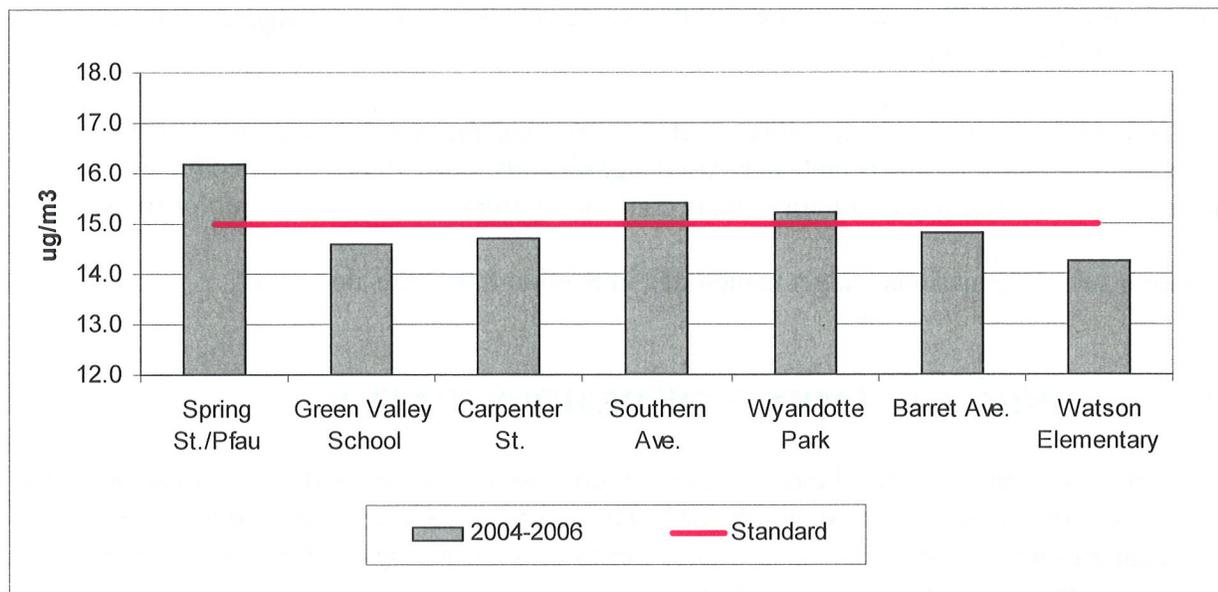


**Chart 2.2**  
**Fine Particle Design Values for the Louisville KY-IN Nonattainment Area**



A more complete picture of the air quality improvement in the Louisville KY-IN fine particle nonattainment area is shown in Chart 4.1 and Figure 4.3, included in Section 4.0 of this document.

### 2.10.3 Emissions Trends Analysis

Control measures have been implemented requiring substantial emissions reductions from mobile, industrial, and area sources. A detailed discussion of emissions trends is included in the Emissions Trends Analysis section of this document (Section 5.0).

## 2.11 CONTROL STRATEGY

Several control measures already in place or being implemented over the next few years will reduce point, on-road mobile and non-road mobile source emissions. The Federal and State control measures which were included in the photochemical modeling for the future year design value and additional control measures due to be implemented, but not included in the modeling are discussed in greater detail in the Control Strategy section of this document (Section 6.0).

## 2.12 MOBILE SOURCE EMISSIONS BUDGET

U.S. EPA requirements outlined in 40 CFR 93.118(e) (4) stipulate that a mobile source emissions budget be established as part of the attainment demonstration. The mobile source emissions budget is necessary to demonstrate conformity of transportation plans with the state implementation plan.

The purpose of transportation conformity is to ensure that Federal transportation actions occurring in the nonattainment area do not hinder the area from attaining and maintaining the annual fine particle standard. This means that the level of emissions estimated by the metropolitan planning organization for the Transportation Implementation Plan and the Long Range Transportation Plan must not exceed the motor vehicle emissions budget as defined in this attainment demonstration.

In general, while the total vehicle miles traveled (VMT) has increased throughout the region, mobile source emissions levels have decreased significantly since 1999. This decline in emissions is a result of federal motor vehicle control requirements and cleaner motor fuels.

The motor vehicle emissions budget is included in Section 8.0 of this document.

### **3.0 TECHNICAL ELEMENTS OF DEMONSTRATION**

This section presents details of the technical work done to analyze air quality data to demonstrate attainment of the annual fine particle standard. The results of the computer modeling and an analysis of air quality and emissions inventory trends presents strong evidence that pending control measures will improve air quality, thereby assuring air quality levels below the annual fine particle NAAQS by April 5, 2010.

#### **3.1 PHOTOCHEMICAL MODELING ANALYSIS**

Indiana is required to submit modeling as part of its attainment demonstration. U.S. EPA's implementation guidance allows states to submit regional or national modeling as the sole (primary) modeling analysis. This modeling demonstration relies upon regional modeling as the primary modeling analysis and Indiana will include national modeling, conducted by U.S. EPA, as a supplemental analysis.

