

Fine Particle Attainment Demonstration
and
Technical Support Document

For the Indiana Portion
of the

Louisville KY-IN
Fine Particle Nonattainment Area

**Jefferson County (Madison Township) and
Clark and Floyd Counties,
Indiana**

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1.0 OVERVIEW

1.1 INTRODUCTION

Particulate matter is one of six criteria air pollutants that scientists have identified as being particularly harmful to humans and the environment. National Ambient Air Quality Standards (NAAQS) have been developed for these six pollutants and are used as measurements of air quality. Fine particles and precursor pollutants are emitted by a wide range of sources, including power plants, cars, trucks, industrial sources and other burning or combustion-related activities.

1.2 NATIONAL AMBIENT AIR QUALITY STANDARDS

The Clean Air Act as amended in 1990 (CAAA) requires areas designated nonattainment of the applicable NAAQS to develop State Implementation Plans (SIPs) to expeditiously attain and maintain the standard. In 1997, the United States Environmental Protection Agency (U.S. EPA) set daily and annual air quality standards for fine particles (fine particulate matter), as shown in Table 1.1 below. The standards were legally challenged and upheld by the U.S. Supreme Court in February of 2001. In 1999, Indiana began monitoring for fine particle concentrations. The U.S. EPA designated areas in Indiana under the standards for fine particles 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})	15.0 µg/m³ Annual arithmetic mean, averaged over 3 years	65.0 µg/m³ 24-hour average, 98 th percentile, averaged over 3 years
2006 Fine Particles Standards (PM _{2.5})	15.0 µg/m³ Annual arithmetic mean, averaged over 3 years	35.0 µg/m³ 24-hour average, 98 th percentile, averaged over 3 years

*The Louisville KY-IN Fine Particle Nonattainment Area meets the 1997 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. Designations have not been made for the 2006 revised daily standard at this time.

On December 17, 2004, based on 2001-2003 monitoring data, U.S. EPA designated the Louisville KY-IN Area of Madison Township in Jefferson County and Clark and Floyd Counties, Indiana, and Bullitt and Jefferson Counties, Kentucky, as nonattainment of the annual standard for fine particles, and subject to CAA Part D, Title 1, Section 172 of Subpart 1 requirements, including the development of a plan to reduce oxides of nitrogen (NO_x), sulfur dioxide (SO₂) and direct PM_{2.5} emissions and a demonstration that the area will meet the annual standard for fine particles by April 5, 2010.

Table 1.2
Louisville KY-IN 2001-2003 Air Quality Monitoring Data used for Designation

SITE ID	COUNTY	SITE NAME	YEAR	Annual Average µg/m ³	2001-2003 Average µg/m ³
18-019-0005/6	Clark	Spring St./Pfau	2001	16.85	
18-019-0005/6	Clark	Spring St./Pfau	2002	16.02	
18-019-0005/6	Clark	Spring St./Pfau	2003	15.78	16.2
18-043-1004	Floyd	Green Valley School	2001	15.73	
18-043-1004	Floyd	Green Valley School	2002	14.62	
18-043-1004	Floyd	Green Valley School	2003	14.44	14.9
21-029-0006	Bullitt	Carpenter St.	2001	15.55	
21-029-0006	Bullitt	Carpenter St.	2002	14.69	
21-029-0006	Bullitt	Carpenter St.	2003	14.37	14.9
21-111-0043	Jefferson	Southern Ave.	2001	17.10*	
21-111-0043	Jefferson	Southern Ave.	2002	17.16	
21-111-0043	Jefferson	Southern Ave.	2003	15.96	16.7
21-111-0044	Jefferson	Wyandotte Park	2001	17.73	
21-111-0044	Jefferson	Wyandotte Park	2002	17.45	
21-111-0044	Jefferson	Wyandotte Park	2003	15.38	16.9
21-111-0048	Jefferson	Barret Ave.	2001	16.90*	
21-111-0048	Jefferson	Barret Ave.	2002	16.43	
21-111-0048	Jefferson	Barret Ave.	2003	15.53	16.3
21-111-0051	Jefferson	Watson Elementary	2001	16.27*	
21-111-0051	Jefferson	Watson Elementary	2002	15.72*	
21-111-0051	Jefferson	Watson Elementary	2003	14.92	15.6

*Indicates that the mean does not satisfy the summary criteria.

