that higher annual fine particles concentrations are driven by individual days with higher fine particles concentrations throughout the monitored year. Therefore, it is difficult to attribute higher fine particles concentrations to annualized meteorological rankings. Review of several of the higher fine particles concentration episodes over the past few years shows conditions were hot in the summer with temperatures in the middle 80^os F or higher and average wind speeds were fairly light. Fall and winter days with higher fine particles concentrations had near normal temperatures, but wind speeds were very light and humidity was higher.

7.7 Upper Air Conditions Present During High Fine Particles Concentrations Days

Upper air ridges and more stagnant surface wind conditions predominately affect development and build up of fine particles. Slow moving upper air ridges can effectively suppress mixing within the many levels of the atmosphere and cause pollutants to build up over time. Inversions or increases in temperature with a rise in altitude will prevent mixing with air from the upper atmosphere. These conditions can occur at any time of the year and are evident in elevated fine particles episodes in spring, summer, fall and winter months. Review of surface and upper air features of higher fine particle concentration days showed stagnant surface conditions and upper air ridges existed on those days and helped in the buildup of fine particle concentrations.

7.8 Analyses of Atmospheric Conditions During High Fine Particles Concentration Days

Analyses have been conducted to determine the atmospheric conditions that are most prevalent during higher fine particle concentration days in Indiana. LADCO applied a Classification and Regression Tree (CART) analysis to data from Indiana that correlated different levels of fine particles concentrations to meteorological conditions from 1999 – 2004. (Donna Kenski, 2005). This type of analysis looks at the meteorological conditions, such as temperature, pressure, wind speed, wind direction, relative humidity and dewpoint temperatures at the surface, as well as lower morning and evening mixing heights in the upper atmosphere which were present when higher concentrations of fine particles were monitored. Results of this CART analysis indicated factors that played a larger role in higher fine particle concentrations in Indiana were warm-weather conditions with high dew points, southwest winds and low evening mixing heights. Previous day's concentrations of fine particles play a key role in higher impacts as well.

Fine particles are made up of several constituents, including direct $PM_{2.5}$, sulfates, nitrates, ammonium, organic carbon and elemental carbon. Depending on the time of the year, concentrations of particulate constituents vary, with nitrates being more prevalent in the winter and sulfates more prevalent in the summer. Emission reductions of sulfates and nitrates appear to have the biggest impact on lower future year fine particle concentrations.

7.9 Summary of Air Quality Index Days in Central Indiana

Another analysis was conducted to review the daily fine particle concentrations over a year to determine the Air Quality Index (AQI) trends. Chart 7.8 below shows by year (2001 through 2008), the percentage number of days during which fine particles concentrations reached the AQI ranges for "Good" (0 to 15.3 $\mu g/m^3$), "Moderate" (15.4 $\mu g/m^3$ to 40.4 $\mu g/m^3$) and "Unhealthy for Sensitive Groups (USG)"(40.5 $\mu g/m^3$ to 65.4 $\mu g/m^3$). There were no days during which fine particle levels reached the "Unhealthy" level of 65.5 $\mu g/m^3$ to 150.4 $\mu g/m^3$.

Chart 7.8
Distribution of $PM_{2.5}$ Concentration Days on the AQI Levels of Health Concern