The primary attainment modeling analysis for the Louisville KY-IN nonattainment area was performed in conjunction with the fine particle (PM<sub>2.5</sub>) and regional haze modeling conducted by LADCO. LADCO is comprised of the five Midwest states (Illinois, Indiana, Michigan, Ohio and Wisconsin). LADCO provides expertise in review of monitoring data, development of emissions inventories and meteorological files and application of photochemical modeling and evaluation of model performance and modeled results. LADCO prepared the "Regional Air Quality Analyses for Ozone, PM<sub>2.5</sub>, and Regional Haze: Technical Support Document" (LADCO, 2008), a detailed technical support document describing the methodology for the fine particle attainment demonstration modeling analysis for all the states supported by LADCO. This document can be found in Appendix E.

Extensive regional modeling has been performed covering the Louisville KY-IN area to determine the effect of national, regional and local emissions control strategies on fine particle levels. These modeling analyses determined that the Louisville KY-IN area, including Clark, Floyd and Jefferson Counties, is impacted by regional transport of fine particles and its precursors: sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), organic carbon (OC) and ammonium (NH<sub>4</sub>) associated with sulfates and nitrates. National emissions reductions, including those associated with the CAIR, are an effective way to demonstrate attainment of the annual fine particle standard in this area. Future year modeled annual fine particle concentrations in the Louisville KY-IN area are expected to be reduced from baseline design values by 18% to 19% in 2009 and by 20% to 23% by 2018 assuring long-term compliance of the annual fine particle NAAQS of 15.0 (µg/m<sup>3</sup>).

The following paragraphs briefly describe the methods, inputs used and major components of this analysis. The attainment demonstration and modeling procedures followed were recommended by U.S. EPA's "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM<sub>2.5</sub> and Regional Haze" (EPA-454/B-07-002, April 2007), Appendix D.

### 3.1.1 Modeling Methodology

The modeling analysis is a complex technical evaluation that begins with selection of the modeling system. LADCO used the following modeling system:

- Air Quality Model: Comprehensive Air Quality Model with Extensions (CAMx version 4.50).
- Meteorological Model: Mesoscale Model (MM5) version 3.7.
- Emissions Models: Emissions Modeling System (EMS-2003) and, CONSolidated Community Emissions Processing Tool (CONCEPT).

#### Model Selection

Title 40, Code of Federal Regulations, Part 51, Appendix W does not offer specific recommendations for photochemical models to be used for attainment demonstrations. However, the models selected must be scientifically appropriate for the intended application and be freely available for review and available to stakeholders and their consultants for execution and verification at low or no cost. Each of the models selected for use in this analysis meet these criteria and have been peer reviewed. Past performance has shown that the models are not biased toward under or overestimates.

The air quality model selected for this technical analysis was CAMx (version 4.50), an Eulerian photochemical grid model developed by ENVIRON and approved by U.S. EPA for this use. CAMx allows for integrated "one-atmosphere" assessment of ozone and PM<sub>2.5</sub>. Notable features of CAMx include flexi-nesting, which allows for reconfiguration of nested grids within

the model, multiple gas phase chemistry mechanism options and Particulate Source Apportionment Technology. CAMx modeling is performed on a Linux computing platform with a Portland Group (PGI) Fortran compiler to create executable files.

### 3.1.2 Modeling Preparation and Objectives

The modeling analysis included (1) preparation of a protocol, (2) preparation of emissions inventories, (3) preparation of meteorological inputs, (4) application of the model and diagnostic analysis of inputs, (5) evaluation of performance, (6) evaluation of reduction scenarios, and, (7) analysis of modeling results. The specific objectives of the analysis were to:

- \* apply the model to 2005 meteorological and emissions data and evaluate CAMx model performance,
- \* prepare future-year (2009) emissions inventory to evaluate future federal, regional and local emissions control strategies for the attainment of the annual fine particle standard, and,
- \* run the model for the future year to evaluate the combined effects of growth and emissions reductions resulting from national, regional and local measures.