Value above the standard

The Spring Street, Jeffersonville, Indiana PM_{2.5} monitor was discontinued and relocated to the Pfau, Jeffersonville Indiana PM_{2.5} monitoring site location in June 2003. As such, air quality monitoring data included for these two sites have been combined as permitted by U.S. EPA criteria.

These designations became effective on April 5, 2005. Also, on April 5, 2005, U.S. EPA issued a supplemental notice changing the designation status of several areas based on updated quality-assured monitoring data from 2002-2004. This action did not affect the Louisville KY-IN nonattainment area. Monitors for fine particle levels are located in all of the counties in the Louisville KY-IN area except for Madison Township in Jefferson County, Indiana (see Figure 1.1). Based on the most recent three years of monitoring data, 2004-2006, the Louisville KY-IN nonattainment area has not measured air quality that meets the standard. A comprehensive detail of the monitoring data is included in Appendix A.

The Clean Air Act as amended in 1990 (CAAA) requires areas designated nonattainment of the applicable NAAQS to develop State Implementation Plans (SIPs) to expeditiously attain and maintain the standard. Section 172 of the CAA stipulates the requirements that nonattainment areas must meet, including the development of a plan to reduce direct and precursor emissions of the applicable NAAQS. The plan must include a demonstration that the area will meet the ambient air quality standard within five (5) years of designation, or April 5, 2010.

The Louisville KY-IN fine particle nonattainment area, as defined in Section 1.3, has not previously been subject to nonattainment area rulemakings for fine particles. However, Clark and Floyd Counties, Indiana, and Jefferson and Bullitt Counties, Kentucky, had been subject to nonattainment area rulemakings under the 1-hour and/or the 8-hour ozone standards. The 1-hour ozone standard was revoked on June 15, 2005, and Clark and Floyd Counties were redesignated to attainment and classified as maintenance under the 8-hour ozone standard on July 19, 2007. Jefferson and Bullitt Counties were redesignated to attainment and classified as maintenance under the 8-hour ozone standard on August 6, 2007.

In accordance with U.S. EPA's *Clean Air Fine Particle Implementation Rule*¹, this document demonstrates that, with the combination of current clean air measures and the implementation of local and federally-required control measures, air quality in the Louisville KY-IN nonattainment area will meet the annual fine particle standard by the attainment date. This document contains the annual fine particle standard attainment demonstration for the Louisville KY-IN fine particle nonattainment area.

1.3 GEOGRAPHICAL DESCRIPTION

Following is a brief description of the Louisville KY-IN fine particle nonattainment area.