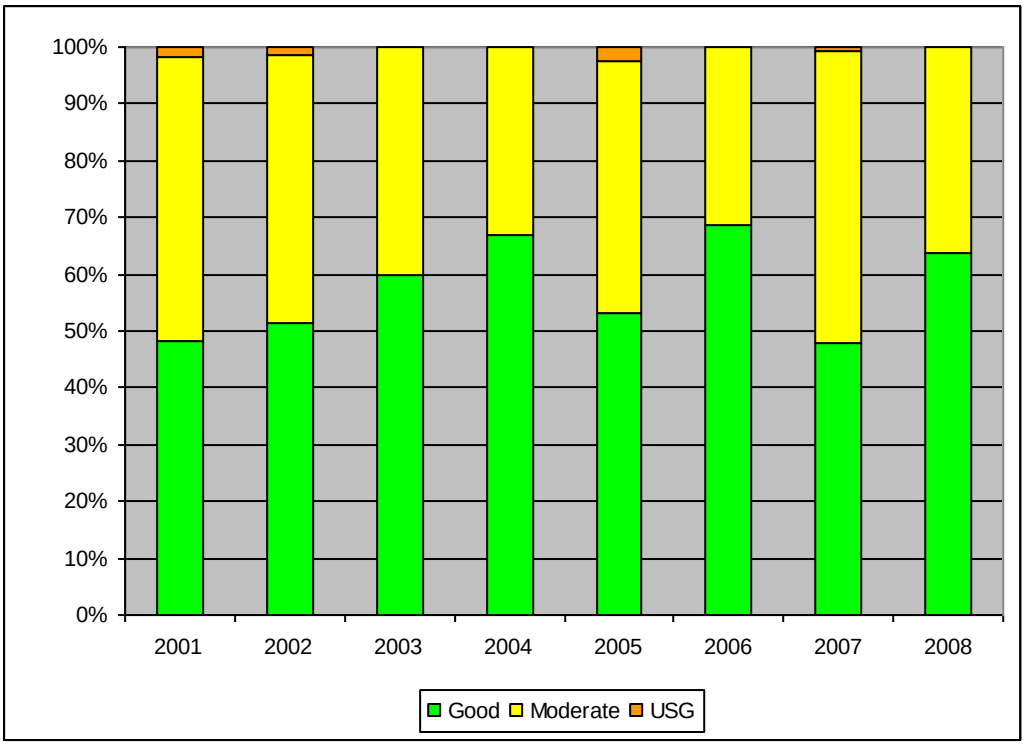


Table 7.4 shows how the years ranked for the three AQI ranges. The most days in the "Good" concentration range during the 8-year period analyzed (2001-2008) occurred in 2006. The most days in the "Moderate" concentration range occurred in 2007 and 2005 had the most days in the "Unhealthy for Sensitive Group" concentration range with no days recorded in 2003, 2004, 2006 and 2008.

Table 7.4
Ranking of Highest Number of Days at AQI Levels of Health Concern

Ranking	Good	Moderate	Unhealthy for Sensitive Group
1st	2006	2007	2005
2nd	2004	2001	2001
3rd	2008	2002	2002
4th	2003	2005	2007
5th	2005	2003	
6th	2002	2008	
7th	2001	2004	
8th	2007	2006	

7.10 Summary of Meteorological Analysis for Central Indiana

Annual fine particle concentrations in the Central Indiana Area are driven by higher fine particle

concentration days that can occur during any time of the year. Conditions that are most prevalent during higher fine particle concentration days are lighter winds, higher relative humidity and above average temperatures in the summer and near normal temperatures in the fall, winter or spring. Upper air weather patterns generally include ridging over the area with stagnant conditions at the surface caused by lower mixing heights and stable conditions. Nitrates are bigger contributors to fine particle concentrations in the winter and sulfates are bigger contributors to fine particle concentrations in the summer.

8.0 CORRECTIVE ACTIONS

8.1 Commitment to Revise Plan

As noted in Section 4.6 above, Indiana commits to review and revise, as appropriate, its Maintenance Plan eight years after redesignation, as required by Section 175A of the CAA.

8.2 Commitment for Contingency Measures

Indiana will monitor fine particles concentrations to determine whether trends indicate higher values or whether emissions appear to be increasing. If it is determined that fine particles levels and emissions are increasing and action is necessary to reverse that trend, Indiana will take action to reverse the noted trend, prior to a violation of the standard occurring.

Indiana commits to adopt and expeditiously implement necessary corrective action in the following circumstance:

Action Level Response

An Action Level Response shall be prompted whenever a violation of the standard (three year average annual arithmetic mean value of 15.1 $\mu g/m^3$ or greater) occurs. In the event that the Action Level is triggered and is not found to be due to an atypical unfavorable meteorological condition, exceptional event, malfunction or noncompliance with a permit condition or rule requirement, IDEM will determine additional control measures needed to assure future attainment of the annual NAAQS for fine particles. In this case, measures that can be implemented in a short time will be selected in order to be in place within eighteen months from the close of the fine particles season that prompted the Action Level.