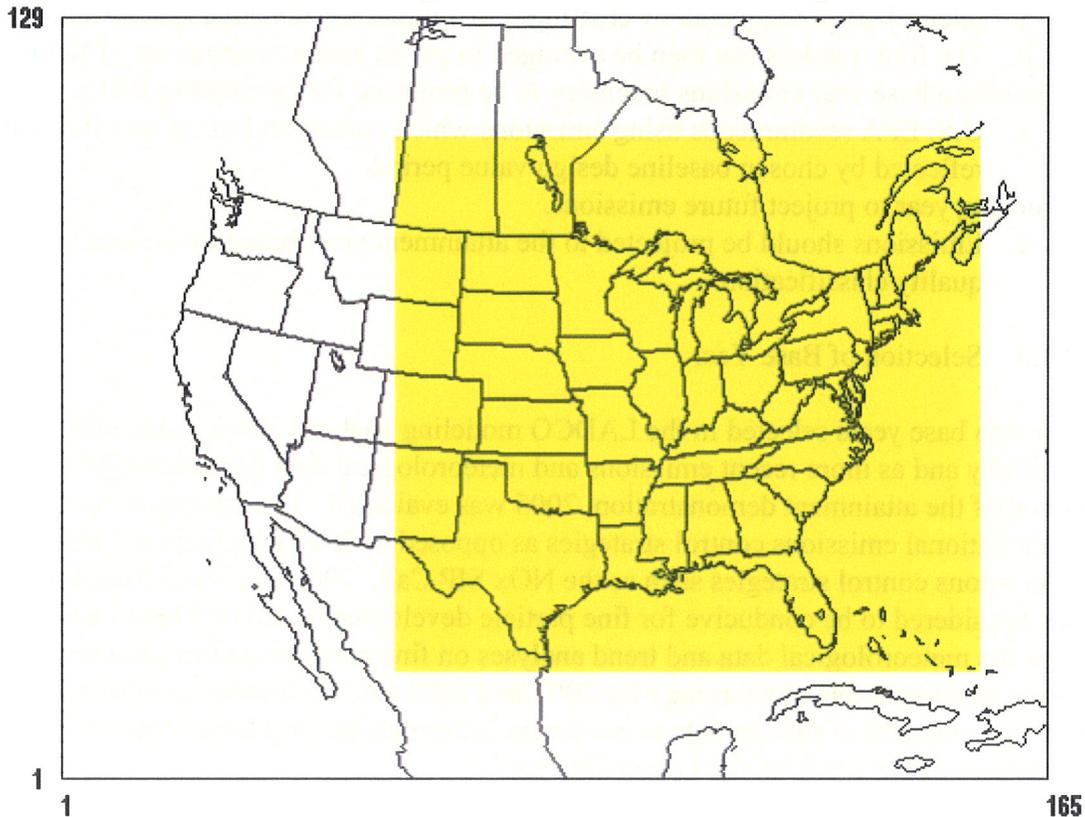
### 3.1.3 Meteorology Selection

Domain and grid resolution for the modeling analyses included a national regional planning organization grid at 36 kilometers for both the meteorological and emissions modeling. Landuse files were based on the Biogenic Emissions Landuse Database, version 3 (BELD3) 1 kilometer data and photolysis rates were calculated with the Tropospheric Ultraviolet-Visible (TUV) radiation model.

### 3.1.4 Modeling Domain

The domain for this modeling analysis was approximately centered on the Midwest portion of the country, including the Louisville KY-IN fine particle nonattainment area. The meteorological modeling domain consists of a grid of 36 kilometer cells that extends over the entire continental United States. The emissions modeling domain consists of a grid of 36 kilometer cells that extends over the LADCO five-state region and adjacent states. Selection of the domain was based upon distribution of emissions sources, locations of meteorological and air quality monitoring sites, and typical meteorological conditions in the area. Figure 3.1 shows the meteorological and emissions modeling domain.

**Figure 3.1**  
**LADCO Meteorological and Emissions Modeling Domain**



Meteorological inputs were processed using the National Center for Atmospheric Research (NCAR) 5<sup>th</sup> generation Mesoscale Model (MM5) version 3.7. A more detailed explanation of the inputs for the MM5 model are listed on page 48 of the “Regional Air Quality Analyses for Ozone, PM<sub>2.5</sub>, and Regional Haze Technical Support Document”, included in Appendix E.

The modeling analysis involves several steps. Below is a brief overview of the steps involved. A more detailed explanation of the modeling analysis and methodology can be found in Appendix F of this document.

#### Modeled Attainment Demonstration for Annual PM<sub>2.5</sub>

- 1) Calculating site-specific baseline concentrations.
  - a. Annual arithmetic mean is calculated by averaging the four quarterly arithmetic mean concentrations observed during a calendar year.
- 2) Identifying grid cells near monitoring site.
  - a. U.S. EPA recommends using the single modeled value in or near the grid cell which contains the monitor.
- 3) Choosing model predictions to calculate a relative response factor (RRF) near a monitor.
  - a. For an annual PM<sub>2.5</sub> prediction, U.S. EPA recommends taking the spatially averaged values of the nearby predictions (mean value of the grid cell array).

- b. The component-specific RRFs are computed by taking the ratio of the mean of the spatially averaged daily predictions.
- 4) Estimating design values at unmonitored locations.
  - a. Interpolate ambient data by creating a set of quarterly average spatial fields.
  - b. The four quarters can then be averaged to get an annual average set of fields.
- 5) Choosing a base year emissions inventory to be projected for calculating RRFs.
  - a. U.S. EPA recommends using emissions which correspond to the monitored period reflected by chosen baseline design value period.
- 6) Choosing year to project future emissions.
  - a. Emissions should be projected to the attainment year, based on an area's air quality classification.