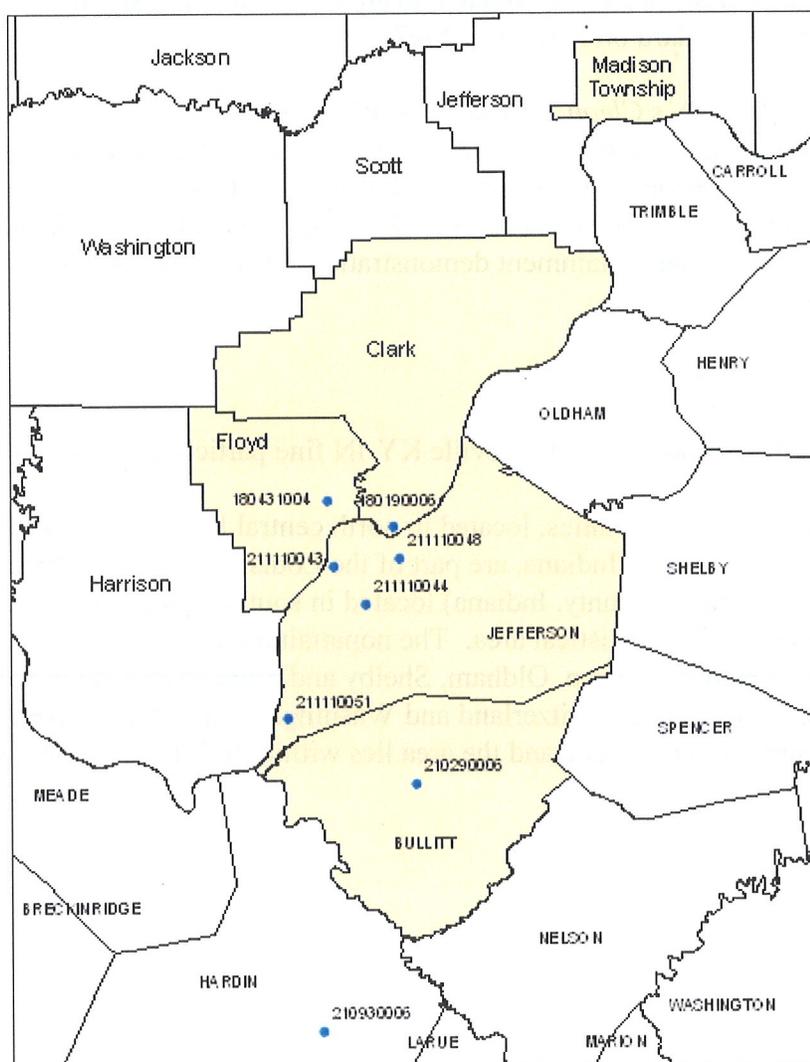
Jefferson, Bullitt and Oldham Counties, located in north central Kentucky, and Clark and Floyd Counties, located in southeastern Indiana, are part of the Louisville metropolitan statistical area. Madison Township (Jefferson County, Indiana) located in southeastern Indiana encompasses the Madison Indiana micropolitan statistical area. The nonattainment area is surrounded by the Kentucky Counties of Hardin, Nelson, Oldham, Shelby and Spencer and the Indiana counties of Harrison, Jennings, Ripley, Scott, Switzerland and Washington. The Ohio River flows along the border between Kentucky and Indiana and the area lies within the Ohio River Valley. This area is depicted in Figure 1.1.

¹ <http://www.epa.gov/fedrgstr/EPA-AIR/2007/April/Day-25/a6347.htm>

The highest levels of fine particle concentrations have been typically monitored at the Spring Street/Pfau monitor (18-019-0005/6), located in Clark County, Indiana. Refer to Figure 1.1 for the location of the monitors in the nonattainment area. Designations were made based upon monitored air quality data measured during 2001, 2002 and 2003. Table 1.2 shows the monitored design values for 2001-2003.

U.S. EPA designated areas under the fine particle standards as attainment, nonattainment or unclassifiable, on December 17, 2004, with an effective date of April 5, 2005. The Louisville KY-IN fine particle nonattainment area was designated nonattainment of the annual fine particle standard pursuant to the CAA. As a result, Section 172(c) of the CAA set forth requirements for Indiana's State Implementation Plan (SIP) submittal.

Figure 1.1
U.S. EPA Fine Particle Nonattainment Area Designations



The agencies responsible for assuring the nonattainment area complies with the CAA requirements are:

- The Louisville Metro Air Pollution Control District, which is responsible for Jefferson County (Louisville) in north central Kentucky;
- The Kentucky Department for Environmental Protection, (KDEP), which is responsible for Bullitt County, Kentucky; and,
- The Indiana Department of Environmental Management (IDEM), which is responsible for Madison Township (Jefferson County) and Clark and Floyd Counties, Indiana.