Control Measure Selection and Implementation

Adoption of any additional control measures is subject to the necessary administrative and legal processes. This process will include publication of notices, an opportunity for

public hearing and other measures required by Indiana law for rulemaking by state environmental boards.

If a new measure or control is already promulgated and scheduled to be implemented at the federal or state level, and that measure or control is determined to be sufficient to address the upward trend in air quality, additional local measures may be unnecessary. Furthermore, Indiana will submit to U.S. EPA an analysis to demonstrate the proposed measures are adequate to return the area to attainment.

8.3 Contingency Measures

Contingency measures to be considered will be selected from a comprehensive list of measures deemed appropriate and effective at the time the selection is made. Listed below are example measures that may be considered. The selection of measures will be based upon cost-effectiveness, emission reduction potential, economic and social considerations or other factors that IDEM deems appropriate. IDEM will solicit input from interested and affected persons in the maintenance area prior to selecting appropriate contingency measures. All of the listed contingency measures are potentially effective or proven methods of obtaining significant reductions of fine particles precursor emissions. Because it is not possible at this time to determine what control measure will be appropriate at an unspecified time in the future, the list of contingency measures outlined below is not comprehensive. Indiana anticipates that if contingency measures should ever be necessary, it is unlikely that a significant number (i.e., all those listed below) will be required.

1) Alternative fuel and diesel retrofit programs for fleet vehicle operations.
2) Require NO_x or SO_2 controls on new minor sources (less than 100 tons).
3) Wood stove change out program.
4) Idle restrictions.
5) Broader geographic applicability of existing measures.
6) One or more transportation control measures sufficient to achieve at least a half a percent (0.5%) reduction in actual area wide precursor emissions. Transportation measures will be selected from the following, based upon the factors listed above, after consultation with affected local governments:
    a. Trip reduction programs, including, but not limited to, employer-based transportation management plans, area-wide rideshare programs, work schedule changes and telecommuting.
    b. Transit improvements.
    c. Traffic flow improvements.
    d. Other new or innovative transportation measures not yet in widespread use that affected state and local governments deem appropriate.

No contingency measure shall be implemented without providing the opportunity for full public participation during which the relative costs and benefits of individual measures, at the time they are under consideration, can be fully evaluated.

9.0 PUBLIC PARTICIPATION

Indiana published notification for a public hearing and solicitation for public comment concerning the draft Redesignation Petition and Maintenance Plan in the Indianapolis Star on August 14, 2009.

A public hearing to receive comments concerning the redesignation request was conducted on September 14, 2009 at the Indianapolis-Marion County Library-West Indianapolis Branch in Indianapolis, Indiana. IDEM received one written comment. The public comment period closed on September 18, 2009. Appendix J includes a copy of the public notice, certifications of publication, the transcript from the public hearing, copies of all written comments received, and a summary of all comments received that includes IDEM's responses, as applicable.

10.0 CONCLUSIONS

The Central Indiana Area has attained the annual NAAQS for fine particles. This petition demonstrates that the Central Indiana Area has complied with the applicable provisions of the CAA regarding redesignation of nonattainment areas for fine particles. IDEM has prepared a State Implementation and Maintenance Plan that meets the requirement of Section 110(a)(1) of the CAA.

Indiana has performed an analysis that shows the air quality improvements are due to permanent and enforceable measures and that additional significant regional NO_x reductions following implementation of Phase II NO_x SIP Call and CAIR and/or its replacement rule or program will ensure continued compliance (maintenance) with the standard. Furthermore, emission projections indicate that SO_2 and NO_x emissions will continue to decline, thus ensuring that the area continues to maintain compliance with the standard and provide for an increased margin of safety. Based on this presentation, the Central Indiana Area meets the requirements for redesignation under the CAA (Section 107(d)(3)) and U.S. EPA guidance for fine particles.

Consistent with the authority granted to the U.S. EPA, the State of Indiana requests that the Central Indiana Area be redesignated to attainment for the annual fine particles standard simultaneously with U.S. EPA approval of this Indiana State Implementation and Maintenance Plan provisions contained.