### 3.1.5 Selection of Base Year

There were two base years selected in the LADCO modeling analyses: 2002<sup>3</sup> and 2005. 2002 was run initially and as more recent emissions and meteorological data became available prior to the submittal of the attainment demonstration, 2005 was evaluated. The emissions for 2005 take into account national emissions control strategies as opposed to 2002 which did not include national emissions control strategies such as the NOx SIP Call. 2005 had meteorological conditions considered to be conducive for fine particle development. LADCO performed several analyses on the meteorological data and trend analyses on fine particles and its pre-cursors. Results showed comparable meteorology for 2002 and 2005 and Theil trend analysis showed consistent improvement of fine particle concentrations throughout the Midwest since 1999 with annual decreases of 0.2  $\mu\text{g}/\text{m}^3$  in the Louisville area.

### 3.1.6 Selection of Future Years

The future year of interest for the Louisville KY-IN area, due to its annual PM<sub>2.5</sub> nonattainment status, was 2010 (five years from the effective date of designation under the annual standard). This year represents the attainment date. Therefore, 2009 is the future year of interest in order to show emissions reductions preceding the attainment year to demonstrate attainment in the area. 2012 and 2018 future years were also modeled in order to demonstrate continued attainment of the fine particle NAAQS.

### 3.1.7 Emissions Inputs

EMS and CONCEPT are two of the key emissions modeling tools used to determine emissions estimates for LADCO's Round 5 photochemical modeling.

- On-road source emissions were developed from CONCEPT using vehicle miles traveled (VMT) and vehicle speeds supplied by state and local planning agencies for 24 networks.

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<sup>3</sup> U.S. EPA guidance recommended using 2002 as the baseyear for modeling analyses, but allows states to use 2005. LADCO began the modeling exercise using 2002 as the baseyear, but as more recent emissions and meteorological data became available prior to the modeling being completed, a decision was made to switch to 2005 as the baseyear. This decision was discussed with U.S. EPA staff.

The CONCEPT model was run for winter (January 15-17) and summer (July 16-18) emission profile days representing a weekday, Saturday and Sunday.

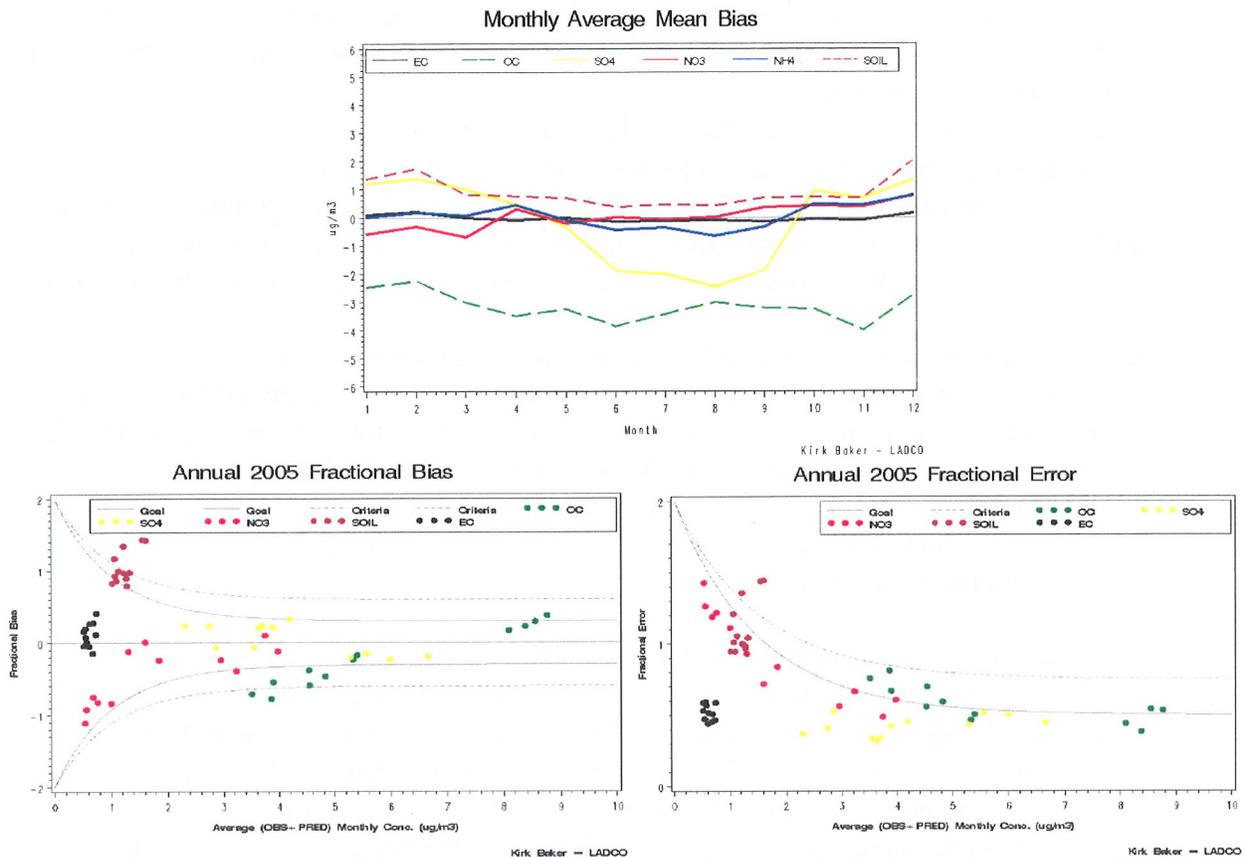
- Non-road source emissions were developed from the National Mobile Inventory Model (NMIM2005). Marine, aircraft and railroad emissions were prepared by ENVIRON and handled separately from non-road sources.
- Area source emissions were developed with EMS for weekday, Saturday and Sunday emissions for each month of the modeled period.
- Point source emissions were developed from state inventories and continuous emissions monitoring (CEM) data from electrical generating units. EMS calculated the point source emissions for weekday, Saturday and Sunday emissions for each month of the modeled period.
- Biogenic emissions were supplied by Alpine using an updated CONCEPT/Model of Emissions of Gases and Aerosols from Nature (MEGAN) biogenic emissions model.
- Ammonium emissions were developed from a Carnegie Mellon University-based 2002 ammonia emissions model which were grown out to 2005 and adjusted by temporal monthly factors.
- Canadian emissions were taken from the 2005 Canadian National Pollutant Release Inventory, Version 1.0 (NPRI).