Indiana and Kentucky have worked cooperatively with U.S. EPA Regions IV and V to address attainment planning issues.

Although Indiana and Kentucky have worked together on a comprehensive plan for the multi-state areas, each state is required to make a separate submittal for its portion of the planning components to U.S. EPA. Attainment demonstrations are SIP submittals and U.S. EPA action on them is taken separately. As such, this submittal covers Madison Township (Jefferson County), and Clark and Floyd Counties, Indiana.

1.4 CONTROL STRATEGY

Several control measures already in place or being implemented over the next few years will reduce stationary point, on-road mobile, and non-road source emissions. The expected Federal and State control measures were modeled for the attainment year of 2009.

The Federal control measures that were modeled included the Tier 2 vehicle standards, the heavy-duty gasoline and diesel highway vehicle standards, low sulfur gasoline and diesel fuels, large non-road diesel engine standards and the non-road spark-ignition engines and recreational engines standards.

The State control measures that were modeled include the NO_x SIP Call and the Clean Air Interstate Rule (CAIR). The control measures included in the modeling are described in greater detail in Section 6.0.

1.5 ATTAINMENT TEST

U.S. EPA guidance requires that attainment demonstrations for fine particles be supported by photochemical grid modeling. A computer model is used to predict maximum fine particle concentrations in every grid cell (or point of analysis) within the nonattainment area.

The attainment test is not based on absolute modeling results, but rather “Relative Responses” achieved by comparing the modeled base year to the modeled control strategy, at specific monitoring sites. The benchmark for attainment is that the results of applying the relative response factors to the current monitored design value are below the annual fine particle standard. The latest regional modeling conducted by the Lake Michigan Air Director’s Consortium (LADCO) shows all future year concentrations well below the annual fine particle NAAQS of 15.0 $\mu\text{g}/\text{m}^3$.

The results of the various steps used to calculate the predicted future year concentrations for each monitor located in the Louisville KY-IN fine particle nonattainment area are shown in Table 1.3. The first three columns are the monitor identification number, monitor name and county in which the monitor is located. The next two columns are the modeling base year design value and the future year design value. As shown in Table 1.3, all of the monitors in the area are expected to be below the standard. According to U.S. EPA guidance, areas with future year design values lower than 14.5 $\mu\text{g}/\text{m}^3$ at each monitor site only need to provide a basic supplemental analysis that the area will attain the annual fine particle standard. Areas with future year design values between 14.5 $\mu\text{g}/\text{m}^3$ and 15.5 $\mu\text{g}/\text{m}^3$ need to provide a more comprehensive weight of evidence analyses to demonstrate that the area will attain the fine particle NAAQS.

Table 1.3
Attainment Test Results

Monitor ID	Monitor Name	County	Design Value 2003-2006	Basecase with CAIR 2009
			($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)
18-019-0006	Pfau	Clark	16.5	13.6
18-043-1004	Green Valley School	Floyd	14.9	12.1
21-029-0006	Carpenter Street	Bullitt	14.9	12.4
21-093-0006	Elizabethtown	Hardin	13.5	11.2
21-111-0043	Southern Avenue	Jefferson	15.7	12.8
21-111-0044	Wyandotte Park	Jefferson	15.4	12.8
21-111-0048	Barret Ave.	Jefferson	15.2	12.5
21-111-0051	Watson Elementary	Jefferson	14.7	12.1

Since the area’s future year design value is predicted to be significantly below the fine particle standard, at 13.6 $\mu\text{g}/\text{m}^3$, only a basic supplemental analysis is required to support the modeling analysis. This analysis further demonstrates that the nonattainment area will comply with the annual fine particle standard by the prescribed attainment date of April 5, 2010. This demonstration includes an analysis of air quality trends, emissions trends, and a current air quality data, a summary of emissions reductions still to occur in 2008 and 2009, along with

additional measures that were not included in the air quality modeling. IDEM believes that the modeled attainment demonstration in conjunction with the supplemental analysis, and an identified set of control measures provides the necessary evidence that the Louisville KY-IN nonattainment area will attain the fine particle standard by April 5, 2010.