Future year emissions were grown from the basecase 2005 emissions and estimates were developed from the emissions models; EMS/CONCEPT and NMIM for on-road and non-road emissions sources. Future year emissions for EGUs were derived from Integrated Planning Model version 3.0 (IPM3.0) with several CAIR emissions control scenarios factored in. Growth and control factors were applied to area, marine/aircraft/railroad and non-EGU point source emissions, as well as emissions changes due to applied local consent decrees, RACT and BART.

### 3.1.8 Model Performance

Model performance was evaluated according to U.S. EPA statistical guideline recommendations, in order for the modeled concentrations to replicate observed concentrations. PM<sub>2.5</sub> model performance was evaluated by LADCO through a variety of methods. Time series plots of monthly average mean bias and annual fractional bias were used and are shown in Figure 3.2.

**Figure 3.2**  
**Model Performance Metrics for Annual PM<sub>2.5</sub> Modeling**



Model performance was relatively good for nitrates, elemental carbon, ammonium and soil with under prediction of organic carbon and over prediction of sulfates, although the sulfate performance would be considered acceptable with bias values within 35%. The day-to-day, as well as the hour-to-hour variations from observed data and modeled data are consistent. There is acceptable modeled performance in the overall fine particle mass concentrations with some variability in the modeled performance of several of the species compositions of the fine particles.

### 3.2 MODELED ATTAINMENT TEST

The modeled attainment demonstration consists of analyses that estimate whether existing and future emissions reductions along with appropriate growth factors for future emissions will result in future ambient concentrations that will meet the NAAQS. The attainment demonstration also identifies a set of emissions control measures that will ensure that an area will continue to attain the NAAQS into the future. In order to make this determination, a modeled attainment test is required.

The annual PM<sub>2.5</sub> attainment test, as described in U.S. EPA guidance, recommends a modeled attainment test in which the results are used in a “relative” rather than “absolute” sense. This approach takes the ratio of the photochemical modeling results and future to baseline predictions at specific monitoring sites. This ratio is known as a relative response factor (RRF). Once a RRF has been determined, the RRF is applied to the current design value of a pollutant or in the case of PM<sub>2.5</sub>, the different components which make up fine particles. The major components that make up fine particles are as follows:

- mass associated with sulfates (SO<sub>4</sub>);
- mass associated with nitrates (NO<sub>3</sub>);
- mass associated with ammonium (NH<sub>4</sub>);
- mass associated with organic carbon (OC);
- mass associated with elemental carbon (EC);
- mass associated with particle bound water (pbw);
- mass associated with “other” primary inorganic particulate matter (soil); and,
- passively collected mass.

The steps involved in the annual PM<sub>2.5</sub> modeled attainment test, otherwise known as the Speciated Modeled Attainment Test (SMAT) are listed below. The specific inputs and results of the SMAT for the Louisville KY-IN area are listed in Section 3.3 of this document.

**Step 1:** Compute the observed quarterly mean PM<sub>2.5</sub> and quarterly mean composition of each monitor.

- This is accomplished by multiplying the monitored quarterly mean concentration of Federal Reference Method (FRM) derived PM<sub>2.5</sub> by the monitored fractional composition of PM<sub>2.5</sub> species for each quarter.
- In the event that monitored speciated data is not available, LADCO used chemically speciated IMPROVE and STN PM<sub>2.5</sub> data to develop seasonal spatial fields for each PM<sub>2.5</sub> species. SAS software package PROC KRIG function (EPA, 2004b) was used to develop these spatial fields.

**Step 2:** Using model results, derive component-specific RRFs at each monitor for each quarter for each of the components for PM<sub>2.5</sub>.