The structure and content of this document addresses each of the elements required by the CAA and U.S. EPA guidance. Compliance with these elements provides the technical analysis necessary to support a demonstration of the following:

- the Louisville KY-IN area will attain the annual fine particle standard by the attainment date;
- air quality in the area is improving;
- emissions reductions from national and regional control measures included in the attainment plan will bring the area into attainment as expeditiously as possible;
- regional modeling performed by LADCO demonstrates that with regional NO_x and SO₂ reductions the area will be able to comply with the annual fine particle standard without additional control measures; and,
- the additional implementation of control measures not included in the modeling analysis will provide further assurance that the standard is attained and maintained.

2.0 CLEAN AIR ACT REQUIREMENTS

Section 172(c) of the CAA specifies the various planning requirements that apply to nonattainment areas. The CAA specifies the following requirements:

1. General requirements for Reasonably Available Control Measures (RACM)/Reasonably Available Control Technology (RACT),
2. Reasonable Further Progress (RFP),
3. Emissions inventories,
4. Identification and quantification of emissions,
5. Permit program for new and modified sources,
6. Other control measures, means or techniques
7. Compliance with Section 110(a)(2),
8. Equivalent techniques, and,
9. Contingency measures.

These components are due April 5, 2008. The following section provides an overview of Indiana's progress in meeting the CAA requirements mentioned above.

2.1 GENERAL REQUIREMENTS [SECTION 172(C)(1)]

2.1.1 Reasonably Available Control Measures (RACM)

The CAA requires a demonstration that the State has adopted all reasonable and available control measures to demonstrate attainment as expeditiously as practicable and that no additional measures that are reasonably available will advance the attainment date. Although regional photochemical modeling indicates that no additional control measures are necessary to achieve the annual fine particle standard by the attainment date, IDEM participates in the regional planning effort through LADCO to evaluate potential control measures to attain the 8-hour ozone and fine particle standards and achieve regional haze goals.

Candidate control measures were evaluated primarily for feasibility, cost effectiveness, and the ability to implement them in a relatively short time frame (i.e., January 1, 2009, for the 2009 monitoring year). Due mainly to the lengthy rulemaking process in Indiana, many of the control strategies evaluated could not be implemented by the 2009 monitoring year and were not pursued since they were not needed to demonstrate attainment in an expeditious fashion.

2.1.2 Reasonably Available Control Technology (RACT)

U.S. EPA's *Clean Air Fine Particle Implementation Rule* makes a determination that areas classified under Subpart 1 will meet the CAA's RACT requirement by submitting a demonstration that shows attainment as expeditiously as practicable, but no later than 5 years after designation. This document will show that this requirement will be met with the implementation of mandatory federal control measures and regional measures implemented in Indiana and Kentucky. This document also shows that the projected annual fine particle design value will provide an ample margin of safety, well below U.S. EPA's defined threshold for a detailed RACT analysis to be completed in conjunction with this submittal.

2.2 REASONABLE FURTHER PROGRESS [SECTION 172 (C)(2)]

Based on U.S. EPA's *Clean Air Fine Particle Implementation Rule*, Reasonable Further Progress (RFP) is met by ensuring emissions reductions needed for attainment are implemented by the beginning of the monitoring season preceding the attainment date (i.e., by January 1, 2009). As confirmed by regional photochemical modeling, no additional local controls are necessary to attain the air quality standard expeditiously by the attainment date.

2.3 EMISSIONS INVENTORIES [SECTION 172 (C)(3)]

U.S. EPA guidance requires the submittal of a comprehensive emissions inventory of direct fine particle and fine particle precursor emissions [oxides of nitrogen (NO_x) and sulfur dioxide (SO₂)] representative of the base year (2005). IDEM has also prepared comprehensive emissions inventory projections for the attainment year (2009). Consistent with the federal implementation rule for fine particles, Indiana does not consider volatile organic compounds or ammonia to be significant contributors to fine particles. IDEM meets this requirement through the submittal of the statewide emissions inventory under the Consolidated Emission Reporting Rule (CERR) for the State of Indiana.

IDEM submitted a statewide 2005 emissions inventory for stationary and area sources to U.S. EPA in June 2007. The 2005 emissions inventory, for Clark, Floyd, and Jefferson Counties is included as Appendix B. The emissions inventory used in this attainment demonstration is also subject to public comment along with the full attainment demonstration.

It should be noted that Madison Township is a small portion of Jefferson County, Indiana, and only accounts for a portion of the county's stationary and area source categories in the emissions inventory. However, the largest stationary point source within Jefferson County, Indiana, an electricity generating facility, is located in Madison Township. To be conservative in demonstrating attainment, the emissions inventory included in this document and Appendix B consists of the entire county.

2.4 IDENTIFICATION AND QUANTIFICATION OF EMISSIONS [SECTION 172 (C)(4)]

Section 172(c)(4) requires the SIP to identify and quantify the emissions of pollutants (in this case, particulate matter, NO_x and SO₂) that sources will be allowed from the construction and operation of major new and modified sources in accordance with Section 173(a)(1)(B), and will not interfere with attainment of the annual fine particle standard by the attainment date. Indiana's permitting rules, which meet this requirement, are outlined in rule 326 IAC 2-3.

2.5 PERMIT PROGRAM FOR NEW AND MODIFIED MAJOR SOURCES [SECTION 172 (C)(5)]

Section 172 (c)(5) requires the State to implement a permit program consistent with the requirements of Section 173. Indiana has a long-standing and fully-implemented New Source Review (NSR) permitting program that is outlined in rule 326 IAC 2-3. Indiana's NSR permitting program was approved by U.S. EPA, on October 7, 1994 (94 FR 24838), as part of the SIP.

Any facility that is not listed in the 2005 emissions inventory, or for the closing of which credit was taken in demonstrating attainment, will not be allowed to construct, reopen, modify, or reconstruct without meeting all applicable permit rule requirements, including an air quality analysis to evaluate whether the new source will threaten the NAAQS.

2.6 OTHER CONTROL MEASURES, MEANS OR TECHNIQUES [SECTION 172 (C)(6)]

Modeling conducted by LADCO to predict future year fine particle design values shows that existing emission control measures will bring the Louisville KY-IN area into attainment of the annual fine particle NAAQS and provide for an ample margin of safety. Federal and local control measures to be phased-in or implemented in the next several years will provide even greater assurance that air quality will continue to meet the standard into the future.

In addition, modeling conducted by LADCO to determine the impact of the Clean Air Interstate Rule in the region, shows that future year design values for the Louisville KY-IN area will attain the annual fine particle standard with values well below 15.0 $\mu\text{g}/\text{m}^3$.

Existing and future national and regional control measures will ensure that attainment in each county will be maintained with an increasing margin of safety over time. These measures are discussed in greater detail in the Control Strategy Section (Section 6.0).

Therefore, no additional control measures are being implemented and modeled to demonstrate attainment. However, additional control measures are being implemented region-wide to provide assurance of the area maintaining air quality below the standard.

2.7 COMPLIANCE WITH SECTION 110(A)(2) [SECTION 172 (C)(7)]

Section 172(c)(7) requires nonattainment SIPs to meet the applicable provisions of Section 110(a)(2). IDEM has reviewed the requirements of Section 110(a)(2) and has concluded that prior rule submittals, along with this attainment demonstration, address the relevant requirements associated with rule development, state implementation plan submissions, and implementation and enforcement of required control measures. Within a letter to U.S. EPA dated December 7, 2007, Indiana reaffirmed that it maintains the necessary infrastructure and resources to comply with Sections 110(a)(1) and (2) for all criteria pollutants (Appendix C).