- Air quality modeling is applied to estimate current and future year concentrations for each component of PM<sub>2.5</sub>.
- Relative response factors are derived by taking the ratio of future year concentrations over the baseline modeled concentrations at the monitoring site.

**Step 3:** Apply the component-specific relative response factors to the observed air quality to obtain quarterly species estimates.

- The current quarterly mean component concentration from Step 1 is multiplied by the component-specific RRF derived in Step 2, which gives an estimated future quarterly mean concentration for each component.

**Step 4:** Calculate a future year annual average PM<sub>2.5</sub> estimate.

- The quarterly mean components (estimated in Step 3) are summed together for a quarterly mean PM<sub>2.5</sub> value.
- The four quarterly mean PM<sub>2.5</sub> values are determined and the average of these four quarterly mean PM<sub>2.5</sub> values will give a future year annual average PM<sub>2.5</sub> value for each monitor analyzed.

### 3.3 ATTAINMENT TEST RESULTS

LADCO performed the attainment tests for all upper Midwest state monitoring sites, including those located in the Louisville KY-IN area. LADCO followed U.S. EPA guidance concerning the modeled attainment test for the Louisville KY-IN area. LADCO's latest modeling (Round 5) showed all future year concentrations were below the annual fine particle NAAQS of 15.0 micrograms per cubic meter.

Results of Step 1 of the attainment test for the annual fine particle NAAQS are shown in Tables 3.1 and 3.2. Table 3.1 shows the percentage of the quarterly mean for each individual pollutant of the observed quarterly mean. Table 3.2 shows the mass of each individual component of the quarterly mean of the fine particle samples. This is the observed quarterly mean and composition of the controlling monitor for the Louisville KY-IN area, which is the Pfau monitor, Jeffersonville, Indiana.

**Table 3.1  
Percent of Quarterly Mean Composition  
Pfau, Jeffersonville, Indiana Monitor**

<b>Pollutant (percent of total mass)</b>	<b>Quarter 1</b>	<b>Quarter 2</b>	<b>Quarter 3</b>	<b>Quarter 4</b>
<b>SO<sub>4</sub></b>	28.25	35.96	36.70	28.51
<b>NO<sub>3</sub></b>	20.61	0.29	0	11.70
<b>OC</b>	20.69	19.54	12.55	21.33
<b>EC</b>	3.76	4.50	3.23	5.24
<b>Soil</b>	2.61	3.31	2.13	3.41
<b>NH<sub>4</sub></b>	15.23	11.91	11.07	13.15
<b>Pbw</b>	8.85	12.34	11.23	8.96

**Table 3.2**  
**Observed Quarterly Mean /Quarterly Mean**  
**Composition for each Component of PM<sub>2.5</sub>**  
**Pfau, Jeffersonville, Indiana Monitor**

<b>Pollutant (µg/m<sup>3</sup>)</b>	<b>Quarter 1</b>	<b>Quarter 2</b>	<b>Quarter 3</b>	<b>Quarter 4</b>	<b>Average</b>
<b>SO<sub>4</sub></b>	4.1443	5.5738	7.6813	3.9914	5.3
<b>NO<sub>3</sub></b>	3.0235	0.0450	0.0000	1.6380	1.2
<b>OC</b>	3.0352	3.0287	2.6267	2.9862	2.9
<b>EC</b>	0.5516	0.6975	0.6760	0.7336	0.7
<b>Soil</b>	0.3829	0.5131	0.4458	0.4774	0.5
<b>NH<sub>4</sub></b>	2.2342	1.8461	2.3170	1.8410	2.1
<b>Pbw</b>	1.2983	1.9127	2.3504	1.2544	1.7
<b>Quarterly FRM Mean (total mass)</b>	14.67	15.50	20.93	14.00	

Passively collected mass is not used in the modeling and calculation of the RRFs. Passive mass appears to result from contamination of the filters from handling and contact with the FRM cassette. Passive mass is not included in Tables 3.1 or 3.2. For this reason, the percentages in Table 3.1 may not total 100% and the mass of the individual pollutant components may not equal the total mass of the Quarterly FRM Mean.

Once the observed quarterly mean and composition of the fine particle concentrations are determined, Step 2 of the attainment test requires that the component-specific relative response factors be derived for each quarter from the basecase and future year modeled concentrations at each monitor. The results of this step are shown in Table 3.3.

**Table 3.3**  
**Relative Response Factors (RRFs) for each Component**  
**Pfau, Jeffersonville, Indiana Monitor**

<b>Pollutant</b>	<b>Quarter 1</b>	<b>Quarter 2</b>	<b>Quarter 3</b>	<b>Quarter 4</b>
<b>SO<sub>4</sub></b>	0.8431	0.6562	0.601	0.7889
<b>NO<sub>3</sub></b>	1.0347	0.8576	0.8536	0.9583
<b>OC</b>	0.9567	1.0139	1.0216	1.0009
<b>EC</b>	0.9271	0.9102	0.9008	0.9106
<b>Soil</b>	1.3139	1.3042	1.4786	1.2928
<b>NH<sub>4</sub></b>	0.897	0.6902	0.6397	0.8406
<b>pbw</b>	0.8586	0.6601	0.6114	0.8141

The derived relative response factors for each quarter are then applied to the observed quarterly compositions of the fine particle concentrations to calculate the projected quarterly species estimates for each monitor, as per Step 3 of the attainment test guidance. Results are shown in Table 3.4.