2.8 EQUIVALENT TECHNIQUES [SECTION 172(C)(8)]

IDEM has followed U.S. EPA guidance on procedures for modeling, preparing emissions inventories and plan submittals. Therefore, IDEM is not requesting approval for equivalent techniques, as allowed under Section 172(c)(8).

2.9 CONTINGENCY MEASURES [SECTION 172 (C)(9)]

Section 172 (c)(9) of the CAA requires states with nonattainment areas to include contingency measures as part of attainment demonstrations. Contingency measures are specific measures to be undertaken in the event that the area fails to attain the standard by the applicable attainment date. The selected contingency measures are discussed in greater detail in Section 9.0 of this document.

2.10 ATTAINMENT DEMONSTRATION

U.S. EPA's Fine Particle Implementation Rule requires the submittal of an attainment demonstration SIP that includes local, regional and/or national modeling analyses that meet the attainment modeling criteria set forth in U.S. EPA's modeling guidance. Through LADCO, photochemical modeling was performed using the Comprehensive Air Quality Model with Extensions (CAMx) for this modeled attainment demonstration. This modeling is being supplemented with regional modeling performed by LADCO in developing the Clean Air Interstate Rule (CAIR) and rulemaking to support national control measures.

U.S. EPA modeling guidance for the annual fine particle standard stipulates that the following elements be included in an approvable attainment demonstration submittal:

- photochemical grid modeling analysis;
- air quality trends analysis;
- emissions trends analysis;
- identification of control measures factored into the modeling analysis, as well as those not factored into the modeling analysis; and,
- identification of mobile source emissions budgets (NO_x and direct PM_{2.5}) for transportation conformity purposes.

Each element of this attainment demonstration is described briefly below and in more detail in the Technical Elements of Demonstration (Sections 3.0 – 7.0) and Mobile Source Emissions Budgets (Section 8.0).

2.10.1 Photochemical Grid Modeling Analysis

A more detailed discussion of the photochemical grid modeling, model selection, methodologies, attainment test, model inputs, modeling protocol and analysis method is included in the Photochemical Modeling Analysis Section of the Technical Elements of Demonstration (Section 3.1).

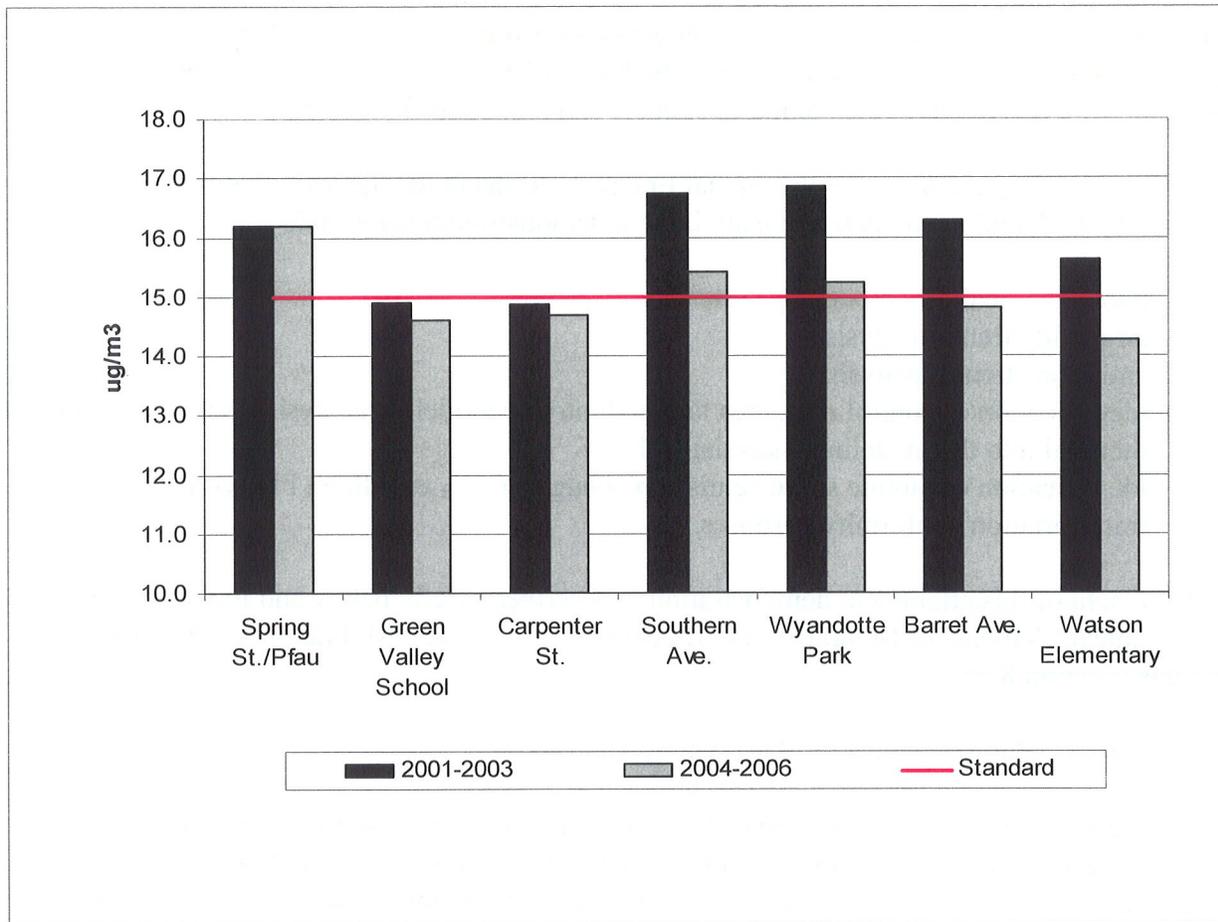
2.10.2 Air Quality Trends Analysis

Implementation of national control strategies has resulted in improvement in air quality within the Louisville KY-IN area. Data show emissions are decreasing, air quality peak values are on the decline, and the number of exceedances are also decreasing.

The technical data (Sections 3.0-7.0) show a continual decline in the fine particle concentration levels since 2001.

Chart 2.1 shows the decline in the controlling fine particle design value² for the Louisville KY-IN area. During the 2001-2003 time period, the Wyandotte Park ambient monitor represented the area's controlling annual fine particle design value. As shown in this table, the area's design value has decreased from 16.9 $\mu\text{g}/\text{m}^3$ to 16.2 $\mu\text{g}/\text{m}^3$, a decline of 0.7 $\mu\text{g}/\text{m}^3$ since being designated as nonattainment. The current design value for 2004-2006 is shown in Chart 2.2. Modeling predicts that this value will decline by an additional 2.6 $\mu\text{g}/\text{m}^3$ by 2009, demonstrating attainment of the standard prior to the April 5, 2010, attainment date.

Chart 2.1
Fine Particle Design Value Trends



² The design value for a nonattainment area, which characterizes the severity of the area's air quality problem, is represented by the highest design value at any individual fine particle monitoring site. The design value of a monitoring site is the average of the fine particle value over a three-year period. If a monitor is less than or equal to 15.0 $\mu\text{g}/\text{m}^3$ it is considered attainment. A monitor that measures 15.05 $\mu\text{g}/\text{m}^3$ or higher is considered nonattainment. (Decimals 0.049 or lower are rounded down, decimals 0.050 are rounded up). Three year design values are reported with only 1 decimal point. Values close to 15.0 may be shown with two decimal points for clarification.