**Table 3.4**  
**Projected Quarterly Species Estimates**  
**Pfau, Jeffersonville, Indiana Monitor**

Pollutant ( $\mu\text{g}/\text{m}^3$ )	Quarter 1	Quarter 2	Quarter 3	Quarter 4	TOTAL
SO <sub>4</sub>	3.4940	3.6575	4.6165	3.1488	3.7
NO <sub>3</sub>	3.1284	0.0385	0.0000	1.5697	1.2
OC	2.9038	3.0708	2.6835	2.9889	2.9
EC	0.5114	0.6349	0.6090	0.6680	0.6
Soil	0.5031	0.6691	0.6592	0.6172	0.6
NH <sub>4</sub>	2.0041	1.2741	1.4822	1.5475	1.6
pbw	1.1147	1.2626	1.4371	1.0212	1.2
<b>TOTAL</b>	13.66	10.61	11.49	11.56	

Finally, Step 4 of the attainment test calculates the future year annual average fine particle concentrations, which are compared to the annual fine particle NAAQS of 15.0 micrograms per cubic meter. Table 3.5 shows a summary of the future year, 2009, modeled concentrations that show all fine particle monitors in Southern Indiana and Northern Kentucky will attain the annual fine particle standard.

**Table 3.5**  
**Attainment Test Results for Louisville KY-IN Nonattainment Area**

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

An additional adjustment is made to values in Table 3.4 to arrive at results in Table 3.5. The reason is, again, passively collected mass. In the attainment test calculations, the passive mass is assumed to remain constant over time, e.g. the RRF equals 1.0. Therefore, the portion of the observed basecase sample attributed to passive mass is added back into the projected 2009 mass, to provide the averages in Table 3.5.

Results for the Green Valley School (ID 18-043-1004) fine particle monitor in New Albany, Indiana, as well as the Northern Kentucky fine particle monitors, that would be considered upwind of Indiana's portion of the Louisville KY-IN fine particle nonattainment area, can be found in Appendix G. Modeled results show similar mean species compositions and relative response factors at all the fine particle monitoring sites and all monitors show compliance with the annual fine particle NAAQS.

### 3.4 UNMONITORED AREA ANALYSIS

U.S. EPA has recommended, in its "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM<sub>2.5</sub> and Regional Haze" (EPA-454/B-07-002, April 2007) an "unmonitored area analysis" for areas without monitors that could potentially exceed the NAAQS if monitors existed in those areas. The "unmonitored area analysis" uses a combination of ambient data to provide spatial fields for monitored and unmonitored areas and model outputs for predicted concentrations throughout a region. Madison Township in Jefferson County, Indiana was designated as nonattainment for the annual fine particle standard despite the fact that there is no fine particle monitor in the county. Jefferson County is adjacent to Clark County, Indiana, which has a monitor in the southern portion of the county, monitoring the Louisville area.

Ambient fine particle monitors in the Southern Indiana/Northern Kentucky area provide adequate coverage, in accordance with 40 CFR, Part 58, Appendix D, 4.7. Indiana has placed fine particle monitors in Jeffersonville, in southern Clark County, and New Albany, in eastern Floyd County, in accordance with this guidance that based the number of monitors on the population of the metropolitan statistical area (MSA) and the design values for monitored areas. The monitors are therefore concentrated in the more urban areas where higher pollutant concentrations are expected. The State of Kentucky has fine particle monitors located in Jefferson, Bullitt and Hardin Counties which surround the urban center of Louisville. While these monitors were sited due to the proximity to the urban center of Louisville, the resulting design values between these monitors are comparable with the latest 3-year design values (2004-2006) ranging between 14.3 and 16.2  $\mu\text{g}/\text{m}^3$ . The urban impact on monitored values is evident as higher readings are measured at the urban center and directly north.

Figure 3.3 shows the Southern Indiana/Northern Kentucky PM<sub>2.5</sub> monitoring network. Circles surrounding the monitors indicate the spatial scale of coverage for each of the monitors. The spatial scale of representation describes the physical dimensions of the air parcel measured at and near the monitor. In the rural areas, the air quality in the spatial coverages of the regional and urban monitor is considered to have similar concentrations. The monitors shown in Figure 3.3 are those closest to the unmonitored nonattainment areas.

A neighborhood monitor has a spatial scale of representation which extends from 0.5 to 4.0 kilometers from the monitoring site. The Clark and Floyd fine particle monitors, as well as the Barret Avenue, Southern Avenue, Wyandotte Park, Watson Elementary, Carpenter Street and Elizabethtown fine particle monitors are neighborhood monitors with spatial extent up to 4

kilometers with uniform land use within the urban core of Louisville. While the neighborhood monitors represent a small portion of an urban area, the annual concentrations are fairly consistent for urbanized  $PM_{2.5}$  concentrations.  $PM_{2.5}$  concentrations in less populated areas and more rural settings would be expected to be lower.

**Figure 3.3**  
**Spatial Representation for Southern Indiana/Northern Kentucky  $PM_{2.5}$  Monitoring Sites**

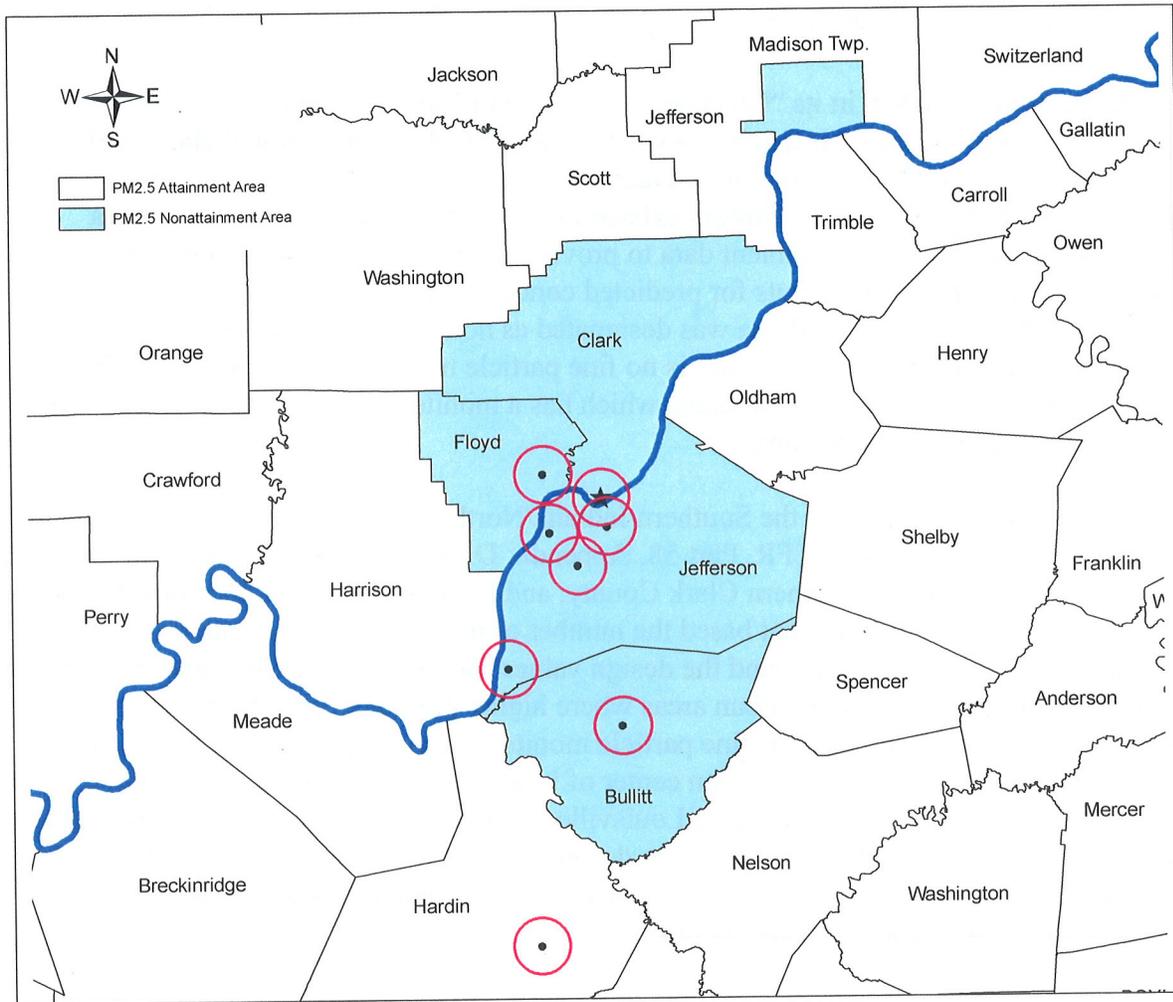


Table 3.6 highlights the fine particle monitors located in and near the urban center of Louisville, with typical annual design values lower in the more rural area fine particle monitors (highlighted) than those impacted by the Louisville urban core emissions. Average differences in concentrations between the rural monitors and urban monitors range from  $0.5 \mu\text{g}/\text{m}^3$  to  $3.0 \mu\text{g}/\text{m}^3$ . It is apparent that the higher annual fine particle concentrations are found in or near the urban center of Louisville. This fact is shown in the annual design values for the fine particle monitors in the nonattainment area and surrounding county fine particle monitors over the past seven (7) years (2000-2006).